Kennebec River Anadromous Fish Restoration
Annual Progress Report - 2005

Flood at Burnham Fishway

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Alewives were also hand bailed over the outlet dam to Webber Pond in Vassalboro, ME. On May 16th enough alewives had accumulated below the outlet dam to warrant hand bailing. A total of 17,346 alewives were captured over the course of 12 days at the base of the dam with dipnets and counted into Webber Pond. No alewife mortalities were recorded during this effort. Additionally, 754 Webber Pond alewives were trucked to Pleasant Pond in Gardiner to continue stocking efforts on the Cobbosseecontee drainage.

A total of 226 adult American shad broodstock were transferred to the Waldoboro hatchery from the Merrimack River. No attempt was made to capture broodstock from the Brunswick Fishway to augment hatchery broodstock in 2005.

Larval shad production in 2005 totaled 1.2 million. All but 96,000 were stocked in the Kennebec River below the Shawmut Project. The remaining 96,000 were stocked in the Androscoggin River. In mid September, 3,600 fingerlings were released into the Medomak River in Waldoboro.

DMR personnel checked pond outlet dams from July through November. Water levels were generally higher than those encountered in previous years and as a result, down stream passage was available during many of the inspections. Known beaver dam problem areas were also visited throughout the season with no problems occurring in 2005.

Bypass facilities were operating at all projects during all visits. A minor eel entrainment event occurred at the Benton Falls in early September. A total of 40 eels were located below the project on September 1st. The American Tissue Project, located on Cobbosseecontee Stream in Gardiner, re-installed intake grating in to prevent American eels from entering the turbine penstock. American Tissue also re-installed the plunge pool for out-migrant alewives. No dead eels or alewives were observed below the American Tissue Project in 2005.

DMR personnel conducted biweekly beach seine surveys at eight sites in the Kennebec River between Augusta and Waterville. A total of 41 seine hauls were made. A total of 762 juvenile alewives, 3,701 juvenile American shad and five American eels were captured. The catch/effort for juvenile shad was 92.53, compared to 16.2 in 2004.

Lockwood, Benton Falls and Burnham dams all began constructing fish passage facilities in 2005. Multiple large rain events in the fall of 2005 hampered construction efforts at all three projects. Despite construction delays all three projects anticipate being operational by May 1st, 2006.

DMR monitored upstream eel passage at the Ft. Halifax Project, Benton Falls Project, Burnham Project, and Hydro-Kennebec Project in 2005. Passage at all locations was poor due to extremely high runoff conditions. An estimated 7,816 eels passed Ft Halifax in 44 days, 469 passed Benton Falls in 38 days, and 2,979 passed Hydro-Kennebec in 50 days. A portable passage installed inside the coffer dam at Burnham for 14 days captured 742 eels, which were released above the project. Eels at Ft. Halifax ranged from 91-221 mm total length (TL) with peaks at 125-129 mm and 165-169 mm; at Benton Falls from 95-255 mm TL with a peak at 115-119 mm; at Burnham from 106-212 mm TL with a mode at 130-134 mm; and at Hydro-Kennebec from 90-187 mm TL with a mode of 115-199 mm.

Down stream eel passage was provided at the Burnham Project and the Benton Falls Project in 2005. The passage facility at Burnham is designed to address the problem of eels that travel down the penstock, and become trapped in the intake forebays by the trashracks. The passage facility consists of an entrance chamber connected to an exit pipe that moves water and eels from the turbine pit down through the turbine pit drain, which exits just before the draft tube, and into the tailrace. At Benton Falls a screen overlay with 1-inch clear space was installed on the intake of the large unit to physically exclude migrating eels, which then presumably would utilize the surface-opening bypass for anadromous fishes.

Introduction

The Kennebec River Restoration Program was initiated following the development of a Strategic Plan in 1985, an Operational Plan in 1986, and the signing of an Agreement in 1986 between the Department of Marine Resources (DMR) and the Kennebec Hydro Developers Group (KHDG). This Agreement provided a delay in fish passage requirements at seven hydropower facilities above Augusta in exchange for funds to initiate the restoration by means of trap-and-truck of alewife and American shad to selected upriver spawning and nursery habitat. In 1998, a new Agreement between state and federal fisheries agencies and the members of the KHDG was signed. The new Agreement provided for the removal of Edwards dam, included new timetables or triggers for fish passage at the seven hydropower facilities above Augusta, and provided additional funds to continue the restoration by trap-and-truck. A more detailed history of the restoration program, including management goals and objectives, is included in Appendix A.

1.0 ALEWIFE RESTORATION METHODS

1.1 *Trap, Transport, and Release*

DMR continued to utilize only Kennebec River adult alewife returns for release into Phase I restoration lakes (Figure 1) in 2005. Adult alewives were collected with a fish pump that had been installed as temporary upstream fish passage in 2000 at the Fort Halifax Project, located on the Sebasticook River.

The fish pump was configured and operated as in previous years. Briefly, the vacuum chamber and intake hoses were mounted on a platform above the turbine outlets, an 80-foot length of 10-inch diameter discharge pipe extended up the side of the powerhouse from the vacuum chamber to a receiving tank, and the intake pipe terminated in a three-foot long section of 10-inch diameter clear lexan. A chain hoist and ropes allowed the operator some adjustment in the intake apparatus.

The pump lifted and deposited alewives and water into a 2,270-gallon fiberglass receiving tank, measuring 9' x 7'6" x 4'6" deep, located at the top of the dam next to the powerhouse. Oxygen levels were maintained in the tank by a microporous delivery system. Supplemental water was supplied by an electric pump and two-inch hose that discharged onto the surface of the tank. Alewives were either caught in a dip net as they exited the discharge pipe or dip netted from the receiving tank, counted, and loaded into stocking tanks that had previously been filled with water pumped from the headpond. Special care was taken to insure that only alewives were dipped into the tanks. No carp, white catfish, or northern pike have been captured since the pump was employed at Fort Halifax in 2000. The stocking trucks are outfitted with pumps to circulate the water in the stocking tanks and with oxygen tanks and a porous pipe delivery system that introduces approximately six liters of oxygen/minute^{-1}. More complete descriptions of the fish pump, receiving tank, stocking tanks, stocking trucks, associated equipment, and fish handling protocols are provided in previous annual reports and are available from DMR upon request.

1.2 *Overview*

On May 10th, 2005, the interim fish pump was installed below the Fort Halifax Hydroelectric Project in Winslow, Maine. Stocking operations were delayed until adequate numbers of alewives were available for pumping. By May 17, the numbers had increased enough to warrant the onset of trucking operations. On May 21st high river flows and depressed water temperatures due to a large 3 day rain event ended pumping operations for ten days. On June 2nd adequate numbers of alewives had returned to the tailrace and stocking operations resumed.

On June 23rd FPL operations personnel replaced the project's flashboards. The headpond was drawn to below crest and the flashboards were installed. FPL has instituted new guidelines for operations personnel and biologists during the herring migration season that state spill over the crest of the dam is to be maintained until FPL biologists safely remove any fish from the ledges to prevent stranding when spill is discontinued. Once the flashboards are installed, the headpond level is to be maintained 0.5 feet below the top of the boards. These procedures, coupled with relatively low spring flows, prevented spill over the crest of the dam onto the south ledges, thereby preventing alewives from ascending the ledges and possibly becoming stranded with the loss of spill.

Between May 17th and June 4th, 2005, a total of 82,475 alewives were collected with the fish pump. It operated for a total of 10 days (seven fewer than in 2004) and an average 8,247 adult alewives (8,584 in 2004) was 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, commercial fishing effort and trip length.

The timing of the alewife run was a little earlier than average (Table 1). Historically (1994-2004), the mean date by which 50% of alewives have been collected is May 24. In 2005, the 50% date of alewife trapping was May 21 (Day 5 of pump operation). The 25% quartile was reached on May 18; the 75% quartile was reached on June 3rd.

Based on 11 years of data (1994-2004), the average peak date of alewife pumping is May 22. In 2005, the peak was on May 18 when 15,281 alewives collected with the fish pump; however, there were also 15,139 alewives collected on May 19 and 13,988 collected on June 3rd (Table 2). The number of mortalities due to handling was very low in 2005. Overall handling mortality was .44%. Trucking mortality was very low; 23 fish, in 2005 compared to 186in 2004 for a trucking mortality rate of 0.03%. Pump mortality at Fort Halifax was 338 individuals. Hhowever, 296 mortalities were the result of two emergency shutdowns where the Fort Halifax Project lost power. It should be noted that several thousand fish were released alive during these shutdowns. The 296 mortalities consisted of the fish trapped in the pipe system until power was restored.

Phase I Habitat

In 2005, a total of 73,463 brood stock alewives were stocked into 10 of the 12 upriver Phase I lakes in the Kennebec River watershed (Table 3). An additional 17,346 were hand-dipped at Webber Pond bringing total transfers to 90,809. Three-Mile and Three-cornered Pond were not stocked in 2005, however due to the high spring flows resulting in good passage adult alewives did migrate upstream from Webber Pond. An individual adult and juvenile were captured at the outlet of Three-mile Pond on October 14th in a Fyke Net. It is unknown how many individuals may have migrated into Three-mile or Three-cornered Ponds. DMR employees surveyed the stream connecting Three-mile and Webber Ponds in July and concluded that even at the then low water conditions that there was adequate passage between the two water bodies for migrating alewives.

In total, 38 alewife-stocking trips (54 tanks) were made to the upriver ponds in 2005, averaging 1,399 alewives per tank (Tables 4 & 5). All 38 trips originated from Fort Halifax, as the Sebasticook River was once again the sole source of alewife broodstock. The alewife stocking program in the Phase I lakes required 10 days to complete between May 16th and June 7th, 2004. The most stocking trips completed to the Phase I ponds in one day was seven, occurring on May 18th and 19th.

Phase II Restoration

No Phase II lakes were stocked in 2005. DMR delayed stocking of Great Moose Pond until improvements can be made in the down stream passage facility. The plunging flow lands on ledge. A plunge pool needs to be constructed or the pipe needs to be extended before alewives are stocked in Great Moose Pond. DMR continued to focus its efforts on obtaining fish passage in the Pioneer and Waverly dams in Pittsfield. DMR met with town officials and The Natural Resources Conservation Service to investigate funding possibilities.

Non-Phase I Transfers

In 2005, transfers from Fort Halifax to waters other than Phase I lakes totaled 8,113 alewives loaded, with 0 trucking mortalities (Table 6). The stocking of non-Phase I habitat with Fort Halifax alewives was far less than previous years due to the reduced number of alewives captured with the fish pump at Fort Halifax. Unusually high spring flows resulted in reduced catchability of alewives at the Fort Halifax project.

The non-Phase I transfers included two ponds within the Kennebec drainage and two ponds in other drainages. Non-Phase I transfers began on June 6th to Lower Patten Pond in Union and Webber Pond in Bremen and continued until June 9th. Alewives transferred to waters other than the Phase I lakes represented 7.3% of the total number trapped at Winslow.

1.3 *Adult Alewife Biosamples*

On five different days between May 16 and June 7, DMR personnel sampled 50 adult alewives collected at Fort Halifax. All samples were collected using the fish pump by dipping them out of the pump-receiving tank or by dipping them directly out of the river. Due to the presence of blueback herring in the Kennebec River, all samples were identified using the guidelines of Liem[1], 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 250 fish collected, identified, and measured, only two (0.8%) fish was identified as a blueback herring, thereby reducing the number of alewives sampled to 248. Of those 248, 47% were females and 53% were males. Males were more abundant than females in all the samples (Figure 2).

On average, adult female alewives collected in 2005 were larger than those collected in 2004. Adult females collected in 2005 were 5 mm longer (mean = 278 mm) than in 2004 (mean = 273 mm) however, they were 2 mm shorter than those collected in 2003 (mean = 280). Additionally, those collected in 2005 were 3.1g heavier (mean = 184.6g) than in 2004 (mean = 173.9 g). Adult males collected in 2005 were 2 mm shorter in length (mean = 271 mm) than the 2004 samples (mean = 273 mm) however, they were 1 mm longer than those captured in 2003 (mean = 270mm). They averaged 7.1 g lighter (mean = 162.9g) in 2005 than in 2004 (mean =174.0 g).

[1] 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.

In 2005, there were minor differences in length and weight, both between sexes and over time. On average, females were longer (278 mm) than males (271 mm). In addition, females were heavier (184.6g) than males (162.9g). 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 16 were longer and heavier (277.44 mm and 182.8 g) than fish collected during the last sample on June 7 (266.6 mm and 158.6 g).

Of the 248 alewives sampled, scales were collected from 80 fish. Most of those sampled were Age IV (43.8%) and Age V males (8.8%). Age IV (33.8%) and Age V females (11.3%) were the next most abundant age classes. Within each sex, Age IV fish dominated the samples: 79.5% of males sampled and 75.0% of females sampled were four-year-olds (Table 7).

1.4 *Commercial Alewife Harvest*

In 2005, the Maine Department of Inland Fisheries and Wildlife (IFW) issued 25 permits to commercial fishermen for the harvest of alewives below Fort Halifax dam in Winslow (Figure 5). There was a 48-hour closure period on the commercial harvesting of alewives beginning at midnight Friday and lasting until midnight the following Sunday. A 150-foot closure area surrounded the intake of the fish pump, a latter condition added to provide DMR/FPL personnel space to work in the river below the dam if needed. As of February 4, 2005, only 11 permit holders had reported their landings for a total of 149,629 alewives (1,247 bushels) harvested, compared to 102,480 alewives (854 bushels) harvested in 2004. It is likely that a small number of crews, 2 or 3 accounted for the majority of the landings reported.

Year	# Permit Holders Reported	Bushel/Fish
2005	11 of 25	1247/149,629
2004	17 of 26	854/102,480
2003	13 of 30	1137/136,440
2002	? of 29	3817/458,040

2.0 AMERICAN SHAD RESTORATION METHODS

2.1 *Adult Capture and Transport*

The shad culture program initiated in 1991 was continued in 2005. The Kennebec River Shad Restoration Program began as a cooperative effort between the 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 now privately owned and operated by Sam Chapman. It 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.

In 2005, the Merrimack River Technical Advisory Committee granted approval for DMR to transport up to 1,660 adult shad (60 for required fish health workup[2] and the remainder for the hatchery and Androscoggin River) from the Merrimack River's Essex fish lift (operated by CHI) to the Waldoboro hatchery. Transfer of adult shad broodstock from the Essex fish lift to the Waldoboro Shad Hatchery began on June 24th; a total of seven trips were made. There were some delays due to high spring flows and low water temperatures (Table 8). Of the 253 shad loaded at the Essex lift, 226 were released alive into the adult spawning tank, resulting in a hauling mortality of 10.7%. Hauling mortality decreased from 2004 level of 14.5 %. This may be the result of lower fish densities in the transport tanks due to the scarcity of fish in 2005 at the Essex fish lift. The hauling mortality in 2005 was inflated due to a single incident when 22 of 80 fish were lost when a 6 ft. diameter 750 gal. tank was used rather than the normal 7 ft. 1000 gal. tank. It is believed the combination of the density 1 fish per 9.3 gal and the tighter turning radius within the tank increased fish stress levels resulting in a 27.5% hauling mortality for that haul. Excluding that one incident hauling mortality for the year was 2.9%.

Between June 24 and July 1, DMR successfully transferred 226 adult American shad broodstock from the Merrimack River to the Waldoboro hatchery for tank spawning. In order to improve egg production at the hatchery, Andy Chapman accompanied DMR staff and hand-

[2] A 60-fish sample of adult American shad (from 226 adults transported from the Essex Fish Lift) was collected at Waldoboro Shad Hatchery Waldoboro, ME. 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.

selected large healthy females as broodstock, as well as healthy males. All 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.

No American shad were captured with the Fort Halifax fish pump in 2005 and no attempt was made by either DMR or FPL staff to capture broodstock shad from the Kennebec and Sebasticook Rivers.

2.2 *Larval Culture and Transport*

All adult shad transported to the hatchery were placed immediately into either one of the two 15-foot diameter spawning tanks. Shad were allowed to spawn "naturally," the eggs collected daily and placed into upwelling incubator jars, and reared to approximately 6-13 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. Otoliths from a 20-fish sample from each batch of fish were examined for OTC mark retention.

Larval shad are loaded into a stocking tank and released directly into the target river. At the hatchery, they 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 of oxygen are 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 2005, no larval shad were intentionally released into the outdoor hatchery ponds for the production of fingerlings.

Between July 15 and July 26, an estimated 1,105,343 shad larvae ranging from 6-13 days old were released just below the Shawmut Project on the Kennebec River (Table 9). In addition, 11,850 were released to the University of New Hampshire for studies and 96,551 were released into the Androscoggin River, for a total larval shad stocking of 1,213,744. The 2005 total of 1,105,343 larvae released into the Kennebec drainage is less than 2004 number (5,442,136), and is lower than average (Figure 6). The lower number of larval shad released in 2005 is attributed to the lower number of adult shad available to the hatchery.

No shad larvae were intentionally stocked into the three culture ponds at the hatchery in 2005; however, runoff from the upwelling incubators drains into these ponds and typically some eggs/larvae are drawn out by the action of the incubators. Since the number of larvae escaping to the ponds is unknown, the ponds are monitored and the larvae/juveniles fed accordingly. On Sept 15th, the first pond was beach seined and approximately 3,600 young fingerlings were subsequently released into the Medomak River. The number of fingerlings released in 2005 was much lower than average due to better retention techniques developed during hatchery operations (Figure 7). For a complete description of 2005 shad hatchery operations, refer to Appendix B, *Waldoboro Shad Hatchery 2005 Annual Report*.

