

MAINE STATE LEGISLATURE

The following document is provided by the
LAW AND LEGISLATIVE DIGITAL LIBRARY
at the Maine State Law and Legislative Reference Library
<http://legislature.maine.gov/lawlib>



Reproduced from scanned originals with text recognition applied
(searchable text may contain some errors and/or omissions)

**State of Maine
Department of Marine Resources
1999 Brunswick Fishway Report**

**Maine Department of Marine Resources
Stock Enhancement Division
#21 State House Station
Augusta, ME 04333-0021**

July 2000



**ANADROMOUS FISH RESTORATION
IN THE ANDROSCOGGIN RIVER WATERSHED**

**1999 Report on the Operation
of the Brunswick Fishway
FERC #2284**

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

July 2000

Prepared by: Sandra J. Lary
In Cooperation With: National Marine Fisheries Service (P.L. 89-304)

Table of Contents

Table of Contents	i-ii
List of Figures	i
List of Tables	ii
Introduction.....	1-3
Goal and Objectives	4-5
Brunswick Fishway Operation.....	6-7
Fish Passage	
River herring	8-10
American shad	10-13
Atlantic salmon	13
Sea lamprey.....	13
American eel	14
Striped bass	14
Other species	14
Juvenile fish species.....	14-15
Environmental data	15

Figures

Figures 1 & 2	
Adult River Herring Captured + water temps/flows Brunswick Fishway, 1999.....	19
Figure 1a	
Adult River Herring Released + Recruits Captured 4yrs Later Androscoggin Watershed, 1985-1995	17
Figures 3 & 4	
American Shad Captured + water temps/flows Brunswick Fishway, 1999.....	24

List of Tables

Table 1. Adult River Herring Captured, Water Temps & Flows Brunswick Fishway, 1999.....	16
Table 1a. Adult River Herring + Recruits Captured 4yrs Later Androscoggin Watershed, 1985-1995	17
Table 1b. Adult River Herring Distribution by Site Androscoggin Watershed, 1999.....	18
Table 2. American Shad Observations Brunswick Fishway, 1994-1999	20
Table 3. American Shad Captured Brunswick Fishway, 1993-1999	21-22
Table 4. Adult American Shad Distribution Androscoggin River, 1987-1999.....	23
Table 5. American Shad Captured Brunswick Fishway, 1999.....	25-27
Table 6. American Shad Fry Releases Androscoggin River, 1999.....	28
Table 7. Number, Origin, and Lengths of Atlantic Salmon Androscoggin River, 1983-1999.....	29
Table 8. Atlantic Salmon Brunswick Fishway, 1999.....	30
Table 9. Fish Community Data Brunswick Fishway, 1999.....	31
Table 10. Adult Fish Species Captured Brunswick Fishway, 1999.....	32
Table 11. Juvenile Fish Community Data Month/Location, 1999.....	33
Tables 12 - 17. Air & Water Temps/Headpond Levels, Brunswick Fishway, 1999	
12. May, 1999	34
13. June, 1999	35
14. July, 1999.....	36
15. August, 1999	37
16. September, 1999	38
17. October, 1999.....	39

INTRODUCTION

The Androscoggin River, with a drainage area of approximately 3,460 square miles, is Maine's third largest river. Historically, the Androscoggin provided access to a large and diverse aquatic habitat to great numbers of diadromous and resident fish species. For most species, the natural upstream migration barrier on the main stem of the Androscoggin River was Lewiston Falls, 22 river miles above tidewater. Although Lewiston Falls was an impassable barrier for most species, sea-run Atlantic salmon and American eel were able to ascend these falls and move upstream to Rumford, 80 river miles above tidewater. According to Atkins (1887), Rumford Falls was an impassable barrier to migrating salmon and excluded them from the New Hampshire waters of the Androscoggin River.

River herring were known to reproduce in lake and pond habitat throughout the Androscoggin and Little Androscoggin River watersheds below Lewiston Falls, while American shad reproduced in the riverine areas below Lewiston Falls. Atlantic salmon, which could ascend the earliest built low head dams at Brunswick, were caught at Lewiston as late as 1815; however, river herring and American shad were excluded from waters above Brunswick after 1807, when the first dam was built at head-of-tide. The Little Androscoggin River, which enters the main stem Androscoggin on the west bank just below Lewiston Falls, was noted for large runs of diadromous fish. Sea-run fish ascended this major tributary to Biscoe Falls, 35 miles above the river's confluence with the main stem Androscoggin. By the early 1930s, the construction of dams that lacked fish passage capabilities, in combination with severely polluted waters, virtually eliminated all opportunity for fish to live and reproduce in the main stem Androscoggin and most of its tributaries.

Since the early 1970s, substantial improvement in water quality and the provision of fishways at some of the dams have enhanced the potential for successful fish restoration within the lower Androscoggin River watershed. In 1982, the Brunswick vertical slot fishway and downstream fish passage were constructed at the first upstream dam on the river. In 1987, an upstream fish lift and downstream passage were provided at the Pejepscot Project, the second upstream dam on the river; in 1988, an upstream fish lift and downstream passage were installed at the Worumbo Project, the third upstream dam on the river. Effective upstream fish passage at these three hydropower projects could potentially provide access for diadromous and resident species as far upstream as Lewiston Falls.

Since 1983, Maine Department of Marine Resources (MDMR) personnel have distributed over 373,000 adult river herring captured at the Brunswick Fishway into otherwise inaccessible habitat on the Androscoggin and Little Androscoggin Rivers. These stocking efforts continue due to the lack of fish passage at subsequent upstream dams on the Little Androscoggin River that prevents access to alewife spawning and nursery habitat areas.

In the six years since 1994, 622 adult shad have been observed at the fishway, while only 102 have actually been captured, indicating that the fishway may be inadequate for the passage of American shad. Visual observations of shad made from the fishway wall and through the use of video equipment have certain limitations that are considered when analyzing the data, such as the potential for overestimating (same fish counted more than once) or underestimating (limited visibility when looking down into the fishway/water) the number of fish actually present. More quantifiable studies may be required in upcoming years.

Since 1987, MDMR personnel have transferred over 5,300 prespawner American shad from the Merrimack and Connecticut Rivers for release into the Androscoggin below Lewiston Falls. Beginning in 1999, American shad fry were released into the main stem Androscoggin River at Auburn.

Over 660 Atlantic salmon have passed the Brunswick Fishway since 1983, averaging 39 captured annually. Of those 660, 628 were sea-run Atlantic salmon in origin, while the remainder were landlocked.

The restoration of native diadromous fish species to the Androscoggin River watershed has multiple benefits to the ecosystem and society. American shad and river herring provide important forage to other fish and wildlife species in both inland and coastal ecosystems. Restoring species to healthy habitat will allow individuals to utilize this valuable resource for recreational and commercial uses as well. The Androscoggin system has the potential to produce an annual sustained yield of 1,000,000 pounds of alewives and 500,000 pounds of American shad, valued at \$80,000 and \$125,000 respectively. The reestablishment of large runs of alewives and American shad could provide employment for a number of commercial fishermen, and large recreational fisheries for American shad could develop in the lower Androscoggin River. The 1,000,000-pound alewife harvest will increase long-term average statewide landings by 33% and provide a substantial source of bait for Maine's 10,000 licensed lobster fishermen. Efforts toward improved water quality, habitat, and fish and wildlife populations improve the overall health of the ecosystem and society.

MDMR provides an annual report on the operation of the Brunswick Fishway to enhance its cooperative partnership with FPLE, Inc. in the operation of the fishway and to assist the company in meeting its FERC reporting requirements. MDMR's report is based upon daily data, records, and logs that are maintained by DMR biologists at the fishway. This includes information regarding daily inspections, fishway cleaning and condition, fish data collection, and operational activities throughout the season (typically May through November). The operation of the Brunswick Fishway is one tool that is utilized in the implementation of the MDMR fishery restoration program for the Androscoggin River. The goals and objectives of this program, along with any additional information not specifically associated with the actual operation of the fishway, are included in this report as a courtesy to provide FERC and FPLE, Inc. with a broader perspective of the purpose,

role, and usefulness of the fishway in the MDMR program. Several legal authorities and state and federal plans that guide state restoration programs include:

Legal Authorities

- The Fish and Wildlife Coordination Act
- Federal Power Act
- Fish and Wildlife Act of 1956
- Federal Aid in Fish Restoration Act (Dingell-Johnson Act)
- Anadromous Fish Conservation Act
- Title 12 M.R.S.A. §6021, §6022, §6051, §6052, §7701, §7702
- Title 38 M.R.S.A. §630-636

Guidance Documents

- Fishery Management Report No. 35 of the Atlantic States Marine Fisheries Commission - Amendment 1 to the Interstate Fishery Management Plan for Shad and River Herring, April 1999.
- Maine Department of Marine Resources: State of Maine Recovery Plan for American Shad (*Alosa sapidissima*) and River Herring (*Alosa pseudoharengus* and *Alosa aestivalis*) for Amendment 1 to the Interstate Fishery Management Plan for Shad and River Herring, May 1999.
- Maine Department of Marine Resources: American Shad Management Plan.
- State of Maine Statewide River Fisheries Management Plan, 1982.
- State of Maine Anadromous Alewife Restoration Program – A Report to the Joint Standing Committee on Inland Fisheries and Wildlife. Prepared by the Maine Department of Inland Fisheries and Wildlife and Maine Department of Marine Resources. February 1998.

GOAL AND OBJECTIVES OF THE RESTORATION PROGRAM

The State of Maine's Department of Marine Resources Fishery Restoration Program goal is to increase ecosystem health in the Androscoggin River watershed by restoring native diadromous fish species and their habitats. The primary focus is to restore river herring (alewives and blueback herring) and American shad to historic habitat areas in the Androscoggin and Little Androscoggin River watersheds, while increasing the restoration potential for other native fish species.

