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**KENNEBEC RIVER  
ANADROMOUS FISH RESTORATION  
ANNUAL PROGRESS REPORT - 1997**

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Revised March, 1998*

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## INTRODUCTION

This progress report covers the eleventh year of the twelve-year interim trap and truck program for American shad and alewives on the upper Kennebec River. The interim trap and truck program is being carried out by the Maine Department of Marine Resources (MDMR) as part of an agreement between the State of Maine fishery agencies and hydroelectric dam owners whose dams are located above the head-of-tide Augusta Dam. This group of dam owners, known as the "Kennebec Hydro Developers Group [KHGDG]," is providing funds for the implementation of the state fishery agencies' fishery management plan (*Lower Kennebec River Anadromous Fish Restoration Plan and Inland Fisheries Management Overview, 1986*). The long-term goal of this plan is to restore American shad and alewives to their historical habitat above the Augusta Dam. The long-term objectives are:

1. To achieve an annual production of six million alewives above Augusta; and
2. To achieve an annual production of 725,000 American shad above Augusta.

The strategy developed to meet these objectives involves restoration planned in two phases. The first phase (January 1, 1986 through December 31, 1998) involves the initiation of restoration by means of trap and truck for alewives and shad to selected water bodies. As originally planned, the Edwards Dam (whose owner chose not to participate in the KHGDG/State Agreement) was to be the primary site for capture of brood stock for this restoration program. Fish for the restoration were not obtained at the Edwards Dam until 1993 for several reasons. No facilities were available at this dam during 1987 and 1988. In 1989, an experimental fish pump was installed by the owner, but this facility proved to be ineffective in capturing sufficient numbers of adult alewives for stocking in upriver lake systems. As a result, from 1987 through 1992, all the alewife brood stock stocked in the Phase I lakes came from outside the Kennebec River, mostly from the Androscoggin River.

A dramatic shift in the source of alewife brood stock occurred in 1993 due to the increasing alewife returns below the Edwards Dam on the Kennebec and the sharp decline in the 1993 run of the Androscoggin donor stock of alewives. Alewife trapping was completely transferred to the Kennebec in 1993, while the method of trapping used was predominantly netting. The alewife brood stock source was split between the two rivers in 1994, but the bulk of the fish came from the Kennebec (93%) with most of those being trapped by the fish pump. The Kennebec was the only source of brood stock in 1995 and trapping was accomplished predominantly by fish pumping. In addition, the interim stocking goal of six alewives per acre was achieved in both 1994 and 1995.

In 1996 and 1997, MDMR obtained alewife brood stock exclusively from the Kennebec River at the Edwards Dam. In the last two years, the vast majority of alewives trapped

were taken by the fish pump. Two lakes included in the list of Phase I stocking sites were stocked for the first time: Wesserunsett Lake in 1996 and Webber Pond in 1997. In addition, the Phase I alewife stocking goals for 1996 and 1997 were achieved.

MDMR has had surplus alewives available at the Edwards Dam since 1994 (alewives in excess of the Phase I lakes stocking goal). MDMR/KHDG-funded personnel have assisted in trapping, loading, and stocking alewives in other river drainages from 1994 through 1997, after the annual Phase I stocking goals have been met.

The future of improved fish passage at Edwards Dam still remains uncertain. The State of Maine is in favor of removal of this dam in order to restore the river segment above it as a spawning and nursery area for all anadromous fish species, including striped bass, rainbow smelt, shortnose sturgeon, and Atlantic sturgeon, which do not utilize conventional fish passage facilities. The relicensing process of the Edwards Dam has included several recent developments. In the fall of 1997, FERC staff released their final basin-wide Environmental Impact Statement which recommended removal of the Edwards Dam. The Commission voted on this removal recommendation and approved it in December. However, the FERC decision supporting removal is currently under appeal and the issue is not likely to be settled prior to the 1998 trapping season.

Alewife collection for the spring of 1998 will be accomplished by trapping fish pumped at the Edwards Dam. Based on past stocking and projected returns, there should be sufficient brood stock available at Augusta to complete the 1998 alewife stocking transfers from the Kennebec River.

Under Phase I of the plan, only those lakes which had approval for stocking by the Department of Inland Fisheries and Wildlife (MIF&W) were to be stocked with six alewives per surface acre. This amounted to eleven lakes (out of twenty-one lakes to be stocked under Phase I), with ten of these to be stocked commensurate with the initiation of the plan, requiring the stocking of 72,894 adult alewives. To date, MDMR has not stocked two of the three Phase I lakes in the Sevenmile Stream drainage, Threemile Pond and Three-cornered Pond. Stocking at these ponds (and Webber Pond) was deferred for a time to allow the Maine Department of Environmental Protection (MDEP) to establish a better, long-term water quality data base on these lakes. Webber was stocked beginning in 1997 (two alewives per acre) and will receive six alewives per acre by 1999. Threemile Pond and Three-cornered Pond will be stocked sometime after the 1998 season.

In past years, American shad brood stock for transfers to the Kennebec River have been obtained from the Connecticut River in Massachusetts. Smaller numbers of shad have also been obtained from the Merrimack River in Massachusetts and the Narraguagus River in Maine. The objective for shad during Phase I is to pass 2,500+ adults a year at the Augusta Dam. If this objective can not be met at the Augusta Dam, then additional shad will be obtained from other sources. Since 1987, fish passage for shad at the Augusta Dam has been nonexistent or ineffective. Although shad have

been obtained from other sources, as noted previously, the numbers stocked have not approached the goal of 2,500. **Therefore, unless new sources become available, the goal for American shad is to stock 1,000 adult shad annually.** In 1997, MDMR transferred 420 brood stock American shad from the Connecticut River to the Kennebec River. Shad transfers were limited by the mitigation policies of the Connecticut River Technical Advisory Committee.

American shad culture efforts were increased in 1997, with expansion of the shad culture facility funded by the Maine Outdoor Heritage Fund and the KHDG. The 1997 shad culture operational budget was funded by MDMR and KHDG. In 1997, MDMR stocked an estimated 1,495,178 American shad fry in the Kennebec River and an additional 474,476 fry in the Sebasticook River. In the fall, 60,261 fall fingerlings were released in the Kennebec River below Waterville. All shad fry and fingerlings were raised at the Medomak Hatchery in Waldoboro from either Connecticut River or Saco River eggs.

**The interim plan for Atlantic salmon is to move whatever salmon become available at the Augusta Dam upriver.** In 1997, fish pumping failed to trap any Atlantic salmon at Edwards Mill. Fish pump operation targeting salmon will continue at Edwards in the future with the approval of the Maine Atlantic Salmon Authority. No attempt will be made to seine or trap salmon at Bond Brook later in the year during high water temperatures, following recommendations of the Maine Atlantic Salmon Authority.

As granted in the KHDG/State Agreement, various studies and monitoring activities were undertaken. These included monitoring downstream emigration of juvenile and adult alewives and shad; monitoring growth rates of juvenile alewives by lake system; surveying lake outlet streams for obstacles to the successful downstream passage of alewives; and the identification and quantification of food organisms in the stomachs of juvenile smelt collected as part of the cooperative study between the MDIF&W, MDEP, and MDMR. The field and lab work portion of the Lake George Alewife Interaction Study is complete; a final interagency report is being written and is expected to be completed in 1998.

In 1997, MDMR tended weirs constructed to trap fish at the outlet streams of Pattee Pond and Nehumkeag Lake (on the Sebasticook River and Kennebec River drainages, respectively). This double weir project is designed to determine alewife emigration numbers and growth rates at the six alewife per acre and twelve alewife per acre stocking levels. MDMR will trap at the Pattee and Nehumkeag weirs in 1998 to complete the study.

The following report summarizes activities and results related to American shad, alewife, and Atlantic salmon restoration which are being carried out in accordance with the KHDG/State Agreement and the 1986 fishery management plan.





## **METHODS: Alewife**

In 1997, the Maine Department of Marine Resources [MDMR] utilized the Kennebec River as its source of brood stock alewives for the truck stocking program for Phase I lakes. The large number of brood stock alewives in the Kennebec River from 1993 through 1996, coupled with the positive effect of this alewife abundance on the efficiency of the Edwards Dam fish pump in trapping the limited number of alewives required for the Phase I restoration effort, caused MDMR to acquire alewives from the Kennebec again in 1997.

Prior to the 1997 alewife run, MDMR and Edwards Manufacturing Company (i.e., Edwards Dam) agreed that the fish pump, which had been used for the purpose of trapping brood stock alewives at the site from 1994 through 1996, would be reinstalled and operated during the 1997 season. The pump was positioned, as in past years, at the south side of the upper tailrace and was affixed to girders above the tailrace. The ten-inch diameter pump intake pipe was fished in two different locations during the 1997 season, as it was in 1996. Early in the season, the intake was located at the extreme upstream end of the north side of the discharge of the southernmost turbine at the upper powerhouse. After the first few days of the season, the intake was moved to the eddy created by the concrete abutment located between the discharges from the two southern turbines in the upper powerhouse. This intake location was the same as that used from 1994 -1996 and was used for most of the 1997 season.

Improvements to the pump system from 1994 -1996 were again utilized during the 1997 season. As in past years, a three-foot long section of transparent lexan, ten inches in diameter, was affixed to the intake end of the pipe. The clear tip on the pipe was added to make the pump less obtrusive to the fish and thus more effective. The intake end of the pipe, just above the lexan tip, was fastened in place with cable. Cable tension and the vertical position of the intake were maintained by adjusting a "come along" attached to the cable and a supporting davit attached to the concrete pier. The intake was also secured by several lines fastened to the concrete pier, which helped prevent the intake pipe from jerking violently as the pump cycled between suction and discharge phases. This more static intake nozzle may have contributed to pump efficiency by scaring the fish less than the unstable arrangement used several years prior.

The pump lifted the alewives and water and deposited them into a fiberglass tank located at the top of the granite wall, just south of the upper tailrace. The receiving tank measured 9' x 7'6" x 4'6" deep. The tank floor was painted white to provide better visual contrast with the alewives in the tank and allow more accurate estimates of alewife numbers in the tank. Dipping alewives from this tank proved difficult until the alewife density was very high in the tank. Alewives were also removed by draining the tank, especially when alewife density was low. Draining was accomplished by stopping the pump and removing a drain plug in the tank floor. A supplemental water supply, which was added to the pump holding tank during the 1994 season and utilized from 1994 -1996, was used again for the 1997 season. This water was supplied by an electric pump and discharged onto the surface of the holding tank water through a two-inch

hose. This backup water supply was used to provide the alewives in the pump tank with fresh, oxygenated water, especially if the fish pump was shut down. When a sufficient number of alewives had been trapped in the absence of a stocking truck, the fish pump could be shut down. Fresh water to sustain the trapped fish was then provided with this auxiliary flow. This arrangement allowed alewives to be stockpiled without fear of overcrowding or mortality of stored fish due to low DO levels.

During the 1997 season, the pump tank was usually drained only at the end of the day. During truck loading, alewives were intercepted before they entered the holding tank as they exited the pipe downstream of the pump. While standing on movable wooden decks laid over the top of the pump tank, MDMR personnel used dip nets to capture the alewives as they entered the tank. The head of the net was usually braced on a wooden plank against the force of the pumped water stream and the alewives were screened from the water as it flowed through the bag of the net. The bag of the dip net was allowed to float in the tank water to reduce stress on the alewives trapped in it. The dip net was exchanged for an empty one between pump cycles and the alewives in the loaded net were placed in the truck tank. Typically, one or two MDMR personnel manipulated the dip nets to catch the alewives, while another worker was handed the full nets, sorted the fish, and counted the alewives as they were released into the truck tanks. While loading the twin tank truck, two personnel were utilized counting and loading alewives on the truck. This second person was especially helpful for loading the front tank on the twin tanker as it is impossible to get the front of the truck close to the pump tank because of site configuration.

