KENNEBEC RIVER ANADROMOUS FISH RESTORATION

ANNUAL PROGRESS REPORTS - 1987/1988

Maine Department of Marine Resources
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Were Funded through a Cooperative Agreement
Between the State of Maine
and
Kennebec Hydro Developers Group (KHDG)

INTRODUCTION & PROGRAM OBJECTIVES -

This document represents a comprehensive summary of restoration efforts for the Kennebec River above Augusta for alewives, American shad, and Atlantic salmon for 1987 and 1988, carried out in accordance with the "Lower Kennebec River Anadromous Fish Restoration Plan and Inland Fisheries Overview." This plan reflects conditions set forth in a Cooperative Agreement between the State of Maine fishery agencies and the Kennebec Hydro Developers Group (KHDG). This Agreement facilitates restoration by setting dates for fish passage and by the provision of funds by KHDG to fully implement an interim restoration program for 1986-1999.

The goal of the Restoration Plan is to restore alewives and American shad to their historical habitat above the Edwards Dam in Augusta. The long term objectives are to achieve an annual production of 6.0 million alewives and 689,000 American shad above the Edwards Dam in Augusta. The strategy developed to meet these objectives involves an interim trap and truck program for alewives fully funded by the KHDG group. This program initially involves the stocking of alewives at a rate of six adults per surface acre in ten lake systems representing about 50% of the alewife habitat historically available. These lakes are located in the subdrainages of the Sebasticook River and Sevenmile Stream. An additional, Wesserunsett Lake, is to be stocked in 1995 when interim downstream passage measures will be implemented on the main stem dams downstream of this lake system. The restoration of alewives to the remaining lakes will be contingent on the outcome of a cooperative research project sponsored by the Maine Department of Marine Resources and the Maine Department of Inland Fisheries & Wildlife to assess the interactions of alewives with smelts and salmonids.

The strategy involved for American shad restoration involves the passage of shad through a requested passage facility at the Edwards Dam and/or supplemented by the trapping and trucking of adult shad from the lower Kennebec River or from out-of-basin for the interim period 1986-1998. The trapping and trucking of shad is to be fully funded by the KHDG group. After this interim period ends in 1998, fish passage will be provided at all main stem dams and tributary dams as outlined in the Plan and Agreement.

The interim Atlantic Salmon Plan for the Kennebec River calls for the passage of Atlantic salmon into the Edwards Dam headpond and trapping at Augusta and transport to selected upriver areas. The spawning escapement needs for Atlantic salmon between Augusta and Waterville, including the Sebasticook River, is 256. Thus, the first 256 salmon will be released or transported to these river segments. The KHDG Agreement provides for the attempted capture of Atlantic salmon below the Edwards Dam if no passage is available in order to accelerate restoration of this species in the Kennebec River.

The following document summarizes activities and results related to alewife, American shad, and Atlantic salmon restoration in the Kennebec River above Augusta and provides a more comprehensive account than the two brief summaries of results released earlier.

1987 Program Objectives:

Alewives - stock 42,582 alewives (six per surface acre of water area) in six lake systems on the Sebasticook River (Table 1).

American shad - locate potential capture sites for American shad in the Eastern, Cathance, and lower Kennebec Rivers. Stock up to 500 adult shad above Augusta.

Atlantic salmon - capture Atlantic salmon from below the Augusta Dam and stock above the Augusta Dam.

Juvenile Emigration Monitoring - monitor juvenile emigration of shad and alewives from waters above the Augusta Dam.

The following report summarizes activities and results related to alewife, American shad, and Atlantic salmon restoration.

METHODS: Alewife-1987

Brood stock alewives were captured at the trapping facilities at the Brunswick Fishway on the Androscoggin River and at the Bridge Street Dam Fishway on the Royal River, Yarmouth. The fish trap at the Brunswick Fishway is highly automated. Consequently, alewives trapped at Brunswick require little handling. Trapped alewives were counted and other fish species were removed. At Brunswick, the alewives and water were loaded into the truck via a 12" diameter flexible pipe leading from an overhead sorting tank to the truck transport tank.

At the Bridge Street Dam trapping facility on the Royal River, alewives were dip netted out of the trap, counted, and separated from other fish species. Alewives were placed in five-gallon buckets and hand carried to the stocking trucks which had already been filled with water.

Alewives were hauled in two stocking trucks owned by the Department of Marine Resources. The fish were placed in a round, 6'6" diameter, 750-gallon tank mounted on a platform body truck. This tank was equipped with a gasoline powered water circulation pump designed to provide a circular water flow around the tank. An overhead water spray system increased the rate of gas exchange for the tank water.

Alewives were transported to the lake to be stocked and immediately released. The stocking truck was backed up to the water's edge and the alewives were released directly into the lake. The name, location, and stocking goal for each lake are summarized in Table 1. The locations of the ponds are illustrated in Figure 1.

Lake systems were sampled regularly through the summer season to monitor juvenile alewives. The young-of-the-year were trapped with 30' and 100' fine mesh beach seines fished on the shores of the lakes. All fish species collected were enumerated and released. Alewives were enumerated and measured to determine their total length.

Lake outlet streams were surveyed to determine the presence of any obstacles to downstream passage of juvenile alewives. The streams were travelled by boat or on foot. Obstructions to juvenile alewife emigration were noted and their structure and location were recorded.

Downstream passage on the Sebasticook and Kennebec Rivers was monitored through the summer and fall. Hydroelectric facilities were visited routinely to assess any downstream passage problems encountered by downstream migrating juvenile alewives. The magnitude and location of spilled water, number of turbines in operation, and the presence or absence of juvenile alewives at the facilities were all noted. The dam sites and their locations are presented in Table 2 and illustrated in Figure 1.

RESULTS & DISCUSSION: Alewife-1987

In 1987, 25,850 alewives were stocked into the six current target ponds in the Kennebec drainage (Table 3). The trap at the Brunswick Fishway on the Androscoggin River contributed 25,350 alewives, while the trap at the Bridge Street Dam Fishway on the Royal River added another 500 fish. The alewife stocking goal of six fish/acre was achieved for Lovejoy Pond and ranged from 47% to 97% of the stocking goal in the other five lakes (Table 3).

In 1987, juvenile alewives were captured in all six ponds stocked with adults. The results of juvenile alewife sampling efforts are presented in Table 4.

Downstream passage through the outlets of Douglas Pond and Sebasticook Lake was adequate because these two lakes drain directly into the Sebasticook River system. Douglas Pond is an impoundment in the West Branch of the Sebasticook, while Sebasticook Lake lies in the course of the East Branch of the Sebasticook River.

