

**Petition to List the Kennebec River Population
of Anadromous Atlantic Salmon as an Endangered Species
Pursuant to the United States Endangered Species Act
16 U.S.C. §§ 1531 - 1544.**

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PETITIONERS:

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Petitioners request the Departments of Interior and Commerce declare the Kennebec River population of anadromous Atlantic salmon (*Salmo salar*) an endangered species under the United States Endangered Species Act, 16 U.S.C. §§ 1531 - 1544. This petition is filed under 5 U.S.C. § 553(e) and 50 C.F.R. part 424.14.

This petition provides three independent lines of evidence supporting protection of Kennebec River Atlantic salmon under the U.S. Endangered Species Act.

The first line of evidence consists of historic observations of Kennebec River Atlantic salmon from the 18th century to the present. These observational records show

there was no period in the 19th and 20th centuries when Atlantic salmon were absent from the Kennebec River.

The second line of evidence consists of microsatellite DNA analysis of tissue samples of 180 wild Atlantic salmon captured in the Kennebec River by USFWS from 1994 to the present. This data conclusively shows wild Kennebec River salmon are genetically distinct from other wild and hatchery Atlantic salmon populations in Maine, including the Penobscot River.

The third line of evidence shows that populations all of the native migratory fish of the Kennebec River have persisted and remain in the river today. These species include Atlantic sturgeon, sea lamprey, shortnose sturgeon, striped bass, white perch, American shad, rainbow smelt, tomcod, alewives and blueback herring. Over the past two centuries, all of these native anadromous fish species of the Kennebec River were subjected to the exact same environmental insults as the native Atlantic salmon of the Kennebec River. All of these native anadromous species survive in the river today.

The only plausible hypothesis which can be drawn from these three independent lines of evidence is that the native Atlantic salmon of the Kennebec River remain alive in the Kennebec River today.

I. REGULATORY STATUS OF KENNEBEC RIVER ATLANTIC SALMON

On November 17, 2000 the USFWS and NMFS (predecessor to NOAA Fisheries) declared a Gulf of Maine Distinct Population Segment (DPS) of anadromous Atlantic salmon (*Salmo salar*) pursuant to the United States Endangered Species Act (65 Fed. Reg. 69459).

USFWS and NMFS defined the Gulf of Maine DPS as including "all naturally reproducing wild populations and those river-specific hatchery populations of Atlantic salmon having historical river specific characteristics found north of and including tributaries of the lower Kennebec River to, but not including, the mouth of the St. Croix River at the U.S.-Canada border" (65 Fed. Reg. 69459).

USFWS and NMFS further declared Gulf of Maine DPS of anadromous Atlantic salmon to be an endangered species pursuant to the United States Endangered Species Act (65 Fed. Reg. 69459).

Kennebec River anadromous Atlantic salmon fall within the geographic bounds of the Gulf of Maine DPS and meet all of the biological requirements set forth in the United States Endangered Species Act and 65 Fed. Reg. 69459. For the past five years USFWS and NMFS have failed to protect Kennebec River Atlantic salmon as an endangered species.

II. BIOLOGICAL STATUS OF KENNEBEC RIVER ATLANTIC SALMON

Prior to 1837 more than 100,000 Atlantic salmon ascended the Kennebec River each spring. Today, the Atlantic salmon of the Kennebec River are nearly extinct. Adult returns since 1995 are estimated at 10-30 salmon each year. Redd counts, observations of adults and juvenile surveys show wild Atlantic salmon continue to reproduce in accessible portions of the Kennebec River and its tributaries.

The National Academy of Sciences (NAS 2004) stated:

"The report on the genetic status of Maine's salmon (NRC 2002a) included salmon from Togus Stream and Bond Brook (collectively labeled Kennebec) in its comparison of genetic assignment success rates among Maine drainages (King et al. 1999). A close examination of the data (NRC 2002a) shows that the salmon populations of the Kennebec drainage are more distinct than are those of the current DPS rivers. The current populations are wild, and they should figure prominently in any restoration effort. The committee concludes that there is nothing to lose by not stocking the Kennebec (NRC 2002b). Atlantic salmon seem to be recolonizing the upper Kennebec main stem above the Togus and Bond Brook tributaries. There is preliminary evidence that salmon are already spawning as far upriver as Ticonic Falls, 19 miles above the former dam site (P. Christman, personal communication, 2002). The opportunity to observe the course of that rebound, in the absence of stocking, should not be missed."

The 1999 removal of the Edwards Dam at the Kennebec River's head of tide in Augusta, Maine provided free access for Atlantic salmon to a 20 mile reach of main-stem habitat from Augusta to the next set of impassable dams in Waterville and Winslow,

Maine. Surveys by the Maine Atlantic Salmon Commission (MASC) estimate at least 10,000 units of Atlantic salmon rearing habitat were restored to this 20 mile reach by the removal of the Edwards Dam.

Observations by MASC staff and volunteers since 2000 show that wild Atlantic salmon in the Kennebec River have dramatically shifted their selection of spawning habitat since the removal of the Edwards Dam. Prior to the removal of this dam, spawning Atlantic salmon and their progeny were frequently observed in the river' s main stem and three small Kennebec River tributaries below its head of tide: Bond Brook in Augusta, Togus Stream in Randolph, and Cobbosseecontee Stream in Gardiner.

Field studies by the MASC show spawning salmon and their progeny have practically disappeared from Bond Brook, Togus Stream and Cobbosseecontee Stream since 1999. At the same time, adult salmon and spawning redds have been observed at numerous locations above the former Edwards Dam site to the next set of impassable dams. These observations suggest Atlantic salmon used the small streams below Augusta only because they were denied access to main-stem river habitat above the Kennebec' s head of tide. Appendix One provides a detailed discussion of this phenomenon.

A. History of the Kennebec River population of Atlantic salmon.

1. Historic Summary

Two historic documents summarize the Kennebec River Atlantic salmon population prior to the construction of the Kennebec Dam at Augusta in 1837.

From the Kennebec Journal, May 22, 1829:

"Salmon Fishery -- A correspondent of the Wiscasset Citizen gives the following account of this fishery in the Kennebec.

"When Col. Wm. Lithgow commanded at Fort Halifax, he discovered Salmon in the month of January at Tyconic Falls. Salmon have also been taken from Peirpoles hole in the Sandy river, in the town of Strong, in the winter season. A gentleman informed me, when first acquainted with that fishery, that salmon were never taken plentifully, until after the spring freshet; and I found that to be the case every year. The first that are taken on the Kennebec in the spring, are at Jones' Eddy, Parker' s Flatts, and Back River

"But few men now on the stage, appear to have a knowledge of the superabundance of these fish as far back as the period before the Revolution. If my memory does not misgive me, a Mr. Rogers and his company, seven all in the year 1784 or 85, at Hunnewell' s Point, exclusive of Fox Island, took in set nets between eight and nine thousand salmon. The average weight of each was 20 pounds of the first shoal, and the last 18 pounds. When I owned the same fisheries, the salmon were two to three pounds lighter. Where Rogers caught a thousand, my fishermen had need be industrious to get 100. In the year 1813, I kept an account of the number and weight of Salmon caught. In five nets, were caught that year, 1,143 Salmon. The last run were usually smoked for the New York market. 240 in number weighing 2,564 (lbs.) and 1,765 (lbs.) when smoked fit for market, sold at 14 cents per pound at the smoke house. I took some care that year to know the amount of Salmon caught on the Kennebec below Fiddler' s Reach. Fox Island caught 1,000 -- all the berths at Cape Small Point, say 500 -- Hunnewell' s Point 1,143- Stage Island and all on the east side below the Fort 1,500. All the above was one eighth of the quantity below Bath on the Kennebec, of Salmon only, making 33,000. You perceive that the small school, from the above would average about \$1 to the Salmon. Those sold fresh in Boston before the middle of May did average 12.5 cents net profit, and 18 to 20 and 22 lbs. each, so that in a lot of 13, weighing 270 lbs. May last, of that year I received \$3,375. From which data, the conclusion may be drawn that every Salmon caught, was at that time worth a dollar. The Salmon fishery alone then, on the Kennebec, below Fiddler' s Reach, was worth to the State \$33,000. And it is a fair estimate to value the Shad and Alewife fishery within the compass at one half the Salmon, making a total of \$49,500 in Kennebec, below Fiddler' s Reach in the year 1813. This appears large, but by the manner the trade was carried on, the fact can be demonstrated with tolerable certainty. One third at least of the Salmon were sold fresh in the Markets of New York, Newport and all the seaports between that and Portland. -- There were three regular trading sloops with a capital of about \$3,000 each, who purchased Salmon only, and generally exchanged the whole of their produce readily for that article, making up \$9,000 in value. And 11,000 for the consumption of the inhabitants was but a reasonable proportion in all the other methods of saving and cooking that fish. If therefore the Salmon, Shad and Alewife fishery, even in that part of the Kennebec could be restored, it would give a source of wealth to the State about equal to the amount of the State tax."

From Atkins (1867):

"Estuarine Fishery (below Augusta):

Touching the former abundance of fish, we have the testimony of sundry persons. Mr. Ezra W. Emmons of Georgetown, 69 years of age, has always lived on the Kennebec, and been familiar with its fisheries. He says that 50 years ago there were twice or three times as many weirs as there are now. At the same time there were a great many set-nets, and as many salmon were taken by them as by the weirs. A Mr. Emerson fished with a weir, and one year, for several days in succession, took 6,000 or 7,000 shad each tide. The salmon used to average 45 each tide.

