Kennebec River Anadromous Fish Restoration
Annual Progress Report - 2004

Alewives at Webber Pond - Vassalboro

Prepared by:
Maine Department of Marine Resources
Stock Enhancement Division
#21 State House Station
Augusta, ME 04333-0021
(207) 624-6340

Maine Atlantic Salmon Commission
270 Lyons Road
Sidney, ME 04330
(207) 547-5326

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EXECUTIVE SUMMARY OF 2004 ACTIVITIES

On April 29, 2004, the temporary fish pump was installed below the Fort Halifax Hydroelectric Project in Winslow, Maine. Trapping of alewives began on May 10 and the pump was used almost daily until June 10. In all, a total of 145,882 alewives were collected with the fish pump. A total of 77,644 alewives were released into Phase I habitat and 51,228 were released into 23 other ponds and rivers throughout the state, including 26,724 into Burnham headpond on the West Branch of the Sebasticook River to test the efficiency of the new fish passage at the outlet of Sebasticook Lake. The East Branch of the Sebasticook River received an additional 15,382 alewives to saturate habitat above Douglas Pond. Unfortunately, due to time constraints, it was not determined if these fish made it to the outlets of Great Moose and Indian Ponds. The total mortality rate of adult alewives (318 mortalities from combined pump and trucking operations) was 0.22%, a decrease from 1.0% in 2003 and the second lowest on record (0.01% in 2002). Flashboards were installed at the Fort Halifax Project on April 29. Low spring flows coupled with early flashboard installation eliminated fish stranding problems on the ledges below the project. The sex ratio of randomly collected alewife samples was 1.26 males: 1.0 females (n=350). As predicted, fish lengths and weights decreased over time. The majority of adult alewives collected were Age IV males (29%) and females (23%). Permits were issued to 26 commercial fishermen. Of those permitted, 17 have reported combined landings of 854 bushels (59,780 pounds).

An experimental "Beaver Deceiver" fish passage was installed on a beaver dam (Figure 2) in the Sevenmile Stream drainage in early May by Dave Wilkens of Bremen, Maine. Department of Marine Resources (DMR) personnel visited the site regularly to determine the passage's effectiveness. It was determined after lengthy observations that the placement of the passage was less than ideal. A few alewives were noted using the passage, but the vast majority (tens of thousands) were not. The beaver dam was subsequently breached by DMR personnel and full and effective passage was attained.

A total of 643 adult American shad broodstock were transferred to the Waldoboro hatchery from the Merrimack River. An attempt was made to capture broodstock from the Brunswick Fishway to augment hatchery broodstock. On July 8th, six shad were captured from the lower pools of the fishway and transported to the Waldoboro Shad Hatchery.

The year 2004 was the second highest for larval shad production. In all, 4.93 million larval shad were released in the Kennebec River and 510,962 in the Sebasticook River; an additional

538,613 were released into the Androscoggin River. In early July, 1,000 shad fingerlings were released into the Medomak River.

DMR personnel checked pond outlet dams from July to November. Water levels were similar to those of 2003 and as a result, downstream passage was available during many of the inspections. Known beaver dam problem areas were also visited throughout the season and were partially breached to provide passage; however, they were typically reconstructed by beaver within days. Particular attention was paid to a large beaver dam located on Sevenmile Stream (outlet to Webber Pond in Vassalboro); DMR personnel partially breached this dam over the course of several days to enable adult alewives to migrate upstream to Webber Pond and to assist juveniles in their fall downstream migration.

DMR personnel also made unannounced visits to hydroelectric dams from July to November. Bypass facilities were operating at all projects during all visits. DMR personnel were advised of fish kills (juvenile alewives and adult eels) at the Benton Falls Project in October. A minor alewife entrainment event occurred at the Burnham hydroelectric facility in October as well. The American Tissue Project, located on Cobbosseecontee Stream in Gardiner, installed intake grating to prevent American eels from entering the turbine penstock after a few eels were found below the project in mid-August. American Tissue also upgraded the plunge pool on its spillway with stout steel work to prevent its destruction during high water events.

DMR personnel conducted biweekly beach seine surveys at eight sites in the Kennebec River between Augusta and Waterville. A total of 42 seine hauls were made. A total of 7,773 juvenile alewives, 648 juvenile American shad, three American eels, and 435 unidentified river herring were captured. The catch/effort for juvenile shad was 14.79, compared to 6.10 in 2003.

DMR installed and monitored eel upstream passage at the Fort Halifax and Benton Falls Projects, assisted with the installation of passage at the Hydro-Kennebec Project, and made nighttime observations at the Lockwood, Shawmut, and Weston Projects. An estimated 66,804 eels passed at Fort Halifax in 40 days, but the size distribution was very different from previous years. The passage at Benton Falls become operational late in the season and the number of eels that passed (2,343) is underestimated because they were able to escape the holding pen for an unknown period of time. Hydro-Kennebec staff installed a new ramp-style passage in 2004 that passed approximately 7,826 eels. FPL Energy passed 4,521 eels at the Shawmut

Project. The location for an eel passage at the Weston Project was determined, but passage at Lockwood needs additional evaluation.

In 2004, DMR installed and calibrated telemetry equipment at the Lockwood Project to continue the study of downstream eel passage. However, no downstream migrants for the study were captured in fyke nets set in Carrabasssett Stream, Martin Stream, and Wesserunsett Stream from September to mid-October. The telemetry study was terminated so DMR biologists could respond to a reported eel kill.

On October 15, DMR received a report that an eel kill was occurring at the Benton Falls Project on the Sebasticook River. DMR biologists conducted a site visit and found several hundred dead or dying eels in the project tailrace. Smaller numbers of dead eels were observed on five occasions through November 22. DMR biologists also conducted site visits to other KHDG projects to determine if downstream migrating eels were being killed. The owner of Benton Falls Project has agreed to screen the turbine intakes in the fall of 2005 to reduce eel mortality.

DMR conducted a pilot study of alewife migration and passage at dams in the Sebasticook River using PIT technology. A single antenna/receiver/datalogger array was deployed at the Sebasticook Lake fishway and 200 alewives were PIT-tagged at Fort Halifax and released into the Burnham headpond. Despite problems with a previously unreported software limitation, the array detected 61 tagged alewives as they passed upstream.

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 2004. 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 April 28, DMR received reports from FPL Energy consulting biologist Jason Seiders [Normandeau Associates] that small schools of alewives were observed below Fort Halifax in Winslow. Stocking operations were delayed until adequate numbers of alewives were available for pumping. By May 10, the numbers had increased enough to warrant the onset of trucking operations.

On April 29, 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 10 and June 8, 2004, a total of 145,882 alewives were collected with the fish pump. It operated for a total of 17 days (five fewer than in 2003) and an average 8,584 adult alewives (6,153 in 2003) 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, and trip length.

The timing of the alewife run was a little earlier than average (Table 1). Historically (1994-2003), the mean date by which 50% of alewives have been collected is May 24. In 2004, the 50% date of alewife trapping was May 18 (Day 7 of pump operation). The 25% quartile was reached on May 13; the 75% quartile was reached on May 24.

Based on 11 years of data (1994-2004), the average peak date of alewife pumping is May 22. In 2004, the peak was on May 13 when 16,761 alewives collected with the fish pump; however, there were also 14,213 alewives collected on May 18 and 15,228 collected on May 24 (Table 2). The number of mortalities due to handling was very low in 2004. In fact, the trucking mortality (mortality=186 fish) rate of 0.12% was the second lowest ever (Table 2).

Phase I Habitat

In 2004, a total of 77,644 broodstock alewives were truck-stocked into 10 of the 11 upriver Phase I lakes in the Kennebec River watershed (Table 3). An additional 4,018 were hand-dipped at Webber Pond on two separate occasions, bringing total transfers to 81,662. A total of 13,400 acres of lake surface area were stocked to a density of approximately six alewives/acre except Douglas Pond, where stocking densities approached full escapement of 36/acre. Due to a concern about the ability of alewives being able to leave the pond, Three-cornered Pond was not stocked in 2004. The results of surveys conducted during the winter/spring of 2005 will determine whether this waterbody will be stocked in 2005.

In total, 37 alewife-stocking trips were made to the upriver ponds in 2004, averaging 2,098 alewives per trip (Tables 4 & 5). All 37 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 10 and May 24, 2004. All of Phase I lakes were stocked by May 24. The most stocking trips completed to the Phase I ponds in one day was seven, occurring on May 13.

Phase II Restoration

No Phase II lakes were stocked in 2004. DMR delayed stocking of Great Moose Pond until improvements can be made in the downstream passage facility. The outlet of the downstream passage facility discharged onto large rocks, so a contractor was retained by DMR in February 2004 to remove them. However, the plunging flow still 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.

With the assistance of the US Fish & Wildlife Service (USFWS), DMR completed a survey of dams and obstructions on the China Lake Outlet Stream. There are presently five dams below China Lake which would need to be provided with fish passage. In addition, DMR staff monitored flows and determined that modifications would need to be made to the China Lake Outlet dam and potentially at two other dams to facilitate downstream passage of adult and juvenile alewives. DMR decided to postpone stocking alewives in China Lake until at least 2008, while it concentrates in obtaining passage in the West Branch of the Sebasticook River.

Non-Phase I Transfers

In 2004, transfers from Fort Halifax to waters other than Phase I lakes totaled 51,253 alewives loaded, with 25 trucking mortalities, for a total of 51,228 alewives stocked (Table 6). The stocking of non-Phase I habitat with Fort Halifax alewives was less from previous years due to surplus stocking of alewives trapped at the Brunswick Hydroelectric Project into non-Phase I waters, as well as alewives stocked from the Coopers Mills fishway into ponds on the Sheepscot River drainage.

The non-Phase I transfers included six rivers and ponds within the Kennebec drainage, including the Sebasticook system, and six ponds in six other drainages. Non-Phase I transfers began on May 14 to Pleasant Pond in the Cobbosseecontee watershed and continued until June 8. Alewives transferred to waters other than the Phase I lakes represented 51% of the total number trapped at Winslow.

1.3 *Adult Alewife Biosamples*

On seven different days between May 10 and June 8, DMR personnel sampled approximately 50 adult alewives collected at Fort Halifax. All samples were collected using the fish pump by dipping them out of the pump-receiving tank. 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

[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.

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 350 fish collected, identified, and measured, only one (0.28%) fish was identified as a blueback herring, thereby reducing the number of alewives sampled to 349. Of those 349, 45% were females and 55% were males. Males were more abundant than females in all the samples (Figure 4).

On average, adult female alewives collected in 2004 were smaller than those collected in 2003. Adult females collected in 2004 were 7 mm shorter (mean = 273 mm) than in 2003 (mean = 280 mm). Additionally, those collected in 2004 were 7.6 g lighter (mean = 173.9 g) than in 2003 (mean = 181.5 g). Adult males collected in 2004 were 3 mm longer in length (mean = 273 mm) than the 2003 samples (mean = 270 mm), and they averaged 12 g heavier (mean = 174.0 g) in 2004 than in 2003 (mean =162.0 g).

In 2004, there were minor differences in length and weight, both between sexes and over time. On average, females were longer (273.9 mm) than males (273.8 mm). In addition, females were lighter (173.9 g) than males (174.0 g). There was a decrease in both length (Figure 5) and weight (Figure 6) of adult alewife returns to the Sebasticook River over time. Fish collected during the first sample on May 10 were longer and heavier (293.9 mm and 173.9 g) than fish collected during the last sample on June 8 (265.5 mm and 153.2 g).

Of the 349 alewives sampled, scales were collected from 110 fish. Most of those sampled were Age IV (29.0%) and Age III males (24.5%). Age IV (22.7%) and Age III females (18.1%) were the next most abundant age classes. Within each sex, Age IV fish dominated the samples: 52.4% of males sampled and 51.0% of females sampled were four-year-olds (Table 7).

1.4 *Commercial Alewife Harvest*

In 2004, the Maine Department of Inland Fisheries and Wildlife (IFW) issued 26 permits to commercial fishermen for the harvest of alewives below Fort Halifax dam in Winslow (Figure 3). 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 17 permit holders had reported their landings for a total of 102,480 alewives (854 bushels) harvested, compared to 136,440 alewives (1,137 bushels) harvested in 2003.

Year	Reported Landings
2004	854 bu = 102,480 fish
2003	1,137 bu = 136,440 fish
2002	3,817 bu = 458,040 fish
2001	575 bu = 69,000 fish
2000	450 bu = 54,000 fish

2.0 AMERICAN SHAD RESTORATION METHODS

2.1 *Adult Capture and Transport*

The shad culture program initiated in 1991 was continued in 2004. 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 2004, 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 4; a total of seven trips were made. There were

[2] A 60-fish sample of adult American shad was collected at the Essex fish lift in Lawrence, MA. 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.

some delays due to high spring flows and low water temperatures (Table 8). Of the 756 shad loaded at the Essex lift, 646 were released alive into the adult spawning tank, resulting in a hauling mortality of 14.5%. Hauling mortality was increased substantially from 2003 levels when on June 5 an oxygen fitting failed, causing a 40% loss of the 166 fish on board. This one event was the cause of the dramatic increase in hauling mortality.

Between June 4 and July 8, DMR successfully transferred 643 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-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 2004 and no attempt was made by either DMR or FPL staff to capture broodstock shad from the Kennebec and Sebasticook Rivers. On July 8, an attempt was made to collect some adult shad broodstock from the Brunswick Fishway. The water was lowered in the fishway and stop nets were employed between pools to prevent shad from descending into lower pools. Several shad were noted in the lower pools as the operation began; long handled dip nets were used to capture these individual fish. This was a long and arduous procedure, both for the shad and the net handler. By operation's end, a total of six shad had been netted from the lower pools of the fishway. After capture, they were placed headfirst into a five-gallon pail half-filled with water and hoisted 40 feet to the deck above and loaded into the waiting stocking truck. Only three survived to supplement the hatchery broodstock.

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 14-21 days old before being released. While in the hatchery, all larvae are marked with oxytetracycline ("OTC"), an antibiotic that leaves a mark on the otolith, or inner ear bone, when viewed under a microscope equipped with fluorescent light so that DMR can later distinguish adult returns as either hatchery or wild in origin. 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 2004, no larval shad were intentionally released into the outdoor hatchery ponds for the production of fingerlings.

Between June 23 and July 19, an estimated 5,442,136 shad larvae ranging from 14-23 days old were released at three sites in the Kennebec and Sebasticook Rivers (Table 9). An estimated 4,548,957 larval shad were released just below the Shawmut Project on the Kennebec River and 382,217 were released at the Fort Halifax Park in Winslow. An additional 510,962 were released into the Sebasticook River in the tailrace of the Burnham Project. In addition, 268,288 were released to the University of New Hampshire for studies and 538,613 were released into the Androscoggin River, for a total larval shad stocking of 6,249,037. The 2004 total of 5,442,136 larvae released into the Kennebec drainage is less than 2003 numbers, but higher than average (Figure 7). The lower number of larval shad released in 2004 may be partially attributed to a failed oxygen fitting causing the loss of many prime broodstock shad.

No shad larvae were intentionally stocked into the three culture ponds at the hatchery in 2004; 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 July 6, the first two ponds were beach seined and approximately 1,000 young fingerlings were subsequently released into the Medomak River. The number of fingerlings released in 2004 was much lower than average due to better retention techniques developed during hatchery operations (Figure 8). For a complete description of 2004 shad hatchery operations, refer to Appendix B, *Waldoboro Shad Hatchery 2004 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 2004, DMR personnel made frequent observations at the Fort Halifax tailrace for the presence of shad. Due to the shallow depth (approximately two to four feet) of a portion of the tailrace, under appropriate conditions (low water flow and bright sunlight), shad were observed as they darted about in the river. Low river flows brought generation to an end on June 14, earlier than in years past. After project generation ceased, shad were no longer attracted to the tailwater area. Observations were discontinued. Numbers of shad observed in the tailrace appeared to be the same as 2003 numbers. However, it should be noted that this is not an accurate means to determine the number of shad in the vicinity as several sightings were most likely repeats; also, the viewing methods were subjective as some observers noticed shad at times when others did not.

Other visual observations, as well as underwater video monitoring and spawning surveys by DMR biologists, indicate that most adult shad near the confluence of the two rivers appear to be utilizing the deeper waters of Ticonic Bay, immediately downstream of the Lockwood Project on the Kennebec. DMR biologists theorize that many shad that are homing to the Sebasticook do not find suitable holding habitat in the river segment below the Fort Halifax dam. As a result, more shad activity is noted in the Kennebec.

2.3 *Juvenile Assessment*

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

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 2004 beach seine effort, 648 juvenile shad were captured at four different sites, with the highest number captured at Site 2. This site is located approximately two miles downstream from Fort Halifax. Results from otolith work from field samples collected in 2004 are pending.

A JAI was calculated for juvenile shad captured in 2004 (Table 11). The index for all sites was 14.79 shad/seine haul. Of all the sites sampled in 2004, Site 2 had the highest comparative JAI of 80.6 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.

