

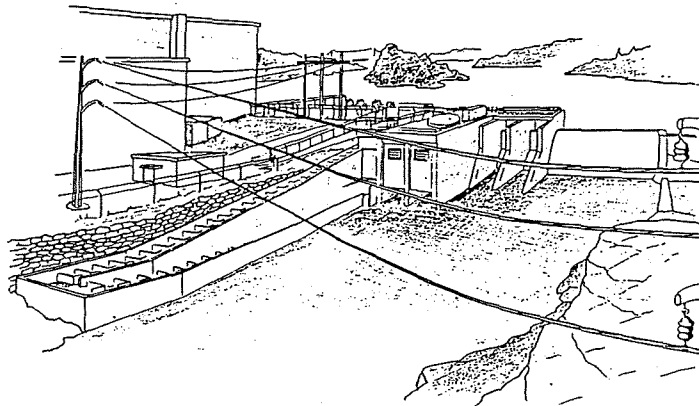
MAINE STATE LEGISLATURE

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
2001 Brunswick Fishway Report



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

March 2002



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

**2001 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

March 2002

Prepared by: Michael E. Brown
In Cooperation With: National Marine Fisheries Service (P.L. 89-304)

Table of Contents

| | |
|----------------------------------|--------|
| Table of Contents | i-iv |
| List of Tables | i-ii |
| List of Figures | iii-iv |
| | |
| Introduction..... | 1-2 |
| Goal and Objectives..... | 3-4 |
| Brunswick Fishway Operation..... | 5-6 |
| Fish Passage | |
| River herring | 6-7 |
| American shad | 7-13 |
| Atlantic salmon..... | 13 |
| Sea lamprey..... | 13 |
| American eel..... | 13 |
| Striped bass | 13 |
| Other species..... | 14 |
| Environmental data | 14 |

List of Tables

| | |
|-------------------------------------------------------------------------------------------------------------------------------------|-------|
| Table 1. Adult River Herring Captured, Water Temperature and Flow at the Brunswick Fishway, 2001 | 15 |
| Table 2. Adult River Herring Distribution in the Androscoggin Watershed by Site 1999-2001 | 16 |
| Table 3. Adult River Herring Habitat Availability, Run Size and Distribution in the Androscoggin River Watershed, 1985-2001..... | 17 |
| Table 4. Adult River Herring Stocking Densities, 1999-2001..... | 18 |
| Table 5. Adult River Herring Sampled at the Brunswick Fishway, 2001 | 19 |
| Table 6. Preliminary Age Composition of Adult Alewives and American Shad Sampled at the Brunswick Fishway, 2000..... | 20 |
| Table 7. American Shad Observations at the Brunswick Fishway 1994-2001. | 21-22 |
| Table 8. American Shad Captured at the Brunswick Fishway, 1993-2001 | 23-24 |
| Table 9. Adult American Shad Captured at the Brunswick Fishway May – July, 2001..... | 25 |
| Table 10. Videotaped Observations of American Shad Behavior Recorded at the Brunswick Fishway During Spring, 1999-2000..... | 26 |

| | |
|------------------------------------------------------------------------------------------------------------------------------------|-------|
| Table 11. American Shad Behavior Recorded by Cameras 1-3 and Classified by Behavior Displayed at the Brunswick Fishway, 2000 | 27 |
| Table 12. Preliminary Underwater Videotape Data Collected at the Brunswick Fishway During the 2001 American Shad Run | 28 |
| Table 13. Adult American Shad Distribution in Main Stem Androscoggin River at Auburn, 1987-2001 | 29 |
| Table 14. American Shad Fry Released into the Main Stem Androscoggin River at Auburn, 1999-2001 | 30 |
| Table 15. Number, Origin and Lengths of Sea-run Androscoggin Atlantic Salmon, 1983-2001 | 31 |
| Table 16. Atlantic Salmon Passed on the Androscoggin River at the Brunswick Fishway, 2001 | 32 |
| Table 17. Fish Community by Month at the Brunswick Fishway for the 2001 Sample Season..... | 33-34 |
| Table 18. Fish Species Captured at the Brunswick Fishway May-October, 2001 | 35 |
| Tables 19-24. Brunswick Fishway Air And Water Temperatures/Headpond Levels, 2001..... | 36-41 |
| 19. May, 2001 | 36 |
| 20. June, 2001 | 37 |
| 21. July, 2001 | 38 |
| 22. August, 2001 | 39 |
| 23. September, 2001 | 40 |
| 24. October, 2001..... | 41 |
| Table 25. Preliminary underwater videotape data collected during 2001 American shad run | 12 |

Figures

| | | |
|------------|-------------------------------------------------------------------------------------------------------------------------------|----|
| Figure 1. | Adult Alewife Captured at the Brunswick Fishway vs. Habitat Availability in the Androscoggin River Watershed, 1985-2001 | 42 |
| Figure 2. | Number of Adult River Herring Captured vs. Water Temperature at the Brunswick Fishway, 2001 | 43 |
| Figure 3. | Number of Adult River Herring Captured vs. Water Flow at the Brunswick Fishway, 2001..... | 43 |
| Figure 4. | Brunswick Fishway Water Temperatures and Flows for May, 2001..... | 44 |
| Figure 5. | Brunswick Fishway Water Temperatures and Flows for June, 2001..... | 44 |
| Figure 6. | Adult American Shad Captured vs. Water Temperature at the Brunswick Fishway, 2001..... | 45 |
| Figure 7. | Adult American Shad Captured vs. Flow at the Brunswick Fishway, 2001..... | 45 |
| Figure 8. | Number of American Shad Observed vs. Water Temperature at the Brunswick Fishway, May – June, 2001 | 46 |
| Figure 9. | Number of American Shad Observed vs. Water Flow (cfs) at the Brunswick Fishway, June – July, 2001 | 46 |
| Figure 10. | Adult American Shad Captured vs. Water Temperature at the Brunswick Fishway, 2001 | 47 |
| Figure 11. | Adult American Shad Captured vs. Flow at the Brunswick Fishway, 2001 | 47 |
| Figure 12. | Location of Cameras Recording American Shad Behavior at the Brunswick Fishway During the 2001 Sample Season..... | 48 |

| | |
|------------------------------------------------------------|----|
| Figure 13. | |
| View of the fishway section at river level | 10 |
| Figure 14. | |
| Lower sections of the fishway leading to corner pool | 11 |
| Figure 15. | |
| Upper section of fishway leading to fish trap | 11 |

INTRODUCTION

The Androscoggin River, with a drainage area of approximately 3,460 square miles, is Maine's third largest watershed. Historically, the Androscoggin provided access to a large and diverse aquatic habitat and supported 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.

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 as well as commercial uses. 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 \$132,000 and \$206,000 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 6,700 licensed lobster fishermen. Efforts toward improved water quality, habitat, and fish and wildlife populations improve the overall health of the ecosystem and society.

DMR provides an annual report on the operation of the Brunswick Fishway to enhance its cooperative partnership with FPL Energy Maine Hydro LLC (FPLE) in the operation of the fishway and to assist the company in meeting its FERC reporting requirements. DMR'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 DMR 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 with a broader perspective of the purpose, role, and usefulness of the fishway in the DMR program. Several legal authorities and state and federal plans that guide state restoration programs include:

Legal Authorities

- 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.

2001 BRUNSWICK FISHWAY MAINTENANCE AND OPERATION

- Maine Department of Marine Resources (DMR) met with the Brunswick dam owner, FPLE, in the spring of 2001 to review Brunswick Station operations, problems occurring with the fishway, and maintenance issues that remained from the fall 2000 season that required resolution prior to the startup of the fishway in May.
- The fishway was officially opened for its 19th consecutive season on May 9, 2001.
- Prior to the 2001 season, FPLE reconditioned the existing fish hoist. The foot valve was replaced, the hopper was sand blasted and repainted. In addition, FPLE installed a supplemental oxygen delivery system to provide oxygen to two overhead fish distribution tanks. The new system allowed DMR personnel to increase the number of alewives that were held in the tanks prior to distribution. Supplemental oxygen was used to aerate water when Atlantic salmon and American shad were held in the overhead tanks. Additionally, the fishway control room was painted and a new floor was installed. Routine maintenance was conducted in the lower section of the fishway; the diffusion chamber grates and baffles were cleaned, inspected and replaced.
- During the first week of operation, there were problems with the physical condition of the fishway equipment. One of the four wheels of the fish crowder sheared off and dropped into the crowding area. The fish crowder remained out of operation until the wheel was retrieved later that day. This was the second time in as many years the same wheel has needed to be replaced. An assessment of the reasons why this keeps occurring should be conducted before a serious malfunction preventing daily use of the crowder occurs. The fish crowder is vital to the trap and truck stocking operation being conducted from the Brunswick Fishway. The circulation pump that supplies oxygenated water to the handling tanks was also inoperable on the first day DMR attempted to use it. The pump remained inoperable for the season. The circulation pump is important because it is the only means to pump water to the overhead holding/distribution tanks if the main pump malfunctions. After the river herring run had concluded, the distribution hose from the overhead tanks ruptured and split in half. A temporary distribution hose was installed and remained in place for the remainder of the season.
- In June and July, the control gate that maintains water height differential at the fishway entrance malfunctioned. The gate control structure remained out of service for the majority of the shad run, June 26 through July 13. Difficulty in finding replacement parts delayed prompt repair of this gate. No shad were captured in the trap after the gate malfunctioned. Two shad were captured after the gate was repaired, July 18 and 19. The effects the gate malfunction had on the numbers of shad making it to the fish trap is unknown.
- In November, FPLE, in cooperation with the USFWS and DMR, made modifications to the seven lowest pools of the fishway. The baffle stub walls of the seven lower fishway slots were removed to increase slot width and provide improved water flow and lessen the risk of physical injury to American shad ascending the fishway.
- The fishway was closed July 19 for five hours (7:30 AM to 12:30 PM) to perform routine cleaning.

- The fishway was closed for the season October 26, 2001 to facilitate planning and preparation for the modifications to the lower fishway.
- The warning light on the Fish Attraction Intake Differential, which monitors the amount of attraction water being supplied to the fishway entrance, was tripped on 27.0% of the days the fishway was checked in June and July. This warning light indicates that the grates on the Fish Attraction Supply Intake were clogged. More attention needs to be paid to these grates in the 2002 fishway season. Weekly cleaning may be necessary to keep these grates clean.

FISH PASSAGE

River Herring:

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. Since 1983, Maine Department of Marine Resources (DMR) personnel have distributed over 401,000 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.

The maintenance crew of FPLE opened the Brunswick Fishway May 9, 2001; DMR personnel staffed the fishway beginning May 10. River herring were observed at the fishway from May 10 through June 11. For the third consecutive year, the number of river herring captured was below average, with a total of 18,196 adults captured. The run peaked May 23 through May 24 when 8,744 and 2,928 were captured respectively; these two days accounted for 64% of the total number captured during the 2001 sample season. Only three times - May 15, May 23 and May 24 - did the number of captured adults exceed 2,000 fish (Table 1). The run size in 1999, 2000 and 2001 was lower than in 1998 (25,189), but slightly higher than that of 1997 (5,540). The number of river herring trapped during the 2001 season ranked 12th best out of the 19 seasons the fishway has been in operation. The total number of river herring captured in 2001 remained well below the 19-year average of 34,394. The number of Androscoggin River adults captured for transport and release was less than the amount of upstream spawning and nursery habitat. The adult release target for the Androscoggin watershed was 27,358 river herring into 1,846 hectares of upstream habitat available for restoration. Of the 18,196 adults captured, 4,615 were transported upstream; 13,375 were released into the headpond; 94 were sacrificed for biological sampling; 10 were used as tagging study controls; 42 were tagged and returned to the tailrace; and 60 were transport mortalities. In order to increase the number of released adults, an additional 18,844 river herring from the Kennebec River were distributed (Table 2). The goal was to compensate for the Androscoggin River deficiency by releasing additional Kennebec River fish into historic spawning habitat on the Androscoggin and Little Androscoggin Rivers. A total of 36,834 adult river herring was released into the Androscoggin River, 23,446 of which were released into eight upstream habitat areas totaling 1,644 hectares, excluding the main stems of the Androscoggin and Little Androscoggin (Table 3). River herring were distributed to Sabattus, Little Sabattus, Lower Range, Loon, Sutherland, Marshall and Taylor Ponds, Sabattus River, Bog Brook, Taylor Brook and the Worumbo and Brunswick headponds. All of these areas received the target number or reached the target stocking density of 14.83 fish per hectare (six

fish/acre) including the Worumbo, Pejepscot and Brunswick headponds, which were stocked with 22.3 fish per hectare due to increased numbers of native Androscoggin fish trapped at Brunswick after stocking for the 2001 season had already occurred in the upper watershed ponds. Lower than average numbers of adult river herring captured in 2001 may have been a result of the low number of adults released into optimum spawning habitats during 1996-97 (Table 3; Figure 1). During this period, DMR was prevented from stocking alewives into several ponds considered prime spawning habitat for river herring; these included Sabattus, Hogan, Whitney and Trip Ponds, located mainly on the Little Androscoggin River. Other factors may have included the unusually dry, hot spring and erratic water flows (Figures 2 & 3).

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; temperature, water flows, operational activities of the hydropower facility; effectiveness of the fishway; and 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.

American Shad:

American shad captured at the fishway are passed upstream into the headpond to continue their upstream migration. Fish lifts at the next two upstream dams provide passage to allow shad to potentially migrate to Auburn, although their effectiveness has not been evaluated. Production potential of the habitat within the range is estimated to be 2.3 adult shad per 100 square yards of water surface acreage. The shad habitat area of 10,217,391 square yards in the Androscoggin could result in a return of 235,000 adult shad annually. The number of pre-spawn adult shad currently captured in the fishway trap at Brunswick is inadequate for a successful restoration program. To increase the abundance, survival, and natural reproduction of adults, Connecticut River pre-spawn shad are obtained through a cooperative agreement with the Connecticut River American Shad Technical Advisory Committee (CRSTAC). These fish are released into spawning and nursery areas in the Androscoggin River at Auburn.

Observed Shad:

Visual observations of adult shad at the Brunswick Fishway during the spawning run have been noted since 1990. Visual observations between 1994 and 2001 documented 1,213 adult shad swimming in the river outside the entrance and in the lower portion of the fishway below the 180-degree turn halfway up the ladder (Table 7). In that same time frame, a total of 214 were captured. In 1998, the highest numbers of both observed and captured shad recorded were 30 and five respectively, until 1999, when 543 were observed and 87 were captured. This information led to a more intensive effort in 1999 to document shad activity at the fishway by making visual observations from the fishway walk and using underwater video equipment.