Objective 1: Increase the abundance, survival, and natural reproduction of pre-spawning adult river herring and American shad in historic spawning and nursery habitat areas.

Strategies:

1. Trap upstream migrating adults at the Brunswick/Topsham Hydroelectric Project Fishway and distribute them into upstream habitat areas that are inaccessible due to the obstruction of passage by dams.
2. Conduct supplemental releases of adult American shad and river herring from other tributaries when necessary.
3. Conduct American shad fry stocking to increase juvenile abundance in nursery habitat areas.

Objective 2: Protect and enhance the health of the native fish community structure in support of river herring and American shad restoration efforts.

Strategies to characterize and assess the fish community structure:

1. Monitor and facilitate up- and downstream movement of native diadromous and resident fish species into historic habitat by the operation of the Brunswick/Topsham Hydroelectric Project Fishway.
2. Collect biological data on all fish species captured at the Brunswick Fishway.
3. Collect fish community data during the juvenile river herring surveys conducted upstream in Sabattus Pond and the lower Androscoggin River.
4. Collect fish community data during the adult river herring emigration assessment conducted in the Sabattus River at the outlet of Sabattus Pond.

Objective 3: Characterize the annual migration of adult river herring and American shad in the Androscoggin River watershed.

Strategies:

1. Assess the timing and magnitude and collect biological data from pre-spawning adult river herring and American shad captured at the Brunswick/Topsham Hydroelectric Project Fishway.
2. Assess the timing and magnitude of the adult American shad migration upstream to the Brunswick Fishway by conducting visual observations and underwater monitoring.

3. Assess the post-spawn adult river herring emigration timing, magnitude, and condition from Sabattus Pond sampling.

Objective 4: Assess the reproductive success of adult and productivity of juvenile alosids in the watershed.

Strategies:

1. Evaluate the juvenile river herring growth and emigration timing, habitat parameters, and fish community in Sabattus Pond, located in the upper Androscoggin River.
2. Evaluate juvenile alosids in the lower river by sampling at the Brunswick Fishway and selected areas in the lower reaches of the Androscoggin River.

Objective 5: Increase the accessibility of historic habitat for native diadromous and resident fish species to increase the abundance, survival, and natural reproduction in historic habitat.

Strategies:

1. Provide oversight, review, and comments on required fish passage operation and downstream effectiveness study plans at hydropower dams.
2. Identify ineffective fish passage and the potential causes by conducting studies, collecting visual observations, and utilizing underwater monitoring data.
3. Provide effective up- and downstream passage for native diadromous fish species at dams currently without passage through the FERC process and non-regulatory partnerships.

Objective 6: Increase public awareness of the Androscoggin River program in order to encourage participation and support in river restoration initiatives.

Strategies:

1. Conduct outreach activities such as providing presentations on the program to public and scientific audiences.
2. Participate in the development and activities of the Androscoggin River Watershed Council.

1999 BRUNSWICK FISHWAY MAINTENANCE AND OPERATION

- Maine Department of Marine Resources (MDMR) met with the Brunswick dam owner, Florida Power and Light, Inc. (FPL, Inc.) in the spring of 1999 to review Brunswick Station operations, problems occurring with the fishway water attraction valve, and maintenance issues that remained from the fall 1998 season that required resolution prior to the startup of the fishway in May.
- The fishway was officially opened for its 17th consecutive season on May 5, 1999.
- During the last week of August, there were several problems with low flows in the Brunswick Fishway associated with dredging in the headpond by FPL, Inc. (conducted by Crooker). FPL, Inc. contacted the MDMR a few times regarding shutting down downstream passage because scuba divers were in the headpond working on the dam near the outlet. However, MDMR was not aware of any other activities, such as the dredging near the grate that provides water to the fishway. On several occasions, MDMR staff arrived at the site with little or no water in the fishway, and/or with the trap gates in the open position. When FPL, Inc. was notified, the grate was cleared; however, after the problem occurred a second time, the MDMR notified FPL, Inc. that it [MDMR] should receive prior notice of any work that may impact fishway operation, a written notice of the work to be conducted, a schedule, and what actions would be taken to prevent impacts to the fishway.

MDMR is fully aware that emergency situations can arise at hydrofacilities that require emergency action to be taken prior to MDMR being notified of the impacts to fishway operation. However, the fishway is scheduled to operate throughout the season to pass fish upstream, and if changes occur that can impact this operation, MDMR should be notified. MDMR successfully coordinates annual maintenance schedules and fish passage requirements with other hydropower companies on the Androscoggin River. Typically, a meeting is held in the spring with company representatives to cooperatively plan for this type of work well in advance (to the degree that is logistically possible). Also, in agreement with the other hydropower companies, MDMR is immediately notified by phone and soon thereafter, in writing, when emergency situations arise that could affect fish passage at those facilities. A cooperative approach is taken in resolving issues and finding solutions with a free exchange of information needs between all parties. It is recommended that a similar annual meeting be held between MDMR and FPL, Inc. to improve communication and understand expectations.

- The Brunswick Fishway was dewatered and cleaned on October 20, 1999 and closed for the season. Closure was earlier than usual because the fish crowder was inoperable (the lower panel rusted and fell off) and the cable that lifts the gate adjacent to the fish hoist (Isolation Gate #2) broke.

- Following the shutdown of the Brunswick Fishway, a letter was prepared and sent to FPL, Inc. to address many maintenance needs. Due to the age of the fishway (16 years), rusting grates and other mechanical parts are breaking regularly and have become a safety concern.
- The last week in November, the MDMR met with FPL, Inc. at the Brunswick Fishway to review the list of repairs needed at the site after its shutdown in October. The plans agreed to were as follows: all of the metal grating below water level would be replaced; wire cables that were not stainless steel would be replaced; the leaking observation window would be resealed; and the office would be painted. Two outdoor outlets near the hoist would be ground-faulted and larger pulleys with cable for the loading hose and holding tank door would replace the existing small pulley and rope. MDMR requested that a roof be constructed over the holding tank to provide shade for the fish; FPL, Inc. agreed to this request. All above-noted repairs and maintenance jobs were to be completed prior to reopening of the fishway in spring 2000.

FISH PASSAGE

RIVER HERRING:

The fishway opened on May 5 and river herring were observed from May 7 through June 8. The river herring capture rate in 1999 was low, with a total of 8,909 adults. The number captured peaked on two dates, May 22 and May 30, when it exceeded 1,000 fish (**Table 1**). The number of fish captured in 1999 was the third lowest capture rate since 1985 (**Table 1a & Figure 1a**). Two years in which the capture rates were lower than 1999 were in 1993 (5,202 adult alewives) and 1997 (5,540 adult alewives). In 1998, 25,189 adult alewives were captured at the fishway. The number of Androscoggin River adults captured at the fishway was much below the optimum number targeted for release into upstream spawning and nursery habitat. The adult release target is 20,192 adult river herring distributed into 1,318 hectares of upstream habitat. Of the 8,909 that were captured, 6,883 were transported upstream; 1,919 were released into the headpond (50 of which were sampled prior to release); 51 were sacrificed for biological sampling; and 56 were transport mortalities.

The statewide goal of the Maine Department of Marine Resources is to restore self-sustaining populations of river herring to their historic range. One benefit is to restore individual river watersheds. A second benefit is that with the reestablishment of river herring populations to Maine rivers, adult broodstock become available for restoration purposes in other Maine river systems. From 1985-1992, the Kennebec River river herring restoration program was sustained by the transport of adults from the Androscoggin River and other Maine river systems for distribution into the Kennebec drainage. In more recent years, for various reasons, the health of the river herring population in the Kennebec River has surpassed that of the Androscoggin River. Therefore, in 1999, a total of 1,788 river herring from the Kennebec River was distributed into the Androscoggin River to supplement the number of adults released. However, due to changes in adult capture methods at the Edwards hydro site on the Kennebec River pending dam removal, the number of adults transferred to the Androscoggin was limited. A total of 10,590 adult river herring was released into the Androscoggin River, 8,671 of which were released into three upstream habitat areas totaling 1,087 hectares. River herring were distributed to Sabattus and Taylor Ponds, Sabattus River, and the Brunswick headpond; none of these areas received the target number or reached the target stocking density of 14.83 fish per hectare (six fish/acre). Areas scheduled to receive fish but not receiving any were Lower Range, Marshall, Sutherland and Loon Ponds; and Bog Brook (**Table 1b**).

There are several factors that can influence the adult river herring capture rates at the fishway. A few include environmental conditions affecting the size of any given year class of returning adults; operational activities of the hydropower facility; effectiveness of the fishway; and to some degree, the number of adults released to reproduce in upstream spawning habitat four to five years earlier. Returning adult river herring to the Androscoggin River are predominantly four years old when they are captured. **Figure 1a**

and **Table 1a** illustrate that while intuitively the number of released adults can impact the number of captured returns, there are clearly additional critical factors that impact capture rates. For example, in 1989, 13,814 adults were released and in 1993, only 5,202 recruits were captured, while in 1993, only 7,748 adults were released and in 1997, 5,540 recruits were captured. In 1995, 10,591 adults were released and four years later, 8,909 were captured. Since one of the lower stocking rates occurred in 1995, this could have contributed to lower capture levels in 1999. However, stocking rates similar to those in 1995 conducted in 1987 and 1990 resulted in the variable capture rates of 77,000 and 19,000 adult alewives respectively. In 1999, an unusually warm, dry spring resulted in erratic water flows and rapid increases in water temperature, which may also have been an important factor (**Figures 1 & 2**).