During the 1997 alewife run, MDMR also trapped a small number of alewives with dip nets below Edwards Mill. When netting alewives, MDMR personnel used dip nets hung with ¼" delta mesh netting. Alewives were dipped from the southern margin of the fast water in the upper powerhouse tailrace, just downstream from the pump intake area. When alewives were dip netted, twenty-five fish lots (or less) of fish were placed in five-gallon buckets half-filled with water. Buckets were immediately removed from the river bank as they were filled and hand carried to the base of the granite block wall at the south side of the upper tailrace. A rope, pulley, and davit affixed to the top of the wall were used to raise the alewives to the stocking truck level. Fish and water were poured into a five-gallon bucket attached to the rope strung over the pulley on the davit. The worker at the base of the wall then hoisted the pail, fish and water hand-over-hand until it was within reach of the worker on the truck bed. The worker on the truck would then swing the bucket in, detach it from the rope, and place the alewives into the tank truck.

Prior to the seining or removal of alewives from the fish pump tank, the stocking trucks in use were filled with water from the headpond with the auxiliary water pump. Water was circulated in the stocking tanks with the truck-mounted pumps. Oxygen was introduced into the stocking tank water via a porous pipe arrangement. Water circulation and oxygen introduction continued as alewife loading progressed in order to provide a healthy, stable environment in the stocking tanks. Alewives were transported in two stocking trucks purchased with funds provided by the KHDG Agreement. A

complete description of these trucks, associated equipment, and standard methods of operation is provided in our 1994 annual report, available from MDMR upon request.

Alewives were trucked from their loading site directly to the lake to be stocked and immediately released. The name, location, and programmed alewife stocking figures for each Phase I lake are summarized in Table 1. The location of each lake is illustrated by Figure 1.

Lake systems were sampled during the summer season to obtain young-of-the-year [YOY] alewives, the progeny of the spring 1997 stocking. The juvenile alewives were collected with beach seines fished from the shores of the lakes. Two beach seines were employed, one measuring 66' long x 6' deep, the other 40' long x 4' deep. Seines were constructed of ¼" or 1/8" delta mesh and were treated with a green dip to prevent rotting. When juvenile alewives were observed in the shallow littoral zone, on the surface, or near a lake outlet dam, a cast net or dip net was sometimes used to collect a sample. The cast net was constructed of multi-filament, ¼" bar mesh and was eight feet in diameter. Dip net frames varied in their dimensions, but were hung with either ¼" or 1/8" delta mesh netting.

All fish species collected were enumerated and released and a subsample of ten fish measured for total length. Alewives were enumerated and a 50-fish sample measured to determine total length in millimeters.

Lake outlet streams were surveyed to determine the presence of obstacles to downstream passage of juvenile and adult postspawner alewives. The streams were traveled by boat or on foot. Obstructions to juvenile alewife migration were noted and their structure and location recorded. Beaver dams on the streams below Pattee, Plymouth, Pleasant, and Lovejoy Ponds are frequently encountered and in years when these dams are active, require regular attention during the late summer and fall to permit free emigration of postspawner and YOY alewives. A small hole opened in the dam in question usually allows downstream passage for several days (until it is repaired by the beavers). Overall, downstream passage through the lake outlet streams was complicated in 1997 by reduced stream flows, the result of infrequent summer and early fall rains. Late fall rains finally provided better late season passage opportunities.

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 juveniles might encounter at these barriers. The condition and operation of downstream bypass facilities, 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 2, while locations of the dams are illustrated in Figure 1.

**TABLE 1. 1997 ALEWIFE STOCKING PLANS - PHASE I LAKES**

**Sebasticook River**

<u>Lake System</u>	<u>Location</u>	<u>River Section</u>	<u># to be Stocked*</u>
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	8,544 **
Unity Pond	Unity	Main Stem	15,168

**Kennebec River**

Wesserunsett Lake	Madison	Kennebec River	8,676
Webber Pond	Vassalboro	Kennebec River	2,504 ***
		<b>TOTAL:</b>	<b>73,202</b>

\* Six adult alewives per lake surface acre.

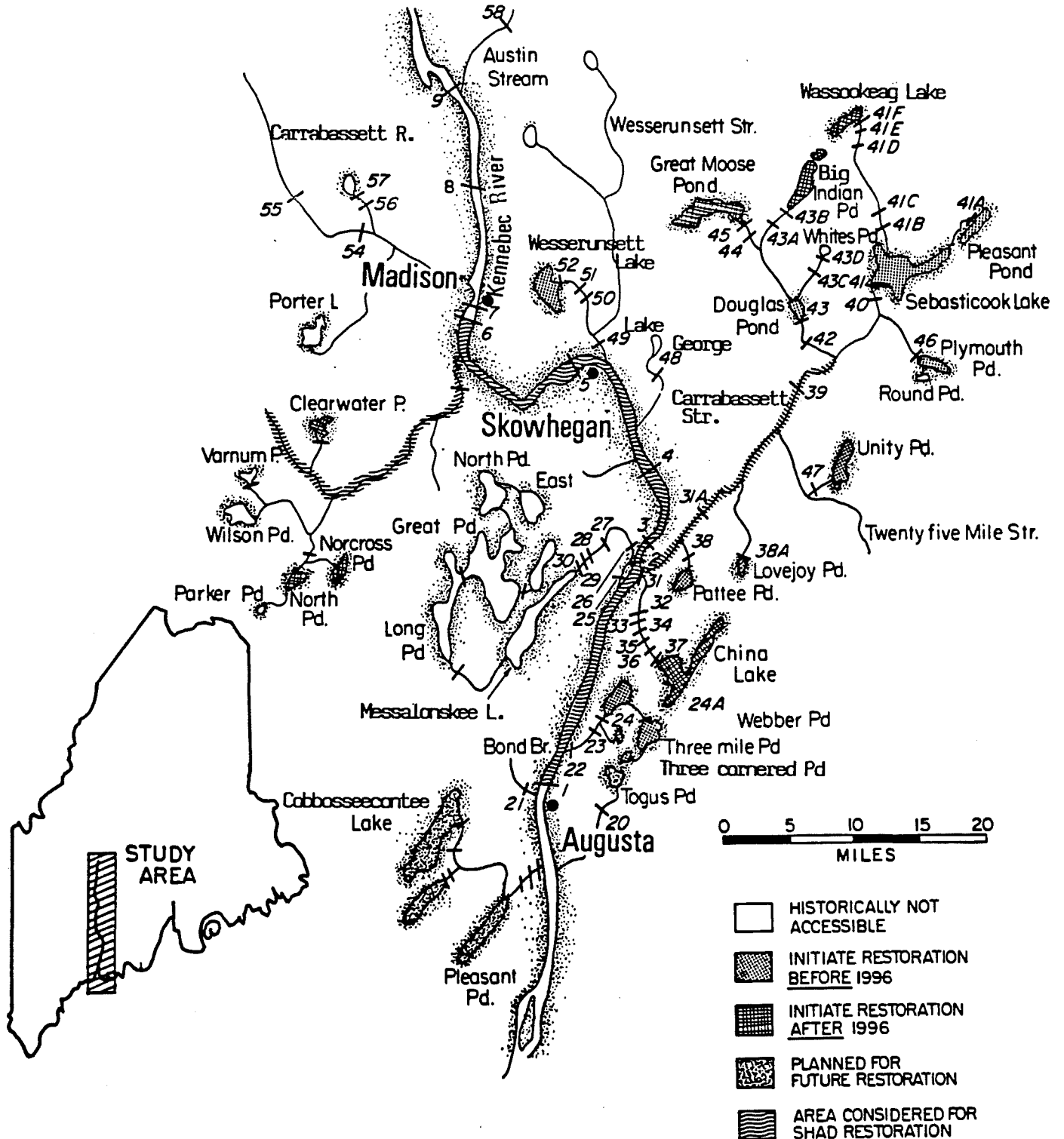
\*\* Twelve adult alewives per lake surface acre.

\*\*\* Two adult alewives per lake surface acre.

FIGURE 1:

# Kennebec River Drainage

## ANADROMOUS FISH RESTORATION PROGRAM



**TABLE 2. HYDROELECTRIC FACILITIES MONITORED FOR DOWNSTREAM PASSAGE, 1997**

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<u>Dam</u>	<u>FERC</u>	<u>#Body of Water</u>	<u>Town</u>	<u>Location (Fig. 1)</u>
Waverly Avenue	#4293	West Branch Sebasticook River	Pittsfield	43
Pioneer	#8736	West 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

## **RESULTS & DISCUSSION: Alewife**

In 1997, 74,165 brood stock alewives were stocked into nine upriver Phase I lakes in the Kennebec River drainage. These nine lakes are programmed for restoration as described in Phase I of the *“Strategic Plan and Operational Plan for the Restoration of Shad and Alewives to the Kennebec River Above Augusta.”* In total, 12,323 acres of lake surface were stocked, usually to a density of approximately six alewives x acre<sup>-1</sup>. Stocking densities in two lakes varied from the general Phase I goal of six alewives x acre<sup>-1</sup>: Pattee Pond was chosen as a site for the study of the effect of stocking density on the number of juveniles emigrating from the lake and was stocked and evaluated at a density of twelve alewives x acre<sup>-1</sup> in 1997. Also in 1997, alewife restoration was initiated in Webber Pond. The stocking rate was adjusted to two alewives x acre<sup>-1</sup> for the first year, with future stocking rates to increase in increments of two alewives x acre<sup>-1</sup> per year up to the general goal of six alewives x acre<sup>-1</sup> (in 1999). Alewife stocking in the nine Phase I lakes is summarized in Table 3.

Eight of the nine lakes stocked in 1997 (seven on the Sebasticook River subdrainage and one on the Kennebec River drainage) have been stocked in previous years as part of the ongoing alewife restoration program in the Kennebec drainage. The restoration program was expanded in 1997 to include the stocking of Webber Pond in Vassalboro, now the closest Phase I lake to tidewater. The addition of Webber Pond to the list of current Phase I alewife restoration ponds increased surface acreage under production from 11,071 acres to 12,323 acres in the Kennebec drainage, an 11% increase.

The initial restoration of alewives in Webber Pond was postponed for several years until 1997. MDMR had previously deferred stocking alewives into the Sevenmile Stream drainage (Webber, Threemile and Three Cornered Ponds) for a number of years due to the ongoing work in water quality improvement by MDEP, local residents, lake associations, and the China Region Lake Alliance. In early 1995, MDMR, MDEP and MDIF&W agreed that alewife restoration at six alewives x acre<sup>-1</sup> would have no negative impact on water quality and may, in fact, have a positive long-term impact through phosphorus export from the lakes. However, a conservative plan was agreed upon which called for stocking in only Webber Pond initially. If all goes well at Webber, the other lakes will be stocked in future years.

MDMR, MDEP and MDIF&W held a public meeting about alewife restoration in Webber Pond in March, 1995. Based on the results of that meeting, stocking in 1995 was deferred for several reasons. Some concern was expressed that any negative trend in water quality (perceived to be related to alewives or otherwise) might have a detrimental effect on securing funding for the new China Region Lake Alliance. In addition, some lakefront property owners remained skeptical about alewife introduction and the Webber Pond Lake Association submitted a letter asking MDMR not to stock alewives into Webber Pond.

MDMR held another public meeting on May 28, 1996 to further discuss the potential for alewife reintroduction into Webber Pond during the 1996 season. While there was no



**TABLE 3. 1997 ALEWIFE STOCKING IN KENNEBEC RIVER DRAINAGE PHASE I LAKES**

<u>PONDED AREA</u>	<u>SURFACE ACREAGE</u>	<u>TARGET NUMBER TO BE STOCKED*</u>	<u>NUMBER STOCKED</u>	<u>NUMBER OF TRIPS</u>	<u>% OF TARGET # ACHIEVED</u>	<u>ALEWIVES PER ACRE</u>
Douglas Pond	525	3,150	3,251	3	103%	6.2
Lovejoy Pond	324	1,944	2,042	2	105%	6.3
Pattee Pond**	712	8,544	8,556	6	100%	12.0
Pleasant Pond	768	4,608	4,669	4	101%	6.1
Plymouth Pond	480	2,880	3,043	2	106%	6.3
Sebasticook Lake	4,288	25,728	25,835	11	100%	6.0
Unity Pond	2,528	15,168	15,366	8	101%	6.1
Webber Pond***	1,252	2,504	2,548	1	102%	2.0
Wesserunsett Lake	1,446	8,676	8,855	4	102%	6.1
<b>TOTALS:</b>	<b>12,323</b>	<b>73,202</b>	<b>74,165</b>	<b>41</b>	<b>101%</b>	

\* Six alewives per lake surface acre (unless otherwise specified).