Detailed visual observations from the fishway walk were continued during the 2001 sample season. Selected pools (pools 1-7, 14, 23, 31, river) were monitored for 30-second intervals to standardize observations between individual pools and the river. All observations were made between 11:00 AM and 12:00 PM. Visual observations from the walkway were conducted on 32 consecutive days beginning May 29 and continuing through July 3. In May, no shad were observed in or around the fishway. In June, a total of 240 shad were observed primarily in the lower half of the fishway and the river. Only three shad were observed in the upper fishway and viewing window, possibly due to visibility problems associated with water turbulence and

lighting. The water temperature when the shad were observed averaged 20.2°C and water flow averaged 4,553 (cfs). 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 rarely observed in the upper fishway. During the 2000 shad run, 352 shad were observed in the fishway and the river immediately adjacent to it. In 1999, visual observations of adult shad present in and around the fishway were recorded daily. A total of 534 shad were observed from the fishway walkway on 32 separate days, beginning on May 23 and continuing through June 30.

Captured Shad:

In 2001, the number of American shad captured at the Brunswick Fishway declined from highs of 87 and 88 captured during 1999 and 2000 respectively. A total of 26 adults were captured between May 25 and July 19 (Table 8). The decrease in run size was disappointing based upon the number of pre-spawn adults stocked upstream in 1996-1997 (Table 13). Returns ranging from 1,540 to 2,698 pre-spawn adults were expected during the 2001 spawning migration. Data were collected on 11 of the 26 shad captured in 2001, including length and sex. Scales were also collected for age determination and fin clips were collected for genetic analysis when additional funding becomes available for this study. Biological sampling was not conducted on eight shad trucked to and released at the Durham boat launch or six shad taken to the Waldoboro Hatchery to supplement broodstock. The condition of these fish was marginal and additional handling to collect biological samples could have killed them. The captured shad that were passed upstream into the Brunswick headpond could have potentially migrated as far upstream as Auburn.

In 2001, 16 adult shad trapped at the Brunswick Fishway were released into the main stem river between Brunswick and Auburn. Two were retrieved dead from the fishway and six were netted from the fishway for transportation to the Waldoboro Hatchery. The largest number of shad was removed from the fishway May 25, with a mean water temperature of 16.5°C and a mean daily flow of 4,580 (cfs). Nine shad were netted from the corner pool and transported upstream for release at the Durham boat launch (Table 17; Figures 6-9). None of the shad were sampled that day in an attempt to reduce their stress and maintain their physical condition. Loose scales retrieved from the holding tank were saved and will be analyzed separately from the other shad samples collected in 2001.

During the 2001 run, the water temperature ranged between 15.2° and 22.8°C, averaging 19.1°C (Figure 6). The water flows ranged between 3,140 (cfs) and 7,530 (cfs), averaging 4,654 (cfs) (Figure 7). Of the 26 adults trapped, five were male (21%), six were female (21%), and 15 were undetermined sex (58%). The average fork length was 452 mm and average total length was 498 mm. (Table 9). The condition of the shad varied, but all 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. Scales were collected for ageing and fin clips were preserved for future genetic analysis. The adult shad were passed upstream into the headpond and may have migrated as far upstream as Auburn.

The DMR considers collection of 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:

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.

In 1999, the first American shad fry were released into the Androscoggin River. These were reared at the Waldoboro Hatchery and released on June 30 into the main stem at the Auburn boat launch. The 280,000 fry were 10 - 17 days old and Connecticut River and Connecticut River/Saco River stock in origin. In 2000, American shad fry stocking occurred for the second time in as many years. The 529,000 fry raised at the Waldoboro Hatchery for release into the Androscoggin River originated from Connecticut/Kennebec River stock. Fry were stocked July 10 and were 7-10 days old at the time of release. Fry stocking continued on the Androscoggin in 2001. On July 1, 309,000 shad fry were released below Lewiston Falls; they were of Merrimack River origin, 23-26 days old, and had been treated with OTC to distinguish them from naturally reproduced fish. All fry received a tetracycline mark prior to release to distinguish them from wild origin adult returns (Table 14).

1999 – 2001 American Shad Study:

In 1999, two underwater video cameras taped approximately 832 daylight hours from June 6 to July 28. The corresponding time, water temperature, location, and behavior were recorded. The videotapes 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, and number exhibiting other behavior (number circling and number holding)(Table 10). The daily mean water temperature and mean water flow were also recorded.

In 2000, three underwater video cameras were installed to observe American shad behavior and movement within the fishway. One camera was placed in the river to record shad behavior outside the fishway. The second camera was placed in the entrance to Pool 6, the lowest portion of the fishway, where water level is identical to that of the river. The last camera was placed at the entrance to Pool 24, just above the corner pool, to record the numbers of shad attempting to ascend the upper fishway. A time-lapse video recorder began recording at 6AM and stopped recording at 6PM each day, beginning June 6 and ending July 24. In 2000, 2,016 hours of video were recorded using the three cameras. Project personnel have reviewed all videotape collected in the fishway and river adjacent to the fishway. A malfunction of the videotape equipment prevented data collection from June 6 through 12, 2000. A check to determine positive identification of fish species viewed using the videotape equipment was conducted June 6, 2000 by trapping fish in selected pools and conducting a partial drawdown of the water level in the fishway. All fish were positively identified by species. Identification of American shad in the fishway was simplified due to the limited number of species using the fishway during the shad run. Other fish species identified during videotaping within the fishway were striped bass, American eel, white catfish, brown trout and sea lamprey.

American shad behavior recorded on the videotape was classified into three categories: shad movement upstream (US), downstream (DS), or other behavior (OB), including circling and holding. A total of 52,837 behavioral observations were recorded during the 2000 spawning season, while 4,377 behavioral observations were recorded at similar locations in 1999 over the same general time period (Table 10). During 2000, the total number of observations recorded on the river camera (Camera 1) was 41,497. The camera in Pool 6, (Camera 2) and Pool 24 (Camera 3) recorded 10,937 and 402 respectively. Several large schools of American shad were documented within 75 feet of the fishway entrance. Schools of over 100 shad were observed occasionally, while schools of 75 were common and easily recorded with the river camera. The large numbers of American shad documented recently at the Brunswick Fishway are likely the result of extensive stocking of pre-spawn adult shad below Lewiston Falls. American shad stocking began in 1984 and will continue in 2002. A total of 6,047 adults and 809,000 fry have been released below Lewiston Falls at Auburn and above Brunswick Hydropower. Prior to DMR's stocking program, American shad had not been documented using areas in or around the fishway from 1983 through 1990, and only 10 adults were documented in this area through 1997. Historically, large numbers spawned in the Androscoggin River above Brunswick. Pollution and barriers preventing upstream passage on the Androscoggin reduced numbers of spawning fish to a fraction of historical levels. To date, there has been no recent evidence of American shad spawning naturally in the Androscoggin River below Brunswick. This point is supported by the number of shad observed at the fishway prior to 1997. Gill nets set in the river during the annual spawning run resulted in only seven shad captured in 17 attempts over a four-year period, 1980 to 1983. It is highly unlikely that spawning at numbers this low would be able to sustain a run in the lower Androscoggin River and even more unlikely, to produce a viable population imprinted to the river below the Brunswick Fishway that by nature refused to ascend the fishway to access spawning habitat above this dam

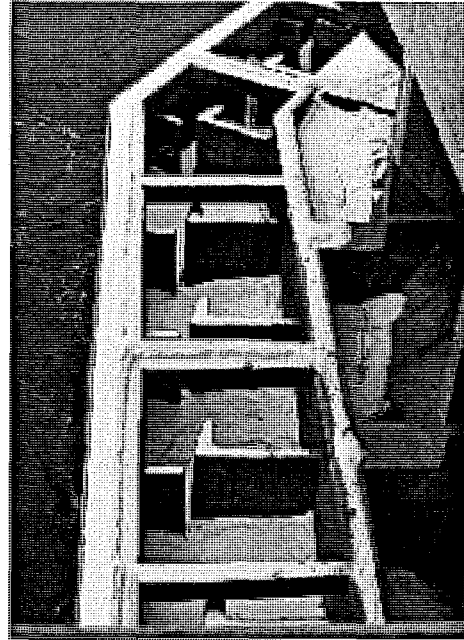


Figure 13. View of the fishway section at river level Pool 6 is seen in the background turning to the right Pool 6 is the last pool of the fishway at river level.

In 2000, the predominant behavior recorded by Camera 1 (river camera) was for American shad in the river to move upstream towards the fishway entrance, 72% in June and 67% in July. Only 26% of the total number of observations recorded on the river camera was recorded in Pool 6, the last pool of the fishway at river level. The number of shad attempts to move upstream (US) through Pool 24, the first pool above the corner pool, was 194, or 0.5%, of the total number of observations recorded on the river camera. Shad attempted to climb the upper portion of the fishway 194 times. Observations indicate 69 of those attempts resulted in shad moving downstream, leaving a net total of 125 attempts by shad to move upstream (Table 11). A total of 88 American shad were captured at the top of the fishway during 2000.



Figure 14. The lower sections of the fishway leading up to the corner pool.

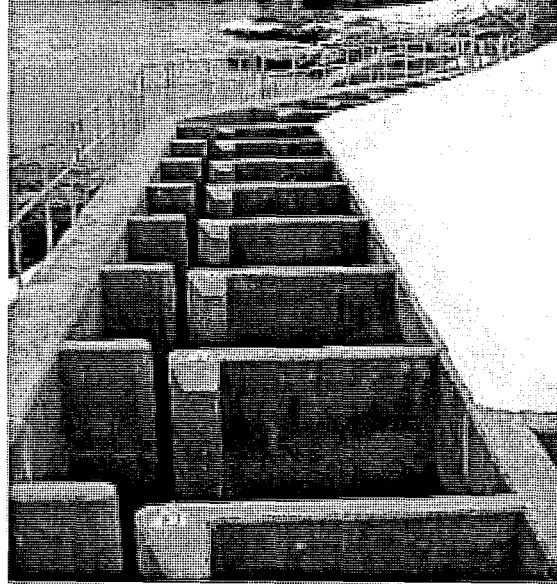


Figure 15. Upper section of the fishway leading to the fish trap. The corner pool can be seen in the upper right.

Circling and holding behavior were most commonly exhibited in Pool 6 (Camera 2) and accounted for 96% of this type of behavior recorded by all cameras in June and 89% in July. Only 4% of the behavior exhibited on Camera 1 (river camera) and Camera 3 (Pool 24) was classified as circling or holding. The effects of this behavior are well documented by Camera 3, which recorded a net of only 125 attempts by shad to move beyond the mid-point of the 40-foot vertical climb to the top of the fishway. The data clearly indicates that shad have returned to their natal river to spawn, but are unable to negotiate the fishway to access the spawning habitat above Brunswick into which pre-spawn and fry stockings have occurred. In fact, few shad moved beyond the halfway point in the 40-foot vertical climb to the fish trap.

The 2001 videotape data collected is currently being analyzed and a complete data analysis will be included in the next report. Currently, 17 of 31 days of video data are analyzed. Preliminary data from the 2001 study indicate that the same types of behaviors are occurring in the same locations of the fishway. Three additional underwater cameras were installed in the fishway to increase coverage and analyze shad behavior at the fishway entrance and Pool 1. As in 1999 and 2000, a large number of upstream behaviors were observed in the river outside the fishway in 2001 (Table 25). The number of upstream observations drop significantly as the shad ascend the fishway to Pool 23, halfway up the 40-pool fishway. FPLE, in cooperation with the USFWS and MDMR, has been working to address poor shad passage during 2001. In November, under the direction of the USFWS, FPLE agreed to modify the first seven pools of the fishway to 1) provide an improved flow field through the lower section of the fishway and 2) increase the slot width of the fishway pools to prevent physical damage to American shad migrating upstream.

Clearly, as with any study, visual observations of shad made from the fishway walk 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. 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. Preliminary data clearly indicates the need for a quantitative study to focus on the numbers of fish in the river and the effectiveness of the Brunswick Fishway in relation to American shad passage on the Androscoggin River.

| | Upstream | Downstream | Other Behavior | |
|------------------|---------------|--------------|----------------|---------------|
| River | 32,767 | 506 | 87 | 33,360 |
| Fishway Entrance | 2,118 | 796 | 93 | 3,007 |
| Pool 1 | 992 | 410 | 463 | 1,865 |
| Pool 6 | 836 | 216 | 756 | 1,808 |
| Pool 23 Entrance | 20 | 7 | 20 | 47 |
| Pool 23 Exit | 67 | 13 | 7 | 87 |
| TOTAL | 38,800 | 1,948 | 1,425 | 40,173 |

Table 25. Preliminary underwater videotape data collected at the Brunswick Fishway during the 2001 American shad run.

Summary:

Based on two years of videotape data collected at the Brunswick Fishway; it is clear that American shad are not utilizing the fishway to reach spawning habitat above Brunswick. Data recorded in 2000 indicates a very small percent (12.8%) of shad observed moving upstream within a 75-foot radius of the entrance at Pool 6. An even lower percent (0.67%) was viewed exhibiting upstream behavior in Pool 24. The numbers retained at the top of the fishway during the past two years verify that very few of the shad documented at the fishway entrance are successfully ascending the upper half of the fishway and making it into the fish trap. The majority of the behavior recorded by Camera 2 suggests fish are resting and holding in the lower section of the fishway. This was confirmed on June 6, when partial drawdown of the fishway revealed 90 shad holding in the lower portion of the fishway. Currently, the fishway is ineffective in attracting fish to the upper portion of the fishway where the trap is located. Catches of 87, 88 and 26 shad in 1999, 2000 and 2001 respectively support these observations. Preliminary data analysis of the 2001 video data support conclusions made from the data collected in the 1999 and 2000 season, that the current vertical slot fishway is inadequate for American shad passage at this location. Modifications were made in November 2001 to improve shad passage through the lower sections of the fishway. If these improvements are effective, additional modifications will be made to additional sections of the fishway.

Work Planned for 2002:

During the 2002 American shad run, six underwater cameras will be deployed in the fishway to record shad behaviors around the modifications made to the fishway in November by FPLE. If these modifications prove successful, then the same modifications will be to additional pools. The USFWS has provided funds to purchase radio tags that will be used to track American shad in the tailrace and within the fishway as shad attempt to ascend into the Brunswick headpond.

FPLE has agreed to contribute spare radio receivers to record the movements of radio tagged shad.