The outlet of Pleasant Pond (Stetson Stream), which flows into Sebasticook Lake, was surveyed during the summer of 1987. Four beaver dams were observed, but juvenile alewives were able to pass over all barriers encountered on Stetson Stream. Subsequent investigation confirmed that alewives were passing over all four dams with little difficulty.

Martin Stream, the outlet of Plymouth Pond, flows into the East Branch of the Sebasticook River. Two segments of Martin Stream were surveyed in 1987: 1) from the outlet of Plymouth Pond to Rte #69 and 2) from the northern terminus of Plymouth Bog to the Ridge Road, Plymouth. Both segments were free of obstructions although flows were low during the summer. The remaining sections of Martin Stream will be surveyed during future field seasons.

Lovejoy Pond is drained by Mill Stream which meets Fifteenmile Stream and enters the Sebasticook River upstream of Clinton.

Pattee Pond is drained by Pattee Pond Brook which enters the Sebasticook River below Benton Falls. Both streams will be surveyed for downstream alewife passage during future field seasons.

The progress of juvenile alewife emigration was monitored during the late summer and fall of 1987. The hydroelectric generating stations on the Sebasticook River were visited routinely to assess any problems which juvenile alewives might encounter at these barriers. A summary of observations is presented in Table 5.

The Fort Halifax Project in Winslow is the lowermost dam on the Sebasticook River. The Department of Marine Resources notified CMP on September 16 that juvenile alewives were present in the Fort Halifax impoundment, indicating that interim downstream fish passage measures should be undertaken in compliance with the KHDG Agreement. CMP acted promptly, opening the trash sluice and notching the most northerly flashboard on the dam. In addition, plywood was installed over the trash racks on the two forebays proximal to the trash sluice. This plywood served to impede alewife movement through the trash racks and to encourage their use of the controlled spill through the trash sluice.

These measures had a significant impact on the route used by the alewives in passing downstream. Large numbers of alewives were observed passing through the trash sluice. However, from these crude observations it is impossible to estimate the percentage of fish using the downstream bypass or passing through the turbines. Certainly we can say the interim measures have had a very positive effect by providing an alternate downstream passage route for juvenile emigrants.

The Benton Falls Dam was under construction during the summer and fall of 1987. It was not a barrier to downstream passage during the 1987 downstream migration of alewives.

The Burnham Dam is located upstream from the new Benton Falls Project. Juvenile alewives were observed at Burnham throughout the fall of 1987. On October 26, modifications to provide interim

downstream passage were first observed. The flashboard closest to the turbine intakes was angled to allow a surface spill from the headpond over the face of the dam. No alewives were observed passing through this spill. On November 10, 1987, Consolidated Hydro closed off the downstream bypass for the season.

Proceeding up the Sebasticook River, the next hydroelectric facility is Pioneer Dam in Pittsfield. No physical modifications were made at Pioneer to allow downstream passage of alewives, but the owner agreed to provide controlled spills over the crest of the dam to allow downstream passage around the turbines. No alewives were observed passing downstream at the Pioneer Dam.

The Waverly Avenue Dam is also located in Pittsfield, just upstream of the Pioneer Dam. Impoundment levels allowed surface spills over the spillways at the south side of the Waverly Avenue Dam for a large part of the migration season. No physical modifications were made to the dam to facilitate downstream passage, but surface spills allowed some opportunity for alewives to avoid entrainment in the turbine intakes.

One issue appears worthy of discussion regarding downstream fish passage on the Sebasticook River during 1987: it is clear that quick action on the part of the developers to provide downstream passage is essential. Large numbers of fish can be lost in hours if no steps are taken. Efficient communication between the Department of Marine Resources and the developers is a prerequisite to rapid response by the developers to a fish passage problem. To this end, the Department of Marine Resources and KHDG members should compile a list of contact persons and their respective phone numbers. These individuals could be contacted immediately when a fish passage problem arises. The delays associated with exchanging postal correspondence and locating the responsible individuals within the chain of command would be eliminated and a positive effect on the resource should be realized.

Table 1. 1987 Alewife Stocking Plans (Sebasticook River)

Lake System	Location	River Section	# to be Stocked*
Douglas Pond	Pittsfield/Palmyra	West Branch	3,150
Pleasant Pond	Stetson	East Branch	4,608
Plymouth Pond	Plymouth	East Branch	2,880
Sebasticook Lake	Newport	East Branch	25,728
Lovejoy Pond	Albion	Main Stem	1,944
Pattee Pond	Winslow	Main Stem	4,272
			42,582 TOTAL

*Six adult alewives/lake surface acre

Table 2. Hydroelectric Facilities Monitored for Downstream Passage, 1987

Dam	FERC #	Body of Water	Town	Location (Figure 1)
Waverly Avenue	#4293	W.Branch, Sebasticook River	Pittsfield	43
Pioneer	#8736	W.Branch, Sebasticook River	Pittsfield	42
Burnham	-----	Sebasticook River	Burnham	39
Fort Halifax	#2552	Sebasticook River	Winslow	31
Edwards Mill	#2389	Kennebec River	Augusta	1

Figure 1. See Table 2 or Table 8 for names of dams corresponding to numbers depicted below.