Based on the results of over a decade of research in the successful American shad restoration of the Connecticut River, DMR biologists have estimated the production potential of shad in the Kennebec watershed. Table 10 shows the yearly natural production potential by river segment, adjusted for 10% mortality resulting from passage through each hydroelectric facility in the river reach, within the historical range of American shad.

In 2005, DMR personnel made few observations at the Fort Halifax tailrace for the presence of shad. Due to the high water in the spring of 2005 and not having flashboards in place observations were difficult at best. No shad were observed in the tailrace.

2.3 *Juvenile Assessment*

Since all young-of-year shad released from the hatchery are marked with OTC (marks confirmed by DMR at time of stocking) , 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. Young-of-year shad were collected during biweekly beach seine surveys (see FISH COMMUNITY ASSESSMENT 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 placed 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. Otoliths were successfully processed for 451 juvenile shad collected collected in 2005. Of the 451 shad only 11 individuals contained an OTC mark demonstrating a hatchery origin contribution of 2.44% of our samples. This is higher than in previous years. In 2004 and 2003 hatchery contribution was 1.55%. The average hatchery contribution since 2000 is 1.92%

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 Juvenile Abundance Index (JAI) for young-of-year shad for this newly reopened stretch of river.

During the 2005 beach seine effort, 3,701 juvenile shad were captured at three different sites, with the highest number captured at Site 8C. This site is located approximately 2170 meters Upstream from Augusta Memorial Bridge.

A JAI was calculated for juvenile shad captured in 2005 (Table 11). The index for all sites was 92.53 shad/seine haul. Of all the sites sampled in 2005, Site 8C had the highest comparative JAI of 400.4 shad/seine haul, which is the highest JAI for an individual site in the four years of sampling. Site 2 had the second highest comparative JAI of 334 shad/seine haul, which is the second highest JAI for an individual site in the four years of sampling. Depending on river flows, there is slack water or an eddy at Site 2. Habitat suitability models indicate that larval shad prefer large eddies[3], which may explain why younger shad are found there.

[3] 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.

3.0 STATUS OF FISH PASSAGE

Upstream Passage, Sebasticook River – Fort Halifax, Benton, & Burnham

Per the KHDG Agreement and the Project License, FPLE was required to install a permanent upstream fish lift at **Fort Halifax** by May 1, 2003, or breach the dam in 2003. In 2002, FPLE proposed to decommission and partially breach the dam in order to provide upstream passage. FERC approved FPLE's Application to Surrender its license and partially breach the dam on January 23, 2004. A request for rehearing was filed by the Town of Winslow on February 19, 2004 and by Save our Sebasticook (SOS) on February 20, 2004. The requests were denied by FERC on May 6, 2004. SOS subsequently filed a petition for review of Final Agency Action with the U.S. Court of Appeals for the District of Columbia Circuit. The Maine Department of Environmental Protection issued an Order approving the breaching of the Fort Halifax dam on May 27, 2004. On August 16, 2004, SOS filed an appeal of DEP's action. The appeal was denied by the Board of Environmental Protection on February 22, 2005. SOS and other plaintiffs filed a Complaint for Declaratory and Other Relief with Maine Superior Court on August 16, 2004, seeking to invalidate the *Lower Kennebec River Comprehensive Hydropower Settlement Accord*. On October 12th, 2005 the Maine Supreme Judicial Court upheld the decision by the Kennebec County Superior Court to dismiss the complaint filed by Save Our Sebasticook challenging the validity of the 1998 Kennebec Hydro Developers Group (KHDG) Agreement which requires fish passage at seven dams on the Kennebec and Sebasticook Rivers. The complaint was dismissed by the Courts on the grounds that it was untimely. The appeal filed by S.O.S. of the DEP decision approving the removal of Ft. Halifax Dam is still pending in the Kennebec County Superior Court. The appeal filed by S.O.S. of the FERC decision approving the removal of Ft. Halifax Dam has been dismissed by the D.C. Circuit Court of Appeals. Therefore, FPLE has proposed, and DMR has concurred, to continue the trap-and-truck or trap-and-sort programs from the Fort Halifax dam in 2006.

Upstream passages at the **Benton Falls** and **Burnham dams** were required to be operational one year following the installation of permanent or temporary upstream fish passage at Fort Halifax and following installation of permanent upstream fish passage at four upriver non-hydro dams. These projects included the implementation of interim upstream passage measures at Fort Halifax dam and the construction of fishways at the Pleasant Pond dam in Stetson, the Plymouth Pond dam in Plymouth, the Sebasticook Lake outlet dam in Newport, and the removal of the Guilford dam in Newport. These projects were completed on June 13, 2003, triggering a June 14, 2004 date for fish passage to be operational.

In regard to passage at Benton Falls, the Licensee submitted functional design drawings to FERC for a fish lift at the facility on January 3, 2005 and was subsequently approved by FERC on January 24, 2005. Fishway construction commenced mid summer 2005 (Figure 8). Due to numerous flood events and unusually high water, setbacks in construction have been experienced. The fish lift facility is scheduled to be operational by May 1, 2006.
DMR, IFW, USFWS, and the Licensee have developed an agreement to incorporate a trapping and sorting facility in the Benton Falls fish passage facility. Functional design drawings were approved on January 13, 2006.

The Burnham Project submitted its final design drawings to FERC on February 14, 2005. Construction began on the Burnham Fishlift early in the summer of 2005. Due to numerous flood events and unusually high water, setbacks in construction have been experienced. The fish lift facility is scheduled to be operational by May 1, 2006

Kennebec River – Lockwood

The *Lower Kennebec River Comprehensive Hydropower Settlement Accord* requires that the Licensee install a trap, lift, and transfer facility at the project's powerhouses. These facilities are to be operational by May 1, 2006. The Licensee submitted final design drawings to FERC on February 1, 2005. Construction commenced in early summer of 2005 (Figure 11). Due to numerous flood events and unusually high water, setbacks in construction have been experienced however, the fish lift facility is still scheduled to be operational on time (Figure 12) (on May 1, 2006).

3.1 *Monitoring of Down stream Fish Passage at Phase I Lake Outlets*

Starting in July, DMR personnel surveyed ten lake outlets regularly through the end 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, Threemile Pond in China, Corundal Lake in Corinna and Lovejoy Pond in Albion. The results are summarized in Table 12 and are briefly described below.

Sebasticook Lake outlet was checked on 20 days to ensure fishway operation. On two of the 20 visits, juvenile alewives were noted using the fishway as down stream passage. The lake drawdown after Labor Day eventually caused the fishway to dewater, but ample opportunity remained for down stream passage through the opened gates. A few adult and juvenile alewives became stranded in the lower pools of the fishway with its dewatering during the lake drawdown; as many as possible were returned to the river below the outlet.

Pleasant Pond in Stetson was visited seventeen times from July 8th through November 21st. Of those 17 visits, down stream passage was available 13 times. DMR personnel observed juvenile alewives above the dam passing down stream and in the river below on August 31st.

Plymouth Pond was checked on 20 days from July 8 through November 21st. Passage was available at Plymouth Pond on all visits, either through the fishway or over the crest of the dam.

Wesserunsett Lake in Skowhegan was surveyed 15 times from July 8th through November 21st. Passage was available during 8 site visits. Passage was not available from early August through early October.

Unity Pond has no outlet dam and has excellent down stream passage into the Twentyfive Mile Stream on all but the driest of years. Unity Pond outlet was checked 14 times from July 11 through November 10th 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 the 20 visits to Webber Pond, (July 12-Nov.10) passage was available all 20 times.

Pattee Pond has no outlet dam and in the past has demonstrated fair to excellent out-migration of alewives. In the past, low water levels combined with a beaver dam obstruction during the summer and early fall made passage out of Pattee Pond difficult, if not impossible. 2005 had plenty of rain events in the fall which should have allowed more than adequate passage for out migrating juvenile alewives. Pattee Pond was visited 12 times and passage was available on all visits.

Three-mile Pond outlet was visited 14 times between July 11 and November 10. Three-mile does not have an outlet dam however, immediately down stream of the outlet the flow enters a wide shallow heavily shrubbed area where passage was questionable. DMR personnel assessed down stream passage below this point to where the flow enters Webber Pond and found passage to be sufficient throughout the low summer water levels. DMR personnel also spent time clearing passage through the shrubbed area and will continue those efforts in 2006.

It was documented that passage was sufficient for adult alewives to migrate up from Webber Pond in the spring and successfully spawn in Three-mile Pond during the high spring flows. During the fall rains in late October and November, down stream passage became readily available again and adult and juvenile fish were documents leaving the system.

Generally, lake outlets were checked on the same schedule as hydropower facilities. Whenever possible, areas known to be past problems for out-migrant alewives and shad were inspected and debris/blockages removed.

3.2 *Monitoring of Down stream Fish Passage at KHDG 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 down stream 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 hydropower project staff to ensure passage effectiveness.

To date, down stream passage effectiveness studies have been conducted at Benton Falls (1995) and Fort Halifax (1997). In addition, qualitative assessments are being recorded at the interim down stream passage facilities at Lockwood and Shawmut. At Hydro-Kennebec, qualitative observations are being conducted by plant personnel to assess whether or not passing juvenile alosines through the turbines has an impact on out-migrant alosine 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. As of this writing Hydro-Kennebec is pursuing plans to install a down stream bypass for American eels, salmon, shad and alewives. At the Burnham Project, permanent down stream passage was installed ahead of schedule. However, since Ridgewood Renewable Power has chosen to pass less than the anticipated minimum bypass flow, the down stream bypass has been considered an interim facility. As such, Ridgewood is conducting qualitative studies in accordance with the Agreement.

Down stream passage at hydropower facilities located on the Sebasticook and Kennebec Rivers was monitored through the summer and fall of 2005. Facilities were visited routinely to assess any problems that down stream migrating juveniles might encounter. The condition and operation of down stream 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 down stream 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 down stream bypass. The down stream 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 2005 season. DMR made 19 visits to the Fort Halifax dam in 2005. All visits found the down stream bypass open and functioning. Observations of the down stream bypass operation were made from the south shore when access to the powerhouse was not available. Juvenile alewives were observed in the Fort Halifax Headpond on both July 28th and September 6th. On Sept. 6th Juvenile alewives were also observed in the river immediately below the Fort Halifax Project.

The **Benton Falls** Project is equipped with permanent down stream 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. During the 2005 season the weirs above both the large and small turbine were open.

DMR personnel made 18 visits to make observations of down stream passage capabilities at Benton Falls in 2005. Due to past problems of debris blocking down stream passage via the bypass, DMR made a more concerted effort to observe this area in 2005. The bypass entrance was open and the facility appeared to be operating properly during each of the site visits and problems associated with debris from the headpond plugging the entrance were not observed. Juvenile alewives were observed in the Benton Falls headpond on July 25th. Thousands of fish could be seen dimpling the surface and swimming along the dam abutment near the down stream passage entrance. At this time no fish were observed using the down stream passage facilities or were observed in the river below.

DMR personnel made 19 visits to the **Burnham** Project in 2005. All inspections found the down stream bypass entrance open and operating according to interim passage requirements. On September 29 a small number of juvenile alewives were observed in the turbine tailrace. Due to the construction of the fishlift temporary down stream passage consisted of a the removal of the flashboard closest to the turbine intake for the summer/fall of 2005.

Down stream passage through the bypass was available during each of the 17 site visits to the **Pioneer** dam in Pittsfield. No overlays had been placed on the intake racks at the project. No juvenile alewives were observed using the down stream passage facilities on any visit.

DMR visited the **Waverly Avenue** dam on 17 occasions during the 2005 season. Down stream passage was available at the site on all occasions. Problems encountered during the 2005 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 down stream 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. No overlay was installed on the intake racks in 2005.

DMR visited both the **Lockwood** and **Hydro-Kennebec** dams as often as possible in 2005. Both of these projects are located on the Kennebec River and must pass all down stream 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 2005 season, interim down stream passage at Lockwood was made available through the power canal trash sluice, which is located near the turbine trash racks. Interim down stream passage at Hydro-Kennebec is achieved by passing out-migrants through the project turbines. No juvenile alosines were observed at either facility

Neither of these two interim passage measures have been approved as adequate for the required permanent down stream passage to be implemented at these hydro projects.

3.3 *Cobbosseecontee Stream Fish Passage*

The Department of Marine Resources is in the process of developing a Diadromous Fish Restoration Plan for the Cobbosseecontee Stream watershed. Presently, the draft is being reviewed within the Department, after which it will be forwarded to IF&W and the Atlantic Salmon Commission (ASC) for review. Several consecutive years of fish kills involving out-migrating alewives and American eels have prompted the DMR to begin to focus on these important fisheries. Both DMR and the USFWS have approved interim plans for down stream fish passage in the form of a flashboard notch and plunge pool. At the current stocking density in Pleasant Pond (the only waterbody in the watershed presently stocked with adult alewives) and resulting alewife offspring production, this bypass method has been successful the past four seasons.

In 2005 the plunge pool was reinstalled as well as the punch plate, (extending from the bottom to within eight feet of the surface), at the American Tissue Project on Cobbosseecontee Stream. No evidence of eel entrainment was noted during multiple site visits in the 2005. In conjunction with the punch plate the deep gate was opened and appeared to successfully pass eels. Alewives appeared to use the plunge pool successfully as none were noted dead or injured below the project site.

4.0 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. DMR staff have observed 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, and even a harbor seal, 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 down stream 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 ledges, 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 10 per resident species. If American shad were captured (Figure 13) a random sample was placed on ice and brought back to the DMR office in Hallowell for otolith work (see Section 3.0 of this report).

Data Analysis

Seining surveys for the 2005 season commenced on July 20. The sampling sites consisted of the same sites as those of late 2002.

A total of 41 seine hauls were made during the community assessment survey on the Kennebec River upstream of the site of the former Edwards dam. A total of 5,753 fish representing 19 species were captured and identified. Of those, total length was assessed for 1,033 fish. Fish of questionable identity were placed on ice for later identification. For a breakdown of diadromous fish captured by site, refer to Table 14.

5.0 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 down stream fish passage measures, based on radio telemetry and other tracking mechanisms and field observations.

5.1 *Upstream passage*

Introduction

DMR biologists initiated a three-year study in 1999 that used a combination of portable passages and visual observations to determine where juvenile eels pass or attempt to pass upstream at each of the seven KHDG facilities. During the first year of the study, DMR discovered that most eels were unable to pass the first dam on the Sebasticook River (Ft. Halifax Dam). Because the lack of passage had implications for the upstream projects, DMR constructed an eel passage (ramp) and trapping facility in 2000, which they have installed and operated at the Ft. Halifax Dam for six years.

In 2001, after three years of study, DMR made recommendations on the appropriate locations for upstream eel passage at four facilities (Benton Falls, Burnham, Hydro-Kennebec and Shawmut), and recommended that additional observations were needed at Lockwood and Weston. An eel passage was installed at the Benton Falls Dam during the summer of 2001, at the Shawmut Dam in the summer of 2003, at the Hydro-Kennebec Dam in 2004 (an experimental passage installed in 2002 was destroyed by ice in 2003), and at the Weston Dam in 2005. Upstream eel passage is expected to be operational at Lockwood in 2006. An additional year of observation may be necessary at Burnham, because the upstream anadromous passage facility (fishlift) constructed in 2005-2006 may have changed flow patterns at the spillway.

Methods

In 2005, DMR installed and operated the eel passage at the Ft. Halifax Dam, assisted with the installation of eel passage at the Benton Falls Dam, and installed a portable passage as an interim measure at the Burnham Dam. These passages have been described in previous reports. DMR enumerated all eels passed at these projects and the Hydro-Kennebec Project, and collected length and weight information on subsamples. In general, the passages were operated seven days per week, and were 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.

Results and discussion

Passage at all locations was poor in 2005 due to extremely high runoff conditions. Flows on the Sebasticook River and mainstem Kennebec River were well above median daily steamflow based on 75 years of record on the Sebasticook and 19 years on the Kennebec (Fig. 14).

The passage at Ft. Halifax Project became operational about three weeks later than usual. Flashboards were installed at the project on 6/14 when discharge dropped below 700 cfs; discharge subsequently increased, and did not decline to 700 cfs until 6/26. The passage was operated for a total of 44 days between 6/28 and 8/29, and passed an estimated 7,816 eels, the lowest number in seven years of operation (Table 15). Nearly all the eels moved upstream during the first month the passage operated (Fig. 15), a pattern that has occurred in most years. Eels ranged from 91-221 mm total length (TL), similar to previous years. However, the size distribution was bimodal (Fig. 16; peaks at 125-129 mm and 165-169 mm), unlike the pattern seen in other years. From 1999 to 2003, the distribution was unimodal with a peak at 105-114 mm (120-129 mm in 2003), and in 2004 the distribution was multimodal (115-199mm, 180-194 mm, and >199 mm).

The passage at Benton Falls Project did not become operational until mid-July because of high flows, spill due to construction of anadromous fish passage, and repair of the eel passage. It operated for 38 days between 7/13 and 8/29, and passed 469 eels, the lowest number to date (Table 15). Most of the eels were captured on a single day (Fig. 17). Eels using the passage ranged from 95-255 mm TL. Unlike the previous three years, the size distribution of eels was unimodal (Fig. 18; peak at 115-119 mm).