\*\* Twelve alewives per lake surface acre. Pattee Pond is part of a stocking density study.

\*\*\* Two alewives per lake surface acre. Alewife reintroduction in Webber Pond commenced in 1997 at a reduced stocking rate of two alewives per acre for the first year.

longer any opposition to alewife stocking by the CRLA or the Webber Pond Lake Association, the Webber Pond residents present were split approximately 50/50 when a show of hands was requested. Based on the response from the public meeting, MDMR decided to postpone alewife reintroduction for one more year, until 1997. As noted previously, MDMR began alewife reintroduction at Webber Pond in a three-phased approach. Alewives were stocked at a rate of two alewives x acre<sup>-1</sup> for the first year (1997), with future stocking rates to increase in increments of two alewives x acre<sup>-1</sup> per year up to the general goal of six alewives x acre<sup>-1</sup> for 1999. This approach was adopted to give local residents more of an opportunity to become accustomed to the seasonal presence of alewives in Webber Pond and to allow time to discuss any perceived problems prior to increasing the stocking density.

As in 1996, MDMR decided to stock brood stock alewives in the Edwards Dam impoundment in 1997 if fish were still available after sufficient numbers had been trapped to satisfy upriver stocking of the nine lakes. MDMR hoped that the alewives released in the impoundment could be observed upstream where their passage would be obstructed by the Fort Halifax Dam at the mouth of the Sebasticook River, or by the Lockwood Dam if they continued up the Kennebec past the Sebasticook. On June 3 - 4, 20,652 alewives trapped by the pump at Edwards were trucked just above the gatehouse and released into the Edwards impoundment.

MDMR personnel checked for alewives in the waters below CMP's Fort Halifax and Lockwood hydroelectric dams on June 7 and observed hundreds of alewives below only Fort Halifax. No alewives were observed below Lockwood, either in the tailrace or below the spillway. Below the Fort Halifax spillway, video was taken of alewives swimming near the ledges on the south side of the Sebasticook, on the opposite side of the river from the Fort Halifax powerhouse. Alewives were also observed and video taped in the tailrace. CMP's Bob Richter was at Fort Halifax on June 7 to confirm the observations made by MDMR.

Alewife stocking efficiency from Edwards Mill in 1997 was similar to that from 1994 - 1996. There was very little overlap between the alewife stocking in the Phase I lakes and the American shad brood stock transfers from the Connecticut River during the 1997 season. The shad transfers were completed prior to and after the alewife stocking to Kennebec drainage ponds, thus allowing the twin tank truck to be employed regularly for alewife transport. Alewife hauling tank densities in 1997 were similar to loading densities of the previous three years. The heavy alewife run and availability of alewives at Edwards Dam during the peak of the run allowed high densities of fresh, lively alewives to be loaded into the tanks. This rapid loading precluded any degradation of the condition of the alewives by avoiding lengthy holding tank times.

<u>YEAR</u>	<u>ALEWIVES STOCKED</u>	<u># TRIPS</u>	<u>ALEWIVES X TRIP<sup>-1</sup></u>
1997	74,165	41	1,809
1996	67,441	41	1,645
1995	59,080	34	1,738
1994	58,701	36	1,631

1993	36,503	28	1,303
1992	23,579	31	761

The 74,165 alewives stocked in the Sebasticook and Kennebec drainage Phase I lakes in 1997 is the highest number of alewives stocked since the KHDG Agreement was implemented (Table 4). The 1997 alewife total represents the fourth year in a row that all seven Sebasticook drainage restoration lakes were stocked to their target stocking density of six alewives x acre<sup>-1</sup> (twelve alewives x acre<sup>-1</sup> in Pattee Pond). In addition, 1997 marked the first year of stocking in Webber Pond and the second year of stocking in Wesserunsett Lake. In total, forty-one alewife stocking trips were made to the upriver ponds. All forty-one trips originated at the Edwards Dam in Augusta and the Kennebec River was the sole source of alewife brood stock in 1997. It was not necessary to import alewife brood stock from outside the Kennebec to meet the goals of the program. The alewife stocking program in the Phase I lakes required ten days to complete, from May 27 to June 5, 1997. A chronological list of individual stocking trips to the nine Phase I lakes is presented in Table 5.

Table 6 is a summary of the 1997 alewife trapping at Edwards Dam. Figure 2 shows the daily trapping data in chart form. During the 1997 season, 135,231 alewives were trapped at the Edwards Dam. Of these, 134,919 were captured by the fish pump and 312 were dip netted. The 135,231 alewives trapped include 74,165 stocked in the nine Phase I lakes; 20,652 stocked in the Edwards Dam impoundment; 6,095 stocked in Kennebec drainage lakes other than Phase I lakes; 27,977 stocked in other river drainages; 2,350 given to CMP; 2,238 released below the Edwards Dam; 254 placed in the MDMR aquarium; 303 biological samples; and 1,100 fish pump and 97 trucking mortalities, respectively. The ninety-seven alewives lost while trucking represent a 0.08% mortality of the 129,240 total alewives loaded.

Operation of the fish pump commenced on May 20, coinciding with a FERC visit to the Edwards Dam site. Although schools of alewives were sighted on May 19, low river temperatures precluded mass alewife movement until May 27 and 28, when the river temperature approached 12°C. Alewife transfers to the Phase I lakes commenced with one light load on May 27 and accelerated on May 28 when 4,267 alewives were trapped. Alewife trapping peaked on June 3 and 4, when 21,756 and 21,249 alewives were trapped. River temperatures were in the 14 - 15°C range on these two days. MDMR trucked 20,652 alewives and released them in the Edwards impoundment just above the Edwards gatehouse on these two days combined. This short trip meant that the pump did not have to be shut down while the truck was away stocking alewives and thus allowed larger numbers of fish to be trapped on these two days.

Stocking in Phase I lakes was completed on June 5, when one load was transported to Webber Pond. Stocking of other drainages, which had commenced to a limited degree during the stocking of the Phase I lakes, was completed between June 5 and June 12 (see Table 7). Significant alewife trapping with the fish pump ended on June 12, with very limited numbers of alewives taken after this date (three pumped and 312 dip netted).

**TABLE 4. KENNEBEC RIVER PHASE I LAKES ALEWIFE STOCKING SUMMARY (1985 - 1997)**

<u>Lake</u>	<u>Year</u>												
	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985
Sebasticook Lake (4,288 acres)	25,835	25,913	25,934	25,911	17,281	2,853	21,030	11,166	24,966	14,850	12,099	8,478	3,567
Plymouth Pond (480 acres):	3,043	3,032	3,012	3,002	3,199	2,903	2,921	2,530	2,925	3,027	2,797	1,220	0
Pleasant Pond (768 acres):	4,669	4,718	4,628	4,789	2,224	3,546	4,689	3,475	4,614	2,648	2,688	0	0
Douglas Pond (525 acres):	3,251	3,349	3,229	3,333	3,504	3,188	3,150	2,959	3,257	3,099	2,286	525	0
Lovejoy Pond (324 acres):	2,042	2,045	2,000	2,008	699	1,952	1,976	2,077	1,741	2,055	1,949	0	0
Pattee Pond (712 acres):	8,556	4,366	4,316	4,315	4,450	4,287	4,327	3,919	4,363	3,393	4,031	0	0
Unity Pond (2,528 acres):	15,366	15,312	15,961	15,343	3,125	2,845	4,632	559	3,301	0	0	0	0
Webber Pond (1,252 acres):	2,548	0	0	0	0	0	0	0	0	0	0	0	0
Wesserunsett Lake (1,446 acre	8,855	8,706	0	0	0	0	0	0	0	0	0	0	0
<b>Total:</b>	<b>74,165</b>	<b>67,441</b>	<b>59,080</b>	<b>58,701</b>	<b>34,482</b>	<b>21,574</b>	<b>42,725</b>	<b>26,685</b>	<b>45,167</b>	<b>29,072</b>	<b>25,850</b>	<b>10,223</b>	<b>3,567</b>

**TABLE 5. 1997 ALEWIFE STOCKING BY TRIP IN KENNEBEC RIVER DRAINAGE PHASE I LAKES**

<u>DATE</u>	<u>LOCATION</u>	<u>NUMBER LOADED</u>	<u>NUMBER MORTALITIES</u>	<u>NUMBER STOCKED</u>
05/27/97	Unity Pond	646	0	646
05/28/97	Sebasticook Lake	1412	0	1412
	Sebasticook Lake	1742	0	1742
05/29/97	Sebasticook Lake	1108	0	1108
	Sebasticook Lake	3003	1	3002
	Sebasticook Lake	1509	1	1508
	Sebasticook Lake	3071	5	3066
	Sebasticook Lake	1635	2	1633
05/30/97	Pattee Pond	1507	0	1507
	Pattee Pond	1541	0	1541
	Lovejoy Pond	1029	0	1029
	Pleasant Pond/Stetson	1005	4	1001
	Pleasant Pond/Stetson	1524	1	1523
05/31/97	Unity Pond	3103	0	3103
	Plymouth Pond	1531	1	1530
	Lovejoy Pond	1013	0	1013
	Unity Pond	3071	2	3069
	Pattee Pond	1202	0	1202
	Douglas Pond	1024	3	1021
06/01/97	Unity Pond	1111	0	1111
	Unity Pond	1530	0	1530
	Sebasticook Lake	3157	1	3156
	Douglas Pond	1510	0	1510
	Sebasticook Lake	3144	0	3144
	Pattee Pond	1047	20	1027
	Pattee Pond	1595	2	1593
06/02/97	Pleasant Pond/Stetson	1151	0	1151
	Unity Pond	3060	3	3057
	Pattee Pond	1686	0	1686
	Plymouth Pond	1515	2	1513
	Sebasticook Lake	3010	1	3009
	Douglas Pond	720	0	720
	Pleasant Pond/Stetson	1000	6	994

**TABLE 5. 1997 ALEWIFE STOCKING BY TRIP IN KENNEBEC RIVER DRAINAGE PHASE I LAKES**

(CONTINUED)

06/03/97	Unity Pond	1542	0	1542
	Seabasticook Lake	3060	5	3055
	Unity Pond	1308	0	1308
	Wesserunsett Lake	1527	0	1527
	Wesserunsett Lake	3036	0	3036
06/04/97	Wesserunsett Lake	1457	2	1455
	Wesserunsett Lake	2837	0	2837
06/05/97	Webber Pond	2548	0	2548
<b>TOTAL FISH:</b>		<b>74227</b>	<b>62</b>	<b>74165</b>
<b>TOTAL DAYS:</b>				<b>10</b>
<b>TOTAL TRIPS:</b>				<b>41</b>

**TABLE 6. ALEWIFE TRAPPING AND STOCKING FROM EDWARDS DAM, KENNEBEC RIVER - 1997**

Date	# of Alewives*			Trucking			Biological Samples	Released Below Dam	Given to CMP
	Fish Pump	Seined/Dipped	Pump Mortalities	Loaded	Mortalities	Stocked			
May 20	28	0	0	0	0	0	28	0	
21	1	0	0	0	0	0	0	1	
22	52	0	0	0	0	0	52	0	
23	380	0	0	115	1	114	0	265	
24	***								
25	***								
26	***								
27	646	0	0	646	0	646	0	0	
28	4,267	0	0	4,267	0	4,267	0	0	
29	10,376	0	0	10,326	9	10,317	50	0	
30	6,826	0	0	6,606	5	6,601	0	220	
31	13,194	0	1,100	10,944	6	10,938	50	1,100	
June 1	13,094	0	0	13,094	23	13,071	0	0	
2	12,342	0	0	12,142	12	12,130	0	200	
3	21,756	0	0	20,406	19	20,387	0	0	1,350
4	21,249	0	0	20,199	3	20,196	50	0	1,000
5	6,975	0	0	6,975	10	6,965	0	0	
6	7,944	0	0	7,944	5	7,939	0	0	
7	2,830	0	0	2,830	0	2,830	0	0	
8	0	0	0	0	0	0	0	0	
9	2,959	0	0	2,959	3	2,956	0	0	
10	5,600	0	0	5,600	0	5,600	0	0	
11	2,112	0	0	1,762	1	1,761	0	350	
12	2,285	0	0	2,285	0	2,285	0	0	
13	0	140	0	140	0	140	0	0	
14	0	0	0	0	0	0	0	0	
15	0	0	0	0	0	0	0	0	
16	0	0	0	0	0	0	0	0	
17	0	50	0	0	0	0	50	0	
18	0	16	0	0	0	0	16	0	
19	3	106	0	0	0	0	7	102	
<b>TOTALS:</b>	<b>134,919</b>	<b>312</b>	<b>1,100</b>	<b>129,240</b>	<b>97**</b>	<b>129,143</b>	<b>303</b>	<b>2,238</b>	<b>2,350</b>

\* Includes alewives that were stocked into the Edwards Dam impoundment, Androscoggin River and other drainages.