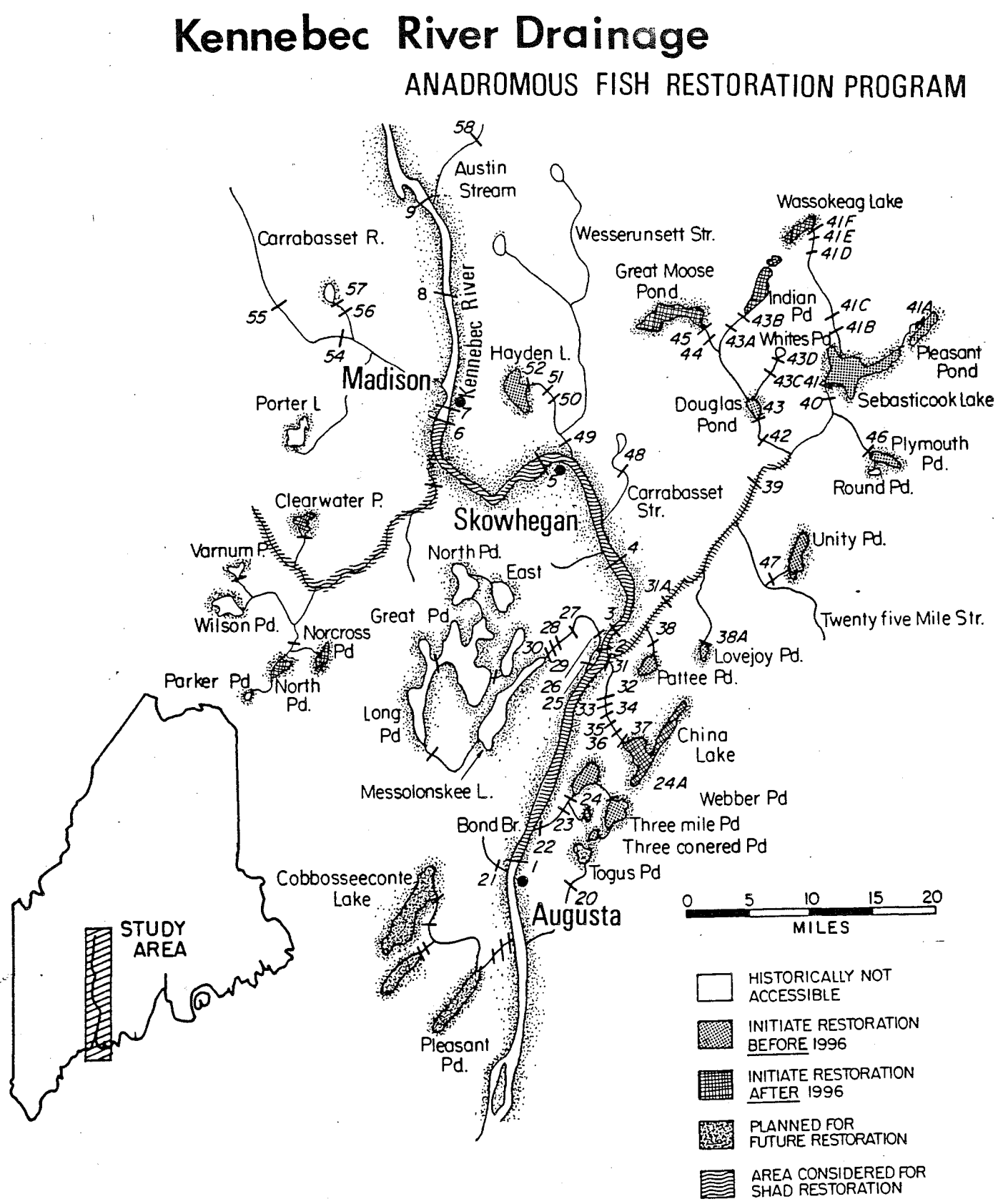

Table 3. 1987 Alewife Stocking in Kennebec Drainage

Ponded Area	Surface Acreage	Target # To Be Stocked	# Stocked*	# Trips	% of Target # Achieved	# Stocked Per Acre
Douglas Pond	525	3,150	2,286	5	73	4.35
Lovejoy Pond	324	1,944	1,949	3	100	6.02
Pattee Pond	712	4,272	4,031	7	94	5.66
Pleasant Pond	768	4,608	2,688	5	58	3.50
Plymouth Pond	480	2,880	2,797	5	97	5.83
Sebasticook Lake	4,288	25,728	12,099	22	47	2.82
TOTALS:	**7,097**	**42,582**	**25,850**	**47**	**61**	**3.64(average)**

*Six fish/acre

Table 4. 1987 Juvenile Alewife Samples From Ponds

Ponded Area	Stocking Density*	Mean Total Length	# of Juveniles+	# of Seine Hauls°
Douglas Pond	4.35	9.9 cm	51	1/6
Lovejoy Pond	6.02	8.7 cm	62	3/11
Sebasticook Lake	2.82	7.9 cm	53	2/8
Pattee Pond	5.66	7.6 cm	105	3/6
Plymouth Pond	5.83	6.1 cm	88	3/3
Pleasant Pond	3.50	5.6 cm	155	6/7

*Adult alewives/surface acre

+Seasonal total

°Number of hauls producing alewives/total number of hauls

Table 5. Downstream Passage Observations at Hydroelectric Facilities - Sebasticook River, 1987

	FACILITY			
Date	FORT HALIFAX	BURNHAM	PIONEER	WAVERLY
8/28	X	---	---	---
9/15	X	X	---	---
9/29	O	X	O	X
10/1	X	X	O	X
10/5	X*	X*	X	X
10/7	---	X*	O	X
10/14	X	O*	O	X
10/19	X	O	O	X
10/21	X	O	O	X
10/26	X	X	X	X

X Interim passage or spill available

O No passage opportunity

--- Not inspected on this date

* Dead juvenile alewives observed

METHODS: American Shad-1987

In 1987, efforts were made to locate potential capture sites for American shad in the tidal waters of the Kennebec River and its tributaries. In previous years, shad have been netted at head-of-tide on the Cathance River in Topsham. During 1987, a 300' beach seine was used at this site to trap any shad that were present.

Several other inshore areas were inspected for the presence of shad. In Phippsburg, the tidal creek entering Drummore Bay and North Creek entering Totman Cove were both examined. Also, the tidal creek just east of Kennebec Point, Georgetown, was inspected for the presence of American shad.

In addition, the main stem of the Kennebec River and selected tributaries (Eastern and Cathance Rivers) were surveyed to determine the location of American shad. These rivers were drift netted using an experimental monofilament drift net. The net measured 100' long, 12' deep, and was comprised of three panels of 4½", 5", and 5½" stretch mesh. The net was tended while it drifted and fish were removed when any unusual motion of the net floats occurred.

To supplement the capture of American shad brood stock from the Kennebec, arrangements were made to obtain shad brood stock from the Narraguagus River. Shad were trapped, along with alewives, in the commercial alewife fish trap in Cherryfield. The operator of the fishery kept the shad in a holding pen in the net as they were trapped. The shad were removed from this pen with dip nets and placed in the stocking truck.

Shad were transported in a stocking truck purchased in the spring of 1987 with funds provided through the KHDG Agreement. This system included a circular fiberglass shad transportation tank 88" in diameter, 42" deep, with a volume of 1100 gallons. The tank water was circulated by a 3.5 HP gasoline powered pump.

The system was designed to create a circular water flow around the tank. Gas exchange was accomplished by a venturi located between the tank outlet and the pump intake. Air was mixed with the circulating water by the pump impeller and the mixture was pushed out into the tank. This tank system was mounted on a 14' platform body affixed to a straight truck.