A portable eel passage was installed at the Burnham Project in 2005. It was placed inside a coffer dam that was erected to permit construction of the anadromous fish lift, and was operated during the final stages of coffer dam dewatering. The portable passage was operated for 14 days from 7/26 to 8/12 during which time 742 eels were collected. Most of the eels were captured the first day the passage was in operation (Fig. 19). They ranged from 106-212 mm TL with a mode at 130-134 mm (Fig. 20).

Eel passage at the Hydro-Kennebec Project was operational for 50 days between 7/8 and 8/26. During this period a total of 2, 979 eels used the passage to migrate upstream, although the majority of movement occurred during a 30 day period (Figure 21). Eels ranged from 90-187 mm TL with a mode of 115-199 mm (Fig. 22).

5.2 *Down stream migration*

Introduction

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

Methods and discussion

In 2005, DMR consulted with Benton Falls Associates ("BFA") and with Ridgewood Power Management LLC ("Ridgewood") on several occasions regarding the provision of down stream eel passage at the Benton Falls Project and the Burnham Project, respectively. Experimental down stream passage facilities were installed at each of these sites in 2005. In addition, DMR conducted observations in the Shawmut tailrace and the Hydro-Kennebec tailrace.

Burnham

Down stream eel passage at the Burnham Project was installed on 9/24 and 9/25. The passage facility is designed to address the problem of eels that travel down the 495-foot penstock, and become trapped in the intake forebays by the 1-inch to 1.25-inch clear-space trashracks that prevents them from exiting through the turbines. The passage facility consists of an entrance chamber connected to an exit pipe that moves water and eels from the turbine pit down through the turbine pit drain, which exits just before the draft tube, and into the tailrace. The entrance chamber consists of a two-foot square box with a slide gate that was welded to a hole cut in the trashrack in the middle intake forebay. This location was chosen because the penstock empties into the middle bay. The entrance is approximately 18 feet below the normal head pond elevation. The exit pipe is made of 10-inch, schedule 40 PVC, and flow through it was calculated to be 6-8 cfs. Extra care was taken to remove any sharp edges and burrs during construction of the passage.

Ridgewood staff reported that during the migration season they found no eels on the racks and saw only a few eels for short periods of time in the intake forebays. DMR was unable to conduct any visual observations or netting in the tailrace, because of high flows.

Benton Falls

Following consultation with DMR and USFWS, BFA proposed to physically exclude eels from the turbine intake of the large unit by installing a screen overlay with 1-inch clear space on the trash rack. Down stream migrating eels would then presumably utilize the surface-opening bypass that had been installed to pass anadromous fishes down stream. BFA initially proposed to have the facility operational by 10/1. However, after DMR strongly recommended that it be operational by 9/1, BFA agreed to work toward an earlier operational date.

On 9/1, before the screen was installed, BFA staff contacted DMR to report an eel kill had occurred while the small unit had been running. DMR biologists visited the site within an hour, and collected 19 freshly killed eels and 15 older mortalities (3 dead eels in deep water could not be retrieved). The following day, DMR biologists searched the same area below the project, and found an additional 8 freshly killed and four mortally wounded eels. After DMR reported this information, BFA stated they would cease nighttime generation over the Labor Day weekend to prevent further kills. On 9/7, the Department of Environmental Protection recommended by letter that BFA cease nighttime generation until the screen overlay was installed, and BFA agreed to follow this recommendation. DMR biologists inspected the tailrace below the project on 9/7, 9/9, and 9/13 and found no dead eels, verifying that the nighttime shutdowns were effective in preventing further eel kills. On 9/13, BFA reported that five dead eels were seen after a deep gate was opened. Following a site visit, DMR determined these eels had been impinged on the gate when it was opened.

On 9/20, the screen overlay on the large unit at the Benton Falls Project was operational, and nighttime generation (large unit only) was initiated. DMR biologists installed a trap in the west dropbox of the anadromous downstream passage on 9/26 to monitor its use by outmigrating eels. The east entrance of the anadromous downstream passage also was open during the eel migration season, but a trap was not installed in this side due to turbulence in the dropbox. On

9/29, a total of 51 eels (26 dead and 25 alive) were removed from the trap, indicating some downstream migrants utilize the surface-opening passage. Most of the eels had contusions on the snout. No eels were seen in the tailrace, but water levels were high at the time. DMR installed a new trap, designed to reduce turbulence and the possibility of trap-induced mortality, in the west dropbox of the anadromous down stream passage on 10/3. On 10/4, four dead eels and other dead fish were removed from the trap. After making necessary modifications to the trash rake, BFA was able to clean the overlay rack on 10/5, and pulled up 16 dead eels, 6-7 live eels which escaped, and a number of other dead fish. The dead eels were netted, measured, and examined. All of them had marks with 1 ¼-in spacing, which corresponds to the spacing on the upper 8 feet of overlay. During the night of 10/5, the anadromous fish passage was run at ½ stop gate to reduce turbulence in the trap, and the trap was checked every hour. However, only one dead eel and one live eel were captured. The following morning the overlay was cleaned again. However, the upper part was raked first, and three dead eels with 1 ¼-inch marks were recovered. When the lower part of the overlay was raked, dead alewife and white perch were pulled up. On 10/7, two dead eels and one live eel were found in the trap. Trapping was discontinued on 10/8 when water level began to rise dramatically.

Shawmut

Visual observations of the Shawmut tailrace were attempted on two dates. On 9/1, water levels were too high to observe the bottom. On 10/4 no mortalities were observed in the tailrace.

Hydro-Kennebec

On 10/4, no mortalities were observed along the west shore below the tailrace.

6.0 ATLANTIC SALMON RESTORATION

In 1984, the Maine Atlantic Sea Run Salmon Commission (MASRSC) adopted '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 Atlantic salmon habitat was inaccessible due to impassable dams and lack of resources to initiate restoration of Atlantic salmon.

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 Kennebec River Atlantic salmon resource was denoted as "unknown" but recognized it included hatchery and wild origin strays with some limited natural production. Restoration was deemed to be passive, with limited activities as resources allowed. The 1995 –2000 goal for the Kennebec was to maintain current numbers of Atlantic salmon and to increase those numbers in the future.

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 1997. 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 (now removed). 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 the Lockwood Dam and the initiation of an Atlantic salmon stocking program.

In 2005, field activities conducted by the Maine Atlantic Salmon Commission (MASC) staff consisted of the following: juvenile salmon population assessments, spawning surveys, habitat assessments, temperature monitoring, streamside and instream incubation.

6.1 *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 Atlantic salmon returning to the Kennebec River. It is now possible for Atlantic salmon to spawn in the mainstem Kennebec River between Augusta and Waterville-Winslow and in tributaries entering this mainstem reach down stream of impassable barriers. Methods utilized to monitor spawning activity and successes were redd counts and electrofishing.

Juvenile Atlantic Salmon Assessments

Methods

The MASC staff from the Sidney Regional Office sampled one site in a single tributary below Waterville-Winslow (Bond Brook) to determine the presence or absence of juvenile Atlantic salmon. Additionally, 24 sites were sampled in the Sandy River drainage to assess survival and growth of fry released from streamside and instream incubators in 2003, 2004 and 2005. All sites were evaluated using a single pass electrofishing assessment method except for 14 sites in the Sandy River drainage where a multiple-run removal method was used. All Atlantic salmon parr captured were sampled for length and weight. A small proportion of the captured Atlantic salmon parr also had a small sample of scales removed for analysis. All salmon were released alive.

Results and Discussion

No Atlantic salmon were found in Bond Brook. However, densities of juvenile Atlantic salmon found in the Sandy River were between 0 and 30.6 for 0+ parr and between 0 and 6.6 for 1+ parr (one unit = 100 m2) (Table 1)

Spawning Surveys

Methods

A single redd count was undertaken by foot on Bond Brook in November. No survey was completed on Messalonskee Stream, Togus Stream or the mainstem Kennebec River due to extremely high water.

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 2005, due to extremely high flows, only a single survey was completed on Bond Brook. We were unable to document any redds.

6.2 *ATLANTIC SALMON HABITAT ASSESSMENT*

Habitat Surveys

Methods

The MASC continued ongoing habitat surveys on tributaries of the Kennebec River to quantify adult salmon habitat and juvenile rearing habitat in the basin. A single survey was conducted on Orbeton stream, a large tributary to the Sandy River in Madrid. Orbeton Stream was surveyed from the outlet of Redington Pond in Redington TWP to below the Reed's Mills Road bridge in Madrid, totaling more than 10 miles of riverine habitat.

Results and Discussion

The quantities of salmon habitat surveyed in 2005 totaled 2034 units of juvenile rearing habitat and 88 units of adult holding habitat in Orbeton Stream. One habitat unit equals 100m2 of juvenile Atlantic salmon habitat, or 100m2 of adult holding pools. (Table 2)

Temperature Monitoring

Methods

Data loggers were deployed and set to record once every hour in the Sandy River and Sebasticook River watersheds. Ten loggers were deployed in the Sandy River drainage to aid analysis of our ongoing instream and streamside incubation projects and 2005 fry stocking. The logger placed into Farnham Brook in Pittsfield is being used to establish a temperature profile for the purpose of future potential streamside incubation. At the end of summer, the data from 3 loggers were downloaded and archived into an electronic database. The data logger in Orberton stream was located just above the confluence of Conant stream. In the mainstem Sandy River, one logger was located just below Small's Falls in Madrid, and the other was located 300 meters below the confluence of Saddleback Stream in Madrid. All others loggers were left in place to record winter temperatures. The monthly maximum, minimum, and average temperatures over the summer months are presented in Table 3 and monthly maximums and minimums for July and August are graphically presented in Figure 1.

Results and Discussion

The Sandy River temperature data collected will be combined with instream incubator fry production and future parr densities. A copy of the entire temperature dataset can be obtained by contacting the MASC.

Research

During the winter of 2004-2005, the MASC continued a research project to test the feasibility of streamside incubation as a method for Atlantic salmon restoration. The MASC signed a memorandum of understanding with the Kennebec Valley Chapter of Trout Unlimited, creating a 3-year partnership with the goal of further evaluating streamside incubation as a restoration tool. 25,000 eyed (38% development) Atlantic salmon eggs were incubated on a small tributary to the Sandy River in Avon, with a survival rate of >90%. The resultant fry were then stocked into the Sandy River in Madrid.

In the fall of 2003 the Sidney Office of The Maine Atlantic Salmon Commission tested instream incubation of green Atlantic salmon eggs for performance and use by volunteers as a restoration tool. Green Atlantic salmon eggs (freshly fertilized) were buried in commercially available incubators and left until June of 2004 when they were removed. The results were however less than satisfactory. None of the incubators recovered showed any egg development. A review of our project lead us to believe that temperature differences between the hatchery and recipient water and/or inappropriate handling may have been the cause of mortality.

In the fall of 2004, a newly designed instream incubator was used to further test instream incubation as a potential method of Atlantic salmon restoration. Results show that eyed eggs can be incubated successfully instream. However, the instream incubation of green eggs was again unsuccessful. All recovered green egg incubators showed no egg development. A review of our project points to handling and travel stress as possible causes of mortality.

In the fall of 2005, green eggs were again buried in the gravel substrate of the Sandy River. The timing and location of fertilization was altered, as were the transportation methods. An interim report with the result of the 2004-2005 instream incubation projects is attached. A full report will be available in the fall of 2006.

Table 1. Summary of Alewife Trapping by Quartile and Peak Alewife Trapping

Year	Capture site	25%	50%	75%	Peak date	Number Stocked (peak day)
2005	Winslow	18-May	21-May	3-Jun	18-May	15,272
2004	Winslow	13-May	18-May	24-May	13-May	16,752
2003	Winslow	21-May	27-May	30-May	21-May	15,467
2002	Winslow	11-May	20-May	23-May	20-May	15,867
2001	Winslow	12-May	14-May	16-May	14-May	18,896
2000	Winslow	9-May	15-May	19-May	7-May	13,578
1999	Augusta	22-May	28-May	31-May	23-May	9,965
1998	Augusta	15-May	18-May	20-May	18-May	16,311
1997	Augusta	31-May	3-Jun	4-Jun	3-Jun	21,756
1996	Augusta	27-May	3-Jun	4-Jun	4-Jun	22,205
1995	Augusta	25-May	27-May	30-May	27-May	10,634
1994	Augusta	28-May	1-Jun	2-Jun	2-Jun	13,050

Table 2. Alewife Trapping & Distribution from Fort Halifax, Sebasticook River, 2005[1]

Date	Pumped	Biological Sample	Returned to River or Pump Mortalities	Number Loaded Into Truck	Truck Mortalities	Released
16-May	0	50				
17-May	7,873		143	7,730	1	7,729
18-May	15,281		8	15,273	1	15,272
19-May	15,139		1	15,138	0	15138
20-May	1,267	50	112	1,105	0	1,105
21-May	2,605		1	2,604	0	2,604
31-May	210	50	160			
2-Jun	11,078		195	10,883	13	10,870
3-Jun	13,988	50	9	13,929	5	13,924
4-Jun	8,266		12	8,254	2	8,254
6-Jun	4,955		-36	4,991	0	4,991
7-Jun	1,743	50	4	1,689	1	1,689
Totals:	**82,405**	**250**	**609**	**81,596**	**23**	**81,576**

Note: 6-Jun 36 fish discrepancy due to recording error. 4991 is the number used for all calculations as it was what was recorded on DMR stocking sheets.

Table 3. Alewife Stocking & Distribution, Phase I and II Lakes, 2005[1]

Ponded Area	Location	Surface Acres	River Section	Stocking Goal[1]	Actual Stocked 2005	No. of Trips	% of Target Number Achieved	Alewives per Acre
Corundel Lake	Corinna	225	Sebasticook, E. Branch	2,000	2084	1	104%	9.3
Douglas Pond	Pittsfield	525	Sebasticook, W. Branch	18,375*	10874	7	59%	<20.71
Lovejoy Pond	Albion	324	Sebasticook, mainstem	1,944	1000	1	51%	3.1
Pattee Pond	Winslow	712	Sebasticook, mainstem	4,272	1604	2	38%	2.3
Pleasant Pond	Stetson	768	Sebasticook, E. Branch	4,608	4608	2	100%	6.0
Plymouth Pond	Plymouth	480	Sebasticook, E. Branch	2,880	2975	1	103%	6.2
Burnham Headpond	Pittsfield	600	Sebasticook, E Branch	30,000*	651	1	2%	1.1
Sebasticook Lake	Newport	4,288	Sebasticook, E. Branch	25,728	25426	9	99%	5.9
Unity Pond	Unity	2,528	Sebasticook, mainstem	15,168	15153	9	100%	6.0
Big Indian Pond[2]	St. Albans	990	Sebasticook, W. Branch	5,940	0	---	---	---
Little Indian Pond[2]	St. Albans	145	Sebasticook, W. Branch	870	0	---	---	---
Great Moose Lake[2]	Hartland	3,584	Sebasticook, W. Branch	21,504	0	---	---	---
Threemile Pond[3]	China	1,077	Kennebec River	6,462	0*	---	---	?
Webber Pond[3]	Vassalboro	1,252	Kennebec River	7,512	19718*	17	262%	15.7
Wesserunsett Lake	Madison	1,446	Kennebec River	8,676	8800	3	101%	6.1
Totals:		**18,944[4]**		**127,675[5]**	**92,893**	**53**	**93%[5]**	**7.5[5]**

[1] Six adult alewives per lake surface acre unless noted with an *

[2] Phase II lakes

[3] 2372 alewives stocked from Ft. Halifax by truck. An additional 17346 alewives were hand netted over the Webber Pond dam from Sevenmile Stream. Three Mile Pond was not stocked as fish in Webber Pond have free passage to Threemile Pond

[4] Includes Burnham Headpond (East Branch habitat) and Douglas Pond (West Branch habitat).

[5] Does not include the three lakes in which DMR was not permitted to stock, Three-mile, or Three-cornered ponds.