\*\* Represents 0.08% trucking mortality.

\*\*\* Pump not operated on this day.

**TABLE 7. DISPOSITION OF KENNEBEC RIVER ALEWIVES STOCKED IN LOCATIONS OTHER THAN PHASE I LAKES - 1997**

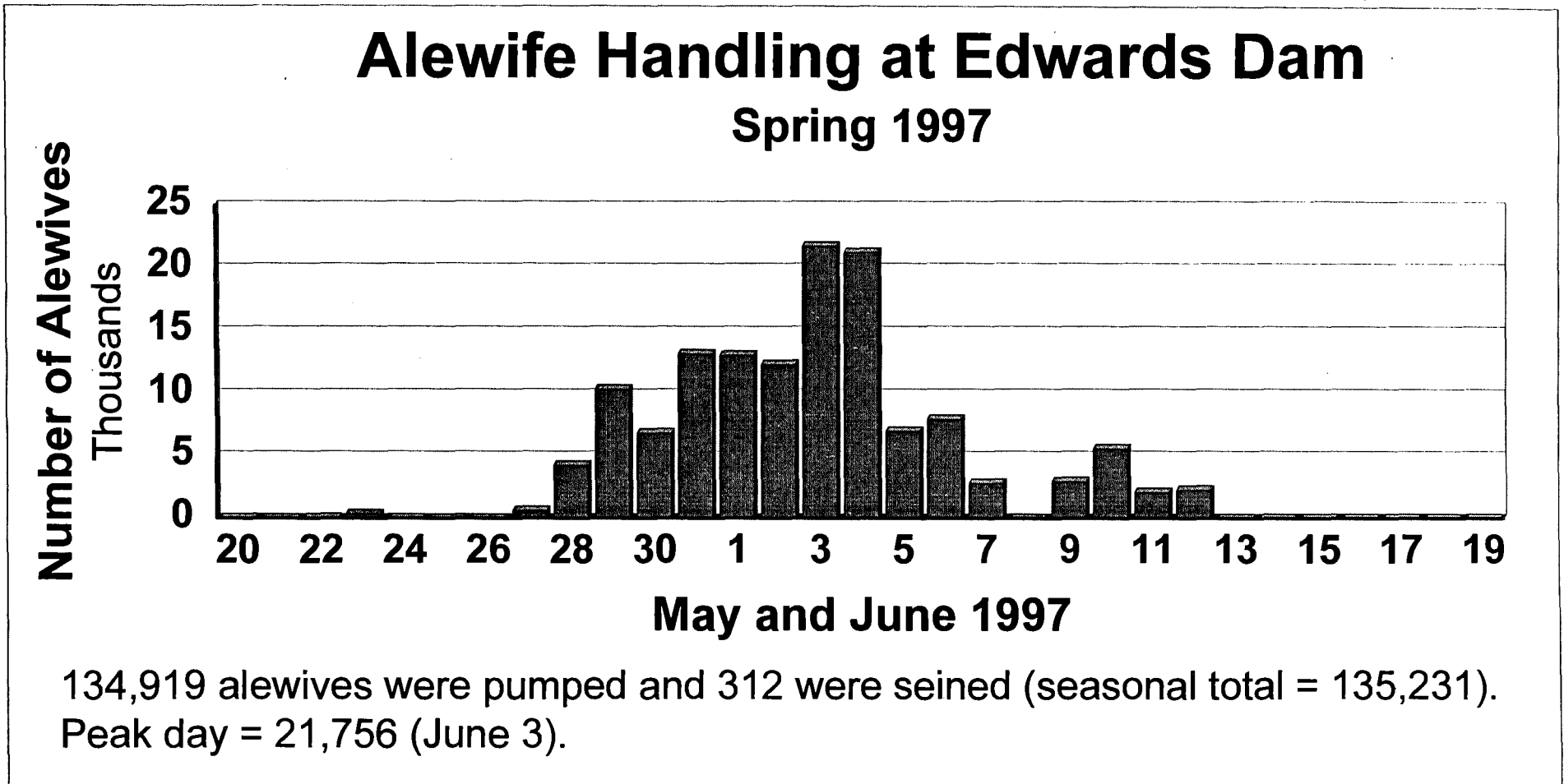
	<u>DATE</u>	<u>LOCATION</u>	<u>NUMBER LOADED</u>	<u>MORTALITIES</u>	<u>NUMBER STOCKED</u>	
KENNEBEC RIVER:	6/03	Edwards Impoundment	1587	2	1585	
	6/03	Edwards Impoundment	1584	3	1581	
	6/03	Edwards Impoundment	3009	0	3009	
	6/03	Edwards Impoundment	2000	0	2000	
	6/04	Edwards Impoundment	2022	0	2022	
	6/04	Edwards Impoundment	2001	0	2001	
	6/04	Edwards Impoundment	4048	0	4048	
	6/04	Edwards Impoundment	2002	0	2002	
	6/04	Edwards Impoundment	2404	0	2404	
			<b>20657</b>	<b>5</b>	<b>20652</b>	
		5/28	Pleasant Pond/Gardiner	1113	0	1113
		6/04	Pleasant Pond/Gardiner	3428	1	3427
				<b>4541</b>	<b>1</b>	<b>4540</b>
	6/11	Nehumkeag Pond	1060	1	1059	
	6/10	Sewell Pond	496	0	496	
		<b>Total</b>	<b>26754</b>	<b>7</b>	<b>26747</b>	
ANDROSCOGGIN RIVER:	6/03	Sabattus River #2	753	0	753	
	6/03	Taylor Pond	1000	9	991	
	6/05	Taylor Pond	2814	4	2810	
	6/05	Durham Boat Launch	790	0	790	
	6/05	Lower Range Pond	823	6	817	
	6/06	Sabattus River #3	832	0	832	
	6/06	Durham Boat Launch	1017	0	1017	
	6/06	Lower Range Pond	906	0	906	
	6/06	Marshall Pond	711	0	711	
6/07	Sabattus River #3	701	0	701		
		<b>10347</b>	<b>19</b>	<b>10328</b>		
CATHANCE RIVER:	6/12	Bradley Pond	502	0	502	



**TABLE 7. DISPOSITION OF KENNEBEC RIVER ALEWIVES STOCKED IN LOCATIONS OTHER THAN PHASE I LAKES - 1997**  
(CONTINUED)

EASTERN RIVER:	6/07	Dresden Bog	1047	0	1047
	6/07	Dresden Bog	1082	0	1082
			<b>2129</b>	<b>0</b>	<b>2129</b>
SHEEPSCOT RIVER:	6/09	Branch Pond	501	0	501
	6/09	Branch Pond	1521	0	1521
	6/09	Savade Pond	321	0	321
	6/09	Travel Pond	616	3	613
	6/10	Turner Mill Pond	862	0	862
		<b>3821</b>	<b>3</b>	<b>3818</b>	
MARSH RIVER:	6/06	Sherman Lake	1024	0	1024
PEMAQUID RIVER:	6/06	Pemaquid River	2133	5	2128
	6/06	Pemaquid Pond	1321	0	1321
	6/10	Duckpuddle Pond	1010	0	1010
		<b>4464</b>	<b>5</b>	<b>4459</b>	
ROYAL RIVER:	6/10	Elm Street Headpond	2521	0	2521
ST. GEORGE RIVER:	6/10	Crawford Pond	711	0	711
	6/11	Crawford Pond	702	0	702
	6/12	South Pond	1157	0	1157
	6/12	Seven Tree Pond	626	0	626
		<b>3196</b>	<b>0</b>	<b>3196</b>	
DMR AQUARIUM:	5/23	Aquarium	115	1	114
	6/13	Aquarium	140	0	140
		<b>255</b>	<b>1</b>	<b>254</b>	
<b>GRAND TOTAL:</b>			<b>55013</b>	<b>35</b>	<b>54978</b>

Figure 2.



In 1997, transfers from the Edwards Dam trapping site to waters other than the Phase I lakes totaled 55,013 alewives loaded, with 54,978 stocked and 35 mortalities (Table 7). Alewives transferred to waters other than the Phase I lakes represented 41% of the total number of alewives trapped at Augusta. Alewives were transferred to the Edwards impoundment, other lakes in the Kennebec drainage, the MDMR aquarium, and other drainages, including the Androscoggin, Cathance, Eastern, Sheepscot, Marsh, Pemaquid, Royal, and St. George. Alewives stocked in the Kennebec drainage represented approximately 75% of the total number of alewives trapped at Augusta, while alewives transferred to waters outside the Kennebec drainage represented 25% of the total (see Figure 3).

The efficiency of trapping at Edwards Dam in 1997 was comparable to the previous seasons from 1996 - 1994. The peak day of pumping in 1997 on June 3 was nearly identical to the peak day of June 4 in 1996. However, two days of this magnitude occurred in 1997 (June 3 and 4), while June 4, 1996 was the only day approaching this magnitude in 1996.

<u>YEAR</u>	<u>PEAK TRAPPING DAY</u>
1997	21,756 alewives
1996	22,205
1995	10,634
1994	13,050

In 1997, the pump operated on twenty-six days and trapped alewives on twenty-one of those days. Over 3,000 alewives were pumped on eleven days; over 5,000 on ten days; and over 10,000 on six days (Table 6, Figure 2).

