Kennebec River Diadromous Fish Restoration

2002 Annual Progress Report

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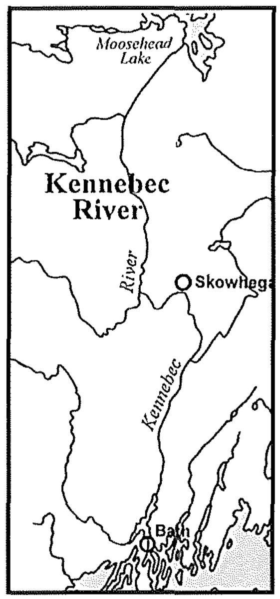
Annual Progress Report - 2002



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EXECUTIVE SUMMARY OF 2002 ACTIVITIES

On May 1, 2002, the temporary fish pump was installed below the Fort Halifax Hydroelectric Project in Winslow, ME. Trapping of alewives began on May 8 and the pump was used almost daily until June 14. In all, a record 153,103 adult alewives were collected with the fish pump; a record 85,626 alewives were released into Phase I habitat; 57,717 were released into 31 other ponds throughout the state; and 12,789 were released directly into the Fort Halifax headpond. The total mortality rate of adult alewives (combined pump and trucking mortality) was only 0.1%, a marked improvement over the 1.6% of 2001. Due to a large number of alewives being attracted to the ledges below Fort Halifax on the south side of the Sebasticook River, dip nets were used to collect and return them to the river below the dam. To prohibit alewives from returning to the ledge area, a series of sandbag and punch plate barriers were constructed along the base of the ledges by FPLE personnel. Overall, the sex ratio of randomly collected samples favored males 1.4:1 and fish length/weight decreased over time. The majority of adult alewives collected were Age IV males (29.7%) and females (23.9%). Permits were issued to 29 commercial fishermen who harvested a reported total of 467,640 adult alewives from below the project site, an increase from the reported 69,000 harvested alewives in 2001.

A total of 688 adult American shad broodstock were transferred to the Waldoboro Hatchery from the Merrimack River, while four adult shad were transferred from the Sebasticook River to the hatchery. Based on knowledge gained in 2001, FPLE employed angling and electrofishing to capture adult shad in 2002. Due to a poor shad run, no broodstock were taken from the Saco River in 2002.

In all, 1.57 million larval shad were released in the Kennebec River above Hydro-Kennebec and 1.03 million larval shad in the Sebasticook River. Additionally, 295,725 larval shad were released into the Androscoggin River. In September, 10,957 shad fingerlings were released into the Medomak River.

In 2002, three fish passage projects were undertaken at non-hydro facilities, two of which were completed. The removal of the Guilford Dam and subsequent riverbed remediation was completed on the East Branch of the Sebasticook River in Newport, while two Alaskan steeppass fishways were installed at the Plymouth Pond Dam in Plymouth. The installation of the pool and chute fishway was begun at the Sebasticook Lake Outlet Dam in Newport and at the time of this printing, is ongoing. In order to obtain the funding necessary to complete these projects, the Maine Department of Marine Resources (DMR) has partnered with the Town of Newport, the US Fish and Wildlife Service, the Natural Resource Conservation Service, the National Marine Fisheries Service, the National Fish and Wildlife Foundation, and the Maine Corporate Wetland Restoration Partnership.

DMR personnel made unscheduled visits to pond outlet dams from July to November. Water levels were similar to those of 2001, and as a result, downstream passage was available during many of the inspections. Known beaver dam problem areas were also visited throughout the season and were partially breached to provide passage; they were typically reconstructed within days of breaching, however.

DMR personnel also made unscheduled visits to hydroelectric dams from July to November. Bypass facilities were operating at all projects during all visits and no facilities experienced entrainment problems in 2002.

DMR personnel conducted biweekly beach seine surveys at nine sites in the Kennebec River between Augusta and Waterville; due to bridge construction activities in August, a new sampling site (Site 8C) was created to replace Site 8A. A total of 6,166 juvenile alewives; 1,975 juvenile American shad; 43 blueback herring, and 665 unidentified alosids were captured throughout the summer.

An upstream American eel passage study was conducted at the Lockwood, Hydro-Kennebec, Shawmut, Weston, Fort Halifax, Benton Falls, and Burnham Projects. The primary objective of the study was to determine where juvenile eels pass, or attempt to pass, at each of these sites. Upstream passages were installed on the south side of Fort Halifax and along the east side of the spillway at Benton Falls. Nighttime observations were conducted at the remaining five KHDG projects.

Downstream eel passage studies were conducted using radio telemetry at the Lockwood Project. The primary objective of this study was to determine the seasonal and diel timing of the downstream migrating adult eels, the behavior of migrating adult eels at hydropower facilities, and the efficiency of various downstream passage measures for adult eels. Five radio-tagged eels were released approximately 0.5 miles above the Lockwood Project. Of these, two passed through turbines, one used the bypass, and two passed by an unknown route (either the bypass or large turbine, judging by signal strength). Eels arrived at Lockwood 6.7 hours to 9.3 days after being released. Once they arrived in the canal below the head works, they passed very quickly (1-21 minutes). Signals from all eels were located downstream of Lockwood on at least one occasion. Attempts to recover one eel that was close to the powerhouse were unsuccessful.

1.0 DIADROMOUS FISH RESTORATION ON THE KENNEBEC RIVER

The information contained in the following sections is intended as an overview of the history of diadromous fish restoration in the Kennebec River watershed.

1.1 History of the Management Plan

As documented in the *State of Maine Statewide River Fisheries Management Plan* (June 1982), the State's goal related to anadromous fish resources is:

> "To restore, maintain, and enhance anadromous fish resources for the benefit of the people of Maine."

With the following objectives:

1. Determine the status of anadromous fish stocks and their potential for expansion;
2. Identify, maintain, and enhance anadromous fish habitat essential to the viability of the resource; and
3. Provide, maintain, and enhance access of anadromous fish to and from suitable spawning areas

With respect to the Kennebec River, the State's goal is to:

> "Restore striped bass, rainbow smelt, Atlantic sturgeon, shortnose sturgeon, American shad and alewives to their historic range in the mainstem of the Kennebec River."

In 1985, the Maine Department of Marine Resources (DMR) developed *"The Strategic Plan for the Restoration of Shad and Alewives to the Kennebec River Above Augusta."* The goal of this plan was:

> "To restore the alewife and shad resources to their historical range in the Kennebec River System."

To meet this goal, the following objectives were developed:

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

Coincidentally with the creation of this plan, the Kennebec Hydro Developers Group (KHDG) was created and a new *"Operational Plan for the Restoration of Shad and Alewives to the Kennebec River"* was implemented in 1986. This plan became the first "Agreement" between the KHDG and DMR. While its goals and objectives were the same as those of 1985, it allowed dam owners upstream of Edwards Dam to delay the installation of fish passage in exchange for funding a trap, truck, and release program to move adult alewives and shad into upstream habitat.

In 1993, the Natural Resources Policy Division of the Maine State Planning Office drafted the *"Kennebec River Resource Management Plan: Balancing Hydropower Generation and Other Uses."* Its goal for anadromous fish restoration in the Kennebec River remained the same as that established in 1982:

> "To restore striped bass, rainbow smelt, Atlantic sturgeon, shortnose sturgeon, American shad, and alewives to their historical range in the mainstem of the Kennebec River."

The objectives for striped bass, rainbow smelt, Atlantic sturgeon, and shortnose sturgeon were to restore or enhance populations in the segment of the Kennebec River from Edwards Dam in Augusta to the Milstar Dam in Waterville. At the time of the 1993 Agreement, there was an ongoing DMR enhancement program for striped bass that consisted of fall fingerling releases. Since mature striped bass, rainbow smelt, and Atlantic and shortnose sturgeon will not utilize fish passage facilities, the strategy for the restoration of these species was to remove the Edwards Dam. Its removal would also enhance the ongoing shad and alewife restoration program by reducing the cumulative impacts of dams on out-migrating juvenile alosids.

With the end of the KHDG Agreement and the removal of the Edwards Dam, a second agreement, '*The Agreement Between Members of the Kennebec Hydro Developers Group (KHDG), The Kennebec Coalition, The National Marine Fisheries Service, The State of Maine, and The US Fish and Wildlife Service,'* was implemented on May 26, 1998. Under this Agreement, the DMR continues to be responsible for implementing a trap, truck, and release program for anadromous alewives and American shad. DMR is also responsible for ensuring that the goals and objectives identified for the Kennebec River in the 1982 plan are met through monitoring and assessment of other anadromous fish species. DMR, the KHDG, and the US Fish and Wildlife Service provide funds for the continued implementation of the state fishery agencies' fishery management plan.

In 1984, the Maine Atlantic Sea-Run Salmon Commission (MASRSC) adopted the *'Management of Atlantic Salmon in the State of Maine: a Strategic Plan'*. In the plan, the MASRSC partitioned existing and historical salmon rivers into four categories (A, B, C, and D). The Kennebec River was one of five historical Atlantic salmon rivers assigned to category "C" primarily because salmon habitat was inaccessible due to impassable dams and lack of resources to initiate restoration.

In 1995, the MASRSC further delineated its proposed activities within the Kennebec River watershed in its *'Maine Atlantic Salmon Restoration and Management Plan, 1995-2000.'* The status of the Kennebec River Atlantic salmon resource was denoted as "unknown," but recognized that it included hatchery and wild origin strays with limited natural production. Restoration was deemed passive, with limited activities as resources allowed. The 1995-2000 goal for the Kennebec was to maintain current numbers of Atlantic salmon and increase those numbers in the future.

In 1997, the Maine Atlantic Salmon Authority (MASA, formerly the MASRSC) adopted the *'Maine Atlantic Salmon Management Plan with Recommendations Pertaining to Staffing and Budget Matters.'* In this document, the MASA identified a ten-year restoration goal to be undertaken in two phases. Under Phase I (1997-2001), the MASA would focus upon improving Atlantic salmon habitat and fish passage in the Kennebec River and tributaries below the Edwards Dam site. The MASA supported ongoing efforts for removal of the Edwards Dam. Phase II (2002–2006) objectives are to focus on developing a multi-agency fisheries management plan for the river above Lockwood, as well as initiate an Atlantic salmon stocking program.

1.2 Implementation of the Management Plan (1986-2001)

The strategy developed to meet the objectives of alosid restoration was planned in two phases. Phase I (January 1, 1986 through December 31, 2001) involved restoration by means of trap and truck of alewives and shad for release into spawning and nursery habitat. Phase II (January 1, 2002 through December 31, 2010), which is currently ongoing, involves providing upstream and downstream fish passage at Phase I release sites, as well as trap and truck operations to Phase II lakes. As originally planned, the Edwards Dam (whose owner chose not to participate in the KHDG/State Agreement) was to be the primary site for capturing returning adults for the restoration program. However, for several reasons, fish for the restoration were not obtained at Edwards until 1993. No capture facilities were available during 1987 and 1988; in 1989, an experimental fish pump was installed by the owner, but proved to be ineffective in capturing sufficient numbers for release in upriver spawning habitat. As a result, from 1987 through 1992, all the alewife broodstock stocked in Phase I lakes (see Table 1 for a list of these lakes) came primarily from the Androscoggin River.

A shift in the source of alewife broodstock occurred in 1993, due to an increased number of returns in the Kennebec below Edwards and the simultaneous decline in the run of the Androscoggin donor stock. In 1993, all adult alewives transferred to upstream habitat were Kennebec River returns and were predominantly trapped by netting. The broodstock source was split between the two rivers in 1994, but the bulk of the fish (93%) were Kennebec River returns, with most collected by the fish pump. Since 1995, DMR has obtained alewife broodstock exclusively from the Kennebec River. Between 1996 and 1999, the majority of alewives transported were collected using the fish pump at the Edwards Dam. In 2000 and 2001, all of the fish transported were again collected with the fish pump; however, following the removal of Edwards Dam, the operation was moved upstream to Fort Halifax in Winslow.

Due to the increased number of adult alewife returns to the Kennebec River since 1994, DMR typically not only meets Phase I stocking goals, but also has additional alewives available for other restoration sites in Maine. In 1998, alewives from the Kennebec were released into four additional ponds within its drainage and 14 ponds in eight other drainages. In 1999, due to a smaller run, this stocking practice was limited to three ponds in the

Androscoggin River. In 2002, a record number of alewives were captured at Fort Halifax and released into 44 ponds throughout Maine (including all Phase I ponds that DMR was permitted and chose to stock).

The Edwards Dam issue was settled in 1998. The State of Maine took possession of the dam on January 1, 1999 as part of an agreement reached with the dam's previous owner, Edwards Manufacturing Company. The relicensing process of Edwards Dam included several landmarks that contributed to the Company's decision to turn the dam over to the state. In the fall of 1997, the Federal Energy Regulatory Commission (FERC) released a basin-wide Environmental Impact Statement, which recommended removal of the Edwards Dam. The FERC voted on this removal recommendation and ordered it in December 1997. In addition, Edwards' power contract with FPL Energy expired December 31, 1998. Rather than participate in a protracted legal battle, Edwards Manufacturing chose to negotiate with and turn the dam over to the State of Maine, allowing its ultimate removal by the state.

Physical removal of the dam began in early June 1999 and was completed by the end of October 1999. The breaching on July 1 and resultant fish passage, coupled with the dewatering of the impoundment previously created by the dam, allows restoration of the Kennebec and Sebasticook Rivers above Augusta. An important component of this restoration is the access to spawning and nursery areas for all anadromous fish species, including striped bass, rainbow smelt, shortnose sturgeon, and Atlantic sturgeon, none of which utilize conventional fish passage facilities. Since dam removal was not completed in time for the 1999 spring spawning runs of alewife and American shad, trap and truck operations continued at Edwards to ensure that those fish trapped below were able to spawn upstream.

On June 25, 1999, DMR, in cooperation with the Maine Department of Inland Fisheries & Wildlife (MDIFW), installed a barrier on Sevenmile Brook to exclude undesirable, non-indigenous species. European carp (previously excluded by the Edwards Dam) have been shown to be detrimental to pond ecosystems. At this time, not enough is known about the potential impacts of this species to risk NOT having a strategic barrier on the Sevenmile drainage. The barrier was installed May 3, 2002 and was checked weekly for cleaning and maintenance until its removal December 14. The barrier will be reinstalled annually until MDIFW installs a permanent barrier, now scheduled for 2003.

Under the Agreement with the Edwards Dam removal, an interim trapping facility was constructed at the Fort Halifax Dam on the Sebasticook River to collect returning adult alewives and American shad in the spring of 2000. This interim facility is slated to be used for the trapping and trucking of adults for release upstream through 2003, after which either a permanent fish lift will be in place at Fort Halifax or the dam will be partially removed.

Under Phase I of the restoration plan, only those lakes approved by MDIFW were to be stocked with six alewives per surface acre. Of the 11 impoundments listed under Phase I, only eight were stocked at the beginning of the program in 1987; Wesserunsett Lake was stocked beginning in 1996. Restoration at the remaining two Phase I impoundments, Threemile Pond and Three-cornered Pond, both in the Sevenmile Brook drainage, was delayed due to their marginal to poor water quality. In 2001, alewives were released into Threemile at a reduced rate of two alewives $acre^{-1}$; however, this was increased in 2002 to six $acre^{-1}$. Restoration at the ten remaining impoundments was contingent upon the outcome of a cooperative research project sponsored by DMR, the Maine Department of Environmental Protection (DEP), and MDIFW to assess the interactions of alewives with resident smelt and salmonids. In June 1997, MDIFW confirmed that the Lake George Study indicated no negative impacts of alewife reintroduction on resident fish populations and outlined a schedule for stocking alewives into Phase II and Phase III habitat.

The initial restoration of alewives to Webber Pond had been postponed for several years to allow DEP time to establish a better long-term water quality database on this pond. In fact, DMR deferred stocking alewives into the whole Sevenmile Brook drainage (Webber, Threemile, and Three-cornered Ponds) for a number of years due to the ongoing work in water quality improvement by DEP, local residents, lake associations, and the China Region Lake Alliance. In early 1995, DMR, DEP, and MDIFW agreed that alewife restoration at six alewives $acre^{-1}$ 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 only Webber Pond initially.

Webber was stocked in 1997 with two alewives per acre, followed by four alewives per acre in 1998, and starting in 1999, six per acre annually. As previously mentioned, DMR implemented a conservative stocking plan at Threemile Pond in 2001 when alewives were released at a density of two alewives $acre^{-1}$.

In 2002, DMR continued to transfer American shad from out-of-basin to the Waldoboro Shad Hatchery for use as captive broodstock in the tank-spawning program. However, beginning in 2001, DMR collected broodstock from the Merrimack River rather than the Connecticut River. Because of the increased run size on the Merrimack over the past few years and the fact that it is much closer to Maine than the Connecticut River, DMR felt it a logical spot to obtain broodstock[1].

In both 2000 and 2001, DMR transferred broodstock from the Kennebec River to the shad hatchery. In 2002, a total of 50 shad were captured near the confluence of the Kennebec and Sebasticook Rivers, although only four females were transported to the hatchery (at the time of the shad capture, the hatchery was already near capacity with shad). Due to poor runs in 2002, no additional broodstock from the Saco River were transferred to the hatchery as in 2001.

American shad fry production increased in 1997 with the Maine Outdoor Heritage and KHDG-funded expansion of the hatchery facility. The 2000 shad culture operational budget was funded by the DMR and Kennebec River Restoration Fund. DMR released more larval shad (2.6 million into the Kennebec watershed) in 2002 than in previous years. All larval shad raised at the hatchery were marked with oxytetracycline prior to release.

[1] Shad restoration efforts in other rivers, such as the Susquehanna, have shown fry releases to be more successful than fingerling or adult releases. Therefore, no broodstock American shad have been transferred from out-of-basin (the Connecticut River was the primary source in past years) directly to the Kennebec River since 1997. Rather, DMR has concentrated on providing broodstock for the hatchery's tank spawning effort.

2.0 ALEWIFE RESTORATION METHODS

2.1 Trap, Transport, and Release

In 2002, DMR continued to utilize only Kennebec River adult alewife returns for release into Phase I restoration lakes. **See Figure 1**. The large number of alewife returns to the Kennebec and Sebasticook Rivers in previous years, coupled with improved capture techniques using the fish pump installed at Fort Halifax, prompted DMR to again trap alewives in the Sebasticook in 2002.

Pump Configuration

As outlined in Exhibit B, Section IV, Part E (1. b.), FPLE, the owners of the Fort Halifax Project were required to:

> "By no later than May 1st of the first migration season following the removal of Edwards Dam, anticipated to be removed in 1999, licensee shall install and have fully operational a temporary fish pump and trap and transport facility..."

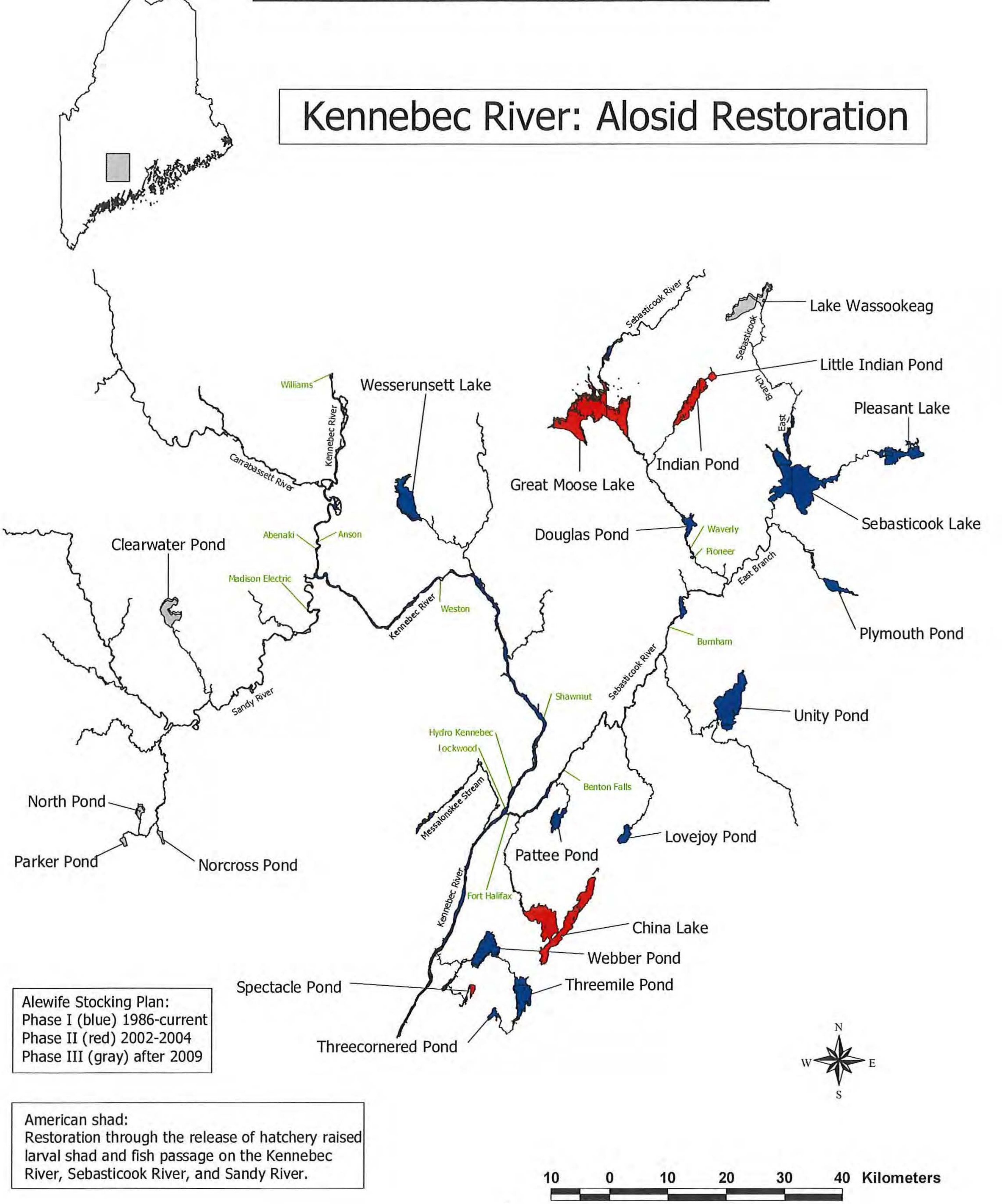
The pump configuration at Fort Halifax was set up in 2002 in a manner similar as in previous years. For a complete description, refer to the *2001 Kennebec River Diadromous Fish Restoration Annual Progress Report.*

Stocking Truck Configuration

A few modifications were made in the configuration of the stocking trucks in 2002 that, while simple, may have contributed to a significant decrease in alewife mortality during the transport stage of the program.

A complete description of the stocking trucks and their configuration, associated equipment, and standard methods of operation are provided in previous annual reports and are available

Figure 1. Kennebec River Restoration Study Area



from DMR upon request. However, some modifications were made in 2002 and are described below:

In 2002, the flexible, porous rubber tubing delivery system first used in 1999 in the C-60 single tanker was installed in the International Harvester (IH) DTA 1900 double tanker. This 3/8" pipe was easy to work with, durable, and inexpensive, and provided a very uniform discharge of very fine oxygen bubbles throughout its length. The hose was routed from the anchor tab on the tank's floor at the perimeter to the offset return water pick-up near the tank's center. This arrangement allowed oxygen to be dispersed throughout the tank more efficiently. Previous installations had the delivery tubes oriented with the tank flow; the tubing is now perpendicular to the tank's flow thus allowing saturation of the entire vertical water column within the tank.

The IH was also fitted with two new Honda WBX type four-stroke water pumps. The original Honda/Stone CP2 water pumps had long since passed their expected service lives and had been rebuilt several times. Problems with the pumps in 2001 prompted their replacement in 2002.

The smallest yet potentially most beneficial change to the stocking trucks was the addition of tank snorkels. Each tank was fitted with a vertical, four-inch schedule 80 PVC snorkel, ten inches high with a 90-degree elbow to the horizontal at the top. The snorkel inlet was oriented to the back of the truck, providing a negative pressure to the tank water surface and removing potentially harmful carbon dioxide build-up. Alewives and shad under stress have been observed to "gulp" air at the water surface. Removing high concentrations of carbon dioxide with a snorkel from the water surface has been shown to improve hauling survival by providing a constant air exchange to the tank water surface.

2.2 Overview

On May 1, 2002, FPLE completed installation of the pump at the Fort Halifax Project. On May 2, DMR received reports that small schools of alewives were observed both at the mouth of the Cobbosseecontee Stream in Gardiner and below Fort Halifax in Winslow. By May 6, a large number of adult alewives had congregated below the dam. On May 8, FPLE and DMR initiated trapping and trucking operations.

Between May 8 and June 14, 2002, a record 153,103 alewives were collected with the fish pump and an additional 50 alewives were collected with dip nets for biosample data. Overall, pump efficiency (fish day^{-1}) at Fort Halifax was similar to historical pump efficiencies. It operated for a total of 17 days and an average 6,597 adult alewives were collected daily. The variation in the number of fish collected is due to a number of factors, including environmental conditions causing variation in fish densities below the dam (e.g., high water and/or depressed water temperatures), truck loading time, and trip length.