Table 4. Alewife Distribution by Trip, Kennebec River Watershed Phase I Lakes, 2005

Date	Location	No Loaded	No. Mortalities	No. Released
5/16/2005	Webber Pond - Vassalboro	538	0	538
5/17/2005	Sebasticook Lake	2074	1	2073
5/17/2005	Sebasticook Lake	3014	0	3014
5/17/2005	Unity Pond	1002	0	1002
5/17/2005	Unity Pond	1640	0	1640
5/17/2005	Webber Pond - Vassalboro	172	0	172
5/18/2005	Douglas Pond	1526	1	1525
5/18/2005	Sebasticook Lake	3019	0	3019
5/18/2005	Sebasticook Lake	3033	0	3033
5/18/2005	Sebasticook Lake	3045	0	3045
5/18/2005	Unity Pond	1480	0	1480
5/18/2005	Unity Pond	1522	0	1522
5/18/2005	Unity Pond	1648	0	1648
5/18/2005	Webber Pond - Vassalboro	808	0	808
5/19/2005	Douglas Pond	1524	0	1524
5/19/2005	Douglas Pond	1539	0	1539
5/19/2005	Sebasticook Lake	3010	0	3010
5/19/2005	Sebasticook Lake	3088	0	3088
5/19/2005	Unity Pond	1657	0	1657
5/19/2005	Unity Pond	3053	0	3053
5/19/2005	Webber Pond - Vassalboro	1169	0	1169
5/19/2005	Webber Pond - Vassalboro	1267	0	1267
5/20/2005	Webber Pond - Vassalboro	1105	0	1105
5/20/2005	Webber Pond - Vassalboro	1492	0	1492
5/20/2005	Webber Pond - Vassalboro	3012	0	3012
5/20/2005	Webber Pond - Vassalboro	3570	0	3570
5/21/2005	Lovejoy Pond	1000	0	1000
5/21/2005	Pattee Pond	702	0	702
5/21/2005	Pattee Pond	902	0	902
5/23/2005	Webber Pond - Vassalboro	327	0	327
6/1/2005	Webber Pond - Vassalboro	2008	0	2008
6/2/2005	Sebasticook Lake	2083	12	2071
6/2/2005	Stetson Pond	1506	1	1505
6/2/2005	Unity Pond	1515	0	1515
6/2/2005	Webber Pond - Vassalboro	334	0	334
6/2/2005	Wesserunsett Lake	2730	0	2730
6/2/2005	Wesserunsett Lake	3049	0	3049
6/3/2005	Douglas Pond	1553	0	1553
6/3/2005	Douglas Pond	1557	0	1557
6/3/2005	Douglas Pond	1715	0	1715
6/3/2005	Plymouth Pond	2975	0	2975
6/3/2005	Stetson Pond	3104	1	3103
6/3/2005	Wesserunsett Lake	3025	4	3021
6/4/2005	Corundel Lake	2084	0	2084
6/4/2005	Douglas Pond	1461	0	1461
6/4/2005	Sebasticook Lake	3073	0	3073
6/4/2005	Unity Pond	1638	2	1636
6/5/2005	Webber Pond - Vassalboro	1006	0	1006
6/7/2005	Sebasticook-Burnham HDP	652	1	651
6/7/2005	Webber Pond - Vassalboro	1101	0	1101
6/8/2005	Webber Pond - Vassalboro	857	0	857
6/8/2005	Webber Pond - Vassalboro	942	0	942
6/23/2005	Webber Pond - Vassalboro	10	0	10
Total # Fish:		**92916**	**23**	**92893**
Total # Days:	**15**			
Total # Trips:	**53**			

Table 5. Summary of Alewife Truck-Stocked into Phase I Habitat

Year	No. released	No. of trips/tanks	No. Alewives per trip/tank
2005*	**75,547**	**38/54**	**1988/1399**
2004*	121,733	62/89	1963/1368
2003*	91,088	58/67	1570/1360
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

* Includes Corundel Lake and Burnham Headpond

Note: 1992-2002 numbers per trip only

Table 6. Disposition of Kennebec River Alewives Distributed in Locations Other Than Phase I Lakes, 2005

Drainage	Date	Location	Number Loaded	Number Mortalities	Number Released
Bagaduce		Pierce Pond	**0**	**0**	**0**
Kennebec	9-Jun	Pleasant Pond (Cobbossee Stream)	417	0	417
	9-Jun	Pleasant Pond (Cobbossee Stream)	338	1	337
	7-Jun	Nehumkeag Pond	1038	0	1038
		Total:	**1,793**	**1**	**1,792**
Pemaquid		Pemaquid Pond	0		0
		Pemaquid River	0		0
		Total:	**0**		**0**
Seal Cove		Seal Cove Pond-MDI	**0**		**0**
Sebasticook		White's Pond	0		0
		White's Pond	0		0
		Martin Stream	0		0
		Total:	**0**	**0**	**0**
Union	6-Jun	Lower Patten Pond	3424	0	3424
		Total:	**3,424**	**0**	**3,424**
Webber Pond	6-Jun	Webber Pond – Bremen	1567	**0**	1567
Mill Brook		Great Pond-Franklin-Taunton Bay	**0**		**0**
		Total Fish:	**6,784**	**1**	**6,783**

Table 7. Age Distribution of Adult Alewives Collected at Fort Halifax, 2005

Sample Date	Age II		Age III		Age IV		Age V		Mean Age	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
16-May	0	0	0	0	7	6	3	0	4.3	4.0
20-May	0	0	0	0	8	7	0	1	4.0	4.1
31-May	0	0	0	0	6	5	2	3	4.3	4.4
3-Jun	0	0	0	0	8	6	2	0	4.2	4.0
7-Jun	0	0	2	0	6	3	0	5	3.8	4.6
Σ=	**0**	**0**	**2**	**0**	**35**	**27**	**7**	**9**	**4.1**	**4.2**
% By Sex	**0**	**0**	**4.5**	**0**	**79.5**	**75.0**	**15.9**	**25.0**		
% of Total	**0**	**0**	**2.6**	**0**	**43.8**	**33.8**	**8.8**	**11.3**		

Table 8. Transfers of American Shad Broodstock to Waldoboro Hatchery, 2005

Source	Trapping Site	Date	Number Loaded	Number Mortalities	Number In Hatchery
Merrimack River	Essex Lift	24-Jun-05	60	2	58
		25-Jun-05	51	1	50
		29-Jun-05	48	0	48
		29-Jun-05	80	22	58
		30-Jun-05	10	2	8
		01-Jul-05	4	0	4
	Total		**253**	**27**	**226**

[1] Represents a 10.7% trucking mortality

Table 9. Larval American Shad Releases, 2005

Receiving Location	Date Stocked	No. Stocked
University of New Hampshire	7/5/2005	5,850
University of New Hampshire	7/12/2005	4,000
University of New Hampshire	7/14/2005	2,000
Kennebec River, downstream of Shawmut Project	7/15/2005	362,229
Kennebec River, downstream of Shawmut Project	7/22/2005	422,764
Kennebec River, downstream of Shawmut Project	7/26/2005	320,350
Androscoggin River, Pejepscot Headpond	8/2/2005	96,551
TOTAL:		**1,201,894**

Table 10. American Shad Annual Production Numbers - Kennebec River Watershed above Augusta[1]

River Segment	Habitat Units (100 sq. yd.)	Potential Shad Production[2]	Potential Shad Production With 10% Down stream Mortality[3, 4]
Sandy River above Madison Electric dam, Madison	36,370	83,650	44,455 (5)
Kennebec River above Weston dam, Skowhegan	55,869	128,498	75,877 (4)
Kennebec River from Shawmut dam, Fairfield to Weston dam	61,252	140,879	92,431 (3)
Kennebec River from Hydro Kennebec dam, Waterville to Shawmut dam	25,314	58,221	42,443 (2)
Kennebec River from Augusta to Lockwood dam, Waterville	63,066	145,053	130,547 (1)
Sebasticook River above Burnham	22,986	52,867	34,686 (3)
Sebasticook River from Benton Falls to Burnham dam, Burnham	20,847	47,948	34,954 (2)
Sebasticook River from Fort Halifax dam, Winslow to Benton Falls, Benton	14,199	32,658	26,453 (1)
Total Kennebec	**205,501**	**472,651**	**341,298**
Total Sebasticook	**58,032**	**133,473**	**96,093**
Total, Kennebec watershed above Augusta	**263,533**	**689,774**	**481,846**

[1] Based on 10% down stream mortality at each hydroelectric dam
[2] Based on estimates derived from Connecticut shad restoration efforts of 2.3 adult shad per Habitat Unit
[3] 10% mortality estimates based on a theoretical efficiency goal
[4] Number in parentheses represents the total dams from that area down stream

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

Site[2]	2001	2002	2003	2004	2005
1	0.00	0.88	0.00	0.00	0.00
2	0.00	0.63	14.20	80.60	334.00
3	0.38	0.50	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00
5	63.25	0.22	0.50	4.40	0.00
7	87.75	0.00	0.00	0.00	5.80
8A[2]	19.88	12.67	---	---	---
8B	0.00	0.13	43.17	1.60	0.00
8C[3]	---	382.80	61.50	43.00	400.40
Total	21.41	1.88/48.14[4]	14.92	16.20	92.53

[1] Except where noted, JAI was calculated on total number of seine hauls per site

[2] Due to bridge construction, Site 8A was abandoned in August 2002.

[3] Site 8C was created as a result of Site 8A being abandoned. JAI based on six trips.

[4] For comparative purposes, the first JAI includes Site 8A; the second JAI includes Site 8C.

Table 12. Downstream Passage Observations of Juvinile Alewives at Lake Outlets in Sebasticook and Upper Kennebec Watersheds, 2005

Date	Sebasticook Lake	Plymouth Pond	Unity Pond	Pleasant Pond	Pattee Pond	Webber Pond	Threemile Pond	Wesserunsett Lake	Corrundal Lake	Lovejoy Pond
8-Jul	O	O		O				O	X	
11-Jul			O		O		O			X
12-Jul						O				
18-Jul	O			O		O				
19-Jul	O	O	O		O			O	X	X
25-Jul	O[AUB]			X				O	X	
26-Jul		O	O		O	O	O			X
29-Jul		O		O					X	
28-Jul	O[AUB]					O				
29-Jul	O									
1-Aug		O						X		
8-Aug	O	O		O						
11-Aug					O	O				
15-Aug	O	O	O	O	O	O	O	X	X	X
18-Aug	O	O	O	X	O	O	O	X	X	X
24-Aug	O	O	O	X	O	O		X	X	X
25-Aug							O			
29-Aug	O	O						X	X	
30-Aug						O				
31-Aug		O	O	O[AUB]	O		O			X
6-Sep	O	O				O				
12-Sep	O	O	O	O	O	O	O	X	O	O
15-Sep						O				
29-Sep						O	O			
3-Oct	O	O	O	X	O	O			O	O
4-Oct							O			
5-Oct								X		
12-Oct							O			
13-Oct						O				
14-Oct	O	O		O					O	
18-Oct	O	O	O	O	O	O	O		O	O
19-Oct						O		O		
24-Oct	O	O		O		O		O	O	
27-Oct			O		O		O			O

Table 12. **Downstream Passage Observations of Juvinile Alewives at Lake Outlets in Sebasticook and Upper Kennebec Watersheds, 2005 cont.**

Date	Sebasticook Lake	Plymouth Pond	Unity Pond	Pleasant Pond	Pattee Pond	Webber Pond	Threemile Pond	Wesserunsett Lake	Corrundal Lake	Lovejoy Pond
1-Nov	O	O		O		O	O	O	X	
2-Nov			O		O					O
7-Nov			O							
9-Nov	O	O		O				O	O	
10-Nov			O		O	O	O			O
21-Nov	O	O		O	O			O	O	

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

Table 13. Downstream Passage Observations at Hydroelectric Facilities, 2005

Date	Fort Halifax	Benton Falls	Burnham	Pioneer	Waverly
8-Jul				O	O
11-Jul	O	O	O		
18-Jul	O	O	O	O	O
25-Jul	O	OH	O	O	O
28-Jul	OH	O	O	O	O
29-Jul					O
11-Aug	O	O			
15-Aug	O	O	O	O	O
18-Aug	O	O	O	O	O
24-Aug	O	O	O	O	O
29-Aug	O		O		
30-Aug	O	O	O	O	O
6-Sep	OH	O	O	O	
12-Sep	O	O		O	O
15-Sep	O	O	O		
29-Sep	O	O	OH	O	O
5-Oct	O	O	O	O	O
18-Oct				O	O
19-Oct			O		
24-Oct	O	O	O	O	O
1-Nov	O		O	O	O
7-Nov		O	O		
9-Nov	O	O	O	O	O
21-Nov	O	O	O	O	O
Totals	**19**	**18**	**19**	**17**	**17**

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

Table 14. Diadromous Fish Captured in the Kennebec River above the Edwards Dam Site, 2005

Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 7	Site 8B	Site 8C
Alewife	2	0	759	1	0	0	0	0
Alosine sp.	0	0	0	0	0	0	1	0
American Eel	4	0	0	0	1	0	0	0
American Shad	0	1670	0	0	0	29	0	2002
Blueback Herring	0	0	0	0	0	0	0	0
Striped Bass	0	0	0	0	0	0	0	0
Site Totals	**6**	**1,670**	**759**	**1**	**1**	**29**	**1**	**2,002**
Grand Total All Sites	**4,469**							
Total By Species								
Alewife	**762**							
Alosine sp.[1]	**1**							
American Eel	**5**							
American Shad	**3,701**							
Blueback Herring	**0**							
Striped Bass	**0**							

Table 15. Summary of upstream eel migration at Ft. Halifax and Benton Falls projects, 1999-2005.

	Fort Halifax		Benton Falls	
Year	Passage operating	Eels passed	Passage operating	Eels passed
2005	6/28-8/29	7,816	7/13-8/29	469
2004	6/28-9/1	66,804	7/15-8/12 (29 days)	2,343
2003	6/11-9/17	155,012	16 days	6,434
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

Table 16. Juvenile Atlantic Salmon Assessments, Kennebec River Tributaries, 2005.

Site	Yoy			Parr		
	Density (fish/100m2)	Density CI 95% Lower	Density CI 95% Upper	Density (fish/100m2)	Density CI 95% Lower	Density CI 95% Upper
Site Name						
Guy Hudson Property, Madrid	30.6	30.6	36.6	5.8	5.8	6.1
Rte 4 Index- Phillips	24.1	24.1	26.2	6.6	6.6	7.7
ISI Site Avon Valley Brook, Avon	10.9	10.9	17.3	0	0	0
Logyard Crossing, Madrid	5.4	5.4	6.7	2.3	2.3	2.7
Bean property just above small tributary, Madrid	0	0	0	2.7	2.7	2.9
Above Saddleback Stream, Madrid	0.6	0.6	0.6	2.3	2.3	2.6
Ledge Chute Run, Phillips	4.3	4.3	5.4	3.5	3.5	4.7
Camp Temperance, Madrid	7.7	7.7	10.2	1.7	1.7	1.8
Below Smalls Falls (2005 Stocking site), Madrid	12.4	12.4	16.2	3.9	3.9	4.3
Below Smalls Falls Foot Bridge, Madrid	4.3	4.3	4.7	0.6	0.6	0.6
Below Rte 4 Ledges, Phillips	1.2	1.2	2.6	6.2	6.2	8
Rte 4 Bridge- Temp. Logger Site, Phillips	4.5	4.5	5.2	5.5	5.5	5.7
Burnt Camp, Madrid	0	0	0	1.4	1.4	n/a
Bond brook index, Augusta	0	0	0	0	0	0
Lower Logyard Riffle, Madrid	0	0	0	1.3	1.3	n/a

Table 17. Atlantic Salmon Habitat Assessments on Selected Tributaries in the Kennebec River Drainage, 2005.

	Habitat Type and Units (unit=100m2)						
Section Surveyed	**Dead Water**	**Glide**	**Pool**	**Falls**	**Riffle**	**Run**	**Riffle+Run**
Orbeton Stream**	N/A	N/A	88	-	1,604	430	2,034
Totals:	-	-	88	-	1,604	430	2,034

**Orbeton Stream from Redington Pond (Redington TWP) to below the Reed's Mill's road bridge.(Madrid)

Table 18. Monthly Maximum, Minimum, and Average Temperatures (°C) for Selected Waters in the Kennebec River Drainage, 2005.