Atlantic Salmon:

An active Atlantic salmon restoration program is not in place for the Androscoggin River, other than providing upstream passage past the first three dams. However, an average of 34 sea-run salmon are captured annually at Brunswick (Table 15). During the 2001 sample season, a total of five Atlantic salmon were passed into the Brunswick headpond from June 8 through July 10, at river temperatures ranging from 16.4° to 22.7°C with a mean temperature of 20.5°C for the period (Table 16). The average fork length of adult Atlantic salmon captured was 718 mm. Four fish displayed a damaged dorsal fin, indicating they may have originated from a salmon hatchery. A left ventral fin clip was observed on one fish, although three others had no clip marks. The Maine Atlantic Salmon Commission determined one returning salmon was the result of natural reproduction or fry stocking. The condition of the fins indicated that this fish was not raised in a hatchery and had been stocked as a smolt in a neighboring river. An analysis to determine the age and whether these salmon are sea-run or landlocked fish will be conducted by the Maine Atlantic Salmon Commission. In June 1999, the Maine Atlantic Salmon Technical Advisory Committee (MSTAC) agreed to include the Androscoggin River in an ongoing genetic sampling program. Fin clips were collected from all salmon captured at the fishway during 2000 and 2001. Genetic analysis may be conducted in the future to determine the origin of the salmon to provide more effective management in the watershed. Through participation in the MSTAC, it was discovered that 15 schools in the Androscoggin River watershed participated in the 2001 Fish Friends, Salmon-in-Schools and Adopt-a-Salmon Family Programs. In these programs, the U.S. Fish & Wildlife Service provides salmon eggs to schools in the spring for students to rear and release as fry into salmon nursery habitat identified in their watershed. In 2000, the fry from these programs were released into the Little River, a tributary that enters the Androscoggin between the second and third upstream dams. Atlantic salmon fry releases occurred in the same locations during the spring of 2001.

Sea Lamprey:

No sea lamprey were captured in 2001. Sea lamprey are sometimes captured at the top of the fishway. Sea lamprey are released downstream and not allowed to pass above Brunswick.

American Eel:

Five American eels were captured in the fishway in July (3) and August (2) 2001; their total lengths averaged 234.0 mm in July and 335.0 mm in August. 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

Striped Bass:

Unlike 2000, when 95 striped bass were captured at the Brunswick Fishway, none were captured or observed in the observation window or trapping area during the 2001 season.

Other Species:

From May 12 through October 26, 2001, 12 fish species and 676 individual fish were captured or passed at the Brunswick Fishway, not including American shad and river herring (Table 18). The most common species captured in May, other than river herring, was white sucker (266). In June, the most common species were smallmouth bass (17) and white catfish (12) (Table 17). At the fishway, 14 white catfish were captured through October. All were sampled and tagged prior to release downstream; total length was recorded and a Floy tag applied posterior to the dorsal fin on the left side. Recapturing tagged fish will provide important information on growth and migration within the Androscoggin River/Merrymeeting Bay estuary. White catfish are a non-indigenous species unintentionally 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 full summary of fish community data by month through October of the 2001 sample season is provided (Table 12).

Environmental Data:

Brunswick Fishway air temperature, water temperature, and water flow data recorded from May through October 2001 are shown in Tables 19-24.

Table 1. Adult River Herring Captured, Water Temperature and Flow at the Brunswick Fishway, 2001

| Date | Number | Temp. (C) | Water Flow (cfs) | % Total Run |
|---------------------|---------------|------------------|-------------------------|--------------------|
| 12-May | 1,797 | 15.4 | 6,420 | 9.88 |
| 15-May | 2,594 | 14.8 | 4,810 | 14.26 |
| 16-May | 787 | 14.5 | 5,550 | 4.33 |
| 18-May | 495 | 15.4 | 4,620 | 2.72 |
| 19-May | 97 | 15.2 | 4,110 | 0.53 |
| 23-May | 8,744 | 15.3 | 5,440 | 48.06 |
| 24-May | 2,928 | 16.1 | 3,530 | 16.09 |
| 25-May | 706 | 16.9 | 4,750 | 3.88 |
| 26-May | 7 | 17.3 | 3,650 | 0.04 |
| 27-May | 2 | 16.1 | 3,590 | 0.01 |
| 29-May | 13 | 16.5 | 4,580 | 0.07 |
| 30-May | 19 | 17.4 | 5,930 | 0.10 |
| 31-May | 4 | 16.2 | 5,480 | 0.02 |
| 3-June | 2 | 15.2 | 7,530 | 0.01 |
| 11-June | 1 | 17.9 | 5,620 | 0.01 |
| 01 Total/Av. | 18,196 | 16.01 | 5,041 | 100.00 |

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

**Table 2. Adult River Herring Distribution in the Androscoggin Watershed
by Site, 1999-2001**

Source: Androscoggin / Kennebec

| Habitat | 1999 | 2000 | 2001 |
|-----------------------------------------|-----------------------------------|------------------------------------|---------------------------------|
| Sabattus Pond | 4,666 / 292 | 5,839 / 4,944 | 1,575 / 9,176 |
| Little Sabattus Pond | - | - | 344 / 0 |
| Taylor Pond | 993 / 1,496 | 0 / 3,801 | 0 / 4,099 |
| Taylor Brook | - | - | 126 / 0 |
| Tripp Pond | - | - | - |
| Lower Range Pond | - | 0 / 1,748 | 1,274 / 615 |
| Androscoggin River | 1,919 / 0 | 3,463 / 0 | 13,375 / 0 |
| Sabattus River | 1,224 / 0 | 0 / 2,050 | 0 / 3,587 |
| Marshall Pond | - | 0 / 612 | 612 / 0 |
| Bog Brook | - | 0 / 690 | 671 / 0 |
| Durham Boat Ramp | - | - | 13 / 0 |
| Loon Pond/Curtis Stream | - | 0 / 415 | 0 / 609 |
| Sutherland Pond | - | 0 / 315 | 0 / 758 |
| | | | |
| TOTAL | 8,802 / 1,788 = 10,590 | 9,302 / 14,575 = 23,877 | 17,990 / 18,844 = 36,834 |
| | | | |
| Brunswick Headpond (passed upstream) | 1,919 / 0 | 3,463 / 0 | 13,375 / 0 |
| TOTAL PASSED | 8,802 / 1,788 = 10,590 | 9,302 / 14,575 = 23,877 | 17,990 / 18,844 = 36,834 |

Table 3. Adult River Herring Habitat Availability, Run Size and Distribution in the Androscoggin River Watershed, 1985-2001

| Year | Habitat* (hectares) | Number Trapped At Fishway | Total Number Stocked (Androscoggin and Kennebec) | Av. Fish Hectare |
|-------------|--------------------------------|--------------------------------------|-------------------------------------------------------------|-----------------------------|
| 1982 | 723 | 0 | 2,326 | 1.3 |
| 1983 | 1,328 | 601 | 6,305 | 4.2 |
| 1984 | 1,328 | 2,650 | 8,359 | 2.6 |
| 1985 | 3,377 | 23,895 | 37,773 | 11.2 |
| 1986 | 2,678 | 35,471 | 17,763 | 6.6 |
| 1987 | 770 | 63,523 | 11,892 | 15.4 |
| 1988 | 887 | 74,341 | 13,183 | 14.9 |
| 1989 | 887 | 100,895 | 13,814 | 15.6 |
| 1990 | 887 | 95,574 | 11,725 | 13.2 |
| 1991 | 887 | 77,511 | 13,574 | 15.3 |
| 1992 | 887 | 45,050 | 12,351 | 13.9 |
| 1993 | 722 | 5,202 | 7,448 | 10.3 |
| 1994 | 887 | 19,190 | 14,549 | 16.4 |
| 1995 | 852 | 32,002 | 10,591 | 12.4 |
| 1996 | 747 | 10,198 | 14,288 | 19.1 |
| 1997 | 612 | 5,540 | 11,524 | 18.8 |
| 1998 | 1,299 | 25,189 | 20,805 | 16.0 |
| 1999 | 1,318 | 8,909 | 10,590 | 8.0 |
| 2000 | 1,318 | 9,551 | 23,877 | 18.1 |
| 2001 | 1,846 | 18,196 | 36,834 | 20.0 |

* Habitat area does not include the Brunswick headpond.

Table 4. Adult River Herring Stocking Densities, 1999-2001

| Habitat | Hectares | 1999 Densities (fish/hectares) | 2000 Densities (fish/hectares) | 2001 Densities (fish/hectares) |
|----------------------|-----------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|
| Sabattus Pond | 723 | 6.9 | 14.9 | 14.9 |
| Little Sabattus Pond | 10 | - | - | 34.4 |
| Taylor Pond | 253 | 9.8 | 15.0 | 16.2 |
| Taylor Brook | 5 | - | - | 25.2 |
| Tripp Pond | 311 | - | - | - |
| Lower Range Pond | 117 | - | 14.9 | 16.1 |
| Androscoggin River | - | - | - | - |
| Sabattus River | 111 | 11.0 | 18.5 | 32.3 |
| Marshall Pond | 41 | - | 14.9 | 14.9 |
| Bog Brook | 24 | - | 28.8 | 28.0 |
| Durham Boat Ramp | 202 | - | - | 0.1 |
| Loon Pond | 28 | - | 14.8 | 21.8 |
| Sutherland Pond | 21 | - | 15.0 | 36.1 |
| Average | | 9.2 | 15.3 | 21.8 |
| TOTAL | 1,846 | | | |

Table 5. Adult River Herring Sampled at the Brunswick Fishway, 2001

| Date | Sex | No. | Av. Total Length (mm) | Av. Fork Length (mm) | Av. Weight (gm) |
|--------|--------|-----|-----------------------|----------------------|-----------------|
| 12-May | F(32%) | 8 | 290 | 256 | 213 |
| | M(68%) | 17 | 275 | 241 | 171 |
| 18-May | F(44%) | 11 | 294 | 258 | 208 |
| | M(56%) | 14 | 277 | 243 | 163 |
| 23-May | F(44%) | 11 | 287 | 253 | 196 |
| | M(56%) | 14 | 272 | 239 | 164 |
| 30-May | F(37%) | 7 | 288 | 255 | 185 |
| | M(63%) | 12 | 274 | 242 | 153 |

| | Total Number | Ave. Total Length(mm) | Ave. Fork Length(mm) | Ave. Weight (g) |
|--------|--------------|-----------------------|----------------------|-----------------|
| Female | 37 | 290 | 276 | 201 |
| Male | 57 | 274 | 241 | 164 |

**Table 6. Preliminary Age Composition of Adult Alewives and American Shad
Sampled at the Brunswick Fishway – 2000**

| | <u>Number</u> | <u>Ave. TL (mm)</u> | <u>Ave. FL (mm)</u> | <u>Ave. Wt (g)</u> | <u>%M</u> | <u>%F</u> | <u>% of Sample</u> |
|-----------------|---------------|---------------------|---------------------|--------------------|-----------|-----------|--------------------|
| Age 3 Alewives: | 3 | 284.7 | 249.0 | 198.0 | 0 | 100 | 3% |
| Age 4 Alewives: | 75 | 276.5 | 244.2 | 177.7 | 64 | 36 | 75% |
| Age 5 Alewives: | 20 | 287.4 | 253.4 | 204.15 | 45 | 55 | 20% |
| Age 6 Alewives: | 2 | 299 | 262.5 | 217.5 | 50 | 50 | 2% |

| | <u>Number</u> | <u>Ave. TL (mm)</u> | <u>Ave. FL (mm)</u> | <u>%M</u> | <u>%F</u> | <u>% of Sample</u> |
|------------|---------------|---------------------|---------------------|-----------|-----------|--------------------|
| Age 3 Shad | 1 | 490.0 | 450.0 | 100 | 0 | 2% |
| Age 4 Shad | 17 | 504.0 | 443.8 | 35 | 59 | 37% |
| Age 5 Shad | 19 | 512.0 | 455.2 | 26 | 74 | 41% |
| Age 6 Shad | 4 | 508.3 | 451.0 | 50 | 50 | 9% |
| Age 7 Shad | 1 | 520.0 | 477.0 | 0 | 100 | 2% |
| Undet. Age | 4 | 501.0 | 460.0 | 50 | 50 | 9% |

Table 7. American Shad Observations at the Brunswick Fishway, 1994-2001*

| Year / Month | Dead | Viewing Windows | Upper Fishway | Lower Fishway | Corner Pool | Outside Fishway | Total # | Mean Water Temp. (C)¹ |
|---------------------|-------------|------------------------|----------------------|----------------------|--------------------|------------------------|----------------|-----------------------------------------|
| 2001 May | - | - | - | - | - | - | - | * |
| June | 3 | 3 | - | 58 | - | 176 | 240 | 20.2 |
| July | - | - | - | - | - | - | - | * |
| August | - | - | - | - | - | - | - | * |
| | | | | | | | | |
| 2000 May | - | - | - | - | - | - | - | * |
| June | - | 21 | 17 | 169 | 106 | 22 | 335 | 18.7 |
| July | - | 3 | 4 | 6 | 4 | - | 17 | 22.5 |
| August | - | - | - | - | - | - | - | * |
| | | | | | | | | |
| 1999 May | 6 | 16 | - | 5 | 15 | 5 | 47 | 19.4 |
| June | 8 | 38 | - | 73 | 218 | 150 | 487 | 22.9 |
| July | 0 | 0 | 0 | 1 | 5 | 0 | 6 | 25.0 |
| August | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 26.1 |
| | | | | | | | | |
| 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 | - | - | - | - | - | - | - | - |

Table 7. Continued

| | | | | | | | | |
|-----------------------|-----------|-----------|-----------|------------|------------|------------|-------------|--------------------|
| 1995 May | - | - | - | - | - | - | - | - |
| June | - | - | - | - | - | - | - | - |
| July | - | - | - | - | - | - | - | - |
| August | - | - | - | - | - | - | - | - |
| | | | | | | | | |
| 1994 May | - | - | - | - | - | - | - | - |
| June | - | - | - | 10 | - | - | 10 | 23.7 |
| July | - | - | - | - | - | - | - | - |
| August | - | - | - | - | - | - | - | - |
| Approx. No. | 22 | 82 | 21 | 328 | 351 | 409 | 1213 | |
| Av. T° (C) | | | | | | | | 21.6 |
| Min/Max T° (C) | | | | | | | | 17.8 / 26.1 |

* Numbers for the 2000 season are visual observations from the fishway platform and do not include numbers of shad observed using underwater video equipment placed in the fishway or river.

¹ Mean water temperature at the time of shad observations.