One activity that may also have contributed to a lower capture rate of river herring at the Brunswick Fishway was a change in the turbine operation during the spawning migration. Due to low flows, FPL, Inc. switched from operating the turbine located adjacent to the fishway entrance (Turbine Unit 1) to the two turbines located on the opposite side of the riverbank (Turbine Units 2 and 3). The amount of water released near the turbine unit bays is greater than the attraction flow at the entrance to the fishway; therefore, river herring and shad can be attracted to the area of turbine operation. In this case, river herring were observed in the river downstream of Units 2 and 3, while the number captured in the fishway declined during the same time frame.

The following observations made at the fishway were recorded in the Brunswick Fishway daily log by MDMR biologists. Since MDMR does not have FPL, Inc. operational records, the date that the turbine change occurred is unknown, but it was first observed on June 4. MDMR could not conduct an efficiency study of the fishway to measure the change in river herring utilization during this period due to the time necessary for preparation of such a study, as well as lack of staff and funds:

- June 4 – Unit 3 was on and large schools of river herring observed on the far shore near Unit 3. Attempts were made to contact several personnel at FPL, Inc. Messages were left requesting that we discuss switching back to Unit 1 because MDMR and USFWS were concerned about fishway entrance attraction flows. No calls were returned.
- June 6 – Unit 3 was on and large schools of river herring were observed on the far shore near Unit 3.
- June 10 – Units 2 and 3 were on; Unit 1 was off.
- June 11 – Unit 1 on; Units 2 and 3, off.
- June 14 – Units 2 and 3 were on; Unit 1, off.
- June 17 - Units 2 and 3 were still on; Unit 1, off.
- June 29 – Unit 1 on; Units 2 and 3, off.

A FPL, Inc. representative later informed MDMR that the turbine units had automatically switched due to low flow conditions. MDMR requested that FPL, Inc. switch back to

Unit 1 to assist with the American shad run. The FPL, Inc. representative stated that the change in turbine operation was a computer-controlled feature that could not be changed. It was recommended by MDMR that in the future FPL, Inc. contact and coordinate with MDMR if generation and/or fishway operation changes are being considered during critical times of fish migration.

The water temperature at the Brunswick Fishway at the start of the herring run on May 7, was 14.5°C and water flow was 10,200 (cfs) at the USGS Station in Auburn, ME. When the run ended on June 8, the water temperature was 24.0°C and water flow was 3,080 (cfs). The water temperature ranged between 14.5°C and 24.0°C, averaging 18.1°C (**Figure 1**). The water flow in Auburn ranged between 2,190 (cfs) and 10,200 (cfs), averaging 5,311 (cfs) (**Figure 2**). On May 11, 65% of the fish were female with an average length of 286.8 mm. Of these, 78.8 % were four years old, while 12.1 % were five years old. The males (remaining 35% of the sample), averaged 277.8 mm and 88.8% of them were four years old. On May 26, the fish were live sampled and 50% were female, with an average length of 291.0 mm. Of those, 80% were four years old and 20% were three years old. The males (remaining 50%) averaged 298.7 mm long; 64% were five years old and 36% were four years old.

AMERICAN SHAD:

OBSERVED SHAD

Between 1994 and 1998, approximately 79 adult shad were observed from the fishway walk, swimming in the river outside the entrance and in the lower portion of the fishway below the sharp turn halfway up the ladder (**Table 2**). In that same time frame, a total of 13 were captured (**Table 3**). In 1995, CMP (previous site owner), USFWS, and MDMR narrowed the large turn pool at Brunswick with the goal of eliminating holding areas and reducing eddies to increase shad passage efficiency; however, the effects of these changes were never evaluated. In 1998, the highest number of both observed and captured shad was recorded (30 observed and five captured), until 1999, when 543 were observed from the fishway walk and 88 were captured. The 1994 - 1998 data identified the need to initiate a focused effort to collect data on the number of adult shad migrating upstream to the fishway, the activity of shad in and around the fishway, and to potentially identify possible solutions for improving upstream passage of shad if necessary. The effort was two-fold and utilized underwater video equipment to document shad activity in and around the fishway, as well as recorded observations of shad numbers and behavior from the fishway walk.

In April 1999, MDMR was directed by FPL, Inc. staff to contact Bill Hanson in its Environmental Department to discuss potentially partnering on the underwater video monitoring portion of the effort. Although FPL, Inc. was initially interested, it later determined it would not participate in the project, so MDMR formed a partnership with the U.S. Fish & Wildlife Service to conduct the study.

In 1999, underwater video taping of approximately 832 daylight hours was conducted from June 6 to July 28. The corresponding time, water temperature, location, and behavior were recorded. The video tapes that recorded underwater shad activity were reviewed throughout the season. Data collected from the tapes included date, location shad were observed, time of day observed, and total number of shad seen at that time of day. Of the total number observed at a certain time, the behavior was broken down into the following categories: number moving upstream, number moving downstream, number moving backward, number circling, and number dead. The daily mean water temperature and mean water flow were also recorded. The data from 1999 will be combined and analyzed with additional data that is collected as the project continues in 2000.

In 1999, visual observations were recorded daily from the fishway walk of adult shad present in and around the fishway. A total of 543 shad were observed on 32 separate days, beginning on May 23 and continuing through August 2 (**Table 2**). In May, a total of 47 shad were observed primarily in the corner pool and viewing window. In June, a total of 487 shad were observed primarily outside the fishway entrance in the river and in the corner pool. In July, seven were observed, six of which were in the corner pool. In August, two dead shad were observed on the trash rack. Shad outside the fishway entrance were usually swimming up- and downstream along the concrete wall in a school. In the corner pool, they were usually holding a single position in a school or circling, but not moving up- or downstream. A few individuals identified by distinctive scars or wounds were observed holding in the corner pool for days, but were never captured. Shad were never observed in the upper fishway. Those that were observed in the MDMR viewing window at the top of the ladder were often schooling with river herring or swimming upstream and downstream in front of the window.

Clearly, as with any study, visual observations of shad made from the fishway wall and through the use of video equipment have certain limitations that are considered when analyzing the data, such as the potential for over-estimating (same fish counted more than once) or underestimating (limited visibility when looking down into the fishway/water) the number of fish actually present. The purpose of collecting this preliminary data was to first determine if there is a need to conduct more quantifiable studies that would require substantially more funds, staff, and equipment.

Based on this preliminary shad observation data, the Brunswick Fishway may be inefficient in passing prespawning adults upstream; therefore, the observations will be continued. There is also a need to obtain an adult population estimate in the lower Androscoggin River and to conduct juvenile surveys in the lower Androscoggin River/Merrymeeting Bay. Since 1983, the Maine Department of Marine Resources has utilized both state and federal funds to restore anadromous fish to the Androscoggin River. Comprehensive studies would be optimum to identify and clarify the potential causes of low capture rates of adult American shad.

The water temperature when the shad were observed averaged 19.4°C and the water flow, 3,547 cfs. In May, the average water temperature when shad were observed was 19.4°C; in June, 22.9°C; in July, 25.0°C; and in August, 26.1°C. The water flow when shad were observed ranged between 4,270 (cfs) and 7,160 (cfs) in May (average of 5,433 cfs); in June, between 1,650 (cfs) and 7,160 (cfs) (average of 3,761 cfs); in July, between 1,730 (cfs) and 3,440 (cfs) (average of 2,864 cfs); and in August, the flow was 2,130 (cfs) (Table 2).

CAPTURED SHAD

In 1999, a greater number of American shad were captured at the Brunswick Fishway than in previous years since the program's inception in 1987. A total of 88 adults were captured between May 23 and July 6; prior to this, the maximum number of captured adults was five in 1998 (Table 3). The increase in the run size may be a result of the adult shad releases conducted in 1994 and 1995; the highest number of Connecticut River shad were released during these two years, 707 and 1,090 respectively, into the main stem Androscoggin at Auburn (Table 4). It may also be due to increased shad restoration activities in other Maine river systems.

During the 1999 shad run, the water temperature ranged between 17.5°C and 25.8°C, averaging 21.6°C (Figure 3). The water flows at Auburn ranged between 1,710 (cfs) and 7,160 (cfs), averaging 3,714 (cfs) (Figure 4). Of the 88 captured adults, 60 were male (68%), 11 were female (13%), and 17 were undetermined sex (19%). The average fork length was 397.0 mm and average total length was 448.2 mm, while the average weight was 0.88 kg (Table 5). The condition of the shad varied from fair to poor, possibly a result of activity from moving up the fishway, as well as the negative impacts observed from fish after being deposited into the square holding tank. Most had at least some scale loss on the sides of the body. Many of the fish had significant scale loss and abrasions; some had cuts and hemorrhaging around the head and mouth area. The shad were carefully handled by MDMR fishery biologists to properly collect data, scales for aging, and fin clips for future genetic analysis prior to being passed upstream into the Brunswick headpond (Table 5). The MDMR considers this data essential for the effective management of the species and participates as a member of the Atlantic States Marine Fisheries Commission, in which specific fishery independent monitoring programs for American shad are conducted.

TRANSPORTED & RELEASED SHAD

For the ten-year period between 1987 and 1997, the Androscoggin River received an average of 428 adult American shad from the Connecticut River. In 1998, no adult shad were released; however, in 1999, the adult stocking program was resumed through coordination with the Connecticut River American Shad Technical Advisory Committee (CRSTAC). In order to approach the number of adults released in 1994 and 1995, 700 shad were requested for the Androscoggin River. The number allocated was 300, 270 of which were successfully released into the main stem Androscoggin at the Auburn boat

launch. Including the 88 fish passed upstream at Brunswick, a total of 358 adult shad were released into the main stem river between Brunswick and Auburn in 1999 (**Table 4**).