3.0 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

[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.

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.* No decision had been rendered as of March 11, 2005. Therefore, FPLE has proposed, and the DMR has concurred, to continue the trap-and-truck program from the Fort Halifax dam in 2005.

Upstream passages at the **Benton Falls** and **Burnham dams** are required to be operational one year following the installation of permanent or temporary upstream fish passage at Fort Halifax and 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. Installation will begin early this year and the facility will be operational by May 1, 2005. DMR, IFW, USFWS, and the Licensee are developing an agreement to incorporate a trapping and sorting facility in the Benton Falls fish passage facility.

The Burnham Project submitted its final design drawings to FERC on February 14, 2005. The permanent fish passage is scheduled to be operational by October 2005.

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 will begin the summer of 2005 and be completed in December 2005; it will become operational on May 1, 2006.

3.1 *Monitoring of Downstream Fish Passage at Phase I Lake Outlets*

Several lake outlet streams were surveyed during the 2004 field season. Due to constraints, only those streams known to be problems in the past were surveyed after the alewife and shad stocking seasons ended. Generally, lake outlets were checked on the same schedule as hydropower facilities. Whenever possible, areas known to be past problems for out-migrant alewives and shad were inspected and debris/blockages removed. Starting in July, DMR personnel surveyed eight lake outlets regularly through the first of October: Sebasticook Lake in Newport, Pleasant Pond in Stetson, Plymouth Pond in Plymouth, Wesserunsett Lake in Skowhegan, Unity Pond in Unity, Webber Pond in Vassalboro, Pattee Pond in Winslow, and Threemile Pond in China. The results are summarized in Table 12 and are briefly described below.

Sebasticook Lake outlet was checked on six days to ensure fishway operation. On four of the six visits, juvenile alewives were noted using the fishway as downstream passage. The lake drawdown after Labor Day eventually caused the fishway to dewater, but ample opportunity remained for downstream 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 six times from July 15 through October 1. Of those six visits, downstream passage was available six times. DMR personnel observed juvenile alewives above the dam on August 18 and August 30.

Plymouth Pond was checked on six days from July 19 through October 1. 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 six times from July 15 through September 29. Passage was available during all site visits, with juvenile alewives observed above the outlet during one visit (August 4).

Unity Pond has no outlet dam and has excellent downstream passage into the Twentyfive Mile Stream on all but the driest of years. Unity Pond outlet was checked five times from July 20 through October 1 and passage was available during all visits.

Webber Pond, like Sebasticook Lake, also uses a fall drawdown for water quality improvement purposes and usually has sufficient water to allow passage over the spillway throughout the season. During six visits to Webber Pond, passage was available six times. A beaver dam located downstream from the outlet dam was breached on three site visits to allow both juvenile and adult alewives to pass downstream.

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. 2004 had plenty of rain events throughout the summer; however, water levels in late summer were characteristically low. Beaver dams were breached on lower reaches of the stream during late summer/early fall to provide adequate flows and passage from Pattee Pond.

The **Threemile Pond** outlet was visited six times between July 16 and September 28. Similar to Pattee Pond, Threemile does not have an outlet dam and the combination of low water conditions and beaver dams appeared to create a barrier to out-migrating juvenile alewives throughout September. However, during the fall rains in late October and November, downstream passage became readily available.

3.2 *Monitoring of Downstream 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 downstream fish passage facilities at project sites. Study plans for these effectiveness studies will be filed with FERC and Maine DEP no later than the date on which passage at a particular project becomes operational, and will be subject to a consultation process with, and written approval from the resource agencies."

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

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

Downstream passage at hydropower facilities located on the Sebasticook and Kennebec Rivers was monitored through the summer and fall of 2004. Facilities were visited routinely to assess any problems that downstream migrating juveniles might encounter. The condition and operation of downstream bypass facilities, magnitude and location of spilled water, number of turbines in operation, and presence or absence of juvenile alewives were noted at each site. The dams and their locations are presented in Table 13; locations were illustrated earlier in Figure 1.

The **Fort Halifax** Project in Winslow is operated by FPL Energy and is the lowermost dam on the Sebasticook River. FPL Energy installed permanent downstream bypass facilities during the summer and fall of 1993; it uses the same trash sluice opening that was used in past years for the interim facility. The old trash sluice was refitted with a weir gate to control depth of flow at the entrance of the downstream bypass. The downstream side of the opening was fitted with a metal trough with an open top to carry water and fish down close to the tailrace elevation. A 12-foot deep metal punch plate trash rack overlay was installed to aid in excluding alewives from the turbine forebays. This configuration and operational regime was approved by the FERC Order issued on September 30, 1996 and was utilized again during the 2004 season. DMR made six visits to the Fort Halifax dam in 2004. All visits found the downstream bypass open and functioning. Observations of the downstream bypass operation were made from the south shore when access to the powerhouse was not available.

The **Benton Falls** Project is equipped with permanent downstream passage facilities that have been on line since 1988. The bypass at Benton Falls consists of two surface weirs, one located above each turbine intake, which interconnect and discharge into the tailrace through a large diameter pipe. Water flow into each weir is regulated by a gate that can be lowered to allow controlled surface spill into the weir. After passing over this gate, fish become committed to the bypass and cannot reenter the headpond. The large turbine weir intake is open throughout the migration period and the small turbine weir intake is typically closed.

DMR personnel made five visits to make observations of downstream passage capabilities at Benton Falls in 2004. Due to past problems of debris blocking downstream passage via the bypass, DMR made a more concerted effort to observe this area in 2004. 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.

On October 14, 2004, DMR personnel were told of several dead eels below the project. A site visit confirmed the presence of dozens of dead and/or dying eels in the immediate tailrace area. A more intense survey of the tailrace and waters below the project revealed more eels that were injured or dead. On October 19, the operator noted that there were injured and dead alewives in the turbine outfall. Generation was ceased and a spill gate was opened to facilitate passage. Alewives at a rate of 15/minute were still visible in the tailrace turbine outflow after generation was reinitiated. In an effort to address this problem, the final stop logs in the intake for the downstream weirs were removed and alewives were noted using the downstream bypass shortly thereafter. An inspection of the shoreline below the project confirmed that a significant number of alewives had been entrained by the project's units. Subsequent visits to the site over the following weeks showed that eels were still being entrained by the project's turbines. On October 21, DMR again surveyed the project's tailwater area and noted several more freshly killed or injured eels. On October 27, DMR inspected the upper reaches of the Fort Halifax impoundment from a boat using an underwater video camera to document the number of eels that were not observable from the surface due to water depth. The project owner intends to install excluder panels on the intake racks to prevent eel entrainment in 2005.

DMR personnel made six visits to the **Burnham** Project in 2004. All inspections found the downstream bypass entrance open and operating according to interim passage requirements. However, on September 21, following notification from a concerned citizen, DMR staff found that a minor entrainment event of out-migrant young-of-the-year alewives had occurred prior to that particular site visit. Alewives were noted in the immediate tailrace area. Further investigation found that the alewives were likely killed some days prior to the site visit. Numerous gulls and cormorants were noted in the lower tailrace area indicating the presence of injured or dead fish. It is believed that the entrainment event was minor.

Downstream passage through the bypass was available during each of the six 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 downstream passage facilities on any visit.

DMR visited the **Waverly Avenue** dam on six occasions during the 2004 season. Downstream passage was available at the site on all occasions. Problems encountered during the 2004 season at Waverly Avenue were similar to those of previous seasons. First, gate leakage at the stop log bays on the far side of the spillway remained a problem, causing downstream migrants to be attracted away from the bypass during low flow conditions. Second, the bypass itself frequently collected debris and lost its effectiveness with this fouling. No overlay was installed on the intake racks in 2004.

DMR visited both the **Lockwood** and **Hydro-Kennebec** dams as often as possible in 2004. Both of these projects are located on the Kennebec River and must pass all downstream migrant alewives from the Wesserunsett Lake alewife restoration effort. Additionally, most of the larval shad released into the Kennebec River are released above both Lockwood and Hydro-Kennebec. During the 2004 season, interim downstream passage at Lockwood was made available through the power canal trash sluice, which is located near the turbine trash racks. Interim downstream passage at Hydro-Kennebec is achieved by passing out-migrants through the project turbines.

Neither of these two interim passage measures has been approved as adequate for the required permanent downstream passage to be implemented at these hydro projects. FPLE consultants observed juvenile alosids in both the Hydro-Kennebec and Lockwood Project forebays on several occasions (personal communication with Jason Seiders, Normandeau Consultants, 2004) and submitted several samples of both juvenile shad and alewives for DMR analysis. However, the effectiveness of these measures has not been quantitatively assessed.

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 IFW 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 downstream 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 three seasons. In 2004, the plunge pool was upgraded with a mild steel reinforcing frame to prevent high water events from destroying the pool. There are tentative designs to upgrade the plunge pool to concrete in the future, making it nearly impervious to damage from debris and high water.

After a minor entrainment event of American eels in mid-August, Ridgewood personnel installed punch plate excluders on the intake racks for the project on September 8. The racks extend from the bottom to within eight feet of the surface. The use of a blinding plate installed in 2003 proved ineffective in deterring eels from the intake to the project's single turbine. The opening of the deep gate in conjunction with the use of the punch plate prevented further entrainment for the remainder of the migration period for the eels. However, the method for passing American eels (installation of a blinding plate along the base of the trash racks and opening the deep gate at least 8") has proven ineffective the past two seasons and nighttime generation was ceased to prevent further entrainment of eels during their migration period. Ridgewood, the operator of the American Tissue Project, has indicated that it would develop permanent fish passage pending DMR's restoration plan.

3.4 *Pilot PIT-tag Study on the Sebasticook River*

Introduction

According to the terms of the *Lower Kennebec River Comprehensive Hydropower Settlement Accord* that was signed in 1998, permanent upstream fish passage was required at the first dam on the Sebasticook River (Fort Halifax) by 2003, and upstream passage at the next two hydropower dams (Benton Falls and Burnham) was triggered by the provision of upstream fish passage at four non-hydro dams located farther upstream (Pleasant Pond outlet dam, Guilford dam, Plymouth Pond outlet dam, and Sebasticook Lake outlet dam; Figure 1). Fish passage was achieved at these four sites between 1999 and 2004. An Alaskan steeppass was installed at the Pleasant Pond outlet dam in 1999, the Guilford dam was removed in 2002, two Alaskan steeppasses were installed at the outlet of Plymouth Pond in 2002, and a pool-and-chute fishway became operational at the Sebasticook Lake outlet dam in 2003. Only the Sebasticook Lake fishway has been minimally tested for passage efficiency. DMR biologists released several thousand alewives below the dam in 2003 and observed them quickly moving up the fishway.

Upstream passage is scheduled to be operational at the Benton Falls dam on May 1, 2005 and at the Burnham dam on May 1, 2006. The owner of the Fort Halifax dam has proposed to provide fish passage by partially breaching the dam; however, this action is being contested by a local citizen's group.

Anadromous fishes should have access to the main stem Sebasticook River and approximately 35% of the lake and pond habitat by the spring of 2006, assuming that the proposed construction schedules are met at Benton Falls and Burnham, and that all legal actions pertaining to Fort Halifax have been decided. This situation will allow DMR to begin assessment of management objectives of the Kennebec River Restoration Project. Specific questions to be addressed include:

- How many adult of each species return to the Sebasticook River each year?
- How accurate are production estimates for each species?
- How efficient is each upstream passage for each species?
- How long does it take for adults to reach spawning habitat?
- How should commercial alewife harvest be managed to avoid extirpation of stocks?
- How long do adults remain in spawning habitat?
- What portion of the spawning population returns to sea?

A number of the questions are best answered by studying individual fish (a representative sample population using telemetry). However, radio or ultrasonic telemetry can be very expensive. In 2004, DMR biologists initiated a pilot study using Passive Integrated Transponder (PIT) technology on alewives to determine whether this methodology could be used in future years to assess the restoration.

Methods

The study was conducted from late-May to mid-June in the Sebasticook watershed. A PIT-tag antenna and receiver/datalogger were installed and calibrated at the Sebasticook Lake outlet dam fishway on May 25. The antenna consisted of four windings of THHN 12-gauge cable inside a 2-foot x 3.5-foot rectangle constructed of 1-inch diameter PVC pipe. The antenna was attached with clamps to a wood frame that was bolted to the downstream face of the uppermost chute of the fishway. The PIT-tag receiver/datalogger (Flinka Fisker) and 200 PIT tags were obtained from Dr. Alex Haro (USGS, S.O. Conte Anadromous Fish Laboratory). The receiver/datalogger and a power source (12-V battery) were housed in a waterproof box that was placed on a wooden platform on the cross-members of the fishway. The platform was located under the walkway grating, which made the waterproof box less noticeable and more secure from vandalism.

On three dates, alewives were captured with a fish pump at the Fort Halifax Project, PIT tagged, and transported approximately 25 miles to the release site. A group of 50 alewives were tagged on May 26, another 75 were tagged on June 1, and a final 75 were tagged on June 2. Each alewife was netted from a large holding tank and measured. A few scales were scraped from the left side and a small incision made in the wall of the abdominal cavity. The PIT tag was inserted and the sex of the fish determined before it was released into a second holding tank on the stocking truck. When tagging was completed, all fish were transported upriver to the release site.

Every three to five days, the battery powering the antenna and receive/datalogger was replaced with a newly charged battery and initially the flash card containing data was replaced with a blank flash card at the same time. However, we discovered that no data had been recorded between June 1 and June 3 because the Flinka Fisker was programmed to write to a 15MB flash card and our spare was a 64MB flash card. After June 3, we removed the 15MB flash card, downloaded data in the field onto a laptop computer, and replaced the flash card. Minimum time to reach the fishway was determined by subtracting the date/time a fish was recorded at the fishway from the date/time it was released. Distance from the release point to the fishway was estimated using GIS. Rate of travel was estimated by dividing the distance by minimum time to reach the fishway.

Results and Discussion

A total of 61 of the 200 PIT-tagged fish were recorded at the Sebasticook Lake fishway. This total includes 14 of 50 fish (28%) tagged on May 28, 21 of 75 (28%) tagged on June 1, and 26 of 75 (35%) tagged on June 2. Fish were recorded in the fishway from 1.12-12. 2 days after their release. Of the 61 detected fish, 31 were female, 26 were male, and four were of undetermined sex.

The average time for females to arrive appeared to be higher than for males (3.11 days versus 2.13 days), although this discrepancy may be due to the lack of data being recorded between May 28 and June 3. The difference was not due to fish size. Average fork length of females (234.2 mm) was similar to that of males (239.4 mm). It is possible that three females that were recorded at the fishway 5.01-9.27 days after being released had passed upstream when the Flinka Fisker was not recording and were detected while migrating downstream. It is not possible to determine swimming direction with a single detection array antenna/receiver/ datalogger).

Swimming speed over the ground (i.e., headway made against any current) ranged from 0.05-0.6 foot/second (nearly equivalent to 0.05-0.6 body length/second). This is the minimal swimming speed over the ground and assumes that a fish swims constantly and swims directly toward the fishway. The rate would be doubled, for instance, if a fish swam only 12 hours per day towards the fishway.

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 downstream to the former Edwards dam site. The objective of the survey was to locate potential sampling sites for the deployment of beach seines and other sampling gear for fish community assessment purposes. Several factors led to the selection (or non-selection) of the sampling sites, including depth; areas of strong currents; and obstructions such as 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 50 per resident species. If American shad were captured

(Figure 9) a random sample of 20 was placed on ice and brought back to the DMR office in Hallowell for otolith work (see Section 3.0 of this report).

Data Analysis

Seining surveys for the 2004 season commenced on July 21. The sampling sites consisted of the same sites as those of late 2002.

A total of 42 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 9,962 fish representing 19 species were captured and identified. Of those, total length was assessed for 1,086 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 downstream 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. In 1999, DMR found that a large number of juvenile eels congregated below the Fort Halifax dam, but few were able to ascend the dam. The following year, DMR constructed and installed an elver passage (ramp) at Fort Halifax to provide passage and to allow quantification of the timing and magnitude of the migration and the size distribution of the eels.

In 2001, after three years of study, DMR made recommendations on the appropriate locations for upstream eel passage at four more facilities (Benton Falls, Burnham, Hydro-Kennebec and Shawmut). The operator of Benton Falls installed an elver passage (ramp) during the summer of 2001. Hydro-Kennebec staff installed an experimental passage in 2002. However, it was destroyed by ice during the winter of 2003 and the plant manager proposed to install a ramp-style passage in 2004. The owner of Shawmut installed an elver passage (ramp) in the summer of 2003. The Burnham Project obtained its FERC license in 2004 and the owner has proposed to install upstream eel passage and anadromous passage concurrently. Both are expected to be operational on May 1, 2006. DMR biologists have continued to make nighttime observations at the remaining two sites (Lockwood and Weston) to determine where eel upstream passage should be located.