Water	Town/Site	June			July			August			Comments
		Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	
Orbeton Stream	Conant Stream confluence, Madrid TWP	n/a	n/a	n/a	24.7	15.1	20	25.2	14.1	18.6	Deployed 07/11
Sandy River	Route 4 Index site, Phillips	21.9	13.6	17.8	23.4	13.6	17.8	23.4	13.6	17.8	Deployed 05/31
Sandy River	Small's Falls, Madrid TWP	20.2	9	14.80	21.5	13	17.10	20.1	13.3	16.60	Deployed 05/31

Figure 1. Kennebec River Restoration Study Area

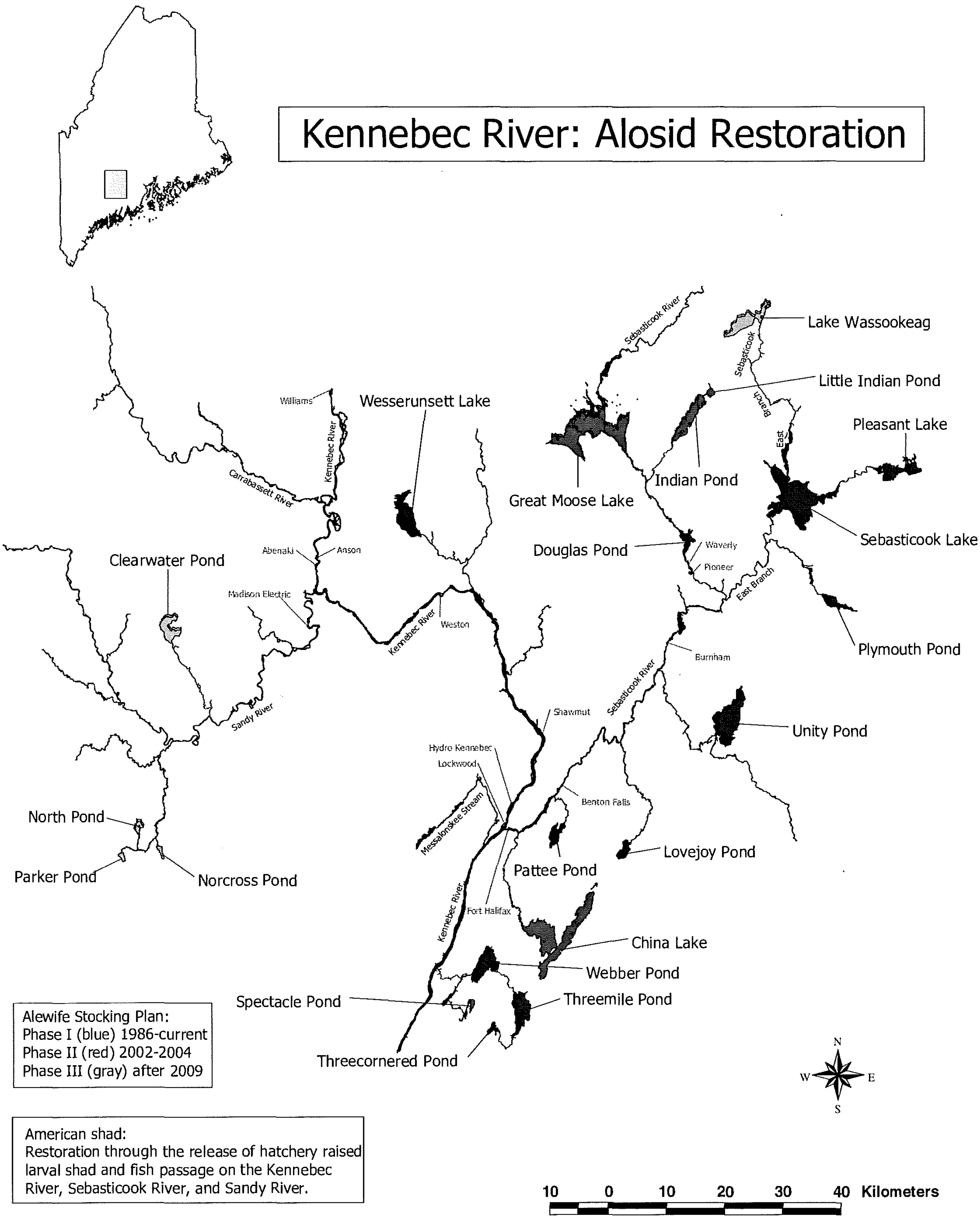


Figure 2. Adult Alewife Biosamples - Male vs. Female Captured at Fort Halifax, 2005

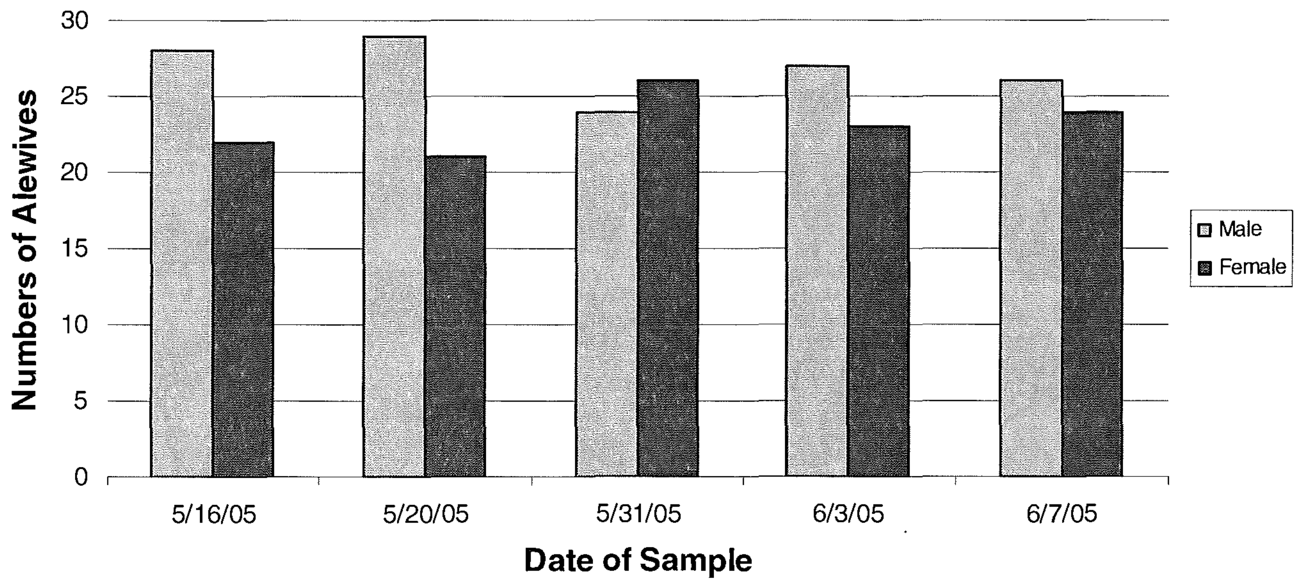


Figure 3. Average Lengths of Adult Alewife Biosamples, 2005

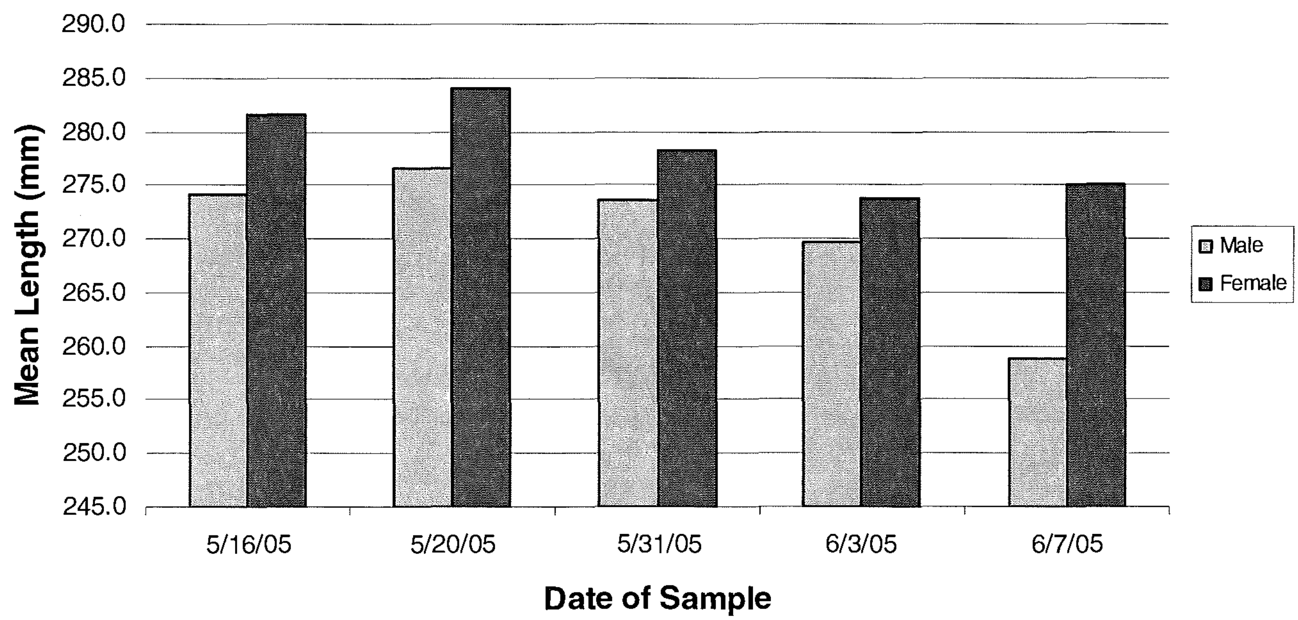


Figure 4. Average Weights of Adult Alewife Biosamples, 2005

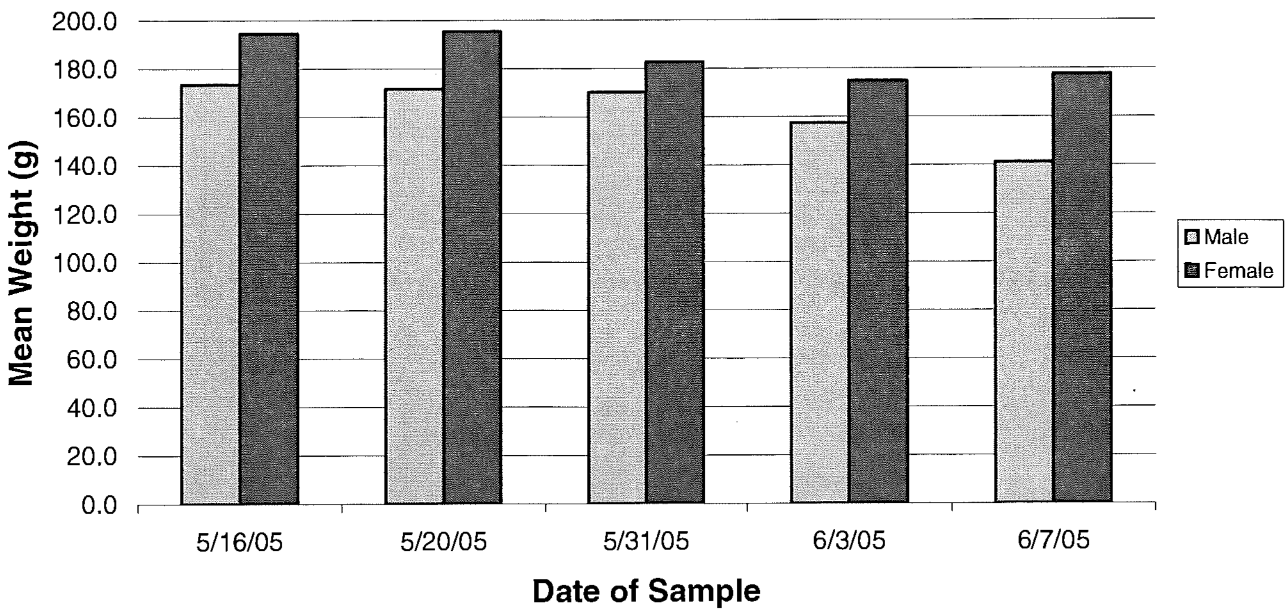


Figure 5. Commercial Alewife Harvest

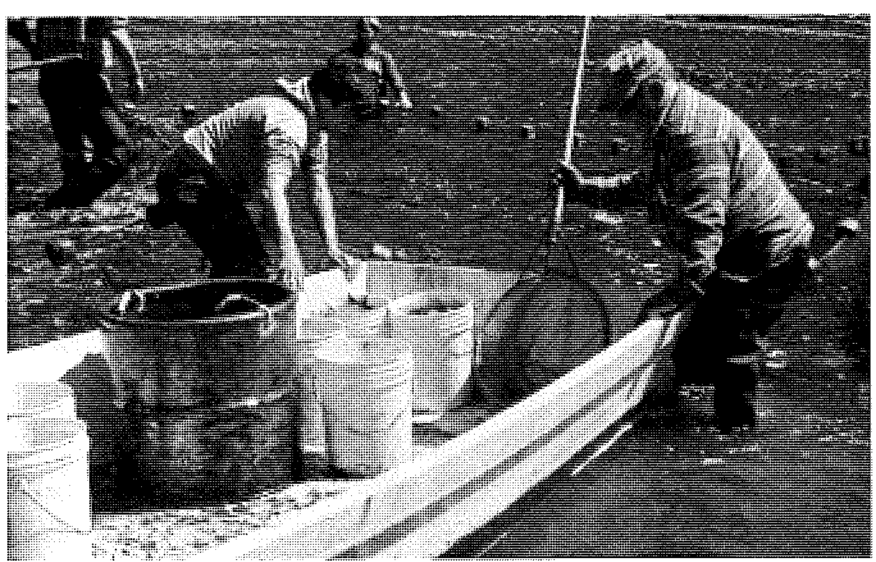


Figure 6. American Shad Larvae Released in the Kennebec Drainage, 1992-2005

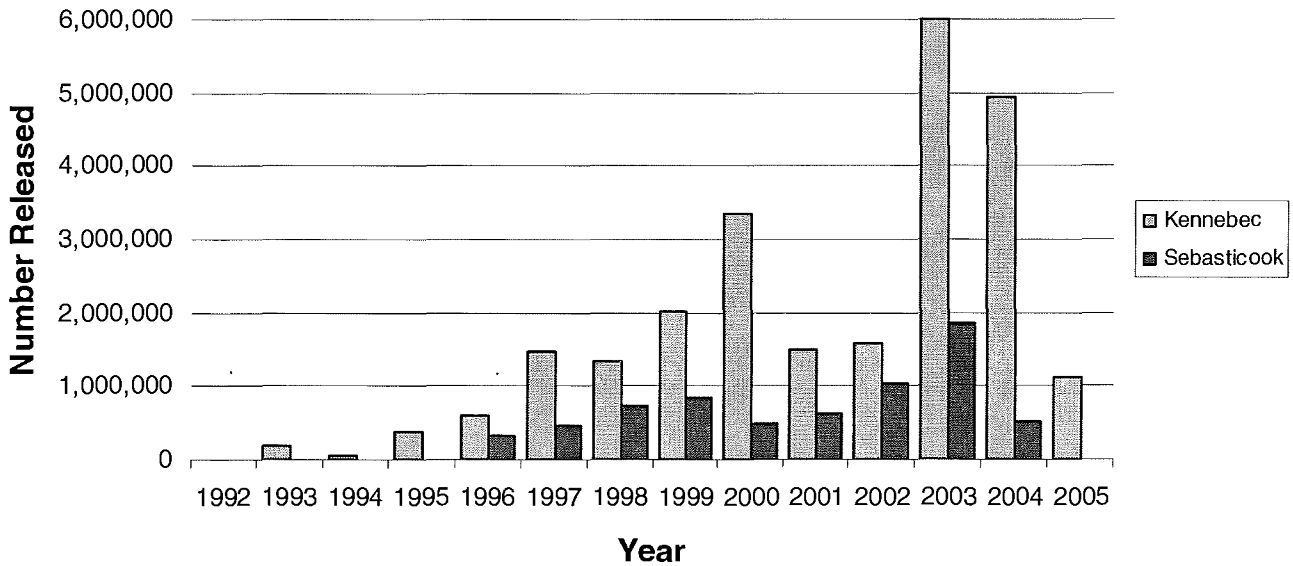


Figure 7. Number of American Shad Fingerlings Released into the Kennebec and/or Medomak Rivers 1992-2005

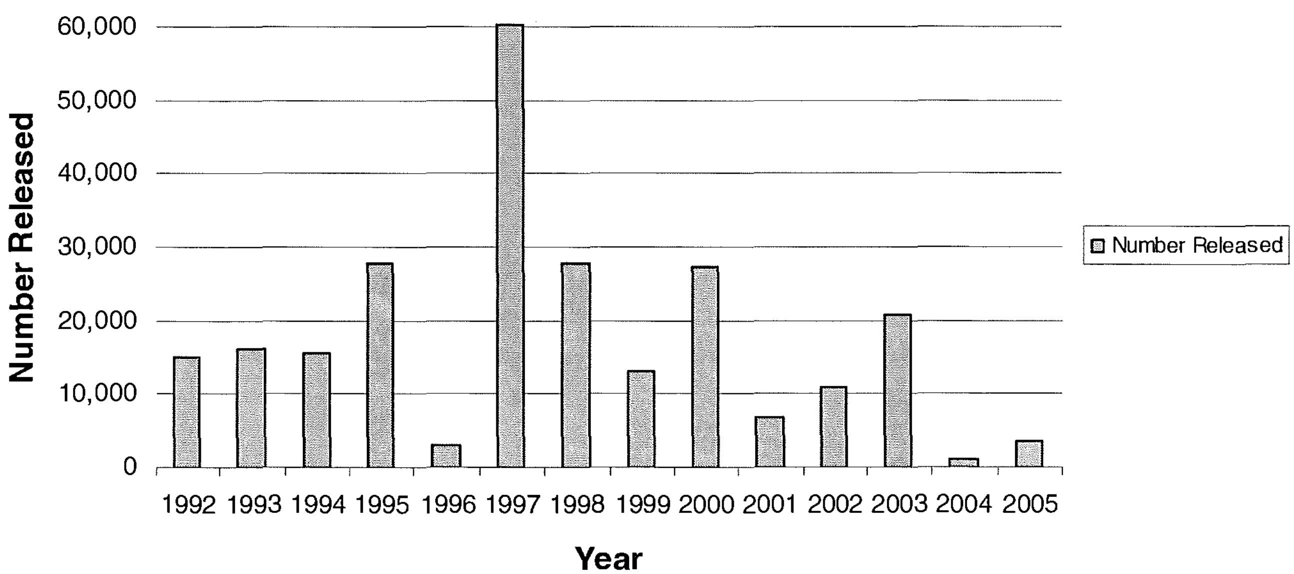
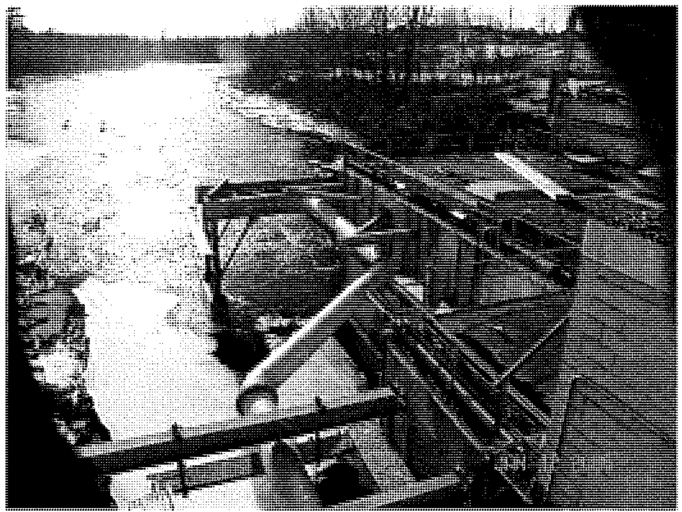
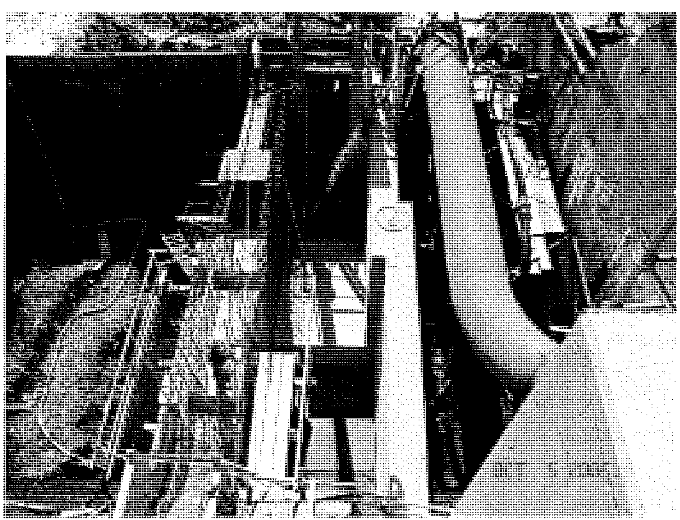