Table 8. American Shad Captured at the Brunswick Fishway, 1993-2001

| Date | No. | Water Temp. (C) | Flow (cfs) |
|------------------|---------------|--------------------|----------------------|
| 5/25/01 | 1 | 16.9 | 4,750 |
| 5/29/01 | 9 | 16.5 | 4,580 |
| 6/3/01 | 2 | 15.2 | 7,530 |
| 6/8/01 | 1 | 16.4 | 6,860 |
| 6/13/01 | 1 | 19.1 | 3,350 |
| 6/14/01 | 2 | 20.2 | 4,100 |
| 6/15/01 | 6 | 22.2 | 4,110 |
| 6/18/01 | 1 | 22.8 | 3,140 |
| 6/22/01 | 1 | 22.2 | 3,469 |
| 7/18/01 | 1 | 22.2 | 3,030 |
| 7/19/01 | 1 | 22.3 | 2,940 |
| Total # | 26 | | |
| Av. | | 19.6 | 4,351 |
| Min / Max | 1 / 9 | 15.2 / 22.8 | 2,940 / 7,530 |
| <hr/> | | | |
| 6/3/00 | 1 | 17.0 | 4,890 |
| 6/5/00 | 4 | 16.9 | 4,490 |
| 6/9/00 | 3 | 17.9 | 4,490 |
| 6/12/00 | 4 | 16.0 | 4,470 |
| 6/14/00 | 1 | 16.8 | 5,870 |
| 6/19/00 | 60 | 19.0 | 3,600 |
| 6/20/00 | 9 | 18.9 | 3,260 |
| 6/21/00 | 2 | 19.0 | 4,040 |
| 6/22/00 | 2 | 19.5 | 2,680 |
| 7/1/00 | 1 | 23.0 | 1,910 |
| 7/3/00 | 1 | 22.0 | 3,430 |
| Total # | 88 | | |
| Av. | | 18.7 | 3,921 |
| Min / Max | 1 / 60 | 16.0 / 23.0 | 1,910 / 5,870 |
| <hr/> | | | |
| 5/23/99 | 1 | 19.0 | 4,270 |
| 5/24/99 | 2 | 18.5 | 4,020 |
| 5/26/99 | 1 | 18.4 | 6,500 |
| 5/27/99 | 2 | 17.7 | 7,160 |
| 5/28/99 | 11 | 18.5 | 6,140 |
| 5/29/99 | 11 | 19.0 | 5,660 |
| 5/30/99 | 4 | 19.0 | 4,760 |
| 5/31/99 | 3 | 20.0 | 4,610 |
| 6/1/99 | 1 | 19.7 | 4,270 |
| 6/2/99 | 2 | 21.0 | 3,720 |
| 6/3/99 | 17 | 20.0 | 3,650 |
| 6/4/99 | 3 | 21.8 | 3,380 |
| 6/5/99 | 1 | 20.0 | 2,380 |
| 6/6/99 | 2 | 21.0 | 2,190 |
| 6/7/99 | 12 | 21.5 | 3,570 |
| 6/8/99 | 1 | 24.0 | 3,080 |
| 6/9/99 | 2 | 23.0 | 3,070 |
| 6/14/99 | 2 | 22.2 | 2,740 |
| 6/22/99 | 1 | 24.0 | 2,870 |
| 6/25/99 | 1 | 25.0 | 2,800 |
| 6/26/99 | 1 | 25.0 | 1,710 |

Table 8. Continued

| | | | |
|--------------------------|---------------|--------------------|----------------------|
| 6/27/99 | 2 | 25.5 | 1,730 |
| 6/29/99 | 3 | 25.2 | 2,820 |
| 6/30/99 | 1 | 25.5 | 2,740 |
| Total # | 87 | | |
| Av. | | 21.4 | 3,743 |
| Min / Max | | 17.7 / 25.5 | 1,710 / 7,160 |
| 5/24/98 | 1 | 18.3 | 3,640 |
| 6/3/98 | 1 | 18.4 | 3,600 |
| 6/4/98 | 1 | 17.9 | 4,470 |
| 6/5/98 | 1 | 17.0 | - |
| 7/28/98 | 1 | 25.0 | - |
| Total # | 5 | | |
| Av. | | 19.6 | 3,903 |
| Min / Max | | 17.0 / 25.0 | 3,600 / 4,470 |
| 6/9/97 | 1 | 17.9 | - |
| 7/1/97 | 1 | 23.2 | - |
| Total # | 2 | | |
| Av. | | 20.6 | |
| 6/11/96 | 1 | 18.8 | - |
| 6/25/96 | 1 | 20.4 | - |
| Total # | 2 | | |
| Av. | | 19.6 | |
| 6/3/95 | 1 | 19.1 | - |
| 6/8/95 | 1 | 20.5 | - |
| 6/10/95 | 1 | 21.8 | - |
| Total # | 3 | | |
| Av. | | 20.5 | |
| 6/22/94 | 1 | 22.2 | - |
| 6/7/93 | 1 | 15.3 | - |
| 6/9/90 | 1 | 19.0 | - |
| Grand Total | 216 | | |
| Overall Av. | | 20.2 | 3,156 |
| Overall Min / Max | 1 / 88 | 15.3 / 25.5 | 1,710 / 7,160 |

Table 9. Adult American Shad Captured at the Brunswick Fishway, May – July 2001

| Date | Total / Fork Length (mm) | Weight (kg) | Sex | Condition | Sample |
|-----------------------------------------|---------------------------------|--------------------|-------------------|-----------------------------------|----------------|
| 5/25 | 468/432 | - | U | Scale loss/bruised sides | Scale/genetic |
| 5/29 | - | - | U | Scale loss | - |
| 5/29 | - | - | U | Scale loss | - |
| 5/29 | - | - | U | Scale loss | - |
| 5/29 | - | - | U | Scale loss | - |
| 5/29 | - | - | U | Scale loss | - |
| 5/29 | - | - | U | Scale loss | - |
| 5/29 | - | - | U | Scale loss | - |
| 5/29 | - | - | U | Scale loss | - |
| 5/29 | 558/509 | 1.62 | F | Scale loss | Scale/genetic* |
| 6/3 | 482/- | - | U | Scale loss | Scale |
| 6/3 | 510/445 | - | M | Scale loss | Scale |
| 6/8 | 502/455 | - | U | Scale loss | Scale/genetic* |
| 6/13 | 514/476 | - | F | Scale loss/dorsal irritated & red | Scale |
| 6/14 | 462/419 | - | M | Scale loss/bruised/L side scrape | Scale/genetic* |
| 6/14 | 555/489 | 2.0 | F | Scale loss/lifted almost dead | Scale/genetic* |
| 6/15 | - | - | U | Scale loss | - |
| 6/15 | - | - | F | Scale loss | Scale/genetic* |
| 6/15 | - | - | F | Scale loss | Scale/genetic* |
| 6/15 | 507/445 | - | M | Scale loss | Scale/genetic* |
| 6/15 | - | - | U | Scale loss | Scale/genetic* |
| 6/15 | - | - | U | Scale loss | Scale/genetic* |
| 6/18 | 430/380 | - | M | Dead | Scale/genetic* |
| 6/22 | 483/455 | - | M | Scale loss/bruised | Scale/genetic* |
| 7/18 | 509/468 | - | F | Scale loss/bruised | Scale/genetic |
| 7/19 | - | - | U | Scale loss/bruised | Scale/genetic |
| Av. | 498 / 452 | | | | |
| Number Males / Females / Unknown | | | 5 / 6 / 15 | | |

* Indicates a necropsy was performed on the fish

Table 10. Videotaped Observations of American Shad Behavior Recorded at the Brunswick Fishway During Spring, 1999-2000

| June-99 | Total No. | US | DS |
|----------------|------------------|-----------|-----------|
| All Cameras | 3655 | 1495 | 625 |

| July-99 | Total No. | US | DS |
|----------------|------------------|-----------|-----------|
| All Cameras | 722 | 385 | 312 |

| Jun-00 | Total No. | US | DS | OB |
|--------------------|------------------|---------------|---------------|--------------|
| Camera 1 | 37,741 | 27,008 | 10,636 | 98 |
| Camera 2 | 10,046 | 3,534 | 1,652 | 4,863 |
| Camera 3 | 379 | 184 | 69 | 126 |
| Grand Total | 48,166 | 30,726 | 12,356 | 5,087 |

| Jul-00 | Total No. | US | DS | OB |
|--------------------|------------------|--------------|--------------|------------|
| Camera 1 | 3,756 | 2,525 | 1,184 | 48 |
| Camera 2 | 891 | 244 | 153 | 494 |
| Camera 3 | 23 | 10 | 0 | 13 |
| Grand Total | 4,671 | 2,779 | 1,337 | 555 |

| | | | | |
|---------------------------|-------------|-------------|-------------|-------------|
| Percent Difference | 0.90 | 0.91 | 0.89 | 0.89 |
|---------------------------|-------------|-------------|-------------|-------------|

Table 11. American Shad Behavior Recorded by Cameras 1-3 and Classified by Behavior Displayed at the Brunswick Fishway During 2000

| June-00 | Total No. | US | DS | OB |
|----------------|------------------|---------------|---------------|---------------|
| Camera 1 | 37,741 | 87.9% | 86.1% | 1.9% |
| Camera 2 | 10,046 | 11.5% | 13.4% | 95.6% |
| Camera 3 | 379 | 0.6% | 0.6% | 2.5% |
| 48,166 | | 100.0% | 100.0% | 100.0% |

| July-00 | Total No. | US | DS | OB |
|----------------|------------------|---------------|---------------|---------------|
| Camera 1 | 3,756 | 90.9% | 88.5% | 8.6% |
| Camera 2 | 891 | 8.8% | 11.5% | 89.0% |
| Camera 3 | 23 | 0.4% | 0.0% | 2.4% |
| 4,671 | | 100.0% | 100.0% | 100.0% |

| June-00 | Total No. | US | DS | OB | % |
|----------------|------------------|-----------|-----------|-----------|----------|
| Camera 1 | 37,741 | 71.6% | 28.2% | 0.3% | 100.0% |
| Camera 2 | 10,046 | 35.2% | 16.4% | 48.4% | 100.0% |
| Camera 3 | 379 | 48.6% | 18.1% | 33.3% | 100.0% |

| | |
|--------------------|---------------|
| Grand Total | 48,166 |
|--------------------|---------------|

| July-00 | Total No. | US | DS | OB | % |
|----------------|------------------|-----------|-----------|-----------|----------|
| Camera 1 | 3,756 | 67.2% | 31.5% | 1.3% | 100.0% |
| Camera 2 | 891 | 27.4% | 17.2% | 55.4% | 100.0% |
| Camera 3 | 23 | 42.9% | 0.0% | 57.1% | 100.0% |

| | |
|--------------------|--------------|
| Grand Total | 4,671 |
|--------------------|--------------|

Camera 1- Deployed in the river adjacent to the fishway
 Camera 2- Deployed at the entrance to Pool # 6
 Camera 3- Deployed at the entrance to Pool # 24

Table 12. Preliminary Underwater Videotape Data Collected at the Brunswick Fishway During the 2001 American Shad Run

| | Upstream | Downstream | Other Behavior | |
|------------------|-----------------|-------------------|-----------------------|---------------|
| River | 32,767 | 506 | 87 | 33,360 |
| Fishway Entrance | 2,118 | 796 | 93 | 3,007 |
| Pool 1 | 992 | 410 | 463 | 1,865 |
| Pool 6 | 836 | 216 | 756 | 1,808 |
| Pool 23 Entrance | 20 | 7 | 20 | 47 |
| Pool 23 Exit | 67 | 13 | 7 | 87 |
| TOTAL | 36,800 | 1,948 | 1,425 | 40,173 |

**Table 13. Adult American Shad Distribution in Main Stem Androscoggin River
at Auburn, 1987-2001**

| Year | Number distributed | Source | | | Mortality during transport |
|--------------|--------------------|--------------|--------------|-----------|----------------------------|
| | | Androscoggin | Connecticut | Merrimack | |
| 2001 | 20 | 20 | - | - | 30.0% |
| 2000 | 88 | 88 | - | - | N/A |
| 1999 | 357 | 87 | 270 | - | 11.0% |
| 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% |
| TOTAL | 5,676 | 210 | 5,374 | 92 | Av.=20.3% |

**Table 14. American Shad Fry Released into the Main Stem Androscoggin River
at Auburn, 1999-2001**

| Date | Source | No. Released | Age | % Mortality | Loading Site Tem(C) | Receiving Site Temp. (C) | Marking Method |
|-------------|--------------------------|---------------------|----------------|--------------------|----------------------------|---------------------------------|-----------------------|
| 7/2/01 | Merrimack | 308,600 | 23-26 days old | ~1% | 18.0 | 23.4 | Tetra-cycline* |
| 7/10/00 | CT x Kennebec | 529,000 | 7-10 days old | ~5% | 18.7 | 25.0 | Tetra-cycline* |
| 6/30/99 | CT x CT and CT x Saco | 280,000 | 10-17 days old | ~2.4% | 17.3 | 24.7 | Tetra-cycline* |

* Fry were exposed to a four-hour Tetracycline bath at the Waldoboro Hatchery

Table 15. Number, Origin and Lengths of Sea-run Androscoggin Atlantic Salmon, 1983-2001

| Age | Sea-Run Hatchery | | | | Sea-Run Wild | | | | Ave. Length (mm) | Total |
|--------------|------------------|------------|----------|----------|--------------|-----------|----------|----------|------------------|------------|
| | 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 | 1 | 2 | 0 | 700 | 5 |
| 2000 | 1 | 1 | 0 | 0 | 0 | 1 | 2 | 0 | 652 | 5 |
| 2001 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | | 718 | 5 |
| Total | 29 | 509 | 6 | 2 | 5 | 82 | 4 | 1 | | 639 |

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 length data were not available

Table 16. Atlantic Salmon Passed on the Androscoggin River at the Brunswick Fishway, 2001

| Date | Fork Length (mm) | Total Length (mm) | Clips/Marks | Water Temp. (C) |
|--------------------|-------------------------|--------------------------|--------------------|------------------------|
| 6/8/01 | 804 | 833 | None | 16.4 |
| 6/13/01 | 723 | 730 | None | 19.2 |
| 6/20/01 | 724 | 731 | Dorsal punch | 21.9 |
| 6/20/01 | 744 | 756 | None | 22.3 |
| 7/10/01 | 594 | 603 | Elastimer tag | 22.7 |
| | | | | |
| Total | 5 | | | |
| Average | 718 | 731 | | 20.5 |
| Min. T° (C) | | | | 16.4 |
| Max. T° (C) | | | | 22.7 |
| | | | | |

Table 17. Fish Community by Month at the Brunswick Fishway for the 2001 Sample Season.