Methods, Results and Discussion

Upstream passages, which have been described in previous reports, were installed at the Fort Halifax and Benton Falls Projects. In general, the passages were operated five days per week and 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. Water temperature at Fort Halifax was obtained from Normandeau Associates. Other environmental information was recorded when the passages were tended.

The passage at **Fort Halifax** Project became operational about three weeks later than usual, because the ram-pump had to be replaced. It was operated for a total of 40 days between June 28 and September 1, and passed an estimated 66,804 eels, the second lowest number in six years (Table 15). Approximately 92% of the eels moved upstream during the first month the passage operated (Figure 10), a pattern that has occurred in most years. However, the size distribution of eels was very different in 2004 compared to previous years. In the past, the distribution has been unimodal, with a peak at 105-114 mm (in 2003 the peak was at 120-129 mm). In 2004, the distribution was multimodal (Figure 11), with peaks at 115-119 mm, 180-184 mm, and >199 mm.

The passage at **Benton Falls** Project did not become operational until mid-July for a number of reasons including passage repair, scheduling difficulties, and turbine repair. It operated for 29 days from July 15 through August 12, and passed at least 2,343 eels (Table 15). During a nighttime site visit on August 3, DMR discovered that eels were escaping from the holding pen, which had been escape-proof when it was installed. The holding pen was repaired and approximately 1400 eels, 58% of the recorded migrants, were captured the following day (Figure 12). As in the previous two years, the size distribution of eels was multimodal although the number of eels >165 mm was reduced compared to the previous two years (Figure 13).

Observations were made on six nights at the **Lockwood** Project (Table 16). Eels were observed in kettleholes under the Rt 201 bridge on June 3 and June 15 when spill ranged from 6-12". No eels were seen along the power canal wall near the headworks. The rest of the observations were made along the easternmost 25' of the spillway, where the use of higher flashboards and bark mulch reduced spill and leakage. Approximately 50-75 eels were seen climbing the dam and passing under the flashboards through the bark mulch on June 18; another 50 were seen behaving similarly on June 23. Only one large eel was seen on July 13 when the water level was low, and a dozen eels were seen between the bridge and the spillway on July 22. During the Lockwood relicensing process, DMR recommended that flow into the bypass be concentrated by means of a notch in the flashboards, which would facilitate siting the upstream eel passage.

In 2004, **Hydro-Kennebec** L.P. staff worked closely with DMR to design and install a fully functional, low maintenance eel passage. The modular passage was constructed of light aluminum stock by a local metal shop. The sections were riveted together and anchored to the concrete wall with steel brackets. The 12-inch wide, 3-inch deep passage has a lower 13-foot section that rises along the dam face at an angle of 62°, an 8-foot level resting area, and a 25-foot upper section that rises at an angle of 45° (Figures 14 & 15). Climbing substrate (Enkamat 7220 flatback) was glued to the passage with construction adhesive, which was tested to verify that it was waterproof and not toxic to the eels. Attraction water (500 gallons per hour) was provided by a battery-powered 12V DC bilge pump. The pump is activated at night by an electric eye and the battery is recharged by a solar panel. The passage entrance was improved by the construction of a Sakrete berm to divert leakage from the flashboards and drains in the retaining wall and by embedding Enkamat in Sakrete below the entrance (Figure 16).

The eel passage at Hydro-Kennebec operated for 28 days from July 14 through August 13. During this time, it passed approximately 7,826 eels. Most of the eels passed on a single day following a pulse of high water (Figure 17). Eels that passed ranged from 84-183 mm (mode = 120-124 mm; Figure 18).

FPL Energy passed 4,521 eels upstream at the **Shawmut** Project between June 9 and August 30. DMR visited the site four times (Table 16). No eels were seen on June 3 when the project was spilling. Several hundred eels were seen along the ledge on the east side of the spillway on June 15, the day before the passage became operational. On June 23, approximately 20-30 eels were seen on the ledge and on July 12, the DMR biologist assisted with counting and weighing eels.

DMR loaned FPLE and Normandeau two portable passages to continue studies of eel passage at the **Weston** Project. DMR made observations on 10 occasions, primarily at night, at the south channel dam. Large quantities of eels were first seen in mid-July (July 20 and July 22), and they tended to concentrate in different areas depending on leakage patterns. FPLE used bark mulch, sandbags, and Sakrete to reduce and/or divert leakage in the first and third bays and eels subsequently appeared to be concentrated in the middle (second) bay. We recommend that permanent passage be installed in the middle bay of the south channel dam and that measures be taken to reduce or control leakage so as to attracted eels to this area.

5. 2 *Downstream Migration*

Introduction

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

Methods and Discussion

The study was conducted from August 23 - October 22 at the Lockwood Project, which is located on the Kennebec River approximately 0.5 miles above the confluence of the Sebasticook River and the Kennebec River. Radio telemetry equipment was installed and calibrated at the Lockwood Project from August 23 - September 14. Eight automated scanning receivers (Model SRX-400, Lotek Engineering, Newmarket, Ontario, Canada), loaned to DMR by FPL Energy, were deployed at the site to record the passage of radio-tagged eels. Two types of antennas (6-element Yagi, and "dropper") were used to monitor different areas of the project. Yagi antennas were deployed above the water surface, while dropper antennas (coaxial cable with distal 18" of insulation removed) were inserted inside braided nylon line and deployed underwater. Each antenna was connected to a scanning receiver. Antennas and receivers were calibrated over a two-week period with assistance from FPL Energy. In general, antennas were deployed and gain settings were adjusted so antennas would detect signals in a particular area, with little overlap between antennas. One 6-element Yagi monitored the power canal, a second was used to monitor the river channel, and a third monitored the tailrace. One dropper antenna was deployed in each of the seven turbine draft tubes. Water temperature was measured and recorded six times a day at a depth of 12 feet in the canal at the Lockwood Project.

Attempts were made at several locations to capture migrating silver eels for the study; however, these efforts were unsuccessful. Two fyke nets were set in Carrabassett Stream, which is located in Clinton approximately 5.75 miles above the Lockwood Project. The nets were fished continuously and checked daily from August 30 - September 2, September 8 - September 10, and September 13 - October 22. A third net was set in Martin Stream (Hinckley) and fished continuously from September 21 - October 14. A fourth net was set on Wesserunsett Stream (Skowhegan) and fished continuously on October 14 - October 22. Although all the nets captured other species (e.g., smallmouth bass, yellow perch, alewife), no migrating eels were captured. The study was discontinued in mid-October because no eels had been captured and the biologist was needed to investigate a reported eel kill (described below).

5.3 *Eel Kill*

On the morning of October 15, 2004, DMR received a report from Mr. Douglas Watts that an eel kill was occurring at the Benton Falls Project. Three DMR biologists drove to the Benton Falls site and inspected the west side of the river below the powerhouse and tailrace by walking along the shore and in the water (dead eels had been observed at this location in 1998). However, no dead or dying eels were seen. Later in the afternoon, one of the biologists accompanied Mr. Watts to the site to determine specifically where Mr. Watts had seen dead eels. The biologist reported seeing 100-200 dead eels in deeper water on the eastern side of the river. The project owner ceased generation over the weekend, but began generating on Monday, October 18. DMR biologists periodically visited the Benton Falls Project until late November, and observed dead eels on a number of occasions (Table 17). In addition, they visited several other projects in the Kennebec watershed to determine the extent of eel kills during the fall migration (Table 17). Inspections at these projects lasted two to six hours and were conducted by walking along shore or using an underwater camera from a boat. DMR will meet with KHDG hydropower owners during the spring of 2005 to discuss additional studies and measures that can be undertaken to reduce eel mortality.

6.0 ATLANTIC SALMON RESTORATION

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 this 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.

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 was recognized to include hatchery and wild origin strays, along 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 its tributaries below the Edwards dam; the MASA supported ongoing efforts for removal of the dam, which occurred in 1999. Phase II (2002 - 2006) objectives 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 2004, 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 main stem Kennebec River from Augusta to Waterville/Winslow as a migratory corridor for the small numbers of mature Atlantic salmon returning to the Kennebec River. It is also now possible for Atlantic salmon to spawn in the main stem Kennebec River between Augusta and Waterville/Winslow and in tributaries entering this main stem reach downstream of impassable barriers. Methods utilized to monitor spawning activity and successes were redd counts and electrofishing.

<u>Juvenile Atlantic Salmon Assessments</u>

Methods

The MASC staff from the Sidney Regional Office sampled three sites in two tributaries below Waterville/Winslow (Bond Brook and Togus Stream) to determine the presence or absence of juvenile Atlantic salmon. Additionally, 14 sites were sampled on the Sandy River in Madrid to assess survival of fry released from streamside incubators in 2003 and 2004. All sites were evaluated using a single pass electrofishing assessment method except for two sites in the Sandy River where a multiple-run removal method was used. All age small and large Atlantic salmon parr captured were sampled for length and weight and all salmon were released alive.

Results and Discussion

No Atlantic salmon were found in Togus Stream or Bond Brook. However, densities per unit found in the Sandy River were between 2.60 and 20.93 for 0+ parr and 0.72 and 9.82 for 1+ parr (one unit = 100 m^2) (Table 18).

<u>Spawning Surveys</u>

Methods

Redd counts were undertaken by foot on tributaries of the Kennebec River in November. Tributaries surveyed during this period included Bond Brook, Sevenmile, and Togus Streams. No survey was completed on Messalonskee Stream due to high water. In addition, approximately 60% of the main stem Kennebec was surveyed by watercraft.

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. Because of high flows in 2004, only a single survey was completed on each tributary. We were unable to document any redds in any of the tributaries. However, within the 60% of the main stem surveyed, two redds were found with the correct dimensions indicative of Atlantic salmon. It is possible that more spawning could have taken place either in the remaining 40% or after our survey was completed.

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 spawning and juvenile salmon-rearing habitat in the basin. Surveys were conducted on the main stem Sebasticook River in Pittsfield and from Farmington to the main stem Kennebec on the Sandy River.

Results and Discussion

The quantities of juvenile salmon habitat surveyed in 2004 included 351 units on the Sebasticook River and 6,870 units on the Sandy River. One habitat unit equals 100 m^2 of juvenile Atlantic salmon habitat of riffles and runs combined (Table 19).

Temperature Monitoring:

Methods

Data loggers were deployed and set to record once every hour in the Sandy River and Bond Brook watersheds in Augusta. The four loggers deployed in the Sandy River drainage were primarily to aid analysis of our fry stocking. The placement of the loggers corresponds to four regions of the basin where fry were stocked. It may be possible to compare different growth rates and densities of parr in the drainage to different thermal regimes. The three loggers deployed in Bond Brook were primarily to look at the thermal influence of Burbank Brook on Bond Brook. One logger Bond Brook index was 800 yards above Burbank; the Burbank logger was in Burbank Brook and the below Burbank logger was 100 feet below the mouth of Burbank in Bond Brook. At the end of summer, the data were downloaded and filtered to generate a table and graph for presentation purposes. The monthly maximum, minimum, and average temperatures over the summer months are presented in Table 20 and monthly maximums and minimums for July and August are graphically presented in Figure 19.

Results and Discussion

The Sandy River temperature data collected will eventually be combined, if needed, with parr densities. The Bond Brook loggers seem to indicate that, at least where they were located, Burbank Brook does not play a significant roll in cooling Bond Brook. The only problem we noted was a beaver dam below the mouth of Burbank Brook which could have minimized the thermal effect of Burbank. Our lower logger was below the dam. A copy of the entire temperature dataset can be obtained by contacting the MASC.

<u>Research:</u>

During the winter of 2003 - 2004, the MASC continued a research project to test the feasibility of streamside incubation as a method for Atlantic salmon restoration. The report will be submitted to the Maine Atlantic Salmon Technical Advisory Committee (TAC) in the fall of 2005 and will be available for dissemination.

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. Eggs were buried in commercially available incubators and left until June 2004 when they were removed. The results, however, were less than satisfactory. None of the incubators recovered showed any egg development. A review of our project leads us to believe that temperature differences between the hatchery and recipient water and inappropriate handling may be the cause of mortality.

Table 1. Summary of Alewife Trapping by Quartile with Peak Dates

Year	Capture site	25%	50%	75%	Peak date	Number pumped
2004	Winslow	May 13	May 18	May 24	May 13	16,761
2003	Winslow	May 21	May 27	May 30	May 21	15,467
2002	Winslow	May 11	May 20	May 23	May 20	15,867
2001	Winslow	May 12	May 14	May 16	May 14	18,896
2000	Winslow	May 9	May 15	May 19	May 7	13,578
1999	Augusta	May 22	May 28	May 31	May 23	9,965
1998	Augusta	May 15	May 18	May 20	May 18	16,311
1997	Augusta	May 31	June 3	June 4	June 3	21,756
1996	Augusta	May 27	June 3	June 4	June 4	22,205
1995	Augusta	May 25	May 27	May 30	May 27	10,634
1994	Augusta	May 28	June 1	June 2	June2	13,050

Table 2. Alewife Trapping & Distribution from Fort Halifax, Sebasticook River, 2004[1]

Date	Pumped	Pump Morts	Biological Sample	Rtn to River	Number Loaded Into Truck	Truck Mortalities	Released
May 10	9,107		50	67	9,040	148	8,892
11	12,837			6	12,831	1	12,830
12	13,458			15	13,443	3	13,440
13	16,761			5	16,756	4	16,752
14	8,914		50	5	8,909	0	8,909
17	11,085		50	59	11,026	1	11,025
18	14,213				14,202	14	14,188
19	6,927			6	6,921	0	6,921
20	1,644		50		1,588	0	1,588
21	5,186				5,179	2	5,177
24	15,228		50		15,174	1	15,173
25	7,687				7,686	2	7,684
26	2,733				2,726	4	2,722
June 1	8,443		50		8,389	0	8,389
2	6,964				6,938	6	6,932
7	2,936			1,568	1,368	0	1,368
8	1,759		50	58	1,701	0	1,701
Totals:	**145,882**	**129[2]**	**350**	**1789**	**143,887**	**186**	**143,691**

[1] Includes all alewives released, not just Phase I ponds
[2] Cumulative for all days

Table 3. Alewife Stocking & Distribution, Phase I Lakes, 2004

Ponded Area	Location	Surface Acres	Stocking Goal[1]	Actual Stocked 2004	No. of Trips	% of Target Number Achieved	Alewives per Acre
Douglas	Pittsfield	525	3,150	3,644	3	115	6.9
Lovejoy	Albion	324	1,944	1,818	2	93.5	5.6
Pattee	Winslow	712	4,272	4,279	5	100	6.0
Pleasant	Stetson	768	4,608	4,613	2	100	6.0
Plymouth	Plymouth	480	2,880	3,008	1	104	6.2
Sebasticook Lk	Newport	4,288	25,728	25,780	9	100	6.0
Unity	Unity	2,528	15,168	15,173	6	100	6.0
Threemile	China	1,077	6,462	6,532	3	101	6.1
Webber	Vassalboro	1,252	7,512	4,093[1]	3	107	6.4
Wesserunsett Lk	Madison	1,446	8,676	8,704	3	100	6.0
Totals:		**13,400**	**80,400**	**77,644**	**37**	**102**	**6.12**

[1]An additional 4,018 were hand dipped over the dam

Table 4. Summary of Alewife Releases to Phase I Habitat

Year	# Released	# Trips	# Alewives/Trip
2004	**77,644**	**37**	**2,098**
2003	75,190	45	1,671
2002	81,067	38	2,133
2001	77,168	41	1,882
2000	74,775	43	1,739
1999	71,857	36	1,996
1998	73,148	34	2,151
1997	74,165	41	1,809
1996	67,441	41	1,645
1995	59,080	34	1,738
1994	58,701	36	1,631
1993	36,503	28	1,303
1992	23,579	31	761
Mean=	**65,409**	**37**	**1,735**

Table 5. Alewife Distribution by Trip, Kennebec River Watershed Phase I Lakes, 2004