The statewide goal of the Maine Department of Marine Resources is to restore self-sustaining populations of American shad to their historic range. A primary benefit of restoring shad to several rivers in Maine is that adult broodstock are available from several nearby Gulf of Maine sources and can be utilized for restoration purposes in other Maine rivers. Therefore, in an effort to establish American shad in the Androscoggin, as well as the Kennebec, the first American shad fry were released into the Androscoggin River. Fry reared at the Waldoboro Hatchery were transported and released by MDMR fishery biologists on June 30 into the main stem river at the Auburn boat launch. The 280,000 fry were 10 to 17 days old and were Connecticut River and Connecticut River/Saco River in origin. They received a tetracycline mark prior to release to distinguish them from wild origin adult returns (**Table 6**).

ATLANTIC SALMON:

Currently, an active Atlantic salmon restoration program is not in place for the Androscoggin River, other than that of providing upstream passage past the first three dams on the river. However, an average of 39 sea-run salmon have been captured annually at Brunswick since 1983 (**Table 7**). During the 1999 season, a total of six Atlantic salmon were passed into the Brunswick headpond. They were captured between June 6 and September 29, at river temperatures of 21.0°C and 16.7°C respectively, with an average temperature of 20.6°C. The first salmon captured was a landlocked, while the remainder were sea-run. Of the sea-run fish, three were wild (all were two sea-winter fish) and two were of hatchery origin (a one sea-winter and a two sea-winter fish). The average fork length of the sea-run salmon was 700.6 mm. One hatchery fish had a deformed adipose, while the second had a left pelvic fin clip (**Table 8**). In June 1999, the Maine Atlantic Salmon Technical Advisory Committee (MSTAC) included the Androscoggin River in an ongoing genetic sampling program. Fin clips were collected from salmon captured on July 20, September 27, and September 29, and provided to the U.S. Fish & Wildlife Service-Maine Anadromous Fish Coordinator. Genetic analysis may be conducted in the future to determine the origin of the salmon to provide more effective management in the watershed. Atlantic salmon adults released upstream may potentially utilize upstream passage at the next two dams to reach spawning and nursery habitat in tributaries upstream of the Brunswick dam.

SEA LAMPREY:

Two sea lamprey were captured in May and averaged 710.0 mm total length (**Table 9**). Sea lamprey are rarely captured in the trap since the flow rate in the fishway may be too high for them to negotiate and any that do move up the fishway may pass through the trap grating.

AMERICAN EEL:

Three American eels were captured in the fishway in June and August 1999, and their total lengths ranged from 307.0 mm - 380.0 mm. Eels are rarely captured in the trap since the flow rate in the fishway is likely too high for them to negotiate; any that do negotiate the fishway may be small enough to pass through the trap grating. Upstream migrating juvenile eels utilize inland freshwater habitat areas for an average of 20 years of growth to adulthood before emigrating to the Sargasso Sea to reproduce. Fish released above the Brunswick dam may use the fish lift facilities located at the next two dams to reach and utilize upstream habitat (Table 9).

STRIPED BASS:

Three striped bass were captured at Brunswick in June 1999, and many more were observed in the fishway and trapping area. The captured fish ranged from 402.0 mm - 421.0 mm total length (Table 9). Many striped bass were also observed feeding on schools of juvenile alosids in the tailrace area from August to October.

OTHER SPECIES:

From May 5 through October 21, 13 fish species and 337 adult fish were captured and passed at the Brunswick Fishway, not including American shad and river herring (Tables 9 and 10). The most common species captured in May were white perch, white sucker, smallmouth bass, and white catfish; in June, the most common species were white catfish and smallmouth bass. In July, a total of 12 fish were captured, eight of which were white suckers. Two American eels and a smallmouth bass were captured in August, and in September, the only fish captured were two Atlantic salmon. No fish were captured during the month of October.

White catfish are a non-indigenous species introduced into Maine waters and are not passed upstream. They were first discovered in the Eastern River, a tributary of the Kennebec, in 1997, and appear to be rapidly expanding their range. The exact rate and location of expansion and the potential effects on native fish communities are undetermined. A total of 105 white catfish were captured in June and July, ranging from 38.0 mm - 390.0 mm total length (Table 9).

JUVENILE FISH SPECIES:

Juvenile fish community sampling was conducted at the Brunswick Fishway. The summarized data is presented in Table 11. The Brunswick Fishway was monitored daily and juvenile fish were captured from June 16 until October 19. The six species of juvenile fish captured and the number of each included: smallmouth bass (150), white sucker (69), white perch (22), river herring (15), pumpkinseed (6), and largemouth bass (1). Approximately 50 unidentified fry were also captured. The average water temperature at the fishway during this period was 22.8°C and average flow at Auburn was 3,186 cfs. A total of 15 juvenile alewives was captured on four separate days

between September 15 and October 19, 1999. They ranged from 55.0 mm - 139.0 mm, averaging 119.0 mm total length. During these four days, the water temperature ranged from 11.1°C - 23.1°C, averaging 16.7°C. The water flow at Auburn ranged from 2,370 cfs – 6,900 cfs, averaging 4,720 cfs (**Table 11**). No juvenile shad were captured at the Brunswick Fishway during the 1999 season.

ENVIRONMENTAL DATA:

Brunswick Fishway air temperature, water temperature, and water flow data recorded from May through October 1999 are shown in **Tables 12-17**.

Table 1. Adult River Herring Captured, Water Temperature, and Flow at the Brunswick Fishway, 1999

Date	Number	Temp. (C)	Water Flow (cfs)	% Total Run
5/7/99	25	14.50	10200	0.28
5/8/99	18	14.85	8990	0.20
5/9/99	111	15.00	7210	1.25
5/10/99	12	15.20	7770	0.13
5/11/99	138	14.90	7770	1.57
5/12/99	137	15.10	6500	1.54
5/13/99	32	15.20	5220	0.36
5/14/99	35	15.10	4450	0.39
5/15/99	42	15.90	3310	0.47
5/17/99	205	17.30	5330	2.30
5/18/99	993	16.70	4920	11.14
5/19/99	294	17.70	4550	3.30
5/20/99	216	17.20	5320	2.42
5/21/99	101	17.50	7610	1.13
5/22/99	1448	18.70	5990	16.25
5/23/99	567	19.30	4270	6.36
5/24/99	283	18.60	4020	3.18
5/25/99	12	17.80	5440	0.13
5/26/99	156	18.50	6500	1.75
5/27/99	558	17.90	7160	6.26
5/28/99	557	18.50	6140	6.25
5/29/99	973	19.00	5660	10.92
5/30/99	1254	19.00	4760	14.07
5/31/99	383	20.00	4610	4.30
6/1/99	92	19.70	4270	1.03
6/2/99	14	21.00	3720	0.16
6/3/99	24	20.00	3650	0.27
6/4/99	2	21.80	3380	0.02
6/5/99	1	20.00	2380	0.01
6/6/99	121	21.00	2190	1.36
6/7/99	103	21.50	3570	1.16
6/8/99	2	24.00	3080	0.02
99 Total/Av.	8909	18.08	5311	100.00

Note: Flow Data from USGS Station 01059000 at Auburn, ME

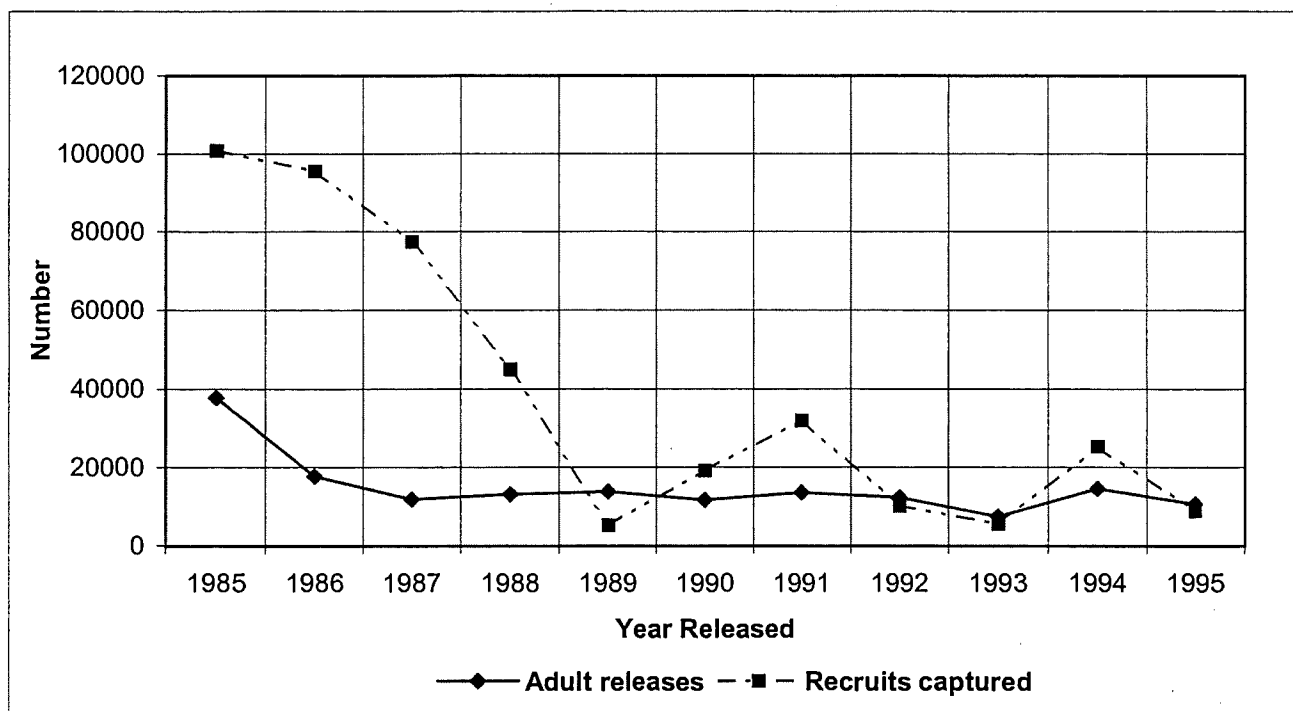


Figure 1a. Number of adult river herring released in the Androscoggin River watershed and recruits captured at the Brunswick Fishway 4 yrs later