The timing of the alewife run was about nine days earlier than average. **See Table 1.** Historically (1994-2002), the mean date by which 50% of alewives have been collected is May 25. In 2002, the 50% date of alewife trapping was May 20 (Day 10 of pump operation). However, the 25% quartile was only one day earlier, while the 75% quartile was the average.

Based on nine years of data (1994-2002), the average peak date of alewife pumping is May 23. **See Table 2.** In 2002, the peak was on May 20 (15,867 alewives collected with the fish pump); however, there were also 15,455 adult alewives collected on May 21. The peak in 2002 was lower than that of 2001 (18,567 adult alewives collected), as well as those of 1996 and 1997. The high numbers of alewives pumped on the peak days in 1996-1997 were due to continuous pump operation to support the short in duration, heavily loaded, truck trips to the Edwards Dam headpond. Similar highs probably could have been attained in other years, including 2002, if the pump had been operated continuously at the peak of the run.

Based on the pump's alewife trapping rate and the time trucks were due back at the site, DMR personnel could perform rough calculations to determine the number of alewives already in the pump tank and the number likely to be pumped prior to a truck's return. If too many alewives were likely to be trapped, an FPLE employee could stop the pump. A maximum of approximately 2,500 alewives could be stockpiled in the pump-receiving tank. A supplemental circulating water supply, added during the 1994 season, allowed fish to be held in the tank when the pump was switched off. If the single tanker was due to return first, a whole load of alewives (1,500 to 1,800) could be stockpiled in the pump tank. If the twin tanker or both trucks were due

Table 1. Summary of Alewife Trapping by Quartile

Year	25%	50%	75%
1994	May 28	June 1	June 2
1995	May 25	May 27	May 30
1996	May 27	June 3	June 4
1997	May 31	June 3	June 4
1998	May 15	May 18	May 20
1999	May 22	May 28	May 31
2000	May 9	May 15	May 19
2001	May 12	May 14	May 16
2002	**May 11**	**May 20**	**May 23**
Mean=	**May 20**	**May 25**	**May 27**

Table 2. Summary of Peak Alewife Trapping

Year	Peak date	Number pumped
2002	**May 20**	**15,867**
2001	May 14	18,896
2000	May 7	13,578
1999	May 23	9,965
1998	May 18	16,311
1997	June 3	21,756
1996	June 4	22,205
1995	May 27	10,634
1994	June 2	13,050
Mean=	**May 23**	**15,799**

to return, the maximum stockpile of alewives (2,500) could be held. Ideally, these fish would be trapped immediately preceding the arrival of a truck so that they were 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. This operational mode allowed loading to be as efficient as possible without sacrificing the quality of the alewives. Because of efficient loading, alewives spent less time in the truck tanks at the loading site, which also helped minimize trucking mortalities.

Loaded trucks were immediately dispatched from Fort Halifax to the stocking sites. The remaining KHDG crewmembers were usually able to complete loading - even the double tanker - with assistance from FPLE personnel. This immediate and staggered departure method allowed tankers to return from the lakes to Winslow 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 Halifax, the waiting crew helped load the first tanker and accelerated its departure.

The number of mortalities due to handling was very low in 2002. In fact, the trucking mortality (mortality=166 fish) rate of 0.11% was one of the lowest ever. The pumping mortality rate of 0.71% was lower than the two previous years (0.84% and 1.12% in 2001 and 2000, respectively). **See Table 3.**

Phase I Habitat

In 2002, 81,067 broodstock alewives were stocked into ten of the 11 upriver Phase I lakes in the Kennebec River watershed. **See Table 4.** In total, 13,400 acres of lake surface area were stocked to a density of approximately six alewives acre^{-1}. Prior to 2001, neither Threemile Pond nor Three-cornered Pond was stocked due to a history of poor water quality. Beginning in 2001, Threemile Pond was stocked with approximately two alewives acre^{-1}; however, in 2002, this was increased to six alewives acre $^{-1}$. Three-cornered Pond was not stocked in 2002.

The 80,067 alewives stocked in the Sebasticook and Kennebec drainage Phase I lakes in 2002 was the highest number ever stocked into these ponds, surpassing the previous record that

Table 3. Alewife Trapping and Distribution from Fort Halifax, Sebasticook River, 2002[1]

Date	Dip Net	Pumped	Pump Mortalities	Biological Sample	Released Above Dam	Number Loaded Into Truck	Truck Mortalities	Released
5/8/02		7,948	76	50		7,872	2	7,870
5/9/02	0	9,463	61			9,402	2	9,400
5/10/02	0	13,916	62			13,854	1	13,853
5/11/02	0	11,024	62	50		10,962	5	10,957
5/13/02	0	13,978	45			13,933	0	13,933
5/14/02	0	2,648	31	50		2,617	1	2,616
5/16/02		45	21		24	0	---	---
5/17/02	0	13,312	53	50		13,259	1	13,258
5/18/02		168	48		120	0	---	---
5/20/02	0	15,867	34	50		15,833	6	15,827
5/21/02	0	15,455	22			15,433	0	15,433
5/22/02	0	8,026	78	50		7,948	0	7,948
5/23/02	0	7,397	57			7,340	83	7,257
5/24/02	0	4,945	33	50		4,912	0	4,912
5/28/02	0	6,012	198	50		5,814	59	5,754
5/29/02	0	3,717	36			3,681	4	3,677
5/30/02	0	2,599	28			2,571	0	2,571
5/31/02	50	0	---	50		0	---	0
6/3/02	0	815	51	50		764	0	764
6/5/02	0	1,405	49	50		1,356	2	1,354
6/7/02	0			50				
6/10/02	0	4,444	49	50		4395	0	4,395
6/13/02	0	4,606	38	50		4,568	0	4,568
6/14/02	0	5,244	18			5,226	0	5,226
Totals:		**153,034**	**1,081**[2]	**550**	**144**	**151,740**	**166**[3]	**151,573**

[1] Includes all alewives released, not just Phase I ponds
[2] - Represents a 0.71% pump mortality
[3] - Represents a 0.11% trucking mortality

Table 4. 2002 Alewife Stocking and Distribution, Phase I and II Lakes[1]

Ponded Area	Location	Surface Acres	River Section	Stocking Goal[1]	Actual Stocked 2002	No. of Trips	% of Target Number Achieved	Alewives per Acre
Douglas Pond	Pittsfield	525	Sebasticook, W. Branch	3,150	3,167	2	101	6.0
Lovejoy Pond	Albion	324	Sebasticook, mainstem	1,944	1,962	2	101	6.1
Pattee Pond	Winslow	712	Sebasticook, mainstem	4,272	4,276	3	101	6.0
Pleasant Pond	Stetson	768	Sebasticook, E. Branch	4,608	4,785	2	104	6.2
Plymouth Pond	Plymouth	480	Sebasticook, E. Branch	2,880	2,975	1	103	6.2
Sebasticook Lake	Newport	4,288	Sebasticook, E. Branch	25,728	26,068	9	101	6.1
Unity Pond	Unity	2,528	Sebasticook, mainstem	15,168	15,204	10	100	6.0
Big Indian Pond[2]	St. Albans	990	Sebasticook, W. Branch	5,940	0	0	0	0
Little Indian Pond[2]	St. Albans	145	Sebasticook, W. Branch	870	0	0	0	0
Great Moose Lake[2]	Hartland	3,584	Sebasticook, W. Branch	21,504	0	0	0	0
Threemile Pond	China	1,077	Kennebec River	6,462	6,237	2	97	5.8
Webber Pond	Vassalboro	1,252	Kennebec River	7,512	7,619	4	101	6.1
Wesserunsett Lake	Madison	1,446	Kennebec River	8,676	8,774	3	101	6.1
Totals:		**18,119**		**108,714**	**81,067**	**38**	**78/101[3]**	**6.1[4]**

[1] Six adult alewives per lake surface acre
[2] Phase II lakes
[3] First number incorporates the three lakes in which DMR was not permitted to stock; the second number excludes them
[4] Does not include the three lakes in which DMR was not permitted to stock

occurred in 2001 (77,168). **See Table 5.** In total, 38 alewife-stocking trips were made to the upriver ponds. All 38 trips originated from Fort Halifax, as the Kennebec River was once again the sole source of alewife broodstock in 2002. The alewife stocking program in the Phase I lakes required nine days to complete between May 8 and May 28, 2002. This is one day more than 2001, but fewer than in 2000 (13 days).

Table 5. Summary of Alewife Releases to Phase I Habitat

Year	Number released	Number of trips	Alewives ($trip^{-1}$)
2002	**81,067**	**38**	**2,133**
2001	77,168	41	1,882
2000	74,775	43	1,739
1999	71,857	36	1,996
1998	73,148	34	2,151
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
Mean=	**63,408**	**37**	**1,708**

The average number of alewives released per trip in 2002 from Fort Halifax (2,133) was higher than the average number of alewives released per trip from the Edwards Dam (1,629) from 1992-1999 and higher than the number released per trip from Fort Halifax in 2000-2001 (1,811). In fact, the average number of fish per trip in 2002 was only second to 1998, when the average was 2,151.

The most stocking trips completed to the Phase I ponds in one day was seven, occurring on May 10. This was one less than 2001, but still the third highest number of trips completed in a single day in the history of the program. The high number of trips day^{-1} in 2002 was due to relatively high pump efficiency, loading efficiency, utilization of the Androscoggin River Project trucks, and the proximity of Fort Halifax to Phase I ponds. **See Table 6.**

2002 marked the fourth year of stocking Webber Pond at six alewives acre^{-1}. Webber was initially stocked in 1997 at a density of two alewives per acre, then at four alewives per acre in 1998, and at six per acre in 1999 and 2000. In 2000, adults were observed in Sevenmile Brook below the outlet dam of Webber Pond. However, it was unclear whether or not these fish were swimming up Sevenmile Brook or dropping out of the pond (the release point is only about 20 meters from the outlet). To help determine the "source" of these adult alewives, on May 30, fish from below the outlet dam were captured with dip nets, fin clipped, and released upstream into Webber Pond. The next day, DMR personnel again collected adult alewives from below the outlet dam with dip nets. No fish captured on May 31 were fin clipped, indicating that the adults below the dam probably swam up Sevenmile Brook from the Kennebec River. In 2001, DMR intended to stock Webber Pond with alewives that returned to the base of the outlet dam. However, by May 11, no adults were observed at the site, so DMR decided to stock Webber with fish from Fort Halifax. DMR later received anecdotal reports that alewives were observed below the outlet dam later in May.

In 2002, DMR again delayed stocking Webber Pond with alewives captured at Fort Halifax until later in the season to try and utilize alewives returning to Sevenmile Brook. However, as was the case in 2001, no adult alewives were observed early in the season, and as a result, Webber Pond was again stocked with alewives captured at Fort Halifax.

Phase II Restoration

The 2002 season was scheduled to be the beginning of the Phase II restoration efforts in the watershed. As such, it was DMR's plan to begin stocking Phase II ponds with alewife broodstock at the rate of six alewives/acre. The 2002 Phase II lakes included Big and Little Indian Ponds in St. Albans and Great Moose Lake in Hartland. In order to inform the local

Table 6. 2002 Alewife Distribution by Trip in Kennebec River Watershed Phase I Lakes

Date	Location	Number Loaded	Number Mortalities	Number Released
5/8/02	Unity Pond	1,484	1	1,483
5/8/02	Sebasticook Lake	3,056	1	3,055
5/8/02	Sebasticook Lake	2,075	0	2,075
5/8/02	Unity Pond	1,257	0	1,257
5/9/02	Unity Pond	1,527	0	1,527
5/9/02	Unity Pond	1,673	0	1,673
5/9/02	Sebasticook Lake	3,102	1	3,101
5/9/02	Sebasticook Lake	3,100	1	3,099
5/10/02	Wesserunsett Lake	3,143	0	3,143
5/10/02	Wesserunsett Lake	2,564	0	2,564
5/10/02	Sebasticook Lake	2,356	0	2,356
5/10/02	Webber Pond	1,505	1	1,504
5/10/02	Unity Pond	1,555	0	1,555
5/10/02	Webber Pond	1,579	0	1,579
5/10/02	Unity Pond	1,152	0	1,152
5/11/02	Wesserunsett Lake	3,067	0	3,067
5/11/02	Unity Pond	1,507	0	1,507
5/11/02	Douglas Pond	1,612	0	1,612
5/11/02	Sebasticook Lake	3,176	0	3,176
5/13/02	Sebasticook Lake	3,107	0	3,107
5/13/02	Sebasticook Lake	3,009	0	3,009
5/13/02	Webber Pond	1,684	0	1,684
5/13/02	Sebasticook Lake	3,090	0	3,090
5/13/02	Unity Pond	1,505	0	1,505
5/13/02	Unity Pond	1,538	0	1,538
5/14/02	Unity Pond	2,007	0	2,007
5/17/02	Threemile Pond	2,971	0	2,971
5/17/02	Threemile Pond	3,266	0	3,266
5/17/02	Stetson Pond	1,608	1	1,607
5/17/02	Douglas Pond	1,555	0	1,555
5/17/02	Webber Pond	2,852	0	2,852
5/17/02	Lovejoy Pond	1,007	0	1,007
5/20/02	Plymouth Pond	2,975	0	2,975
5/20/02	Lovejoy Pond	955	0	955
5/20/02	Stetson Pond	3,178	0	3,178
5/28/02	Pattee Pond	1,501	9	1,492
5/28/02	Pattee Pond	1,286	2	1,284
5/28/02	Pattee Pond	1,503	3	1,500
Total Fish:		**81,087**	**20**	**81,067**
Total Days:	**9**			
Total Trips:	**38**			

residents of the restoration program, DMR held several informational meetings with the Great Moose Lake Association in both 2001 and in the spring of 2002. However, despite the endorsement of the stocking plan by regional fishery biologists, MDIFW decided not to grant DMR permission to stock the Phase II lakes as a result of some concerns from members of the Lake Association. Subsequently, DMR will initiate the stocking of Phase II lakes in 2003.

Non-Phase I Transfers

In 2002, transfers from Fort Halifax to waters other than the Phase I lakes totaled 70,653 alewives loaded, with 146 trucking mortalities, for a total of 70,506 alewives stocked. **See Table 7.** The non-Phase I transfers included ponds within the Kennebec drainage (13), including the Sebasticook system, as well as 24 ponds in 11 other drainages. Non-Phase I transfers began on May 11 to Lower Range Pond in the Androscoggin River watershed and continued until May 24. Alewives transferred to waters other than the Phase I lakes represented 46.1% of the total number trapped at Winslow. In addition, a total of 12,933 adult alewives were released into the Sebasticook River directly above the Fort Halifax Dam.

Table 7. Disposition of Kennebec River Alewives Distributed in Locations Other Than Phase I Lakes – 2002

Drainage	Date	Location		Number Loaded	Number Mortalities	Number Released
Androscoggin	5/11/02	Lower Range Pond		1,600	5	1,595
	5/14/02	Marshall Pond		610	1	609
	5/20/02	Sabattus Pond		1,513	1	1,512
	5/20/02	Sabattus Pond		1,630	0	1,630
	5/21/02	Sabattus Pond		1,535	0	1,535
	5/21/02	Sabattus River Launch		3,075	0	3,075
	5/21/02	Sabattus Pond		1,517	0	1,517
	5/21/02	Sabattus Pond		3,114	0	3,114
	5/22/02	Branch Pond		1,024	0	1,024
	5/22/02	Travel Pond		581	0	581
	5/22/02	Branch Pond		1,023	0	1,023
	5/23/02	Sherman Lake		1,018	0	1,018
			Total:	**18,240**	**7**	**18,233**
Bagaduce	6/3/02	Pierce Pond		764	0	764
			Total:	**764**	**0**	**764**

Table 7 (Cont.)

Eastern	5/30/02	Dresden Bog		1,544	0	1,544
			Total:	**1,544**	**0**	**1,544**
Kennebec	5/20/02	Pleasant Pond (Cobbossee Stream)		3,093	0	3,093
	5/20/02	White's Pond		944	0	944
	5/21/02	Pleasant Pond (Cobbossee Stream)		1,466	0	1,466
	5/23/02	Nehumkeag Pond		1,051	81	970
	5/24/02	Adams Pond		500	0	500
	5/28/02	Whiskeag Creek		403	3	400
	5/24/02	Center Pond		515	0	515
	5/24/02	Sewell Pond		500	0	500
	5/28/02	Cathance, Route 5		499	5	494
			Total:	**8,971**	**89**	**8,882**
Mill Brook (Taunton Bay)	6/5/02	Great Pond		1,356	2	1,354
			Total:	**1,356**	**2**	**1,354**
Pemaquid	5/22/02	Pemaquid River		2,046	0	2,046
	5/23/02	Pemaquid Pond		1,019	1	1,018
	5/30/02	Duckpuddle Pond		1,027	0	1,027
			Total:	**4,092**	**1**	**4,091**
Royal	5/22/02	Elm Street Headpond		3,274	0	3,274
	5/28/02	Runaround Pond		622	37	584
	6/14/02	Royal River		1,400	0	1,400
			Total:	**5,296**	**37**	**5,258**
St. George	5/21/02	Sennebec Lake		3,061	0	3,061
	5/23/02	South Pond		1,002	0	1,002
	5/29/02	Seventree Pond		520	1	519
	5/29/02	Crawford Pond		1,479	1	1,478
			Total:	**6,062**	**2**	**6,060**
Seal Cove, MDI	5/29/02	Seal Cove Pond		1,417	1	1,416
			Total:	**1,417**	**1**	**1,416**
Sebasticook	5/20/02	Martin Stream		1,545	5	1,540
	5/21/02	Corundel Lake		648	0	648
	5/21/02	Corundel Lake		1,017	0	1,017
	6/10/02	Fort Halifax headpond		1,615	0	1,615
	6/10/02	Fort Halifax headpond		1,541	0	1,541
	6/10/02	Fort Halifax headpond		1,239	0	1,239

Table 7 (Cont.)						
	6/13/02	Fort Halifax headpond		2,076	0	2,076
	6/13/02	Fort Halifax headpond		732	0	732
	6/13/02	Fort Halifax headpond		1,760	0	1,760
	6/14/02	Fort Halifax headpond		1,803	0	1,803
	6/14/02	Fort Halifax headpond		2,023	0	2,023
			Total:	**15,999**		**15,994**
Sheepscot	5/29/02	Savade Pond		265	1	264
			Total:	**265**	**6**	**264**
Union						
	5/23/02	Lower Patten Pond		3,250	1	3,249
	5/24/02	Upper Patten Pond		3,397	0	3,397
			Total:	**6,647**	**1**	**6,646**
			Total Fish:	**70,653**	**146**	**70,506**

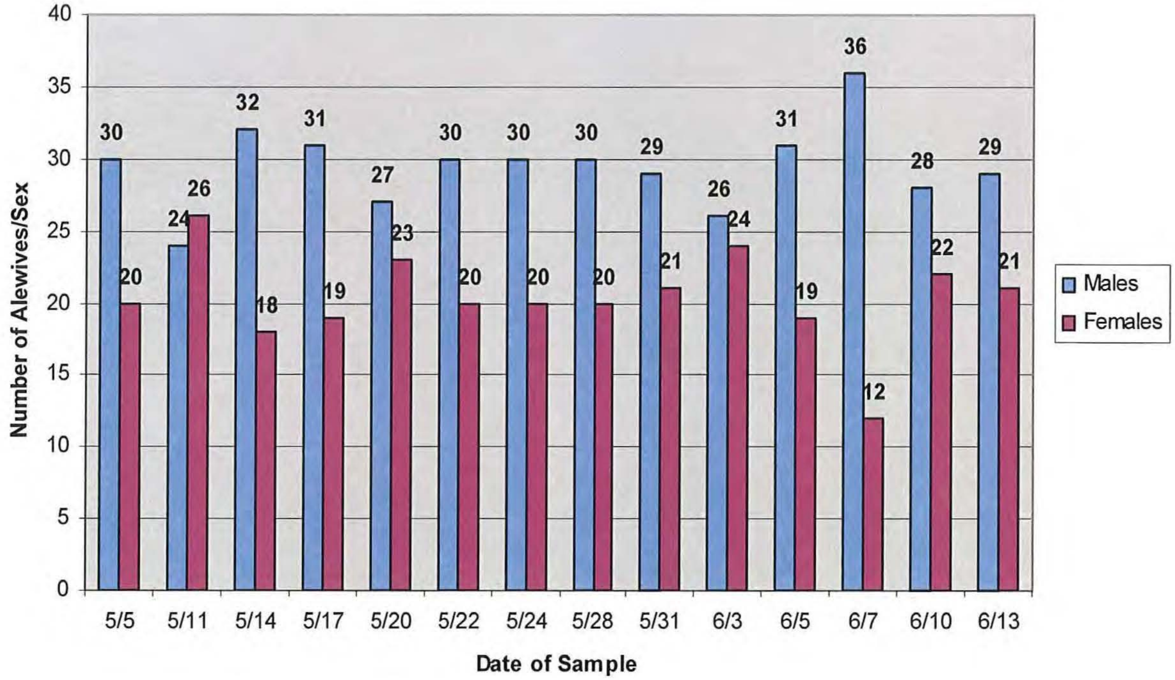
2.3 Adult Alewife Biosamples

On 14 different days between May 8 and June 13, DMR personnel sampled 50 adult alewives collected at Fort Halifax. The samples were collected either using the fish pump (they were dipped out of the pump receiving tank) or by dip net from below the dam next to the pump intake. Due to the presence of blueback herring in the Kennebec River, all samples were identified using the guidelines of Liem[2], which basically relate to body shape, size and position of the eye, and color of the peritoneum (i.e., lining of the gut cavity; alewives are white/silvery and bluebacks are charcoal). Once the fish were identified, they were measured to the nearest millimeter, weighed to the nearest 0.01 grams, sexed, and scale sampled for later age analysis. Water temperature was measured to the nearest degree Celsius at the time the sample was collected.

Of the 700 fish collected, identified, and measured, nine (1.3%) fish were identified as blueback herring, thereby reducing the number of alewives sampled to 691. Of those 691, 41% were females and 59% were males. With the exception of one sample on May 11, males were in greater abundance than females. **See Figure 2.**

[2] Liem, A.H. 1924. The life history of the shad [Alosa sapidissima (Wilson)] with special reference to the factors limiting its abundance. Contrib. Can. Biol. 2:161-284.

Figure 2. Adult Alewife Biosamples, Comparison of Male vs. Female Captured at Fort Halifax, 2002



On average, adult female alewives collected in 2002 were shorter and lighter than those collected in 2001. Adult females collected in 2002 (mean = 282mm) were 4mm longer than in 2001 (mean = 278mm). Additionally, those collected in 2002 (mean = 185.0g) were 7.6g heavier than in 2001 (mean = 177.4g). Adult males collected in 2002 (mean = 272mm) averaged the same length as in 2001, although they averaged 2.7g heavier in 2002 (mean = 164.4g in 2002, 161.7g in 2001).

In 2002, there were significant differences in length and weight, both between sexes and over time. On average, females (282mm) were longer than males (272mm). In addition, females (185.0g) were heavier than males (164.4g). There was a decrease in both length (**Figure 3**) and weight (**Figure 4**) of adult alewife returns to the Sebasticook River over time. Fish collected during the first sample on May 8 (283.02mm and 193.94g) were longer and heavier than fish collected during the last sample on June 13 (263.66mm and 146.5g).