Date	Location	# Loaded	# Morts	# Released
5/10	Douglas Pond	1408	0	1408
5/10	Sebasticook Lake	3016	0	3016
5/10	Sebasticook Lake	3110	85	3025
5/10	Douglas Pond	1506	63	1443
5/11	Sebasticook Lake	3012	0	3012
5/11	Sebasticook Lake	3045	0	3045
5/11	Sebasticook Lake	3053	1	3052
5/11	Douglas Pond	793	0	793
5/12	Sebasticook Lake	3052	0	3052
5/12	Sebasticook Lake	3036	0	3036
5/12	Sebasticook Lake	3028	2	3026
5/13	Threemile Pond	1610	0	1610
5/13	Sebasticook Lake	1516	0	1516
5/13	Threemile Pond	1620	0	1620
5/13	Wesserunsett Lake	3021	0	3021
5/13	Wesserunsett Lake	2845	3	2842
5/13	Wesserunsett Lake	2841	0	2841
5/13	Threemile Pond	3303	1	3302
5/14	Stetson Pond	3067	0	3067
5/17	Stetson Pond	1546	0	1546
5/17	Plymouth Pond	3008	0	3008
5/18	Webber Pond	1502	2	1500
5/18	Webber Pond	1500	0	1500
5/18	Webber Pond	1093	0	1093
5/19	Lovejoy Pond	972	0	972
5/19	Lovejoy Pond	846	0	846
5/21	Pattee Pond	857	0	857
5/21	Pattee Pond	863	0	863
5/21	Pattee Pond	869	1	868
5/21	Pattee Pond	852	0	852
5/21	Pattee Pond	840	1	839
5/24	Unity Pond	3283	0	3283
5/24	Unity Pond	3116	0	3116
5/24	Unity Pond	1588	0	1588
5/24	Unity Pond	1543	0	1543
5/24	Unity Pond	3101	0	3101
5/24	Unity Pond	2543	1	2542
Total # Fish:		**77,805**	**161**	**77,644**
Total # Days:	**10**			
Total # Trips:	**37**			

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

Drainage	Date	Location	# Loaded	# Morts	# Released
Bagaduce	6/8	Pierce Pond	**930**	**0**	**930**
Kennebec	5/14	Pleasant Pond (Cobbossee Stream)	2,787	0	2,787
	5/17	Pleasant Pond (Cobbossee Stream)	1,957	1	1,956
	5/21	Nehumkeag Pond	898	0	898
		Total:	**5,642**	**1**	**5,641**
Pemaquid	5/25	Pemaquid Pond	514	0	514
	5/25	Pemaquid River	2,447	1	2,446
		Total:	**2,961**	**1**	**2,960**
Seal Cove	5/26	Seal Cove Pond-MDI	**1,712**	**4**	**1,708**
Sebasticook	5/18	White's Pond	450	0	450
	5/18	White's Pond	452	1	451
	5/19	Corundel Lake	2,049	0	2049
	5/24	Martin Stream	1,708	0	1,708
	5/18	Burnham Project Headpond	3,020	0	3,020
	5/18	Burnham Project Headpond	3,073	2	3,071
	5/18	Burnham Project Headpond	3,112	9	3,103
	5/19	Burnham Project Headpond	3,054	0	1,470
	5/26	Burnham Project Headpond	1,014	1	1,684
	6/1	Burnham Project Headpond	195	0	195
	6/1	Burnham Project Headpond	2,598	0	2,598
	6/1	Burnham Project Headpond	2,636	0	2,636
	6/1	Burnham Project Headpond	2,960	0	2,960
	6/2	Burnham Project Headpond	575	1	1,463
	6/2	Burnham Project Headpond	1,555	0	621
	6/2	Burnham Project Headpond	1,768	4	1,764
	6/8	Burnham Project Headpond	771	0	771
		Total:	**30,990**	**18**	**30,972**
Union	5/25	Lower Patten Pond	3,017	1	3,016
	6/2	Lower Patten Pond	3,045	0	3,045
		Total:	**6,062**	**1**	**6,061**
Webber Pond	5/20	Webber Pond – Bremen	**1,588**	**0**	**1,588**
Mill Brook	6/7	Great Pond-Franklin-Taunton Bay	**1,368**	**0**	**1,368**
		Total Fish:	**51,253**	**25**	**51,228**

Table 7. Age Distribution of Adult Alewives Collected at Fort Halifax, 2004

Sample Date	Age II		Age III		Age IV		Age V		Mean Age	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
May 10	0	0	4	4	6	2	0	0	3.6	3.3
May 14	0	0	3	4	3	6	0	0	3.5	3.6
May 17	0	0	2	1	6	3	1	3	3.7	4.2
May 20	0	0	1	1	5	7	1	1	4.0	4.0
May 24	0	0	6	5	3	1	0	0	3.3	3.1
June 1	0	0	8	1	4	3	0	0	3.3	3.7
June 8	0	0	3	4	5	3	0	0	3.6	3.4
Σ=	**0**	**0**	**27**	**20**	**32**	**25**	**2**	**4**	**3.5**	**3.6**
% By Sex	**0.0**	**0.0**	**44.2**	**40.8**	**52.4**	**51.0**	**3.2**	**8.1**		
% of Total	**0.0**	**0.0**	**24.5**	**18.1**	**29.0**	**22.7**	**1.8**	**3.6**		

Table 8. Transfers of American Shad Broodstock to Waldoboro Hatchery, 2004

Source	Trapping Site	Date	# Loaded	# Morts	# In
Merrimack River	Essex Lift	6/4	159	20	139
		6/5	166	68	98
		6/7	141	2	139
		6/15	159	7	152
		6/22	50	3	47
		6/25	76	8	68
	Brunswick FW	7/8	6	3	3
	Totals:		**756**	**110**	**646**

[1] Represents a 14.5% trucking mortality

Table 9. Larval American Shad Releases, 2004

Receiving Location	No. Stocked
Kennebec River, Fort Halifax Park	382,217
Kennebec River, downstream of Shawmut Project	4,548,957
Sebasticook River, below Burnham Project	510,962
Androscoggin River, Pejepscot Headpond	538,613
University of New Hampshire	268,288
TOTAL:	**6,249,037**

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% Downstream 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% downstream mortality at each hydroelectric dam
[2] Based on estimates derived from Susquehanna shad restoration efforts of 2.3 adult shad per Habitat Unit
[3] 10% mortality estimates based on downstream passage efficiencies at hydroelectric facilities along the Susquehanna River
[4] Number in parentheses represents the total dams from that area downstream

Table 11. American Shad Juvenile Abundance Index - Kennebec River Watershed above Augusta[1]

Site[2]	2000	2001	2002	2003	2004
1	0.12	0.00	0.88	0.00	0.00
2	0.00	0.00	0.63	14.2	80.6
3	0.67	0.30	0.50	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00
5	2.00	56.20	0.25	0.60	4.4
7	29.43	87.75	0.13	0.00	0.00
8A	0.11	18.67	0.00[3]	---	---
8B	0.13	0	0.13	51.8	1.6
8C	---	---	318.83	73.8	43.0
Total	**4.37**	**17.23**	**24.69**	**6.10**	**14.79**

[1] Except where noted, JAI was calculated on eight trips, with one haul/trip
[2] Due to bridge construction, Site 8A was abandoned in August 2002; JAI based on three trips.
[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 at Lake Outlets in Sebasticook & Upper Kennebec Watersheds, 2004

Date	Sebasticook Lake	Plymouth Pond	Unity Pond	Pleasant Pond	Pattee Pond	Webber Pond	Threemile Pond	Wesserunsett Lake
7/15/04	O			O				O
7/16/04						O	O	
7/19/04		O						
7/20/04			O		O			
8/2/04					O	O^B	O	
8/3/04			O					
8/4/04	O^U	O		O				O^A
8/16/04			O				O	
8/17/04						O		
8/18/04	O^U	O		O^A				O
8/30/04	O^U	O		O^A				O
9/2/04			O		X			
9/3/04						O[1]	X	
9/14/04			O		X[1]		X	
9/15/04	O^U	O		O				O
9/16/04						O[1]		
9/28/04					X[1]	O[1]	X	
9/29/04	O							O
10/1/04		O		O				
Total Visits	**6**	**6**	**5**	**6**	**5**	**6**	**6**	**6**

[1] Beaver dam partially breached to allow alewife passage

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

Table 13. Downstream Passage Observations at Hydroelectric Facilities, 2004

Date	Fort Halifax	Benton Falls	Burnham	Pioneer	Waverly
7/16/04	O				
7/19/04		O	O	O	O
8/2/04		O			
8/3/04	O		O	O	O
8/16/04	O	O	O		
8/18/04				O	O
9/1/04	O	O[H]	O		
9/2/04				O	O
9/14/04	O	O			
9/16/04			O	O	O
9/28/04	O				
10/1/04			O	O	O
Totals	**6**	**5**	**6**	**6**	**6**

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

Table 14. Diadromous Fish Captured in the Kennebec River above the Edwards dam Site, 2004

Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 7	Site 8B	Site 8C
Alewife	7,650	9	10			1	88	13
Alosid sp.[1]								435
American Eel	2	1						
American Shad		403			22		8	215
Blueback Herring								
Striped Bass								
Site Totals	**7,652**	**413**	**10**	**0**	**22**	**1**	**96**	**663**
Total By Species:								
Alewife	**7,773**							
Alosid sp.[1]	**435**							
American Eel	**3**							
American Shad	**648**							
Blueback Herring	**0**							
Striped Bass	**0**							

[1] Further laboratory analysis needed to determine species of larval samples

Table 15. Summary of Upstream Eel Migration - Fort Halifax & Benton Falls, 1999-2004

	Fort Halifax		Benton Falls	
Year	Passage operating	Eels passed	Passage operating	Eels passed
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. Summary of Visual Observations (at night unless noted) at Five Projects

Project	Dates of observations									
Benton Falls	8/3	8/4								
Lockwood	6/3	6/15	6/18	6/23	7/13	7/22				
Hydro-Kennebec	6/3	6/29	7/13	7/20	7/22	7/27				
Shawmut	6/3	6/15	6/23	7/12						
Weston	6/23	7/12	7/16	7/20	7/22	7/27	7/28	7/29	8/2	8/5

Table 17. Summary of Observations - Fall 2004 Below Various Hydropower Projects

Date	Site	Observations	Observers
Oct 15 AM	Benton Falls tailrace	No dead eels seen on west side	Zink, Bartlett, Gray
Oct 15 PM	Benton Falls tailrace	100-200 dead eels seen on east side	Gray, Watts
Oct 18 AM	Benton Falls tailrace	Approx 2 dozen dead eels on east side	Zink, Bartlett, Gray
Oct 21	Benton Falls tailrace	Approx 3-4 dozen dead/injured eels	Zink, Bartlett, Gray
Oct 26	Lockwood tailrace	1 dead eel	Zink, Bartlett, Gray
Oct 27	Benton Falls tailrace	8-10 dead eels	Zink, Bartlett, Gray
Oct 28	American Tissue tailrace	No dead eels	Zink, Bartlett, Gray
Oct 28	Shawmut tailrace	Approximately 10 dead eels	Zink, Bartlett, Gray
Nov 18	Benton Falls tailrace	8 dead eels	Zink, Bartlett, Gray
Nov 22	Benton Falls tailrace	3 dead eels	Zink, Bartlett, Gray
Nov 24	Benton Falls tailrace	0 dead eels	Zink, Gray

Table 18. Juvenile Atlantic Salmon Assessments - Kennebec River Tributaries, 2004

Site	Yoy			Parr		
	Yoy Density	Density CI 95% Lower	Density CI 95% Upper	Parr Density	Density CI 95% Lower	Density CI 95% Upper
Burned Camp, Sandy R.	2.60	2.60	n/a	0.00	n/a	n/a
Bean Property, Sandy R.	5.34	5.34	n/a	0.00	n/a	n/a
Saddleback Mouth, Sandy R.	2.87	2.87	n/a	0.72	0.72	n/a
Madrid Index, Sandy River	10.35	9.58	11.99	6.90	6.90	6.90
Rt 4, Madrid, Sandy R.	6.54	6.22	7.40	9.82	8.51	12.06
Twin Bridges, Sandy R.	3.59	3.59	n/a	2.87	2.87	n/a
Above Orbeton Mouth, Sandy R.				1.36	1.36	n/a
Davenport Flats, Sandy R.	16.31	16.31	n/a	0.00	n/a	n/a
Dickey Brook Mouth, Sandy R.	2.70	2.70	n/a	0.00	n/a	n/a
Rt. 4, Strong	20.93	20.92	n/a	1.00	1.00	n/a
Reeds Mill Rd., Orbeton S.	4.38	4.38	n/a	0.00	n/a	n/a
Conant Stream	9.24	9.24	n/a	0.00	n/a	n/a
Above Echo Valley Rd., Orbeton S.	2.37	2.37	n/a	0.17	0.17	n/a
Buzzle Rd., Orbeton S.	3.43	3.43	n/a	0.00	n/a	n/a

Table 19. Atlantic Salmon Habitat Assessments - Selected Tributaries in the Kennebec River Drainage, 2004

	Habitat Type and Units (unit=100m2)						
Section Surveyed	Dead Water	Glide	Pool	Falls	Riffle	Run	Riffle+Run
Sebasticook River*	N/A	N/A	-	-	303	48	351
Sandy River**	N/A	N/A	-	-	3,668	3,202	6,870
Totals:	-	-	-	-	3,971	3,250	7,221

*Partial survey, Sebasticook in Pittsfield

**Sandy River from Farmington to confluence

Table 20. Monthly Maximum, Minimum, & Average Temps (°C) - Selected Waters in the Kennebec River Drainage, 2004

Water	Town/Site	June			July			August			Comments
		Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	
Orbeton Stream	Buzzel Road Madrid	21.28	10.54	15.95	23.12	13.32	17.5	23.8	12.1	17.1	Deployed 06/10
Sandy River	Braids Strong	24.71	11.64	18.31	25.58	16.32	20.05	27.16	14.7	20.27	Deployed 06/04
Sandy River	Route 4 Madrid	24.69	8.83	14.81	21.81	13.01	16.85	22.31	11.9	17.17	Deployed 06/04
Sandy River	Davenport Flats Phillips	22.97	10.69	16.76	24.7	13.93	18.11	25.74	12.5	18.06	Deployed 06/10
		July			August			September			Comments
Bond Brook	Bond Brook Index Augusta	25.06	16.32	19.96	24.88	15.53	19.84	20.33	10.6	15.88	Deployed 07/08
Burbank Brook	Burbank Brook Augusta	22.35	14.29	18.2	24.05	13.21	18.8	20.86	9.02	15.21	Deployed 07/08
Bond Brook	Bond Brook Below Burbank Brook Augusta	25.54	15.98	19.53	25.03	15.03	19.68	20.64	9.91	15.78	Deployed 07/08