Table 1a. Number of adult river herring released from 1985-1995 in the Androscoggin River watershed and recruits captured at the Brunswick Fishway 4 years later

Year	Adult releases	Recruits captured
1985	37773	100895 (1989)
1986	17763	95574 (1990)
1987	11892	77511 (1991)
1988	13183	45050 (1992)
1989	13814	5202 (1993)
1990	11725	19190 (1994)
1991	13574	32002 (1995)
1992	12351	10198 (1996)
1993	7448	5540 (1997)
1994	14549	25189 (1998)
1995	10591	8909 (1999)

Table 1b. Adult River Herring Distribution in the Androscoggin Watershed by Site, 1999

Source: Androscoggin / Kennebec

Habitat	1999
Sabattus Pond	4,666 / 292
Taylor Pond	993 / 1,496
Tripp Pond	-
Lower Range Pond	-
Androscoggin River	-
Sabattus River	1,224 / 0
Marshall Pond	-
Bog Brook	-
Durham Boat Ramp	-
Loon Pond	-
Sutherland Pond	-
TOTAL	6,883 / 1,788=8,671
Brunswick Headpond (passed	1,919 / 0
TOTAL PASSED	*8,802 / 1,788=10,590

* Total Androscoggin captured was 8,909,
107 of which were sampled for biological data

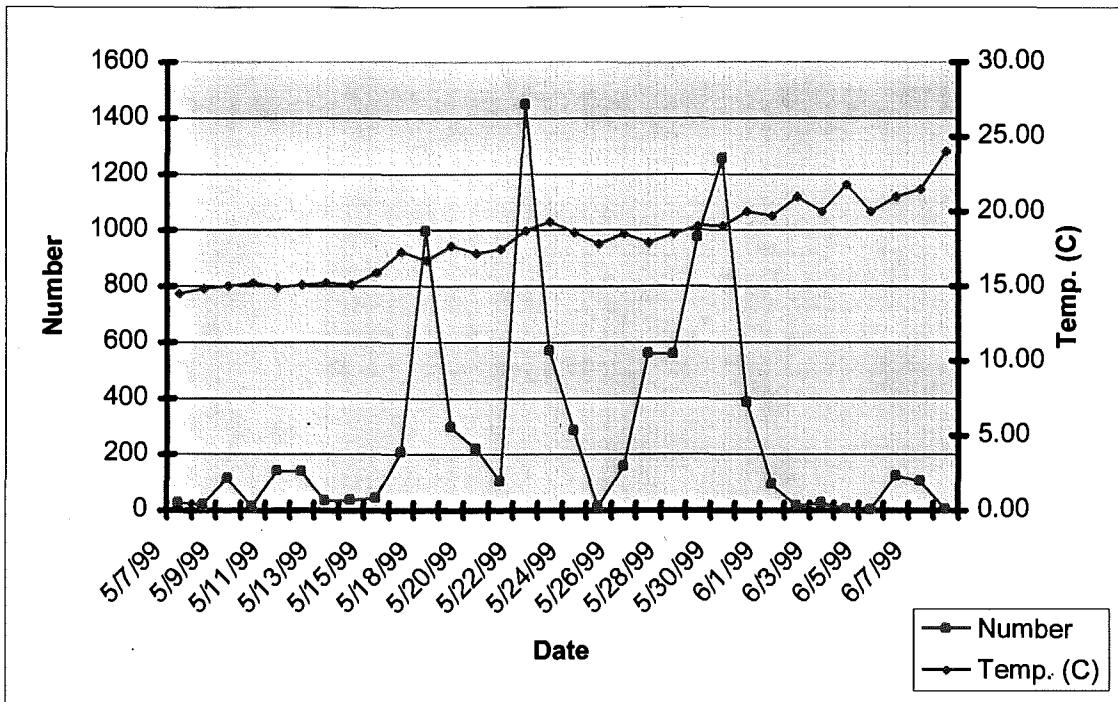


Figure 1. Number of adult river herring captured and water temperature at the Brunswick Fishway, 1999

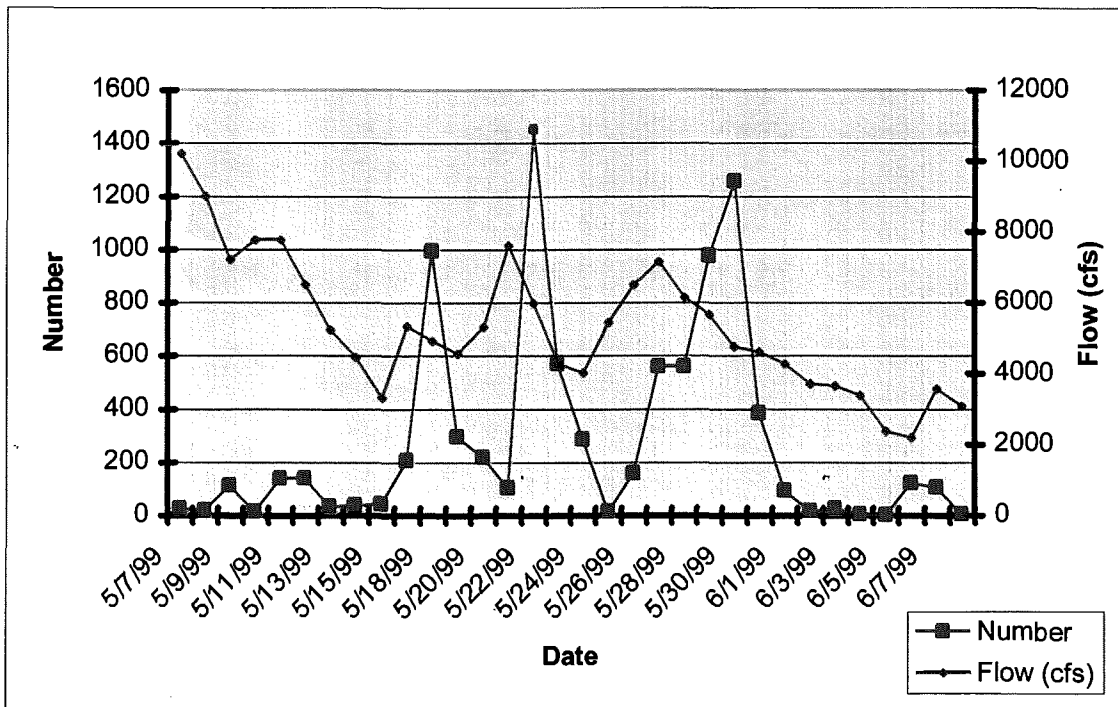


Figure 2. Number of adult river herring captured at the Brunswick Fishway and water flow at Auburn, 1999

Table 2. American Shad Observations at the Brunswick Fishway, 1994-1999

Year / Month	Dead	Viewing Window	Upper FW	Lower FW	Corne Pool	Outside FW	Total (month)	Mean Flow	Mean Water Temp. (C)¹
1999 May	6	16	-	5	15	5	47	5433	19.4
June	8	38	-	73	218	150	487	3761	22.9
July	1	0	0	1	5	0	7	2864	25.0
August	2	0	0	0	0	0	2	2130	26.1
Total	17	54	0	79	238	155	543	3547	Av = 23.4
1998 May	-	-	-	-	-	-	-		-
June	2	1	-	6	-	-	9		17.8
July	1	-	-	-	-	20	21		23.8
August	-	-	-	-	-	-	-		-
1997 May	-	-	-	-	-	-	-		-
June	-	-	-	-	3	36	39		17.9
July	-	-	-	-	-	-	-		-
August	-	-	-	-	-	-	-		-
1996 May	-	-	-	-	-	-	-		-
June	-	-	-	-	-	-	-		-
July	-	-	-	-	-	-	-		-
August	-	-	-	-	-	-	-		-
1995 May	-	-	-	-	-	-	-		-
June	-	-	-	-	-	-	-		-
July	-	-	-	-	-	-	-		-
August	-	-	-	-	-	-	-		-
1994 May	-	-	-	-	-	-	-		-
June	-	-	-	10	-	-	10		23.7
July	-	-	-	-	-	-	-		-
August	-	-	-	-	-	-	-		-
1994-99 TOTAL	37	109	0	174	479	366	1165		
AV. T° (C)									22.1
Min/Max T°									17.8 / 26.1

¹ Mean water temperature at the time of shad observations

Table 3. American Shad Captured at the Brunswick Fishway, 1993-1999

Date	No.	Water Temp. (C)	Flow (cfs)
5/23/99	1	19.0	4270
5/24/99	2	18.5	4020
5/26/99	1	18.4	6500
5/27/99	2	17.7	7160
5/28/99	11	18.5	6140
5/29/99	11	19.0	5660
5/30/99	4	19.0	4760
5/31/99	3	20.0	4610
6/1/99	1	19.7	4270
6/2/99	2	21.0	3720
6/3/99	17	20.0	3650
6/4/99	3	21.8	3380
6/5/99	1	20.0	2380
6/6/99	2	21.0	2190
6/7/99	12	21.5	3570
6/8/99	1	24.0	3080
6/9/99	2	23.0	3070
6/14/99	2	22.2	2740
6/22/99	1	24.0	2870
6/25/99	1	25.0	2800
6/26/99	1	25.0	1710
6/27/99	2	25.5	1730
6/29/99	3	25.2	2820
6/30/99	1	25.5	2740
7/6/99	1	25.8	3010
Total/Average	88	21.6	3714
Min / Max		17.7 / 25.5	1710 / 7160

Table 3. (CONTD)