Figure 3. Average Lengths of Adult Alewife Biosamples, 2002

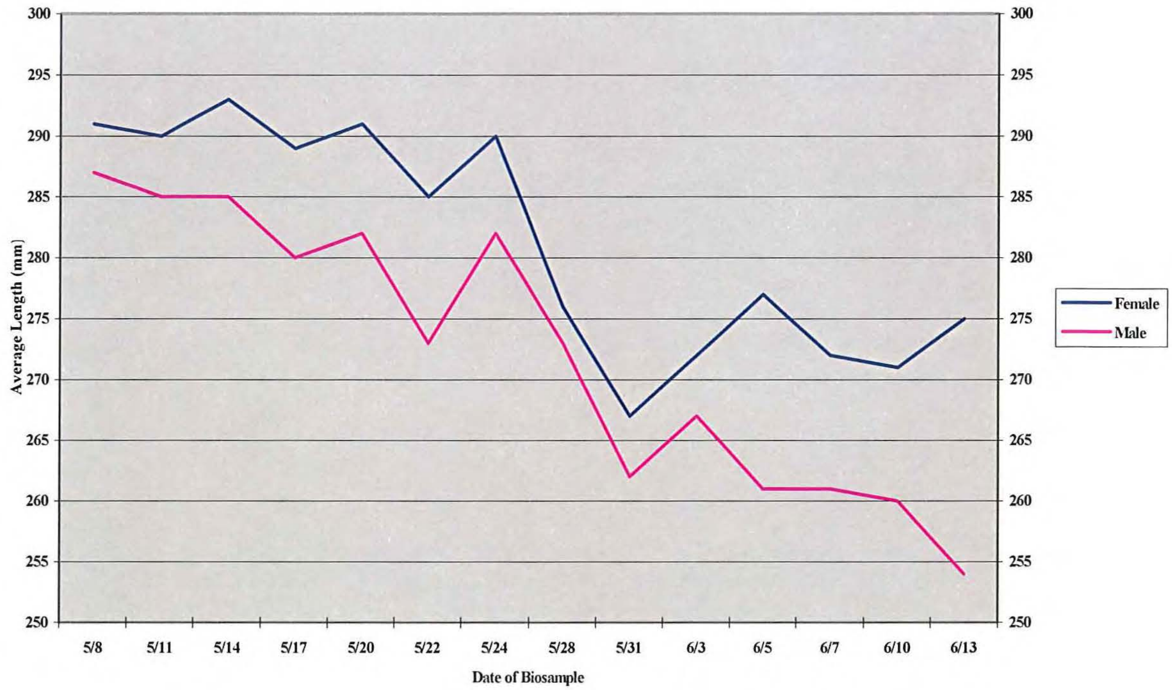
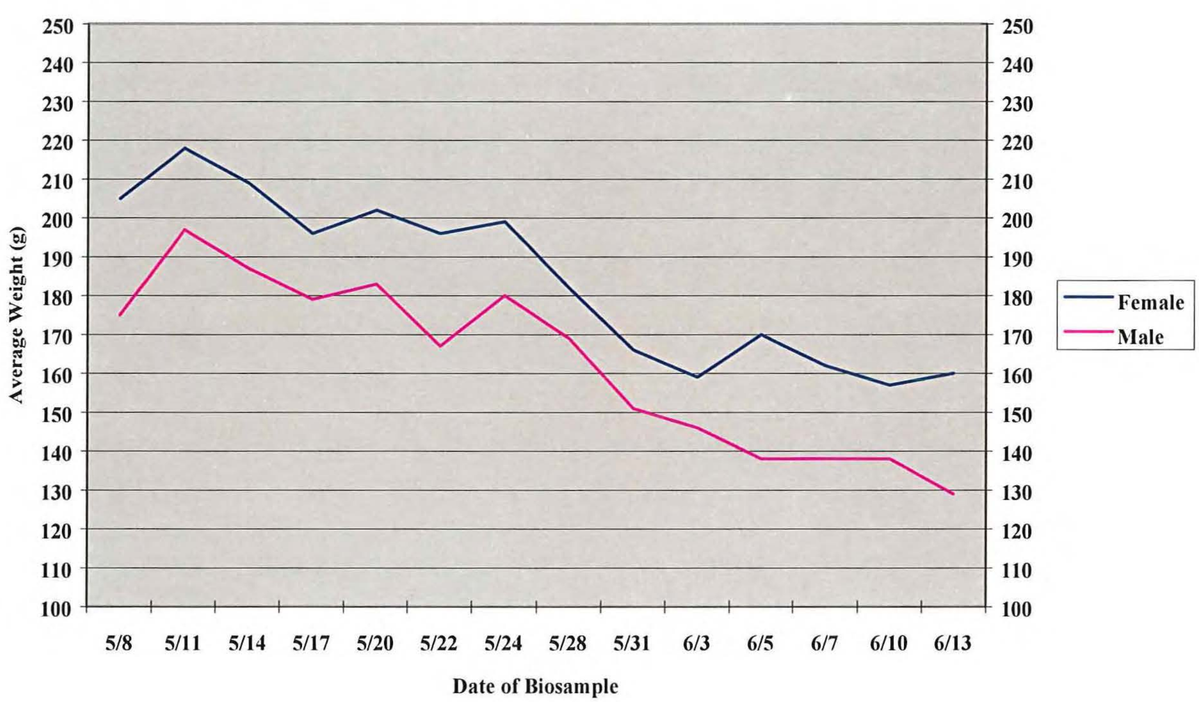


Figure 4. Average Weights of Adult Alewife Biosamples, 2002



Of the 691 alewives sampled, scales were collected from 153 fish. Most of those sampled were Age IV males (29.7%) and Age IV females (23.9%). Age V males (13.1%) and Age V females (12.6%) were the next most abundant age classes. Within each sex, Age IV fish dominated the samples; 54.1% of males sampled and 53.0% of females sampled were four-year-olds. **See Table 8.**

Table 8. Age Distribution of Adult Alewives Collected at Fort Halifax, 2002

Sample Date	Age III		Age IV		Age V		Age VI		Age VII		Mean Age	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
May 8	2	1	4	4	4	1	0	0	0	0	4.2	4.0
May 11	0	0	1	3	4	6	2	0	0	0	5.1	4.7
May 14	1	0	6	2	3	3	1	0	0	0	4.4	4.6
May 17	1	0	4	1	4	2	1	2	0	0	4.5	5.2
May 20	1	0	4	1	4	6	1	1	0	0	4.5	5.0
May 22	0	0	2	4	3	4	0	1	0	0	4.6	4.7
May 24	0	0	5	6	2	3	0	0	0	0	4.3	4.3
May 28	2	2	5	4	2	1	0	0	0	0	4.0	3.9
May 31	3	5	5	3	0	0	0	0	0	0	3.6	3.4
June 3	0	2	6	7	1	0	0	0	0	0	4.1	3.8
June 5	1	0	8	4	1	1	0	0	0	0	4.0	4.2
June 7	3	0	8	4	1	0	0	0	0	0	3.8	4.0
June 10	4	3	4	4	0	0	1	0	0	0	3.8	3.6
June 13	3	2	4	6	0	1	0	0	0	0	3.6	3.9
Σ=	**21**	**15**	**66**	**53**	**29**	**28**	**6**	**4**	**0**	**0**	**4.2**	**4.2**
% By Sex	**17.2**	**15.0**	**54.1**	**53.0**	**23.8**	**28.0**	**4.9**	**4.0**	---	---		
% of Total	**9.6**	**6.8**	**29.7**	**23.9**	**13.1**	**12.6**	**2.7**	**1.8**	---	---		

2.4 Commercial Alewife Harvest

In 2002, the Maine Department of Inland Fisheries and Wildlife issued 29 permits to commercial fishermen for the harvest of alewives below Fort Halifax Dam in Winslow. Conditions of the permit were consistent with DMR alewife harvesting permits in that 1) there is a 72-hour closure in the fishery from 6AM each Thursday until 6AM the following Sunday, and 2) landings must be reported to DMR no later than December 31 of each year. If landings are not reported, the permit may not be reissued the following year. An additional condition specific to Fort Halifax was added that made it unlawful to fish within 150 feet of the fish pump. The latter condition was added to provide DMR/FPLE personnel space to work in the river below the dam if needed. As of February 11, 2003, a reported 467,640 adult alewives were harvested from the Sebasticook River below the Fort Halifax Project in 2002, up from 69,000 in 2001.

In 2001, MDIFW enacted a 72-hour closed period to prevent the harvesting of alewives in the Sebasticook River. This statewide policy was enacted to allow enough alewives to pass in order to spawn, thereby keeping the run healthy. However, in the case of the Sebasticook, this policy was considered a moot point; since the Fort Halifax dam blocks the river immediately upstream, the closure policy was lifted for the 2002 season.

3.0 AMERICAN SHAD RESTORATION METHODS

Per Section IV. E. 1. c. of the Agreement, FPLE is required to "...install, have fully operational and maintain and operate below the Fort Halifax dam all measures except for construction of permanent upstream passage facilities, necessary to capture shad unharmed in sufficient quantities to satisfy the needs of DMR for hatchery spawning of shad at its Waldoboro shad hatchery, so long as populations of shad have been sighted in the waters below the Fort Halifax dam."

3.1 Adult Capture and Transport

In 2002, FPLE utilized angling and electrofishing in attempts to capture adult shad broodstock for the Waldoboro Hatchery. Angling took place mainly in the Sebasticook River at the Fort Halifax Dam downstream to the Kennebec River. An electrofishing boat was used to shock the waters from the Fort Halifax Project downstream to the confluence with the Kennebec. Additionally, FPLE shocked from the tailrace and bypass reach of the Lockwood Project downstream to the Donald Carter Bridge in Waterville. All adult shad captured were immediately placed into either a stocking truck or a circular, seven-foot diameter holding tank at Fort Halifax.

Due to poor shad runs in 2002, DMR did not collect shad broodstock from either the Saco or the Androscoggin Rivers in Maine. In past years, shad broodstock were collected from the Cataract Hydro fish lift (owned and operated by FPLE) on the Saco River, where the fish are trapped in the fishway and held in circular tanks until sufficient numbers are collected for DMR to send a truck down to transport them to the hatchery.

In 2002, the Merrimack River Technical Advisory Committee granted approval for DMR to transport up to 1,660 adult shad (60 for required fish health workup[3] and the remainder for the hatchery and Androscoggin River) from the Lawrence Hydroelectric Project fish lift (operated by CHI Energy, Inc.) on the Merrimack River to the Waldoboro Hatchery.

The stocking trucks used to transport adult shad are the same as those used to transport adult alewives. However, when transporting shad, the amount of oxygen introduced into the transport tanks was increased from the six liters minute^{-1} used for alewives to approximately 12 liters minute^{-1}. When transporting shad, a combination of salts (50 pounds of sodium chloride and five pounds each of calcium chloride, magnesium sulfate, and potassium chloride) was added to the approximately 1,100 gallons of transport water. In addition, one pound of baking soda was added as a buffer. Mixing salt into the transport water has been observed, qualitatively by DMR personnel and quantitatively by others[4], to reduce the mortality associated with handling of American shad. DMR has found the addition of salts particularly useful when shad are transported long distances (e.g., from the Merrimack and Saco Rivers).

Five trips were made to the Merrimack River to obtain broodstock for the hatchery between May 28 and July 1. **See Table 9**. Of the 684 shad loaded at the Essex lift, 607 were released alive in the adult spawning tank, resulting in a hauling mortality of 11.2%, about 4.9% higher than in 2001.

In 2002, a total of 50 adult American shad were captured by electrofishing near the confluence of the Sebasticook and Kennebec Rivers, while an additional five shad were captured by angling in

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[3] A 60-fish sample of adult American shad was collected at the Essex fish lift in Lawrence, MA on May 21, 2002. They were packed in ice and transported to the Inland Fisheries & Wildlife Governor Hill Hatchery facility in Augusta, ME. Kidney, spleen, and gill samples were taken in accordance with the AFS Fish Health Blue Book Procedures. Samples were processed for the detection of bacterial and viral fish pathogens, but found to be free of any pathogens of concern to the State of Maine. These procedures are necessary to comply with state law concerning importation of live fish and eggs into Maine waters.

[4] Meinz, Michael, 1978. Improved method for collecting and transporting young American shad. The progressive Fish-Culturist. 40(4):150-151.

Table 9. Transfers of American Shad Broodstock to Waldoboro Hatchery, 2002

Source	Trapping Site	Date	Number Loaded	Number Mortalities	Number In
Merrimack River	Essex Lift	5/28/02	200	36	164
		5/30/02	159	5	154
		5/31/02	165	32	133
		6/12/02	144	3	141
		7/1/02	16	1	15
		7/10/02	4	0	4
	Total		**688**	**77**	**611**
Sebasticook River	Below Fort Halifax	7/8/02	4	0	4
	Total		**4**	**0**	**4**
	Grand Total		**692**	**77**[1]	**615**

[1] Represents an 11.1% trucking mortality

the Fort Halifax tailrace[5]. Of these, only four females were transported to the hatchery. At the time of the capture, the hatchery was already saturated with shad broodstock from the Merrimack and the addition of all 55 shad would have created an overcrowded situation. Therefore, DMR decided to only transfer four females for broodstock.

The majority of the remaining fish (47) were marked with a Floy tag and a yellow Hallprint tag, and then released back into the river. All shad that were released were also marked with an upper caudal clip[6]. Under the right conditions, shad were observed in large numbers in this area. Smaller schools were occasionally observed in the Fort Halifax tailrace, while others were noted in the Lockwood tailrace (personal communication with Jason Seiders, Normandeau Consultants, Inc., 2003). Of the shad observed near Lockwood, five had been previously tagged; two tagged shad were observed in the Fort Halifax tailrace (Ibid.). They would linger for a brief period of time below the project and then move back downstream out of the tailrace. It is unknown how many entered the Sebasticook River or what percentage were repeat sightings of the same school. No American shad were captured with the fish pump in 2002.

[5] FPL Energy Maine Hydro LLC, and Normandeau Associates, Inc. 2003. FPL Energy Maine Hydro LLC Diadromous Fish Passage Efforts in the Lower Kennebec River Watershed During the 2002 Migration Season.

[6] Ibid.

3.2 Larval Culture and Transport

The shad culture program initiated in 1991 was continued in 2002. The Kennebec River Shad Restoration Program is a cooperative effort between DMR, the KHDG, the Town of Waldoboro, and the Time & Tide Mid-Coast Fisheries Development Project, the latter of which was created and administered by the local Time & Tide Resource Conservation and Development Organization. The hatchery is located in the Town of Waldoboro and consists mainly of two 15-foot diameter adult spawning tanks, one 12-foot diameter adult spawning tank, and seven six-foot diameter larval rearing tanks. There are also three outdoor settling ponds formerly used for the production of shad fingerlings.

All adult shad transported to the hatchery were placed immediately into either one of two 15-foot diameter spawning tanks (Saco, Androscoggin, and Merrimack fish) or into the 12-foot diameter spawning tank (Kennebec fish). Shad were allowed to spawn "naturally," the eggs collected daily and placed into upwelling incubator jars, and reared to approximately 14-21 days old before being released. While in the hatchery, all larvae are marked with oxytetracycline ("OTC," an antibiotic that leaves a mark on the otolith, or inner ear bone, when viewed under a microscope equipped with fluorescent light), so that DMR can later distinguish adult returns as either hatchery or wild in origin. Prior to releasing larval shad from the hatchery, otoliths from a 20-fish sample from each batch of fish were examined for OTC mark retention. For complete details regarding hatchery operations, please refer to Appendix A, the *Waldoboro Shad Hatchery 2002 Annual Report.*

After OTC mark retention is verified, larval shad are loaded into a stocking tank and released directly into the target river. At the hatchery, larval shad are drained from their rearing tank directly into a four-foot diameter hauling tank that is affixed to the bed of a ¾-ton pickup truck. Approximately 12 liters $minute^{-1}$ of oxygen is released into the approximately 150 gallons of hauling water via an air stone. Upon arrival at the stocking site, temperatures of the hauling water and river are assessed. If needed, river water is bucketed into the hauling water to gradually equilibrate the temperatures. Larval shad are then released into the river by draining the hauling tank through a hose attached to the bottom drain of the tank. Several five-gallon buckets of river water are poured through the tank to rinse any remaining larvae into the river. In

2002, no larval shad were intentionally released into the outdoor hatchery ponds for the production of fingerlings.

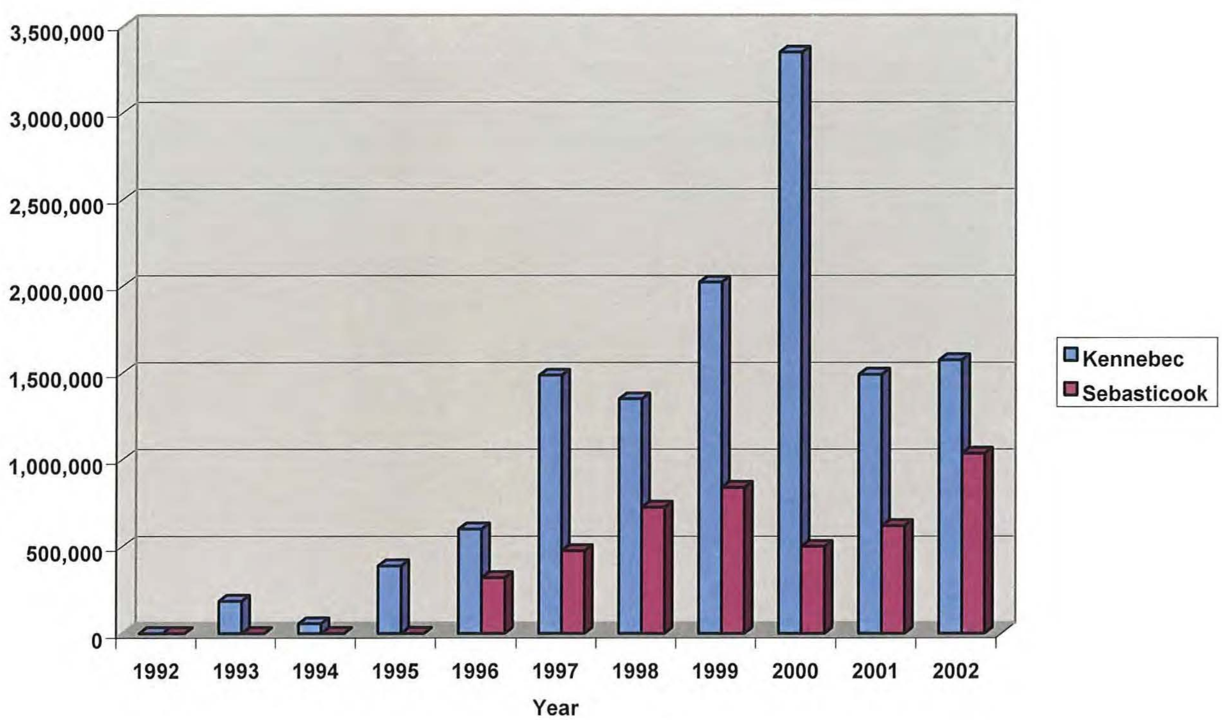
Between May 28 and July 10, DMR successfully transferred 615 adult American shad broodstock from the Kennebec/Sebasticook and Merrimack Rivers to the Waldoboro Hatchery for tank spawning. **Refer to Table 9 above.** These shad were placed in a spawning tank and allowed to spawn over the next several weeks. The fertilized eggs were collected, disinfected, and placed in upwelling incubators. After hatching, the larvae were raised in 575-gallon circular fiberglass tanks and fed brine shrimp. On August 7, the surviving adult shad broodstock (186 fish) were released into the Medomak River. For a complete description of 2002 shad hatchery operations, refer to Appendix A, *Waldoboro Shad Hatchery 2002 Annual Report.*

Between June 21 and August 21, an estimated 2,606,063 shad larvae ranging from 14-23 days old were released at three sites in the Kennebec and Sebasticook Rivers. **See Table 10.** An estimated 1,571,856 shad fry were released just below the Shawmut Project on the Kennebec River; an additional 505,902 larval shad were released into the Sebasticook River in the tailrace of the Burnham Project; and 528,305 larval shad were released downstream of Fort Halifax. The 2002 total of 2,606,063 larvae released into the Kennebec drainage is the third largest amount released to date, behind 2000 and 1999 (3,846,731 and 2,859,906 respectively). **See Figure 5**. The number of larval shad released in 2002 is primarily due to the poor egg production of the Merrimack River adults transported to the Waldoboro Shad Hatchery (See *Waldoboro Shad Hatchery 2002 Annual Report*, Appendix A).

Table 10. Larval American Shad Releases, 2002

River	Date	Release Site	Number Released
Kennebec	7/2/02	Downstream of Shawmut Dam	420,379
	7/3/02	Downstream of Shawmut Dam	540,787
	7/11/02	Downstream of Shawmut Dam	470,440
	8/7/02	Downstream of Shawmut Dam	140,250
	Total		**1,571,856**
Sebasticook	6/21/02	Burnham Project tailrace	505,902
	7/23/02	Downstream of Fort Halifax	354,585
	7/29/02	Downstream of Fort Halifax	111,183
	8/12/02	Downstream of Fort Halifax	62,537
	Total		**1,034,207**
	Grand Total		**2,606,063**

Figure 5. Number of American Shad Larvae Released in the Kennebec Drainage, 1992-2002



DMR continued to view the Sebasticook River as the logical choice to receive some of the shad larvae in 2002 for several reasons. First, DMR sought to ensure that returning adult shad could be collected and used for future tank-spawning egg take at the hatchery. Using broodstock collected from the Kennebec and Sebasticook Rivers is preferred over continuing to collect broodstock from out-of-state.

Second, both Benton Falls and Fort Halifax have installed permanent downstream passage facilities that would allow passage of the out-migrating shad stocked below Burnham. Finally, DMR chose that section of the Sebasticook below Burnham and above Benton Falls to receive the shad larvae due to the large amount of quality habitat available in this long river segment. DMR believes this area is highly productive and conducive to good shad growth.

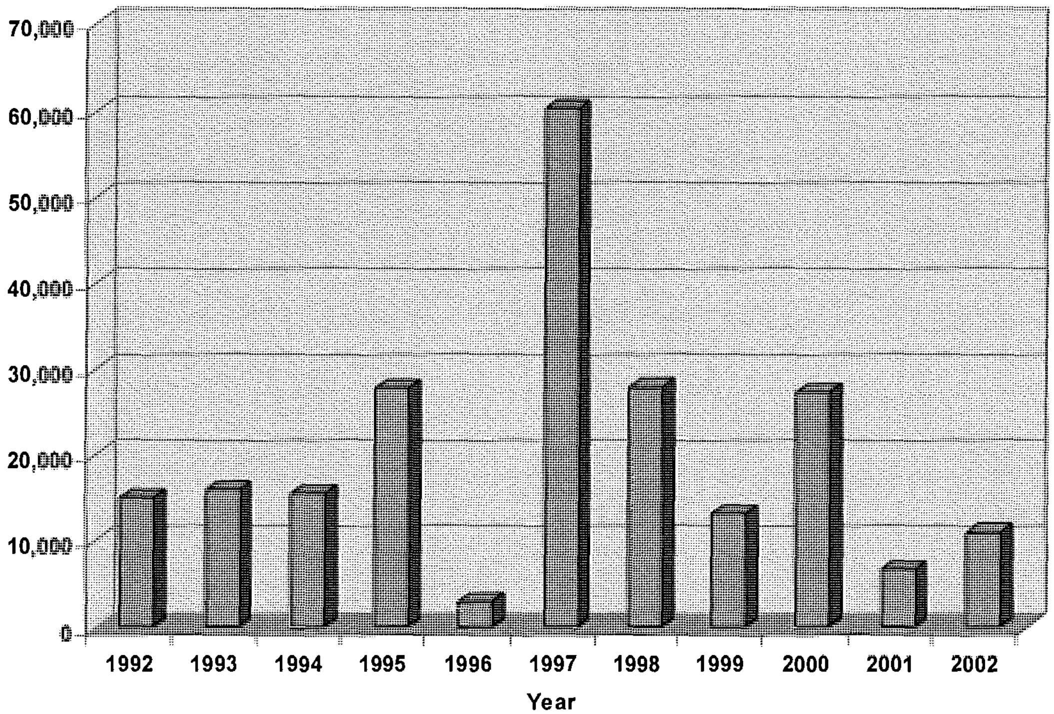
No shad larvae were intentionally stocked into the three culture ponds at the hatchery in 2002. However, the runoff from the upwelling incubators drains into these ponds and typically some eggs/larvae are drawn out by the action of the incubators into the ponds. Since the number of larvae escaping to the ponds is unknown, the ponds are monitored and the larvae/juveniles fed accordingly.

On August 7, the first two ponds were beach seined and 10,980 fall fingerlings were loaded into the stocking truck. Of these, 10,957 (less 23 mortalities) were released into the Medomak River with a hauling mortality rate of 0.21%. The number of fingerlings released in 2002 was lower than average, indicating either poor survival of young-of-year in the ponds or fewer egg/larval escapees. **See Figure 6.**

3.3 Hatchery Evaluation

Since all young-of-year shad released from the hatchery are marked with OTC, DMR is able to assess the relative contribution of hatchery-reared shad to the Kennebec River shad population. Starting in 2000, adult and young-of-year shad collected in the Kennebec were kept for OTC mark analysis. No adult shad were intentionally killed for this study; rather, mortalities from the hatchery were kept and analyzed. Young-of-year shad were collected during biweekly beach

Figure 6. Number of American Shad Fingerlings Released into the Kennebec and Medomak Rivers[1]



[1]Fall fingerlings released into Medomak River in both 1992 and 2002

seine surveys (see *Community Assessment Methods* in this report for complete details on capture sites and techniques). Otoliths were removed, cleaned in distilled water, and mounted in a thermoplastic resin. Lapping film (9, 3, and 1 micron grit) was used to grind each otolith to mid-saggital plane on one side; otoliths were then flipped over and ground to mid-saggital plane on the opposite side. A drop of Type FF (low fluorescing) immersion oil was place on each ground otolith and then covered with a glass cover slip. Otoliths were then viewed under a compound microscope equipped with fluorescent light and a FITC filter set. With this microscope configuration, any fish marked with OTC would exhibit a glowing ring for the day that fish was marked.