Figure 1. Kennebec River Restoration Study Area

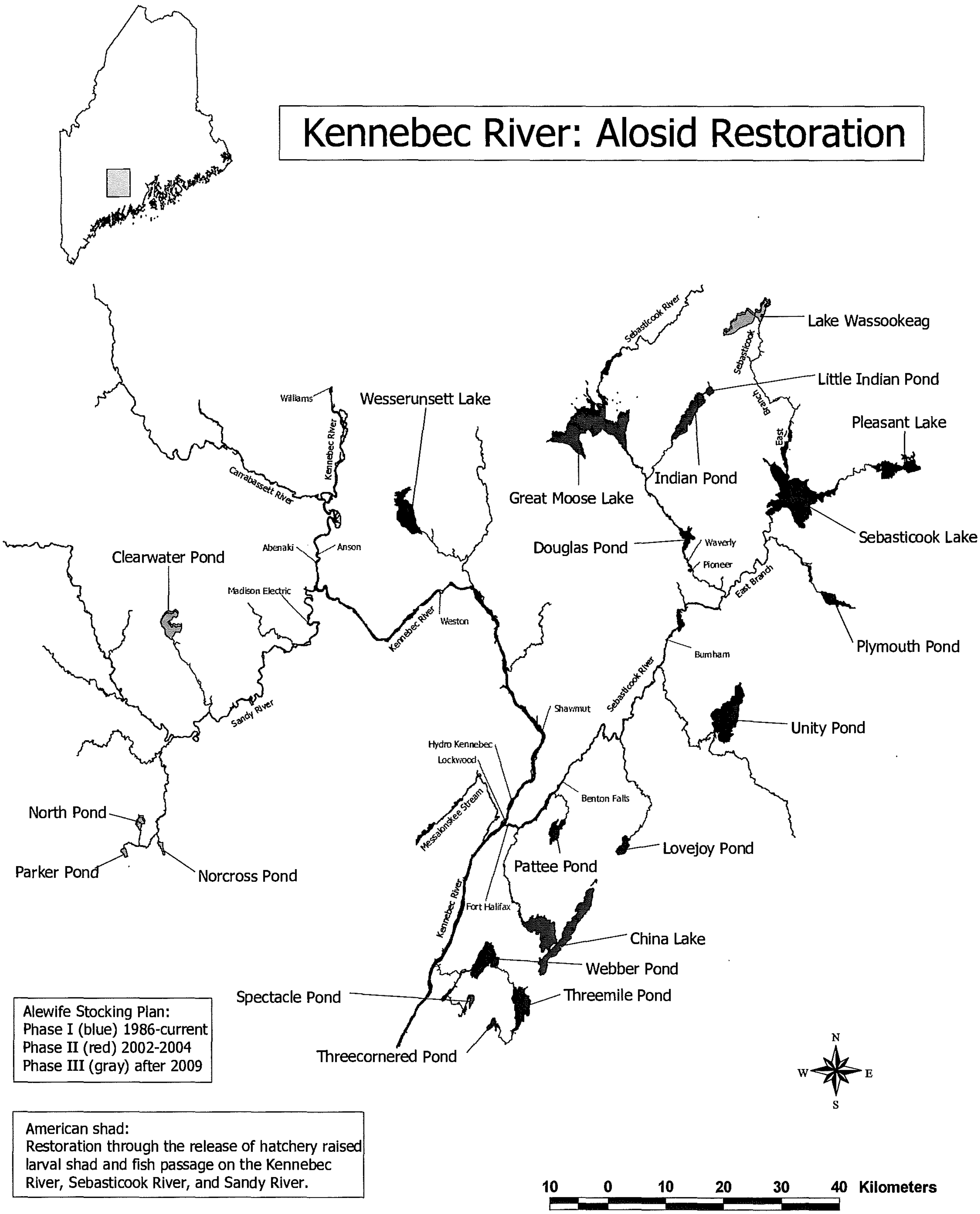


Figure 2. Beaver Dam & "Deceiver" at Sevenmile Stream, Vassalboro – Spring 2004

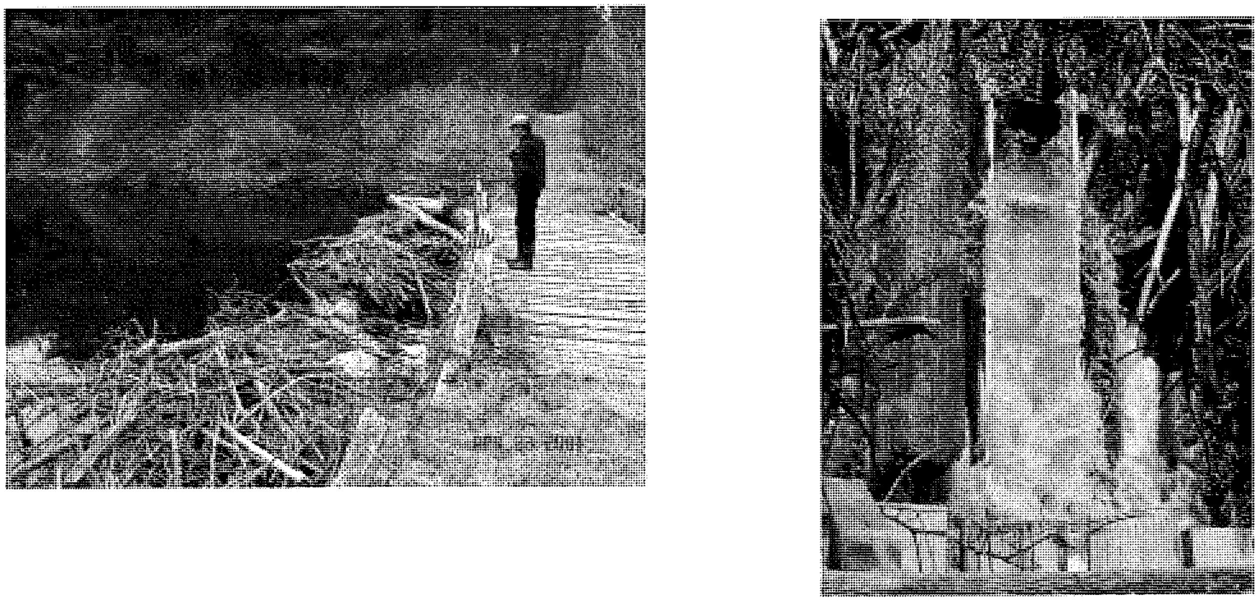


Figure 3. Commercial Alewife Harvest

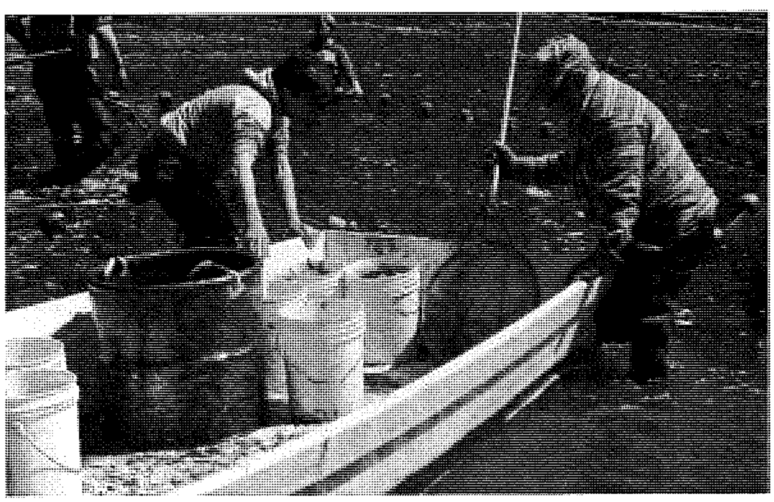


Figure 4. Adult Alewife Biosamples - Male vs. Female Captured at Fort Halifax, 2004

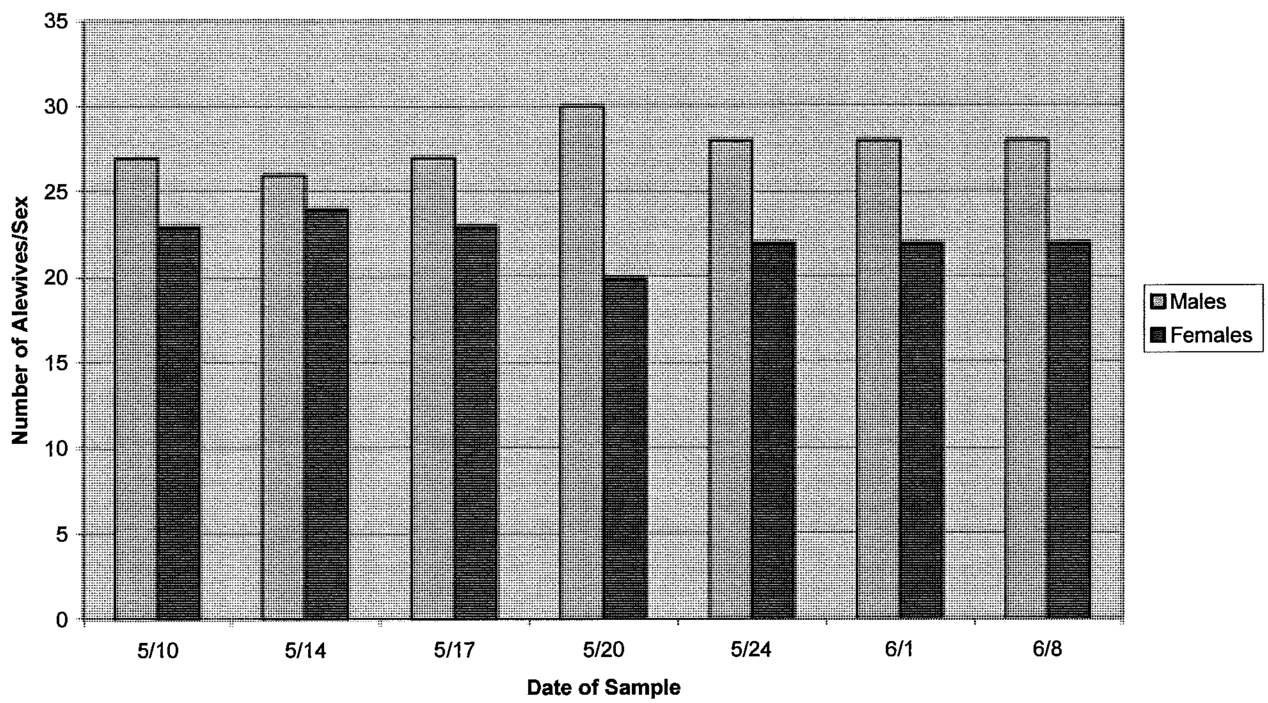


Figure 5. Average Lengths of Adult Alewife Biosamples, 2004

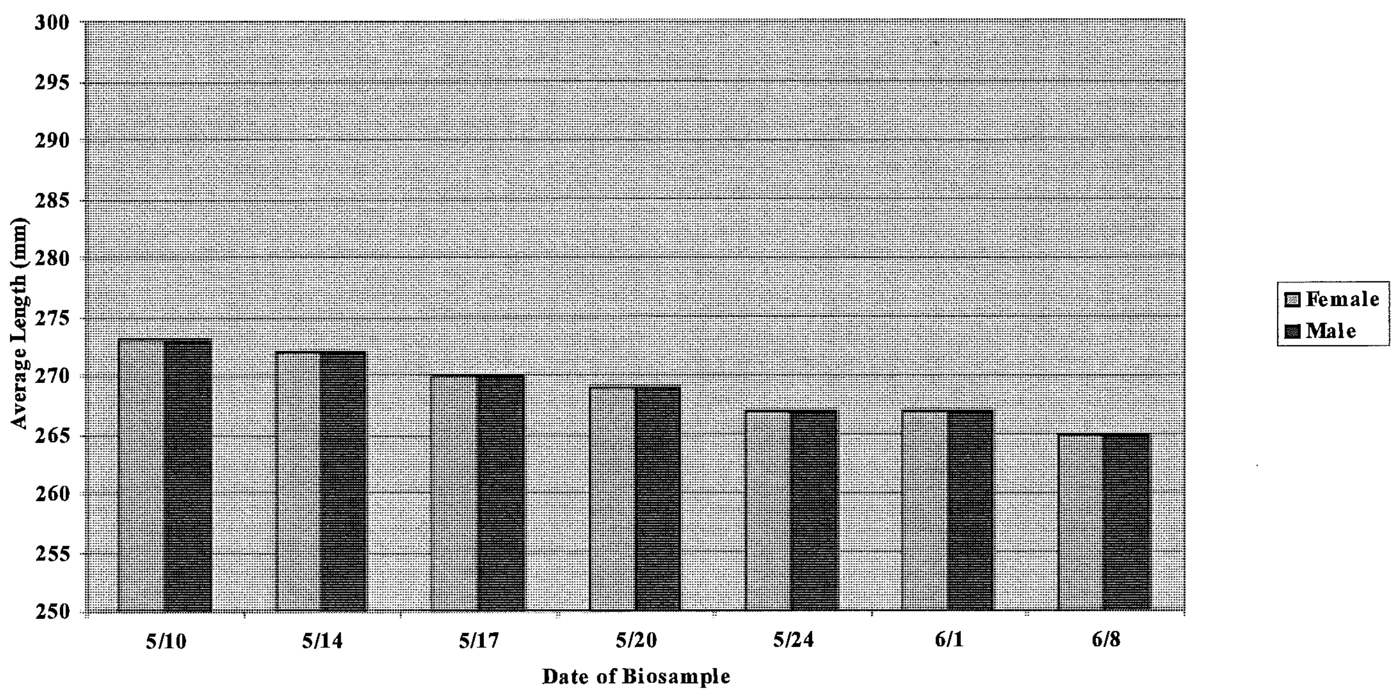


Figure 6. Average Weights of Adult Alewife Biosamples, 2004

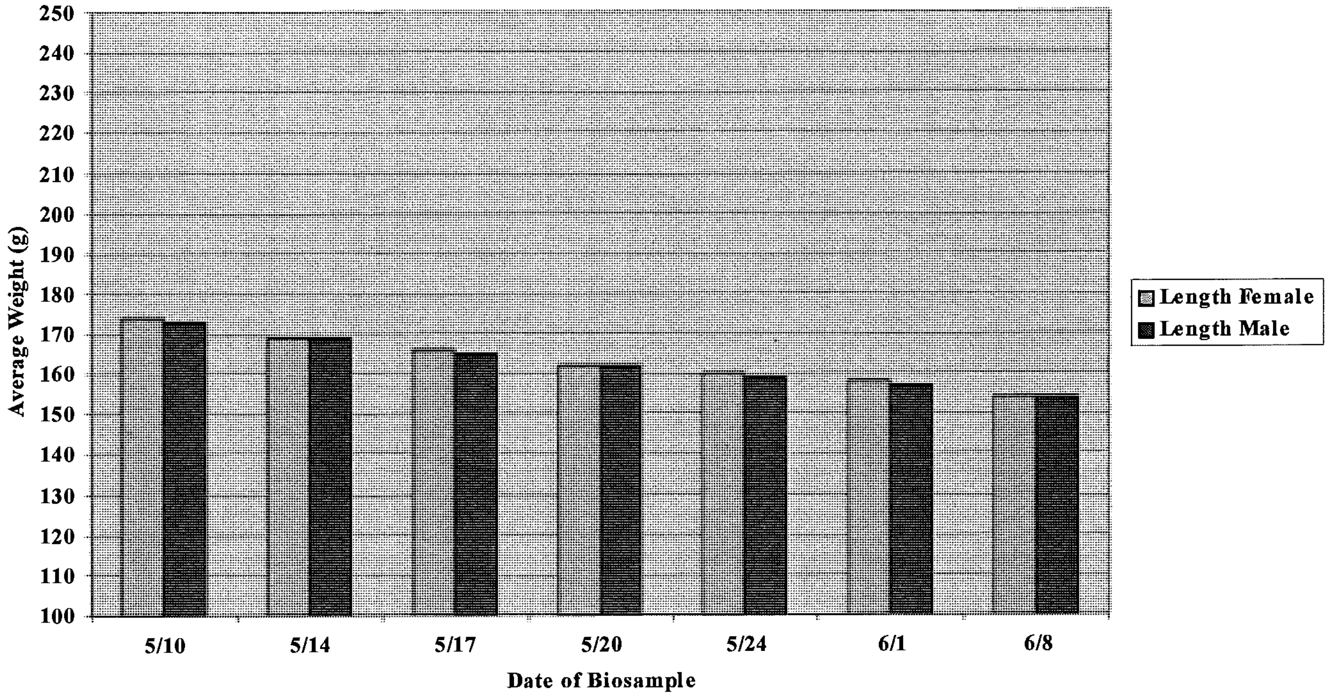


Figure 7. American Shad Larvae Released in the Kennebec Drainage, 1992-2004

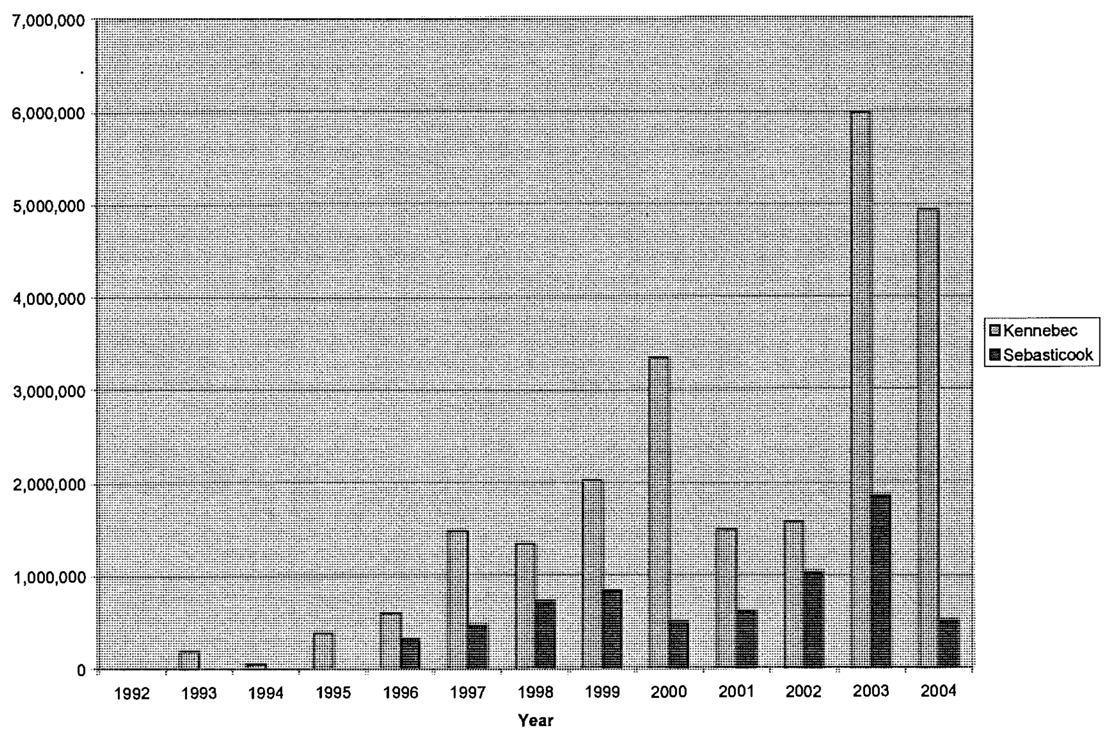


Figure 8. Number of American Shad Fingerlings Released into the Kennebec and/or Medomak Rivers 1992-2004