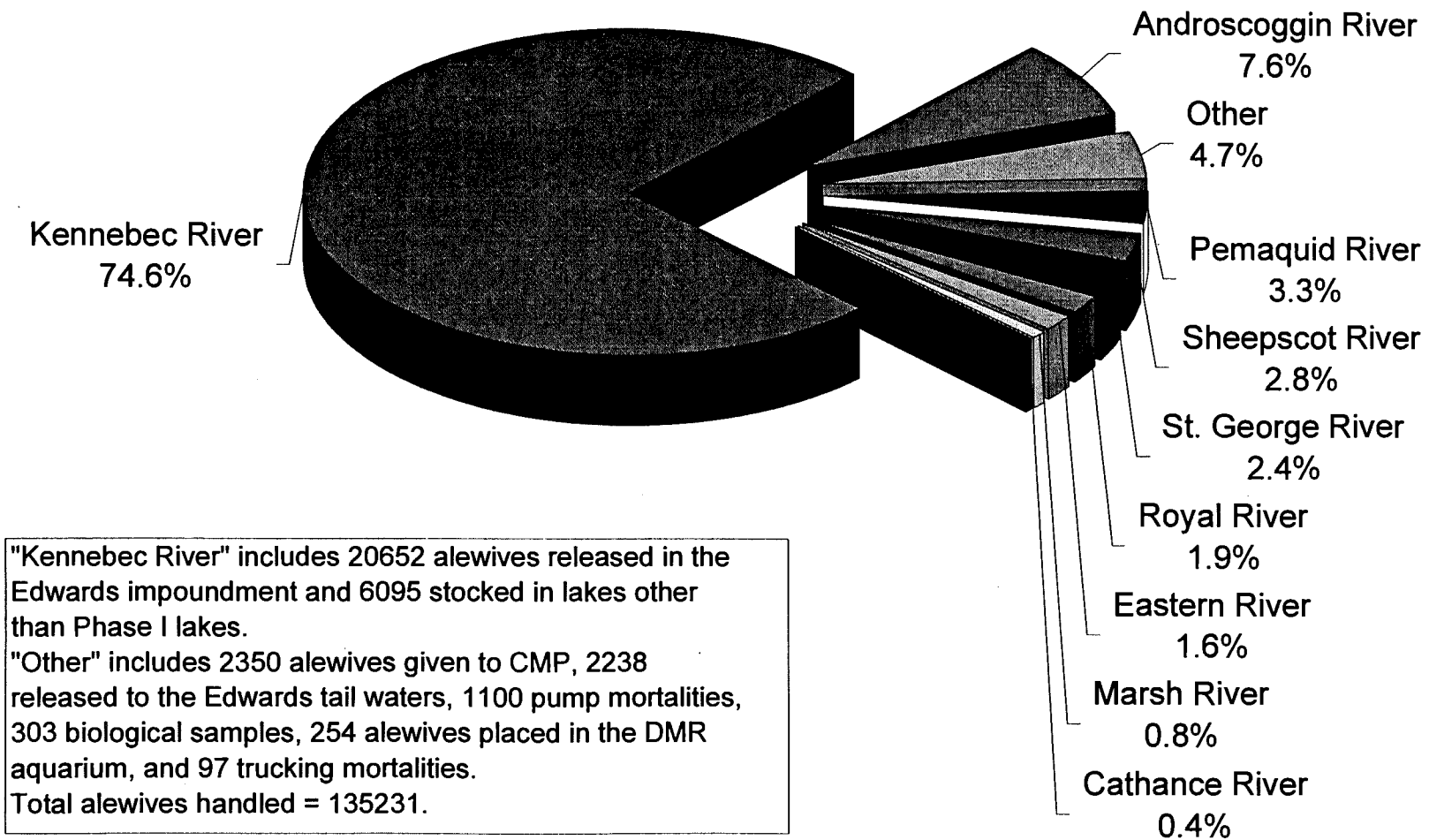
The most stocking trips completed to the Phase I ponds in one day was seven, on June 1, and again on June 2. If the short trips to the Edwards impoundment are included, nine trips were completed on June 3 (five to lakes, four to the impoundment). In addition, another two trips were made on June 3 to the Androscoggin drainage by MDMR Androscoggin River Project personnel with that project's stocking truck.

Based on experience gained during alewife trapping at Edwards in previous years, MDMR developed a basic standard operating procedure for using the fish pump in an efficient manner. Since the shad transfers in 1997 did not occur at the same time alewife stocking was underway, there were usually five KHDG Project personnel available to work on alewife trapping and transport. While two crew members traveled with each of the two stocking trucks, the fifth worker usually remained at Edwards Dam to coordinate pump operations.

Based on the pump's alewife trapping rate and the time trucks were due back at the site, the MDMR staffer could perform rough calculations to determine the number of alewives already in the pump tank and the number likely to be pumped into the tank prior to a truck's return. If too many alewives were likely to be trapped prior to the

Figure 3.

# Stocking Location of Alewives Trapped at Edwards Dam - 1997



truck's return, the pump could be stopped by an Edwards employee. A maximum of approximately 2,500 alewives could be stockpiled in the pump tank. A supplemental circulating water supply (added during the 1994 season) allowed alewives to be held in the tank when the pump was switched off. If the single tanker was due to return first, a whole load (1,400 -1,600) of alewives could be stockpiled in the pump tank. If the twin tanker or both trucks were due to return, the maximum stockpile (2,500) of alewives could be held. Ideally, these fish would be trapped immediately preceding the arrival of the truck to allow the alewives to be held in the tank for a minimum amount of time. As the loading of the double tank truck commenced, the pump would be restarted and additional alewives would be trapped to finish the load (perhaps as many as 3,200 alewives). This operational mode allowed loading to be as efficient as possible without sacrificing the quality of the alewives being loaded. Because of efficient loading, the alewives also spent less time in the truck tanks at the loading site. Both these factors helped to minimize trucking mortalities.

Loaded trucks were immediately dispatched from Edwards to the stocking site. Three remaining crew members were usually adequate to complete loading even the double tanker. This immediate and staggered departure method allowed tankers to return from the lakes to Edwards Dam at alternating intervals and prevented waiting in line to load the next batch of alewives, contributing to more efficient trucking overall. If trucks did overlap at Augusta, the waiting crew helped in loading the first tanker and accelerated its departure.

The configuration of the hauling tank system and the operational procedure used by the MDMR/KHDG crew were very important in hauling the large loads of alewives. The porous pipe/oxygen delivery system first fitted to the trucks in 1992 for American shad hauling was used extensively during the 1997 alewife trucking operations. This system consisted of porous polyethylene pipes four feet long fastened to the tank floors and connected to lexan-ball type flow meters downstream of the welding type regulators attached to the oxygen tank. This porous pipe produced finer diameter bubbles and used a lesser volume of oxygen than prior systems. These fine bubble, porous pipes are used on the Susquehanna River shad hauling trucks to increase dissolved oxygen levels.

One of the double tanker tanks was fitted with Bio-Weve diffuser, which was also used during the 1995 -1996 seasons. This experimental application continued to work about as well as the porous polyethylene tubing for delivering oxygen, but may be more durable. Evaluation will continue in future seasons.

After truck tanks were filled with river water, the circulation pumps were operated prior to loading the first alewives. Dissolved oxygen levels in the tank water were monitored during loading and while on the road, by using remote probes in the tanks connected to a meter in the truck cabs. During the loading process, the flow of oxygen into the tank water was increased as alewife density increased. With the remote monitoring of the DO level in the tank water, oxygen input could be adjusted to keep the tank DO within

acceptable limits, usually above 6mg/l, and below saturation at the given temperature. Monitoring during loading and transport indicated that the oxygen input was more than adequate to maintain tank DOs and keep pace with alewife oxygen demand at the fish densities and average temperatures experienced in 1997.

The maximum alewife density hauled to the lakes during the 1997 season was approximately 1,500 alewives/1,000 gallons of water per tank. However, seven tank loads of 2,000 alewives/1,000 gallons or more were transported the short time and distance to the Edwards impoundment. The alewives were observed to be in excellent condition upon their release into the river. These trips only lasted approximately one-half hour from the initiation of loading to the release of the alewives back to the river above the dam. If necessary, it may be possible in future years to experiment with heavier loads like those outlined above on the longer trips to the upriver lakes. Significant mortalities may occur at some theoretical density, making time spent collecting the alewife mortalities less efficient.

Few problems were experienced with the KHDG Project tank trucks during the 1997 stocking season. A minor breakage of the plumbing on the twin tank truck on June 2 was repaired on site at Edwards Mill, and the truck returned to service immediately, transporting a load of alewives that evening.

During the summer and fall of 1997; young-of-the-year alewives were captured in eight of the nine Phase I restoration lakes stocked with adults (Table 8). No juvenile alewives were captured in Lovejoy Pond in 1997. Juvenile alewives were captured in seventeen of the thirty-two seine hauls made in 1997. Dip nets contributed five samples in twelve attempts and cast nets added three samples from fifteen attempts completed.

A weir was used throughout the summer and fall of 1997 to monitor YOY alewife emigration from Pattee Pond. Large numbers of YOY alewives were trapped and sampled at Pattee Pond in 1997, but the data is still under analysis and was not available at the time of publication. There is no data presented in Table 8 for Pattee Pond due to the pending analysis of the data.

Alewife YOY emigration from Pattee Pond was monitored with a weir and a fyke net during the 1996 season at a stocking density of six alewives x acre<sup>-1</sup>. The number of YOY alewives emigrating from Pattee Pond at the six alewives x acre<sup>-1</sup> stocking rate (1996 and 1998) will be compared to the number emigrating from the pond at the twelve alewives x acre<sup>-1</sup> stocking rate (1997). This study also includes another lake in the Kennebec drainage, Nehumkeag Pond, which is not included in the list of Phase I lakes currently under restoration. Nehumkeag Pond is being stocked with the same two stocking densities in alternate years with Pattee Pond to act as a control with respect to any effects related to the specific lake or year. Further information on this study will be made available as further information is collected and the data analysis is completed.

**TABLE 8. JUVENILE ALEWIFE SAMPLES FROM PHASE I LAKES - 1997**

<u>Lake</u>	<u>Stocking Density</u>	<u># of Seine Hauls</u>	<u># of Cast Net Attempts</u>	<u># of Dip Net Attempts</u>	<u># of Fyke Net Sets</u>	<u># of Juveniles</u>	<u>Mean Total Length (mm)</u>
Douglas Pond	6.2	0/1	0/1	1/1	0/0	54	69
Lovejoy Pond	6.3	0/0	0/0	0/0	0/0	0	
Pattee Pond	12.0	0/0	0/0	0/0	*	*	
Pleasant Pond	6.1	0/2	1/1	0/0	0/0	50	59
Plymouth Pond	6.3	0/0	0/11	3/10	0/0	119	83
Sebasticook Lake	6.0	6/7	0/0	0/0	0/0	101	69
Unity Pond	6.1	7/13	0/0	1/1	0/0	140	91
Webber Pond	2.0	0/5	1/1	0/0	0/0	52	147
Wesserunsett Lake	6.1	4/4	1/1	0/0	0/0	94	55
<b>TOTALS:</b>		<b>17/32</b>	<b>3/15</b>	<b>5/12</b>	<b>0/0</b>	<b>610</b>	

**Notes:**

Stocking density is adult alewives/surface acre.

# of seine hauls is the # of hauls producing alewives/total # of hauls (seasonal total).

# of cast net attempts is the # of throws producing alewives/total # of throws (seasonal total).

# of dip net attempts is the # of dips producing alewives/total # of dips (seasonal total).

# of fyke net sets is the # of sets producing alewives/total # of sets (seasonal total).

# of juveniles is the total # of juveniles measured (seasonal total).

Pattee Pond outlet was monitored with a weir for the entire 1997 season.

The **Fort Halifax Project** in Winslow is operated by the Central Maine Power Company and is the lowermost dam on the Sebasticook River. Permanent downstream bypass facilities were installed by CMP during the summer and fall of 1993, after FERC issued an amended license for the project. The permanent bypass uses the same trash sluice opening that was used in past years for the interim facility. The old trash sluice was refitted with a weir gate to control depth of flow at the entrance of the downstream bypass. The downstream side of the opening was fitted with a metal trough with an open top to carry water and fish down close to the tailrace elevation. Mark/recapture studies completed by CMP in 1993 indicated that the experimental four-foot deep, plywood trash rack overlay - used in lieu of installing a reduced clear space trash rack overlay - was not providing the bypass efficiency desired at the site.

Twelve-foot deep, fine mesh, plastic screens attached to support frames were tested as a new alternative trash rack overlay in eight separate trials during the 1994 season. While the plastic mesh screens were effective at preventing the alewives from passing through the upper portion of the trash racks, YOY alewives sometimes sounded and passed under the plastic screens into the forebay. This was especially noticeable when the alewife density near the trash racks was high. In addition, the plastic mesh was difficult to clean and apt to tear when heavily fouled with debris.