Augusta Fisheries:

"At Augusta, Mr. William Kennedy estimates the number of salmon taken in 1820 at 4,000. There were twelve drift nets engaged in the fishery. The year that the Augusta Dam was built, Mr. K. caught more than usual, namely, 500; but from that time the fish immediately fell away, and very soon the yield was only 12 per year."

"Charles Hume of Augusta, used to fish at Waterville with a driftnet from 1830 to 1837, and took 150 salmon yearly. But he says the fishing at that place had been falling off for many years. Total catch at Waterville, 2,000 salmon. In 1838 he came to Augusta, the dam being built, and that year caught 300 or 400 salmon. From this time they declined in a few years to 15 or 20 salmon yearly, and after 1850 to four or five, and some years none. Salmon used to be brought down to Augusta from Waterville and sold at four cents per pound, but the price at the mouth of the river was six cents.

Waterville Fisheries:

Mr. William Getchell, who owned the small island in the middle of the river at Ticonic Falls, Waterville, and fished there with a dip net from 1804, used to take \$500 to \$600 worth of shad and alewives annually. With his three boys he had taken 1,100 shad and 20 salmon in one afternoon. One day four men, of whom he was one, dipped out and boated ashore 6,400 large shad. The most of the salmon fishing was with drift nets below the falls. Mr. Getchell had counted 82 of these nets, each employing two men with a canoe, fishing at one time. He estimates the average at 40 canoes, and that each took three salmon per day. This gives 4,800 salmon in forty days fishing.

Skowhegan Fisheries:

From Samuel Philbrick of Skowhegan, we learn that there were many salmon and shad caught at that point, although the falls were not favorable for fishing, and nearly all the fish passed by. The fishing here was with dipnets and a man would not generally dip more than 20 shad in a day. A trap set for salmon, in 1808 and several years after, used to average six salmon a day. At Carratunk falls was better fishing, and it was easy to load a boat with salmon in a day.

Solon Fisheries:

Col. Christopher Thompson of Embden, used to fish at Carratunk falls. The greatest catch he ever knew with a drift net was 60 salmon in one night. The year when the Augusta dam was carried away he and his brother caught 30."

Major Tributary Fisheries:

Sandy River:

"Salmon were taken at various points with spear and net. Mr. John Tibbets of New Sharon, used to set a net for them, and had taken three while getting his net into the water. From several others in New Sharon we have information to the same effect. Seventy years ago they were plenty in Strong. But in 1804 the New Sharon dam was built. This stopped shad and alewives, but a fishway is said to have been maintained for a few years which permitted salmon to pass. A few years later another dam was thrown across the river nearer its mouth and the fishways were no longer maintained. It is probably, however, that in high water the salmon could still pass all the obstructions, for Mr. David Hunter of Strong, took a salmon there only 40 years ago. Into its mouth and tributaries they still came. In Sawyer' s stream, in Starks, they spawned in great numbers. Mr. Levi G. Sawyer has seen and taken many of them there, but only in the fall and winter. In October they came and were seen spawning; and sometimes were observed through the ice. They were diminishing for several years before 1837. That year Mr. Sawyer took two, and they were his last. A salmon weighing 22 pounds was caught in this stream."

Carrabassett River:

"This is similar to the Sandy river. Its source is among the mountains, and it is subject to very sudden variations in volume. It has the same clean, stony, gravelly and sandy bottom, over which the water glances with a shallow current. But it is more transparent and has even less dead water. It is eminently a salmon river, and we obtained no tradition of shad or alewives ever having visited these parts. As early as the month of June the salmon ascended the river to Kingfield or farther; and they have been seen spawning in Salem village, thirty miles from the Kennebec. A various points on the Carrabassett salmon were taken by spear and dip net. Maj. C. Steward, of North Anson, remembers when ' tons' of them were caught at that place. At New Portland so many were sometimes taken that only the bellies were saved, the rest of the fish thrown away. They disappeared from the river; but during the year when the Augusta dam was carried away, they ascended again to Kingfield, and twenty were taken at North Anson village."

Dead River:

"The salmon has a namesake here in ' Salmon Stream,' the first large brook above the Forks. The story is, attested by several witnesses, that salmon were seen lying in great numbers at the mouth of this stream, whence its name ... Mr. Luther Moore, who has lived at Bingham 78 years, says that salmon used to run above the Forks on the East Branch ten miles and on the West Branch (Dead River) sixteen miles. That would just carry them to Grand falls on the Dead River, and to the only difficult fall on the main river."

2. Chronological History

a. 18th Century:

Excerpt from the personal papers of Col. Samuel Howard of Augusta regarding the history of region during the French and Indian War (1760s), printed in the Kennebec Journal, edition of May 12, 1826:

"The Indians, during the war, frequently appeared at this Fort (Halifax), and at a time when two of the soldiers were taking salmon at Ticonick Falls they fell upon them -- killed one, and wounded the other."

From Ulrich (1990):

"On April 6, 1775, Ephraim (Ballard) secured a lease from Silvester Gardiner of Boston, one of the wealthiest of the Kennebec Proprietors, to ' Fort Halifax and all lands adjoining.' The Fort, originally built by the Massachusetts government, stood on a peninsula between the Kennebec and Sebasticook Rivers. Surrounded by 400 acres of timber, it was described by one contemporary as "a great Salmon fishery in the summer and a bass fishery in the Winter." Original source of fish quote is: James Phinney Baxter, Documentary History of the State of Maine, in The Midwife' s Tale, The Diaries of Martha Ballard, Laurel Thacher Ulrich, 1990.

From the personal diary of Martha Ballard, an early resident of Augusta:

May 7, 1787: "I was called to see Mr. Edson. There were 11 salmon caught in the sein[e] at Kennedy' s fishing place."

May 15, 1787: "The girls went to school afternoon. Mr. Ballard ploughed flax in, I brewed. Samuel brought a salmon, weighed 21 one-half lbs."

b. 1800 to Construction of the Augusta Dam in 1837:

Historian James North on Daniel Cony:

"Daniel came in the spring of the year, in ' fish time,' and informed his father (Deacon Samuel Cony), among other things in a highly favorable report of the country, that the river was the ' meat tub' of the inhabitants, so abundant and so easily taken were the fish which thronged it." (North' s History of Augusta, p. 169)

From the personal diary of Daniel Cony, an early resident of Augusta, Maine:

April 15, 1808: "Dined on fresh salmon."

May 1, 1809: "Fresh salmon."

May 8, 1810: "Fresh salmon."

From the statement of William Matthews in "Recollections of Waterville in the ' Olden Time' " in the Centennial History of Waterville, Maine. 1902.

"My father had a trap on the east side of Ticonic Falls, which he visited twice daily, and from which he took salmon weighing from ten to 20 to 30 pounds. It is difficult to tell a big fish story without exaggerating, but if I can trust my memory, he caught one salmon that at least weighed 40 pounds."

1821 -- Petition of Inhabitants of Phippsburg.

"To the Honorable Senate and House of Representatives of the State of Maine in Legislature assembled --

"The subscribers inhabitants of the Town of Phippsburg respectfully ask leave to represent that the Inhabitants of said Town are deeply interested in the Fisheries. First, that a large number depend almost entirely upon the River Fishery. Second, that a still larger proportion of our Inhabitants as well as those of the neighboring towns, and even Fishermen from various other parts of the State are wholly dependent at certain seasons of the year, on the wears erected at and near the Mouth of the Kennebec, for bait fish, in order to pursue the Codfishery; that the owners of these wears are at great expence in erecting these, whereby a large number of poor persons are employed, which is a great means of support in the Spring of the year.

"Your Petitioners further represent that to be deprived of the privilege and means of taking fish called Salmon, Shads and Alewives, a privilege which we and our forefathers have enjoyed of a time immemorial, would not only be depriving your Petitioners of the principal means of support, but would subject many others of our Inhabitants to great distress, and thereby become chargeable to the Public. That to be deprived of the means of obtaining Baitfish, for carrying on the Codfishery would be subjecting a large number of the Inhabitants of our State on the Seaboard to the greatest inconvenience.

"Your Petitioners further represent that in their humble opinion the wears and other obstructions at the Mouth of the Kennebec are not the cause of the Diminution of fish on said River, the said wears do not in any degree obstruct the fish passing up and down the Channels of the River; that from the outer part of the wears to the shore on the opposite side of the River, the space is no part less than half a mile distance, that the wears are without exception erected on the Flats which we hold by the same right as the lands adjoining, that with two exceptions only, the wears are up the Bays and Coves and quite aside from the main passage of the fish in the River.

"Your Petitioners are of the opinion that the Diminution of Fish on the Kennebec is caused by the erection of Mill Dams and by other Obstructions on and across the Streams and Brooks, when the fish usually go up to cast the spawn, that many schools of fish, particularly of the Salmon and Alewives which formerly frequented those Streams and Brooks are known to have been entirely cut off by the erection of the Mill Dams and other obstructions which prevented them from going up to cast their spawn. That the

Salmon in great numbers formerly passed up the Androscoggin, but since the erection of Mill Dams across said River, a School of Salmon called "The Brunswick School" have been entirely destroyed or left the River, and to prove this and many other important circumstances, the testimony of many aged and respectable Citizens can be produced.

"Your Petitioners further represent that the Lumber towards the mouth of the Kennebec is almost entirely exhausted, that the state of the Soil principally by the Sea Coast is such as to render it impossible to obtain support by Agriculture. Thus your Honours will be convinced that the privilege and means of taking fish at and near the mouth of the Kennebec is of the first and greatest importance to the subsistence of a great number of Citizens.