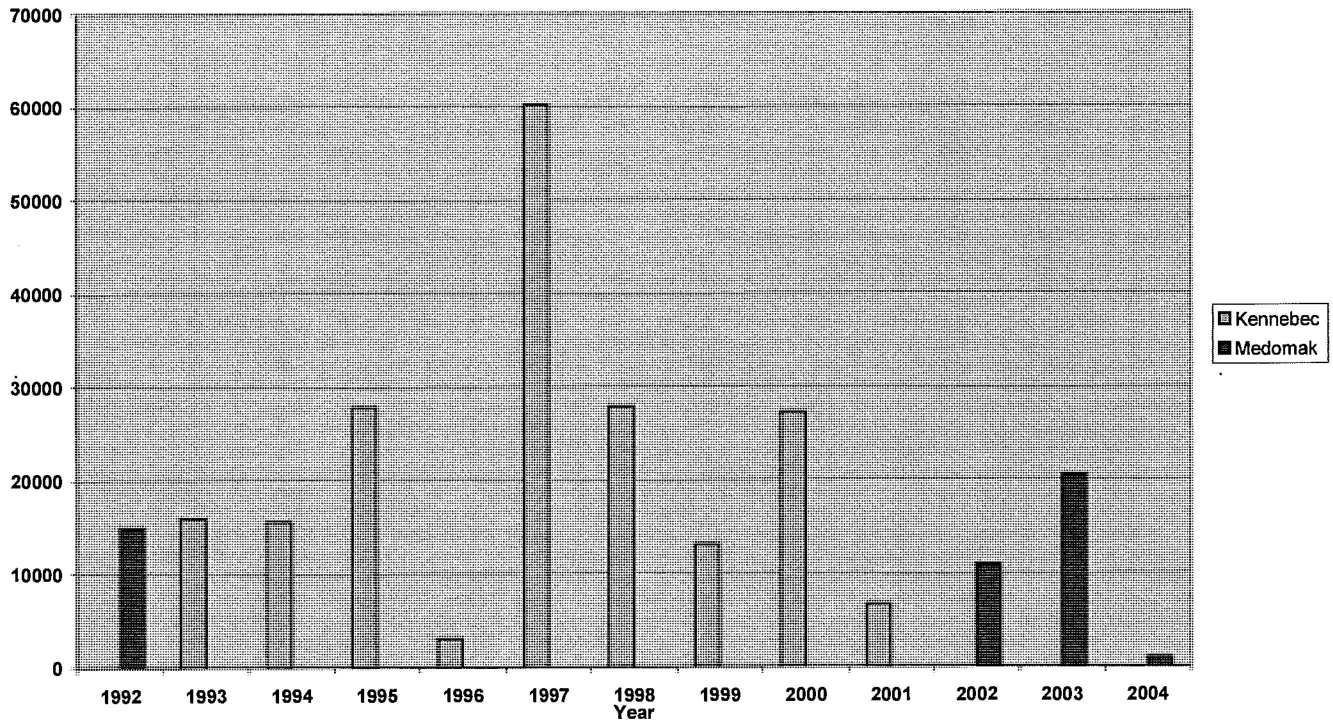


Figure 9. Shad Sample from Community Assessment Study, 2004

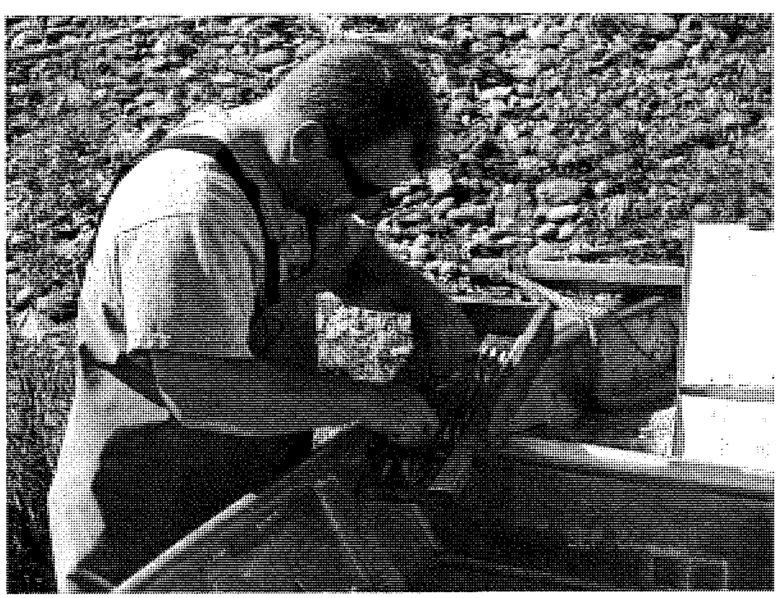


Figure 10. Eel Passage at Fort Halifax During the 2004 Season

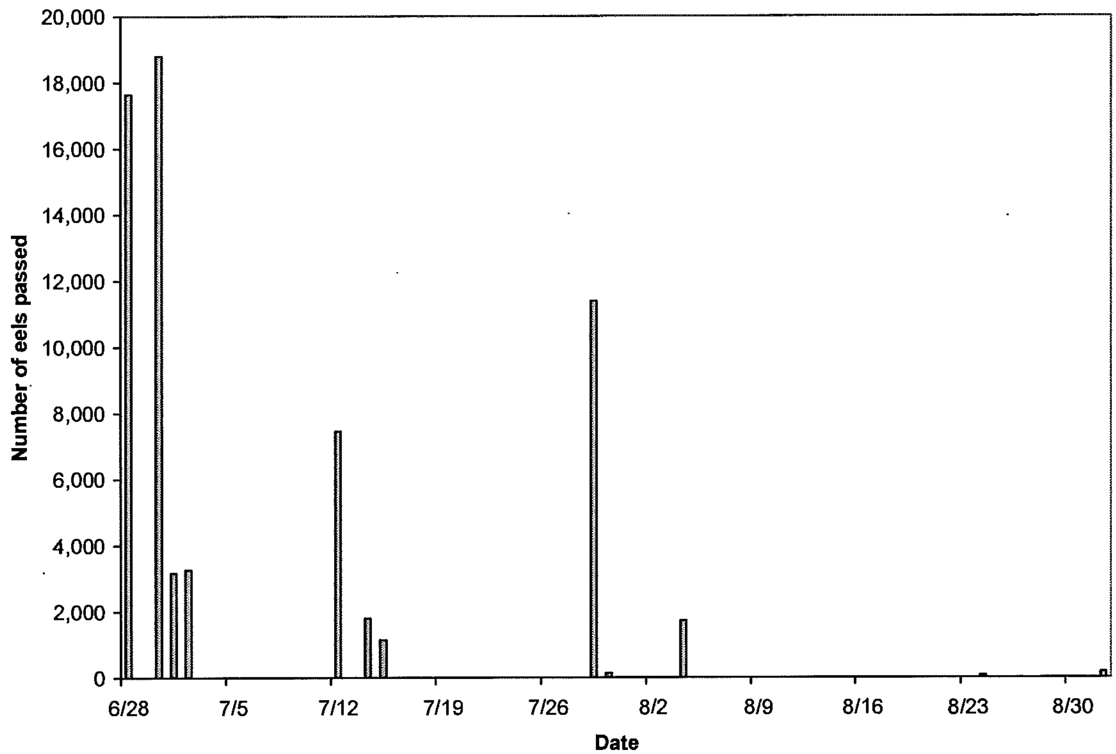


Figure 11. Total Length of Eels Passed at Fort Halifax, 2004

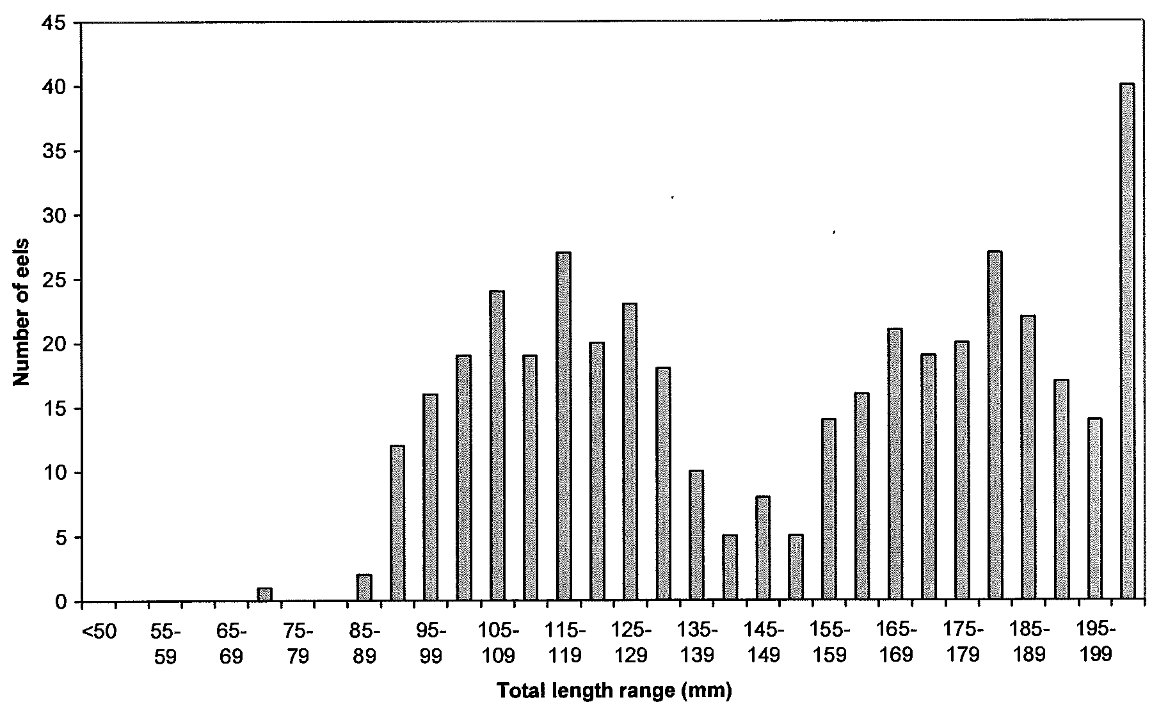


Figure 12. Eel Passage at Benton Falls During the 2004 Season

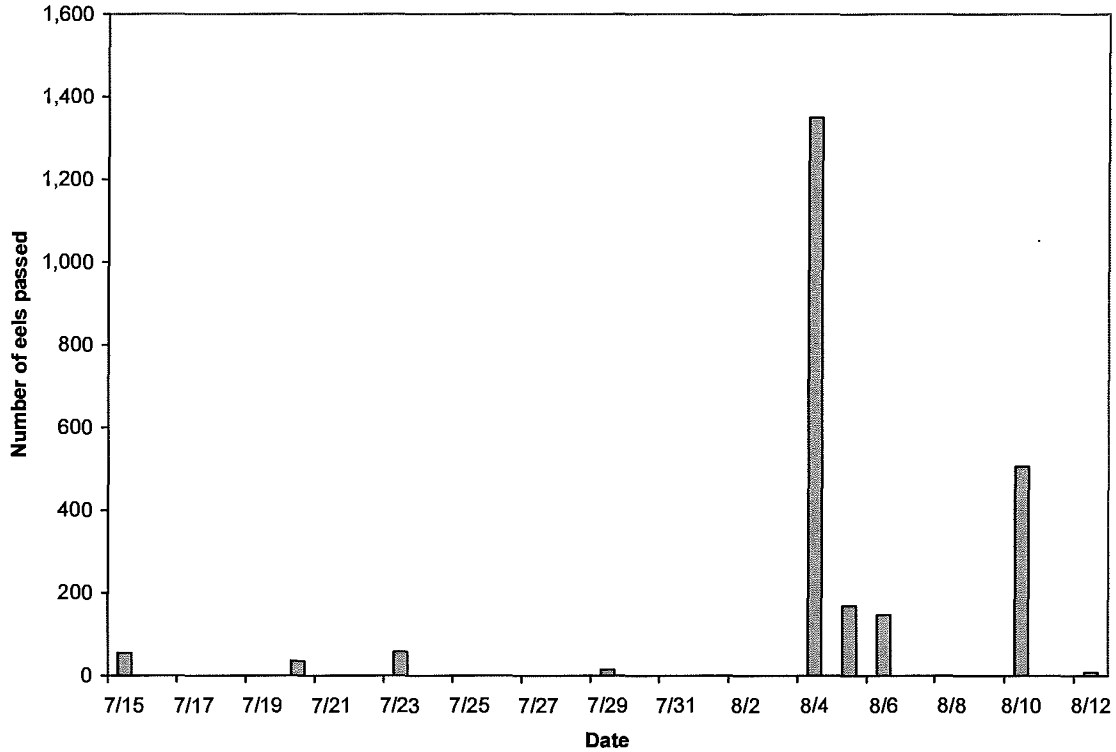


Figure 13. Total Length of Eels Passed at Benton Falls, 2004

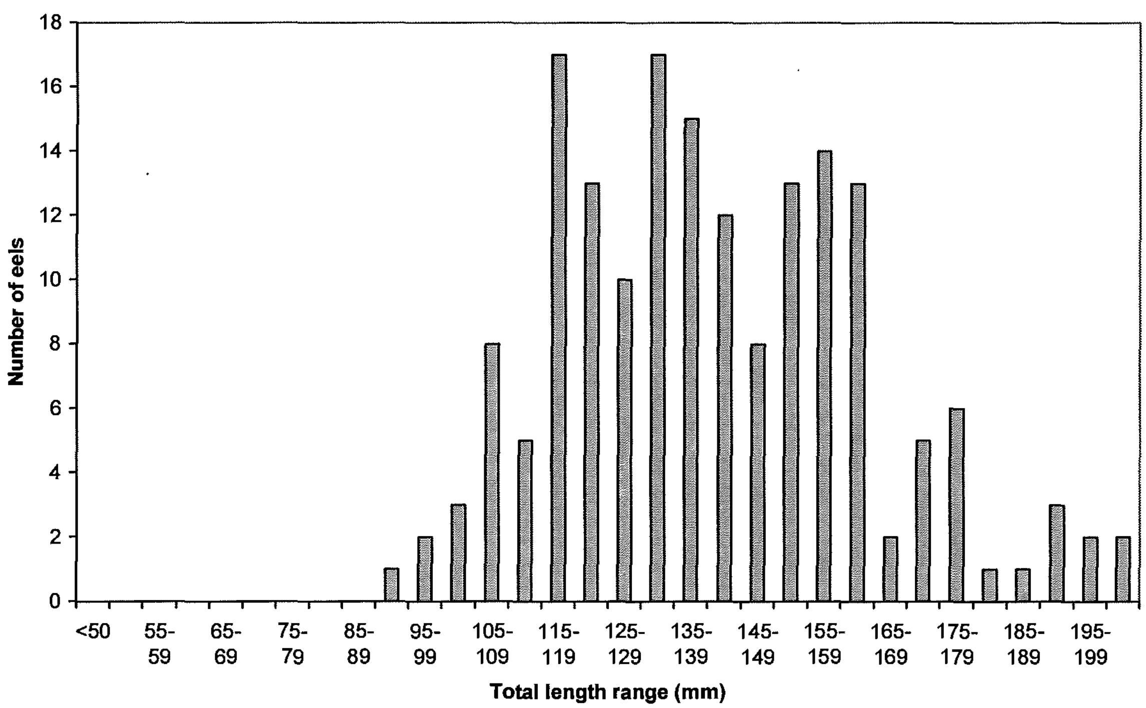
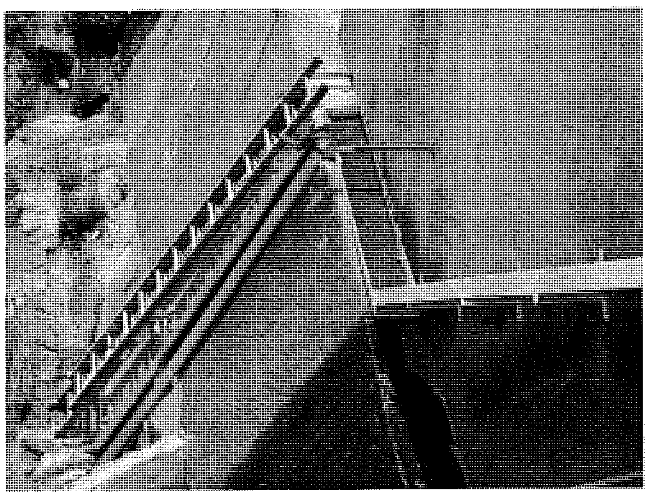
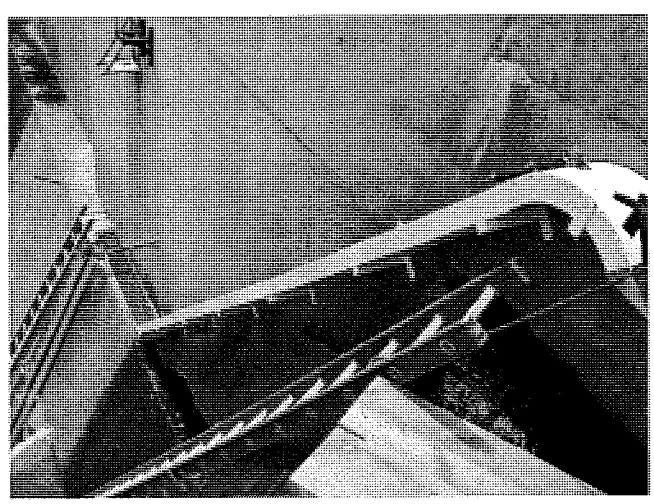