The tank was equipped with an 8' cylindrical chute that was employed when fish were unloaded. The chute was placed over the rear port on the tank and the fish and water exited the tank through the chute and flowed into the river being stocked.

In 1987, all shad obtained for the Kennebec River restoration were stocked into that segment of river between Augusta and Waterville. During the summer, the impoundment between Augusta and Waterville was sampled to obtain information on the abundance of juvenile shad. This sampling was accomplished with a 100' long, 6' deep, ½" stretch mesh beach seine. One end of the net was held in a fixed position onshore while the other end was pulled out and then back to shore with a boat. All fish collected were identified by species, enumerated, and a sample was measured for total length. All American shad collected were measured for total length. All fish trapped were released immediately after data collection was completed.

RESULTS & DISCUSSION: American Shad-1987

In 1987, the search for American shad brood stock began on the Cathance River. Using the 300' beach seine on several days in early May, Marine Resources personnel were unable to capture any shad at head-of-tide on the Cathance. Later in the season this site supports a commercial alewife fishery. The alewife harvester was contacted regularly to determine if any shad were netted as bycatch in the alewife seining. No shad were trapped during the alewife harvest at this site.

The tidal creek at the north end of Drummore Bay, Phippsburg, includes several pools which are readily accessible with the stocking truck, making this an attractive capture site. These pools were visually inspected for shad on May 19. Two shad were sighted in one pool, too few to make this an efficient capture site.

North Creek, on Totman Cove, Phippsburg, contains several pools that held shad during 1987. One pool near the mouth of the creek contained seven shad on May 19. This small number of fish did not justify the effort needed to capture and transport them.

On the eastern side of the Kennebec River, the tidal creek on the eastern side of Kennebec Point, Georgetown, has held shad in past years. On May 15, 28 shad were captured in this creek. Two beach seines were used to trap the shad. One was used as a blocking seine and the other was used to surround the fish and bring them in close to shore. The shad were hand carried to the stocking truck in five-gallon pails filled with water. The shad were taken immediately to the Sidney boat launch ramp and released into the Kennebec River impoundment between Augusta and Waterville. Of the 28 fish loaded, 16 survived the trip to the Kennebec. The Kennebec Point capture site was inspected again on May 18, but no shad were visible in the creek. The drift netting operations in the Kennebec and its tributaries were accomplished in June.

The Eastern River was drift netted on June 16 and 19. On June 16, the river reach just above Rte #27 to Rte #128 was drift netted. No shad were trapped during this operation. On June 19, the river reach from one-half mile below Rte #27 to the confluence of Merrymeeting Bay below Rte #128 was drift netted. No shad were collected on these drifts.

The main stem of the Kennebec River was drift netted from the Father Curran Bridge in Augusta to the mouth of Togus Stream in Gardiner on June 17. This segment of the river was drifted in four contiguous drifts, none of which netted any shad.

The Cathance River was drift netted on June 22. Drift netting covered that section of the river from "River Bend," east of Bowdoinham, to the mouth of the Muddy River, just above Merrymeeting Bay. No shad were captured in the Cathance River.

American shad were obtained from the Narraguagus River to supplement the shad brood stock obtained within the Kennebec drainage. The commercial alewife fishery at Cherryfield on the Narraguagus also traps American shad. With the consent of the operator, shad were removed from the alewife trap with dip nets and placed into the stocking truck. Between June 10 and 15, five shad hauling trips were completed from Cherryfield to Sidney where the shad were released into the Kennebec River at the state boat launching ramp. In total, 185 shad were loaded at Cherryfield. Of the 185 fish loaded, 183 were stocked into the Kennebec. Two shad died in transit to the release site.

Including the 16 fish trapped at Kennebec Point and the 183 fish trucked from the Narraguagus River, a total of 199 American shad were stocked into the main stem of the Kennebec River between Augusta and Waterville in 1987 (Table 6). The minimum stocking goal of 500 shad above Augusta was not achieved in 1987 because of inadequate sources of brood stock. No juvenile American shad were collected from the river reach between Augusta and Waterville during the 1987 field season.

Table 6. American Shad Stocking - Kennebec River, 1987

Date	Source	# Loaded	# Stocked	# Mortalities*
5/15	Lower Kennebec Georgetown	28	16	12
6/10	Narraguagus	31	30	1
6/11	Narraguagus	30	30	0
6/12	Narraguagus	25	25	0
6/13	Narraguagus	35	34	1
6/15	Narraguagus	64	64	0
TOTALS:		**213**	**199**	**14**

*In transit

METHODS: Atlantic Salmon-1987

Efforts were made to locate potential capture sites for Atlantic salmon brood stock in the tidal waters below the Edwards Mill Dam in Augusta. Pools and lies frequented by salmon were surveyed in July and August to determine where fish were located. Pools were examined to determine how fish could be netted and how they could be transported to the tank truck.

Atlantic salmon captured in the tidal waters were transported in the stocking truck purchased in the spring of 1987 with funds provided through the KHDG Agreement. Fish were deposited in a round, 8' diameter, 1100-gallon tank mounted on a platform body truck. Water circulation was provided by a gasoline powered water pump. Gas exchange was supplemented with the help of a venturi, allowing air to mix with the circulating water upstream of the water pump. The water/air mix was pumped out to the tank water.

Salmon were released directly into the segment of the main stem of the Kennebec River between Augusta and Waterville. Fish were measured to determine total length and scale samples were collected.

RESULTS & DISCUSSION: Atlantic Salmon-1987

In Augusta, the mouth of Bond Brook was selected as a prime spot to capture salmon. Historically, Atlantic salmon were frequently sighted in this lowest pool. In addition, this area offers good access for a stocking truck.

As a result of fish sightings in this pool, netting operations were conducted on July 21 and August 14 and 21. No salmon were contacted on the first two days of netting; on August 21, however, one adult Atlantic salmon was captured and transported to Fort Halifax Park in Winslow and released into the main stem of the Kennebec River there.

The scale samples taken by DMR personnel were analyzed by the Maine Atlantic Sea-Run Salmon Commission staff. The Commission staff determined that this fish had spent two winters at sea before returning to spawn and was of hatchery origin (a stray fish from another river since no hatchery fish have recently been stocked in the Kennebec). This salmon measured 99.5 centimeters total length and was the only Atlantic salmon captured in 1987. It was moved upstream in the hope that other salmon would be trapped and stocked in the same location to allow natural reproduction to take place. However, no additional salmon were collected throughout the remainder of the year.