Figure 8. Benton Fishway Construction

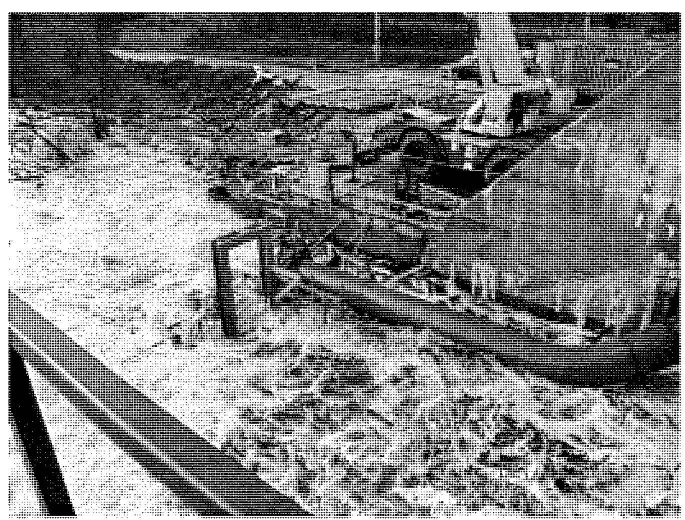


Picture taken January 12th 2006 from Benton Falls Dam facing down stream overlooking fishway structure. Steelwork in center of picture will be where lift is located. Steelwork in bottom of picture will be location of sorting facility.

Figure 9&10. Burnham Fishway Construction

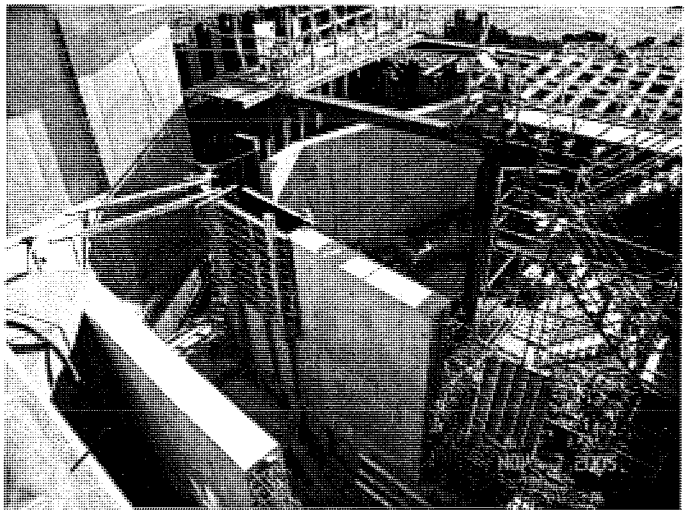


Picture taken October 5th 2005 from Burnham Dam facing down stream overlooking fishway structure. Fishlift entrance gate is visible in top canter of picture. Hopper will be located in bottom center of picture. The large pipe in right side of picture is the down stream passage and will aide in attraction

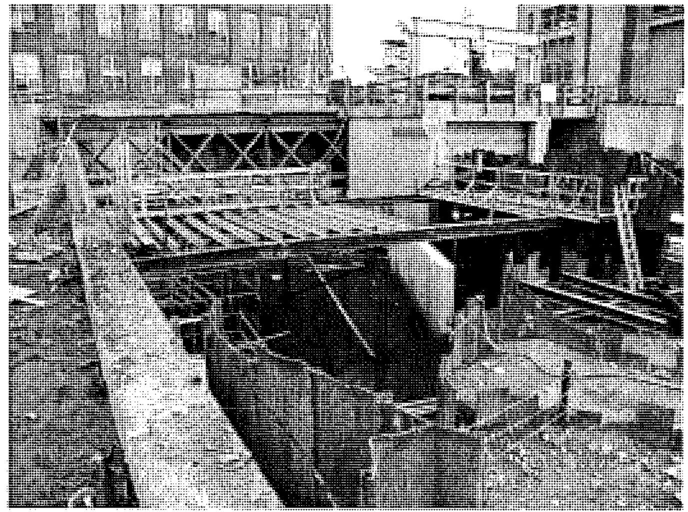


Picture taken October 19th 2005 from Burnham Dam facing down stream overlooking fishway structure during flood event. This was one of many flood events which delayed construction efforts.

Figure 11&12. Lockwood Fishway Construction



Picture taken November 7th 2005 from Lockwood dam facing down stream overlooking fishway structure. Fishlift entrance will be in top canter of picture. Hopper will be located in bottom right of picture out of view.



Picture taken October 11th 2005 at Lockwood dam facing upstream from below coffer dam overlooking fishway structure. This was one of many flood events which delayed construction efforts.

Figure 13. Shad Sample from Community Assessment Study, 2004

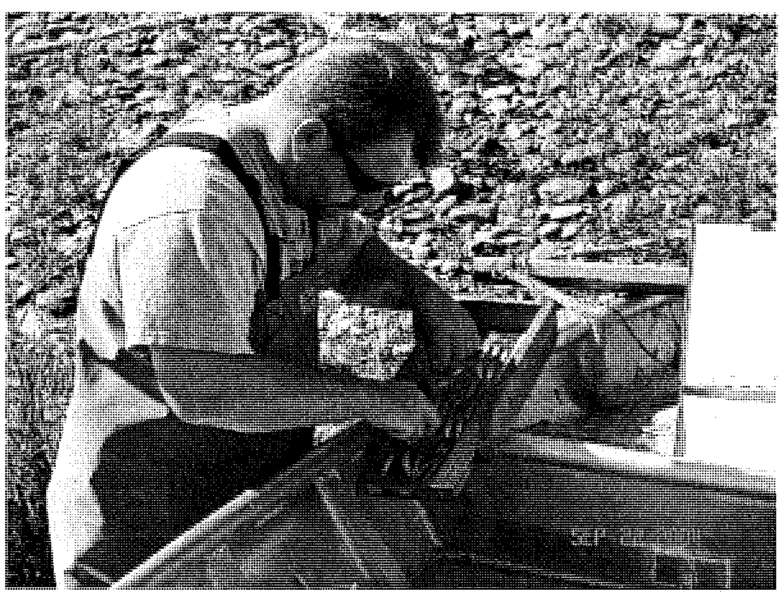
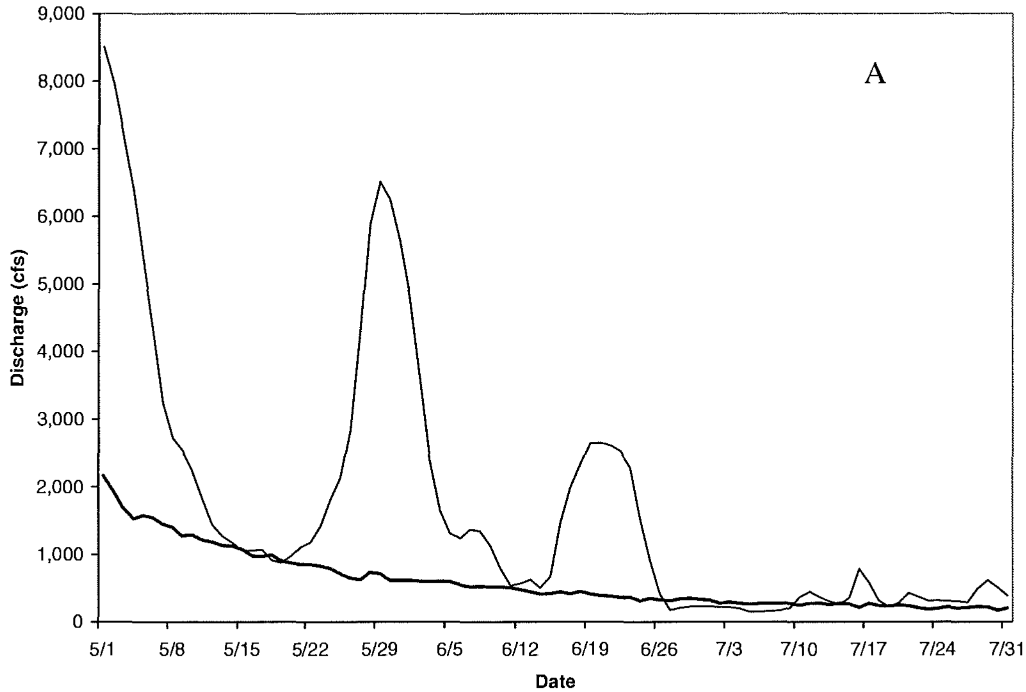


Figure 14. Provisional streamflow on the (A) Sebasticook River near Pittsfield (USGS 01049000) and (B) the Kennebec River near North Sidney (USGS 01049265) from May 1 to July 31 in 2005. Thin black line is daily mean discharge. Heavy blue line is median daily discharge.



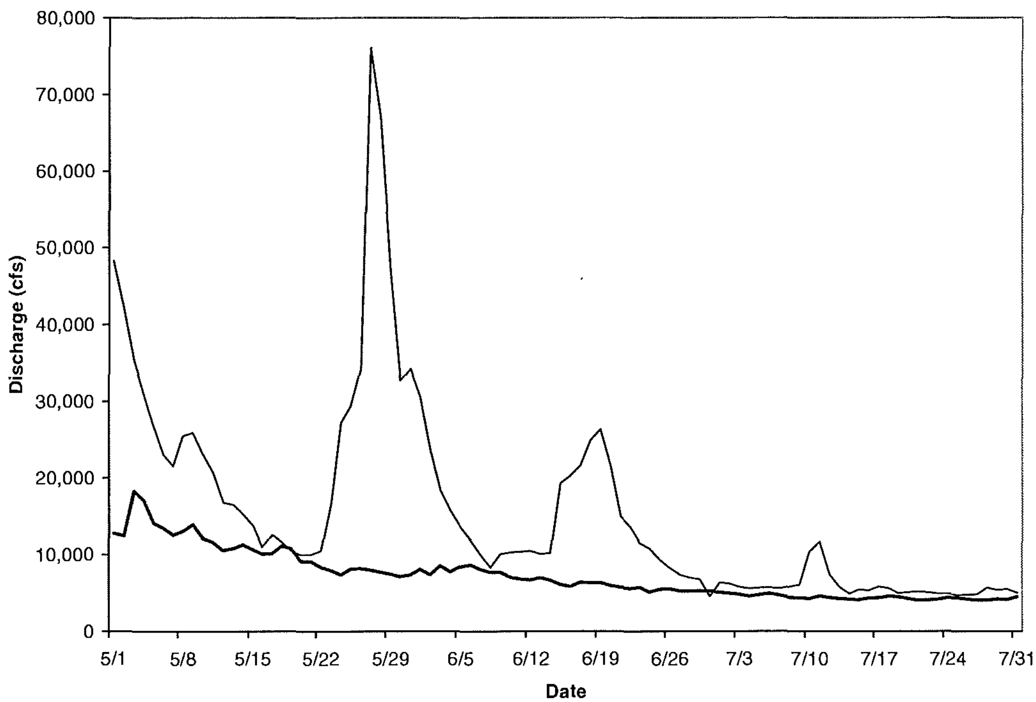


Figure 15. Eel passage at Ft. Halifax during the 2005 field season.

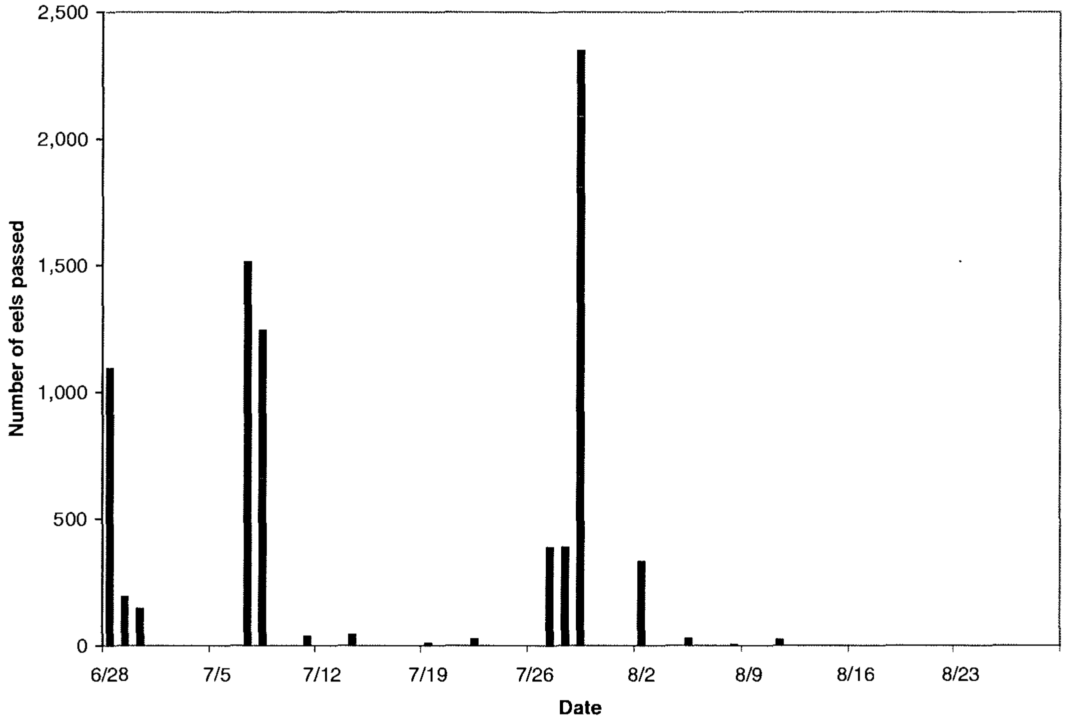


Figure 16. Total length of eels passed at Ft. Halifax in 2005.

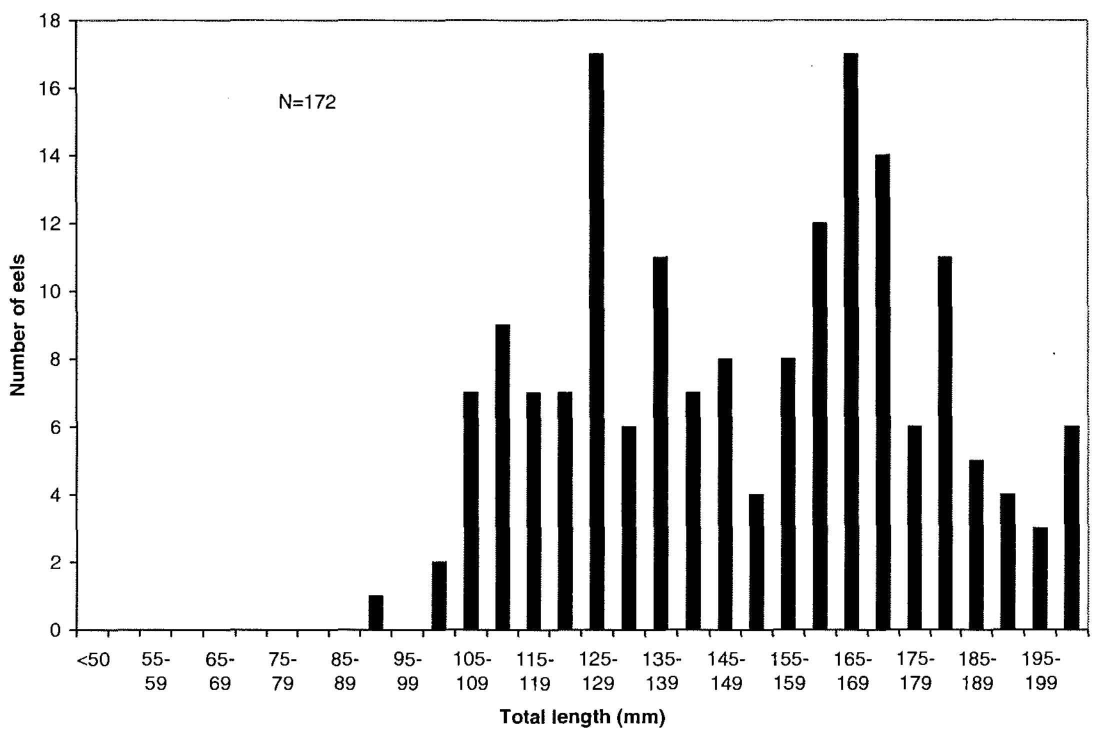


Figure 17. Eel passage at Benton Falls during the 2005 season.