Figure 14. Lower section (A), middle section (B), and upper section (C) of eel passage at Hydro-Kennebec

A

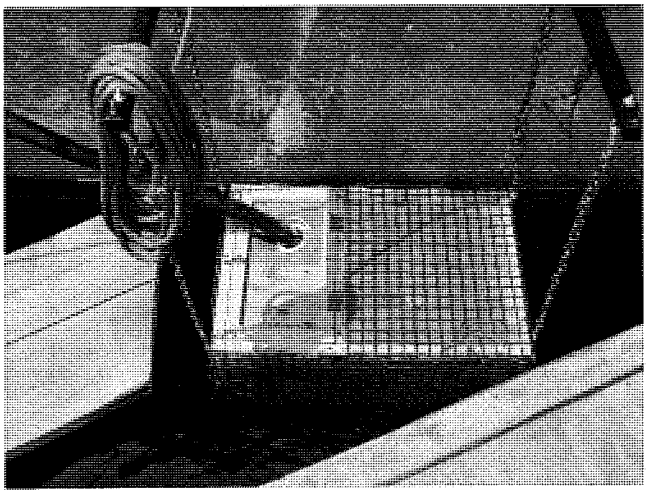


B



C

Figure 15. Collection Box at Hydro-Kennebec Eel Passage



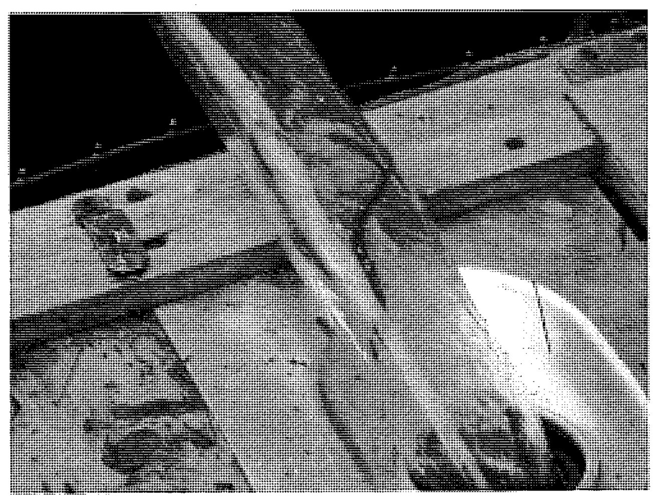
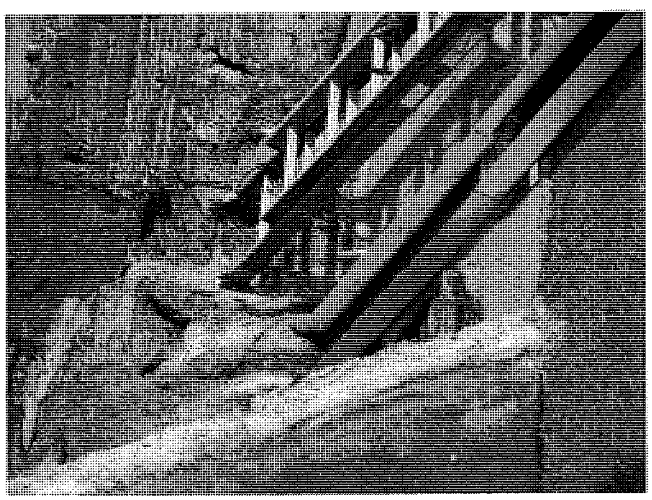


Figure 16. Entrance of Eel Passage at Hydro-Kennebec



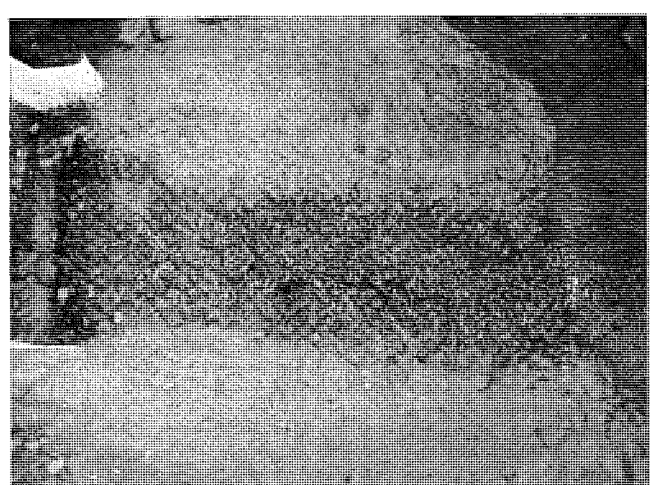


Figure 17. Eel Passage at Hydro-Kennebec During the 2004 Season

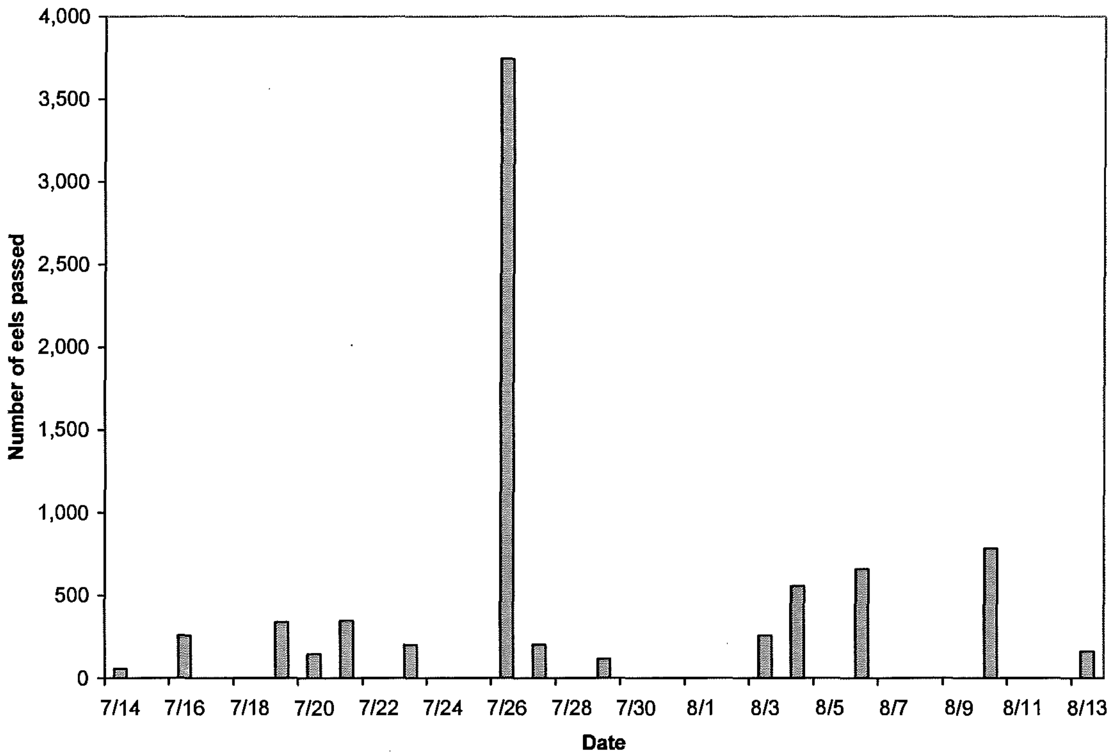


Figure 18. Total Length of Eels Passed at Hydro-Kennebec, 2004

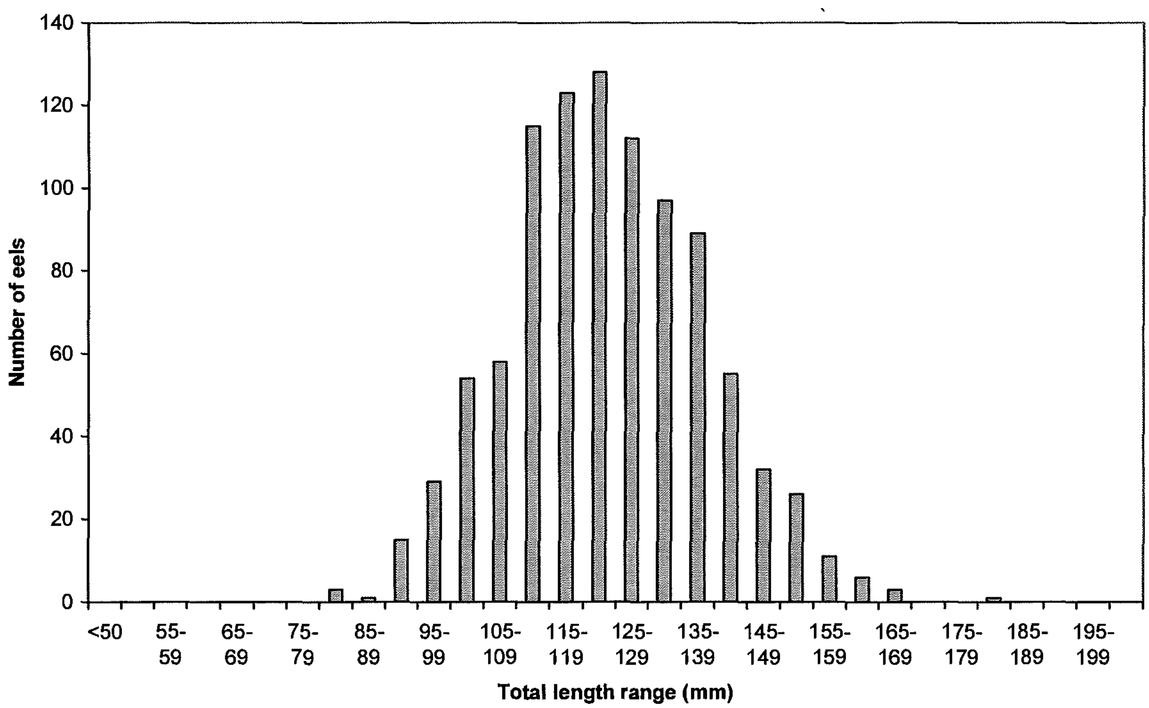
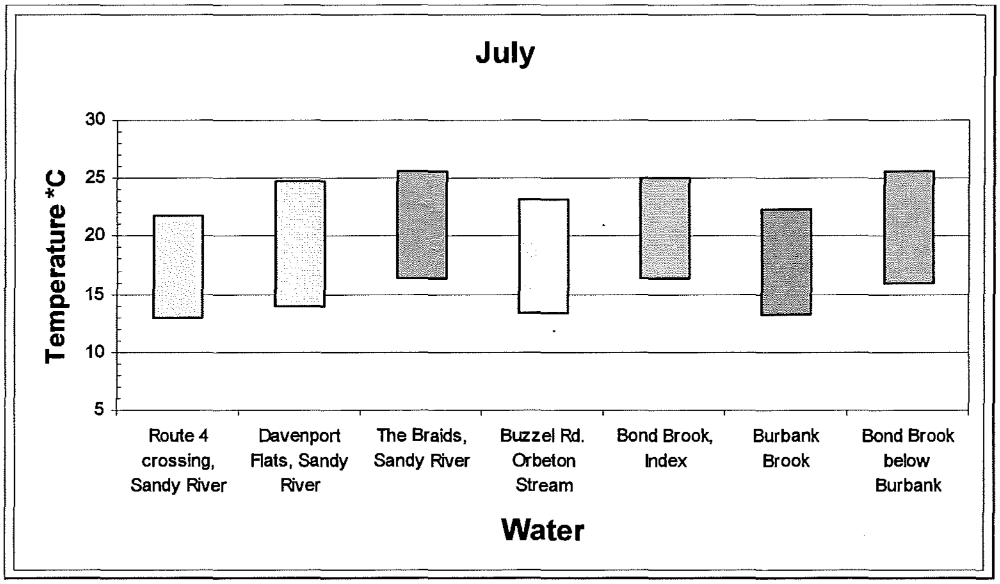
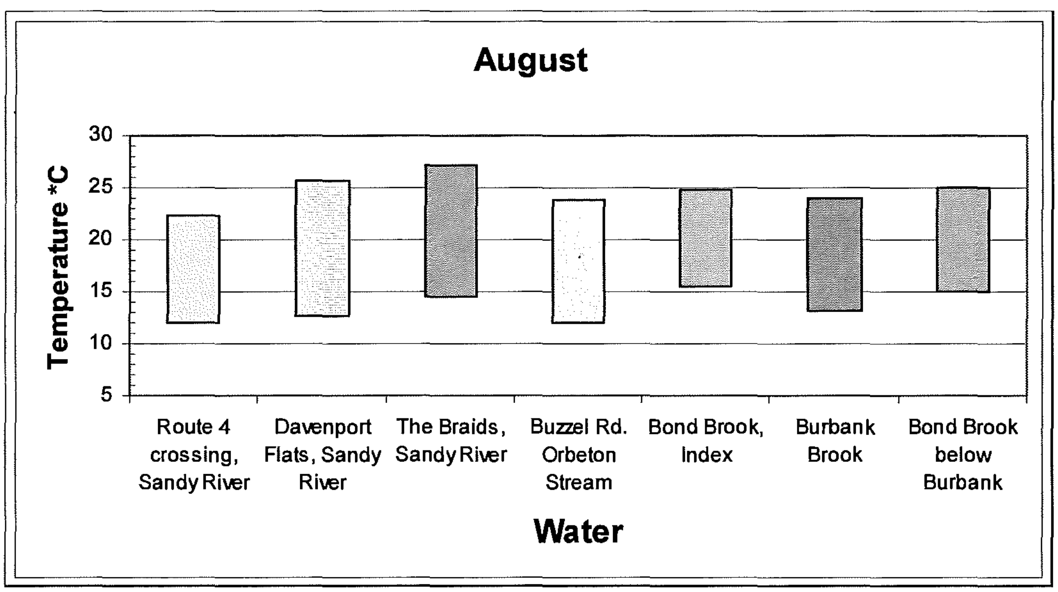


Figure 19. Maximum & Minimum Temperatures for July & August in Selected Waters - Kennebec River Drainage, 2004





APPENDIX A - History of Management Plan

Diadromous Fish Restoration on the Kennebec River

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

1.1 History of the Management Plan

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

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

With the following objectives:

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

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

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

In 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 alosids.

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

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

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

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

1.2 Implementation of the Management Plan (1986-2001)

The strategy developed to meet the objectives of alosid restoration was planned in two phases. Phase I (January 1, 1986 through December 31, 2001) involved restoration by means of trap and truck of alewives and shad for release into spawning and nursery habitat. Phase II (January 1, 2002 through December 31, 2010), which is currently ongoing, involves providing upstream and downstream fish passage at Phase I release sites, as well as trap and truck operations to Phase II lakes. As originally planned, the Edwards dam (whose owner chose not to participate in the KHDG/State Agreement) was to be the primary site for capturing returning adults for the restoration program. However, for several reasons, fish for the restoration were not obtained at Edwards until 1993. No capture facilities were available during 1987 and 1988;

in 1989, an experimental fish pump was installed by the owner, but proved to be ineffective in capturing sufficient numbers for release in upriver spawning habitat. As a result, from 1987 through 1992, all the alewife broodstock stocked in Phase I lakes (see Table 1 for a list of these lakes) came primarily from the Androscoggin River.