Since 1979, DMR has conducted beach seine surveys in the Kennebec River from Augusta south to Bath. The information gathered in these surveys was used to calculate a Juvenile Abundance Index (JAI) for young-of-year shad, alewives, blueback herring, and striped bass. Starting in 2000, DMR began conducting similar beach seine surveys in the Kennebec River north of

Augusta, upstream to Waterville/Winslow. Based on the information gathered during these surveys, DMR has begun to calculate a second JAI for young-of-year shad for this newly reopened stretch of river.

During the 2002 beach seine effort, 1,933 juvenile shad were captured at seven different sites in 2002, with the highest number captured at the newly created Site 8C. This site, located approximately 500 yards downstream of Site 8A, was added on August 28 after Site 8A was compromised due to bridge construction. Of the examined samples of field caught larval shad (about 90% of the samples have been evaluated), less than 10% are of hatchery origin. Results of the adult shad otolith analyses are pending.

A Juvenile Abundance Index was calculated for juvenile shad captured in 2002. **See Table 11.** Due to the loss of Site 8A and resulting creation of Site 8C during the mid-sampling season, two separate JAI's were created for comparison purposes. The index for all sites prior to the loss of Site 8A/creation of Site 8C was 0.32 shad seine^{-1}; however, after the creation of Site 8C, the resulting JAI for all sampling sites increased to 40.17 shad seine^{-1}. Of all the sites sampled in 2002, Site 8C had the highest comparative JAI of 318.83, which is also the highest JAI for an individual site in the three years of sampling. Depending on river flows, there is slack water or an eddy at Site 8C. Habitat suitability models indicate that larval shad prefer large eddies[7], which may explain why younger shad are found there. The models also suggest that juvenile shad may use slow, warmer areas of rivers for feeding since there may be a higher abundance of plankton in these areas.

DMR also sampled the various locations in the Sebasticook and Kennebec Rivers with D-nets to assess the presence of juvenile shad and shad eggs, respectively. While no young-of-year shad were captured in the nets, a total of 2,055 shad eggs were collected between June 20 and July 11, the majority of which were collected from the Sebasticook River (**see Section 5.0**).

[7] Ross, R. M., T. W. H. Backman, and R. M. Bennett. 1993. Evaluation of habitat suitability index models for riverine life stages of American shad, with proposed models for premigratory juveniles. U.S Fish and Wildlife Service Biological Report 14. 26pp.

Table 11. Juvenile Abundance Index (JAI) for American Shad in the Kennebec River Above Augusta[1]

Site[2]	2000	2001	2002
1	0.12	0.00	0.88
2	0.00	0.00	0.63
3	0.67	0.30	0.50
4	0.00	0.00	0.00
5	2.00	56.20	0.25
7	29.43	87.75	0.13
8A	0.11	18.67	0.00[3]
8B	0.13	0	0.13
8C	---	---	318.83
Total	4.06	19.15	0.32/40.17[5]

[1] Except where noted, JAI was calculated on eight trips, with one haul/trip
[2] See Figure 9 for site locations
[3] Due to bridge construction, Site 8A was abandoned in August 2002. JAI based on three trips
[4] Site 8C was created as a result of Site 8A being abandoned. JAI based on six trips.
[5] For comparative purposes, the first JAI includes Site 8A; the second JAI includes Site 8C

4.0 FISH PASSAGE METHODS

As part of the KHDG Agreement, the State agreed to take the lead in seeking fish passage at four non-hydro dams on the Sebasticook River, which included the outlet dams on Pleasant Lake in Stetson, Plymouth Pond in Plymouth, Sebasticook Lake in Newport, and the Guilford of Maine Dam, also in Newport. In the 1999 Annual Report, DMR proposed that passage be provided at these dams in 2001. The United States Fish and Wildlife Service (USFWS) prepared conceptual designs and cost estimates for these sites; total estimated cost for passage at all four dams was $510,000 (1997 dollars).

4.1 Fish Passage at Lake Outlets

Pleasant Pond Dam, Stetson

In 1999, the Town of Stetson decided to rebuild the spillway of the Pleasant Lake Outlet Dam, which drains into Stetson Stream. DMR and the Town agreed it would be to everyone's benefit if a fishway were installed during spillway reconstruction, and as a result an Alaskan steeppass fishway was installed for a cost of $57,370. In addition, the old Archer Sawmill Dam downstream was removed, which was completely funded by NCRCS and the USFWS.

Plymouth Pond Dam, Plymouth

In the summer of 2002, two Alaskan steeppass fishways were installed at the Plymouth Pond site. **See Figure 7**. The outlet, which is located on Martin Stream, a tributary to the East Branch of the Sebasticook River, is divided into two distinct channels by a ledge projecting from the middle portion of the dam in a westerly direction. As a result, a passage was cut into this ledge to allow fish in the south channel to pass to the north channel and access the fishways. This project was completed for a total cost of $122,275.

Figure 7. Alaskan Steeppass Fishways at Plymouth Pond Outlet Dam, October 2002

Guilford Industries Dam, Newport

Throughout the summer and fall of 2002, the removal of the 80-year-old Guilford Dam and subsequent river channel restoration were undertaken. The structure, which was owned by the Town of Newport, was in poor shape and viewed as a liability. In 2001, DMR worked with

Newport and Guilford of Maine Industries (to which the dam provided fire water protection) to provide an alternative supply of water for fire control.

In May 2001, the Guilford Dam headpond was drawn down to facilitate surveys of the Rt. 2 bridge structure and the substrate beneath the bridge piers. At that time, DMR and Newport decided it was best to leave the gates at the dam open and the headpond drawn down, which allowed the dewatered headpond to revegetate over the course of the summer and thereby help stabilize the newly exposed soil. Stabilizing the riverbanks by natural means during the summer was desirable over artificial means at the time of dam removal, which was initially proposed for the fall of 2001.

The physical removal of the Guilford Dam began in July and was initially completed in August 2002. However, higher than expected water velocities from the Sebasticook Lake seasonal drawdown resulted in the formation of a head cut being created at the Rt. 2 bridge abutments. The cut worked its way upstream approximately 40-50 feet, threatening the town's subchannel waterline and ultimately creating an impassable barrier to alewives and other species. As a result of this unexpected issue, the river channel was reworked and additional larger boulders were inserted into the streambed, ultimately reducing future higher velocities, protecting the waterline, and maintaining fish passage in the channel. The final restoration was completed in December 2002. The total cost of the restoration project, including the rebuild of the channel, was $237,429. **See Figure 8.**

Sebasticook Lake Dam, Newport

As of late March 2003, construction of the fishway at the Sebasticook Lake Outlet Dam is ongoing. **See Figure 9.** Harsh winter conditions have contributed to the delay of construction operations; however, with the onset of warmer weather, the project is slated for completion in May 2003. The Town of Newport owns the dam, which was rebuilt in the 1980s to maintain lake levels throughout the year. Upstream passage at this site will take the form of a pool and chute fishway on the dam's eastern side, next to the town park so that the public will be

Figure 8. Site of the Former Guilford Dam
August 2002

Figure 9. Construction of the Sebasticook Lake Outlet Fishway
March 2003

able to view migrating species. The pool and chute design will also minimize the amount of water needed for effective upstream and downstream passage.

Several lake outlet streams were surveyed during the 2002 field season. Due to constraints, only those streams known to be problems in the past were surveyed after the alewife and shad stocking seasons ended. Generally, lake outlets were checked on the same schedule as hydropower facilities. Whenever possible, areas known to be past problems for out-migrant alosids were inspected and debris/blockages removed. While drought conditions were not as severe as the previous year, the lack of water was again the most notable hindrance to downstream passage in 2002. Starting in July, DMR personnel surveyed eight lake outlets regularly through the first of November: Sebasticook Lake in Newport, Pleasant Pond in Stetson, Plymouth Pond in Plymouth, Wesserunsett Lake in Skowhegan, Unity Pond in Unity, Webber Pond in Vassalboro, Pattee Pond in Winslow, and Threemile Pond in China. The results are summarized in **Table 12** and are briefly described below.

While Table 13 states that the **Sebasticook Lake** outlet was checked on ten days (to ensure minimum flow requirements were being met), in actuality it was checked almost on a daily basis from July through October while the removal of the Guilford Dam and construction of the fishway at the outlet were underway. Aside from August 19, when juvenile alewives were observed above the outlet, downstream passage was not available until the lake was drawn down after Labor Day because of construction activities..

Pleasant Pond in Stetson was visited nine times from July 10 through November 1. Of those nine visits, downstream passage was available six times. DMR personnel observed juvenile alewives either above or below the dam on July 22, September 17, and September 30.

Plymouth Pond was checked on ten days from July 19 through November 1. As with the Sebasticook Lake Outlet Dam, water was held at Plymouth Pond while the installation of the steeppass fishways was underway. As a result, downstream passage was not available for much of August through October. During this time, thousands of juvenile alewives were observed

Table 12. Downstream Passage Observations at Lake Outlets, 2002

Date	Sebasticook Lake	Plymouth[1] Pond	Unity Pond	Pleasant Pond	Pattee Pond	Webber Pond	Threemile Pond	Wesserunsett Lake
7/8/02					X	O^{B}		
7/10/02	X	O	O	O		O		
7/22/02	X			O^{AB}				O
7/23/02						X		
7/24/02		O^{A}						
7/25/02					X		X	
7/26/02	X					O^{B}		
8/5/02			O		X	O	X	
8/6/02	X	O^{A}		O				O^{B}
8/19/02	O^{A}	X	O	X				X^{B}
8/20/02						O	X	
8/21/02					O^{B}			
9/3/02	X	X^{A}	O	X				X
9/5/02						O	X	
9/16/02						O	X	
9/17/02	O	X^{A}		X^{B}				X
9/19/02		X^{A}			X[2]			
9/30/02	O	X^{A}		O^{A}				X^{A}
10/1/02			O			X	X	
10/15/02	O							X
10/17/02		X^{A}	O	O			X	
10/18/02					O	O		
10/28/02						O		
10/29/02			O				O	
11/1/02	O	O		O			O	O
Total Visits	**10**	**10**	**7**	**9**	**6**	**11**	**9**	**8**

[1] The installation of fishways at the Plymouth Pond Dam delayed out-migration in 2002

[2] Beaver dam partially breached to allow alewife passage

O = Downstream passage available at time of survey
X = Downstream passage not available at time of survey
= Not surveyed on this day
^{U} = Juvenile alosids using downstream passage facilities
^{A} = Juvenile alosids above outlet
^{B} = Live alosids present below outlet
^{D} = Dead alosids present below outlet

regularly as they swam along the upstream face of the spillway and gates in search of downstream passage.

Wesserunsett Lake in Skowhegan was surveyed eight times from July 22 through November 1. Passage was available during two site visits, with juvenile alewives observed below the outlet during one visit (August 6). Juvenile alewives were also observed below the outlet on August 19 and above the outlet on September 30.

Unity Pond has no outlet dam and has excellent downstream passage into the Twentyfive Mile Stream on all but the driest of years. Unity Pond outlet was checked seven times from July 10 through November 1 and passage was available during all visits.

Webber Pond, like Sebasticook Lake, also uses a fall drawdown for water quality improvement purposes and usually has sufficient water to allow passage over the spillway throughout the season. During 11 visits to Webber Pond, passage was available nine times. Juvenile alewives were observed below the outlet during both the July 8 and July 26 visits.

Pattee Pond has no outlet dam and in the past has demonstrated fair to excellent out-migration of alewives. However, low water levels combined with beaver dams during the summer and early fall of 2001 made passage out of Pattee Pond difficult, if not impossible. While 2002 was not as dry as the previous year, the combination of low water and obstructions like beaver dams still made downstream passage difficult or impossible for most of the season. However, during the fall rains in late October and November, downstream passage became readily available.

The **Threemile Pond** outlet was visited seven times between July 25 and October 17. Similar to Pattee Pond, Threemile Pond does not have an outlet dam and the combination of low water conditions and beaver dams appeared to create a barrier to out-migrating juvenile alewives throughout August and September. However, during the fall rains in late October and November, downstream passage became readily available.

4.2 Fish Passage at Hydropower Projects

Per section III (F) of the Agreement, hydroelectric dam owners are required to conduct passage effectiveness studies. Specifically, the Agreement states:

> "KHDG dam owners will conduct effectiveness studies of all newly constructed interim and permanent upstream and downstream fish passage facilities at project sites. Study plans for these effectiveness studies will be filed with FERC and Maine DEP no later than the date on which passage at a particular project becomes operational, and will be subject to a consultation process with, and written approval from the resource agencies."

DMR has been working with the hydro project owners/operators to develop and evaluate quantitative and qualitative effectiveness studies. As new passage becomes available, DMR will continue to work with hydro project staff to ensure passage effectiveness.

To date, downstream passage effectiveness studies have been conducted at Benton Falls (1995) and Fort Halifax (1997). In addition, qualitative assessments are being recorded at the interim downstream passage facilities at Lockwood and Shawmut. At Hydro-Kennebec, qualitative observations are being conducted by plant personnel to assess whether or not passing out-migrant alosids through the turbines has an impact on their survival. If the owners of Hydro-Kennebec desire to utilize turbine passage once adult shad or salmon begin to inhabit the impoundment, they will be required to conduct site specific quantitative studies, but not before 2006. At the Burnham Project, permanent downstream passage was installed ahead of schedule. However, since CHI is choosing to pass less than the anticipated minimum bypass flow, the downstream bypass is considered an interim facility. As such, CHI is conducting qualitative studies in accordance with the Agreement.

Downstream Passage Monitoring

Downstream passage at hydropower facilities located on the Sebasticook and Kennebec Rivers were monitored through the summer and fall of 2002. Facilities were visited routinely to assess any problems that downstream migrating juveniles might encounter. The condition and operation of downstream bypass facilities, magnitude and location of spilled water, number of turbines in operation, and presence or absence of juvenile alewives were noted at each site. The dams and their locations are presented in **Table 13;** locations were illustrated earlier in **Figure 1**.

The **Fort Halifax Project** in Winslow is operated by FPL Energy and is the lowermost dam on the Sebasticook River. FPL Energy installed permanent downstream bypass facilities during the summer and fall of 1993; it 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. A 12-foot deep metal punch plate trash rack overlay was installed to aid in excluding alewives from the turbine forebays. This configuration and operational regime was approved by the FERC Order issued on September 30, 1996 and was utilized again during the 2002 season.

DMR made 11 visits to the Fort Halifax Dam in 2002. All visits found the downstream bypass open and functioning. During the August 20 site visit, juvenile alewives were observed in the headpond. Observations of the downstream bypass operation were made from the south shore when access to the powerhouse was not available.

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 that can be lowered to allow controlled surface spill into the weir. After passing over this gate, fish become committed to the bypass and cannot reenter the headpond. The large turbine weir intake is open throughout the migration period and the small turbine weir intake is typically closed.

Due to restricted access to the facility, DMR personnel were limited to three separate observations of downstream passage capabilities at Benton Falls in 2002. The bypass was open and operating during each of the site visits and there were no problems associated with debris from the headpond plugging the entrance. However, due to past problems of debris blocking

Table 13. Downstream Passage Observations at Hydroelectric Facilities, 2002

Date	Fort Halifax	Benton Falls	Burnham	Pioneer	Waverly	Lockwood	Hydro Kennebec
7/10/02	O						
7/12/02	O					O	
7/18/02						O	
7/22/02						O	
7/24/02				O	O	O	
7/30/02							O
8/2/02		O	O		O[H]	O	
8/6/02	O			O	O		
8/7/02						O	O
8/12/02						O	
8/16/02						O	
8/19/02	O		O	O	O		O
8/20/02	O[H]						O
8/28/02						O	
8/29/02						O	
8/30/02		O	O		O		
9/3/02	O			O	O	O	
9/5/02	O		O				O
9/10/02							O
9/12/02							O
9/16/02	O		O				
9/17/02				O	O		O
9/19/02							O
9/20/02						O	
9/30/02				O	O		
10/01/02	O		O				
10/15/02			O	O	X		
10/18/02	O						
10/29/02	O	O	O				
11/1/02				O	O		
Totals	**11**	**3**	**8**	**8**	**10**	**12**	**9**

O = Downstream passage available at time of survey
X = Downstream passage not available at time of survey
· = Not surveyed on this day
[H] = Juvenile alosids in headpond

downstream passage via the bypass, DMR personnel will make a more concerted effort to observe this area in 2003.

Under the KHDG Agreement, the **Burnham Project** was required to install an interim bypass facility by 1998. Instead, CHI opted to install a permanent facility, which was operational by the end of the juvenile alewife out-migration in 1999. In addition, the existing trash racks were screened with an expanded metal overlay, similar to the one in use at Fort Halifax. It serves to exclude fish from the wide-spaced trash rack and thus prevent their entrainment into the penstock.

In its April 16, 1999 letter, CHI indicated that the Burnham downstream fish bypass would be operated continuously at 20 cfs until license issuance. However, during subsequent consultation and bypass operation up to and including the fall of 2002, CHI has agreed to a) operate the downstream bypass at a flow of 20 cfs until flushing flows from Sebasticook Lake arrive at Burnham in September; b) increase bypass flow to 125 cfs coincident with the arrival of flushing flows; and c) restrict generation to no more than one and three-quarter (1.75) units, as necessary, to prevent or reduce fish mortality from entrainment. CHI's operational measures are designed to afford successful downstream fish passage at the site. During subsequent consultation, both DMR and USFWS recommended higher interim bypass flows, but agreed to allow CHI to operate at 20 cfs. The agreement to operate at 20 cfs carried the condition that if a fish kill took place at Burnham, then CHI would either increase bypass flow or shut the turbines down during alewife migration.

DMR personnel made eight visits to the Burnham Dam in 2002. All inspections found the downstream bypass open and operational. Unlike 2001, neither CHI nor DMR personnel observed entrainment of juvenile alosids in 2002.

Downstream passage through the bypass was available during each of the eight site visits to the **Pioneer Dam** in Pittsfield. No juvenile alewives were observed using the downstream passage facilities on any visit.

DMR visited the **Waverly Avenue Dam** on ten occasions during the 2002 season. Downstream passage was available at the site on all occasions except October 15. Problems encountered during the 2002 season at Waverly Avenue were similar to those of previous seasons. First, gate leakage at the stop log bays on the far side of the spillway remained a problem, causing downstream migrants to be attracted away from the bypass during low flow conditions. Second, the bypass itself frequently collected debris and lost its effectiveness with this fouling. DMR personnel observed YOY alewives in the Waverly Avenue headpond during the August 2 site visit.

DMR personnel visited both the **Lockwood** and **Hydro-Kennebec Dams** as often as possible in 2002. Both of these projects are located on the Kennebec River and must pass all downstream migrant alewives from the Wesserunsett Lake alewife restoration effort. Additionally, most of the larval shad released into the Kennebec River are released above both Lockwood and Hydro-Kennebec. During the 2002 season, interim downstream passage at Lockwood was made available through the power canal trash sluice, which is located near the turbine trash racks. Interim downstream passage at Hydro-Kennebec is achieved by passing out-migrants through the project turbines. FPLE consultants observed juvenile alosids in both the Hydro-Kennebec and Lockwood Project forebays on several occasions (personal communication with Jason Seiders, Normandeau Consultants, 2003) and submitted several samples of both juvenile shad and alewives for DMR analysis.

Upstream Passage Monitoring

The owners of the **Fort Halifax Dam** are required to provide interim trapping of alewives and shad (which began in 2000) in order to continue the interim trap and truck program until 2003, at which time either a fish lift or partial dam removal will provide permanent upstream passage. In the spring of 2002, FPL proposed to surrender its license and proceed with the partial dam removal option. At the time of this printing, FERC is currently weighing the options regarding the fate of the project, but it is expected to make its decision by May 1. During the alewife runs between 2000 and 2002, FPLE installed the fish pump formerly used to collect alewives at the Edwards Dam that served as the required interim trapping facility. It is expected that the fish pump will again be deployed in 2003 as a temporary means of upstream fish passage.

Upstream passages at the **Benton Falls** and **Burnham Dams** are required to be operational one year following the installation of permanent or temporary upstream fish passage at Fort Halifax and installation of permanent upstream fish passage at four upriver non-hydro dams: Pleasant Lake in Stetson (completed in 2001); Plymouth Pond in Plymouth (completed in 2002); the Guilford of Maine Dam in Newport (removed in 2002); and the Sebasticook Lake Outlet Dam (ongoing). In 2002, DMR contacted the owners/operators of the Benton Falls and Burnham Projects to inform them of the progress DMR was making towards the installation of fish passage at the aforementioned non-hydro dams.

In 2001, upstream passage design plans for Fort Halifax, Benton Falls, and Burnham were submitted to the agencies for review. DMR personnel reviewed preliminary and functional designs for a fish lift to be installed at Fort Halifax. Currently, FPLE is working on final designs, as well as investigating the possibility of removing the project. DMR personnel reviewed conceptual designs for Benton Falls and Burnham, both of which are proposing passages consisting of four-foot wide denil fish ladders. DMR will continue to consult with representatives from each hydro project to ensure that effective fish passage becomes available per the Agreement.

5.0 FISH COMMUNITY ASSESSMENT

With the removal of the Edwards Dam in 1999, approximately 17 miles of Kennebec River habitat was reopened for the first time since the dam was built in the mid-1800s. The benefits of dam removal are already being realized with anecdotal reports of enhanced recreational angling opportunities and results, as well as an increase in available spawning and nursery habitat for native anadromous fish species. For example, evidence of American shad spawning has occurred as far upriver as Winslow. In addition, both striped bass and sturgeon are now observed in Winslow. There are also increased observations of wildlife species benefiting from this newly opened river stretch. Bald eagles, osprey, great blue heron, several species of ducks and Canada geese, as well as various species of aquatic furbearers, including mink and river otter, have been observed utilizing this free-flowing segment of the Kennebec.

The intent of this investigation is to document the presence and spawning activity of anadromous fish species (e.g., American shad, blueback herring, and rainbow smelt) in this newly reopened stretch of river. This data will be useful to examine the impact current restoration programs are having on Kennebec River stocks of anadromous fish. Additionally, habitat information will be collected at each fish sample site. Data will be used to document changes in habitat types over time and determine how these changes will benefit anadromous fish.

Sampling Sites

In June 2000, Kennebec River Project personnel surveyed the 17-mile stretch of the Kennebec River from the Fort Halifax and Lockwood Dams downstream to the former Edwards Dam site. The objective of the survey was to locate potential sampling sites for the deployment of beach seines and other sampling gear for fish community assessment purposes. Several factors led to the selection (or non-selection) of the sampling sites, including depth; areas of strong currents; and obstructions such as ledge, logs, and boulders, which render potential sites unsuitable for seining and fyke net deployment. Generally, sites with even, regular bottoms were chosen. Originally, a total of eight sites were sampled biweekly between Waterville and Augusta from June/July (immediately following alewife/shad stocking) until November.

Biological Sampling Procedures

Depending on river flow, either a 17-foot or 19-foot johnboat equipped with a jet drive was used to access all of the sampling sites. At sites where water depth exceeded the ability to wade, the johnboat was used to deploy an 8' x 150' x 3/8" delta mesh net with an 8' x 8' x 8' x ¼" delta mesh bag seine. The bag was used to better capture and, more importantly, retain the items sampled by eliminating the gap between the net and river bottom at the vertex of the seine as it was hauled. The beach seine was flaked onto the bow of the boat. After landing at the survey site, a crewmember would debark and hold one end of the beach seine. The boat would then be backed out into the river and continue until approximately 2/3 of the net had been deployed. At this point, the boat would back towards shore. As the boat reached wading depth, a crewmember would debark, taking the other end of the net to shore where the haul would be completed.

In order to best understand the structure of the fish community present, every species of fish (diadromous and resident) was examined. Total number of fish caught was assessed, as was number per species. Total length was assessed to the nearest millimeter for up to 100 diadromous fish per species and up to 50 per resident species. If American shad were captured, a random sample of 20 was placed on ice and brought back to the DMR office in Hallowell for otolith work (see **Section 3.0** of this report).

Physical Data Collected

Over the coming years, it is expected that some of the physical characteristics of the river will change (i.e., depth, substrate composition, and temperature). To monitor how these changes may impact fish community assemblages, Kennebec Project personnel will measure physical parameters at each sample site annually. Data concerning river discharge will be obtained from USGS gauging stations.

In 2000, transects were constructed at each sample site perpendicular to river flow and extended from one bank to the other. At each site, starting on one bank of the river, a linear measurement was taken of the riparian zone from the water's edge to the beginning of the understory/ vegetation. Notes were taken that reflected erosion levels, riparian vegetation cover, and erosion levels caused by human activity, if any. A weight with a 12-meter line attached was then cast perpendicular to the river's flow towards the far bank; where the weight landed was the transect station. Measurements of flow, dissolved oxygen, and temperature were taken with a Marsh-McBirney Model 2000 Portable Flow Meter and a YSI Model 55 Dissolved Oxygen Meter, respectively. The probes of these two instruments were attached to a staff with one-foot incremental checks. Measurements at each station were repeated for surface, middle, and bottom depths if the depth exceeded 1.5 meters (five feet). If the depth was less than 1.5 meters, then one measurement of flow, temperature, and dissolved oxygen was taken in the middle of the water column. Substrate composition (if visible), as well as aquatic vegetation coverage, was also noted. This process continued until the opposite shore was reached, when another measurement of the linear depth of the riparian zone was taken, along with notes on erosion levels.