5/24/98	1	18.3	3640
6/3/98	1	18.4	3600
6/4/98	1	17.9	4470
6/5/98	1	17.0	-
7/28/98	1	25.0	-
Total/Average	5	19.3	3903
Min / Max		17.0 / 25.0	3600 / 4470
6/9/97	1	17.9	-
7/1/97	1	23.2	-
Total/Average	2	20.6	
6/11/96	1	18.8	-
6/25/96	1	20.4	-
Total/Average	2	19.6	
6/3/95	1	19.1	-
6/8/95	1	20.5	-
6/10/95	1	21.8	-
Total/Average	3	20.5	
6/22/94	1	22.2	-
6/7/93	1	15.3	-
6/9/90	1	19.0	-
Grand Total	101		
Overall Av.		20.9	3734
Overall Min / Max		15.3 / 25.5	1710 / 7160

Table 4. Adult American Shad Distribution: Main Stem Androscoggin at Auburn, 1987-1999

Year	Number distributed	Source			Mortality during transport
		Androscoggin	Connecticut	Merrimack	
1999	358	88	270	-	10.6%
1998	5	5	-	-	N/A
1997	221	2	219	-	13.0%
1996	312	2	310	-	37.8%
1995	1,090	3	1,087	-	9.8%
1994	707	1	706	-	38.0%
1993	580	1	579	-	20.0%
1992	566	-	566	-	15.0%
1991	357	-	357	-	31.0%
1990	354	1	353	-	21.0%
1989	414	-	414	-	25.5%
1988	513	-	513	-	1.2%
1987	92	-	-	92	11.0%
TOT.	5,569	103	5,374	92	19.5%

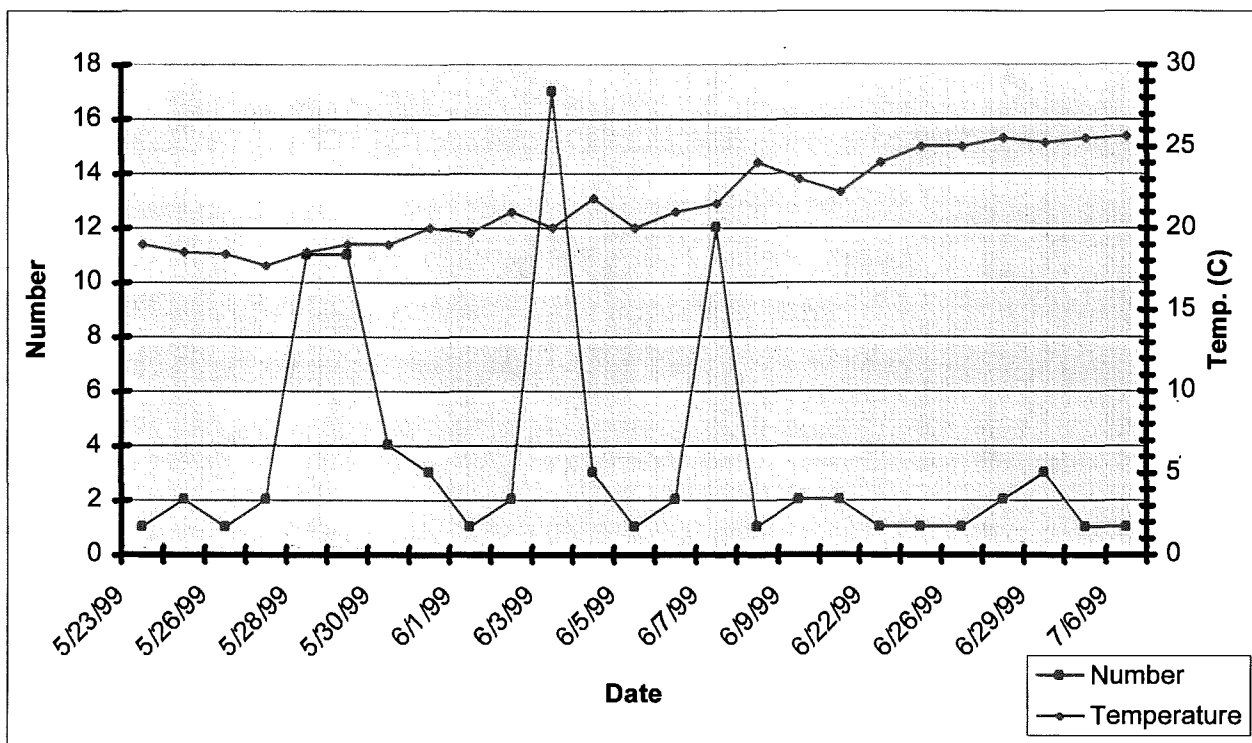


Figure 3. Adult American shad captured and water temperature at the Brunswick Fishway, 1999

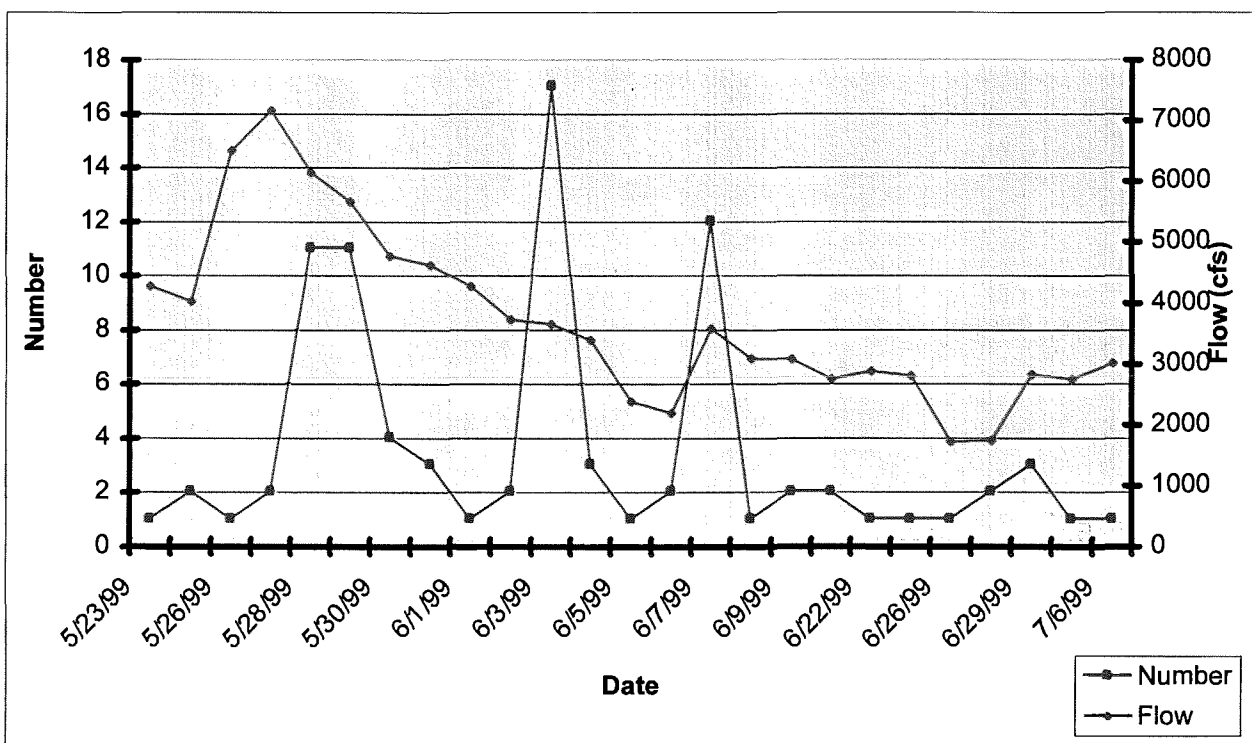


Figure 4. Adult American shad captured at the Brunswick Fishway and water flow at Auburn, 1999

Table 5. American Shad Captured - Androscoggin River, Brunswick Fishway, 1999

Date	Total Length	Fork Length	Weight (kg)	Sex	Condition	Sample
23-May	395	370	-	-	Hemorrhaging around head	Scales
24-May	390	345	-	-	-	Scales
24-May	480	435	-	-	-	Scales
26-May	390	365	-	-	-	Scales
27-May	464	420	-	-	Hemorrhaging around mouth	Scales
27-May	410	361	-	-	Active	Scales
28-May	440	392	-	-	-	Scales
28-May	402	353	-	-	-	Scales
28-May	436	395	-	-	-	Scales
28-May	492	456	-	-	-	Scales
28-May	463	399	-	-	-	Scales
28-May	442	394	-	-	-	Scales
28-May	470	413	-	-	-	Scales
28-May	478	425	-	-	-	Scales
28-May	390	325	-	-	-	Scales
28-May	450	402	-	-	-	Scales
28-May	425	380	-	-	-	Scales
29-May	465	420	1.00	M	Scale loss, abrasions; hemorrhaging	Scales
29-May	450	400	0.90	F	"	Scales
29-May	460	410	1.00	M	"	Scales
29-May	453	400	0.80	M	"	Scales
29-May	430	375	0.60	M	"	Scales
29-May	462	410	0.90	M	"	Scales
29-May	455	400	0.90	M	"	Scales
29-May	490	433	1.15	F	"	Scales
29-May	411	365	0.50	M	Slight scale loss	Scales
29-May	500	440	1.20	F	Fatally injured in holding tank	Scales
29-May	475	420	1.20	F	Weak	Scales
30-May	428	390	0.60	M	Scale loss & abrasions	Scales
30-May	410	360	0.80	M	Scale loss on right side	Scales
30-May	465	409	1.00	F	Scale loss & abrasions	Scales
30-May	465	408	1.05	M	Normal	Scales
31-May	476	420	1.05	M	Scale loss	Scales
31-May	446	393	0.70	M	1" gash on side, scale loss	Scales
31-May	446	391	0.75	M	Dead, abrasions & scale loss	Scales