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

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

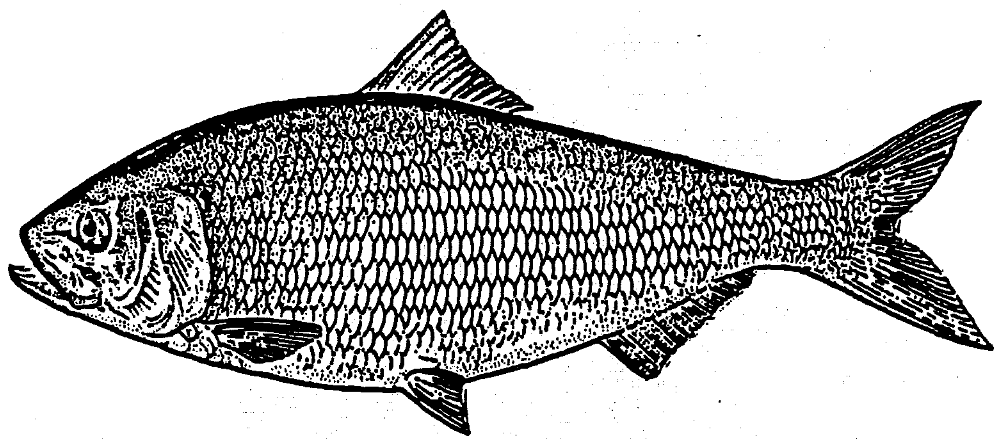
In 2003, DMR continued to transfer American shad from out-of-basin to the Waldoboro Shad Hatchery for use as captive broodstock in the tank-spawning program. However, beginning in 2001, DMR collected broodstock from the Merrimack River rather than the Connecticut River because of its increased run size 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—2004 Shad Hatchery Report

WALDOBORO SHAD HATCHERY



2004

ANNUAL REPORT

Carolyn, Samuel and Andrew Chapman

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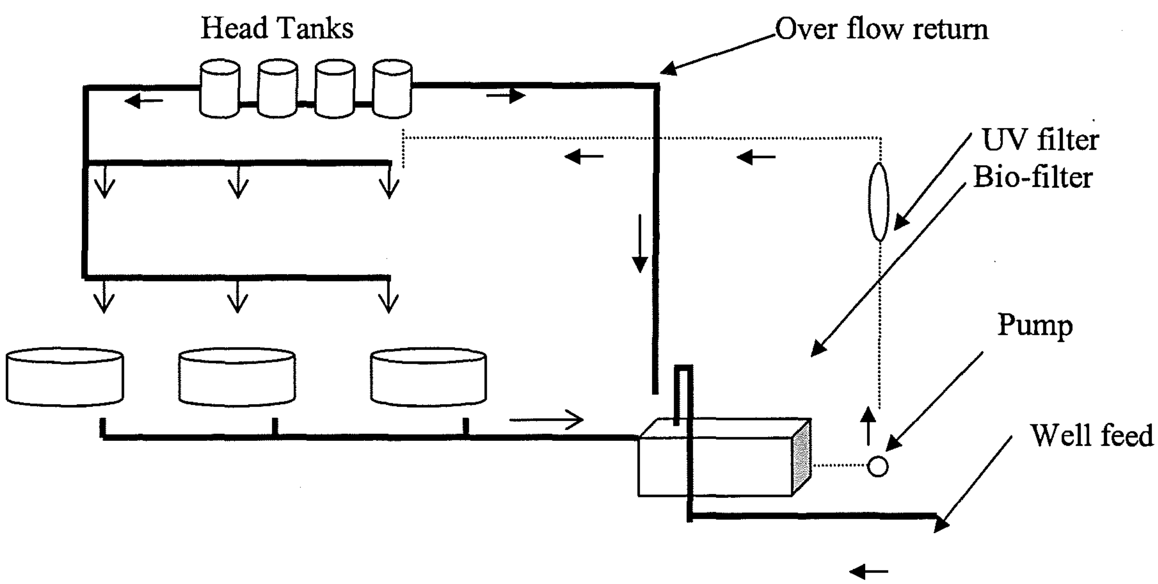
INTRODUCTION

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 2004 and during that period, provided 34,531,905 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 are connected to two systems of pipes, valves, and timers that automatically feed a plentiful diet of newly hatched shrimp over a 22-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 undersized heating capacity for maintaining optimal tank spawning temperatures early in the season. Each bio-filter tank has had its degassing capabilities augmented with the addition of aeration towers with extra surface-to-water enhancing media.

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

TANK SPAWNING SYSTEM

2004 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 is slightly 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.

For the 2004 season, the hatchery maintained the theory that more fish would produce more eggs. Supposedly, three times as many fish would produce three times as many eggs. This only works if the proportion of female fish to male fish is properly balanced. During the 2004 season, extra effort was made to select quality female shad from the fish lift holding pen, located in Lawrence, MA on the Merrimack River. This activity resulted in broodstock that were in very good condition and produced the largest number of eggs, to date, of all broodstock batches. Mortalities collected from the spawning systems were 56% female and 44% male.

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; therefore, the cleaning time interval varies from one batch of larvae to the next. When a tank is cleaned, the bottom waste is siphoned into several plastic buckets and diluted to 15 liters per bucket; the contents are suspended by mixing with an open hand. While a bucket is being mixed, three 10-ml samples are removed and emptied into three individual petri dishes. The live and dead larvae are counted separately, but both are counted as mortality. An average of the three samples, including live and dead larvae, are determined as larvae mortality per milliliter. The number of mortalities per bucket is estimated by multiplying the average of the three samples by 15,000. Finally, total mortality is estimated as the sum of the means of all the buckets. Mortalities were determined for all batches of cultured shad and are listed as "Fry Discarded" in the data Table 1. The number of fry discarded increases with the amount of time they are maintained in the hatchery system.

HATCHERY PRODUCTION SUMMARY FOR 2004

WALDOBORO HATCHERY TANK SPAWNING SYSTEM:
Merrimack River Shad

A total of 643 Merrimack River shad were delivered to the Waldoboro Shad Hatchery between June 4 and June 25. While in the hatchery system, the Merrimack fish produced a total of 153.2 liters of eggs >2mm, equaling 9,194,549 eggs, with an average viability of 71%. During culture, 597,036 dead and alive shad fry were siphoned with waste from the bottom of the tanks and discarded into waste treatment ponds. After spawning, 245 Merrimack shad (38%) remained alive and were released into the wild on July 20-22. A total of 5,980,749 fry were stocked in the Kennebec, Sebasticook, and Androscoggin Rivers between June 23 and July 22. One thousand fingerlings were seined from the waste treatment ponds and released into the Medomak River on September 15. On that same day, 200 fry were provided to the University of New Hampshire.

Androscoggin River Shad

A total of three adult shad were delivered to the Waldoboro Shad Hatchery in good condition and placed in Spawning Tank #1 with a number of Merrimack shad.

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 2004 season:

Date	Egg Location	Stocking Location	# Fry Stocked
6/22/04	Merrimack	Shawmut-Kennebec	847,344
6/28/04	Merrimack	Shawmut-Kennebec	746,061
6/29/04	Merrimack	Shawmut-Kennebec	760,800
6/30/04	Merrimack	Shawmut-Kennebec	776,849
7/6/04	Merrimack	UNH-NHIFG	268,288
7/7/04	Merrimack	Pejepscot-Androscoggin	538,613
7/9/04	Merrimack	Shawmut-Kennebec	749,251
7/13/04	Merrimack	Shawmut-Kennebec	668,652
7/19/04	Merrimack	Burnham-Sebasticook	510,962
7/22/04	Merrimack	Ft. Halifax-Kennebec	382,217

POND CULTURE

No shad fry were intentionally stocked into the ponds for rearing; however, fall fingerlings were produced as a result of fry either escaping from the hatchery culture tanks or caught when waste was removed from the bottom of the tanks. The culture tanks have a 500-micron nylon screen that fits tightly over the tank standpipe to prevent fry from escaping down the drains. Even so, when the standpipe screens are changed, a few larvae escape into the drains. On September 15, 2004, approximately 1200 two and three-inch fall fingerlings were seined and released into the Medomak River, 200 of which were provided to UNH.

Table 1. Merrimack Egg Production

Date	Source	Fry Tank	Incub.	Total Egg Volume (mls)	Eggs >2mm (mls)	Number Eggs/10"	Number Eggs/L	Total Eggs >2mm	% Viability	Viable Eggs >2mm	Fry Started	Fry Discarded	Fry Stocked	Date	Location
6/10	Merrimack	3	1	2,550	1,950	100	71,507	139,439	64%	89,241	38,151				
6/11	Merrimack	3	2	3,900	2,000	97	65,436	130,872	61%	79,832	38,152				
6/11	Merrimack	3	3	2,000	2,000	97	65,436	130,872	61%	79,832	38,152				
6/11	Merrimack	3	4	2,200	2,200	97	65,436	143,959	61%	87,815	38,152				
6/12	Merrimack	3	5	5,200	3,700	96	63,570	235,209	61%	143,477	38,153				
6/12	Merrimack	3	6	3,650	3,650	96	63,570	232,031	61%	141,539	38,153				
6/13	Merrimack	3	7	3,850	3,300	90	52,286	172,544	75%	129,408	38,154				
6/13	Merrimack	3	8	3,300	3,300	90	52,286	172,544	75%	129,408	38,154	33,208	847,344	6/23	Shawmut
6/14	Merrimack	2	9	5,750	4,600	92	55,217	253,998	76%	193,039	38,156				
6/14	Merrimack	2	10	4,650	4,650	92	55,217	256,759	76%	195,137	38,156				
6/15	Merrimack	2	11	7,700	6,000	94	60,039	360,234	72%	259,368	38,157				
6/15	Merrimack	2	12	6,000	6,000	94	60,039	360,234	72%	259,368	38,157	160,850	746,061	6/28	Shawmut
6/16	Merrimack	1	13	5,800	3,200	93	57,569	184,221	76%	140,008	38,158				
6/16	Merrimack	1	14	3,200	3,200	93	57,569	184,221	76%	140,008	38,158				
6/17	Merrimack	1	15	8,300	6,000	94	60,039	360,234	60%	216,140	38,158				
6/17	Merrimack	1	16	6,000	6,000	94	60,039	360,234	60%	216,140	38,158				
6/17	Merrimack	1	17	3,200	3,200	94	60,039	192,125	60%	115,275	38,158	66,771	760,800	6/29	Shawmut
6/18	Merrimack	4	18	5,550	4,450	93	57,569	256,182	87%	222,878	38,159				
6/19	Merrimack	4	19	3,250	2,550	92	55,217	140,803	72%	101,378	38,161				
6/20	Merrimack	4	20	3,500	2,500	90	52,286	130,715	76%	99,343	38,162				
6/20	Merrimack	4	21	2,500	2,500	90	52,286	130,715	76%	99,343	38,162				
6/21	Merrimack	4	22	3,150	2,250	93	57,569	129,530	79%	102,329	38,163				
6/21	Merrimack	4	23	2,250	2,250	93	57,569	129,530	79%	102,329	38,163				
6/22	Merrimack	4	24	2,300	1,400	96	63,570	88,998	75%	66,749	38,163	17,500	776,849	6/30	Shawmut
6/23	Merrimack	5	25	3,300	3,300	90	52,286	172,544	76%	131,133	38,164				
6/23	Merrimack	5	26	3,350	3,350	90	52,286	175,158	76%	133,120	38,164				
6/23	Merrimack	5	27	3,350	3,350	90	52,286	175,158	76%	133,120	38,164				

6/24	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A				
6/25	Merrimack	5	28	5,250	3,850	91	53,724	206,837	80%	165,470	38,167	24,230	538,613	7/7	Andro
6/26	Merrimack	6	29	5,050	2,550	90	52,286	133,329	71%	94,664	38,168				
6/26	Merrimack	6	30	2,550	2,550	90	52,286	133,329	71%	94,664	38,168				
6/27	Merrimack	6	31	5,400	3,600	94	60,039	216,140	62%	134,007	38,169				
6/28	Merrimack	6	32	4,100	3,650	90	52,286	190,844	76%	145,041	38,170				
6/29	Merrimack	6	33	3,700	2,700	93	57,569	155,436	74%	115,023	38,171				
6/30	Merrimack	6	34	3,950	3,000	96	63,570	190,710	89%	169,732	38,172	3,880	749,251	7/9	Shawmut
7/1	Merrimack	7	35	4,150	2,650	97	65,436	173,405	74%	128,320	38,173				
7/2	Merrimack	7	36	4,800	2,800	97	65,436	183,221	68%	124,590	38,174				
7/2	Merrimack	7	37	2,800	2,800	97	65,436	183,221	68%	124,590	38,174				
7/3	Merrimack	7	38	3,700	2,950	97	65,436	193,036	78%	150,568	38,175				
7/4	Merrimack	7	39	1,000	450	103	77,752	34,988	87%	30,440	38,175				
7/5	Merrimack	7	40	3,050	2,000	100	71,507	143,014	80%	114,411	38,176	4,267	668,652	7/13	Shawmut
7/6	Merrimack	8	41	4,450	3,350	97	65,436	219,211	81%	177,561	38,178				
7/7	Merrimack	8	42	2,900	2,450	98	66,896	163,895	65%	106,532	38,179				
7/8	Merrimack	8	43	4,100	3,400	102	75,976	258,318	56%	144,658	38,180				
7/9	Merrimack	8	44	2,500	1,600	103	77,752	124,403	46%	57,225	38,181				
7/10	Merrimack	8	45	500	450	99	69,404	31,232	80%	24,985	38,182	0	510,962	7/19	Burnham
7/11	Merrimack	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A				
7/12	Merrimack	9	46	3,200	2,600	102	75,976	197,538	70%	138,276	38,184				
7/13	Merrimack	9	47	1,550	1,100	103	77,752	85,527	84%	71,843	38,185				
7/14	Merrimack	9	48	2,200	1,900	97	65,436	124,328	81%	100,706	38,186				
7/15	Merrimack	9	49	1,950	1,300	109	93,362	121,371	65%	78,891	38,186				
7/16	Merrimack	9	50	600	0	130	150,000	0	N/A	N/A	N/A				
7/17	Merrimack	9	N/A	250	0	130+	150,000	0	N/A	N/A	N/A				
7/18	Merrimack	9	N/A	2,100	350	113	103,180	36,113	N/A	N/A	N/A	7,500	382,217	7/23	Halifax
	Total			**186**	**147**			**8,898,511**	**71%**	**6,298,957**		**318,206**	**5,980,749**		

APPENDIX C - Proposed 2005 Trap & Truck Budget

Job 1. Trap and Truck Alewives

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

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

If blueback herring are captured, they may be stocked into riverine habitat above the Fort Halifax dam. Alewife stocking goals for 2005 are summarized in Table 1.

Table 1.
Phase I and II Stocking Locations with Alewives (6/acre) in 2005

Ponded Area	Surface Acreage	Stocking Target
Sebasticook Lake	4,288	25,728
Lovejoy Pond	324	1,944
Plymouth Pond	480	2,880
Pleasant Pond (Stetson)	768	4,608
Douglas Pond	525	18,000
Burnham Headpond	625	30,000
Pattee Pond	712	4,272
Threemile Pond	1,077	6,462
Unity Pond	2,528	15,168
Webber Pond	1,252	7,512
Wesserunsett Lake	1,446	8,676
Big Indian Pond	990	5,940*
Great Moose Lake	3,584	21,504*

*Pending approval

Job 2. Trap and Truck of American Shad

Transfer of broodstock American shad via tank truck will begin in May and conclude in July. DMR expects to transfer about 1,000 shad broodstock to the shad hatchery. Due to the efficient and highly successful 2004 season, the majority of broodstock will be transferred from the Merrimack River. However, FPL Energy is required by the *Kennebec River Settlement Accord* to install, operate, and maintain all measures necessary for the capture of adult shad broodstock. DMR will transport any adult shad captured at Fort Halifax to the shad hatchery where they will be placed into a tank spawning system. Lengths, scales, and otoliths will be collected from all adult mortalities occurring at Fort Halifax during transport and at the hatchery.

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 October and may include seining, fyke netting, trawling, electrofishing, or sampling downstream migrants at hydroelectric sites. Representative numbers of juvenile shad will be retained for otolith extraction and checked for tetracycline marks applied at the hatchery.

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

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

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

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

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

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 2005.

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.

2005 Budget

	Q1	Q2	Q3	Q4	TOTAL
Personal Services	$28,405.00	$41,906.00	$48,656.00	$35,156.00	**$154,123.00**
Materials/Supplies	$2,661.00	$3,828.00	$911.00	$911.00	**$8,311.00**
Operations/Maintenance	$2,185.00	$5,899.00	$4,042.00	$2,185.00	**$14,311.00**
State Indirect Cost (2%)	$638.80	$1,006.42	$1,045.94	$738.80	**$3,429.96**
Capital					
TOTALS	**$33,889.80**	**$52,639.42**	**$54,654.94**	**$38,990.80**	**$180,177.96**

APPENDIX D - Proposed 2005 Kennebec River Atlantic Salmon Restoration

Work Plan & Budget

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

A standard habitat survey will be conducted on selected tributaries and main stem 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 main stem of the Kennebec River below Skowhegan.

Job 2. Produce Geographic Information System Coverages

Using the habitat information collected above, MASC staff will produce Geographic Information System (GIS) coverages to display the location and estimate the amount of salmon habitat types available in the surveyed streams. Coverages produced from the 2001- 2005 habitat surveys will also give us the ability to display redd locations and areas of critical importance to salmon in the lower main stem and tributaries.

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

The MASC staff will continue to electrofish various waters including Togus Stream 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 main stem Kennebec from Waterville-Winslow to Augusta and all lower main stem 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 & 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, & Implementation of a Long-Range Restoration & Management Plan

The MASC staff is starting the planning process to develop a Kennebec River Atlantic salmon management plan. It will outline 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	$ 500.00	$2,136.00	$2,136.00	$1,428.00	$ 6,200.00
Capital	$ -	$ -	$ -	$ -	$ 0.00
Totals:	$4,909.00	$7,040.00	$13,708.00	$ 12,100.00	$37,757.00