"Your Petitioners therefore pray your Honors that they may be continued unmolested in the enjoyment of their rights and privileges they now possess and in duty bound every pray.

Phippsburg, Jany. 24, 1821"

Source: Original document at Maine State Archives, Augusta, Maine.

From the Kennebec Journal, June 11, 1825:

"Salmon in considerable numbers continue to be taken in the Kennebec, though they have never been sold, we believe, in this town, for less than 7 or 8 cents per pound, and the opinion is prevalent that they are annually diminishing. The salmon which now enter our river stand but a desperate chance of again leaving in the briny flood; toils and lurking dangers beset them on every side. The excellence of this fish renders all others of comparatively little importance. A halibut weighing 252 lbs. was sold in the market of Bath last week."

1826 -- Petition of Samuel Bunker and 152 others.

"To the Senate and House of Representatives of the State of Maine in Legislature assembled, January 1826

"We the subscribers, inhabitants of the County of Somerset, would humbly represent, that heretofore, Salmon and other fish have ascended the River Kennebec and in the season of the year for said fish, the Inhabitants of the County have been well supplied and benefitted by said fish but of late years, by reason of Mill Dams and other obstructions in said Kennebec River said fish have been prevented coming up, so that said Inhabitants are deprived of the benefit of said fish.

"We therefore pray that your honourable body would take the subject into your wise consideration and take such measures as will totally remedy the evil above complained by totally removing the obstructions to the said Salmon passing up Said River

or making suitable sluiceways for said fish to pass up in, and as in duty bound will ever pray.

Sept. 12, 1826"

Source: Original document at Maine State Archives, Augusta, Maine.

1827 -- Petition of Charles Hayden and 52 others.

"To the Honorable the Legislature of the State of Maine

"We the undersigned inhabitants of several towns in the vicinity of the Kennebec River respectfully represent that the fish called Salmon, Shad and Alewives which pass up the river every spring of the year are considered of great importance not only as a convenience but comfort and help to support many of said inhabitants, and that said fish are greatly obstructed and destroyed in their usual passage up and down said river by reason of numerous machines and obstructions placed in said river to take, kill and destroy said fish.

"At the mouth of said river or near thereunto are placed a multitude of weirs for the purpose of taking said fish which prove very destructive by killing and breaking the schools of fish and driving them back into the ocean so that it is believed that comparative few in number make their way up the river. Next they are met in almost every eddy and mouth of small streams by nets of enormous lengths until they arrive at Ticonic falls between Winslow and Waterville, where the fish are met by new extraordinary and sure instruments of death called traps which placed in almost every avenue where it would be possible for the fish to run. These machines, implements or contrivances to take and kill said fish are kept almost constantly in the river have nearly destroyed the whole run of said fish. And at present fish laws for said river, if any there be, is found altogether inadequate for the purpose of protecting the passage of said fish up and down said river.

"We therefore earnestly request that the Legislature at its present session would enact such a law for the whole river Kennebec and Sebasticook as will give said fish a complete protection in their passage up and down the same and that the fish may have at least three days in each week to pass free of any obstruction. That all nets or seines used for the purpose of taking fish should be of limited and proper length and all improper obstructions removed and forbidden for the future and such a fine or penalty imposed as will deter any person from violating the law -- which should be so plain that he who reads may understand, and will give us a complete relief as it respects the above premises and in duty bound will every pray.

January 9, 1827"

Source: Original document at Maine State Archives, Augusta, Maine.

1828 -- Maine Laws. Chapter DLV. "An Act Regulating Fisheries at the mouth of Kennebec River."

"Be it enacted by the Senate and House of Representatives, in Legislature assembled, That if any person or persons shall set or use any net or seine for the purpose of catching Salmon on or by the shores or islands at the mouth of the Kennebec River, below the Fort, of a greater length than eighty fathoms, he or they shall forfeit and pay a sum not less than twenty nor more than fifty dollars, to be recovered in any court of competent jurisdiction, one moiety thereof to the use of the person who may sue for the same, and the other moiety to the use of the town where such offence shall be committed; and Act to the contrary notwithstanding."

Approved by the Governor, February 23, 1828.

Source: Maine Laws, Acts and Resolves for 1828. Maine Legislative Law Library, Augusta, Maine.

1831 -- Maine Laws. Chapter 198. "An Additional Act to the Several Acts relating to the taking of Salmon, Shad and Alewives in the Kennebec River."

"Sect. 1. Be it enacted by the Senate and House of Representatives, in Legislature assembled, That all weirs and hedges now built or which shall, hereafter be built in the Kennebec river for the purpose of taking Salmon, Shad and Alewives shall be so altered and constructed as to afford a convenient place for all young fish which may enter such weirs and hedges, which outlet shall be in the form of net work, and the meshes not less than one inch square, and the whole to be not less than eight feet wide, and four feet high; and all gates which may be made the weirs and hedges for the purpose of giving free passage to fish, instead of the dimensions now established, shall be required to be three feet square only ..."

Approved by the Governor March 31, 1831.

Source: Maine Laws, Acts and Resolves for 1831. Maine Legislative Law Library, Augusta, Maine.

Citizen Petition to the Maine Legislature -- 1835

"To the Legislature of Maine

"We the undersigned citizens of the State respectfully represent that great injury is experienced by the good people of this State and particularly by that portion of them which reside on and in the vicinity of the waters of the Kennebec River by the dams which have been erected across the Kennebec and its branches especially that branch called Sandy River and thereby preventing the free egress and regress of those Fish called

Alewives, Shad, Salmon and Trout, and indeed for every kind of Fish which formerly passed up the waters of those Streams before the erection of said dams.

"And we further represent that the privilege of these kinds of Fisheries is of great and essential benefit to the public and to be deprived of them is a public injury which in our humble opinion requires redress. And for that purpose we earnestly solicit the attention of the Legislature to the subject and pray that passage ways through the several dams across the Kennebec River and its branches may be kept open at those seasons of the year when, or during which these several kinds of Fish usually pass up these streams."

Signed by Thomas Yeaton and numerous others.

Source: Original document at Maine State Archives, Augusta, Maine.

1836 -- Citizen Petition to the Maine Legislature.

"To the Legislature of Maine --

"We the undersigned citizens of the State respectfully represent that great injury is experienced by the good people of this State and particularly by that portion of them which reside on, and in the vicinity of the waters of the Kennebec River and its branches by the dams which have been erected across the Kennebec and its branches especially that branch called Sandy River and thereby preventing the free egress and regress of those Fish called Alewives, Shad, Salmon and Trout, and indeed for every kind of Fish which formerly passed up the waters of those Streams before the erection of said dams.

"And we further represent that the privilege of these kinds of Fisheries is of great and essential benefit to the public and to be deprived of them is a public injury which in our humble opinion requires redress. And for that purpose we earnestly solicit the attention of the Legislature to the subject and pray that passage ways through the several dams across the Kennebec River and its branches may be kept open at those seasons of the year when, or during which these several kinds of Fish usually pass up these streams."

Signed by O.L. Currier and numerous others.

Source: Original document at Maine State Archives, Augusta, Maine.

c. Construction and Reconstruction of the Augusta Dam (1837-1900):

1839 -- "Petition of John Brown of Bowdoinham and 57 others praying that inquiry be made into the proceedings of the Kennebec Dam Company and that measures may be taken to protect the fisheries of the Kennebec River and its branches."

"The Hon. Legislature of Maine --

"The undersigned inhabitants of the Town of Bowdoinham respectfully represent that whereas a certain Corporation called the Kennebec Dam Company, incorporated March 7th 1834 have erected a dam across the Kennebec River at Augusta; and whereas among other considerations, or regulations in the erecting of said dam, the act of incorporation provides, "that a good and sufficient passage way up, through or over said dam, at the most suitable part of the same, so as to render the passage of Salmon, Shad and Alewives, practicable and easy, so that the same may go up the said River into the freshwater ponds, streams and other waters connected with the Kennebec River above said dam," should be constructed and maintained from the twentieth of April to the twentieth of July in each year; but no such passage way has been constructed by the company, and the dam is so constructed that the fish cannot pass up the said river. It therefore becomes highly injurious to the fisheries on the Kennebec and its branches; The catching of Salmon, Shad and Alewives on the Kennebec and its branches has been of great utility, and many have derived a considerable part of their support from that source; and still continue to be greatly dependent on the same as a means of procuring an honest living.

"The undersigned have no doubt but the dam at Augusta as it now is will by preventing the fish from ascending the river, to deposit their spawn, be of material injury to the fishery, and finally be the means of turning the fish from their usual course, and causing them to visit other rivers, where they can find egress to the ponds etc. to deposit their spawn."

Signed, John Brown and 57 others.

Source: Original document at Maine State Archives.

1856 -- Petition of Abijah Crosby of Winslow, Maine and 44 others for a fishway through the Kennebec Dam at Augusta.

"To the Hon. Legislature of the State of Maine

"The undersigned would most respectfully call your attention to the fact that no fishway or structures exists in the Kennebec Dam in Augusta as provided in the Charter for said dam. If a fishway was opened large numbers of fish would pass up the Kennebec River and into the adjacent streams which would afford a source of profit to the Inhabitants residing on the rivers and streams above said Dam, and pray that the sluiceway required in the charter of said dam should be provided and opened.

Abijah Crosby and 44 others. Dated Winslow, March 10th, 1856."

Source: Original document at Maine State Archives.

1859 -- Petition for a Fish Way at the Kennebec Dam, Augusta.

"PETITION !