Data Analysis

Comparisons of species compositions will be assessed both within years between sites and among years between sites, when the data becomes available. The data can be incorporated into an Index of Biotic Integrity (IBI). IBI models have been utilized successfully by many Midwest states as a way to measure a river's health. Some states in the Northeast have developed IBI models, but the results are inconsistent. Even though the models have not been perfected, an IBI should be able to highlight any changes that are occurring in the river. Additionally, the data collected on larval and juvenile shad will be used to evaluate the shad hatchery program and the success of the restoration program in general (see the **Section 3.0** of this report for more details).

Seining surveys for the 2002 season commenced on July 18. The sampling sites consisted of the same sites as 2001. However, on August 28 it was discovered that Site 8A was compromised due to construction activities for the new Kennebec River bridge crossing in Augusta. As a result, a new sampling site (Site 8C) was created approximately 500 yards downstream of Site 8A.

Between May 30 and July 11, D-nets were set at various sites in the Kennebec and Sebasticook Rivers to capture any eggs that shad may have released during natural spawning events. The D-nets were set in water depths ranging between three and 12.5 feet deep. **See Figures 10 and 11** for the locations of the D-nets in 2002 and **Table 14** for their respective descriptions. A total of 2,055 shad eggs were collected during this period, with the greatest majority (1,238 eggs) captured in the Sebasticook River at the south shore, upper site.

Figure 10. Locations of D-nets in Kennebec River, 2002

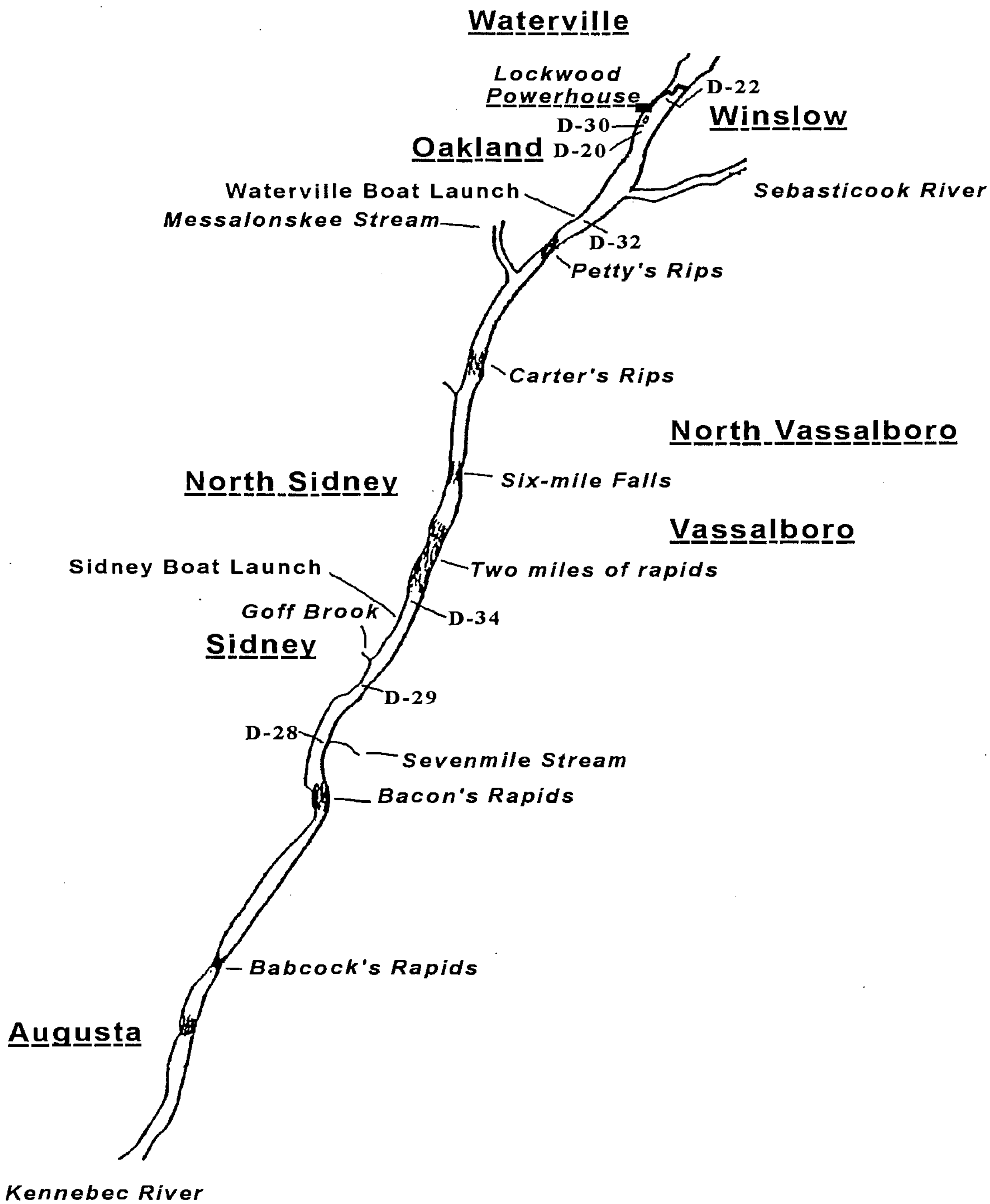


Figure 11. Locations of D-nets near Kennebec/Sebasticook Confluence, 2002

Scale: 1" = 200'

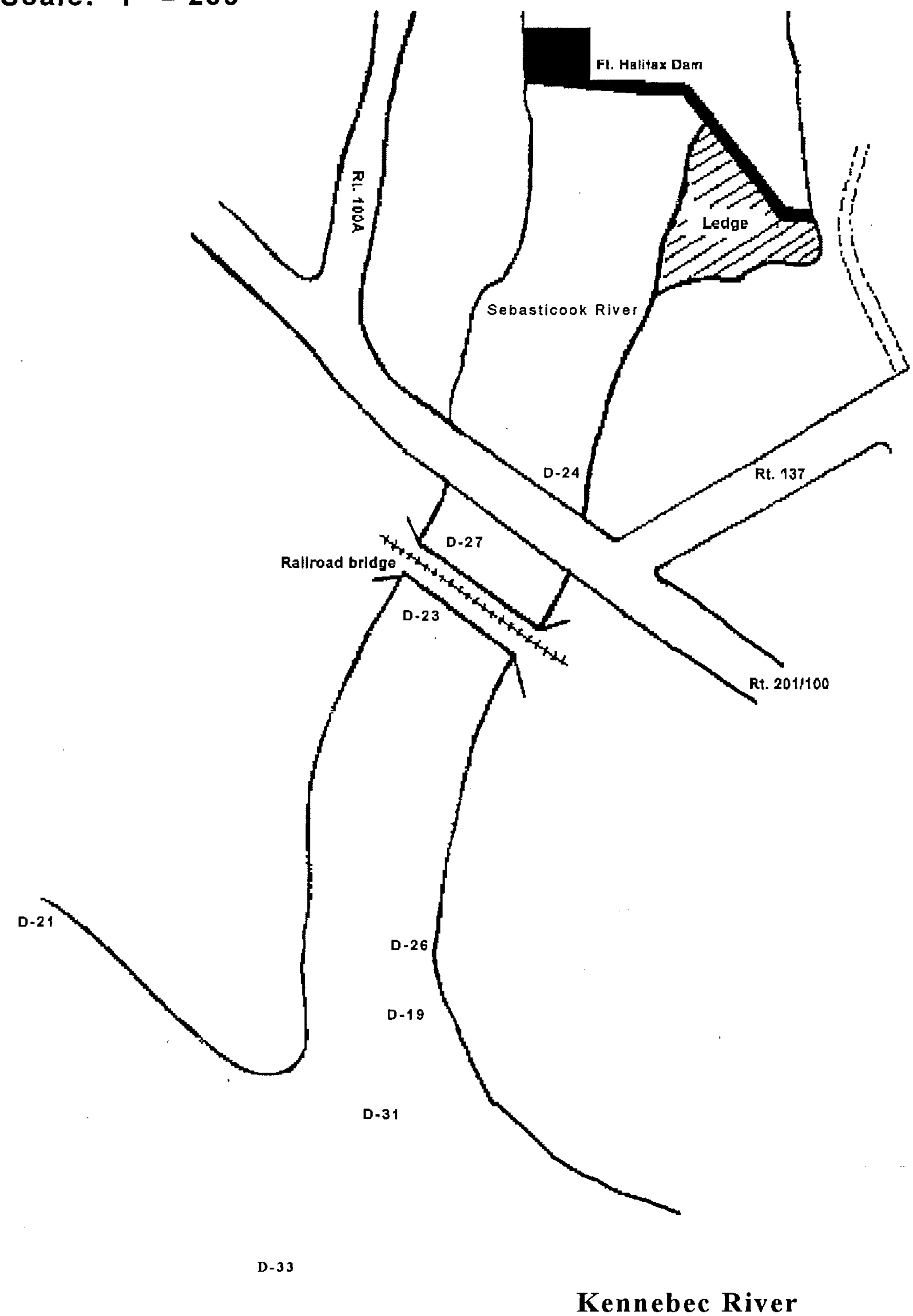


Table 14. Locations and Results of D-Net Sets, 2002

Site	Depth (ft.)	Water Temp	Air Temp	Date Set	Day Hauled	Number of Eggs	Number of Larvae	ID
Sebasticook River mouth	3.5	17.5	18.4	5/30/2002	5/30/2002	0	0	
Kennebec River below Lockwood	12.5	17.5	18.4	5/30/2002	5/30/2002	0	0	
Sebasticook River		19.0	15.6	6/3/2002	6/4/2002	0	0	
Kennebec River Fort Halifax Park	4	14.0	NA	6/3/2002	6/4/2002	0	0	
Kennebec River east of Lockwood	6	15.3	16.4	6/4/2002	6/6/2002	0	0	
Sebasticook River below RR bridge	3	19.3	16.4	6/4/2002	6/6/2002	0	0	
Sebasticook River below RR bridge	3	19.1	27.1	6/10/2002	6/11/2002	0	0	
Sebasticook River above auto bridge	5	19.1	27.1	6/10/2002	6/11/2002	0	0	
Kennebec River Fort Halifax Park	3	15.7	23.2	6/10/2002	6/11/2002	0	0	
Kennebec River Fort Halifax Park	5	15.6	29.5	6/19/2002	6/20/2002	299	0	American Shad
Sebasticook River South shore upper site	3	17.3	29.5	6/19/2002	6/20/2002	59	0	American Shad
Sebasticook River South shore upper site	3	17.3	29.5	6/19/2002	6/20/2002	0	1	Smallmouth Bass
Sebasticook River South shore lower site	3	17.3	29.5	6/19/2002	6/20/2002	87	0	American Shad
Kennebec River Fort Halifax Park	4	15.9	27.8	6/20/2002	6/21/2002	106	0	American Shad
Sebasticook River South shore upper site	3	NA	NA	6/20/2002	6/21/2002	566	0	American Shad
Sebasticook River between bridges	3	18.6	21.2	6/20/2002	6/21/2002	30	0	American Shad
Kennebec River Mouth of 7 Mile Stream	8	18.6	29.4	6/20/2002	6/21/2002	0	1	Lamprey
Sebasticook River South shore upper site	4	20.7	23.8	6/26/2002	6/27/2002	58		American Shad
Sebasticook River South shore upper site	4	20.7	23.8	6/26/2002	6/27/2002	0	3	Alewife
Kennebec River above Sidney boat launch	5	20.7	27	6/26/2002	6/27/2002	0	3	Lamprey
Kennebec River 1 mile below Sidney launch	7	20.4	27.1	6/26/2002	6/27/2002	65	0	American Shad
Kennebec River 1 mile below Sidney launch	7	20.4	27.1	6/26/2002	6/27/2002	0	2	White Sucker
Sebasticook River South shore upper site	3	24.1	24.9	7/8/2002	7/9/2002	555	0	American Shad
Kennebec River east of Lockwood	4	22.8	24.9	7/8/2002	7/9/2002	0	0	
Kennebec River Fort Halifax Park	4	22.8	24.9	7/8/2002	7/9/2002	166	0	American Shad
Kennebec River Fort Halifax Park	4	22.8	24.9	7/8/2002	7/9/2002	0	2	Smallmouth Bass
Kennebec River Fort Halifax Park	4	22.8	24.9	7/8/2002	7/9/2002	0	1	White Sucker
Kennebec River 1 mile below Sidney launch	7	23.4	NA	7/8/2002	7/9/2002	0	0	
Sebasticook River above auto bridge	9	24.4	26.4	7/9/2002	7/10/2002	0	0	
Kennebec River Mouth of 7 Mile Stream	8	23.8	NA	7/9/2002	7/10/2002	0	0	
Kennebec River below Lockwood Island	3	21.6	22.2	7/10/2002	7/11/2002	0	1	Smallmouth Bass
Confluence of Sebasticook and Kennebec River	4	21.9	NA	7/10/2002	7/11/2002	64	0	American Shad
Confluence of Sebasticook and Kennebec River	4	21.9	NA	7/10/2002	7/11/2002	0	1	Smallmouth Bass
Confluence of Sebasticook and Kennebec River	4	21.9	NA	7/10/2002	7/11/2002	0	1	Smelt
Kennebec River opposite Waterville boat launch	4	22.4	23.8	7/10/2002	7/11/2002	0	0	
Kennebec River 1 mile above Sidney boat launch	5	21.3	23.8	7/10/2002	7/11/2002	0	15	Alewife
Kennebec River 3/4 mile above Waterville boat launch	6	20.6		7/11/2002	7/12/2002	0	5	Unknown

A total of 80 seine hauls were made during the community assessment survey on the Kennebec River. A total of 11,511 fish representing 19 species were captured and identified. Of those, total length was assessed for 1,706 fish. Fish of questionable identity were placed on ice for later identification. For a breakdown of diadromous fish captured by site, refer to **Table 15.**

Table 15. Diadromous Fish Captured in the Kennebec River, 2002

Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 7	Site 8A	Site 8B	Site 8C[2]
Alewife	4,113	84	0	0	9	1,943	15	1	1
Alosid sp.[1]	0	20	0	0	0	23	617	5	0
American Eel	2	0	1	1	0	0	0	1	0
American Shad	7	5	4	0	2	1	0	1	1,913
Blueback Herring	18	0	0	0	0	14	9	2	0
Striped Bass	0	0	0	0	0	0	0	1	0
Site Totals	**4,140**	**109**	**5**	**1**	**11**	**1,981**	**641**	**11**	**1,914**
Grand Total All Sites	**8,813**								
Total By Species									
Alewife	**6,166**								
Alosid sp.[1]	**665**								
American Eel	**5**								
American Shad	**1,933**								
Blueback Herring	**43**								
Striped Bass	**1**								

[1] Further laboratory analysis needed to determine species of larval samples
[2] Site 8C was added on August 28, 2002 after Site 8A was compromised due to bridge construction

6.0 AMERICAN EEL

The *Lower Kennebec River Comprehensive Hydropower Settlement Accord* requires that KHDG dam owners and DMR, in consultation with NMFS and USFWS, and subject to approval by FERC, undertake a three-year research project to determine 1) the appropriate placement of upstream passage for American eel at each of the seven KHDG facilities based upon field observations of where eel are passing, or attempting to pass, upstream at each facility, and 2) appropriate permanent downstream fish passage measures based on radio telemetry and other tracking mechanisms and field observations.

6.1 Upstream Passage

Introduction

The primary objective of this study was to determine where juvenile eels pass, or attempt to pass, upstream at each of the seven KHDG facilities. Secondary objectives were to determine the timing of the upstream migration, the magnitude of the migration, and the size distribution of the migrants. On the basis of three years of study, DMR staff made recommendations in 2001 on the appropriate locations for placement of upstream eel passage at five of the seven KHDG facilities (Fort Halifax, Benton Falls, Burnham, Hydro-Kennebec, and Shawmut). DMR staff made additional nighttime observations in 2002 to continue the identification of areas where eels naturally congregate. In addition to these observations, passages were deployed at Fort Halifax and Benton Falls to allow continued monitoring of recruitment and to pass eels upstream.

Methods

DMR staff conducted nighttime visual observations at five sites in 2002 (**Table 16**). As in previous years, the locations of eel concentrations were noted, an estimate was made of the number of eels, and in most cases, a sample was taken for total length measurements. On several occasions eels were videotaped.

Upstream passages, which have been described in previous reports, were installed at the Fort Halifax and Benton Falls Projects. In general, the passages were operated five days per week and tended at least twice per week. If the number of eels captured at a project was less than 70, all eels were counted and total weight recorded. If catches exceeded 70, all eels were weighed and the number estimated from subsamples. Eels were released above each dam into the headpond after measurements were taken. Water temperature at Fort Halifax was obtained from Normandeau Associates. Other environmental information was recorded when the passages were tended.

Table 16. Summary of Visual Observations at Five Projects[1]

Project	Dates of nighttime observations						
Burnham	7/24						
Lockwood	7/30	8/1	8/7	8/16	8/28	8/29	9/3
Hydro-Kennebec	8/20	9/5					
Shawmut	7/30	8/20	8/28				
Weston	7/24	8/7					

[1]Observations were made at night unless otherwise noted.

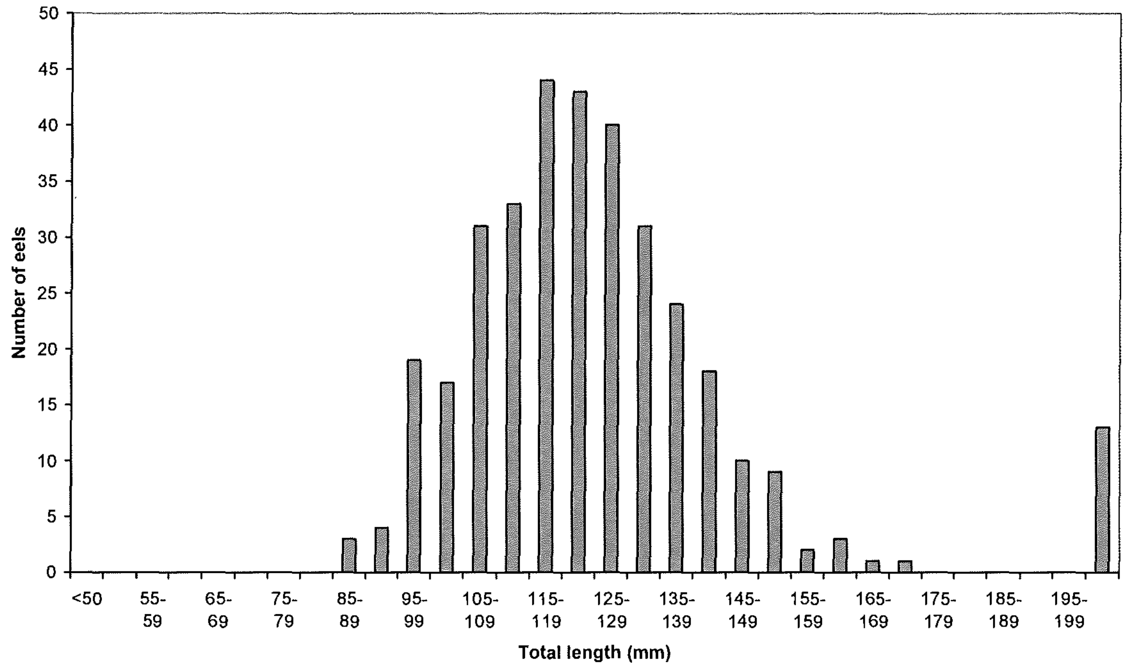
Results and Discussion

The **Burnham Project** was visited at night on July 24 and observations were made from shore using binoculars and a 500,000 candlepower light. As in 2001, eels were observed on the western side of the spillway, below the two easternmost sets of stop logs.

Observations were made on seven occasions at the **Lockwood Project** and a fyke net was set above the abandoned fishway where eels were observed in 2001. DMR staff determined that there is no single place where eels tend to concentrate because of widespread leakage. Juvenile American eels attempt to scale the dam at numerous locations along the spillway and adjacent canal wall where spray or leakage occurs, and the locations vary daily with changes in river flow and impoundment level. After climbing to the crest of the dam or top of the canal wall, eels are commonly washed downstream when encountering the brunt of leakage flow passing through small holes in the flashboards or small cracks in the concrete. At two locations where eels had been seen climbing, Lockwood personnel cut small grooves into the concrete to reduce leakage flow velocity, but the effectiveness of these modifications is not known. Eels collected by dip net below the dam ranged from 85-210mm total length. The median size was 115-119mm. **See Figure 12.**

After consulting with DMR, personnel at the **Hydro-Kennebec Project** installed an experimental upstream eel passage, made of flexible exhaust hose with Enkamat lining the invert, on the west side of the spillway. Problems with leakage, attraction water, entrance location, and the climbing substrate were identified and corrected through the summer. Testing of this experimental passage will continue in 2003. Eels collected by dip net below the dam

Figure 12. Total Length of Eels at Lockwood, 2002



ranged from 91-167mm total length. The size distribution was bimodal with peaks at 110-119mm and 125-129mm. **See Figure 13.**

The **Shawmut Project** was visited three times. As in 2001, eels were observed swimming in the upper pool below the easternmost side of the spillway. Twelve eels, captured below the dam by dip net, ranged from 246-311mm total length.