CMP tested a metal punch plate trash rack overlay during the 1995 season. Rack overlays up to twelve feet in depth were tested in 1995. Two different sized punch holes were compared for fish impingement, fish exclusion, ease of cleaning, and durability. Cleaning was accomplished by using a compressed air wand to blow debris off the face of the punch plate after the turbines were shut down to reduce water pressure on the debris. Testing of the punch plate overlays in 1995 was promising. Cleaning was easy with the compressed air and the tearing common to the earlier plastic system was eliminated. MDMR observed large numbers of YOY alewives passing through the downstream facilities on three visits in 1995 and the arrangement seemed to direct many YOY alewives away from the turbines and through the downstream bypass to the river below the dam. However, MDMR did observe YOY alewives inside the punch plate overlay, in the forebay at Fort Halifax on October 11, 1995, despite the downstream bypass being fully operational. These observations and one possible explanation are discussed in the 1995 version of this report.

During early 1996, CMP and the state and federal resource agencies met and decided that the metal punch plate overlay system would be installed again for the 1996 downstream passage season. The configuration previously described was operated for the 1996 alewife emigration period to allow further study and assessment. On September 30, 1996, FERC issued an order approving the current downstream fish passage configuration and operational regime at Fort Halifax as permanent. This downstream passage system was utilized during the 1997 season and will be used in the future, based on the FERC order.



Overall, MDMR made seven visits to the Fort Halifax Dam in 1997, beginning on July 4 and concluding on October 17. The downstream bypass was open and operational on all seven visits (see Table 9). MDMR personnel observed large numbers of YOY alewives in the Fort Halifax headpond using the downstream bypass, and in the river below the dam during the October 17, 1997 visit. Staff from CMP and the USF&WS were also at the site on this day and observed the YOY alewives.

The **Benton Falls Project** is equipped with permanent downstream passage facilities that have been on line since 1988. The bypass at Benton Falls consists of two surface weirs, one located above each turbine intake, which interconnect and discharge into the tailrace through a large diameter pipe. Water flow into each weir is regulated by a gate which can be lowered to allow a controlled surface spill into the weir. After passing over this gate, fish become committed to the bypass and cannot reenter the headpond. Large numbers of juvenile alewives were observed passing through the facilities while they were operated during the 1988 -1996 seasons.

During the 1990 -1993 seasons, KHDG conducted downstream passage studies at Benton Falls using VHS cameras to count fish passing through the facilities. The successful study work in 1990 led to the continuation of the study in 1991 and 1992. In 1993 and 1994, Benton Falls Associates continued the study work to collect additional data on downstream fish passage efficiency. VHS cameras were placed over the weir intakes located over both turbines and the camera at the large turbine weir intake recorded fish passage throughout the season. The large turbine weir intake is open throughout the migration period and the small turbine weir intake is typically closed.

MDMR personnel observed the Benton Falls downstream passage during twelve visits in 1997, beginning on July 11 and ending on October 28. The bypass was open and operating on all site visits. American shad fry were stocked in the river reach above the Benton Falls project during the summer of 1997, as they were in 1996. Therefore, alosid YOY observed at Benton Falls may be either shad or alewives, with their ID plausible but not definitive without a sample being taken. However, some indication of their species identity is possible from their schooling and swimming behavior. MDMR observed YOY alosids (thought to be alewives and possibly American shad) during two visits at Benton Falls in 1997, August 22 and September 23. On both visits, the alosids were observed to be schooling in the headpond above the project. MDMR did not observe any fish passing through the downstream bypass during the 1997 visits.

MDMR first visited the **Burnham Dam** on July 11 in 1997. Prior to this visit, the flashboard closest to the intake structure had already been notched down below the other flashboards. This modification allowed surface spill from the headpond over the crest of the spillway and so provided some opportunity for interim downstream passage. This type of controlled spill for downstream passage has been utilized in past years at the Burnham Dam.

**TABLE 9. DOWNSTREAM PASSAGE OBSERVATIONS AT HYDROELECTRIC FACILITIES - SEBASTICOOK RIVER, 1997**

<u>Date</u>	<u>Ft. Halifax</u>	<u>Benton Falls</u>	<u>Burnham</u>	<u>Pioneer</u>	<u>Waverly</u>
7/11		X	X	X	O
7/24	X	X	X	X	X
7/31		X	X	X	O
8/06	X	X	X	X	O
8/13	X	X	X	X	O
8/14					O
8/15					O
8/22	X	X	O	X	O
8/28	X	X	X	X	X
9/9	X	X	X	X	X
9/23		X	X*	X	X
10/10		X	X*	X	X
10/17	Xa				
10/21		X	X	X	X
10/28		X	X	X	X
<b>Total Number</b>					
<b>Site Visits:</b>	<b>7</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>14</b>

<p>X = Downstream passage available  O = No downstream passage available  = Not surveyed on this day  * = Dead alewives present in the tailrace  a = Juvenile alewives using downstream passage facilities  A = Adult alewives using downstream passage facilities  f = Juvenile alewives in turbine forebay  s = Downstream passage available only over dam spillway</p>
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MDMR visited the Burnham Dam on twelve days in 1997. Some level of controlled spill was available as an interim downstream bypass during eleven of the twelve MDMR visits in 1997. However, on one of these days the depth of water flowing through the interim bypass was under one foot deep, and on four of the visits the flow was six inches deep or less. These low bypass flows are due to variations in headpond level since the crest of the notched flashboard comprising the temporary bypass is of fixed height. This flow may lack the volume needed to attract emigrating alewives and prevent them from being entrained in the project pen stock. Alewife entrainment is already a concern at the site at higher bypass flows. In addition, during one of the visits there was no downstream bypass flow available at all, with the only possibility for passage through the project's turbines.

Interim bypass flows under six inches in depth occurred on August 6, 13, 28, and September 9. No bypass flow was available during the August 22 visit, when the headpond level had been drawn down below the notched flashboard that provides interim bypass flows. Injured and dead YOY alewives were observed exiting the project's turbines on the September 23 visit. The interim bypass was passing approximately eighteen inches of water at the time, but no alewives were observed using the bypass during the visit. In addition, there were approximately four inches of water passing over the project's flashboards. The increased river flow at this time of year was due to the Seabasticook Lake drawdown which began earlier in the month of September. Large scale movement of YOY alewives in the Seabasticook River are documented annually on this lake drawdown flow. On September 23, YOY alewives passed through the project turbines, despite higher river flows providing higher bypass flows and spill over the flashboards.

MDMR did not observe any alewives using the controlled spill for downstream passage during any of its twelve site visits in 1997. As was noted in several prior KHDG Project reports, alewife entrainment problems at Burnham may be related to the distance between the controlled spill and the pen stock intake, the wide clear space of the station's racks (which were replaced with similarly spaced racks in late 1996), and/or the ratio of water flow through the controlled spill vs the turbine. This latter hypothesis is supported by observed low bypass flows due to headpond fluctuations, as mentioned above.

MDMR believes the interim downstream bypass at the Burnham Dam has been failing to provide adequate downstream passage of alewives at the site. Over multiple visits through many years, MDMR has repeatedly observed dead and injured YOY alewives in the project tailrace, inadequate or no bypass flows, and small numbers of alewives using the interim spill. As discussed above, the configuration of the bypass and trash racks, as well as the operational mode of the project, are not consistent with safe and effective downstream passage for alewives.

In 1996, MDMR sought increased bypass flows by requesting additional flashboards be notched to improve interim passage opportunities at the Burnham Project, at least

during the peak of the downstream migration. CHI did not agree that increased interim bypass flows were necessary at Burnham and declined to provide them at that time. MDMR again requested improved interim passage at Burnham during the annual meeting of the KHDG group and the MDMR in early 1997. CHI is reluctant to commit to any increased efforts in downstream passage until the FERC licensing of the project is settled and permanent conditions are imposed and agreed to. However, some time after the annual meeting, MDMR was informed that CHI would increase efforts toward improved interim downstream passage at Burnham.

MDMR did not observe any physical changes in the interim downstream passage configuration or in the operational regime of the project during the 1997 season. In MDMR's view, remedial measures are long overdue at the site and Burnham remains the most significant and troublesome obstacle to downstream passage on the Sebasticook River at the present time. MDMR strongly recommends measures be adopted immediately to significantly improve interim downstream passage at the Burnham site until permanent downstream passage (to be approved through the FERC licensing process) can be installed. MDMR is more than willing to discuss further interim measures for downstream passage for the 1998 season at CHI's earliest convenience.

From 1987 through 1993, downstream passage at the **Pioneer Dam** in Pittsfield consisted of intermittent controlled spills over the crest of the spillway. Construction of the downstream bypass at Pioneer began during the summer of 1990. The wood bypass trough and associated concrete work were completed during the summer and fall of 1993. During the 1994 season, bypass sluice stop logs were added near the entrance to the downstream bypass. These stop logs were added to control flow through the bypass and prevent alewives from backing out of the bypass flume after entering it.

Pioneer's owner, Chris Anthony, made an attempt to comply with the requirement to reduce trash rack spacing to one inch from June 15 to November 30. The metal mesh overlay which was hung over the project racks in past years and which was utilized for the 1997 season does have a small clear space and would probably physically exclude alewives from passing through it. However, it does not fit securely and gaps are sometimes present. The biggest problem with this fine mesh overlay is that it apparently clogs very rapidly when a turbine is operated. Water then flows under the six-foot depth of the overlay and alewives are likely to be drawn in the same direction. Cleaning of the overlay appears to be another major shortcoming of the materials and design used.

Of the twelve site visits conducted by MDMR in 1997, nine observations indicated that downstream passage through the bypass was severely restricted due to extremely low flows through the bypass (July 11 through September 23). On eight of the nine days when only very limited passage was available, less than four inches of water flowed through the bypass. On July 11, the trash rack overlay was fouled with debris rendering

it ineffective. Fortunately, shallow spills over the project spillway provided improved opportunity for downstream passage during all of the nine visits when the bypass flows were restricted. Bypass flows were improved during the last three visits to the site in 1997, from October 10 through 28. MDMR did not observe YOY alewives at the site nor were any observed using the downstream bypass at Pioneer during the 1997 season.

In 1997 as in prior years, there continued to be several chronic problems at the Pioneer site which will need to be resolved. First, the overlay should be improved so that it can be operable, cleanable, and maintainable if the turbine(s) are to be run during the migration season. As an alternative, the unit(s) may be shut down throughout the passage season. Second, maintaining adequate water flow through the bypass is still a problem. The bypass was built with a very shallow floor, compared to normal pond elevation with no flashboards. Furthermore, the bypass is usually stop logged to further restrict bypass flow. Increased flow through the bypass, routine checks to adjust bypass flow, and regular debris removal would be improvements over the current conditions. The project's owner has requested that he be allowed to install flashboards at the site. This would provide deeper bypass flows given the current elevation of the bypass. However, the practice of placing stop logs in the bypass to reduce its flow would continue to have a detrimental effect on passage even with the added pond height.

MDMR visited the **Waverly Avenue Dam** on fourteen days during the 1997 season. The project was back on line after a mechanical failure in 1996 took it out of operation for the entire 1996 season. Seven of the fourteen visits in 1997 revealed that the flow through the bypass was severely reduced to an unacceptable level of less than six inches in depth on three days and clogged with debris on four days. Because fish passage was severely limited or prohibited through the bypass and no flow was present over the spillway on these seven days, passage was listed as not available on those dates (see Table 9).

MDMR personnel, frustrated by the clogged bypass and simultaneous presence of YOY alewives in the headpond on August 13, returned to the Waverly Avenue Dam on August 14 and 15 to clean the bypass, perform minor repairs, and, if possible, sample juvenile alewives in Douglas Pond. Debris was removed from the bypass on the 14th and 15th, and several loose boards were fastened back into position on the 15th. Alewife samples were obtained on both days. Downstream passage was ineffective until the MDMR crew removed the debris and made the necessary repairs. The trash rack overlay was not noted to have been installed until September 23, 1997. On this visit and the three subsequent visits, flows through the bypass were deeper and improved over conditions earlier in the season.