"To the Hon. Senate and House of Representatives of Maine in Legislature assembled:

"The undersigned, legal voters in said State would respectfully represent, that prior to the building of the Kennebec Dam, across the Kennebec River in Augusta, Salmon, Shad, Alewives and other fish were accustomed to ascend the Kennebec, and from that, the Sebasticook and its tributary streams into the lakes and ponds from which those streams flow, and were taken in large quantities by the Inhabitants in the vicinity of said rivers and streams: that a large business was carried on in taking and selling fish thus taken.

"That by building of said Dam without a proper passage-way for fish, they have been entirely cut off from ascending the Kennebec above said Dam, and by reason of being unable to go up to their usual breeding places the number coming up the river to the Dam has been greatly diminished: that by the original charter of the Kennebec Dam Company, said Company were to make and keep in repair a sufficient passage-way for said fish to pass: that said Company has never complied with said provision, but the said Dam continues to obstruct and prevent the passage of the fish as aforesaid, to the great loss and injury of the people of the State; They, therefore, pray than an act may be passed to compel said Company, or the owners of said Dam to build and keep in repair a good and sufficient fish-way in said Dam, and in default of their so doing, to repeal all acts by virtue of which any persons derive any right to maintain said Dam, so that the same may be abated as a nuisance."

Abijah Crosby, Winslow, Maine and numerous others.

Source: Original document at Maine State Archives.

1859 -- Draft of a Legislative Act.

"State of Maine in the year of our Lord one thousand eight hundred and fifty nine --

An Act additional to an Act relating to the Kennebec Dam

Be it enacted by the Senate and House of Representatives in Legislature assembled as follows:

Section 1. An Act entitled "An Act to incorporate the Kennebec Dam Company," approved March 7, 1834 and all acts and parts of acts additional thereunto, or authorizing the building or continuance of the Kennebec Dam across the Kennebec River in Augusta are hereby repealed.

Section 2. The preceding sections of this Act shall take effect and be in force from and after the first day of December next, unless the owners or other persons interested in said Dam shall have constructed and are ready to maintain, a suitable fishway up through, or over said Dam as provided in the Eleventh Section of said Act entitled, "An Act to incorporate the Kennebec Dam Company."

Section 3. If before said first day of December next such owners or persons interested shall satisfy the Governor and Council that the provisions of the said section eleven of said act have faithfully complied with the Governor shall issue his proclamation accordingly and section first of this act shall not take effect."

Source: Original document at Maine State Archives.

[This Legislative Act was never passed into law. A note at the bottom original document reads: "In the House of Representatives, March 25, 1859. Read three times and indefinitely postponed. G.E.W. Wilcox, Clerk."]

After a ten-year legal battle with Sprague Manufacturing, the owner of the Kennebec Dam at Augusta, the State of Maine won a court decision compelling the dam owner to install a fishway at the dam, as required under the 1834 Legislative Charter which authorized the dam' s initial construction. The fishway was completed in the spring of 1880. A detailed story describing the fishway' s design, construction and was published in the Kennebec Journal in July, 1880. No mention was made of the ten-year legal battle. On July 12, 1880 the Kennebec Journal published a news item stating that Atlantic salmon had been observed using the new fishway and these salmon were later observed 20 miles upriver in Waterville, Maine. Records indicate that the fishway fell into disrepair at some point after 1880. Despite the State of Maine' s 10-year legal battle to force the installation of the fishway, the State of Maine did nothing to ensure the fishway was maintained in an operating condition once it was built. Except for this short period during the early 1880s, the Kennebec Dam would never have an operating fishway again. In 1999, the dam was removed from the bed of the Kennebec River.

d. 1900 to 1960:

Despite the lack of fish passage at the Kennebec Dam for 60 years and increasingly severe water pollution, the Kennebec River continued to support its native population of Atlantic salmon. This is proven by the 1917 report of the Maine Commissioner of Sea and Shore Fisheries, who reported the following convictions of Augusta citizens for illegally spearing and netting native Atlantic salmon below the Augusta Dam.

"Violator, Odolinn Blanchett, Augusta. Offense, spearing salmon at Kennebec Dam, Augusta. Taken before Judge Lancaster and fined \$25.00 and costs, appealed to Sept. Term. Supreme Court. Date of offense, Sept. 9, 1917.

"Violator, David Weston, Augusta. Offense, spearing salmon at Kennebec Dam, Sept. 9, 1917. Taken before Judge Lancaster and fined \$25.00 and costs. Costs paid, fine suspended.

"Violator, Forest Barnes, Augusta. Offense, spearing salmon at Kennebec Dam, Sept. 9, 1917. Taken before Judge Lancaster and fined \$25.00 and costs, costs paid, fine suspended.

"Violator, John Cook, Augusta. Offense, spearing salmon at Kennebec Dam, Sept. 9, 1917. Taken before Judge Lancaster and fined \$10.00 and costs, fine and costs paid.

"Violator, Lewis Paquin, Augusta. Offense, netting salmon at Kennebec Dam, Sept. 11, 1917. Taken before Judge Lancaster and fined \$10.00 and costs, fine and costs paid.

"Violator, Edward Pomislean, Augusta. Offense, spearing salmon at Kennebec Dam, Sept. 9, 1917. Taken before Judge Lancaster and fined \$10.00 and costs, fine and costs paid."

Source: Report of Maine Commissioner of Sea and Shore Fisheries, 1917. Maine State Archives, Augusta, Maine.

The practice of spearing, netting and snagging large Atlantic salmon below the Kennebec Dam continued unabated until the dam was removed in 1999 (personal interviews and press reports, this study).

Records indicate that by the 1920s and 1930s, water pollution in the Kennebec River became so severe that Maine fisheries officials gave up hope of restoring the rivers' once enormous migratory fish runs. Annual reports of the Maine Commissioner of Sea and Shore Fisheries during the period 1900-1960 are so devoid of observational information about migratory fish stocks in the Kennebec River that no conclusions about the status of Kennebec River Atlantic salmon can be safely drawn from them.

However, in July 7, 1936, outdoors writer Gene Letourneau of Waterville, Maine provided the following information in his "Sportsmen Say" column in the Kennebec Journal:

"Joseph Stickney, supervisor of the Maine Warden Service, is firm in his belief that if proper fishways were provided in the Kennebec River, sportsmen in Augusta and Waterville would be able to enjoy sea salmon and bass fishing. These fish, he has learned, abound at the mouth of the Kennebec and at points upriver where they have free access. From one of the veteran anglers in the Elm City [Waterville] the writer has learned that it has been some 20 years since the last sea salmon reached Ticonic Falls in Waterville. In Augusta, sea salmon have been reported below the dam in recent years."

In a 1983 "Sportsmen Say" column in the Kennebec Journal, Gene Letourneau published a photograph of a 9.5 pound Atlantic salmon caught by a Waterville resident, Red Noel, at Ticonic Falls in Waterville in the spring of 1943. According to Letourneau, during the 1940s the Kennebec Dam was approx. 16 feet high and some Atlantic salmon could leap over it during high river flows. Gene Letourneau's 1943 photograph of the Atlantic salmon caught by Red Noel of Waterville is the only known photograph of a Kennebec River Atlantic salmon prior to the 1970s.

In August 1998, while installing an educational sign along Bond Brook in Augusta, Friends of the Kennebec Salmon members Douglas Watts and Monica Castellanos met a 95-year-old Augusta resident who said that he fished and played at the first dam on Bond Brook as a child and observed salmon below the dam. He also said that as an employee of the Edwards textile mill in Augusta, he and other workers observed and speared Atlantic salmon below the Kennebec Dam during the 1940s and 1950s. He said the salmon congregated along the timber cribs at the base of the dam.

After a severe fish kill of Atlantic salmon below the Kennebec Dam in July 1973, noted Atlantic salmon angler Ai Ballou of Litchfield, Maine informed a reporter for the Kennebec Journal that it was not unusual for Atlantic salmon to come up to the base of the Kennebec Dam. "They congregate by the mill underneath the dam," Ballou said. (Kennebec Journal, July 31, 1973).

In an August 1973 story in the Kennebec Journal, outdoors writer Gene Letourneau quoted Maine State Representative Donald Carter of Winslow, who said he had obtained an affidavit from an experienced underwater diver who had seen numerous "big" Atlantic salmon below the Kennebec Dam while doing repairs to the dam prior to 1969. In 1985, Representative Carter provided this affidavit to the USFWS. In his cover letter, Carter informed USFWS he was submitting to them, "An affidavit by Donald M. Towle of Smithfield, Maine, dated April 16, 1969, which testifies to the fact that he saw and counted numerous Atlantics while working to repair the Edwards Dam in Augusta."

e. 1960 to Present

The Kennebec River Atlantic salmon population has been documented and studied by numerous qualified fisheries scientists for 45 years (Foye et al. 1969; Havey 1968; Beland 1986; Buckley 1999).

Study methods in the Kennebec River drainage have included juvenile population assessments, redd counts, examination of adults caught by anglers, and most recently, microsatellite DNA analysis of wild juveniles and adults captured in the rivers' tributaries (Havey 1968; Foye et al. 1969; Beland 1986; Ed Baum, personal communication, 1997; Buckley 1999; King et al. 1999).

Naturally reproducing populations of wild Atlantic salmon have been documented and studied in the Kennebec River drainage since at least the early 1960s. Foye et al. (1969) wrote:

"Biological studies show that small numbers of young Atlantic salmon are still produced in Togus Stream, a tributary of the Kennebec below Augusta. These young salmon are frequently mistaken for small trout by uninformed anglers. ... Togus Stream enters tidal waters of the Kennebec in Randolph. The only major obstruction on this small stream is a 10-foot wood and concrete dam which impounds Lower Togus Pond in Chelsea. Salmon spawning and nursery areas in this stream below Lower Togus Pond support the only known population of Atlantics in the Kennebec drainage today."