Nighttime observations were made on two dates at the south and north channel dams of the **Weston Project**. Eels were observed actively climbing the southernmost section of the southern channel dam, the same area where they were seen in 2001. Eels collected by dip net below the dam ranged from 112-148mm total length with a median of 125-129mm. **See Figure 14.**

An estimated 56,292 migrating eels were passed at **Fort Halifax** in 2002, the lowest number ever passed. **See Table 17.** Approximately 96% of the eels moved upstream within a 36-day period (**Figure 15**), similar to the pattern seen in previous years. The size range of eels was

Figure 13. Total Length of Eels at Hydro-Kennebec, 2002

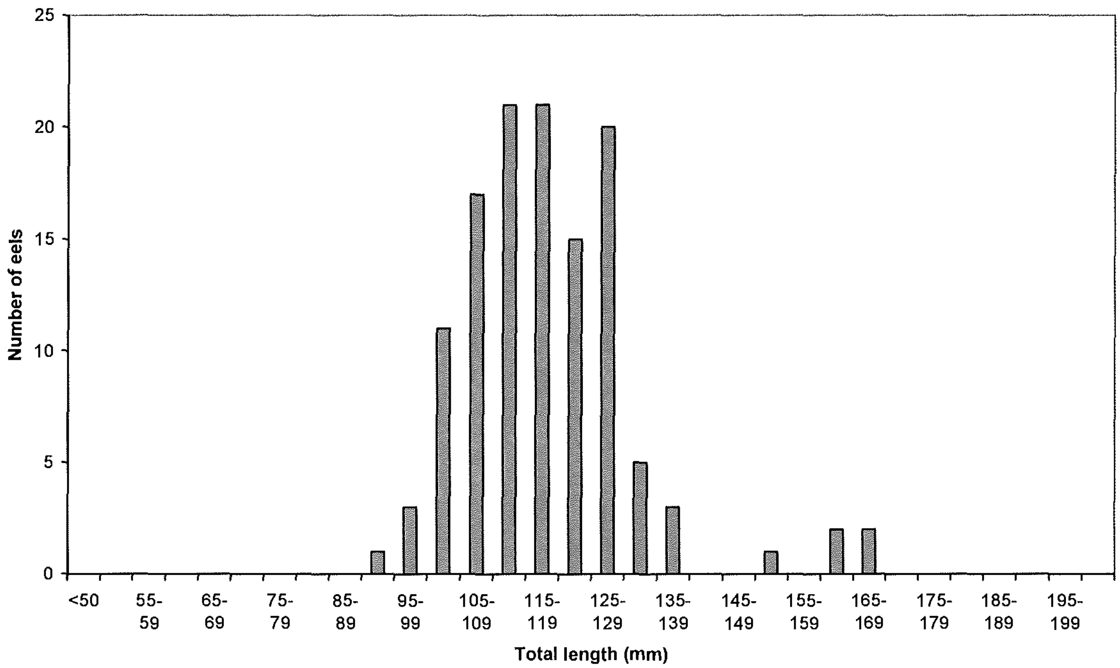


Figure 14. Total Length of Eels at Weston, 2002

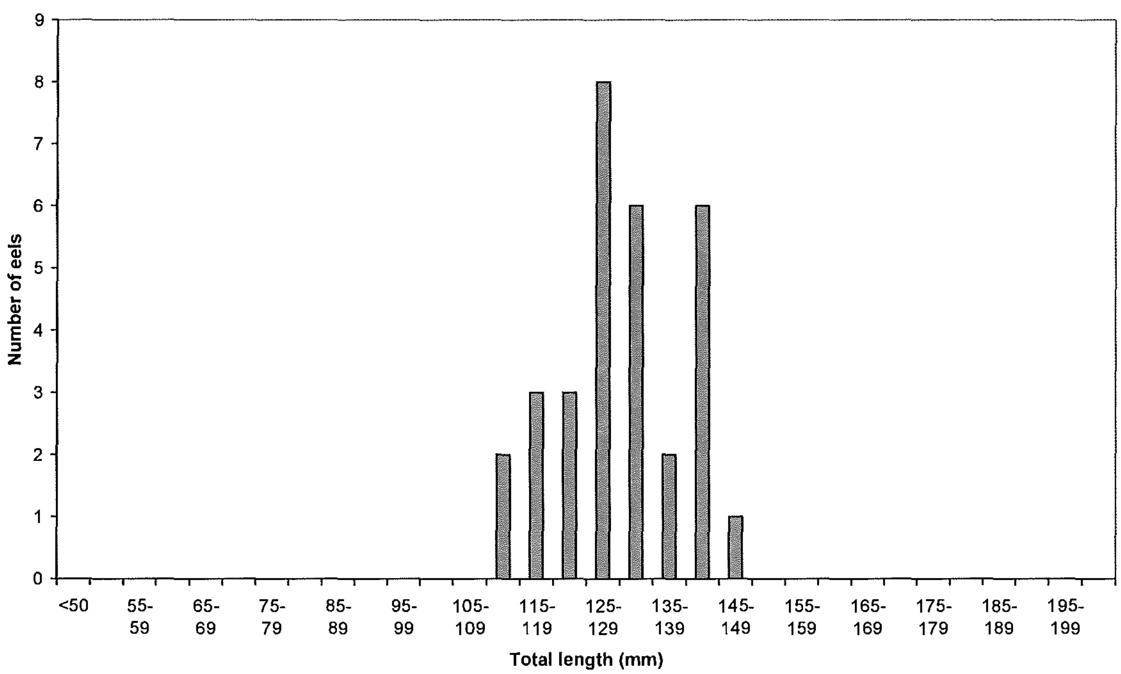
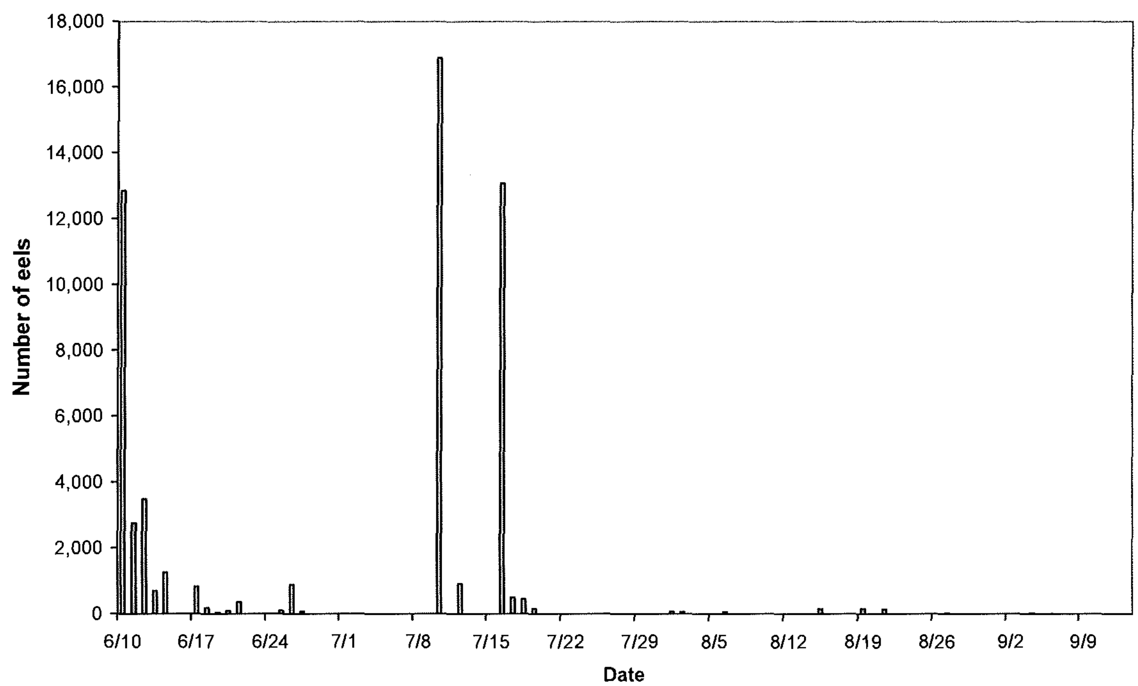


Table 17. Summary of Upstream Eel Migration at

Fort Halifax and Benton Falls, 1999-2002

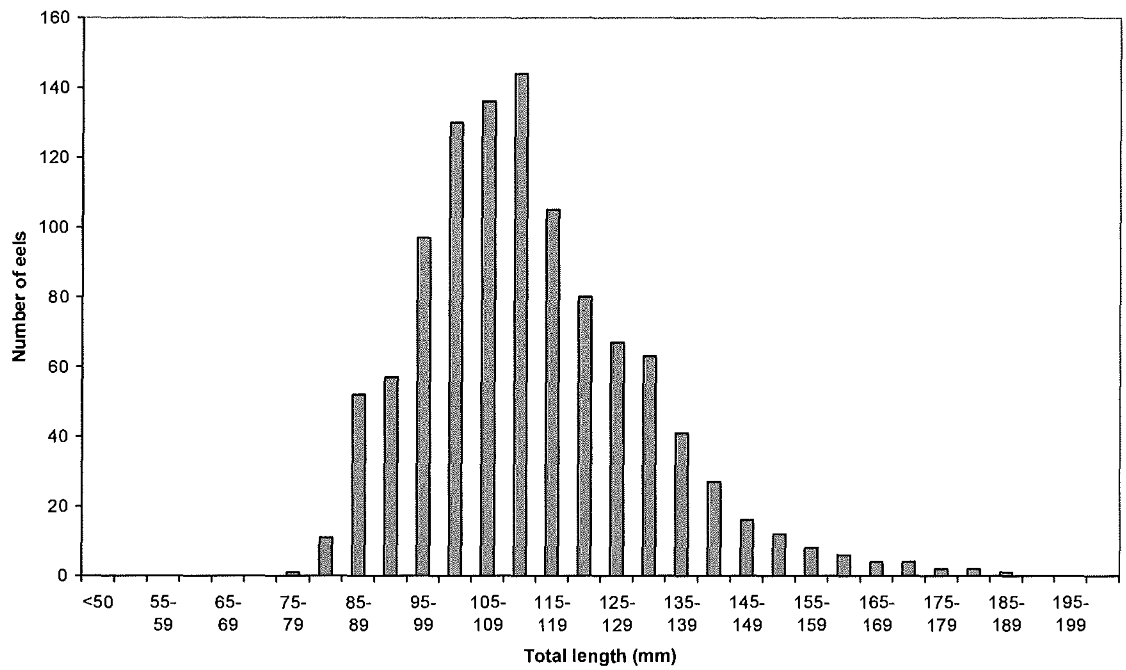
	Fort Halifax		Benton Falls	
Year	Passage operating	Eel passed	Passage operating	Eels passed
2002	6/10-9/13	56,292	6/18-9/13	22,502
2001	5/26-8/24	224,373	6/6-8/24	231,859
2000	6/21-7/28; 8/15-8/22	81,628	6/29-7/28; 8/14-8/24	37,207
1999	6/4-9/15	551,262	6/22-9/16	14,335

Figure 15. Eel Passage at Fort Halifax, 2002



similar to that of previous years (78-188mm total length) with a median of 110-114mm (**Figure 16**).

Figure 16. Total Length of Eels Passed at Fort Halifax, 2002



An estimated 22,500 eels were passed at **Benton Falls**, the second lowest number passed. Approximately 96% of the eels migrated within a 30-day period (**Figure 17**). The size range of eels was similar to previous years (86-236mm total length), but the median size was greater than in previous years (115-124mm) and 37% of the eels were greater than 150mm (**Figure 18**).

6.2 Downstream Migration

Introduction

The primary objectives of this study were to determine the seasonal and diel timing of the downstream migration of adult eels, the behavior of migrating adult eels at hydropower facilities, and the efficiency of various downstream passage measures for adult eels.

Figure 17. Eel Passage at Benton Falls, 2002

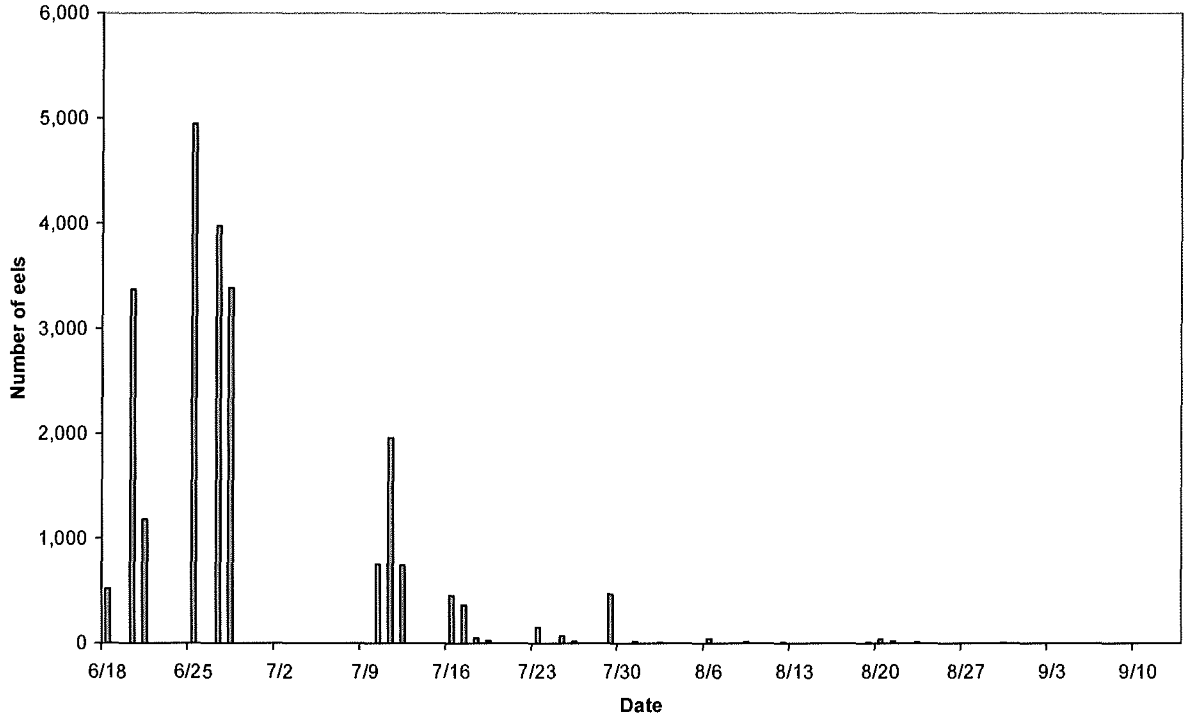
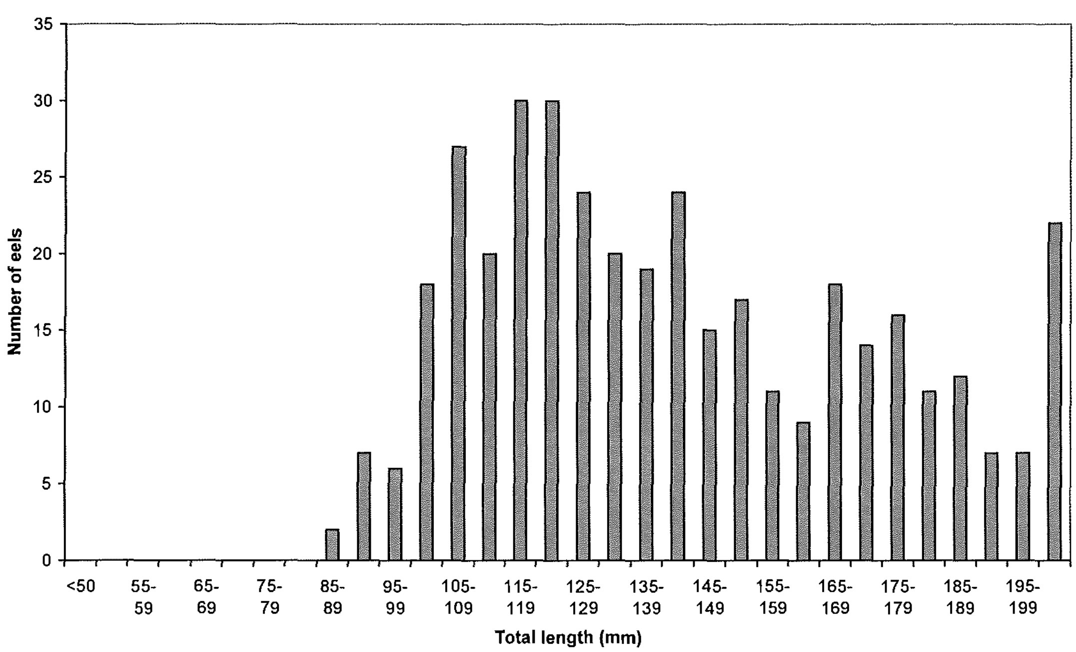


Figure 18. Total Length of Eels Passed at Benton Falls, 2002



Methods

The study was conducted from September 30 to November 22 at the Lockwood Project, which is located on the Kennebec River approximately 0.5 mile above the confluence of the Sebasticook and Kennebec Rivers. Eels used for study were obtained from Carrabassett Stream, located in Clinton approximately 5.75 miles above the Lockwood Project.

Radio telemetry equipment was installed and calibrated at the Lockwood Project from September 30 to October 24. Eight automated scanning receivers (Model SRX-400, Lotek Engineering, Newmarket, Ontario, Canada) were deployed at the site to record the passage of radio-tagged eels. Three types of antennas (4-element Yagi, 6-element Yagi, and "dropper") were used to monitor different areas of the project. Yagi antennas were deployed above the water surface, while dropper antennas (coaxial cable with distal 18" of insulation removed) were inserted inside braided nylon line and deployed underwater. Each antenna was connected to a scanning receiver unless otherwise stated. In general, antennas were deployed and gain settings were adjusted so antennas would detect signals in a particular area, with little overlap between them. One 4-element Yagi monitored the power canal, one 6-element Yagi was used to monitor the river channel, and a second 6-element Yagi was used to monitor the tailrace. The canal and river channel antennas were attached to a switcher, connected to a single receiver. One dropper antenna was deployed in each of the seven turbine draft tubes (although two were shut down for repair during the entire study period) and in the downstream bypass. In addition to the fixed stations, eels were located by scanning sections of the river on foot or by boat with a radio receiver and handheld Yagi antenna on eight occasions between October 25 and November 15. Data from the scanning receivers was downloaded four times during the study period. Water temperature was measured and recorded six times a day at a depth of 12 feet in the canal at the Lockwood Project.

Eels to be radio-tagged were captured on October 22 and 31 **(Table 18)** in a fyke net set in Carrabassett Stream. On both dates, the captured eels were removed from the net, transported to the Hydro-Kennebec Project that is located approximately 0.5 mile above the Lockwood Project, and held overnight in a net pen prior to being fitted with a transmitter. During the tagging

Table 18. Summary of the Tag/Release Date, Eel Size, and Release Location, 2002

Date tagged	Date released	Tag number	Eel total length (mm)	Release location
10/24	10/25	11	614	Hydro-Kennebec tailrace
10/24	10/25	12	588	Hydro-Kennebec tailrace
1024	10/25	13	552	Hydro-Kennebec tailrace
10/24	10/25	15	558	Hydro-Kennebec tailrace
10/31	11/01	14	644	Hydro-Kennebec tailrace

procedure, an individual eel was placed in a cooler containing a solution of Eugenol for 15-20 minutes to anesthetize it. A small ventral incision was made approximately 1.75 inches anterior to the vent and a 16-gauge needle was inserted about 0.5 inch posterior to the incision. The radio tag was inserted into the incision and the tag antenna trailed from the body cavity through the small puncture left by the needle. The incision was sutured and treated with betadine. The coded radio tags (Model MCFT-3CM, Lotek Engineering, Newmarket, Ontario, Canada) were 11mm in diameter, 36mm long, weighed 5.9g in air and 2.6g in water, and had a typical operation life of 100 days. The tags emitted a coded signal every five seconds at 149.460 MHz.

Four eels were tagged between 12:00-13:30 on October 24, held overnight in the net pen, and released at noon on October 25 in the Hydro-Kennebec tailrace. A single eel was tagged between 12:30-14:00 on November 1 and released the same day at 16:00 in the Hydro-Kennebec tailrace.

Results

Daily mean water flow in the Kennebec River was below the 16-year mean each day of the study. Instantaneous stream flow ranged from 2960-6790 cfs; average daily water temperature in the canal at Lockwood ranged from 9.3-3.7 °C during the study period.

Eels were detected at the Lockwood Dam from 6.7 to 223.3 hours after being released in the Hydro-Kennebec tailrace. **See Table 19**. Two eels began moving downstream soon after being released. After four hours, Eel 12 had moved into the open river and Eel 13 had traveled approximately halfway to Lockwood. The two slowest eels, which arrived at Lockwood four to

Table 19. Time of Release, Arrival, and Passage for Radio-tagged Silver Eels at the Lockwood Project, 2002

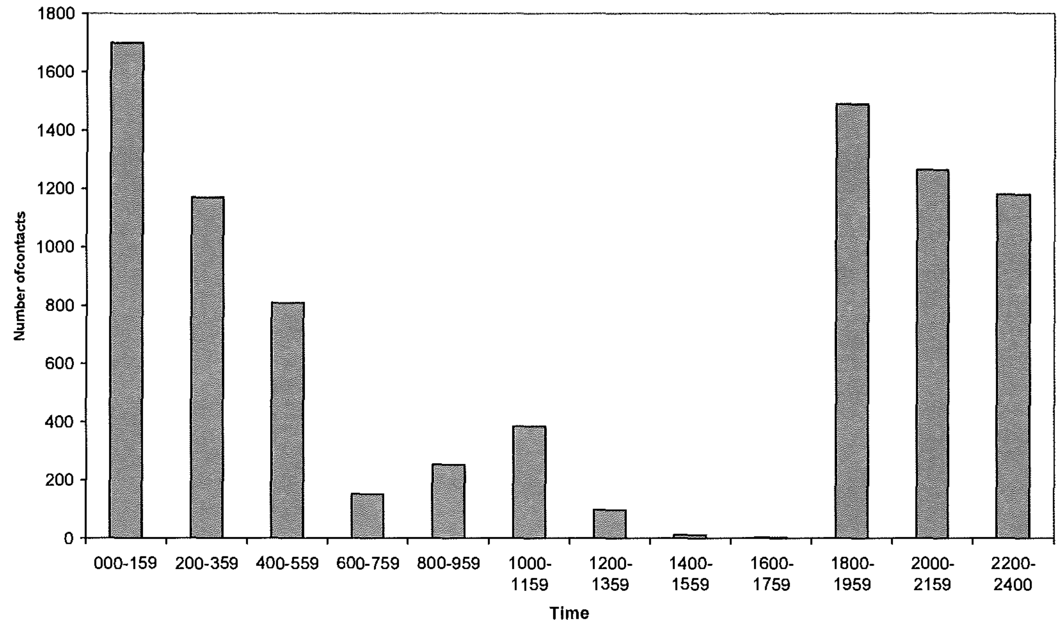
Tag	Release		Arrival at dam		Passage at dam		Release to arrival (hr)	Arrival to passage (min)	Route
	Date	Time	Date	Time	Date	Time			
11	10/25	1200	10/30	2:06	10/30	2:07	110.1.	1	unknown
12	10/25	1200	10/27	1:11	10/27	1:14	37.19	3	bypass
13	10/25	1200	10/25	18:43	10/25	18:47	6.70	4	turbine
15	10/25	1200	10/27	4:19	10/27	4:23	40.33	4	unknown
14	11/01	1600	11/10	23:19	11/10	23:30	223.3	21	turbine

nine days after release, remained at the release point for several days. Once in the forebay of the Lockwood Project, eels passed downstream very quickly. The time from arrival to passage ranged from 1-21 minutes.

All five eels released above Lockwood passed the project. Two eels (40%) passed through turbines, one (20%) used the downstream bypass, and two (40%) passed by an unknown route. On the basis of signal strengths obtained from the receivers, the latter two eels either used the bypass or passed through Turbine 7.

The eel (12) that used the bypass appeared to continue its downstream migration. One day after passing the project, it was located approximately 0.5 mile downstream in Ticonic Bay. It was not detected three days later, when the 17-mile stretch from Waterville to Augusta was checked for signals by boat. Eels that passed through the turbines (13 and 14) did not continue migrating and were presumed to be injured or dead. Eel 13 was detected in a pool east of the powerhouse on October 28, 30, and November 1. A diver attempted to locate it on November 1 without success. Eel 14 was located once along the west shore of Ticonic Bay. The remaining two eels (11 and 15), which passed by an unknown route, were located on several dates below the project. Eel 15 was found opposite the Waterville boat launch on October 30, 31, November 4, and 12. Eel 11 was located on October 30 and 31 below the Sebasticook River on the east shore. Migrating eels were active primarily during darkness. Approximately 89% of the contacts were made between 6PM and 6AM (**Figure 19**) and all eels passed during darkness.

Figure 19. Number of Eel Contacts Made by Time of Day, 2002



Discussion and Recommendations

The study will be continued in 2003.

7.0 ATLANTIC SALMON RESTORATION

In 2002, field activities conducted by the Maine Atlantic Salmon Commission (MASC) staff consisted of the following: juvenile salmon population assessments, spawning surveys, habitat assessments, and temperature monitoring.

Atlantic Salmon Population Monitoring

The removal of the Edwards Dam in 1999 opened approximately 17 miles of the mainstem Kennebec River from Augusta to Waterville/Winslow as a migratory corridor for the small numbers of mature Atlantic salmon returning to the Kennebec River. It is also now possible for Atlantic salmon to spawn in the mainstem between Augusta and Waterville/Winslow and in tributaries entering this mainstem reach that do not have impassable barriers. Methods utilized to monitor spawning activity and successes were redd counts and electrofishing.

7.1 Juvenile Atlantic Salmon Assessment

Methods

The MASC staff from the Sidney Regional Office sampled five sites in two tributaries below Waterville/Winslow (Bond Brook and Togus Stream) and one site on the mainstem Kennebec River in Sidney by electrofishing for the presence or absence of juvenile Atlantic salmon. Additionally, one site was sampled on the Sandy River to determine baseline species composition in the event that the MASC were to stock juvenile Atlantic salmon in the Sandy River as part of Phase II implementation of the 1997 management plan. All sites were evaluated using a single pass method. All large Atlantic salmon parr captured were sampled for length and weight, a scale sample taken for age determination, and a tissue biopsy taken for genetic analyses. All salmon were released alive.

Results and Discussion

Atlantic salmon were found in Togus Stream and the mainstem Kennebec River. **See Table 20.** One large Atlantic salmon parr was sampled in Togus Stream above the Barber Road crossing and one small parr was sampled near the gravel islands on the mainstem Kennebec in Sidney. Small populations of Atlantic salmon have been found in Togus Stream in previous years and the 2002 results are consistent with prior surveys. The origin of the small parr from the mainstem is currently unknown, but there are at least three possibilities: 1) it could be a wild fish from anadromous Atlantic salmon spawning in the mainstem; 2) it could be a wild fish from landlocked Atlantic salmon spawning in the mainstem, or 3) it could be from anadromous Atlantic salmon fry released by Fish Friends, an elementary school educational program.

Fish species found during the baseline species composition study of the Sandy River included brook trout, brown trout, slimy sculpin, blacknose dace, and white sucker. **See Table 20**. While not all of these species are indigenous to Maine; many are present in Maine's Atlantic salmon rivers.

Table 20. Juvenile Atlantic Salmon Assessments, Kennebec River & Tributaries, 2002

Date	Tributary	Sampling Location	Number of Salmon Parr	Ave. Fork Length (mm)	Ave. Weight (g)	Other Species Observed
8/21	Sandy River	Site 1: Avon	0	0	0	blacknose dace, brown trout, brook trout, white sucker
8/22	Bond Brook	Site 1: Bond Brook Rd index site	0	0	0	blacknose dace, brown trout, American eel, landlocked salmon, white sucker
8/22	Bond Brook	Site 2: Below mill site	0	0	0	blacknose dace, creek chub, American eel, brook trout, white sucker
8/22	Bond Brook	Site 3: Behind baseball field	0	0	0	brown trout, blacknose dace, lamprey, white sucker
8/23	Togus Stream	Site 1: Above Barber Rd	1	201	89	blacknose dace, common shiner, American eel, pumpkinseed, smallmouth bass, white sucker, largemouth bass
8/23	Togus Stream	Site 2: Above Rt. 27	0	0	0	blacknose dace, common shiner, smallmouth bass, American eel, pumpkinseed, golden shiner
8/26	Kennebec River mainstem	Site 1: Sidney	1	66	35	smallmouth bass, blacknose dace, white sucker

Spawning Surveys: *Methods*

Redd counts were undertaken by foot on tributaries of the Kennebec River between November 12 and December 2. Tributaries surveyed during this period included Bond Brook, Togus Stream, and Sevenmile Brook.