1988 Program Objectives:

Alewives - stock 72,894 adult alewives in ten lake systems at the rate of six/acre in six lakes and two/acre (increments up to six/acre) in four additional lakes.

American shad - stock 500 adult shad, obtained from the lower Kennebec or Narraguagus Rivers, or out-of-state source(s), into the Kennebec above the Augusta Dam.

Atlantic salmon - capture Atlantic salmon from below the Augusta Dam and stock above the Augusta Dam.

Juvenile Emigration Monitoring - monitor juvenile emigration of shad and alewives from waters above the Augusta Dam.

METHODS: Alewife-1988

Brood stock alewives were captured at the trapping facilities at the Brunswick Fishway on the Androscoggin River. Trapped alewives were counted with dip nets as other species of fish were removed. After the desired number of alewives had been isolated, the alewives and water were sluiced into the waiting truck via a 12" diameter flexible pipe leading from an overhead sorting tank to the truck transport tank.

Alewives were hauled in two stocking trucks. The primary stocking truck was purchased in the spring of 1987 with funds provided by the KHDG Agreement. This larger truck was fitted with a circular fiberglass shad transportation tank 88" in diameter, 42" deep, and 1100 gallons in volume. The tank water was circulated by a 3.5 HP gasoline powered pump. The system was designed to create a circular water flow around the tank. Gas exchange was accomplished by a venturi located between the tank outlet and the pump intake. Air was mixed with the circulating water by the pump impeller and the mixture was pushed out into the tank. This tank system was mounted on a 14' platform body affixed to a straight truck.

The tank was equipped with an 8' long cylindrical chute that was employed when fish were unloaded. The chute was placed over the rear part of the tank and the fish and water exited the tank through the chute and flowed into the river being stocked.

The smaller truck, owned by the Department of Marine Resources, was used to supplement alewife stocking by the larger KHDG truck. This truck was fitted with a circular, 6'6" diameter, 750-gallon tank attached to a 14' platform body. This tank was equipped with a 3.5 HP gasoline powered water circulation pump and was designed to provide a circular water flow around the tank. An overhead water spray system increased the rate of gas exchange for the tank water.

Alewives were transported to the lake to be stocked and immediately released directly into the lake. The name, location, and number of fish programmed for stocking in each lake is summarized in Table 7.

The locations of the lakes are illustrated by Figure 1.

Lake systems were sampled regularly through the summer season to obtain juvenile alewives. The young-of-the-year were trapped with 40' and 100' 1/4" mesh beach seines fished on the shores of the lakes. All fish species collected were enumerated and released. Alewives were enumerated and measured to determine their total length.

Lake outlet streams were surveyed to determine the presence of any obstacles to downstream passage of juvenile and adult post spawner alewives. The streams were travelled by boat or on foot. Obstructions to juvenile alewife emigration were noted and their structure and location recorded.

Downstream passage on the Sebasticook and Kennebec Rivers was monitored through the summer and fall. Hydroelectric facilities were visited routinely to assess any problems which downstream migrating juvenile alewives might encounter at these barriers. The magnitude and location of spilled water, number of turbines in operation, and the presence or absence of juvenile alewives at each facility were all noted. The dam sites and their locations are presented in Table 8. The locations of the dams are illustrated in Figure 1.

RESULTS & DISCUSSION: Alewife-1988

In 1988, 29,072 adult alewives were stocked into six target ponds in the Kennebec drainage. All the alewives stocked in the Kennebec drainage in 1988 were trapped at the Brunswick Fishway on the Androscoggin River. In total, 7,097 acres of lake surface were stocked to an overall density of 4.10 fish per acre. Stocking densities varied from a high of 6.34 alewives per acre in Lovejoy Pond to a low of 3.45 alewives per acre in Pleasant Pond. The results of the 1988 alewife stocking are presented in Table 9. Stocking in four additional ponds was deferred for the following reasons: Unity Pond-lack of adequate numbers of alewife brood stock; Webber, Three Mile, and Three Cornered Ponds-by request from DEP to establish long term water quality data base prior to alewife stocking.

During the summer of 1988, juvenile alewives were captured in five of the six ponds stocked with adults that spring. Large schools of juvenile alewives were sighted in all ponds and in the Sebasticook River throughout the summer and fall. The numbers of juveniles visible in the basin suggest strong recruitment from the spawning adult alewives stocked that spring. The results of juvenile alewife sampling efforts in the stocked ponds are summarized in Table 10.

The progress of the juvenile alewife emigration was monitored during the late summer and fall of 1988. The hydroelectric generating stations on the Sebasticook River were visited routinely to assess any problems which juvenile alewives might encounter at these barriers. A summary of field observations is presented in Table 11.

The Fort Halifax Project in Winslow is the lowermost dam on the Sebasticook River. When the facility was inspected on July 11, 1988, a notched flashboard had been installed to allow a controlled spill at near full headpond conditions. Juvenile alewives were observed in the headpond but were not observed passing downstream.

During the July 19 inspection, it was noted that the trash sluice just west of the forebays was open to allow better opportunity for downstream migration. In addition, plywood had been installed to a depth of 4' over all the forebay trash racks. This plywood served to discourage alewife movement through the trash racks into the turbines and to encourage their use of the controlled spill through the trash sluice. This system passed significant numbers of juveniles during the 1987 season when only the two trash racks closest to the sluice were covered with plywood. The coverage of the surface of the remaining trash racks in 1988 further aided the downstream passage effort.

During the August 16 inspection, Leigh Alexander of CMP was engaged in his own review of passage operations at Fort Halifax. Because of recent high headpond levels, Mr. Alexander suggested that additional plywood be added to forestall entrainment of the juveniles over the extant plywood and into the turbines. This plywood was installed soon after August 16.

Downstream passage remained operative throughout the late summer and fall. The DMR notified CMP after the November 10 inspection that downstream passage facilities could be closed for the season. The positive attitude and cooperation of the operators and Mr. Alexander had a significant, beneficial impact on the downstream passage effort at Fort Halifax. Their efforts are commendable.

The Benton Falls Project was engaged in construction of permanent downstream passage facilities in July, 1988. Two surface weirs (one over each turbine intake) were interconnected and discharged into the tailrace via a large diameter pipe. These new facilities were observed in operation on August 12, 1988. Throughout the summer large numbers of juvenile alewives were observed successfully negotiating the downstream bypass. Limited field observations made in 1988 suggest these facilities are rather effective in passing juvenile alewives. However, because of the intermittent use of the passage facilities during 1988, significant numbers of juvenile alewives were entrained and passed through the turbine(s).