Former Maine inland fisheries biologist Matthew Scott assisted biologist Keith Havey in the 1960s studies of the Togus Stream Atlantic salmon population. Mr. Havey is deceased. Scott told Friends of the Kennebec Salmon in 1998 that department biologists

were aware of the Togus Stream Atlantic salmon population "long before" detailed investigations of the population were conducted in the 1960s. (Matthew Scott, personal communication to Douglas Watts, 1998).

Scott told Friends of the Kennebec Salmon that during his tenure with the department' s Augusta regional office from 1962 to 1970 he received calls every spring from workers at the Hudson Paper mill in Augusta who reported that adult Atlantic salmon were congregating directly the Edwards Dam and that mill workers were poaching them with nets. (Matthew Scott, personal communication to Douglas Watts, 1998).

According to Baum (1997) no juvenile salmon were stocked in the Penobscot River in 1960, 1961, 1963 and 1964. Matthew Scott' s reports of adult salmon in the Kennebec each year from 1962 to 1970 is problematic since it is unlikely all of the salmon sighted (and according to Scott, frequently poached by workers at the Hudson Paper mill) in the Kennebec in those years could have resulted from strays from stocking in the Penobscot. Scott said that during this period, his department made no surveys to locate salmon in the Kennebec River below the dam, except to investigate specific poaching incidents.

In July 1973, journalist, angler and Augusta resident Harry Vanderweide wrote in a story in the Kennebec Journal: "The Kennebec has long been known to hold a remnant population of salmon, most of which run up Togus Stream to spawn when the water cools in the fall."

In January 1985, Maine State Representative Donald Carter of Winslow, provided written testimony to the U.S. Fish & Wildlife Service regarding the agency' s Environmental Impact State for Restoration of Atlantic Salmon to New England Rivers. Rep. Carter' s testimony stated in part:

"My recommendations were based on the fact that the Kennebec River, despite years of high pollution and impeding natural barriers that exist on the Kennebec River, has throughout these intervening years supported a wild strain of Atlantic salmon. These fish have, despite all odds, managed to spawn as they did on day #1 and still do today on Togus Stream and Bond Brook. Both of these streams are immediately below the Edwards Dam in Augusta, Maine."

Beland (1986) stated:

"The Kennebec River currently has a small population of Atlantic salmon below the Augusta Dam, composed of hatchery strays from other rivers as well as wild fish originating from tributaries below Augusta. The salmon runs in the Kennebec below Augusta are of uncertain magnitude, but are believed to number less than 200 adults in recent years."

In 1995, the "Four Rivers Working Group" of the Governor' s Maine Atlantic Salmon Task Force (Vail et al. 1995) stated:

"There currently exist what appear to be self sustaining populations of Atlantic salmon present in at least two of the three major tributaries below the Augusta dam."

In 1998, Maine Dept. of Inland Fisheries & Wildlife regional fisheries biologist William Woodward told Friends of the Kennebec Salmon that he had frequently conducted electrofishing surveys of Bond Brook in Augusta and Manchester since 1978. Woodward said he often found juvenile Atlantic salmon in Bond Brook during his surveys. He said the juveniles were found throughout the brook, including its uppermost headwaters as well as several small tributary streams to the brook. (William Woodward, MDIFW, personal communication to Douglas Watts, 1998)

A small, impassable dam in lower Bond Brook in Augusta breached and became passable to adult Atlantic salmon in the mid 1970s (Woodward, personal communication, 1998). This breaching and Woodward' s surveys indicate that Atlantic salmon re established a natural population in Bond Brook almost as soon as the brook became accessible to spawning adults. In 1996, Friends of the Kennebec Salmon and Maine Atlantic Salmon Authority staff biologists documented seven Atlantic salmon redds in the short stretch of stream below the small dam site near the mouth of Bond Brook. Edward Baum stated that he had also observed Atlantic salmon spawning in this area of the brook in the early 1970s (Letter from Edward Baum to Douglas Watts, 1996).

On Nov. 15, 1999 Baum, the former senior scientist of the Maine Atlantic Salmon Authority, wrote in an opinion column in the Kennebec Journal:

"It is a well documented fact that Atlantic salmon have been successfully spawning in several lower tributaries of the Penobscot River since the early 1950s and the lower Kennebec River since the early 1970s (I have personally observed them doing so in both rivers on many occasions). And there is no reason to believe that salmon were not successfully spawning in those areas for many years prior to that, because no one was looking for spawning salmon at the time."

Mr. Baum' s comment is significant since records indicate that as soon as fisheries biologists began specifically attempting to locate spawning Atlantic salmon in the Kennebec drainage in the 1960s, they quickly found them. As Baum suggests, temporal gaps in the historic record of Atlantic salmon in the Kennebec are more likely due to a lack of interest by fisheries biologists to locate spawning salmon in the river drainage during the period from 1900 to 1960 -- rather than the absence of any wild Atlantic salmon in the Kennebec River.

Since 1990, wild Atlantic salmon juveniles and/or adults have been documented in three tributaries of the lower Kennebec River and in the river' s mainstem.

In 2000, Atlantic salmon spawning was documented at several locations up to 20 miles above the site of the former Edwards Dam in Augusta, which was removed in 1999. (Paul Christman, Maine Atlantic Salmon Commission, personal communication to Douglas Watts, 2000). Christman estimated that less than one third of the accessible spawning habitat in the main-stem was surveyed for redds in the fall of 2000.

In July, 2001 a 2SW adult Atlantic salmon of wild origin was captured and released by staff of FPL Energy at Ticonic Falls in Waterville during fisheries research at the Lockwood dam, approx. 19 miles above the former Edwards Dam in Augusta (Paul Christman, Maine Atlantic Salmon Commission, personal communication, 2001).

The removal of the Edwards Dam and restoration of 20 miles of main-stem Atlantic salmon habitat above Augusta, Maine has greatly complicated efforts to determine how many Atlantic salmon are in the Kennebec River population today. Numerous sections of the river containing high quality salmon habitat are over 1,000 feet in width, making redd counts and juvenile assessments problematic. In some years, redd counts have not even been attempted due to high river flows in late October and November (Paul Christman, personal communication, 2004). Even in years with flows suitable for redd counts on the Kennebec main-stem, the sheer amount of suitable spawning habitat has forced the MASC to limit its redd surveys to discrete segments of the river. To date, no complete redd count has ever been undertaken on the Kennebec River main-stem from Augusta to Waterville, Maine. While very limited in nature, these surveys have confirmed the continued presence of wild Atlantic salmon in the Kennebec River, continued natural spawning activity, and a marked preference of Kennebec River Atlantic salmon for spawning and rearing habitat in the river' s mainstem. These observations are consistent

with those made by Atkins (1869) and those by volunteers of Friends of the Kennebec Salmon in November 1997, when a number of large salmon redds were discovered in the main-stem of the Kennebec River several hundred yards off the mouth of Bond Brook below the Edwards Dam in Augusta. Since Bond Brook was fully accessible to spawning Atlantic salmon in 1997, these observations made clear that some Kennebec River Atlantic salmon prefer to spawn in the river' s mainstem even when they have full access to a nearby tributary containing high quality Atlantic salmon habitat.

III. GENETIC CHARACTER OF KENNEBEC RIVER ATLANTIC SALMON

Since 1994, tissue samples from more than 185 Kennebec River Atlantic salmon have been collected and analyzed as part of larger studies of the genetic character of Atlantic salmon in the State of Maine (King et al. 1999)

Summarizing these analyses, National Academy of Sciences (2004) stated:

"NMFS and USFWS (1999) characterize the Gulf of Maine DPS (Distinct Population Segment) as including "all coastal watersheds with native populations of Atlantic salmon north of and including the Kennebec River (below the Edwards Dam) to the mouth of the St. Croix River at the U.S.-Canada border." The agencies later excluded the salmon populations from the lower Kennebec drainage from the DPS. The Kennebec is the second largest watershed in Maine and historically had produced similar numbers of Atlantic salmon (Atkins 1869; Kendall 1935). The largest impact on the survival of Atlantic salmon in Maine will be obtained by conserving and nurturing the Penobscot populations, but the second largest impact can be obtained by restoring Atlantic salmon to the Kennebec.

"With the removal of Edwards Dam on the lower Kennebec, the possibility of salmon recovery in the upper Kennebec mainstem has become a matter of considerable interest. Viable populations of Atlantic salmon are in Togus Stream and Bond Brook tributaries, both joining the main stem below Edwards Dam. Strays from other rivers have been documented within the drainage (Beland 1986; Baum 1997). It is not entirely clear whether the current populations represent the remnants of persistent aboriginal populations within the drainage (Baum 1997; Beland 1986; Buckley 1999; Foye et al. 1969; Havey 1968, Vail et al. 1995), but neither Bond Brook nor Togus Stream were incorporated into the DPS (NMFS and FWS 1999).

"The report on the genetic status of Maine' s salmon (NRC 2002a) included salmon from Togus Stream and Bond Brook (collectively labeled Kennebec) in its comparison of genetic assignment success rates among Maine drainages (King et al. 1999). A close examination of the data (NRC 2002a) shows that the salmon populations of the Kennebec drainage are more distinct than are those of the current DPS rivers. The current populations are wild, and they should figure prominently in any restoration effort. The committee concludes that there is nothing to lose by not stocking the Kennebec (NRC 2002b). Atlantic salmon seem to be recolonizing the upper Kennebec main stem above the Togus and Bond Brook tributaries. There is preliminary evidence that salmon are already spawning as far upriver as Ticonic Falls, 19 miles above the former dam site (P. Christman, personal communication, 2002). The opportunity to observe the course of that rebound, in the absence of stocking, should not be missed.