Results and Discussion

In general, two surveys, one early and one late in the spawning season, are conducted to generate a final redd count. This is primarily due to the distortion of redds over time by high flows and the potential for late spawning. In 2002, due to early ice formation and high flows, only a single survey on each tributary was completed. Consequently, it is possible to have had spawning occur even though we didn't document any redds. In addition, no redd counts were conducted on the mainstem of the Kennebec River, also due to unseasonably high flows and poor visibility.

7.2 Atlantic Salmon Habitat Assessment

Habitat Surveys: *Methods*

The MASC continued ongoing habitat surveys on tributaries of the Kennebec River to quantify adult salmon spawning and juvenile salmon-rearing habitat in the basin. Surveys were conducted on Twentyfive Mile Stream, the mainstem Sebasticook River from the Burnham Dam to Benton Falls Dam, and the Sandy River in Phillips.

Results and Discussion

The quantities of habitat surveyed in 2002 included 560 units on Twentyfive Mile Stream; 2,202 units on the Sebasticook River; and 3,604 units on the Sandy River in Phillips. One habitat unit equals $100m^2$ of juvenile Atlantic salmon habitat of riffles and runs combined. **See Table 21.** Surveys encompassed approximately 35 miles of riverine habitat.

Table 21. Atlantic Salmon Habitat Assessments on Selected Kennebec Tributaries, 2002

	Habitat Type and Units (unit=100m2)						
Section Surveyed	**Dead Water**	**Glide**	**Pool**	**Falls**	**Riffle**	**Run**	**Riffle+Run**
Twentyfive Mile Stream	-	2,199	14	5	229	331	560
Sebasticook River*	6,578	10,218	101	-	618	1,584	2,202
Sandy River**	-	359	212	13	1,731	1,874	3,605
Totals:	6,578	12,776	327	18	2,578	3,789	6,367

*Partial survey, Sebasticook River between Burnham Dam to Benton Falls Dam
**Partial survey, Sandy River in Phillips

Temperature Monitoring: *Methods*

Data loggers were deployed and set to record once every hour in Cobbosseecontee Stream (Gardiner), Kennebec River (Norridgewock, Skowhegan, Shawmut), Martin Stream (Fairfield), Outlet Stream (Winslow), Sebasticook River (Clinton), Togus Stream (Randolph), and Sandy River (Phillips, Strong, Farmington, New Sharon) to document summer river temperatures to gain insight into the thermal regimes that exist in streams with the potential for Atlantic salmon restoration. At the end of summer, the data was downloaded and filtered to generate a table and graph for presentation purposes. The monthly maximum, minimum, and average temperatures over the summer months are presented in **Table 22** and monthly maximums and minimums for July and August are graphically presented in **Figure 20**.

Results and Discussion

The temperature data collected indicates most sites in 2002 would have been thermally stressful, but potentially non-lethal to Atlantic salmon. Even though maximum temperatures recorded in Togus Steam, Outlet Stream, and the Sandy River exceeded 30^0C, the duration was short and the streams maintained enough diurnal variation by dropping below 23^0C to allow some daily thermal relief. Notable exceptions were the Shawmut site on the mainstem of the Kennebec River and the Sebasticook site in Clinton, which both met or exceeded daily minimum temperatures of 23^0C for almost the entire month of August. A copy of the entire temperature dataset can be obtained by contacting the ASC.

Table 22. Monthly Maximum, Minimum, and Average Temperatures (°C) for Selected Waters in the Kennebec River Drainage, 2002

Spring											
Water	Town/Site	March			April			May			Comments
		Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	
Cobbosseecontee	Gardiner							20.9	19.4	20.1	Deployed 5/31
Kennebec mainstem	Norridgewock										Deployed 6/11
Kennebec mainstem	Skowhegan										Deployed 6/04
Kennebec mainstem	Shawmut										Deployed 6/04
Martin Stream	Fairfield, Covell Rd.										Deployed 6/07
Martin Stream	Fairfield, Rte. 104										Deployed 6/06
Outlet Stream	Winslow, Rte. 32										Deployed 6/05
Outlet Stream	Winslow, Lower Bassett Rd.							23.2	18.5	20.2	Deployed 5/30
Sebasticook River	Clinton, Gogan Rd.							21.1	18.5	19.7	Deployed 5/30
Togus Stream	Randolph, above Rte. 27							23.4	18.0	20.0	Deployed 5/30
Togus Stream	Randolph, Upper Barber Rd.							22.4	18.4	20.1	Deployed 5/30
Sandy River	Phillips, Rte. 4										Deployed 6/04
Sandy River	Phillips, Reeds Mills Rd.										Deployed 6/04
Sandy River	Strong, The Braids										Deployed 6/04
Sandy River	Farmington, Rte. 4										Deployed 6/04
Sandy River	New Sharon, Iron bridge										Deployed 6/04

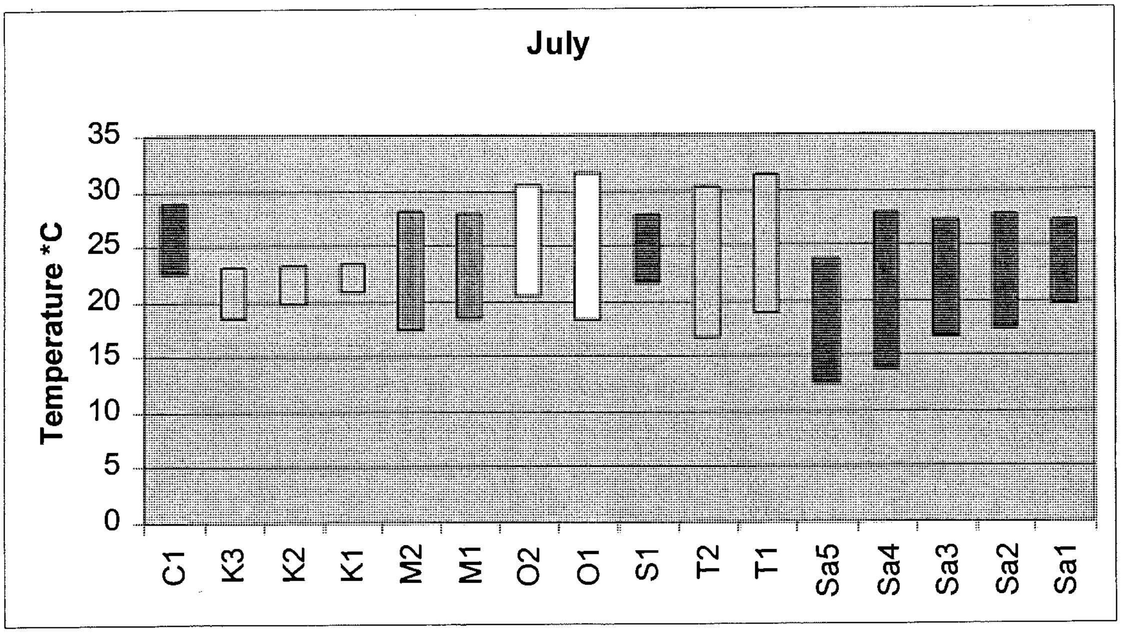
Table 22 (Cont.) **Summer**

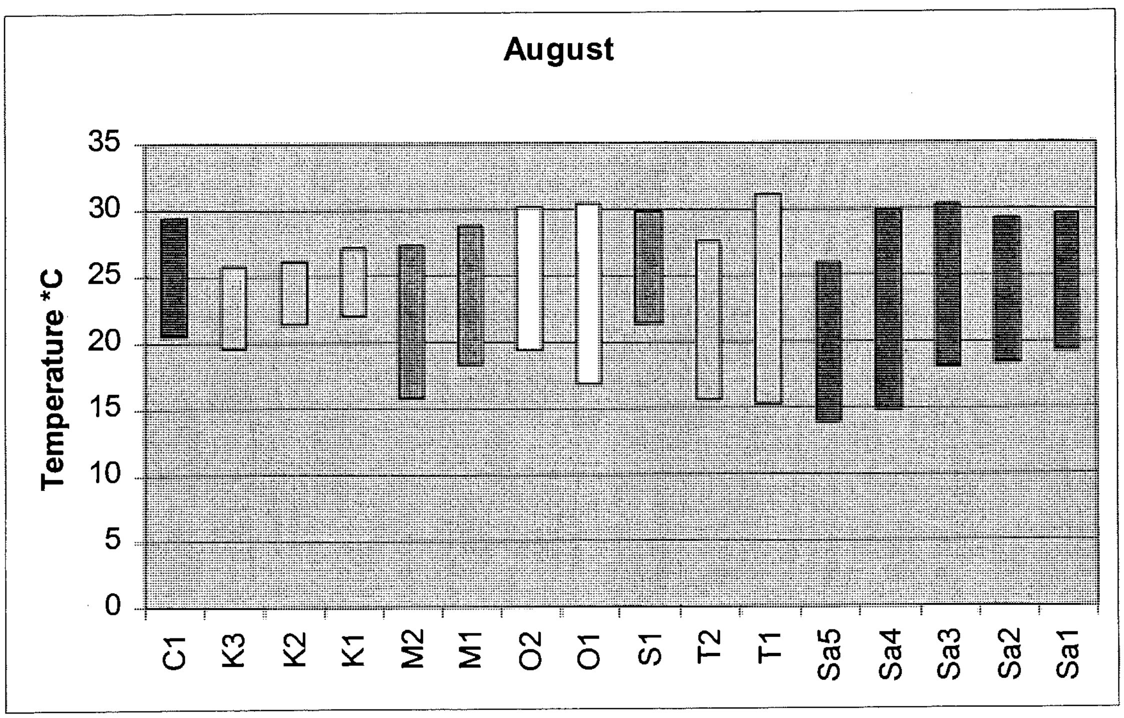
Water	Town/Site	June			July			August			Comments
		Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	
Cobbosseecontee	Gardiner	25.0	16.1	19.7	28.9	22.4	24.8	29.4	20.4	24.7	
Kennebec mainstem	Norridgewock	19.7	12.8	16.4	23.0	18.5	20.6	25.7	19.5	22.9	
Kennebec mainstem	Skowhegan	21.0	13.6	16.4	23.3	19.8	21.3	26.1	21.3	23.6	
Kennebec mainstem	Shawmut	21.1	14.6	16.8	23.3	20.8	22.0	27.1	22.0	24.0	
Martin Stream	Fairfield, Covell Rd.	24.7	13.0	18.2	28.2	17.4	21.3	27.3	15.8	21.2	
Martin Stream	Fairfield, Rte. 104	24.0	12.9	18.1	27.9	18.6	22.0	28.8	18.4	22.8	
Outlet Stream	Winslow, Rte. 32	26.1	14.4	19.5	30.4	20.5	24.0	30.1	19.4	24.1	
Outlet Stream	Winslow, Lower Bassett Rd.	27.7	13.9	19.1	31.6	18.4	23.3	30.5	16.8	23.0	
Sebasticook River	Clinton, Gogan Rd.	25.7	15.7	19.4	27.7	21.6	23.8	29.9	21.3	25.1	
Togus Stream	Randolph, above Rte. 27	27.6	12.7	18.4	31.3	16.7	22.7	31.1	15.3	22.5	
Togus Stream	Randolph, Upper Barber Rd.	25.8	13.1	18.8	30.3	18.8	22.9	27.6	15.6	21.4	
Sandy River	Phillips, Rte. 4	20.0	8.8	13.3	23.8	12.5	17.8	25.9	13.9	19.4	
Sandy River	Phillips, Reeds Mills Rd.	23.3	9.4	14.6	27.9	13.8	19.8	29.9	14.9	21.8	
Sandy River	Strong, The Braids	24.9	10.4	16.3	27.2	16.6	21.4	30.3	18.1	23.0	logger moved 8/18 to opposite channel into moving water
Sandy River	Farmington, Rte. 4	25.0	10.5	16.8	27.8	17.4	22.0	29.3	18.4	23.6	
Sandy River	New Sharon, Iron bridge	25.0	11.4	18.0	27.3	19.6	23.5	29.6	19.2	24.3	logger had broken chain, removed from water, redeployed 7/18, on 8/13 found out of water and moved

Table 22 (Cont.) — **Fall**

Water	Town/Site	Sept			Oct			Nov			Comments
		Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	
Cobbosseecontee	Gardiner	25.3	16.5	20.4	20.3	13.4	16.6				Retrieved 10/15
Kennebec mainstem	Norridgewock	23.6	16.1	19.8	25.0	10.2	16.3				Retrieved 10/15
Kennebec mainstem	Skowhegan	22.1	17.6	20.0	18.0	13.5	15.8				Retrieved 10/16
Kennebec mainstem	Shawmut	22.3	18.5	20.4	18.7	13.3	16.3				Retrieved 10/15
Martin Stream	Fairfield, Covell Rd.	22.6	11.5	16.4	24.0	3.2	11.5				Retrieved 10/16
Martin Stream	Fairfield, Rte. 104	24.0	13.0	17.8	17.1	7.8	12.3				Retrieved 10/16
Outlet Stream	Winslow, Rte. 32	25.6	14.6	19.3	20.0	8.9	14.3				Retrieved 10/15
Outlet Stream	Winslow, Lower Bassett Rd.	26.4	11.9	18.3	21.0	6.4	13.3				Retrieved 10/15
Sebasticook River	Clinton, Gogan Rd.	24.0	16.4	19.7	18.9	10.8	14.9				Retrieved 10/16
Togus Stream	Randolph, above Rte. 27	25.9	10.5	17.3	19.8	4.6	11.8				Retrieved 10/15
Togus Stream	Randolph, Upper Barber Rd.	23.0	11.7	16.7	17.5	6.3	11.9				Retrieved 10/15
Sandy River	Phillips, Rte. 4	24.2	9.1	15.3	17.6	3.9	10.1				Retrieved 10/15
Sandy River	Phillips, Reeds Mills Rd.	28.2	9.6	16.9	19.8	4.0	10.8				Retrieved 10/15
Sandy River	Strong, The Braids	25.4	12.6	18.3	18.7	7.2	12.6				Retrieved 10/15
Sandy River	Farmington, Rte. 4	25.5	12.8	18.7	18.8	7.3	12.9				Retrieved 10/15
Sandy River	New Sharon, Iron bridge	24.8	15.0	19.6	17.9	9.3	14.0				Retrieved 10/15

Figure 20. Maximum and Minimum Temperatures for July and August in Selected Waters, Kennebec River Drainage, 2002

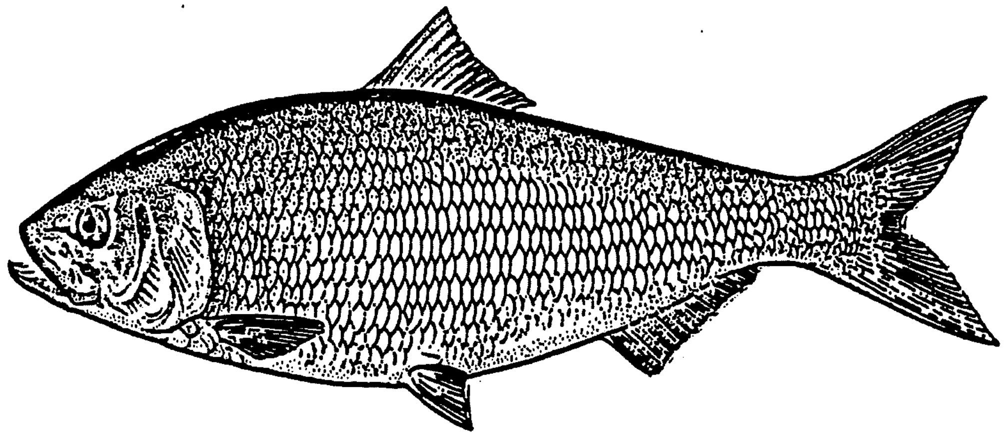




Temperature logger key: C=Cobbosseecontee, K=Kennebec River mainstem, M=Martin Stream, O=Outlet Stream, S=Sebasticook River, T=Togus Stream, Sa=Sandy River. The lower the number, the lower the logger was placed in the tributary or mainstem.

APPENDIX A--2002 Shad Hatchery Report

WALDOBORO SHAD HATCHERY



2002

ANNUAL REPORT

Carolyn, Samuel and Andrew Chapman

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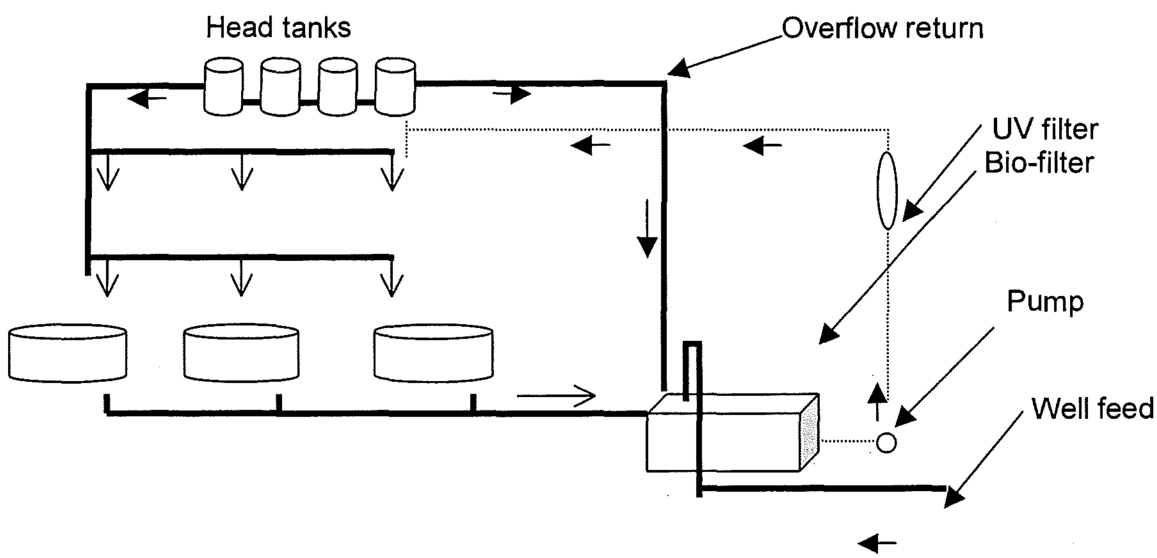
INTRODUCTION

In 1992, the Time and Tide Resource Conservation and Development Area Council, in cooperation with and financed by the Maine Department of Marine Resources, established a pilot shad hatchery in the town of Waldoboro, Maine. This operation was run in an 18' x 19' aluminum shed that had no running water or sanitary facilities. Water for the hatchery's operation was piped 325' from an artesian well overflow. Technology developed at the Susquehanna River Van Dyke Shad Hatchery proved to be very sound and reliable, and was adopted for use at the Waldoboro Shad Hatchery. The Waldoboro Hatchery has successfully operated from 1992 to 2002 and during that period provided 18,897,469 fry for distribution by the DMR.

BASIC HATCHERY CULTURE SYSTEM

Well water to the culture area comes through a raised head tank, a bank of four separate tanks, which provide constant low-pressure gravity-fed water through a 2" PVC pipe system.



DETAILED SYSTEM INFORMATION

Water coming into the building goes through a 50-micron filter and UV sterilizer before entering the head tank. The tank rests on a shelf close to the ceiling to provide water pressure and some height for the pipes above the culture tanks. Excess flow to the head tanks is allowed to return to a bio-filter recirculation tank where it is mixed with new water coming into the building, heated, aerated, and pumped back up into the head tanks. Seven 6' diameter x 3' deep fiberglass tanks were constructed locally and are positioned under the pipe system in a floor plan that allows easy access for culture and cleaning. Plastic upwelling incubators sit on tables beside the tanks. Newly hatched fry swim up to the top of the incubators and are automatically drained into the fry culture tanks; they are held in the tanks 10-20 days after hatching. Brine shrimp are the primary fry diet and a system to conveniently provide feed to all the tanks is required. Two fiberglass 125-gallon, conical bottom tanks were set up to supply the hatched brine shrimp for the fry. A 250-gallon fiberglass tank holds a day's supply of brine shrimp and is connected to a system of pipes, valves, and a timer that automatically feeds a plentiful diet of newly hatched shrimp over a 22-hour period to all the culture tanks simultaneously. The fiberglass tanks used to culture the fry are 6' in diameter and 3' deep, with a slight slope to the center drain. This drain is a threaded 2" fitting designed to accept a 2" standpipe, which in turn maintains the tank water level. All water flow out of the fry culture tanks is filtered and piped into the outflow end of the head tank bio-filter recirculation system. If a water crisis should develop, the larval culture tanks can be put into a temporary recirculation loop through the biofilter tank without stress to the fish in the tanks.

Tank effluent normally drains to a nearby pond, but the drain arrangement may be changed by opening and closing a series of valves in order to allow fry ready to be stocked to drain directly into the stocking tank on the bed of a ¾ -ton pickup.

TANK SPAWNING SETUP

The system consists of one 12' and two 15' diameter x 4' deep adult shad holding tanks that gravity drain into separate 3'x 3' x 8' bio-filter tanks from which treated water is pumped back into the spawning tanks at a rate of approximately 30 gallons per minute. Depending upon its size, each round spawning tank receives 5-7.5 gallons of new water per minute. Each bio-filter tank is now fitted with three 3000-watt stainless steel immersion heaters, each set of which provides as much heating capacity as a standard 30,000 BTU 40-gallon home hot water heater. The previous use of 4000-watt immersion heaters was an undersized heating capacity for maintaining optimal tank spawning temperatures early in the season. Each bio-filter tank has had its degassing capabilities augmented with the addition of aeration towers with extra surface-to-water enhancing media.

Because shad eggs sink, the spawning tank has to drain from the center bottom. To accomplish this, an 8" plastic collar is placed around the 4" overflow. This collar causes the water to drain from the center bottom of the tank, carrying along with it any eggs that naturally drift to the center. Water coming from the spawning tank enters the bio-filter tank through a 3" pipe tee that is drilled with ¾" holes and acts as a muffler in slowing down the water velocity and evenly diffusing water currents. Knitted polyethylene bags of 0.5mm mesh are tied onto both legs of the water muffler to collect eggs released by adult shad; the bags are changed each morning and the collected eggs are placed in incubators.

TANK SPAWNING SYSTEM - 2002 OPERATION

The system was operated in the same manner as that described in the 1999 report. The eggs from the tank spawning systems were produced without the use of hormones.

QUALITY OF BROODSTOCK

Broodstock adult shad transported to the hatchery by truck can exhibit obvious bruising about the head and inside the eyes, as well as severe scale loss. Any incoming shad that exhibit bruising about the head are either DOA or die soon after being transferred to the spawning tank. In addition to the bruised and traumatized shad, there is a significant percentage that are lightly battered and descaled. These shad soon become festooned with heavy patches of fungus and eventually die. Careful selection by the transport crew of only vigorous and blemish-free fish has been shown to have a dramatic positive effect on the overall survival of the transported shad.

Maintaining several spawning systems allows a separation of shad originating from different rivers, thus enabling hatchery personnel to observe a difference in survival rates between the populations and batches within a population.

For the 2002 season, the hatchery developed the theory that more fish would produce more eggs. Supposedly, three times as many fish would produce three times as many eggs. That theory only works if the proportions of female fish to male fish are properly balanced. The volume of eggs produced by the fish was not as great as expected due to a perceived preponderance of males to females in the tank system.

EGG VIABILITY

It has been noticed that some batches of eggs exhibit low viability due to the presence of small, immature eggs. These eggs contribute to nutrient loading and the promotion of fungal growth in the incubators that would be lessened if the small eggs were removed. Since 1998, all eggs delivered to or produced at the hatchery are sieved on a variety of mesh sizes. Past investigation has revealed that most eggs <2mm are not viable. Generally, only the eggs that are retained on a 2mm screen are selected for incubation.

ENUMERATION OF CULTURE TANK MORTALITY

During the hatchery season, waste that is routinely siphoned from the bottom of the culture tanks is sampled to determine larval mortality after hatching and up to the time of stocking. Individual tanks were/are not cleaned daily. It takes several days for detritus to develop and show on a tank bottom; therefore, the cleaning time interval varies from one batch of larvae to the next. When a tank is cleaned, the bottom waste is siphoned into several plastic buckets and diluted to 15 liters per bucket; the contents are suspended by mixing with an open hand. While a bucket is being mixed, three 10-ml samples are removed and emptied into three individual petri dishes. The live and dead larvae are counted separately, but both are counted as mortality. An average of the three samples, including live and dead larvae, are determined as larvae mortality per milliliter. The number of mortalities per bucket is estimated by multiplying the average of the three samples by 15,000. Finally, total mortality is estimated as the sum of the means of all the buckets. Mortalities were determined for all batches of cultured shad and are listed as "Fry discarded" in the data of Table 1. The number of fry discarded increases with amount of time they are maintained in the hatchery system.