Summary of Fish Community at BFW: May, 2001

| Species | Total # | Destination | Mean Total Length (mm) |
|--------------------------------|---------|--------------------|------------------------|
| alewife adult | 4,661 | stocking habitat | - |
| alewife adult | 13 | Durham boat launch | - |
| alewife adult | 52 | tagged | - |
| alewife adult | 13,373 | headpond | - |
| alewife adult | 93 | sampled | 286 |
| American shad | 8 | Durham boat launch | - |
| American shad | 1 | headpond | 468 |
| American shad | 1 | mortality | 558 |
| blueback herring | 1 | sampled | 284 |
| brook trout | 1 | headpond | 287 |
| brown trout | 5 | headpond | 356 |
| landlocked salmon | 5 | headpond | 188 |
| smallmouth bass | 20 | headpond | 332 |
| white sucker | 266 | headpond | 384 |
| Total Number | 18,500 | | |
| Mean Water Temperature: 15.3°C | | | |

Summary of Fish Community at BFW: June, 2001

| Species | Total # | Destination | Mean Total Length (mm) |
|-------------------------------|---------|-------------|------------------------|
| alewife adult | 2 | headpond | - |
| alewife adult | 1 | mortality | 283 |
| American shad | 5 | headpond | 472 |
| American shad | 3 | mortality | 501 |
| American shad | 6 | hatchery | - |
| Atlantic salmon | 5 | headpond | 701(fork) |
| brown trout | 5 | headpond | 426 |
| common shiner | 6 | headpond | 78 |
| smallmouth bass | 17 | headpond | 302 |
| white sucker | 1 | headpond | 250 |
| white catfish | 12 | downstream | 358 |
| unidentified fry | 59 | downstream | - |
| Total Number | 122 | | |
| Mean Water Temperature 20.5°C | | | |

Summary of Fish Community at BFW: July, 2001

| Species | Total # | Destination | Mean Total Length (mm) |
|-------------------------------|---------|-------------|------------------------|
| American eel | 3 | headpond | 234 |
| American shad | 2 | headpond | 509 |
| Atlantic salmon | 1 | headpond | 603 |
| smallmouth bass | 8 | headpond | 342 |
| spottail shiner | 33 | headpond | - |
| white catfish | 2 | downstream | 331 |
| unidentified fry | 79 | downstream | - |
| Total Number | 128 | | |
| Mean Water Temperature 22.8°C | | | |

Summary of Fish Community at BFW: August, 2001

| Species | Total # | Destination | Mean Total Length (mm) |
|-------------------------------|---------|-------------|------------------------|
| American eel | 2 | headpond | 335 |
| pumpkinseed sunfish | 1 | headpond | 100 |
| smallmouth bass | 104 | headpond | 93 |
| spottail shiner | 1 | headpond | 52 |
| white sucker | 2 | headpond | 72 |
| white perch | 4 | headpond | - |
| unidentified fry | 15 | downstream | 57 |
| Total Number | 129 | | |
| Mean Water Temperature 24.4°C | | | |

Table 17 continued. Fish Community by Month at the Brunswick Fishway for the 2001 Sample Season.

Summary of Fish Community at BFW: September, 2001

| Species | Total # | Destination | Mean Total Length (mm) |
|-------------------------------|---------|-------------|------------------------|
| pumpkinseed sunfish | 2 | headpond | 60 |
| smallmouth bass | 8 | headpond | 102 |
| unidentified fry | 4 | sampled | 44 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| Total Number | 14 | | |
| Mean Water Temperature 20.5°C | | | |

Summary of Fish Community at BFW: October, 2001

| Species | Total # | Destination | Mean Total Length (mm) |
|-------------------------------|---------|-------------|------------------------|
| alewife juvenile | 22 | downstream | - |
| spottailed shiner | 3 | downstream | - |
| white sucker | 1 | downstream | - |
| pumpkinseed sunfish | 1 | downstream | - |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| Total Number | 27 | | |
| Mean Water Temperature 14.3°C | | | |

Summary of Fish Community at BFW: November, 2001

| Species | Total # | Destination | Mean Total Length (mm) |
|-----------------------|---------|-------------|------------------------|
| | | | |
| | | | |
| | | | |
| | | | |
| Closed for the season | | | |
| | | | |
| | | | |
| | | | |

Summary of Fish Community at BFW: December, 2001

| Species | Total # | Destination | Mean Total Length (mm) |
|-----------------------|---------|-------------|------------------------|
| | | | |
| | | | |
| | | | |
| | | | |
| Closed for the season | | | |
| | | | |
| | | | |
| | | | |

**BFW was closed October 26

Table 18. Fish Species Captured at Brunswick Fishway, May-October 2001

| | Species Total |
|-------------------------------------------------------------------------|----------------------|
| American Shad <i>(Alosa sapidissima)</i> | 26 |
| River Herring <i>(Alosa aestivalis)(Alosa pseudoharengus)</i> | 18,218 |
| Atlantic Salmon <i>(Salmo salar)</i> | 5 |
| Landlocked Salmon <i>(Salmo salar)</i> | 6 |
| White Sucker <i>(Catostromus commersoni)</i> | 270 |
| American eel <i>(Anguilla rostrata)</i> | 5 |
| Smallmouth Bass <i>(Micropterus dolomieu)</i> | 157 |
| Brook Trout <i>(Salvelinus fontinalis)</i> | 1 |
| Brown Trout <i>(Salvelinus trutta)</i> | 10 |
| Spottail Shiner <i>(unknown)</i> | 37 |
| Common Shiner <i>(Notropis heterolepis)</i> | 6 |
| Pumpkinseed Sunfish <i>(Lepomis gibbosus)</i> | 4 |
| White Perch <i>(Morone americanus)</i> | 4 |
| White Catfish <i>(Ictalurus catus)</i> | 14 |
| Unidentified Fry <i>(unknown)</i> | 157 |
| MONTHLY TOTAL | 18,920 |

Table 19. Brunswick Fishway Air and Water Temperatures and Headpond Levels, May 2001

| <u>Day</u> | <u>Air Temp (°C)</u> | <u>Water Temp (°C)</u> | <u>Headpond Level</u> | <u>Flow(cfs)</u> |
|-------------|----------------------|------------------------|-----------------------|------------------|
| 1 | - | - | - | 18,500 |
| 2 | - | - | - | 21,100 |
| 3 | - | - | - | 23,200 |
| 4 | - | - | - | 22,700 |
| 5 | - | - | - | 20,400 |
| 6 | - | - | - | 16,400 |
| 7 | - | - | - | 13,300 |
| 8 | - | - | - | 11,600 |
| 9 | - | 12.3 | 41.0 | 10,800 |
| 10 | - | 13.0 | 41.2 | 8,780 |
| 11 | 20.1 | 14.4 | 39.0 | 6,500 |
| 12 | 16.9 | 15.4 | 39.4 | 6,420 |
| 13 | 12.5 | 14.8 | 39.1 | 6,350 |
| 14 | 16.5 | 14.7 | 39.3 | 6,440 |
| 15 | 11.0 | 14.8 | 38.3 | 4,810 |
| 16 | 12.2 | 14.5 | 39.1 | 5,550 |
| 17 | 10.0 | 14.6 | 39.0 | 5,500 |
| 18 | 12.3 | 15.4 | 39.0 | 4,620 |
| 19 | 14.5 | 15.2 | 38.5 | 4,110 |
| 20 | 17.1 | 14.8 | 37.8 | 4,230 |
| 21 | 12.4 | 15.9 | 38.9 | 5,480 |
| 22 | 16.4 | 15.3 | 38.5 | 5,500 |
| 23 | 18.5 | 15.3 | 39.0 | 5,440 |
| 24 | 17.9 | 16.1 | 38.0 | 3,530 |
| 25 | 18.0 | 16.9 | 39.0 | 4,750 |
| 26 | 17.8 | 17.3 | 39.0 | 3,650 |
| 27 | 13.3 | 16.1 | 38.6 | 3,590 |
| 28 | - | - | - | 3,520 |
| 29 | 18.0 | 16.5 | 39.2 | 4,580 |
| 30 | 15.4 | 17.4 | 39.2 | 5,930 |
| 31 | 9.9 | 16.2 | 39.3 | 5,480 |
| Mean | 15.0 | 15.3 | 39.1 | 8799 |

Table 20. Brunswick Fishway Air and Water Temperatures and Headpond Levels, June 2001

| <u>Day</u> | <u>Air Temp (°C)</u> | <u>Water Temp (°C)</u> | <u>Headpond Level</u> | <u>Flow(cfs)</u> |
|-------------|----------------------|------------------------|-----------------------|------------------|
| 1 | 18.6 | 17.2 | 39.0 | 5,000 |
| 2 | - | - | - | 4,950 |
| 3 | 11.4 | 15.2 | 40.0 | 7,530 |
| 4 | 18.2 | 15.4 | 41.3 | 17,200 |
| 5 | 20.8 | 15.5 | 41.0 | 14,299 |
| 6 | 21.4 | 15.6 | 40.0 | 11,500 |
| 7 | 22.7 | 16.0 | 40.0 | 9,520 |
| 8 | 23.7 | 16.4 | 39.4 | 6,860 |
| 9 | - | - | - | 5,990 |
| 10 | 22.5 | 17.3 | 39.0 | 5,830 |
| 11 | 19.5 | 17.9 | 39.0 | 5,620 |
| 12 | 16.4 | 17.5 | 38.5 | 2,790 |
| 13 | 20.1 | 19.1 | 39.0 | 3,350 |
| 14 | 25.6 | 20.2 | 39.0 | 4,100 |
| 15 | 28.8 | 22.2 | 38.9 | 4,110 |
| 16 | 29.7 | 21.5 | 38.5 | 2,770 |
| 17 | 22.1 | 21.6 | 38.5 | 1,880 |
| 18 | 26.4 | 22.8 | 39.0 | 3,140 |
| 19 | - | - | - | 2,870 |
| 20 | 30.6 | 22.4 | 39.0 | 3,190 |
| 21 | 22.8 | 23.2 | 37.5 | 3,449 |
| 22 | 17.7 | 22.2 | 38.3 | 3,469 |
| 23 | - | - | - | 2,950 |
| 24 | 23.3 | 21.9 | 38.9 | 2,870 |
| 25 | 24.8 | 22.6 | 38.5 | 3,430 |
| 26 | 29.3 | 24.0 | 38.0 | 3,680 |
| 27 | 29.7 | 24.5 | 38.0 | 4,050 |
| 28 | 27.8 | 26.0 | 38.6 | 4,010 |
| 29 | 22.4 | 24.2 | 37.8 | 3,960 |
| 30 | - | - | - | 1,780 |
| Mean | 23.1 | 20.1 | 39.0 | 5204.9 |

Table 21. Brunswick Fishway Air and Water Temperatures and Headpond Levels, July 2001

| <u>Day</u> | <u>Air Temp (°C)</u> | <u>Water Temp (°C)</u> | <u>Headpond Level</u> | <u>Flow(cfs)</u> |
|-------------|----------------------|------------------------|-----------------------|------------------|
| 1 | - | - | - | 1,820 |
| 2 | 17.1 | 23.2 | 38.1 | 1,950 |
| 3 | 14.7 | 23.0 | 38.5 | 3,320 |
| 4 | - | - | - | 1,770 |
| 5 | 23.7 | 21.8 | 39.0 | 2,640 |
| 6 | - | - | - | 3,570 |
| 7 | - | - | - | 2,130 |
| 8 | 17.7 | 22.7 | 38.0 | 1,820 |
| 9 | 22.5 | 22.4 | 39.0 | 2,960 |
| 10 | 19.3 | 22.9 | 39.0 | 3,170 |
| 11 | 18.4 | 22.7 | 39.0 | 4,300 |
| 12 | 23.3 | 22.6 | 39.0 | 5,170 |
| 13 | 22.1 | 21.8 | 39.0 | 4,710 |
| 14 | - | - | - | 4,940 |
| 15 | - | - | - | 3,220 |
| 16 | 23.9 | 22.4 | 39.0 | 3,420 |
| 17 | 17.8 | 22.4 | 38.4 | 3,910 |
| 18 | 21.9 | 22.3 | 39.0 | 3,030 |
| 19 | 24.5 | 22.8 | 38.9 | 2,940 |
| 20 | 27.1 | 23.3 | 38.7 | 2,530 |
| 21 | - | - | - | 2,130 |
| 22 | - | - | - | 2,680 |
| 23 | 21.2 | 23.8 | 38.0 | 3,030 |
| 24 | 19.9 | 23.2 | 38.0 | 2,800 |
| 25 | 26.8 | 24.7 | 38.5 | 2,770 |
| 26 | 17.3 | 23.6 | 39.0 | 1,870 |
| 27 | 17.5 | 23.4 | 38.5 | 1,840 |
| 28 | - | - | - | 2,420 |
| 29 | - | - | - | 2,260 |
| 30 | 23.8 | 23.3 | 38.7 | 2,370 |
| 31 | 28.4 | 24.1 | 38.6 | 1,830 |
| Mean | 21.4 | 23.0 | 38.7 | 2,881 |

Table 22. Brunswick Fishway Air and Water Temperatures and Headpond Levels, August 2001

| <u>Day</u> | <u>Air Temp (°C)</u> | <u>Water Temp (°C)</u> | <u>Headpond Level</u> | <u>Flow(cfs)</u> |
|-------------|----------------------|------------------------|-----------------------|------------------|
| 1 | 27.4 | 24.1 | 38.4 | 1,800 |
| 2 | 28.2 | 24.7 | 38.9 | 2,730 |
| 3 | 30.4 | 26.0 | 37.7 | 2,780 |
| 4 | - | - | - | 1,670 |
| 5 | - | - | - | 1,660 |
| 6 | 20.5 | 25.2 | 38.4 | 2,700 |
| 7 | 32.1 | 26.2 | 37.8 | 2,480 |
| 8 | 29.3 | 26.8 | 37.6 | 2,410 |
| 9 | 29.3 | 26.1 | 38.1 | 3,100 |
| 10 | 30.8 | 26.7 | 37.6 | 2,810 |
| 11 | - | - | - | 1,640 |
| 12 | - | - | - | 1,650 |
| 13 | 23.0 | 25.0 | 38.7 | 1,700 |
| 14 | 20.1 | 24.4 | 38.6 | 1,650 |
| 15 | 23.9 | 23.7 | 39.0 | 1,830 |
| 16 | 23.9 | 23.6 | 38.0 | 1,830 |
| 17 | 21.3 | 23.7 | 38.0 | 1,840 |
| 18 | - | - | - | 1,690 |
| 19 | - | - | - | 1,860 |
| 20 | 19.8 | 24.0 | 38.5 | 2,390 |
| 21 | 25.0 | 24.3 | 39.0 | 2,380 |
| 22 | 24.1 | 24.5 | 37.9 | 2,760 |
| 23 | 26.1 | 24.7 | 38.0 | 2,580 |
| 24 | 24.5 | 24.8 | 38.9 | 1,860 |
| 25 | - | - | - | 1,620 |
| 26 | - | - | - | 1,620 |
| 27 | 26.1 | 23.2 | 38.9 | 1,850 |
| 28 | 26.0 | 23.4 | 38.4 | 1,610 |
| 29 | - | - | - | 1,620 |
| 30 | 21.2 | 23.0 | 38.5 | 1,640 |
| 31 | 22.8 | 22.8 | 39.0 | 1,610 |
| Mean | 25.3 | 24.6 | 38.4 | 2044.2 |