Table 5. (CONTD)

Date	Total Length	Fork Length	Weight (kg)	Sex	Condition	Sample
1-Jun	455	405	0.95	-	Normal	Scales
2-Jun	425	380	1.00	M	Normal	Scales
2-Jun	445	400	0.90	M	Normal	Scales
3-Jun	450	400	-	M	Severe abrasions	Scales/fin clip
3-Jun	432	380	0.55	M	Normal	Scales/fin clip
3-Jun	445	392	0.55	M	Normal	Scales/fin clip
3-Jun	455	405	0.95	M	Deep gash & fungal growth on back	Scales/fin clip
3-Jun	442	385	0.85	M	Normal	Scales/fin clip
3-Jun	502	445	1.45	F	Scale loss, unripe	Scales/fin clip
3-Jun	453	400	0.90	M	Normal	Scales/fin clip
3-Jun	464	410	0.90	M	Scale loss	Scales/fin clip
3-Jun	451	403	0.95	U	Scale loss, severe abrasions	Scales/fin clip
3-Jun	415	364	0.70	M	Normal	Scales/fin clip
3-Jun	446	391	0.80	M	Normal	Scales
3-Jun	489	427	1.00	F	Normal	Scales
3-Jun	458	407	0.90	M	Scale loss	Scales
3-Jun	444	391	1.00	M	Normal	Scales
3-Jun	430	380	0.70	M	Normal	Scales
3-Jun	449	397	0.90	M	Scale loss	Scales
3-Jun	473	416	1.15	F	Normal, unripe	Scales
4-Jun	446	432	0.90	M	Severe scale loss	Scales/fin clip
4-Jun	445	395	0.90	M	Scale loss	Scales/fin clip
4-Jun	-	-	1.40	F	Severe scale loss, abrasions; dead	Scales/fin clip
5-Jun	439	388	0.70	M	Scale loss, cut & hemorrhaging on	Scales
6-Jun	450	395	0.80	M	Normal	Scales
6-Jun	434	378	0.75	M	Normal	Scales
7-Jun	471	414	1.05	F	Normal	Scales/fin clip
7-Jun	421	375	0.80	M	Normal	Scales/fin clip
7-Jun	469	419	1.10	M	Normal	Scales/fin clip
7-Jun	441	383	0.90	M	Normal	Scales/fin clip
7-Jun	467	410	1.10	M	Normal	Scales/fin clip
7-Jun	456	395	0.80	M	Normal	Scales/fin clip
7-Jun	456	399	0.90	M	Normal	Scales/fin clip
7-Jun	366	325	0.40	M	Normal	Scales/fin clip
7-Jun	466	412	0.80	M	Normal	Scales/fin clip

Table 5.(CONTD)

Date	Total Length	Fork Length	Weight (kg)	Sex	Condition	Sample
7-Jun	445	392	0.60	M	Normal	Scales/fin clip
7-Jun	464	411	0.95	M	Normal	Scales/fin clip
7-Jun	464	409	1.00	M	Normal	Scales/fin clip
8-Jun	411	365	0.65	M	Abrasions, scale loss; died	Scales/fin clip
9-Jun	451	399	0.65	M	Slight abrasions	Scales/fin clip
9-Jun	468	416	0.90	M	Scale loss	Scales/fin clip
14-Jun	441	385	0.70	M	Right eye bloody/protruding, scale	Scales/fin clip
14-Jun	436	370	0.70	M	Scale loss	Scales/fin clip
22-Jun	462	409	1.00	M	Scale loss	Scales/fin clip
25-Jun	464	409	0.95	M	Scale loss, hemorrhaging on mouth	Scales/fin clip
26-Jun	475	425	0.90	M	Severe scale loss, dead	Scales/fin clip
27-Jun	485	428	1.00	F	Normal	Scales/fin clip
27-Jun	467	441	0.95	M	Weak	Scales/fin clip
29-Jun	452	395	0.85	M	Scale loss, scarring on mouth	Scales/fin clip
29-Jun	408	360	0.60	M	Scale loss	Scales/fin clip
29-Jun	459	402	0.85	M	Severe scale loss	Scales/fin clip
30-Jun	420	373	0.70	M	Abrasions on sides and mouth	Scales/fin clip
6-Jul	470	423	0.90	M	Abrasion on right side	Scales/fin clip
Av.	448.2	397.5	0.88			
% Males:Females:Unknown				68.2%:12.5%:19.3%		

Table 6. American Shad Fry Releases into the Main Stem Androscoggin at Auburn, 1999

Date	Source	No. Released	Age	% Mortalit	Loading Site Temp. (C)	Receiving Site Temp. (C)	Marking Method
30-Jun	CT x CT and CT x Saco	280,000	10 to 17 days old	~2.4%	17.3	24.7	TCN*

* Fry were exposed to a 4-hour tetracycline bath at the Waldoboro Hatchery on 6/29/99

Table 7. Number, Origin and Lengths of Sea-Run Androscoggin Atlantic Salmon, 1983-1999

	Sea-Run Hatchery				Sea-Run Wild				Av. Length (mm)	Total
Age	1SW	2SW	3SW	Repeat	1SW	2SW	3SW	Repeat		
Year										
1983	1	16	0	0	0	3	0	1	*	21
1984	4	79	1	0	0	7	0	0	*	91
1985	1	18	0	0	0	2	0	0	*	21
1986	0	72	1	0	0	8	0	0	*	81
1987	2	20	3	0	0	1	0	0	729	26
1988	2	11	0	0	1	0	0	0	723 (TL)	14
1989	1	17	0	0	0	1	0	0	712 (TL)	19
1990	6	168	0	1	1	9	0	0	706	185
1991	0	9	0	0	0	12	0	0	759 (TL)	21
1992	2	9	0	0	1	3	0	0	658	15
1993	1	33	0	0	1	9	0	0	727	44
1994	2	16	0	1	0	6	0	0	707	25
1995	2	12	0	0	0	2	0	0	710	16
1996	2	19	1	0	1	16	0	0	708	39
1997	0	0	0	0	0	1	0	0	*	1
1998	0	4	0	0	0	0	0	0	737	4
1999	1	1	0	0	0	3	0	0	701	5
Total	27	504	6	2	5	83	0	1		628

Data source: U.S. Atlantic Salmon Assessment Committee Annual Report 1998/10

SW - # Sea Winters/number of years at sea

TL - total length measured; all others are fork length

Repeat - repeat spawner

* - Data unavailable

Note: 1998 average fork length differs from Table 10 because total length data were used where fork lengths were not available

Table 8. Atlantic Salmon - Androscoggin River, Brunswick Fishway - 1999

Date	Fork Length	Total Length	Clips/Marks	Origin:Age	Water Temp.
	(mm)	(mm)			
6-Jun	374	398	None	LLS H:1	21.0
11-Jun	772	783	Adipose	ATS H:2	22.0
16-Jun	589	620	None	ATS H:1	22.5
20-Jul	722	747	None	ATS W:2*	25.2
27-Sep	750	850	Left pelvic fin	ATS W:2*	16.2
29-Sep	670	750	Severe scratches	ATS W:2*	16.7
Total	6				
Average	555	691			20.6
Min./ Max T°					16.2 / 25.2

LLS is a one-year old landlocked salmon of hatchery origin; ATS denotes sea-run Atlantic salmon

*Fin clip samples were collected from these 3 fish

Table 9. Adult Fish Community Data - Brunswick Fishway, 1999

Month	Species	Total #	Av. Total	Min	Max	Av. Fork	Min	Max
			Length (mm)			Length (mm)		
May	White sucker	73	376.3	255.0	452.0	351.0	244.0	424.0
	White perch	85	136.3	120.0	157.0	129.4	115.0	150.0
	Brown trout	6	380.2	314.0	470.0	377.8	310.0	485.0
	Smallmouth bass	37	344.4	136.0	495.0	327.3	133.0	460.0
	Sea lamprey	2	710.0	695.0	725.0	*	*	*
	Monthly Total	203						
June	Brown trout	6	390.0	327.0	490.0	379.7	317.0	480.0
	Smallmouth bass	11	305.5	259.0	375.0	288.5	245.0	351.0
	Striped bass	3	412.3	402.0	421.0	393.0	390.0	398.0
	White catfish	69	346.7	273.0	390.0	323.7	285.0	365.0
	Golden shiner	1	75.0	*	*	67.0	*	*
	American eel	2	370.0	360.0	380.0	*	*	*
	Monthly Total	92						
July	Smallmouth bass	10	115.9	360.0	380.0	276.7	245.0	315.0
	White catfish	36	236.5	38.0	378.0	308.6	265.0	355.0
	Pumpkinseed	1	170.0	*	*	163.0	*	*
	Common shiner	58	43.7	30.0	66.0	*	*	*
	Spottail shiner	1	36.0	*	*	*	*	*
	Monthly Total	106						
August	Smallmouth bass	1	330.0	*	*	*	*	*
	American eel	1	307.0	*	*	*	*	*
	Common shiner	5	54.2	42.0	74.0	*	*	*
	Monthly Total	7						
September	Spottail shiner	1	55.0	*	*	*	*	*
	Monthly Total	1						
October	Spottail shiner	4	63.0	*	*	*	*	*
	Monthly Total	4						
1999	Grand Total	413						