In the future, continuous operation of the passage facilities would improve survival of juvenile emigrants. Stacy Fitts, the Benton Falls Project operator, was very receptive to DMR personnel and his cooperation through the 1988 season was notable.

The next hydroelectric facility on the Sebasticook River is the Burnham Project. In 1988, downstream passage was first observed at Burnham on August 18, when high river flows provided a spill over the crest of the dam for an undetermined period of time. The August 29 inspection revealed a flashboard on the eastern side of the dam had been lost. Some passage through this opening may have been possible despite its considerable distance from the main river flow into the turbine intakes near the west shore.

Inspection of the Burnham Project on September 29 revealed that juvenile alewives had passed through the missing flashboard only to become trapped in a large concrete plunge pool at the base of the dam. Approximately 100 square feet of this pool were covered with dead juvenile alewives. Alewives had passed through the missing flashboard hole and became stranded in the pool below when the headpond level receded. The lack of inflow of fresh water into this plunge pool allowed pool level to fall as water drained out of its porous walls. The remaining fish were concentrated into less water and probably died due to lack of oxygen or high temperatures in the confined area.

The dead alewives were present until inspection on November 4 revealed that most had been flushed away. Personnel from DEP and IF&W investigated this fish kill on September 28, 1988, while a DMR crew was inspecting the site.

Inspection on October 11 revealed that a flashboard on the western side of the dam (near the turbine intake) was lowered to allow a temporary spill for downstream passage. It remained open throughout the rest of the fall season. The problem flashboard above the plunge pool mentioned earlier had been reinstalled.

Despite the removal of flashboards to provide controlled spills, large numbers of juvenile alewives were observed entering and exiting the turbines at Burnham. Dead or crippled juveniles were collected in the tailrace on July 25, August 2 and 9, October 4 and 11, and November 2. Entrainment into the turbines at Burnham appears to be related to the wide fluctuations in headpond level associated with the intermittent operations of the turbines. As pond level falls below flashboard level, any controlled spills cease and the only migration route is via the turbines.

In 1988, inspections at the Pioneer Dam in Pittsfield suggested that downstream passage was sporadic. Pioneer has no mechanism for bypassing fish around its turbines and so provides controlled spills to allow downstream passage. Controlled spills were observed on only four of 19 inspection days in 1988. Spills may have occurred on inspection days before or after DMR personnel were present or on non-inspection days, but the result was still intermittent passage.

Douglas Pond is the impoundment formed by the Waverly Avenue Dam in Pittsfield. Downstream passage at Waverly Avenue is possible when pond level rises above the crest of the spillways at the south side of the dam. Spills allowing downstream passage were observed on nine of 24 inspection days. The current impact of Pioneer and Waverly Avenue Dams on juvenile alewife migration on the Sebasticook is relatively light. Douglas Pond is the only lake currently above these two dams that is stocked with alewives and represents only 7.4% of the lake surface acreage stocked in 1987 and 1988. However, future stocking of Great Moose Pond and Indian Pond will result in significant alewife production from this area. Interim downstream passage at Waverly Avenue and Pioneer Dams has been requested in 1989 and permanent downstream passage facilities have been requested in 1990, as outlined in the December 28, 1988, letter from DMR to FERC.

Table 7. 1988 Alewife Stocking Plans (Sebasticook River)

Lake System	Location	River Section	# to be Stocked*
Douglas Pond	Pittsfield	West Branch	3,150
Pleasant Pond	Stetson	East Branch	4,608
Plymouth Pond	Plymouth	East Branch	2,880
Sebasticook Lake	Newport	East Branch	25,728
Lovejoy Pond	Albion	Main Stem	1,944
Pattee Pond	Winslow	Main Stem	4,272
			42,582 TOTAL

Additional Ponds:

Unity Pond	Unity	Twentyfive Mile Stream	15,168
Webber Pond	Vassalboro	Sevenmile Brook	7,512
Three Mile Pond	China	Sevenmile Brook	6,462
Three Cornered Pond	Augusta	Sevenmile Brook	1,170
			30,312 TOTAL

*Six adult alewives/lake surface acre

Table 8. Hydroelectric Facilities Monitored for Downstream Passage, 1988

Dam	FERC #	Body of Water	Town	Location (Figure 1)
Waverly Avenue	#4293	W.Branch, Sebasticook River	Pittsfield	43
Pioneer	#8736	W.Branch, Sebasticook River	Pittsfield	42
Burnham	-----	Sebasticook River	Burnham	39
Benton Falls	#5073	Sebasticook River	Benton	31A
Fort Halifax	#2552	Sebasticook River	Winslow	31
Edwards Mill	#2389	Kennebec River	Augusta	1

Table 9. 1988 Alewife Stocking in Kennebec Drainage

Ponded Area	Surface Acreage	Target # To Be Stocked	# Stocked*	# Trips	% of Target # Achieved	# Stocked Per Acre
Douglas Pond	525	3,150	3,099	4	98	5.90
Lovejoy Pond	324	1,944	2,055	3	106	6.34
Pattee Pond	712	4,272	3,393	3	79	4.77
Pleasant Pond	768	4,608	2,648	3	57	3.45
Plymouth Pond	480	2,880	3,027	3	105	6.31
Sebasticook Lake	4,288	25,728	14,850	20	58	3.46
TOTALS:	**7,097**	**42,582**	**29,072**	**36**	**68**	**4.10(average)**

*Six fish/acre

Table 10. 1988 Juvenile Alewife Samples From Ponds

Ponded Area	Stocking Density*	Mean Total Length	# of Juveniles+	# of Seine Hauls°
Douglas Pond	5.90	7.9 cm	99	4/8
Lovejoy Pond	6.34	10.0 cm	7	2/13
Sebasticook Lake	3.46	---	0	0/6
Pattee Pond	4.77	9.1 cm	183	3/19
Plymouth Pond	6.31	6.3 cm	8	1/16
Pleasant Pond	3.45	7.8 cm	120	3/10

*Adult alewives/surface acre

+Seasonal total

°Number of hauls producing alewives/total number of hauls

Table 11. Downstream Passage Observations at Hydroelectric Facilities - Sebasticook River, 1988