"The Kennebec also provides an excellent opportunity for fishery managers and biologists to determine whether dam removal will be sufficient to allow recolonization and expansion of wild fish populations upstream of previous impediments. A review of accumulated experience in Bond Brook and Togus Stream suggests that some recolonization of the upstream Kennebec main stem can be expected. For the short term, salmon should be allowed the chance to rebound naturally in the Kennebec without hatchery augmentation. Conditions should be monitored closely, however. If the population of wild salmon does not rebound naturally in the Kennebec, an enhancement program can be implemented (presumably using Togus and/or Bond Brook brood stock), but if the main stem population rebounds naturally, subsequent stocking should be avoided."

As stated in the NAS Interim Report on Genetics (2002), the Kennebec River collection studied by King et al. (1999) is the largest Maine collection analyzed (n=185). This collection consisted wholly of wild Atlantic salmon juveniles and adults collected in two tributaries (Bond Brook, Augusta; Togus Stream, Randolph) that have no history of stocking (Baum 1997) and well documented wild Atlantic salmon populations.

The assignment test results summarized in the NAS Interim Report (2002) indicate the Kennebec River collection had the highest percentage of correct assignments (74 percent) of any Maine river collection except the Penobscot. Of 185 individual wild salmon in the Kennebec collection, only eight individuals (4 percent) were incorrectly assigned to the Penobscot River collection; and only 13 individuals (8 percent) from the Penobscot collection were incorrectly assigned to the Kennebec collection.

These results contradict the hypothesis that the Kennebec River wild Atlantic salmon are solely "strays" from the Penobscot restoration program or the progeny of these strays. It is well known that Penobscot-origin adults enter the Kennebec River and have

been documented spawning in the river' s tributaries (Joseph McKeon, USF&WS, personal communication, 1997). Despite this, the highest number of incorrect assignments for the Kennebec collection is to the East Machias collection (n=14), which has never been suggested as a potential source of stray adult salmon to the Kennebec nor has that river ever been used as a source of broodstock for statewide restoration programs (Baum 1997).

The assignment test results of King et al. (1999) show the Kennebec collection is no less distinct than any other Maine river collection studied. In fact, the Kennebec collection appears at least or more "distinct" as any other Maine collection studied -- in except for the Penobscot.

A March 24, 1998 memo from Dr. Timothy King to Mr. Jerry Marancik of the U.S. Fish & Wildlife Service in East Orland, Maine contained this reference to King' s analysis of the Kennebec collection:

"Lower Kennebec 1995 and 1996 samples -- Analysis of the lower Kennebec River samples has been completed. The results suggest that the three Bond Brook samples appear to be very similar to each other (ie. cluster closely together), yet are divergent from other collections in Maine. Even if hatchery strays founded this population (as suggested by some), it appears to be a stable reproducing population that is somewhat divergent from other collections including Togus Stream. Two of the three Togus Stream samples are very similar to each other and somewhat divergent. The third collection is divergent from all Maine collections. We are still trying to discern why the one population appears so different from the rest."

King' s comments in this memo and in the 1999 and 2000 studies appear to argue against the "stray" hypothesis for two reasons:

a) The data suggests the Bond Brook and Togus Stream populations are somewhat divergent from each other. If both of these tributary populations are wholly supported by an annual influx of "hatchery strays," one would expect them to be identical since their parentage is from an annual influx of an identical donor stock.

b) The data suggests the Bond Brook and Togus Stream populations are somewhat divergent from other Maine populations, including the Penobscot. If "hatchery strays" were the sole supply of spawning adults to these Kennebec tributaries, one would expect the salmon in these tributaries to be genetically indistinguishable from the alleged

"donor" stock, ie. the Penobscot. To the contrary, the study by King et al. has found Kennebec and Penobscot River salmon to be readily distinguishable from each other.

The Kennebec collection is one of the most robust examined by King et al. (1999) for the following reasons:

- a) Sample size (n=185) is larger than most of the other Maine collections.
- b) Samples were taken from two geographically separate tributaries (Bond Brook, Augusta; Togus Stream, Randolph), located nearly six miles from each other.
- c) Samples were obtained from multiple year classes of Atlantic salmon from both tributaries during each of the three years they were surveyed (1994, 1995, 1996). Spawning adults were also sampled in both tributaries.
- d) On Bond Brook, juveniles in each sampling year were collected from two separate sections of the brook (over 1 mile apart) to reduce the chance of familial sampling. Juveniles of several year classes were collected from all sites surveyed. Difficult access conditions prevented the type of broad spatial sampling of Togus Stream as that conducted on Bond Brook.
- e) Neither of the sampled Kennebec River tributaries have been subjected to any known stocking of Atlantic salmon.

IV. Evidence from other Native Fish Species of the Kennebec River.

During the past 30 years, some fisheries scientists and others have declared without any evidence that the native Atlantic salmon of the Kennebec River were extirpated at some point during the 20th century due to the cumulative effects of impassable dams and severe water pollution.

Proving a population has been extirpated is problematic because it consists of proving a negative, ie. making a positive conclusion from a negative finding. Even modern and sophisticated fish population sampling techniques (electrofishing, beach seining) can fail to document fish populations in a waterbody, especially when the populations are small, migratory or occupy narrow habitat niches.

For example, extensive electrofishing sampling of the Kennebec River below Waterville, Maine in 2002 and 2003 (Yoder et al. 2004) failed to locate any life stages of Atlantic or shortnose sturgeon in the Kennebec River. However, both species are known to be well established in the sampled portions of the river; and spawning adults have been observed in recent years as far upriver as Waterville, Maine. Prior to 1970, there were no scientific efforts to document the fish species assemblage of the Kennebec River below the Edwards Dam in Augusta, Maine (Matthew Scott, personal communication, 1998; Foye et al. 1969). As Maine's former senior Atlantic salmon biologist Edward Baum wrote in November, 1999:

"It is a well documented fact that Atlantic salmon have been successfully spawning in several lower tributaries of the Penobscot River since the early 1950s and the lower Kennebec River since the early 1970s (I have personally observed them doing so in both rivers on many occasions). And there is no reason to believe that salmon were not successfully spawning in those areas for many years prior to that, because no one was looking for spawning salmon at the time."

As shown above, the proposition that the native Atlantic salmon population of the Kennebec River was extirpated at some period during the early to mid 20th century is inherently speculative. Records show there were no scientific efforts to document the presence of Atlantic salmon or any other fish species in the Kennebec River from 1900 to the early 1960s. The first scientific efforts in the 20th century to determine the presence of Atlantic salmon in the Kennebec River began in the early 1960s (Matthew Scott, personal communication, 1998). These efforts confirmed the annual presence of adult Atlantic salmon at the base of the impassable Edwards Dam in Augusta; and documentation of a functioning, naturally reproducing population of wild Atlantic salmon in a lower Kennebec River tributary, Worromontogus Stream (Havey 1968; Foye et al. 1969). The scientific investigation of the wild Atlantic salmon population in Worromontogus Stream (which began in 1962) was in response to reports by streamside residents that Atlantic salmon had been spawning in the stream for many years prior to 1962 (Matthew Scott, personal communication, 1998).

The proposition that the native Atlantic salmon of the Kennebec River were extirpated due to impassable dams and severe water pollution at some period prior to the initiation of scientific investigation can be illuminated by examining the fate of the other

native migratory and resident fish species of the Kennebec River during this same period. Historic records (Atkins 1869; Goode 1887; Squiers 1988) show the lower Kennebec River hosted a diverse array of native diadromous and resident fish species. These include the Atlantic sturgeon, shortnose sturgeon, striped bass, Atlantic salmon, American shad, sea lamprey, American eel, alewife, white perch, blueback herring, rainbow smelt, tomcod, yellow perch, white sucker, chain pickerel, brown bullhead, blacknose dace, fallfish, banded killifish, pumpkinseed sunfish, redbreasted sunfish, spot-tailed shiner, nine-spine stickleback, four spine stickleback and other species.

Contemporary evidence (Yoder et al. 2004; numerous other studies) shows that *none* of these native diadromous and resident fish species were extirpated from the Kennebec River due to impassable dams and pollution; and *all* of the above native species are still found in the Kennebec River today.

The proposition that of all 24 of the Kennebec River' s native fish species, only the Atlantic salmon fully succumbed to the effects of dams and water pollution at some undefined moment during the 20th century strains credulity.

Were impassable dams sufficient to cause the extirpation of Atlantic salmon and other native fish species of the Kennebec River?

Historic and contemporary evidence on this question is conclusive. Diminished populations of 24 of the Kennebec River' s native migratory and resident fish species have persisted despite the existence of impassable dams on the Kennebec River since 1837. One half century after construction of the Edwards Dam at the river' s head of tide, Goode (1887) stated that weir fishermen in the lower Kennebec River fishing for American shad were still catching 100 or more Atlantic salmon in their weirs each year. Goode further stated: "The only breeding ground remaining accessible to the salmon was on the gravel beds within the first half mile below the Augusta Dam, and to this opportunity is the continuance of the brood in the river doubtlessly due." Contemporary evidence (Havey 1968; Foye et al. 1969; Beland 1986; USFWS 1999; King et al. 1999) show that wild Atlantic salmon populations have managed to survive in the Kennebec River and its tributaries despite impassable dams at the river' s head of tide and most of its tidal tributaries. Contemporary studies (Yoder et al. 2004; Squiers 1988) shows that all of the other native migratory fish species of the Kennebec River have managed to survive despite impassable dams on the river and its tidal tributaries for the past 170 years.