Table 23. Brunswick Fishway Air and Water Temperatures and Headpond Levels, September 2001

| <u>Day</u> | <u>Air Temp (°C)</u> | <u>Water Temp (°C)</u> | <u>Headpond Level</u> | <u>Flow(cfs)</u> |
|-------------|----------------------|------------------------|-----------------------|------------------|
| 1 | - | - | - | 1,660 |
| 2 | - | - | - | 1,620 |
| 3 | - | - | - | 1,610 |
| 4 | 19.0 | 21.2 | 38.6 | 1,850 |
| 5 | 21.5 | 21.4 | 38.5 | 2,450 |
| 6 | - | - | - | 2,010 |
| 7 | 24.7 | 21.4 | 38.3 | 1,980 |
| 8 | - | - | - | 1,620 |
| 9 | - | - | - | 1,630 |
| 10 | 20.3 | 21.9 | 38.5 | 1,680 |
| 11 | 23.8 | 22.8 | 38.5 | 1,610 |
| 12 | 17.5 | 22.2 | 38.9 | 1,630 |
| 13 | 20.7 | 22.1 | 38.2 | 1,630 |
| 14 | 17.9 | 21.1 | 38.7 | 1,640 |
| 15 | - | - | - | 1,610 |
| 16 | - | - | - | 1,600 |
| 17 | 17.7 | 18.8 | 38.6 | 1,650 |
| 18 | 23.4 | 19.2 | 39.2 | 1,650 |
| 19 | 19.4 | 19.6 | 38.0 | 1,640 |
| 20 | - | - | - | 1,450 |
| 21 | 17.6 | 19.3 | 38.6 | 1,700 |
| 22 | - | - | - | 1,630 |
| 23 | - | - | - | 1,620 |
| 24 | 16.3 | 19.2 | 38.6 | 1,860 |
| 25 | 18.4 | 19.3 | 38.6 | 2,790 |
| 26 | 20.5 | 19.7 | 39.0 | 2,400 |
| 27 | 18.5 | 19.2 | 38.9 | 3,240 |
| 28 | 11.0 | 18.7 | 38.1 | 3,140 |
| 29 | - | - | - | 2,120 |
| 30 | 4.7 | 16.7 | 38.0 | 1,850 |
| Mean | 18.5 | 20.2 | 38.5 | 1885.7 |

Table 24. Brunswick Fishway Air and Water Temperatures and Headpond Levels, October 2001

| <u>Day</u> | <u>Air Temp (°C)</u> | <u>Water Temp (°C)</u> | <u>Headpond Level</u> | <u>Flow(cfs)</u> |
|-------------|----------------------------------------|------------------------|-----------------------|------------------|
| 1 | 11.5 | 16.2 | 39.0 | 2,220 |
| 2 | 22.4 | 17.1 | 39.3 | 3,160 |
| 3 | 18.0 | 16.7 | 39.0 | 1,990 |
| 4 | 22.6 | 17.3 | 38.2 | 1,670 |
| 5 | 15.6 | 17.1 | 38.9 | 1,640 |
| 6 | - | - | - | 1,650 |
| 7 | - | - | - | 1,630 |
| 8 | 4.3 | 15.9 | 39.5 | 1,660 |
| 9 | 9.1 | 14.0 | 39.5 | 1,620 |
| 10 | 12.2 | 13.7 | 39.6 | 1,660 |
| 11 | 15.2 | 13.1 | 38.9 | 1,610 |
| 12 | 22.7 | 14.1 | 38.5 | 1,590 |
| 13 | - | - | - | 1,820 |
| 14 | 11.9 | 14.9 | 39.4 | 2,020 |
| 15 | 13.3 | 15.1 | 39.4 | 2,010 |
| 16 | 16.1 | 14.8 | 39.4 | 1,719 |
| 17 | 13.7 | 14.6 | 39.0 | 1,880 |
| 18 | 12.1 | 13.7 | 39.2 | 2,020 |
| 19 | 6.3 | 12.6 | 39.0 | 1,960 |
| 20 | - | - | - | 1,620 |
| 21 | - | - | - | 1,620 |
| 22 | 13.9 | 12.1 | 39.1 | 1,620 |
| 23 | 11.5 | 12.1 | 39.0 | 1,620 |
| 24 | 18.5 | 12.9 | 38.6 | 1,650 |
| 25 | 14.7 | 12.8 | 38.1 | 1,660 |
| 26 | 13.0 | 12.4 | 39.0 | 2,570 |
| 27 | Fishway closed for the season 10-27-01 | | | 1,670 |
| 28 | | | | 1,610 |
| 29 | | | | 2,120 |
| 30 | | | | 1,910 |
| 31 | | | | 2,070 |
| Mean | 14.2 | 14.4 | 39.0 | 1847.4 |

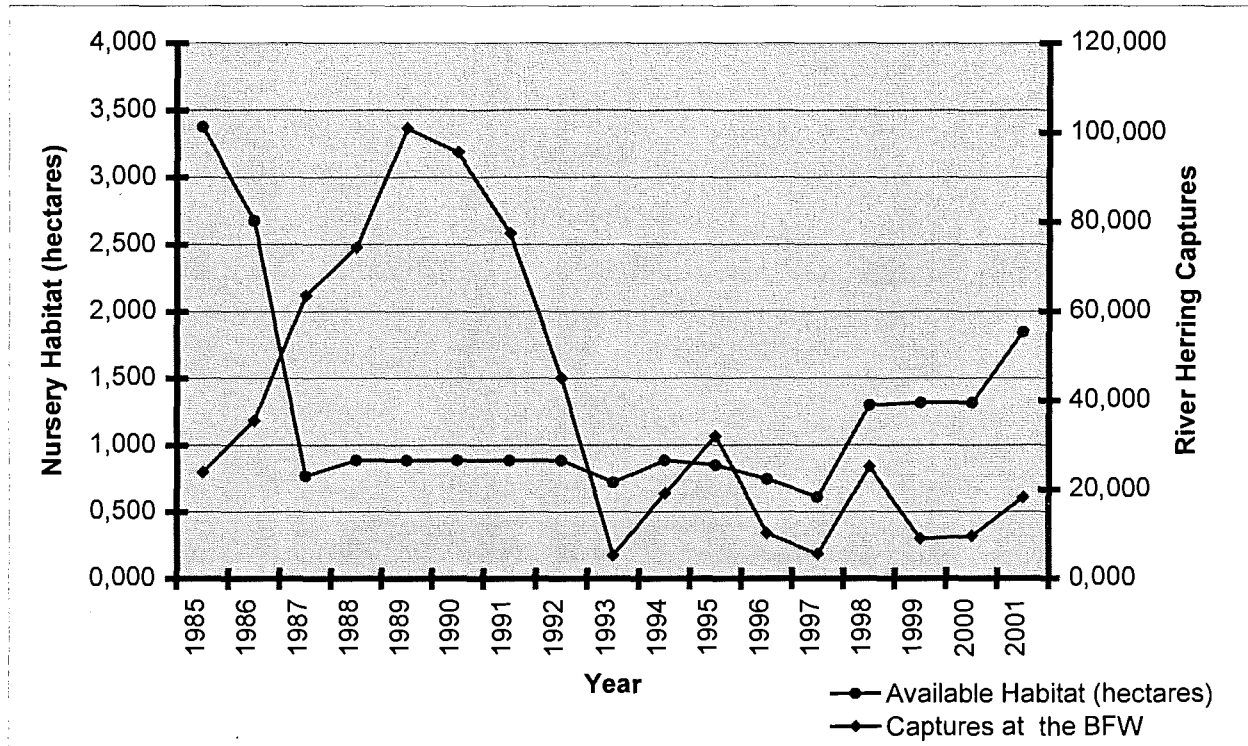


Figure 1. Adult Alewife Captured at the Brunswick Fishway vs. Habitat Availability in the Androscoggin River Watershed, 1985-2001

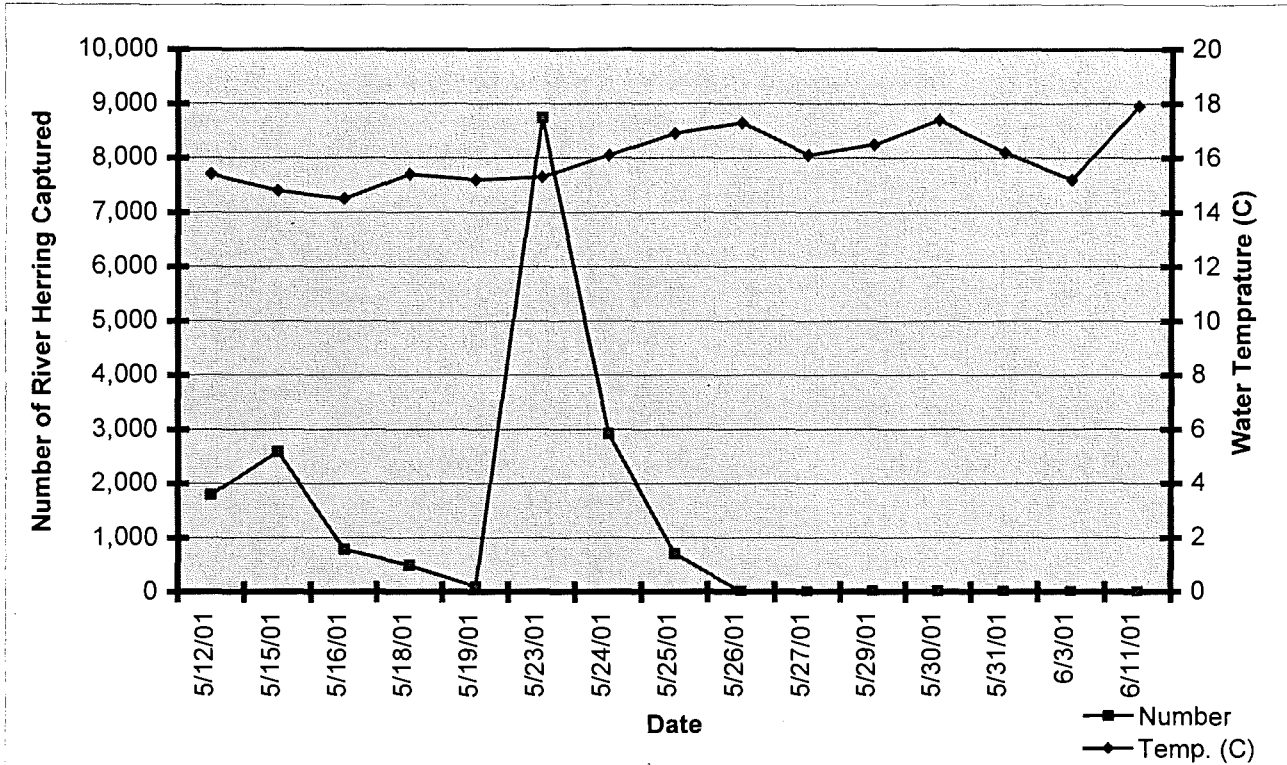


Figure 2. Number of Adult River Herring Captured vs. Water Temperature at the Brunswick Fishway, 2001

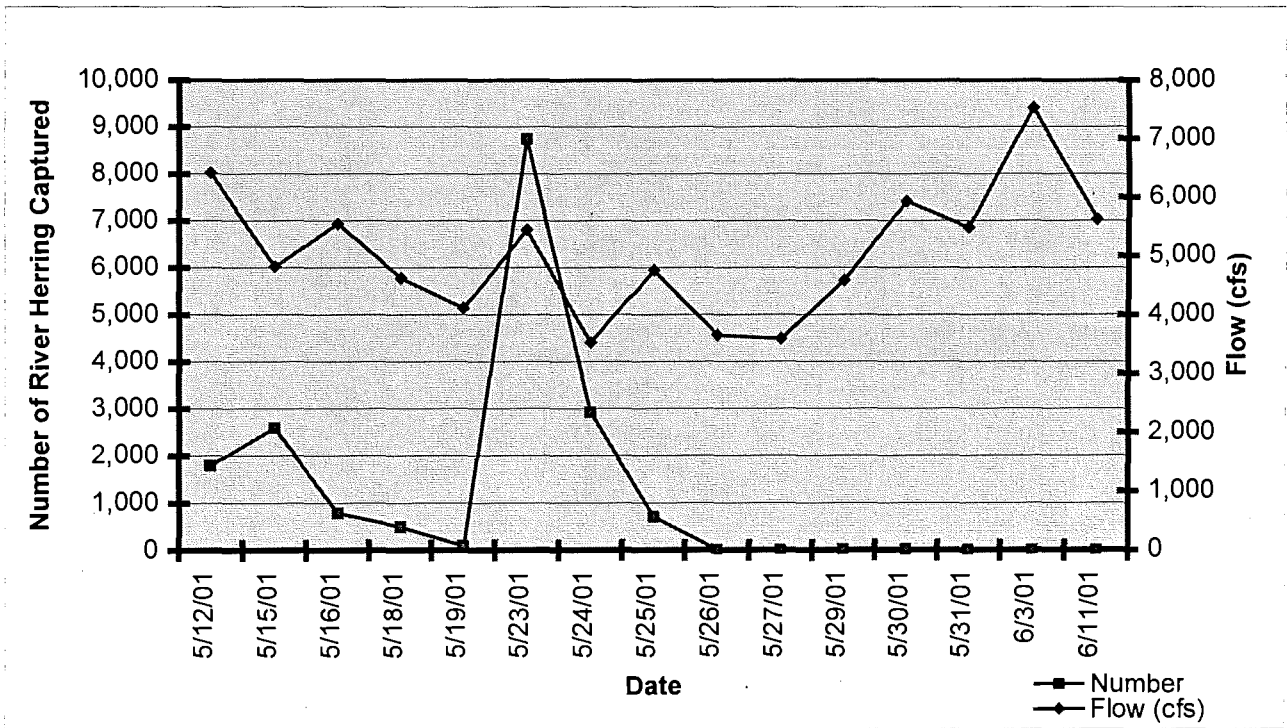


Figure 3. Number of Adult River Herring Captured vs. Water Flow at the Brunswick Fishway, 2001