HATCHERY PRODUCTION SUMMARY - 2002

Waldoboro Hatchery Tank Spawning System:

Merrimack River Shad

A total of 607 Merrimack River shad were delivered to the Waldoboro Shad Hatchery between May 28 and July 1. While in the system, the Merrimack fish producedapproximately 4,388,115 eggs with an average viability of 66%. Most of the incubated eggs (74.02 liters) were >2mm with an average viability of 68%. However, 425 mls of eggs <2mm that appeared to be fertilized (collected July 14, 26, and 30) were selected for incubation. These had an average viability of 47%. During culture, approximately 270, 594 shad fry were siphoned with waste from the bottom of the tanks and discarded into settling ponds. A total of 2,881,446 fry were stocked in the Kennebec and Sebasticook Rivers between June 21 and August 12. An additional 10,957 fingerlings were seined from the settling ponds and released into the Medomak River on September 12.

Kennebec River Shad

On July 10, a total of four adult shad captured at the confluence of the Kennebec and Sebasticook Rivers were delivered to the Waldoboro Shad Hatchery in good condition and placed in spawning Tank #1 with a number of Merrimack shad. Kennebec shad were not marked in any way to distinguish them from Merrimack fish. No eggs were produced in Tank #1 after the Kennebec fish were added.

Disposition of Adult Shad

After spawning, live adult shad were released into the nearby Medomak River. Sixty-six Merrimack shad were released on July 3. On August 8, an additional 203 shad were released, but four of these may have been of Kennebec origin and could not be distinguished from those of the Merrimack. Therefore, at least 265 Merrimack River shad (44%) and possibly four Kennebec shad were released alive. No mortalities were observed after these fish were released.

POND CULTURE

No shad fry were intentionally stocked into the ponds for rearing; however, fall fingerlings were produced as a result of fry either escaping from the hatchery culture tanks or caught when waste was removed from the bottom of the tanks. The culture tanks have a 500-micron nylon screen that fits tightly over the tank standpipe to prevent fry from escaping down the drains. Even so, when the standpipe screens are changed a few larvae escape. On September 20, 2002, approximately 11,000 three-inch fall fingerlings were seined from the hatchery pond system and released into the Medomak River by DMR personnel.

FRY AND FINGERLING STOCKING SUMMARY - 2002

Stock Date	Egg Source	Receiving Site	Number Released
06/21/02	Merrimack	Sebasticook River - Burnham	505,902
07/02/02	Merrimack	Kennebec River- Shawmut	420,379
07/03/02	Merrimack	Kennebec River - Shawmut	540,787
07/11/02	Merrimack	Kennebec River - Shawmut	470,453
07/17/02	Merrimack	Androscoggin River	295,725
07/23/02	Merrimack	Kennebec River - Fort Halifax	354,585
07/29/02	Merrimack	Kennebec River - Fort Halifax	90,828
08/07/02	Merrimack	Kennebec River - Shawmut	140,250
08/12/02	Merrimack	Kennebec River - Fort Halifax	62,537
09/12/02	Merrimack	Medomak River - Town landing	10,957

Total fry released - 2,881,446
Total fingerlings released - 10,957

Total Released 2,892,446

TABLE 1

Date	Source	Fry Tank	Incubator	Total egg volume (mls)	Volume eggs>2mm (mls)	Number eggs/10"	Number eggs/L	Total eggs >2mm	% Viability	Viable eggs >2mm	Fry started	Fry discarded	Fry stocked	Date stk	Location
5/29	Merrimack	1	1	2,375	925	99	69,404	64,199	0	0					
5/30	Merrimack	1	N/A	1,100	500	N/A	N/A	500							
5/31	Merrimack	1	2	1,900	800	95	61,770	49,416	0	0					
6/1	Merrimack	1	3	4,250	1,700	93	57,569	97,867	0	0					
6/2	Merrimack	1	4	3,700	2,600	94	60,039	156,101	62	96,783	6/6				
6/3	Merrimack	1	N/A	N/A	N/A	N/A	N/A	0							
6/4	Merrimack	1	N/A	N/A	N/A	N/A	N/A	0							
6/5	Merrimack	1	5	2,490	2,100	93	57,569	120,895	86	103,607	6/10				
6/6	Merrimack	1	6	4,425	3,925	90	52,286	205,223	80	164,178	6/11				
6/7	Merrimack	1	7	5,425	4,800	90	52,286	250,973	80	200,778	6/12				
6/8	Merrimack	1	8	635	310	96	63,570	19,707	49	9,656	6/12		505,902	6/21	Burnham
6/9	Merrimack	2	N/A	N/A	N/A	N/A	N/A	0							
6/10	Merrimack	2	9	3,150	2,850	87	47,017	133,998	86	115,239	6/13	3,066			
6/11	Merrimack	2	10	5,600	4,650	89	50,897	236,671	81	191,704	6/15				
6/12	Merrimack	2	11	350	250	97	65,436	16,359	92	15,050	6/16	1,067			
6/13	Merrimack	2	12	4,300	3,250	92	55,217	179,455	77	138,181	6/18	18,133			
6/14	Merrimack	2	13	925	625	97	65,436	40,898	60	24,539	6/18	45,767	420,379	7/2	Shawmut
6/15	Merrimack	N/A	N/A	840	190	106	86,093	16,358	0	0					
6/16	Merrimack	3	14	4,040	3,750	92	55,217	207,064	85	176,004	6/20	67			
6/17	Merrimack	3	15	4,900	4,300	90	55,286	237,730	56	133,129	6/20	400			
6/18	Merrimack	3	16	3,475	3,250	92	55,217	179,455	84	150,742	6/22				
6/19	Merrimack	3	17	5,250	3,800	88	48,912	185,866	66	122,671	6/23		540,787	7/3	Shawmut
6/20	Merrimack	4	18	1,950	1,800	88	48,912	88,042	76	66,912	6/24	32,667			
6/21	Merrimack	4	19	1,300	800	102	75,976	60,781	68	41,331	6/24				
6/22	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A	0							
6/23	Merrimack	4	20	4,200	3,800	91	53,724	204,151	91	185,778	6/27				
6/24	Merrimack	4	21	3,300	2,900	92	55,217	160,129	87	139,312	6/28	5,867			
6/25	Merrimack	4	22	542	195	100	71,507	13,944	85	11,852	6/29	14,000			
6/26	Merrimack	4	23	1,850	1,300	97	65,436	85,067	90	76,560	7/1	4,933	470,453	7/11	Shawmut
6/27	Merrimack	5	24	375	275	96	63,570	17,482	97	16,957	7/1	533			
6/28	Merrimack	5	25	1,400	900	96	63,570	57,213	89	50,920	7/2	3,633			

6/29	Merrimack	5	26	2,750	2,100	92	55,217	115,956	94	108,998	7/3	5,758			
6/30	Merrimack	5	27	725	350	96	63,570	22,250	76	16,910	7/4	18,933			
7/1	Merrimack	5	28	750	250	103	77,752	19,438	79	15,356	7/5	26,933			
7/2	Merrimack	N/A	N/A	0	0	N/A	N/A	0				2,800			
7/3	Merrimack	5	29	2,400	2,100	99	69,404	145,748	70	102,024	7/7	12,267	295,725	7/17	Andro
7/4	Merrimack	6	30	2,600	2,200	103	77,752	171,054	85	145,396	7/8	1,600			
7/5	Merrimack	6	31	170	90	106	86,093	7,748	93	7,206	7/9	8,000			
7/6	Merrimack	6	32	1,525	1,200	101	73,695	88,434	80	70,747	7/10	20,600			
7/7	Merrimack	6	33	440	350	97	65,436	22,903	81	18,551	7/11	3,200			
7/8	Merrimack	N/A	N/A	0	0	N/A	N/A	0				1,380			
7/9	Merrimack	6	34	2,110	1,950	97	65,436	127,600	83	105,908	7/13	4,520			
7/10	Merrimack	6	35	335	160	112	99,761	15,962	86	13,727	7/14	1,080	354,585	7/23	Ft.Halifax
7/11	Merrimack	7	36	1,000	900	88	48,912	44,021				520			
7/12	Merrimack	7	37	280	190	105	83,402	15,846	31	4,912	7/16	1,790			
7/13	Merrimack	7	38	825	750	99	69,404	52,053	60	31,232	7/16	3,680			
7/14	Merrimack	7	39A	500	500	105	83,402	41,701	76	31,693	7/18	560			
7/14	Merrimack	7	39B	275	0	137	150,000	41,250	13	5,363	7/18	560			
7/15	Merrimack	7	40	375	200	110	94,892	18,978	54	10,248	7/19	0	90,828	7/29	Ft.Halifax
7/16	Merrimack	7	41	715	640	94	60,039	38,425	47	18,060	7/19	240			
7/17	Merrimack	8	42	385	350	104	80,823	28,288	89	25,176	7/20	0			
7/18	Merrimack	N/A	N/A	0	0	N/A	N/A	0				0			
7/19	Merrimack	8	43	435	400	99	69,404	27,762	53	14,714	7/23	1,560			
7/20	Merrimack	8	44	280	250	104	80,823	20,206	75	15,155	7/24	0			
7/21	Merrimack	8	45	933	900	93	57,569	51,812	92	47,667	7/25	13,440			
7/22	Merrimack	8	46	400	250	107	87,497	21,874	56	12,249	7/26	0			
7/23	Merrimack	8	47	735	500	101	73,695	36,848	86	31,689	7/27	0			
7/24	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A					0	140,250	8/7	Shawmut
7/25	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A					1,560			
7/26	Merrimack	9	48A	100	100	111	98,089	9,809	9	883	7/30	0			
7/26	Merrimack	9	48B	150	0	130	150,000	22,500	59	13,275	7/30	0			
7/27	Merrimack	9	49	700	650	98	66,896	43,482	35	15,219	7/31	0			
7/28	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A						62,537	8/12	Ft.Halifax
7/29	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A								
7/30	Merrimack	9	50	250	0	118	150,000	37,500	70	26,250	8/1	0			
7/31	Merrimack	9	51	175	150	107	87,497	13,125	88	11,550	8/2	2,680			
8/1	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A								

8/2	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A					
8/3	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A				2,160	
8/4	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A					
8/5	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A				3,960	
8/6	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A					
8/7	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A					
8/8	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A					
8/9	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A					
8/10	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A					
8/11	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A					
8/12	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A				680	
	Total			**96,365**	**74,025**			**4,388,115**		**3,152,040**	**270,594**	**2,881,446**
												3,152,040
	Average					**99.22**	**71,918**		**67**			

Table 2

Date	Tank 1 (15')	Tank 2 (15')	Tank 3 (12')	Total number shad	Eggs >2mm	Eggs >2mm/ shad
5/28	103	61	0	164	0	0
5/29	103	58	0	161	64,199	391
5/30	158	153	0	311	500	3
5/31	157	175	103	435	49,416	159
6/1	159	169	102	430	97,867	225
6/2	156	168	101	425	156,101	363
6/3	155	168	101	424	0	0
6/4	152	165	100	417	0	0
6/5	149	156	96	401	120,895	290
6/6	147	150	93	390	205,223	512
6/7	141	144	87	372	250,973	644
6/8	136	141	85	362	19,707	53
6/9	136	133	81	350	0	0
6/10	132	125	80	337	133,998	383
6/11	130	125	76	331	236,671	702
6/12	185	183	99	467	16,359	49
6/13	183	180	96	459	179,455	384
6/14	181	180	94	455	40,898	89
6/15	180	179	89	448	16,358	36
6/16	177	176	87	440	207,064	0
6/17	177	176	86	439	237,730	0
6/18	174	176	84	434	179,455	409
6/19	171	173	81	425	185,866	428
6/20	169	168	77	414	88,042	207
6/21	169	167	77	413	60,781	147
6/22	167	163	76	406	0	0
6/23	154	158	76	388	204,151	503
6/24	153	157	75	385	160,129	413
6/25	153	154	75	382	13,944	36
6/26	153	150	75	378	85,067	223
6/27	153	149	70	372	17,482	46
6/28	152	148	69	369	57,213	154
6/29	151	148	68	367	115,956	314
6/30	151	147	68	366	22,250	61
7/1	151	160	67	378	19,438	53
7/2	150	158	67	375	0	0
7/3	150	155	66	371	145,748	389
7/4	149	153	0	302	171,054	461
7/5	148	151	0	299	7,748	26
7/6	148	149	0	297	88,434	296
7/7	148	146	0	294	22,903	77
7/8	148	143	0	291	0	0
7/9	148	142	0	290	127,600	438
7/10	152	141	0	293	15,962	55
7/11	151	140	0	291	44,021	150
7/12	150	139	0	289	15,846	54

7/13	150	139	0	289	52,053	180
7/14	149	138	0	287	82,951	287
7/15	148	137	0	285	18,978	66
7/16	146	137	0	283	38,425	135
7/17	145	136	0	281	28,288	100
7/18	145	136	0	281	0	0
7/19	144	135	0	279	27,762	99
7/20	144	135	0	279	20,206	72
7/21	143	134	0	277	51,812	186
7/22	142	134	0	276	21,874	79
7/23	141	134	0	275	36,848	134
7/24	137	134	0	271	0	0
7/25	136	132	0	268	0	0
7/26	134	130	0	264	32,309	121
7/27	133	128	0	261	43,482	165
7/28	131	126	0	257	0	0
7/29	130	125	0	255	0	0
7/30	129	121	0	250	37,500	147
7/31	125	119	0	244	13,125	53
8/1	123	119	0	242	0	0
8/2	116	117	0	233	0	0
8/3	108	112	0	220	0	0
8/4	105	112	0	217	0	0
8/5	99	110	0	209	0	0
8/6	93	108	0	201	0	0
8/7	97	106	0	203	0	0
8/8	0	0	0	0	0	0
8/9	0	0	0	0	0	0
Total					**4,388,116**	

APPENDIX B--Proposed 2003 Trap and Truck Budget

Job 1. Trap and Truck Alewives

Transfer of broodstock alewives via tank truck will begin in May and conclude in June. About 90% of the alewife habitat that has been stocked in past years is in the Sebasticook drainage, which means that the majority of returning adult alewives will home to the Sebasticook River.

Alewives will be trapped using the Transvac fish pump and storage tank that were employed last year at Fort Halifax. DMR personnel will remove trapped fish from the tank, sort all fish collected, remove undesirable species, pass other target species, and count and load alewives in the tank trucks. DMR personnel will transport the alewives and release them in the designated lake spawning habitat.

If blueback herring are captured, they may be stocked into riverine habitat above the Fort Halifax Dam. Alewife stocking goals for 2003 are summarized in Table 1.

Job 2. Trap and Truck of American Shad

Transfer of broodstock American shad via tank truck will begin in May and conclude in July. DMR expects to transfer about 1,000 shad broodstock to the shad hatchery. The broodstock transfers planned for 2003 can be split into three different types, based on origin:

1. DMR's first priority in 2003 will be to obtain adult shad broodstock at the Fort Halifax Dam. The project's owner, Florida Power Light and Energy (FPLE), is required by the *Kennebec River Settlement Accord* to install, operate, and maintain all measures necessary for the capture of adult shad broodstock. DMR will transport adult shad captured at Fort Halifax to the shad hatchery where they will be placed into a tank spawning system. Lengths, scales, and otoliths will be collected from all adult mortalities occurring at Fort Halifax, during transport, and at the hatchery.

2. DMR will transport American shad broodstock from the Cataract fish lift on the Saco River to the DMR-funded shad hatchery. These shad will also be utilized in tank spawning, as outlined above. The Saco shad are normally collected as their run picks up in June. Light loads will be used to transport the fish, since few are available per day and

the lower hauling densities help reduce hauling mortality and delayed mortality at the hatchery.

3. DMR will transport American shad broodstock from the Essex fish lift on the Merrimack River to the DMR-funded shad hatchery. These shad will also be utilized in tank spawning, as outlined above. DMR hopes to saturate the hatchery with Merrimack River broodstock early in the season. Once Kennebec and Saco River shad become available, DMR will remove Merrimack origin shad from the hatchery to make room for the Maine broodstock.

Job 3. Transportation of American Shad Larvae

DMR will load, transport, and release shad larvae produced at the hatchery. As the larvae reach 7 to 21 days old, they will be loaded into a transportation tank, trucked to the appropriate habitat, and released. This operation begins in mid-June and may continue through mid-August.

Job 4. Assessment of Young-of-Year American Shad and Alewives

DMR will sample young-of-year American shad in the segments of the Sebasticook and Kennebec Rivers that were stocked with shad fry, fall fingerlings, and adult broodstock. Sampling will occur between July and October and may include seining, fyke netting, trawling, electrofishing, or sampling downstream migrants at hydroelectric sites. Representative numbers of juvenile shad will be retained for otolith extraction and checked for tetracycline marks applied at the hatchery.

DMR will sample young-of-year alewives in both Great Moose Pond and Big Indian Lake, which are being stocked with broodstock alewives for the first time. Sampling will occur between July and October and may include seining, fyke netting, trawling, electrofishing, dip or cast netting, in addition to sampling downstream migrants at hydroelectric sites or lake outlet dams.

Job 5. Assessment of Downstream Passage of American Shad and Alewives

DMR will survey the outlet streams of lakes or ponds stocked with broodstock alewives to determine the feasibility of downstream migration of the postspawner adult and young-of-year alewives. Potential obstacles to passage will be recorded and revisited as the emigration of alewives is observed in the river system. Much of the stream survey work will take place in late June through August, with the follow up visits occurring as needed throughout the fall.

DMR will visit hydroelectric dams, as well as non-hydro dams, located below shad and alewife stocking sites and record observations regarding the availability, quality, and effectiveness of downstream passage at these sites. The proper authorities will be notified if problems are observed. Dam surveys may begin as early as June and will take place through November and the termination of alosid emigration.

Job 6. Studies of the Fish Assemblage of the Kennebec River:
Augusta to Waterville – Before and After Edwards Dam Removal

DMR collected some baseline data on the fish community in the impounded river above the Edwards Dam during the summer and fall of 1998 and summer of 1999. From 2000 through 2002, DMR sampled several sites between Augusta and Waterville to collect data on community assemblage. In addition, habitat data including DO, substrate type, water temperature and depth, flow, and measurements of bank stability and vegetation were collected. This effort will continue in 2003.

Sampling methods will include fyke netting, electrofishing, minnow trapping, trawling, and beach seining. Beach seines will be used as the primary means of capturing YOY fish. However, other means may need to be employed to capture adults. Samples will be collected biweekly from all sites and otoliths will be extracted from samples of American shad captured to determine the presence of an OTC mark.

Job 7. Temporary Fish Weir on Sevenmile Brook

The Maine Department of Inland Fisheries & Wildlife is slated to install a permanent fish barrier on Sevenmile Brook in 2003. Once the permanent fish barrier and counting station is installed, DMR will tend the trap daily during the alewife run to identify and enumerate all species and to selectively pass fish upstream.

Table 1.
Lakes and Ponds to be Stocked with Alewives (6 acre^{-1}) in 2003

Ponded Area	Surface Acreage	Stocking Target
Sebasticook Lake	4,288	25,728
Lovejoy Pond	324	1,944
Plymouth Pond	480	2,880
Pleasant Pond (Stetson)	768	4,608
Douglas Pond	525	3,150
Pattee Pond	712	4,272
Threemile Pond	1,077	6,462
Unity Pond	2,528	15,168
Webber Pond	1,252	7,512
Wesserunsett Lake	1,446	8,676
Big Indian Pond	990	5,940
Great Moose Lake	3,584	21,504

2003 Budget

	Q1	Q2	Q3	Q4	TOTAL
Personal Services	$24,943.26	$41,679.25	$43,646.37	$ 26,120.62	**$136,389.50**
Materials/Supplies	$ 1,700.00	$ 1,925.00	$ 375.00	$ 500.00	**$ 4,500.00**
Operations/Maintenance	$ 1,310.00	$ 3,881.00	$ 2,581.00	$ 1,319.88	**$ 9,091.88**
State Indirect Cost (2%)	$ 559.07	$ 949.71	$ 932.05	$ 558.81	**$ 2,999.63**
Capital					
TOTALS	**$28,512.33**	**$48,434.96**	**$47,534.41**	**$ 28,499.31**	**$152,981.00**

APPENDIX C--Proposed 2003 Kennebec River Atlantic Salmon Restoration Work Plan and Budget

Job 1. Perform Habitat Surveys on Tributaries of the Kennebec River

A standard habitat survey will be conducted on selected tributaries and the mainstem of the Kennebec River. Maine Atlantic Salmon Commission (MASC) staff from the Sidney office will record quantitative measurements (length, width, depth, etc.), substrate composition, suitability for juvenile rearing, spawning, and holding habitat for salmon and provide Global Positioning System (GPS) points for habitat breaks. Work will continue within the Sebasticook River drainage, the Sandy River, and mainstem Kennebec River below Skowhegan.

Job 2. Produce Geographic Information System Coverages

Using the habitat information collected above, MASC staff will produce Geographic Information System (GIS) coverages to display the location and estimate the amount of salmon habitat types available in the surveyed streams. Coverages produced from the 2001, 2002, and 2003 habitat surveys will also give us the ability to display redd locations and areas of critical importance to salmon in the lower mainstem and tributaries.

Job 3. Assess Current Atlantic Salmon Populations in the Kennebec River and Tributaries

The MASC staff will continue to electrofish Messalonskee, Sevenmile, and Togus Streams and Bond Brook to 1) add to the historical database for Togus Stream and Bond Brook, and 2) establish presence/absence and/or densities of salmon in the lower mainstem Kennebec River tributaries. In addition, other tributaries identified as having salmon habitat will be electrofished for the presence/absence of salmon or to establish baseline fish species composition information.

In a further effort to assess adult returns to the lower Kennebec River and its tributaries, complete redd counts will be conducted on all spawning habitat identified by the habitat surveys. This will entail surveying for evidence of spawning salmon in the mainstem Kennebec from Waterville/Winslow to Augusta and all lower mainstem tributaries to their first upstream obstruction.

Job 4. Obtain Temperature Profiles of Selected Kennebec River Tributaries

The MASC will monitor water temperature throughout the summer months in the Kennebec River and selected tributaries. Data loggers will be deployed in lower tributaries (e.g., Togus

Stream and Sebasticook River), the mid-Kennebec River portion of the drainage (e.g., Sandy River, Carrabassett River), and the mainstem of the Kennebec River below Madison to record summer river temperatures and to gain a better understanding of thermal regimes that may exist in streams with the potential for Atlantic salmon restoration.

Job 5. Streamside Incubation

MASC staff proposes to test six 5,000-egg capacity streamside incubators in the Sandy River. Incubating Atlantic salmon eggs remotely in this river will provide MASC with the following information and benefits: 1) success of fry hatching using water sources in the Sandy River drainage; 2) growth and survival of juvenile salmon in the Sandy River in concert with recently collected habitat information; 3) cost effectiveness for establishing a volunteer group streamside incubator program; and 4) experience building and operating streamside incubators.

A streamside incubator program operated successfully in remote locations within the Kennebec could be a viable option for restoration start-up until federal and/or state hatchery resources can be made available, privately-funded hatcheries are constructed, or private hatcheries are contracted to provide eggs and/or juvenile salmon of suitable stock.

Job 6. Annual Report and Recommendations

The MASC staff will produce an annual report with recommendations for future salmon efforts in the Kennebec River and its tributaries. These recommendations will be based upon available habitat, current populations status, and estimated salmon production potential in the waters currently accessible to salmon.

Job 7. Development, Updating, and Implementation of a Long-Range Restoration and Management Plan

The MASC staff will participate in joint planning and development of a comprehensive basin-wide fish management plan with the Departments of Marine Resources and Inland Fisheries and Wildlife. Long-term planning is necessary for the proper management of the existing Atlantic salmon resource and potential future expansion of a restoration program in the Kennebec River.

Job 8. Public Outreach

The MASC staff will participate in meetings, forums, round-tables, etc., as necessary to apprise public and private groups of MASC activities within the Kennebec River drainage. This will include interpretation, explanation, and promotion of MASC programs, policies, and concerns to the public, private organizations, stakeholders, and the media in the Kennebec River watershed.

2003 Budget	**Q1**	**Q2**	**Q3**	**Q4**	**Totals**
Personal Services	$5,007.60	$2,782.00	$7,233.20	$7,233.20	**$22,256.00**
Materials/Supplies	$1,500.00	$2,000.00	$2,000.00	$1,500.00	**$ 7,000.00**
Operations/Maintenance	$ 750.00	$1,500.00	$1,500.00	$ 750.00	**$ 4,500.00**
Capital	$3,000.00	$2,000.00	$1,500.00	$2,000.00	**$ 8,500.00**
Totals:	**$8,213.72**	**$7,363.72**	**$9,403.53**	**$8,444.29**	**$42,256.00**