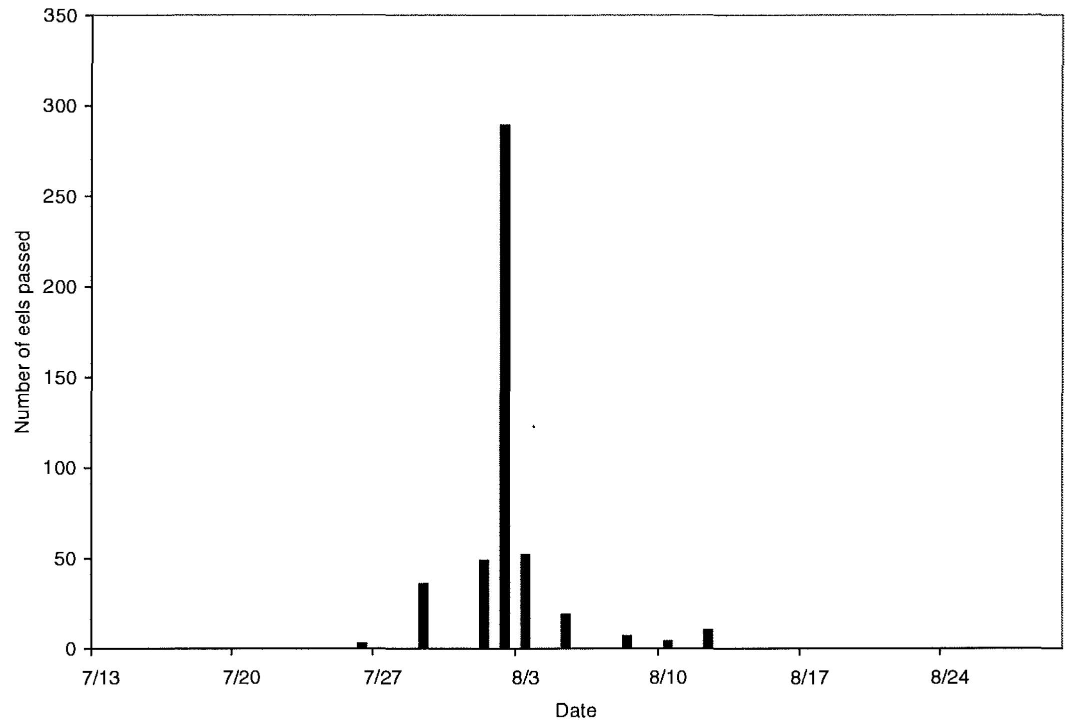


Figure 18. Total length of eels passed at Benton Falls in 2005.

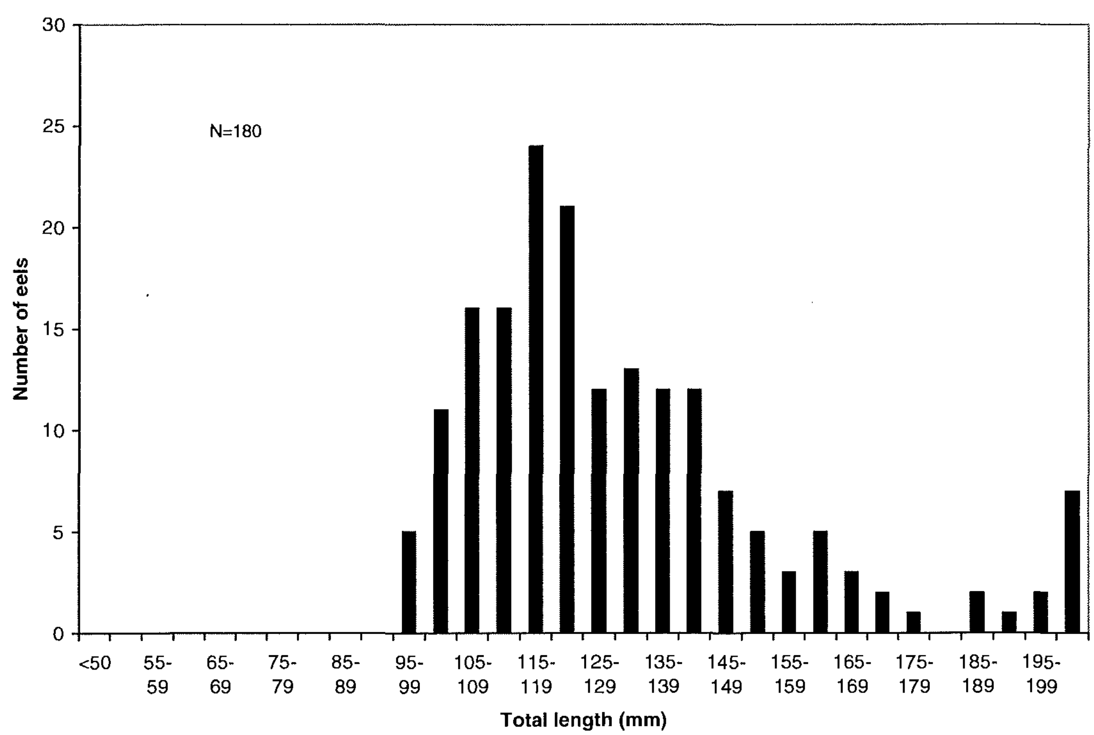


Figure 19. Eel passage at the Burnham project during the 2005 season.

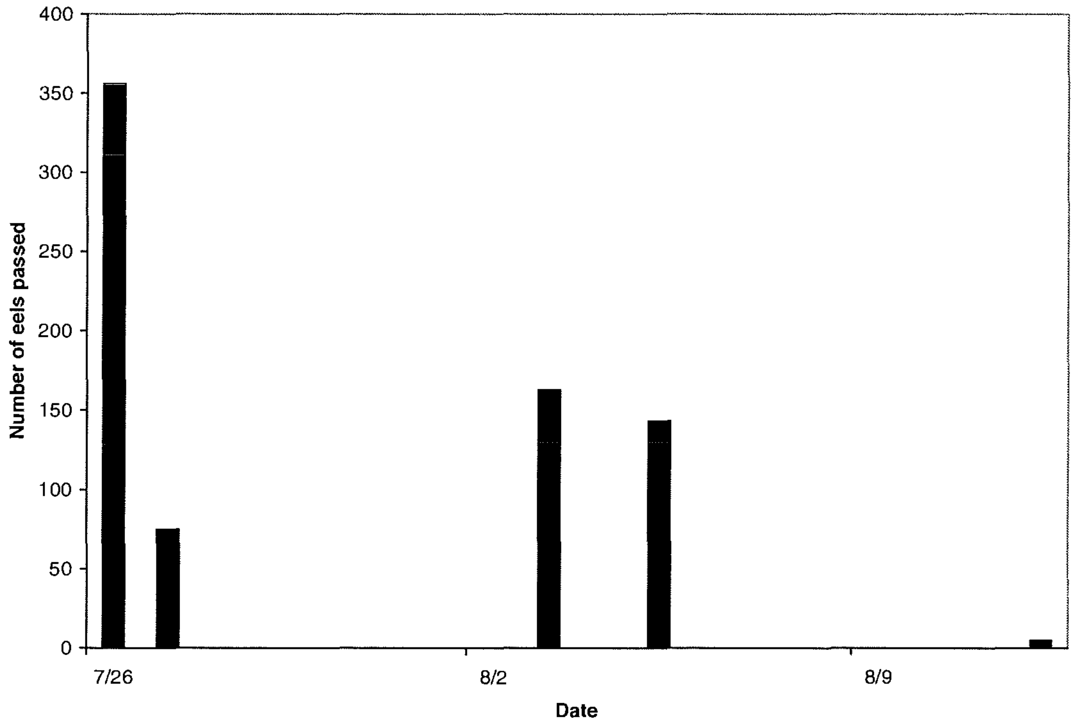


Figure 20. Total length of eels passed at the Burnham Project in 2005.

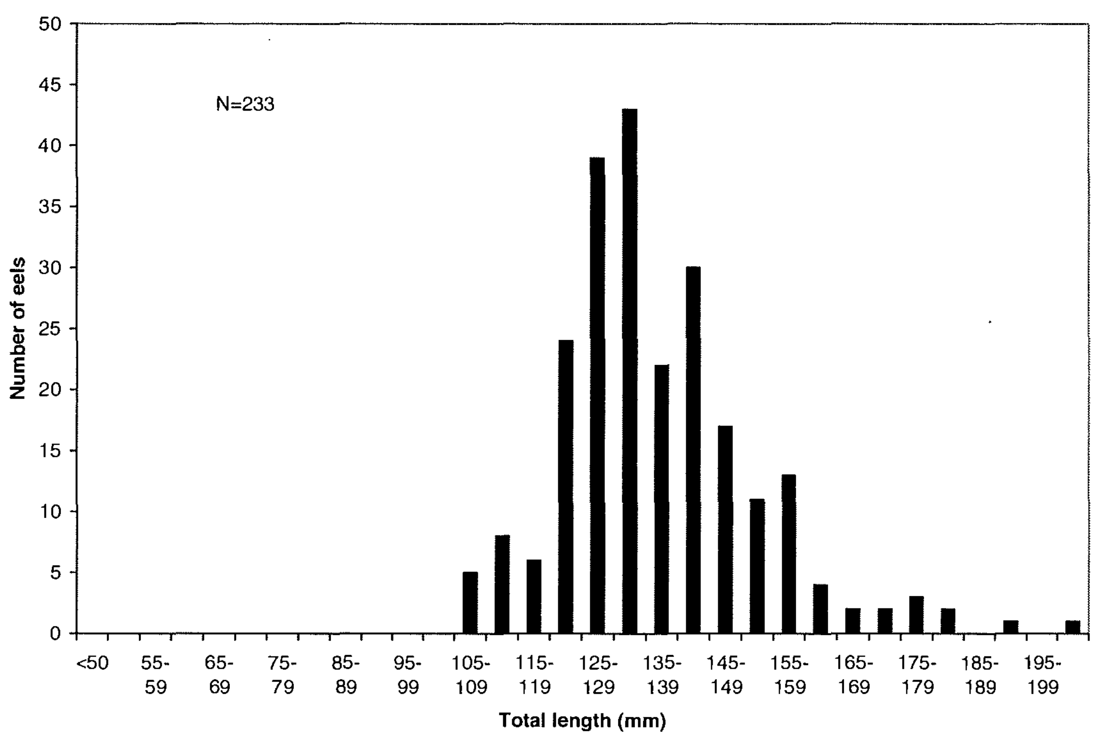


Figure 21. Eel passage at the Hydro-Kennebec Project during the 2005 season.

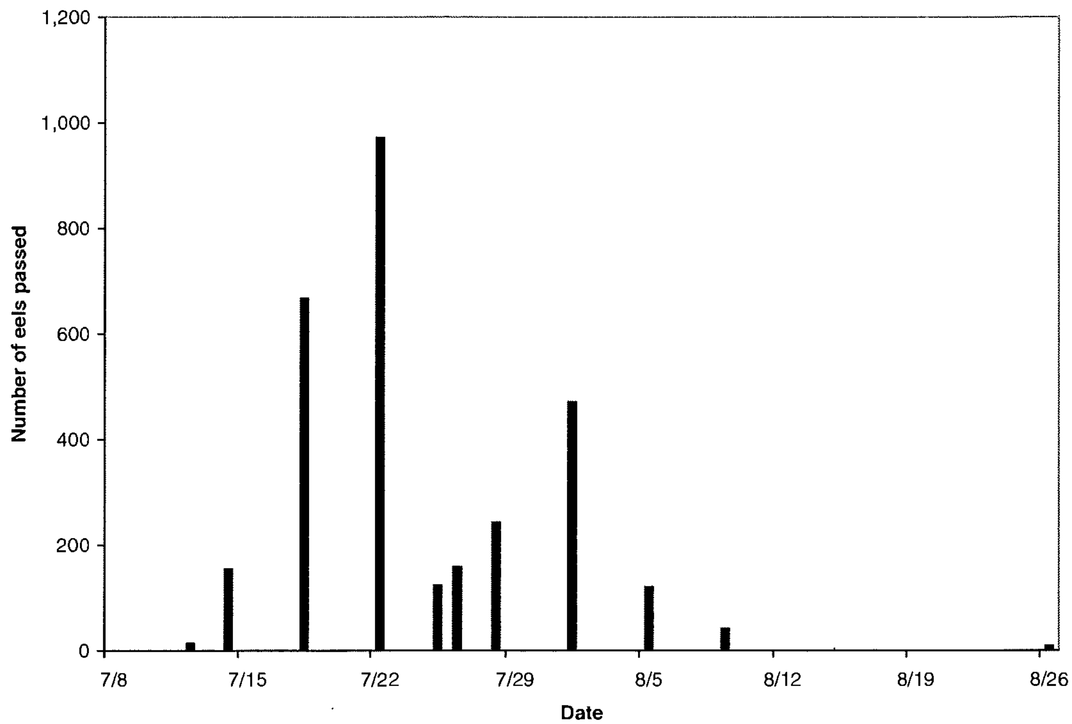


Figure 22. Total length of eels passed at the Hydro-Kennebec Project in 2005.

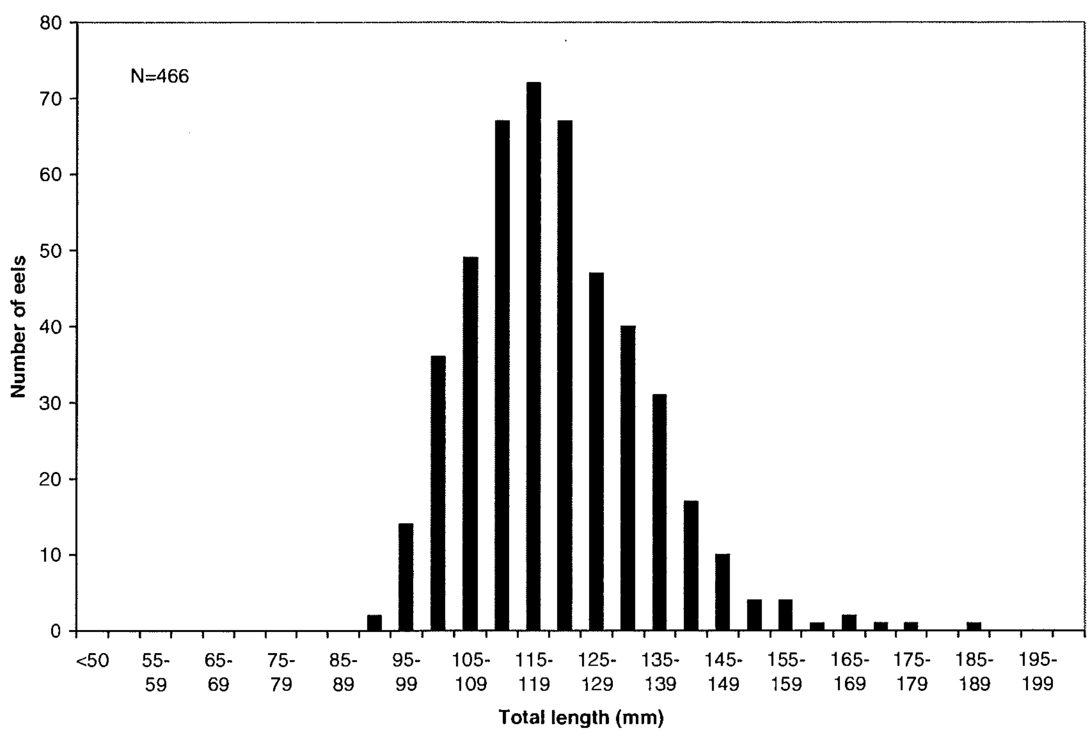
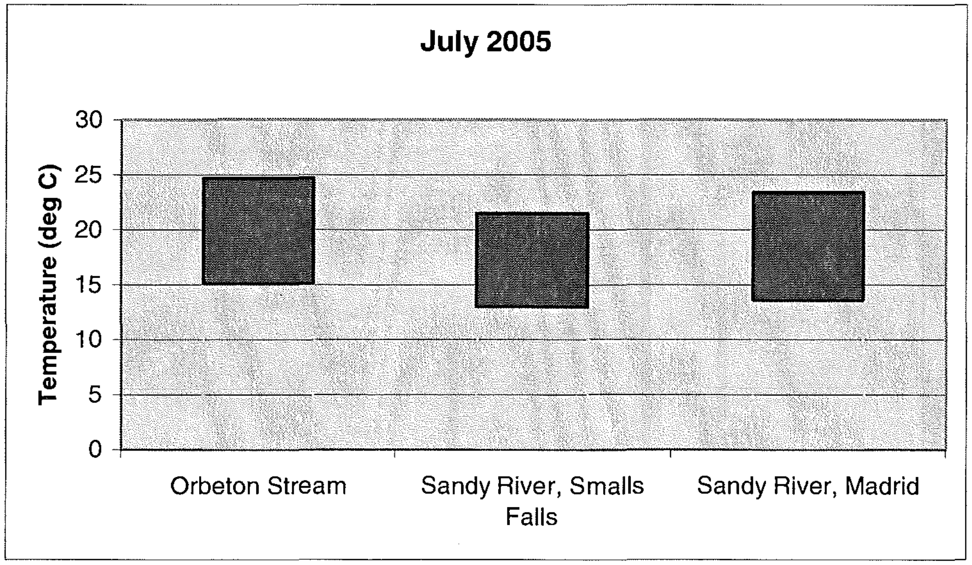
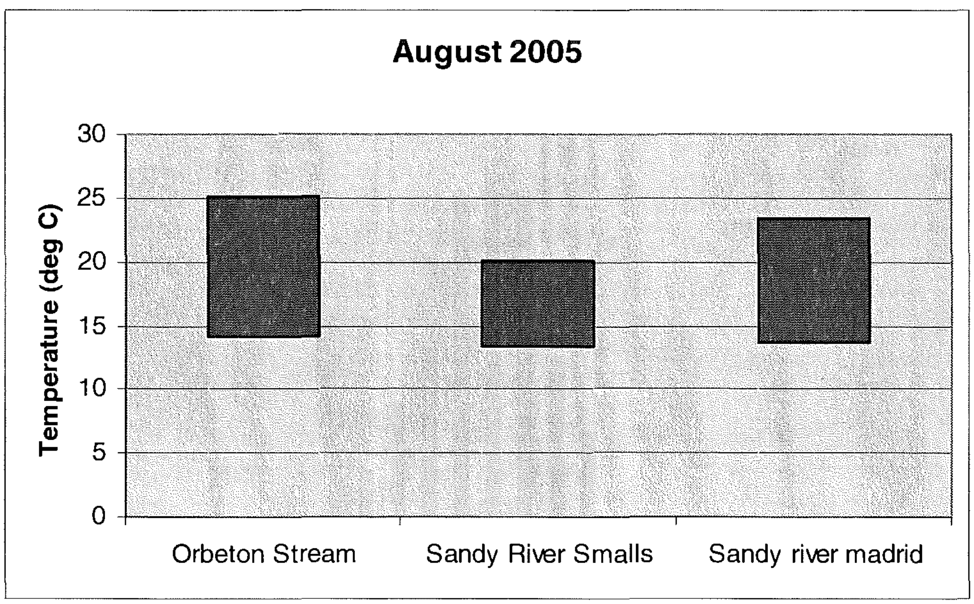


Figure 23. Maximum and Minimum Temperatures for July and August in Selected Waters, Kennebec River Drainage, 2005.