Was severe water pollution sufficient to cause the extirpation of Atlantic salmon and other native fish species of the Kennebec River?

Contemporary studies (Yoder et al. 2004; Squiers 1988) show that all of the native migratory fish species of the Kennebec River managed to survive despite severe water pollution in the Kennebec River from the early 20th century to the 1980s. During the early 1960s, when Maine fisheries scientists were studying the population of wild Atlantic salmon in Worromontogus Stream, water pollution in the Kennebec River was at its worst. During this period, large fish kills in the river were commonplace and fumes from the polluted river were so strong they peeled the paint off riverside buildings.

Evidence shows all 24 of the native fish of the Kennebec River managed to survive more than a century of impassable dams and water pollution. The proposition -- based on no evidence -- that the native Atlantic salmon of the Kennebec River were the only one of 24 native fish species to disappear from the Kennebec River due to dams and pollution is false. No evidence exists to support it and numerous independent lines of evidence clearly refute it.

V. Existing Threats to the Kennebec River Atlantic Salmon

Threats to the Kennebec River population of Atlantic salmon are similar to those faced by other populations within the Gulf of Maine DPS of anadromous Atlantic salmon (65 Fed. Reg. 69459; NAS 2004). A threat unique to the Kennebec River Atlantic salmon compared with other populations in the DPS is the presence of numerous hydro-electric dams in the Kennebec River and its tributaries. Impassable dams have been the primary cause of the decline of the Kennebec River Atlantic salmon population since the early 19th century (NAS 2004; historic documents, this study). Impassable hydro-electric dams continue to prevent Kennebec River Atlantic salmon from gaining access to 90 percent or more of their historic spawning and nursery habitat in the Kennebec River watershed.

Construction of upstream fish passage facilities for Atlantic salmon in the Kennebec River drainage is in its infancy. An upstream fish passage facility at the lowermost Kennebec River dam, the Lockwood Dam in Waterville, is scheduled to be in operation by May 1, 2006. Upstream fish passage facilities at two hydro-electric dams on the Sebasticook River, the Kennebec' s largest tributary, are scheduled to be in operation

in 2006 as well. These are the Benton Falls Dam in Benton, Maine and the Burnham Dam in Pittsfield, Maine. Upstream passage for Atlantic salmon at the lowermost dam on the Sebasticook River, the Fort Halifax Dam in Winslow, is scheduled to be provided via breaching the dam. Due to several pending lawsuits by local residents who oppose the breaching of the Fort Halifax Dam it is doubtful this dam will be breached in 2005.

Beginning in May 2006, Kennebec River Atlantic salmon will have the opportunity to enter the fish lift facility at the Lockwood Dam in Waterville, Maine. However, there is only one mile of river between the Lockwood Dam and the next impassable hydro-electric dam, the Hydro Kennebec Dam in Waterville and Winslow. Nearly all of this one mile reach of river is impounded by the Lockwood Dam and for this reason lacks suitable depths and current velocities for spawning and juvenile Atlantic salmon. Due to these circumstances, any Atlantic salmon captured at the Lockwood Dam fish lift will have to be transported by aerated truck and released into suitable upstream habitat in the Kennebec River drainage; or released back into the Kennebec River below the Lockwood Dam.

In order for anadromous Atlantic salmon to complete their lifecycle they must migrate from their freshwater habitat to their marine habitat. Atlantic salmon accomplish this migration by swimming downstream to the ocean. Juvenile Atlantic salmon in Maine generally migrate from freshwater to saltwater during their second and third year of life and migrate during the spring and fall (Baum 1997). Adult Atlantic salmon migrate to their marine environment after spawning and initiate these migrations in late fall and spring (Baum 1997; historic documents, this study). Hydro-electric dams can impede or completely prevent Atlantic salmon from completing this migration (NAS 2004). Population recruitment requires parents. If juvenile and adult Atlantic salmon cannot reach their marine habitat a population cannot be maintained.

There are no downstream fish passage facilities for Atlantic salmon on the main-stem hydro-electric dams of the Kennebec River; nor are there plans to construct downstream passage facilities at these dams during the next several years (MDMR 2005). Two hydro-electric dams on the Sebasticook River are equipped with downstream passage facilities for anadromous alewives (*Alosa pseudoharengus*) and American shad (*Alosa sapidissima*). Even with these facilities, fish kills of juvenile alewives at these dams can be frequent and severe due to turbine mortality (MDMR 2005). The effectiveness of these two downstream passage facilities (at the Benton Falls Dam and

Burnham Dam) for safely passing juvenile and adult Atlantic salmon has never been tested. Downstream passage at the Fort Halifax Dam is scheduled to be provided by breaching the dam.

Even with "effective" downstream passage facilities, the Maine Department of Marine Resources estimates a loss of 10 percent of migrating alewives and American shad at each main-stem Kennebec River hydro-electric dam due to turbine entrainment, injury and mortality (MDMR 2005). Nearly all the free-flowing spawning and nursery habitat in the Kennebec River drainage above Waterville, Maine is located above four to eight hydro-electric dams. These habitat areas include the Sandy River drainage (5 dams); the Carrabassett River drainage (6 dams); and the upper main-stem Kennebec (6 to 8 dams). All but several miles of the approx. 35 mile reach of the main-stem Kennebec River below the mouth of the Sandy River is impounded by hydro-electric dams which has rendered this habitat unusable for spawning and juvenile Atlantic salmon.

Simple arithmetic demonstrates that a 10 percent loss of Atlantic salmon migrating downstream past each of these dams would result in a cumulative mortality of 40-60 percent of all downstream migrants. With no effective downstream fish passage facilities in place at these dams (as is the case at present), cumulative mortality will undoubtedly be much greater.

VI. Conclusion

Eleven years have passed since 1994, when the U.S. Fish & Wildlife Service began taking tissue samples from wild Kennebec River Atlantic salmon to determine if they qualify for protection under the United States Endangered Species Act. During these eleven years the USFWS has taken no action to protect the wild Atlantic salmon of the Kennebec River under the U.S. Endangered Species Act. In Nov. 2000, the USFWS delineated a "Gulf of Maine DPS" of Atlantic salmon which included the Kennebec River and its wild Atlantic salmon within its geographic bounds. Simultaneously, the USFWS excluded wild Atlantic salmon in the Kennebec River from any protection under the U.S. Endangered Species Act (65 Fed. Reg. 69459). A half decade later, the USWFS has yet to take any steps to include wild Kennebec River Atlantic salmon in the Gulf of Maine DPS or protect them under the U.S. Endangered Species Act.

Nearly all of the historic evidence in this petition regarding the persistence of Atlantic salmon in the Kennebec River was submitted to the USFWS and NMFS in 1999 during the public comment period for the Services' 1999 Status Review for Anadromous Atlantic Salmon (Comments of Friends of the Kennebec Salmon to Mary Colligan, National Marine Fisheries Service, March 8, 1999). The 1999 Status Review made no reference or citation to any of this historic information presented; nor did the Nov. 2000 listing decision which included -- but also excluded -- Kennebec River wild Atlantic salmon (65 Fed. Reg. 69459).

Actions by the USFWS to date have been arbitrary, capricious and in violation of the U.S. Endangered Species Act. Since 1994, the USFWS has taken tissue samples (pieces of fin) from more than 180 wild Kennebec River Atlantic salmon to prove the "Gulf of Maine DPS" of Atlantic salmon merits protection under the ESA, and in the same stroke, excluded these same wild Kennebec River salmon from ESA protection. Since 1994, the USFWS has provided no explanation for its continued refusal to protect wild Kennebec River Atlantic salmon under the ESA except to say the population remains "under study."

Until they are extinct?

The U.S. Endangered Species Act requires the USFWS to make its listing determination on the best scientific and commercial information available at the time of the listing decision (U.S.C. 16 §§ 1533). Five years have now passed since the Nov. 2000 USFWS listing decision excluding the Kennebec River population of Atlantic salmon from the Gulf of Maine DPS of Atlantic salmon protected under the ESA. The USFWS has yet to provide any factual basis for its decision to exclude the Kennebec River Atlantic salmon population from ESA protection (65 Fed. Reg. 69459). The United States Endangered Species Act does not allow the USFWS to put a population of an endangered species in a perpetual state of being "under study" and thus deprived protection under the ESA.

Petitioners request the Departments of Interior and Commerce make an immediate decision to protect or not protect the Atlantic salmon of the Kennebec River as an endangered species pursuant to the United States Endangered Species Act.

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VIII. APPENDIX ONE

Evidence of a shift in Atlantic salmon behavior -- Kennebec River, 1999-2005.

By Douglas Watts
Friends of the Kennebec Salmon
Augusta, Maine -- February 2005.

Prior to the removal of the Edwards Dam in 1999, it was common to see large numbers of Atlantic salmon and trout congregating at the mouth of Bond Brook in Augusta during the hottest part of each summer (mid July - mid August).

Because it is fed by springs and groundwater, Bond Brook maintains a cooler temperature than the Kennebec River during mid-summer. Prior to the removal of the Edwards Dam in 1999, a deep pool at the mouth of Bond Brook, just below the stone arch bridge on Water St., provided an area large enough for up to 100 salmon and trout to lie in cool water during the heat of the summer.