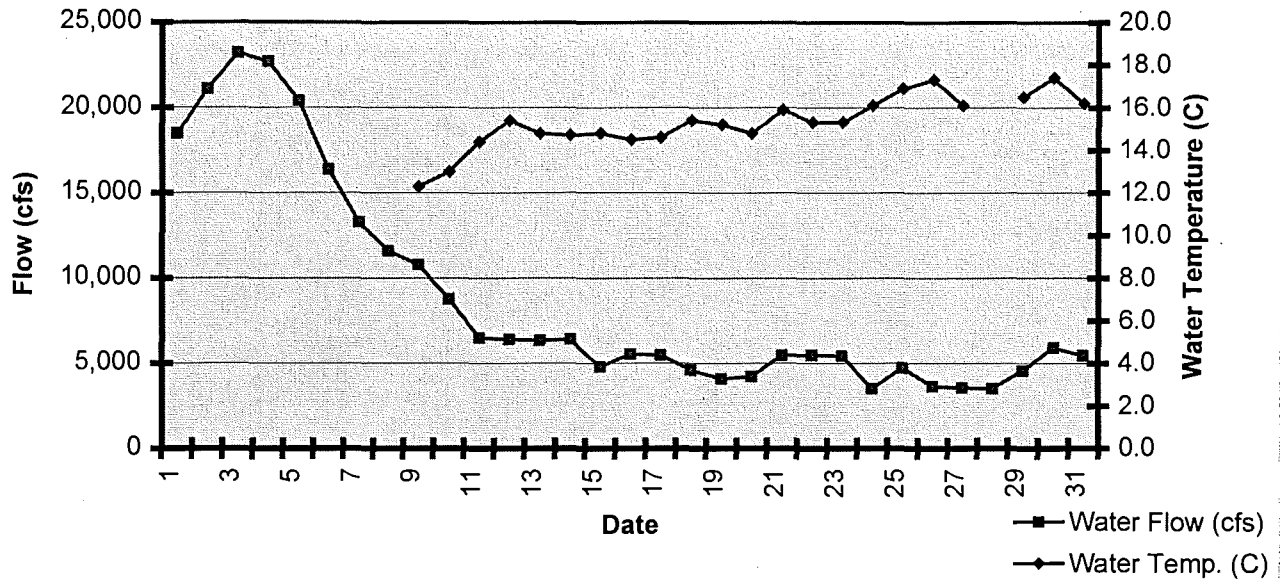


Figure 4. Brunswick Fishway Water Temperatures and Flows for May, 2001

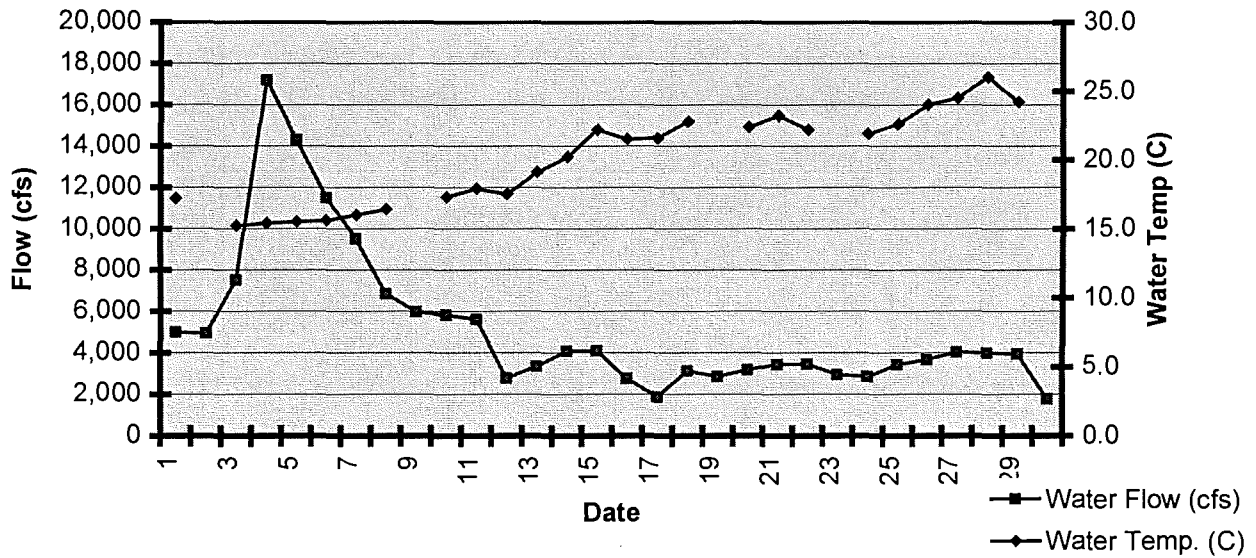


Figure 5. Brunswick Fishway Water Temperatures and Flows for June, 2001

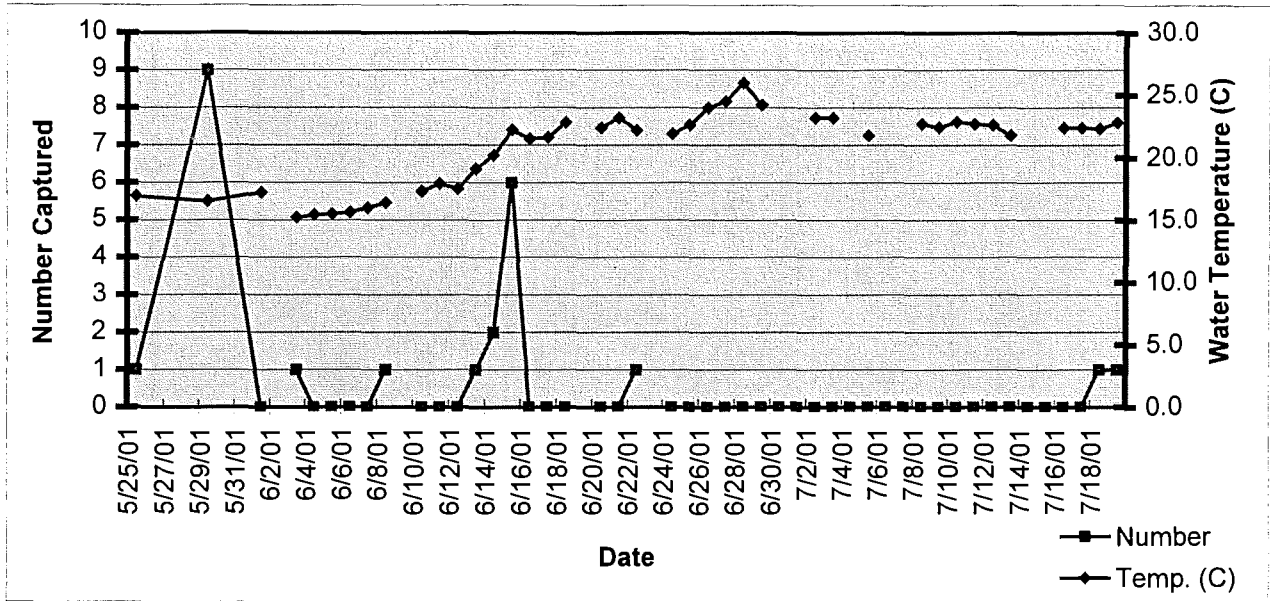


Figure 6. Adult American Shad Captured vs. Water Temperature at the Brunswick Fishway, 2001

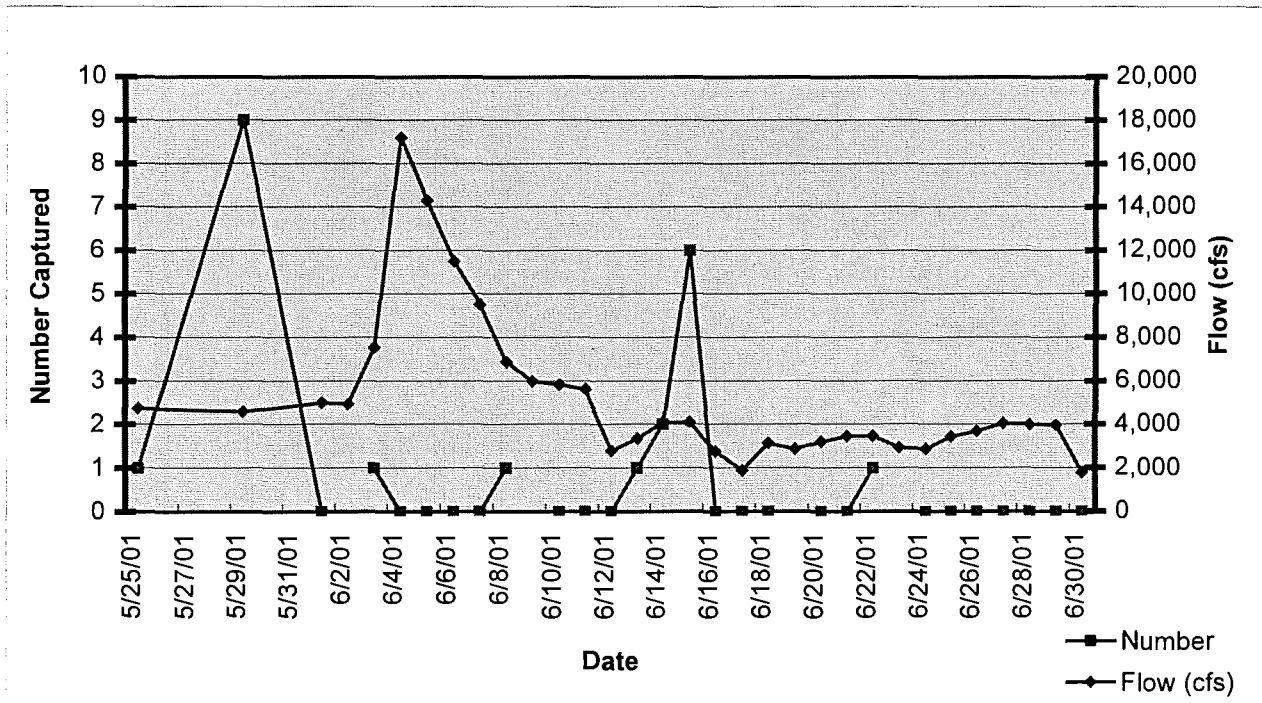


Figure 7. Adult American Shad Captured vs. Flow at the Brunswick Fishway, 2001

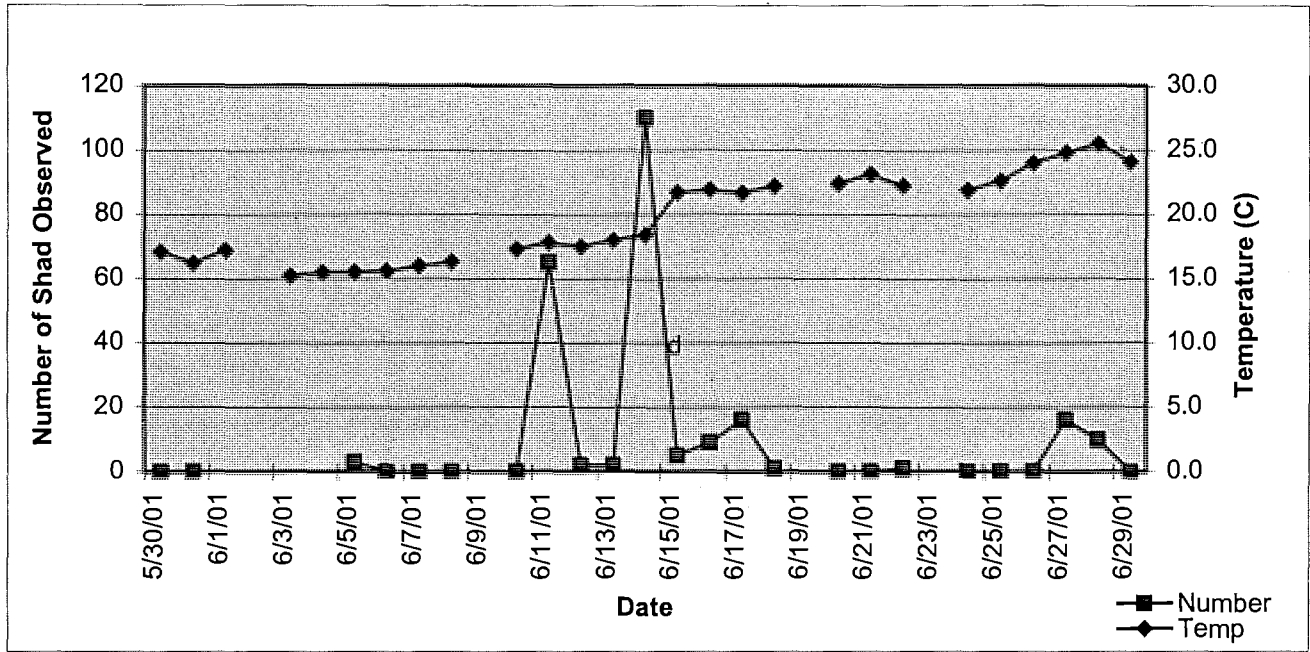


Figure 8. Number of American Shad Observed vs. Water Temperature at the Brunswick Fishway, May - June, 2001