Problems encountered during the 1997 season at Waverly Avenue Dam were similar to problems with the downstream bypass and its operations noted in previous seasons. First, gate leakage at the stop log bays on the far side of the spillway from the powerhouse remained a problem. This leakage causes downstream migrants to be

attracted away from the bypass during low flow conditions. Second, the bypass itself was in a poor state of repair with several broken boards partially clogging the trough of the bypass and collecting more debris as it passed by. Third, the deflector at the terminus of the bypass (which was installed to direct the plunging bypass flow away from the draft tube of the turbine) was not functioning properly and the flow was, in part, striking the draft tube. These problems need to be addressed to bring the bypass up to its maximum level of performance. These problems were minimized by the lack of generation at the plant during the 1996 season, but returned as serious and persistent problems during the 1997 season. They will require the attention of the dam's owner prior to and during the 1998 downstream passage season.

MDMR personnel sighted YOY alewives in the headpond at Waverly Avenue on four days in 1997: August 13, 14, 15, and 22. Samples were collected on August 14 and 15.

During the spring, summer and fall of 1997, MDMR personnel made observations on a minimum of seventeen different days at the downstream passage at **Edwards Mill** on the Kennebec River. Adult or YOY alosids were observed in the forebay near the downstream bypass on eleven of these visits. Adult alewives were observed in the forebay on six days, while adult American shad were observed on four days. Adult alewives were observed using the downstream bypass during four site visits in 1997. Adult American shad were not observed using the downstream bypass during any of the site visits in 1997.

MDMR observed YOY alosids, either alewives or shad, in the Edwards forebay on eight visits in 1997. Alosid YOY were observed using the downstream bypass on three of these eight days. Samples of YOY alosids were collected at Edwards Mill whenever possible during the 1997 passage season. Samples were collected on seven different days in 1997, from August 12 to October 22. Samples were collected with scoop net, dip net, cast net, and fly rod. In total, 301 YOY alewives and 158 YOY American shad were collected from the Edwards Mill forebay during the 1997 season. YOY shad were collected on five of the sampling days; YOY alewives were collected on six days. The American shad YOY may have been the progeny of adult brood stock transfers from the Connecticut River or survivors of the 1997 fry stocking from the Medomak Hatchery to the Edwards impoundment.

Adult American shad were observed in the Edwards Mill forebay on four days in 1997. These shad were survivors of the June brood stock transfers from the Connecticut River. The observation of these shad indicates that some survived the transfers and did not suffer mortality immediately after stocking. A small number of postspawner shad were observed in the Edwards forebay in 1997. The limited number of adult downstream migrant shad observed this year was probably due to the fact that only three trips from the Connecticut occurred in 1997, so there were fewer fish placed in the impoundment.

## **METHODS: American Shad**

This section of the annual report has been compressed. If you require a complete "METHODS" section, please refer to any other KHDG report from 1987-1994; only those changes which occurred during the 1997 shad hauling season will be noted in this report.

One of the most notable changes during the hauling season was the taking of adult shad from Central Maine Power Company's Cataract East Channel Fishway on the Saco River to the Waldoboro Hatchery for experimental spawning studies and egg take. Changes for the 1997 hauling season included hauling adult prespawner shad from the Hadley Falls facility in Massachusetts to the Westfield River above its first fishway. These additional transfers of fish represent the most significant change to the 1997 shad hauling season. All adult shad transferred to Maine were stocked at the Waterville boat launch; this site is preferred because of its proximity to prime spawning habitat.

During the 1997 field season, the Edwards Dam forebay at turbines #7 and #8, as well as the Benton Falls Dam impoundment, were sampled to obtain information on the abundance of juvenile shad. Sampling in 1997 was accomplished using dip nets, fly rods, cast nets, electroshock and scoop nets. With all five types of sampling gear, fish collected were identified by species; the shad were enumerated and a sample measured for total length.

## **RESULTS & DISCUSSION: American shad**

A fish health inspection was performed on the Connecticut River shad stock in the spring of 1997. A 150-fish sample of adult American shad was collected at the Holyoke fish lift on May 14, 1997. Kidney, spleen, and gill samples were taken in accordance with the AFS Fish Health Blue Book Procedures and returned to Dave Tillinghast of the Maine Department of Inland Fisheries & Wildlife in Augusta, Maine. Samples were processed for the detection of bacterial and viral fish pathogens and found to be free of those pathogens of concern to the State of Maine. These procedures were necessary to comply with state law concerning importation of live fish and eggs into Maine waters.

### **Adult Transfers -**

Since 1991, the Connecticut River has been the **only** source for shad brood stock introductions into the Kennebec. Three days of shad transfers from Holyoke to the Kennebec River occurred between June 7 and June 9, 1997. Of the 565 shad loaded at Holyoke, 420 were stocked into the Kennebec, with an overall trucking mortality of 25.6%. Results of the 1997 shad transfers are presented in Table 10. The one-to-one hauling agreement with the Connecticut Technical Advisory Committee was again in effect for 1997. Seven trips were made to the Connecticut River, resulting in 1,548 adults stocked in West Chesterfield. Fifty-one mortalities were recorded for these trips.

The remote DO probe mounted on the tank truck in 1992 was used again for the 1997 stocking season and was connected to a Model 57 YSI DO meter located in the cab of

**TABLE 10. STOCKING OF AMERICAN SHAD BROODSTOCK IN THE KENNEBEC RIVER, 1997**

Adult Shad Truck Stocking:

<u>Date</u>	<u>Broodstock Source</u>	<u># Loaded</u>	<u># Morts</u>	<u># Stocked</u>	<u>Stocking Site</u>	<u>Water Temperature (C)</u>	
						<u>Source</u>	<u>Kennebec</u>
6/07	CT River, Holyoke	242	108	134	Waterville	18.0	
6/08	CT River, Holyoke	159	16	143	Waterville	18.5	16.2
6/09	CT River, Holyoke	164	21	143	Waterville	18.5	14.2
<b>TOTALS:</b>		<b>565</b>	<b>145</b>	<b>420</b>			

<b>TRUCK STOCKING:</b>	<b>420</b>
<b>FISH PASSAGE:</b>	<b>0</b>
<b>TOTAL STOCKED:</b>	<b>420</b>



the truck. This system allowed constant monitoring of DO levels while the fish were loaded and also allowed DO levels to be maintained while on the road. The commercial anti-foam agent (NO FOAM) was used again during the 1997 shad hauling season.

#### Juvenile Sampling -

One of the most effective gear types used to sample 1997 YOY alosids was a fly rod. This simple yet effective tool could be easily employed at the Edwards #7 and #8 forebay to collect samples of both YOY shad and alewives. On August 27, September 10 and 30, a total of fifty-seven juvenile shad were captured using this method.

The shad scoop net was again used in the #7 and #8 turbine forebay to sample YOY alosids. The scoop net was deployed several times, but no YOY shad were captured.

The cast net was used on several occasions in the #7 and #8 turbine forebay at Edwards Dam. Cast net proficiency has been on the rise in our field work and six YOY shad were captured by this method at Edwards on September 10, 1997.

A dip net was utilized throughout the 1997 season to take biological samples at the Edwards Dam interim downstream bypass; this net was used when YOY alosids were observed using the downstream bypass. Early in the field season, Edwards employees installed a chain link fence in front of the downstream bypass for safety reasons. A small bolt could be removed and the gate opened to allow access to the throat of the bypass. On September 5, 10 and October 8, a total of 100 shad and thousands of alewives were captured using a dip net.

In total, KHDG-funded personnel captured 157 juvenile shad in the Edwards impoundment in 1997. MDMR is working on methods to discriminate between hatchery-raised and brood stock YOY shad. This could prove to be an important program assessment tool.

Benton Falls Dam headpond was sampled with the electrofishing boat. Since this impoundment is very steep-sided and access is limited, it was decided that the electrofishing boat was the best sampling device to utilize. On several visits to this area, what appeared to be YOY shad were seen dimpling and jumping on the surface of the water. Several alewives were sampled, but no shad were contacted on two trips to the headpond.

#### Shad Culture -

The experimental shad culture program initiated in 1991 was continued in 1997. The shad restoration program on the Medomak River is a cooperative program between the Department of Marine Resources (MDMR), the Kennebec Hydro Developers Group, the Town of Waldoboro, and the Time & Tide Mid-Coast Fisheries Development Project, which was created and administered by the local Time & Tide Resource Conservation and Development Organization.

On the evenings of June 3-14, 1997, a total of 2,889,002 eggs were taken from ripe and running female American shad. These eggs were transported to a small hatching facility located at the site of the former Medomak Canning Company in Waldoboro, Maine. The eggs were disinfected and then placed in custom-built upwelling egg incubators where they remained until hatch-out. Of the 2,889,002 eggs taken, an estimated 1,772,202 ultimately hatched for a 61% hatch-out. After hatching, the larvae were raised in 575-gallon circular fiberglass tanks and fed brine shrimp.

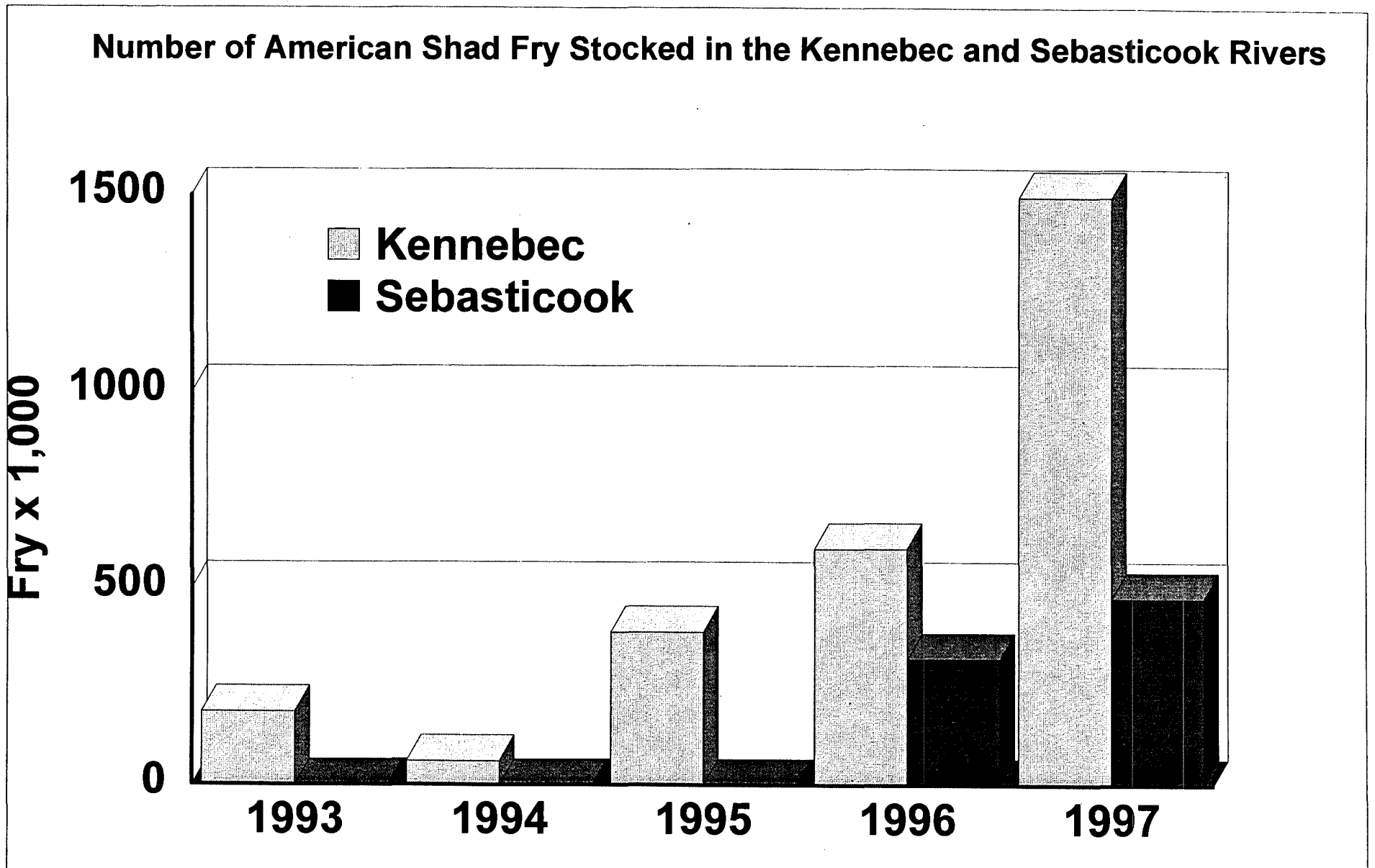
On June 24, 25, July 22, 23 and 30, an estimated 1,484,908 shad fry ranging from 14-23 days old were released into the Kennebec River at the Waterville and Sidney boat launches. On June 27, 474,313 shad fry were released in the tailrace of the Burnham Dam on the Sebasticook River. The history of shad fry stocking in the Kennebec and Sebasticook Rivers is represented in Figure 4.