Salmon and trout would not be seen in this pool until water temperatures in the Kennebec River exceeded 70 F, usually in mid-July. By mid-August, water temperatures in the Kennebec River drop back below 70 F and the salmon and trout congregating at the mouth of Bond Brook would disperse back into the Kennebec River.

Breaching of the Edwards Dam, one fourth mile upstream of Bond Brook, commenced on July 1, 1999. Removal of the dam structure continued through the summer and fall. Fish were not able to migrate upstream past the dam until a large (200 foot wide) breach was completed on August 12, 1999. This breach restored the 15 mile reach of the Kennebec River impounded by the Edwards Dam to its natural elevation, depth and flow.

Summer 2000 marked the first hot weather season in over a century when Atlantic salmon were able to inhabit the 20 mile reach of the Kennebec River between the former Edwards Dam in Augusta and the Lockwood Dam at Ticonic Falls in Waterville, Maine.

Repeated observations (often daily) have been made at the mouth of Bond Brook during the summers of 2000, 2001, 2002, 2003 and 2004. Throughout the past five summers since the Edwards Dam was removed, not a single salmon or trout has been observed at the mouth of the Bond Brook during hot weather periods. Prior to the removal of the Edwards Dam, up to 100 Atlantic salmon and trout could be observed seeking the cool water at the mouth of the brook during hot weather periods.

What might explain this sudden change?

We begin with a process of elimination.

Bond Brook has not changed. The brook and its mouth were not affected by removal of the Edwards Dam, one fourth mile up river. Bond Brook maintains the same flow and temperature as it did prior to removal of the Edwards Dam.

Numbers of salmon and trout in the river do not appear to have changed. Salmon are observed leaping in the river from Augusta to Waterville and spawning at various locations above Augusta. Trout in the river are frequently caught by anglers.

Climatic conditions have not changed. The summers of 2000, 2001, 2002, 2003 and 2004 have been similar in temperature, if not hotter and dryer, than summers in previous years.

What has changed?

Since 2000, the Edwards Dam is no longer a migration barrier to salmon and trout.

Removal of the Edwards Dam has restored the natural channel, depth and flow of the 15 miles of the Kennebec River formerly impounded by the dam; and restored free access to the entire river to Ticonic Falls in Waterville, Maine.

Removal of the Edwards Dam has restored access to more than a dozen first and second order tributaries of the Kennebec River between Augusta and Waterville; and portions of three larger tributaries, Seven Mile Stream, Messalonskee Stream and the Sebec River.

In 2000, 2001, 2002, 2003 and 2004 these tributaries have been visited repeatedly during mid-summer to determine their potential and actual use as thermal refugia for salmon and trout in the Kennebec River. The following observations have been made.

All of the first and second order tributaries are either dry or at extreme low flows in mid summer. Those not dry have water depths of one to six inches with few if any accessible pools of sufficient size to hold salmon or trout. Of those not dry in mid-summer, measurements with a pocket thermometer show no appreciable difference in water temperature between the tributaries and the Kennebec River. No trout or salmon have been observed in or at the mouths of these tributaries in mid-summer seeking thermal refugia.

Three larger tributaries of the Kennebec River above the Edwards dam site are of sufficient size to accommodate Atlantic salmon and trout seeking thermal refugia during mid summer. These are Seven Mile Stream, Messalonskee Stream and the Sebec River.

Seven Mile Stream is similar to Bond Brook in size, with channel widths of 15-25 feet and pools of sufficient depth to hold an adult Atlantic salmon or trout. The first dam on Seven Mile Stream is at the outlet of Webber Pond, three miles upstream from the

Kennebec River. Seven Mile Stream receives most of its flow from a series of natural, warmwater ponds east of the Kennebec. Mid-summer water temperatures in Seven Mile Stream are equal to or higher than water temperatures in the Kennebec River.

Messalonskee Stream is much larger than Seven Mile Stream, with a drainage of 200 square miles, channel widths of 50-80 feet and numerous pools with depths of 6 to 12 feet. The source of Messalonskee Stream is a group of large, natural lakes and ponds, known as the Belgrade Lakes, located 10-15 miles west of the Kennebec River. All but the lowermost mile of Messalonskee Stream is impounded by a series of hydro-electric dams which are impassable to fish. Mid-summer water temperatures in Messalonskee Stream are higher than in the Kennebec River.

The Sebasticook River is the largest tributary of the Kennebec, with a drainage area of nearly 1,000 square miles. An impassable dam is located on the Sebasticook approx. 1,400 feet above its confluence with the Kennebec River. The Sebasticook is fed by many large and small natural lakes. The lowermost eight miles of the river is impounded by two hydro-electric dams. Mid-summer water temperatures in the accessible portion of the Sebasticook are consistently higher than in the Kennebec River.

The review above indicates that none of the tributaries to the Kennebec River in the 20 mile reach from Augusta to Waterville, Maine appear to offer thermal refugia for Atlantic salmon and trout. These tributaries are either too small to hold Atlantic salmon or have mid-summer water temperatures warmer than the Kennebec River itself.

Despite the removal of the Edwards Dam, the only accessible Kennebec River tributary with sufficient mid-summer flow, depth and cool water to provide thermal refugia for Atlantic salmon and trout is still Bond Brook in Augusta.

Yet, since the removal of the Edwards Dam, not a single Atlantic salmon or trout has been observed using the thermal refugia at the mouth of Bond Brook, even during hottest days of the summer.

What has caused this change?

During mid-summer "hot spells" water temperatures in the Kennebec River can reach 75 F. These are temperatures known to cause Atlantic salmon and other salmonids to seek thermal refugia.

This creates a conundrum. None of the Kennebec tributaries above Bond Brook in Augusta appear to offer any mid-summer thermal refugia for salmon and trout. At the same time, since removal of the Edwards Dam, salmon and trout have completely abandoned their decades-long habit of congregating in large numbers in the thermal refugia at the mouth of Bond Brook. Prior to removal of the dam, up to 100 Atlantic salmon and trout sought thermal refugia in the mouth of Bond Brook, even though the mouth is in a highly visible, urban area frequented by salmon poachers.

By a process of elimination, this information suggests that since removal of the Edwards Dam, Atlantic salmon and trout have located mid-summer thermal refugia in the Kennebec River itself.

In some ways, the 20 mile reach of the Kennebec River from Waterville to Augusta confounds standard assumptions about large New England rivers. It is normally assumed that first, second and third order tributaries to the lower reach of a large river (5,000 square miles) should be cooler during mid-summer than the large river. Observations and temperature data for the lower Kennebec since removal of the Edwards Dam indicate the main-stem of the Kennebec is often cooler during mid-summer than the small tributaries entering into it.

Several observations made since the removal of the Edwards Dam may shed light on this.

The first observation is that removal of the Edwards Dam and restoration of the river's natural channel has revealed numerous spring seeps along the river's banks from Augusta to Waterville. Many of these seeps, located slightly above or below the river's edge, maintain temperatures of 50-60 F throughout the summer. The surficial geology of this portion of the Kennebec River suggests much of the precipitation falling in the watershed adjacent to the river enters the river as groundwater rather than surface flow. Much of the 20 mile reach of the Kennebec from Waterville to Augusta consists of thick deposits of well sorted, permeable sand and gravel interspersed with layers of marine clay. A large and pronounced glacial esker forms the west bank of the river from Sidney to Augusta (approx. 10 river miles) that is intensively mined for sand and gravel. These geological

features, coupled with the observation that most first and second order tributaries to the Kennebec in this area become nearly dry during summer, suggests groundwater inputs to this reach of the river may be significant.

The second observation is that mid-summer water temperatures in the restored river channel vary significantly as one moves across the channel perpendicular to the river's flow. During mid-summer, near shore, shallow areas (less than 1 foot in depth) are noticeably warmer than the "center channel" which is deeper and has much higher flow velocities. Similar to a deep lake which stratifies vertically during mid-summer, the Kennebec appears to be stratify horizontally, with the center of the channel noticeably cooler than near-shore areas in mid-summer. This makes recording mid-summer water temperatures in the Kennebec problematic, since a temperature reading taken near the river's bank would be significantly different than a reading taken in the river's center channel. That temperature-sensitive fish such as Atlantic salmon and trout would take advantage of these differences in water temperature across the river channel appears self-evident.

This discussion does not attempt to provide definitive answers to the questions it raises. Instead, it documents a sudden and dramatic change in the behavior of Atlantic salmon and trout in the Kennebec River coincident with the removal of the Edwards Dam; and examines factors which may have caused this change.

Since removal of the Edwards Dam, Atlantic salmon and trout of the Kennebec River have abandoned their well known thermal refugia at the mouth of Bond Brook. Because we know Atlantic salmon and trout are still present in the Kennebec River, we can surmise that with removal of the Edwards Dam, they have located thermal refugia elsewhere which suits their needs as well or better than Bond Brook. However, none of the accessible tributaries of the Kennebec River above the Edwards Dam site appear to offer any thermal refugia. By the process of elimination, the only location for thermal refugia must be the Kennebec River itself.

Qualitative observations of the lower Kennebec River in the five years since removal of the Edwards Dam provide several potential explanations. Observation of numerous springs and seeps along the river suggest groundwater inputs to the river may be significant. The post-glacial history and surficial geology of the river reach are consistent with these observations. The observation of a mid-summer, horizontal water temperature

gradient across the river channel suggests a segregation of river flow into warmer and cooler ' threads,' providing salmonids the opportunity to selectively inhabit those portions of the river channel best suited to their physiological requirements. It is also possible other factors are at play as well.

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