APPENDIX A - History of Management Plan

<u>Diadromous Fish Restoration on the Kennebec River</u>

(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 1986, the Maine Department of Marine Resources (DMR) developed *"The Strategic and Operational 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 alosines.

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 initiating an Atlantic salmon stocking program.

1.2 Implementation of the Management Plan (1986-2001)

The strategy developed to meet the objectives of alosine 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 down stream 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 2003, 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 (IFW), 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, 2003 and IFW was responsible for its cleaning and maintenance.

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 2004.

Under Phase I of the restoration plan, only those lakes approved by IFW 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 IFW to assess the interactions of alewives with resident smelt and salmonids. In June 1997, IFW 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 IFW 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 initially stocking only Webber Pond. 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 2003, 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 its increased run size over the past few years and its closer proximity to Maine[4]. 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).

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 2003 than in previous years. All larval shad raised at the hatchery were marked with oxytetracycline prior to release.

[4] 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.

APPENDIX B— Proposed 2006 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 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 drainage, and mainstem of the Kennebec River below Madison.

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- 2006 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 various waters including Togus streams and Bond Brook to 1) add to the historical database for Togus Stream and Bond Brook, and 2) tributaries identified as having salmon habitat will be electrofished for 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 locations associated with fry stocking from instream and streamside incubation. Thermal characterization of different regions of the Sandy River will aid us in understanding any growth difference we observe.

Job 5. Instream Incubation
MASC staff will continue testing instream egg incubators in the Sandy River drainage. Incubating Atlantic salmon eggs remotely in the Sandy River will provide MASC with the following information and benefits: 1) can fry be successfully hatched 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 instream incubator program.

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 on 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 is anticipating the completion of a 5-year Kennebec River Atlantic salmon management plan. It will out line the initiation of active Atlantic salmon restoration in the Kennebec River in the near future. 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.

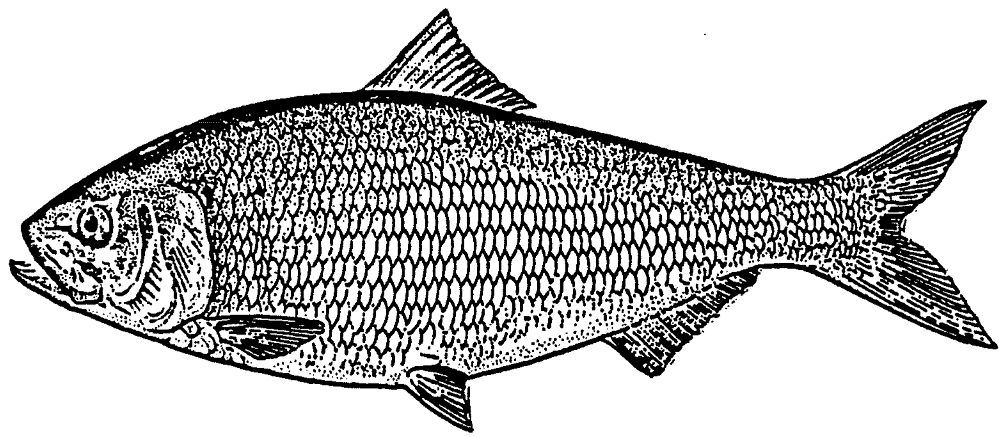
Job 8. Public Outreach

The MASC staff will participate in meetings, forums, round-tables, etc. as necessary to appraise 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.

	Q1	Q2	Q3	Q4	Totals
Personal Services	$2,784.00	$3,479.00	$9,047.00	$9,047.00	$24,357.00
Materials/Supplies	$1,625.00	$1,425.00	$2,525.00	$1,625.00	$ 7,200.00
Operations/Maintenance	$ 1344.00	$2,980.00	$2,980.00	$2,272.00	$ 9,576.00
Capital	$ -	$ -	$ -	$ -	$ 0.00
Totals:	$5,753.00	$7,884.00	$14,552.00	$ 12,944.00	$41134.00

APPENDIX C—2005 Shad Hatchery Report

WALDOBORO SHAD HATCHERY



2005

ANNUAL REPORT

Carolyn, Samuel and Andrew Chapman

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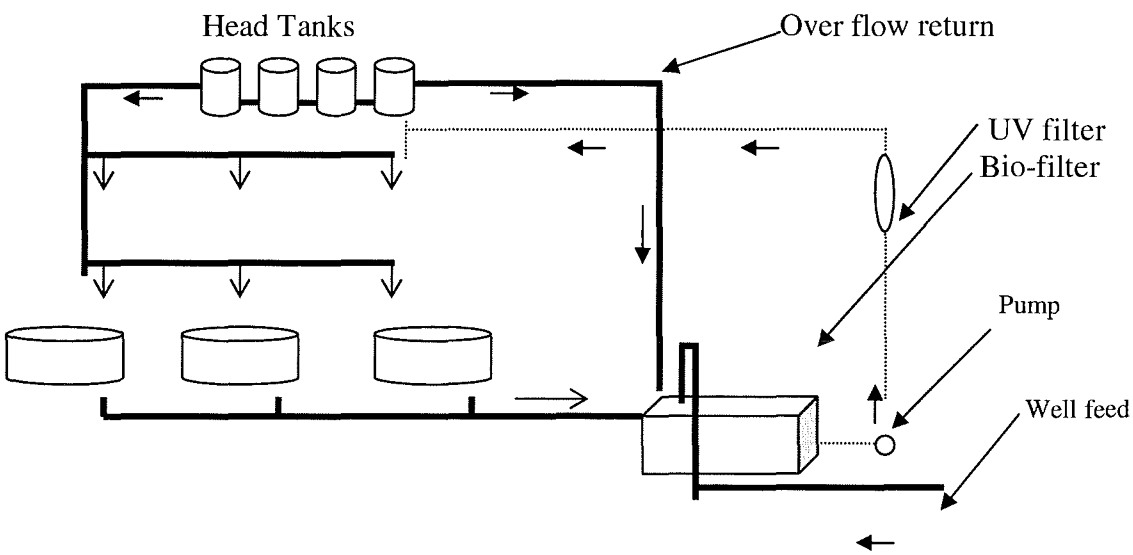
INTRODUCTION

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 in from an artesian well overflow 325' from the site. 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 2005 and during that period, provided 29,764,900 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 provides 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 is built 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 5-7 days after hatching. Brine shrimp are the primary fry diet and a system to conveniently provide feed to all the tanks is required. Four fiberglass 125-gallon, conical bottom tanks were set up to supply the hatched brine shrimp for the fry. Two 250-gallon fiberglass tanks hold a day's supply of brine shrimp and is connected to two systems of pipes, valves, and timers that automatically feed a plentiful diet of newly hatched shrimp over a 24-hour period to all the culture tanks at once. 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 that is 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 bio-filter tank with no 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 under-sized 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 placed in incubators.

TANK SPAWNING SYSTEM

2005 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 shown to have a dramatic positive effect on the overall survival of the transported shad.

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 egg 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; there-fore, 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 table 1.

The number of fry discarded increases with amount of time they are maintained in the hatchery system.

HATCHERY PRODUCTION SUMMARY FOR 2005

Waldoboro Hatchery Tank Spawning System:

Merrimack River Shad

A total of 227 Merrimac River shad were delivered to the Waldoboro Shad Hatchery between June 24 and June 30. While in the hatchery system the Merrimac fish produced a total of 28.25 liters of eggs >2mm, equaling 1,929,141 eggs with an average viability of 73%. During culture, 134,093 dead and alive shad fry were siphoned with waste from the bottom of the tanks and discarded into waste treatment ponds. On July 27, 110 Merrimac River shad were released back into the wild. A total of 1,201,894 fry were stocked in the Kennebec, and Androscoggin Rivers, between July 2, and July 21.

Kennebec River Shad

No Kennebec River shad were provided to the hatchery system this year.

Of the 227-broodstock shad held in the tank spawning system, 110 or 48% were released back into the wild.

Fry Stocking Summary:

The following list of dates, names, locations, and numbers of fry are the American shad fry released back into Maine waters during the 2005 season:

Date	Egg location	Stocking location	# Fry stocked
7/5/05	Merrimac	Berlinsky- UNH	5,850
7/12/05	Merrimac	Berlinsky- UNH	4,000
7/14/05	Merrimac	Berlinsky- UNH	2,000
7/15/05	Merrimac	Shawmut- Kennebec	362,229
7/22/05	Merrimac	Shawmut- Kennebec	422,764
7/26/05	Merrimac	Shawmut- Kennebec	320,350
8/2/05	Merrimac	Pejepscot- Androscoggin	96,551

POND CULTURE

No shad fry were intentionally stocked into the ponds for rearing. But there are always a few escapees that make it out the drain and into the pond.

This season 3,600 pond reared fingerlings were stocked into the Medomak River.

Table 1. Merrimack Egg Production

Date	Source	Fry tank	Incubator	Total egg	Volume eggs	Number eggs/10"	Number eggs/L	Total eggs	% viability	Viable eggs	Fry started	Fry discarded	Fry stocked	Date stk	Stocking location
25-Jun	Merrimac	3	1	400	200	95	61770	12354	0	0					
26-Jun	Merrimac	no eggs		0	0	0	0	0	0	0					
27-Jun	Merrimac	3	2	1650	1050	86	44647	46879	78	36566	2-Jul				
28-Jun	Merrimac	3	3	1825	1400	99	69404	97166	69	67044	2-Jul				
29-Jun	Merrimac	3	4	3200	2850	96	63570	181175	58	105081	4-Jul				
30-Jun	Merrimac	3	5	1800	850	102	75976	64580	47	30352	4-Jul				
1-Jul	Merrimac	3	6	3800	2700	95	61770	166779	73	121749	5-Jul				
2-Jul	Merrimac	3	7	600	500	90	52286	26143	89	23267	6-Jul	21833	362229	15-Jul	Shawmut
3-Jul	Merrimac	no eggs		0	0	0	0	0	0	0					
4-Jul	Merrimac	2	8a	3400	1900	97	65436	124328	58	72110	9-Jul		5850	5-Jul	B. UNH
4-Jul	Merrimac	2	8b	1900	1900	97	65436	124328	58	72110	9-Jul		4000	12-Jul	B. UNH
5-Jul	Merrimac	no eggs		0	0	0	0	0	0	0			2000	14-Jul	B. UNH
6-Jul	Merrimac	no eggs		0	0	0	0	0	0	0					
7-Jul	Merrimac	2	9	3150	2550	98	66896	170585	51	86998	11-Jul				
8-Jul	Merrimac	2	10	3000	2400	103	77752	186605	72	134355	12-Jul				
9-Jul	Merrimac	2	11	2000	1800	97	65436	117785	93	109540	12-Jul	40500	422764	22-Jul	Shawmut
10-Jul	Merrimac	1	12	1900	1500	101	73695	110543	84	92856	14-Jul				
11-Jul	Merrimac	no eggs		0	0	0	0	0	0	0					
12-Jul	Merrimac	1	13	1800	1400	98	66896	93654	92	86162	15-Jul				
13-Jul	Merrimac	1	14	2025	1800	101	73695	132651	73	96835	17-Jul				
14-Jul	Merrimac	1	15	540	500	100	71507	35754	97	34681	19-Jul				
15-Jul	Merrimac	1	16	900	650	105	83402	54211	74	40116	19-Jul	30300	320350	26-Jul	Shawmut
16-Jul	Merrimac	no eggs		0	0	0	0	0	0	0					
17-Jul	Merrimac	4	17	375	250	108	90366	22592	30	6777	21-Jul				
18-Jul	Merrimac	4	18	1650	1200	100	71507	85808	76	65214	22-Jul				
19-Jul	Merrimac	4	19	425	300	108	90366	27110	93	25212	23-Jul				
20-Jul	Merrimac	4	20	450	325	105	83402	27106	87	23582	24-Jul				
21-Jul	Merrimac	4	21	260	225	109	93362	21006	82	17225	25-Jul	41460	96551	2-Aug	Andro
22-Jul	Merrimac	no eggs													
23-Jul	Merrimac	no eggs													
24-Jul	Merrimac	no eggs													
25-Jul	Merrimac	no eggs													
26-Jul	Merrimac	no eggs													
27-Jul	Merrimac	no eggs	110 Adults released to Medomak River												

APPENDIX D - Proposed 2006 Trap & Truck Budget

Job 1. Trap and Sort Alewives

Transfer of broodstock alewives via Transvac pump at the Ft. Halifax facility 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. However, since fish passage installation will be complete at Benton Falls and Burnham (Pittsfield) dams by May 1st, 2006, alewives returning to the Sebasticook River will be collected with the Transvac pump and then released into the Ft. Halifax headpond to continue upstream. Therefore, trucking operations will be greatly reduced from the Ft. Halifax facility with nearly all Phase I habitat in the Sebasticook River drainage accessible to the alewives with the new fish passages installed.

Job 2. Trap/Sort and Truck Alewives/American shad

Transfer of broodstock alewives via tank truck will begin in May and conclude in July. Alewives and American shad returning to the mainstem Kennebec will be captured at the new fishlift facility installed by FPL/Constellation Energy at the Lockwood hydroelectric facility. Alewives returning to Lockwood will be used to stock Wesserunsett Lake in Skowhegan as well as Douglas Pond on the Sebasticook drainage. Excess fish from the Lockwood facility will also be used to stock out of basin as time permits. The fishlift will deposit captured fish in a holding tank where undesirable species will be removed and returned to the river below the dam. Alewives will be sorted into receiving tanks with discharge pipes to be loaded into stocking trucks. American shad captured at the Lockwood fishlift will be loaded into a stocking truck and trucked to the Hydro-Kennebec headpond to saturate available habitat above that facility.

.**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 400-600 shad broodstock to the shad hatchery from the Merrimack River. These fish will spawn naturally in tanks at the hatchery. For a complete description of shad hatchery operations see attached report.

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 continue to 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 early November 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.

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 alosine emigration.

Job 6. Studies of the Fish Assemblage of the Kennebec River

DMR will continue to collect data on the fish community at several locations in the Kennebec River between Merrymeeting Bay and Winslow. In addition, habitat data including DO, substrate type, water temperature and depth, flow, and measurements of bank stability and vegetation will be collected. This effort will continue in 2006.

Sampling methods will include fyke netting, electrofishing, minnow trapping, trawling, angling, 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.

2006 Budget

	Q1	Q2	Q3	Q4	TOTAL
Personal Services	$26,405.00	$40,656.00	$36,906.00	$30,156.00	**$134,123.00**
Materials/Supplies	$911.00	$3,246.48	$2,079.48	$911.00	**$7,147.96**
Operations/Maintenance	$1,185.00	$4,899.00	$3,042.00	$1,185.00	**$10,311.00**
State Indirect Cost (2%)	$638.80	$1,045.94	$1,006.42	$738.80	**$3,429.96**
Capital					
TOTALS	**$29,139.80**	**$49,847.42**	**$43,033.90**	**$32,990.80**	**$155,011.91**