On June 20 and 26, MDMR personnel hauled sixty (roughly 50/50 male:female) prespawner adult shad from Central Maine Power Company's Cataract East Channel Fishway on the Saco River to the Waldoboro Shad Hatchery for experimental tank spawning. Some of these shad were injected with gonadotropin analog to stimulate spawning. Spawning occurred over several weeks from June 21 to August 6, ultimately producing 943,876 fry, 484,635 of which were stocked below Bar Mills on the Saco River. Four stocking trips were made to the Saco to release these shad fry. The remainder were stocked in the main-stem of the Kennebec River at Waterville.

MDMR's decision to stock a portion of the shad fry available in 1997 into the Sebasticook River was based on several factors: MDMR sought to ensure that returning adult shad could be collected and used for the future tank spawning egg take in the shad hatchery. Using shad brood stock collected from the Kennebec is preferred over continuing to collect brood stock from out-of-state. Fry stocked in 1997 would return in 2002 as five-year-old spawners. During this five-year period, the Edwards Dam relicensing is likely to be resolved. If this dam is removed, returning shad would have free access to Waterville. Fry stocked below Lockwood and Fort Halifax Dams would not have the same strong urge to pass back up over these dams as would fry stocked and imprinted with a more upriver stretch above one of these barriers. Trapping shad in a fish passage at one of these dams would be a more effective means of acquiring live, healthy brood stock rather than by gill netting or attempting to trap shad in the open segment of the Kennebec River below Waterville.

MDMR viewed the Sebasticook River as the logical choice to receive some of the shad fry in 1997 rather than the Kennebec above Lockwood Dam for two reasons, both related to fish passage. First, MDMR believes that an upstream fish passage and trapping facility must certainly be built at Fort Halifax to support the burgeoning alewife restoration program on the Sebasticook River. Assuming such passage is present at Fort Halifax, the site becomes a natural place to trap returning brood stock shad imprinted with an upriver segment to fuel the hatchery egg take effort. Second, the lower hydroelectric dams on the Sebasticook River, Benton Falls and Fort Halifax, have

Figure 4.

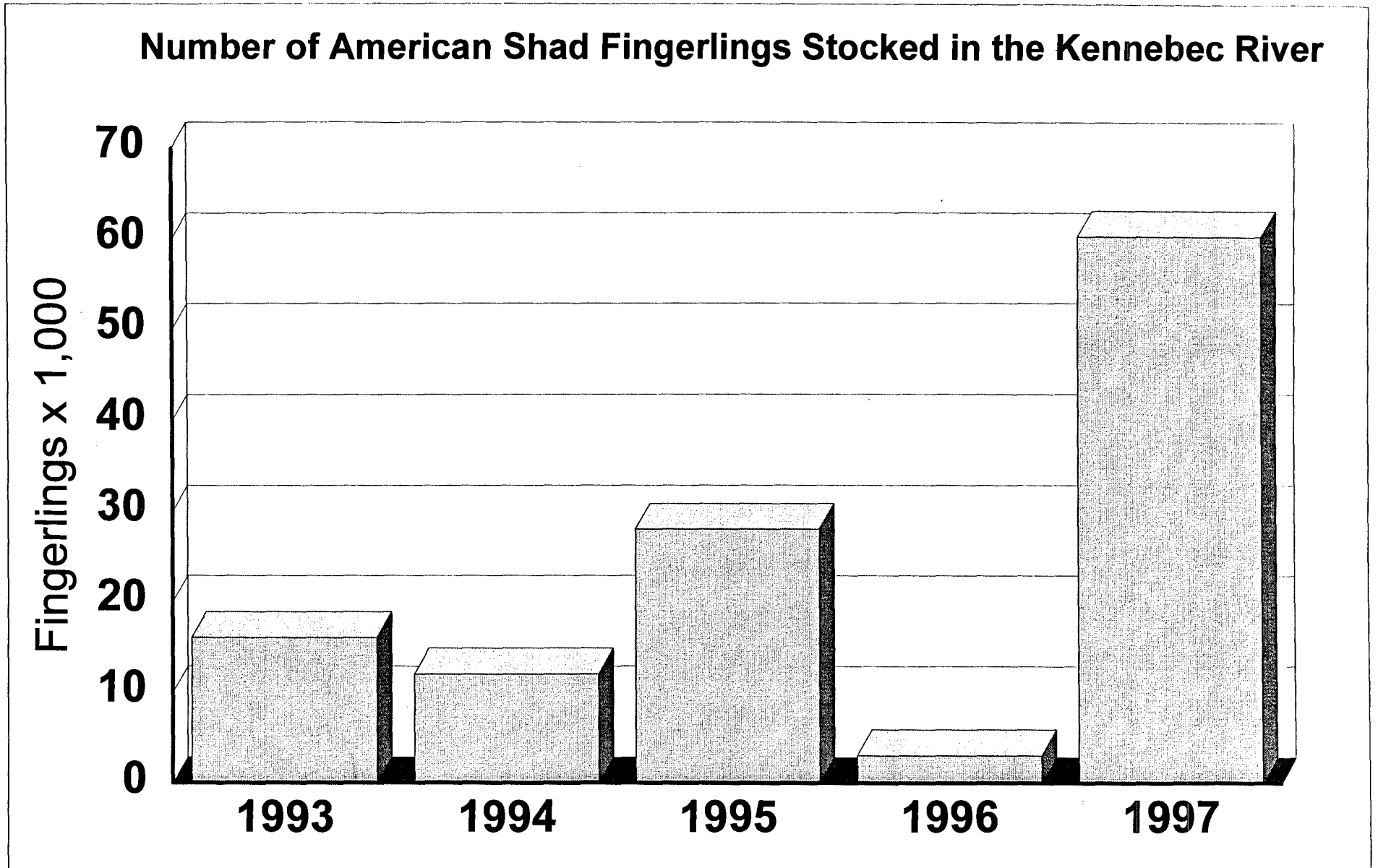


installed permanent downstream passage facilities and have conducted site studies relevant to alewife downstream passage. MDMR believes stocking shad fry on the Sebasticook above these dams is a more reasonable action than stocking fry above the Lockwood or HydroKennebec Dams on the Kennebec River, both of which currently have no downstream passage. Furthermore, MDMR did not want to stock all of the increased number of fry available in 1997 in one river segment. Since the 2,686,139 fry available for release in 1997 was more than twice the number of fry produced in 1996 (the previous record), MDMR sought to distribute them in two river segments so as not to "put all our eggs [fry] in one basket" on the chance of some type of lethal condition occurring in the "one" segment, thus causing the loss of a major portion of the whole year's fry production.

Finally, MDMR chose that section of the Sebasticook below the Burnham Dam and above Benton Falls to receive the shad fry because of the large amount of quality habitat available in this long river segment. MDMR believes this area is highly productive and conducive to good shad growth.

The remaining fry were stocked into the three culture ponds at the hatchery and raised until late fall. On September 24, 26, 29 and October 2, 15, and 22, 60,261 fall fingerlings 2-6" in length were stocked into the Kennebec impoundment at the Waterville boat launch. The history of shad fall fingerling stocking in the Kennebec is represented in Figure 5.

Figure 5.



## **ATLANTIC SALMON**

Atlantic salmon biologists from Maine's ASA [Atlantic Salmon Authority] have recommended against seining and handling salmon, particularly during periods of hot weather. For this reason, MDMR did not make any attempts to seine Atlantic salmon in Bond Brook during the summer of 1997.

The experimental fish pumping system at Edwards Dam failed to entrain any Atlantic salmon during the past season. Throughout the 1997 field season, a few Atlantic salmon were observed in both the upper and lower powerhouse tailraces.

During the 1997 summer, very few Atlantic salmon were seen below the Mt. Vernon Avenue Bridge in downtown Augusta. Bond Brook temperatures average 5-7°C cooler than those of the Kennebec main stem during the height of summer and thus provide much needed refuge from the warm water conditions of the Kennebec. MDMR personnel visited the Mt. Vernon Avenue site regularly during the warm summer months when salmon were in residence to keep track of numbers and discourage opportunistic poaching.

## **INTERIM PROGRESS REPORT ON THE LAKE GEORGE STUDY**

In 1987, MDMR entered into a nine-year cooperative study with MDEP and MIF&W to explore the interactions of anadromous alewives and resident fresh water species. MDMR's role is funded by a portion of the study funds provided by the KHDG Agreement.

All three of the above noted state agencies have an interest in learning more about the relationships between alewives, fresh water fish and the water quality of the lakes. This study was formulated to address some of the unanswered questions about these relationships. Lake George, located in Skowhegan/Canaan Twps., was chosen as the study site because of its manageable size (335 acres), its species composition (rainbow smelt, smallmouth bass, and salmonids, such as brook and brown trout), and its location/accessibility.

The overall study can be outlined in three temporal segments or phases: Phase I was four years in length, beginning in 1987 and ending in 1990. During this phase, baseline background data was collected prior to the introduction of anadromous alewives:

### PHASE I - 4 years

- A. Determine age distribution/growth rates of landlocked smelts annually (MIF&W)
- B. Determine population abundance of landlocked smelt annually (MIF&W)
- C. Determine food habits of landlocked smelt (capture by MIF&W, stomach analyses by MDMR)
  - 1. Sample zooplankton for species composition and densities (MDEP)
- D. Determine population parameters for salmonids
  - 1. Determine population size (MIF&W)
    - a. Since population is maintained through a stocking program, reduce variables as much as possible (number stocked, size at stocking, time of stocking) (MIF&W)
  - 2. Determine age structure and growth rates (MIF&W)
- E. Determine population parameters for other gamefish: smallmouth bass, pickerel, white perch (MIF&W)

### PHASE II - 3 years

- A. Stock adult alewives at six per surface acre of lake habitat annually (MDMR)
- B. Continue steps A-E of Phase I
- C. Determine population parameters for the alewife population
  - 1. Growth rate of juvenile alewives (MDMR)
  - 2. Monitor adult and juvenile emigration from lake (MDMR)
- D. Determine food habits of juvenile alewives; continue for smelt (MDMR)

PHASE III - 2 years (3 years?)

- A. Discontinue alewife stocking
- B. Continue steps A-E of Phase I

CURRENT STATUS:

To date, MDMR has completed analysis of the smelt stomachs collected by MIF&W at Lake George from 1987-1995. In addition, the technician will analyze the stomach contents of adult and juvenile alewives as well as those of smallmouth bass and white perch collected during the 1993 and 1994 field seasons. There are a small number of these samples remaining and they should be completed during the winter of 1997; 1996 smelt stomachs will be analyzed under directive from MIF&W.