Table 10. Adult Fish Species Captured at Brunswick Fishway, 1999

	May	June	July	August	September	October	Species Total
American Shad (<i>Alosa sapidissima</i>)	35	52	1	0	0	0	88
River Herring (<i>Alosa aestivalis</i>)	8550	359	0	0	0	0	8909
Atlantic Salmon (<i>Salmo salar</i>)	0	3	1	0	2	0	6
White Sucker (<i>Catostomus commersoni</i>)	73	0	8	0	0	0	81
American Eel (<i>Anguilla rostrata</i>)	0	2	0	2	0	0	4
Striped Bass (<i>Morone saxatilis</i>)	0	3	0	0	0	0	3
Smallmouth Bass (<i>Micropterus dolomieu</i>)	37	14	2	1	0	0	54
White Perch (<i>Morone americana</i>)	85	0	0	0	0	0	85
Sea Lamprey (<i>Petromyzon marinus</i>)	2	0	0	0	0	0	2
White Catfish (<i>Ictalurus catus</i>)	24	64	0	0	0	0	88
Pumpkinseed Sunfish (<i>Lepomis gibbosus</i>)	0	1	0	0	0	0	1
Golden Shiner (<i>Notemigonus crysoleucas</i>)	0	1	0	0	0	0	1
Brown Trout (<i>Salvelinus alpinus</i>)	6	6	0	0	0	0	12
Monthly Total	8812	505	12	3	2	0	9334

Table 11. Juvenile Fish Community Data by Month/Location, 1999

Month	Location	Species	Tot. No.	Av. Tot.	Min.	Max.
				Length (mm)		
June	BFWY	Unidentified fry	48	20.0	*	*
		Pumpkinseed	1	49.0	*	*
		White sucker	53	67.5	*	*
	Monthly Total		102			
	Mean Water Temp. (c)		23.5			
	Mean Flow (cfs)		2943			
July	BFWY	Smallmouth bass	119	56.2	34.0	84.0
August		White sucker	16	46.6	40.0	56.0
		Monthly Total	135			
	Mean Water Temp. (c)		25.1			
	Mean Flow (cfs)		2635			
	BFWY	Smallmouth bass	31	73.2	50.0	94.0
		Largemouth bass	1	55.0	*	*
		White perch	4	51.3	42.0	61.0
		Pumpkinseed	4	41.3	35.0	46.0
	Monthly Total		40			
	Mean Water Temp. (c)		23.0			
	Mean Flow (cfs)		2857			
September	BFWY	River herring	11	113.3	55.0	127.0
		White perch	17	79.1	60.0	89.0
		Pumpkinseed	1	45.0	*	*
	Monthly Total		29			
	Mean Water Temp. (c)		17.8			
	Mean Flow (cfs)		5400			
October	BFWY	White perch	1	85.0	*	*
		River herring	4	134.3	130.0	139.0
		Pumpkinseed	1	42.0	*	*
	Monthly Total		6			
	Mean Water Temp. (c)		11.8			
	Mean Flow (cfs)		4515			

Table 12. May 1999 - Brunswick Fishway (air and water temperatures)

DAY	AIR TEMP(°C)	WATER TEMP(°C)	WATER FLOW* (cfs)
1	-	-	5720
2	-	-	5220
3	-	-	6110
4	-	-	5860
5	16.10	12.90	6020
6	16.75	13.95	11100
7	13.80	14.50	10200
8	14.40	14.85	8990
9	17.80	15.00	7210
10	15.40	15.15	7770
11	17.25	14.85	7770
12	14.75	15.05	6500
13	13.00	15.23	5220
14	14.05	15.05	4450
15	17.75	15.90	3310
16	15.90	16.00	4190
17	18.85	17.30	5330
18	19.50	16.70	4920
19	16.70	17.70	4550
20	14.95	17.20	5320
21	19.50	17.50	7610
22	16.65	18.65	5990
23	16.65	19.25	4270
24	13.45	18.55	4020
25	17.15	17.80	5440
26	14.45	18.45	6500
27	16.00	17.90	7160
28	18.60	18.50	6140
29	22.25	19.00	5660
30	23.65	20.00	4760
31	28.20	20.25	4610
AV.	17.17	16.78	6062
MIN.	13.00	12.90	3310
MAX.	28.20	20.25	11100

*Flow Data is from USGS Station 01059000 at Auburn, ME

Table 13. June 1999 - Brunswick Fishway (air and water temperatures)

DAY	AIR TEMP(°C)	WATER TEMP(°C)	WATER FLOW* (cfs)
1	20.20	19.70	4270
2	23.30	21.00	3720
3	26.55	20.00	3640
4	19.53	20.00	3380
5	22.95	20.50	2380
6	18.50	21.00	2190
7	25.50	21.50	3570
8	22.50	24.00	3080
9	15.60	23.00	3070
10	19.75	21.70	3060
11	19.60	23.80	3260
12	21.65	23.00	2330
13	23.55	23.00	2390
14	19.95	22.20	2740
15	23.75	24.00	2870
16	18.70	22.50	3240
17	19.70	22.00	4000
18	18.70	21.00	3190
19	22.20	21.50	1690
20	22.05	23.00	1650
21	24.15	22.50	2910
22	28.45	24.00	2870
23	27.95	24.00	2950
24	27.40	25.00	2810
25	25.20	25.00	2800
26	29.60	25.00	1710
27	28.80	25.50	1730
28	22.70	24.50	2760
29	25.50	25.20	2820
30	26.75	25.50	2740
AV.	23.02	22.82	2861
MIN.	15.60	19.70	1650
MAX.	29.60	25.50	4270

*Flow Data from USGS Station 01059000 at Auburn, ME

Table 14. July 1999 - Brunswick Fishway (air and water temperatures)

DAY	AIR TEMP(°C)	WATER TEMP(°C)	WATER FLOW* (cfs)
1	22.10	24.80	2990
2	24.30	24.30	3150
3	27.25	24.60	1790
4	31.05	25.10	1890
5	32.25	25.40	1690
6	22.15	25.60	3010
7	25.85	26.00	2780
8	21.45	25.00	3540
9	23.90	24.40	4510
10	28.80	25.30	2300
11	22.95	25.40	2260
12	24.60	24.10	2850
13	19.60	23.50	2740
14	23.75	24.50	3440
15	22.20	23.00	3380
16	*	*	2740
17	*	*	1790
18	32.00	26.50	1730
19	28.35	26.50	2920
20	*	25.20	2370
21	25.15	25.35	2280
22	24.20	24.00	2670
23	27.50	25.00	2640
24	*	*	1650
25	24.15	25.50	1640
26	24.45	25.00	1970
27	25.75	25.50	2070
28	27.55	25.50	2240
29	28.35	25.65	3330
30	*	*	3080
31	22.70	26.10	2150
AV.	25.48	25.07	2567
MIN.	19.60	23.00	1640
MAX.	32.25	26.50	4510

* Flow Data is from USGS Station 01059000 at Auburn, ME

Table 15. August 1999 - Brunswick Fishway (air and water temperatures)

DAY	AIR TEMP(°C)	WATER TEMP(°C)	WATER FLOW* (cfs)
1	*	*	2090
2	25.10	26.10	2130
3	*	25.50	2150
4	*	25.05	2130
5	*	*	2120
6	*	25.15	2190
7	*	*	2170
8	*	*	2670
9	*	23.10	2980
10	22.50	22.00	3430
11	*	*	2470
12	23.50	23.25	2290
13	19.10	23.00	2940
14	*	*	1780
15	*	23.40	1760
16	23.10	23.15	2850
17	24.45	23.00	3920
18	24.85	23.50	2550
19	*	*	2530
20	*	23.70	2060
21	*	21.80	1700
22	*	*	1710
23	*	21.80	2140
24	*	21.70	2210
25	*	*	2200
26	*	23.45	2260
27	*	24.30	2270
28	*	*	1680
29	*	22.85	1670
30	*	*	2080
31	*	22.30	2040
AV.	23.23	23.41	2296
MIN.	19.10	21.70	1670
MAX.	25.10	26.10	3920

*Flow Data is from USGS Station 01059000 at Auburn, ME

* Fishway air thermometer malfunctioning

Table 16. September 1999 - Brunswick Fishway (air and water temperatures)

DAY	AIR TEMP(°C)	WATER TEMP(°C)	WATER FLOW* (cfs)
1	*	22.80	1760
2	*	21.90	1760
3	*	23.05	1670
4	*	*	1660
5	*	24.05	1660
6	*	*	1810
7	*	24.35	1850
8	*	24.35	2170
9	*	*	1890
10	*	*	2260
11	*	23.45	5900
12	*	*	8600
13	*	*	5880
14	*	*	4090
15	*	23.10	2370
16	*	18.27	4920
17	*	*	24700
18	*	*	45700
19	*	*	34100
20	*	*	19300
21	*	*	13900
22	*	*	12100
23	*	*	12000
24	*	*	10600
25	*	*	8260
26	*	16.60	7010
27	*	16.20	6900
28	*	16.30	5240
29	*	16.70	5480
30	*	16.60	6260
AV.	N/A	20.55	8727
MIN.	N/A	16.20	1660
MAX.	N/A	24.35	45700

*Flow Data is from USGS Station 01059000 at Auburn, ME

* Fishway air thermometer malfunctioning

Table 17. October 1999 - Brunswick Fishway (air and water temperatures)

DAY	AIR TEMP(°C)	WATER TEMP(°C)	WATER FLOW* (cfs)
1	*	*	6450
2	*	16.30	8630
3	*	*	8130
4	*	15.40	6590
5	*	14.30	6610
6	*	13.90	5370
7	*	13.25	4770
8	*	12.50	4660
9	*	*	5490
10	*	*	4400
11	*	12.90	4020
12	*	*	4870
13	*	*	5530
14	*	12.20	5090
15	*	11.56	4860
16	*	*	6300
17	*	11.55	6350
18	*	11.90	5940
19	*	11.10	4370
20	*	10.40	4390
21	Fishway Closed		
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
AV.	N/A	12.87	5641
MIN.	N/A	10.40	4020
MAX.	N/A	16.30	8630

* Flow Data is from USGS Station 01059000 at Auburn, ME

* Fishway air thermometer malfunctioning