	FACILITY				
Date	FORT HALIFAX	BENTON FALLS	BURNHAM	PIONEER	WAVERLY
6/22	---	---	---	---	O
6/27	---	---	---	---	X
7/06	---	---	---	---	O
7/08	O	O	O	---	---
7/11	X	O	O	---	O
7/15	X	O	O	X	X
7/19	X	O	O	O	O
7/25	X	O	O*	O	O
8/02	X	X	O*	O	X
8/09	X	---	O*	O	O
8/10	---	---	O	O	O
8/12	---	X	O	O	O
8/16	X	X	---	O	O
8/18	X	---	X	O	X
8/29	X	X	X	O	O
9/06	X	X	X	O	O
9/12	---	---	---	---	O
9/23	X	X	O**	O	O
9/26	---	---	O**	---	---
9/28	---	---	O**	---	---
9/30	---	---	O**	---	---
10/4	X	O	O*	O	X
10/11	X	O	X*	X	X
10/13	X	---	---	---	---
10/18	X	O	X	O	X
10/25	X	X	X	O	O
10/26	X*	O*	X	---	---
10/27	X	O	X	---	---
10/31	X	O*	X	O	O
11/2	X	X	X*	X	X
11/10	X	X	X	X	X

X Downstream passage available
O No downstream passage available
--- Not surveyed on this day
* Dead fish present exiting turbine
** Large fish kill

METHODS: American Shad-1988

During the spring of 1987, attempts were made to capture adult American shad brood stock in the tidal waters of the Kennebec River and its tributaries. These efforts produced 28 adult shad, 16 of which survived to be stocked in the upper Kennebec. An additional 185 adult shad were obtained from a commercial alewife trap on the Narraguagus River in Cherryfield. Of the fish loaded in Cherryfield, 183 survived trucking and were stocked in the Kennebec River at Sidney. In total, 199 adult American shad were stocked in the Kennebec River in 1987.

Alternate sources of American shad brood stock were sought to meet the spring 1988 stocking goal of up to 500 fish, as outlined in the 1988 Operational Plan. American shad from the Narraguagus River were not available in the spring of 1988, emphasizing the need for additional sources of brood stock.

Early in 1988, Department of Marine Resources personnel received permission to obtain American shad from the Connecticut River at Holyoke, Massachusetts. The Connecticut River Technical Advisory Committee allowed the DMR to transport adult shad from the fish trap at the fish passage facilities located at the Hadley Falls Dam.

Fish health inspection is required by the Maine Department of Inland Fisheries & Wildlife for any fish being stocked into the inland waters of Maine if the fish are imported from outside the borders of the state; since the American shad obtained from the Connecticut River for the Kennebec River restoration were stocked into the impoundment above the Edwards Dam in Augusta, the appropriate health work was performed.

Adult shad exiting the twin fish lifts into the headpond level canal were trapped by Connecticut River personnel from the University of Massachusetts Cooperative Fisheries Unit. Shad were then dip netted into rolling hoppers in 25 fish lots and lowered on an electric chain hoist down to the stocking truck. Shad and water were dumped into the tank which had been previously half filled with river water.

Two tank trucks purchased with KHDG funds were used to transport shad from the Connecticut River. The smaller truck, which had first been used during the 1987 field season, was employed until the new, larger truck arrived in mid-June, 1988. This smaller truck was fitted with a circular fiberglass shad transportation tank 88" in diameter, 42" deep, and 1100 gallons in volume. The tank water was circulated by a 3.5 HP gasoline powered pump. The system was designed to create a circular water flow around the tank. Gas exchange was accomplished by a venturi located between the tank outlet and the pump intake. Air was mixed with the circulating water by the pump impeller and the mixture was pushed out into the tank. This tank system was mounted on a 14' platform body affixed to a straight truck.

The tank was equipped with an 8' long cylindrical chute that was employed when fish were unloaded. The chute was placed over the rear part of the tank and the fish and water exited the tank through the chute and flowed into the river being stocked.

In mid-June, the new twin tank stocking truck purchased with KHDG funds was ready for service. The design of the larger twin tank truck was similar to that of the single tanker, except that the larger truck was fitted with two of the tanks previously described. These tanks were mounted one behind the other on a 20' platform truck body. The tanks were connected by an 18" diameter tunnel for the purpose of unloading both tanks through the rear of the back tank. In this way, all fish and water on board were emptied by backing the rear of the truck up to the water to be stocked.

Each tank on the twin tanker operated independently of the other while on the road. Tanks were individually equipped with a water pump and venturi gas exchange system, previously described. Fish were confined by gates to the tank in which they were originally placed. The only time shad could travel from one tank to the other was as the truck was unloaded at the stocking site. The twin tank truck was equipped with an 8' long offloading chute, identical to the chute associated with the single tank truck described above.

In 1988, all American shad obtained as brood stock for the Kennebec River restoration were stocked into that segment of the river between Augusta and Waterville. During the summer, the impoundment between Augusta and Waterville was sampled to obtain information on the abundance of juvenile shad. This sampling was accomplished with an 80' long, 8' deep, 1/4" mesh beach seine. One end of the net was held in a fixed position on shore while the other end was pulled out and then back to shore with a boat. All fish collected were identified by species, enumerated, and a sample was measured for total length. All American shad collected were measured for total length. All fish trapped were released immediately after data collection was completed.

RESULTS & DISCUSSION: American Shad-1988

At Hadley Falls on May 9, 1988, DMR personnel obtained and sacrificed a 60-fish sample of adult American shad from the early portion of the spawning run on the Connecticut River. Spleen tissue, kidney tissue, and blood samples removed from the shad were processed by the U.S. Fish & Wildlife Service Fish Health Unit at Lamar, Pennsylvania. The fish were found to be free of any viral or bacterial diseases and given a clean bill of health.

The results of American shad transfers from the Connecticut River and water and air temperatures during the transfers are presented in Table 12. Of 965 fish loaded, 899 were stocked alive into the Kennebec at the Sidney boat launch ramp. The difference, 66 shad, died in transit.

Of the 899 live adults released into the impoundment above Augusta, 283 were recovered dead from the impoundment in the week following the last transfer trip. These delayed mortalities were thought to be caused by the extremely high river and air temperatures associated with the last two trips in conjunction with the poor condition of the shad in these latter days of the spawning run. The warm air temperatures (over the course of the five-hour return trip), acting on the already warm river water, probably caused significant stress on these late-run shad.

The survival of at least some of the 616 remaining shad was substantiated by the appearance of fresh adult shad on the turbine trash racks at Edwards Mill during the summer of 1988. These fish survived in the impoundment for some time and so it is hoped they had the opportunity to reproduce successfully. Although the shad brood stock had to be imported rather than obtained from the Narraguagus or lower Kennebec, the goal of 500 adult shad stocked above Augusta was substantially exceeded in 1988. The impoundment was sampled for juvenile shad on July 8 and 16 and on August 4 and 15. The beach seine hauls produced one juvenile shad, 7.6 centimeters in total length. Captured with a school of juvenile alewives on August 4, it was the only juvenile shad contacted in the impoundment. The existence of this fish suggests some spawning

success by the stocked adult shad, but it is impossible to estimate how many adults survived to spawn or how many juveniles were produced.

Table 12. 1988 American Shad Transfers from Connecticut River to Kennebec River

Date	# Loaded	# Stocked	# Morts in Transit	H2O Temp C° Connecticut	H2O Temp C° Kennebec	Air Temp C°
05/29	118	109	9	18.5	19.0	25.0
06/04	128	126	2	18.0	18.0	21.0
06/11	249*	241	8	19.5	18.5	20.0
06/12	250*	222	28	21.0	20.0	23.0
06/13	220*	201	19	21.0	21.0	28.0
TOTALS:	**965**	**899**	**66**			

899
-283 delayed mortalities
616 total fish released alive

*Reflects the double capacity of the twin tank truck used on these days

METHODS: Atlantic Salmon-1988

An experimental upstream fish passage device (collection pool and fish pump) was installed at Edwards Mill during the summer of 1988. It was never fully operational during the summer or fall of 1988 and no fish were trapped or passed by the device.

Atlantic salmon were trapped in the mouth of Bond Brook, just below Edwards Mill on the west bank of the Kennebec River. The 1987 studies indicated that this was the only practical capture area. The lowest pool in Bond Brook was inspected regularly from July through October. When salmon were sighted in the brook, attempts were made to capture those salmon. A 40' x 4' 1/4" mesh beach seine was used to block the salmon's escape path back into the Kennebec. An 80' x 8' 1/4" mesh beach seine was hauled through the holding pool to trap the salmon.

Salmon captured in the pool were immobilized in a hand held salmon transportation device supplied by the Maine Atlantic Sea-Run Salmon Commission. Salmon were weighed to the nearest decagram and measured for total length to the nearest millimeter. A scale sample was removed from each fish near the base of the dorsal fin. Salmon were examined for any tags or fin clips and released into the stocking truck.

Atlantic salmon were hauled in a round, 1100-gallon tank measuring 88" in diameter and 42" in depth. Water circulation was provided by a gasoline powered 3.5 HP water pump. Gas exchange was supplemented with the help of a venturi, allowing air to mix with the circulating water upstream of the water pump. The water/air mix was pumped out into the tank water.

Salmon were released from the truck by gently dip netting them out of the tank after the water level was reduced. Salmon were then released by hand into the Edwards Mill impoundment at the Sidney boat launch, about 7½ miles above Augusta.

RESULTS & DISCUSSION: Atlantic Salmon-1988

The results of the trapping and stocking efforts are presented in Table 13. Of the 18 salmon trapped, 17 were released into the headpond. One fish suffered mortality in transit. Three of the salmon trapped were tagged as smolts with National Marine Fisheries Service Carlin tags. The results of the tag returns are presented in Table 14. Scale samples collected by DMR personnel were analyzed by Maine Atlantic Sea-Run Salmon Commission personnel. Their findings are represented in Table 15. On the Kennebec, 20 salmon were caught; two were rod and reel catches with the remaining 18 trapped by DMR personnel in Bond Brook. Table 15 shows that four of these 20 fish spent one winter at sea, while 15 spent two winters at sea. One fish was determined to be a repeat spawner.

Overall, Atlantic salmon trapping efforts were much more successful in 1988 than in 1987, probably due to the high water temperatures experienced in 1988. Water temperatures in Bond Brook, which is spring fed, are substantially lower than the main stem Kennebec during hot summer periods. Only one fish was moved in 1987 compared to 17 moved successfully in 1988. Efforts will be made to increase the number of salmon trapped in future years. The operation of the temporary fish passage facility at Edwards Mill in Augusta may contribute additional salmon brood stock to the restoration effort

Table 13. ATLANTIC SALMON CATCHES - 1988

KENNEBEC RIVER - BOND BROOK

DATE	TOTAL LENGTH(CM)	WGT(KG)	SEX	TAGS/MARKS	DISPOSITION
7/15	78.7	4.65	-	-	SIDNEY
7/15	81.3	4.09	-	-	SIDNEY
7/15	56.5	1.36	-	-	SIDNEY
7/15	73.7	3.06	-	-	SIDNEY
7/15	77.5	4.09	-	-	SIDNEY
7/15	67.3	2.72	-	NMFS CARLIN #344408 USA	MORTALITY
7/15	82.6	5.22	-	NMFS CARLIN #313385 USA	SIDNEY
7/15	54.9	1.59	-	-	SIDNEY
7/15	51.4	-	-	-	SIDNEY
7/15	59.7	1.93	-	-	SIDNEY
7/15	74.3	3.75	-	-	SIDNEY
7/18	83.8	5.11	-	-	SIDNEY
7/18	73.7	3.75	-	ADIPOSE CLIP	SIDNEY
7/18	78.7	4.31	-	NMFS CARLIN #383375 USA	SIDNEY
7/18	74.3	3.63	-	-	SIDNEY
8/04	74.3	3.29	-	DEFORMED DORSAL FIN	SIDNEY
8/04	64.1	2.61	-	-	SIDNEY
8/04	62.2	1.93	-	-	SIDNEY

Table 14. Atlantic Salmon Tag Returns

The following information was received from Al Meister (ASRSC) concerning tagged Atlantic salmon taken at Augusta:

Tag #	Captured	Location	Date Stocked	Location Stocked
#344408	7/15/88	Augusta*	May 7-8, 1986	Milford (Penobscot)
#313385	7/15/88	Augusta*	May 8, 1986	Greenbush (Penobscot)
#383375	7/18/88	Augusta*	May 9, 1986	Eddington (Penobscot)

*Bond Brook

NOTE: All Carlin tags were green in color

Table 15. Atlantic Salmon Scale Analysis

1988 Atlantic Salmon Catches - Kennebec River

	1SW	2SW	Sea-Age Repeat SP	Totals
Kennebec:				
Bond Brook-Nets	4	13	1	18
Rod	0	2	0	2
TOTALS:	4	15	1	20

NOTE: Scales read by Maine Atlantic Sea-Run Salmon Commission; samples taken from fish by DMR personnel