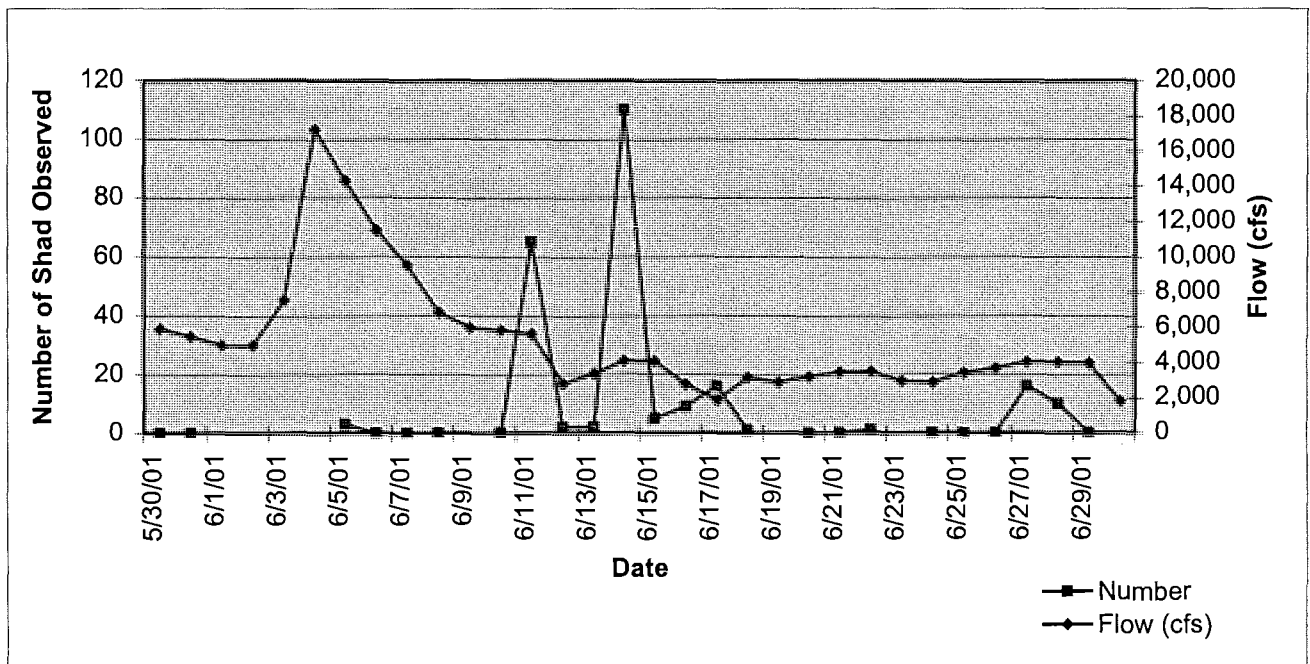


Figure 9. Number of American Shad Observed vs. Water Flow (cfs) at the Brunswick Fishway, June - July, 2001

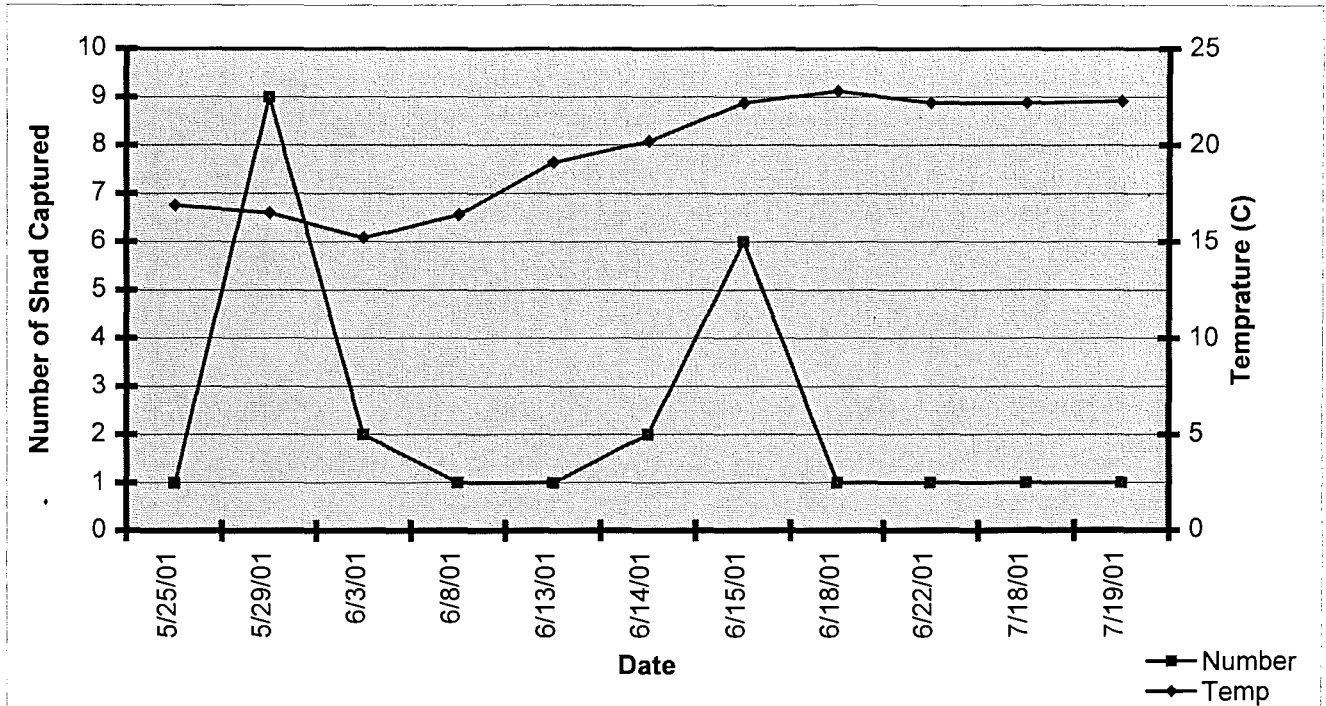


Figure 10. Adult American Shad Captured vs. Water Temperature at the Brunswick Fishway, 2001

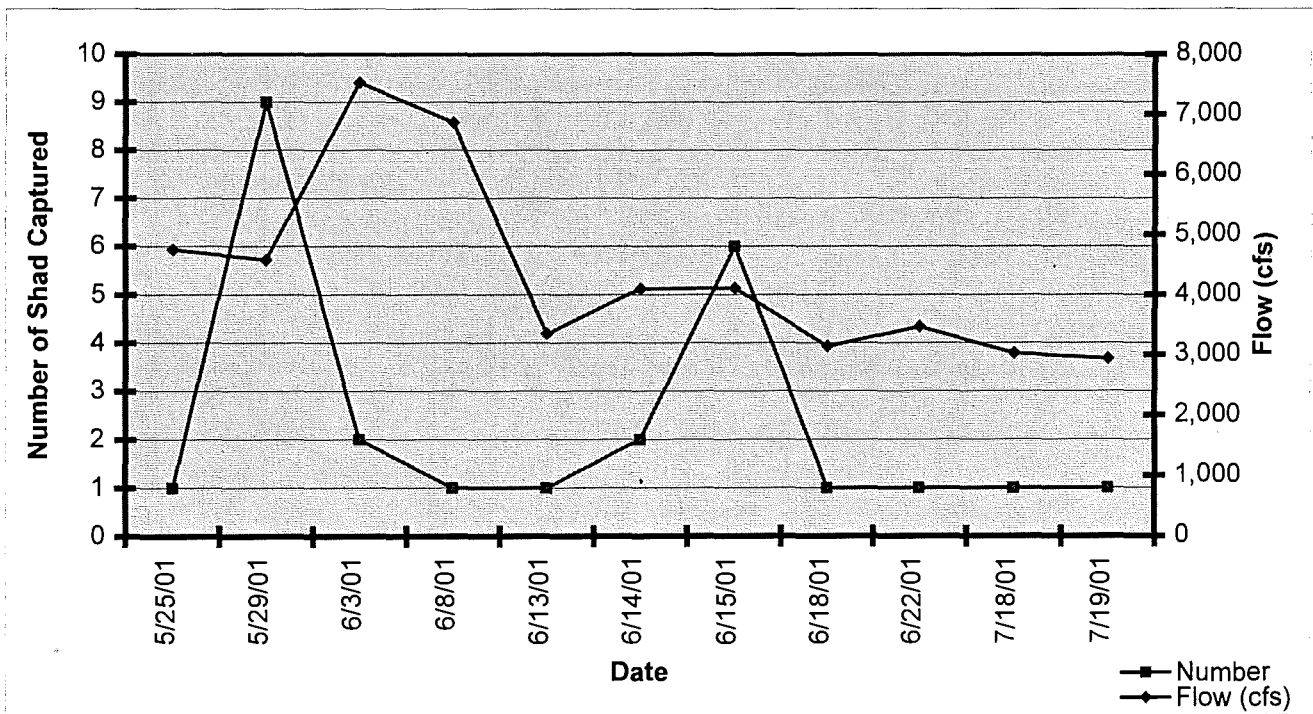


Figure 11. Adult American Shad Captured vs. Flow at the Brunswick Fishway, 2001

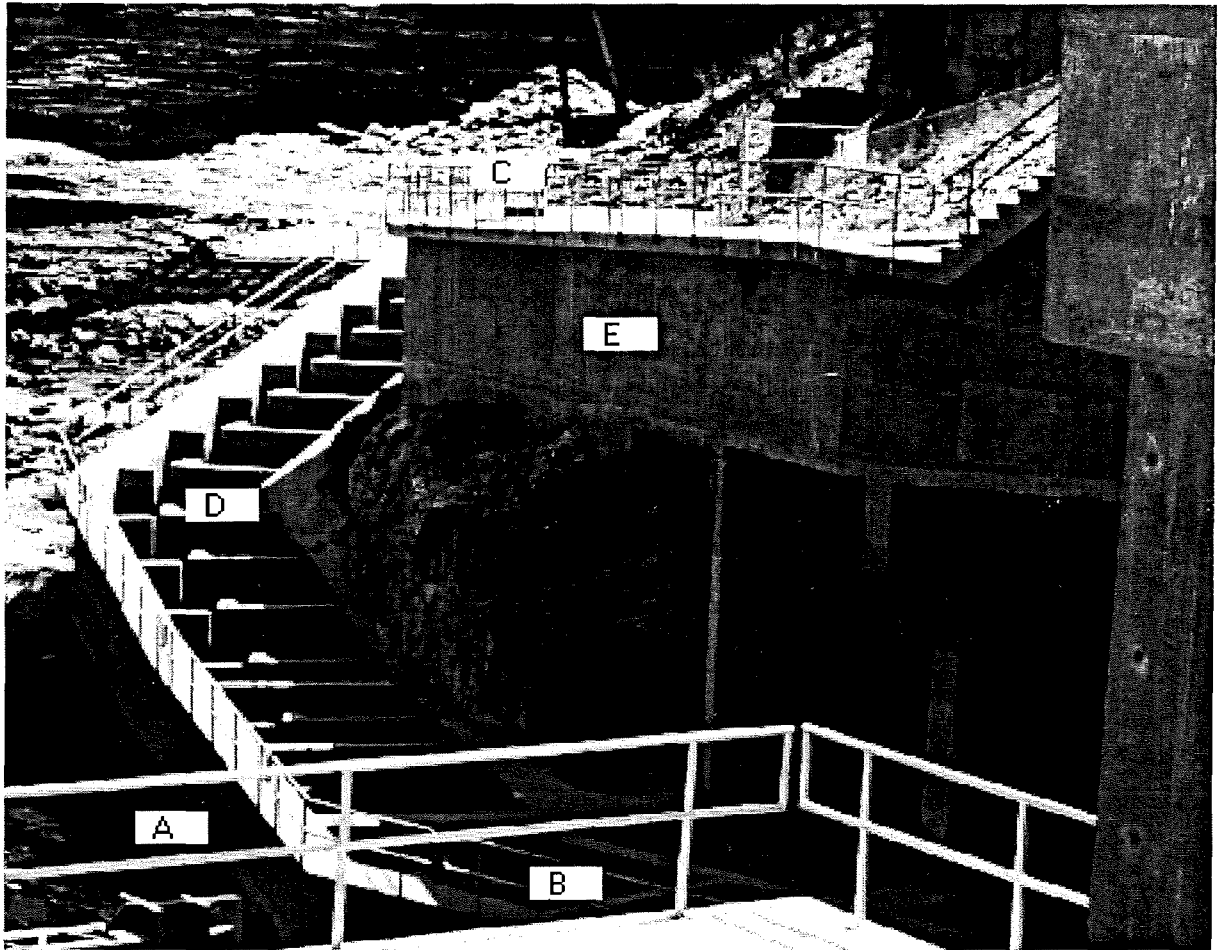


Figure 12. Brunswick fishway; (A) Location of River Camera, (B) Pool Number 6, (C) Corner Pool, (D) Lower Fishway, (E) Upper Fishway.

Brunswick Fishway Specifications

| | |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type: | Vertical Slot |
| Description: | Reinforced concrete w/precast baffles |
| Overall Length: | 570' +/- |
| Floor Elevations: | Elevation 34.0 at fishway exit Elevation -5.0 at fishway entrance |
| Floor Slope: | 1 on 10 |
| Pool Size: | 8'-6"W x 10'-0"L with 11" wide slot |
| Drop per Pool: | 12" |
| Design Populations: | 85,000 shad per year 1,000,000 alewives per year |
| Fishway Operating Range: | Maximum headwater elevation 43.0 Maximum tailwater elevation 7.5 Q = 30,000 CFS Normal headwater elevation 39.4 Normal tailwater elevation 2.5 Q = 4,400 CFS Minimum headwater elevation 37.4 Minimum tailwater elevation -1.0 Q = 0 CFS |
| Design Flow: | 30 CFS |
| Supplementary Attraction Flow: | 70 CFS (gravity) |
| Total Attraction Flow: | 100 CFS |
| Fishway Entrance Jet Velocity: | 4.0 FPS to 6.0 FPS |
| Tailrace Velocity: | 5.0 FPS maximum |
| <u>Appurtenances:</u> | |
| Gates: | 1 - 7' x 10' motorized & instrumented sluice gate at fishway exit. This gate to be closed when pond level reaches elevation 43.0+ 1 - 4' x 10' motorized & instrumented sluice gate at entrance to downstream |

Appurtenances, cont.:

| | |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gates: | Migrant passage on north side of powerhouse 2 - 27" diameter motorized & instrumented sluice gates at intake of supplementary attraction flow system 2 - pneumatic trap gates at fish trap Stop logs at fishway entrance & exit Trash rack: 1 10' x 12' at fishway exit with 5 3/4" clear bar spacing |
| Fish Crowder | 1" x 4" grating on motorized trolley at fish trap |
| Fish Hopper | 500-gallon capacity with electric hoist at fish trap |

Related Work:

| | |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Existing Overflow Spillway | Addition of flashboards (120 L.F.) to elevation 42.0 to prevent discharge into tailrace at river flow 20,000 CFS |
| Fish Barrier Wall | Reinforced concrete semi-gravity type with top at elevation 21.0 to prevent discharge into tailrace at river flows up to 20,000 CFS |
| Overall Length | 170' +/- |
| Maximum Height | 30' +/- |
| Appurtenances | Sluice gate for dewatering intermediate pool |

Species Observed Using The Brunswick Fishway 1983-2001

Brook trout
Brown trout
Smallmouth bass
Largemouth bass
White sucker
Striped bass
American shad
Coho salmon
Carp
Sea lamprey
Rainbow trout
Chinook salmon
White perch
Yellow perch
Atlantic salmon
American eel
Landlocked salmon
Sunfish (Bluegill)
Sunfish (Pumkinseed)
Pumpkinseed Sunfish
Creek chub
Golden Shiner
Common Shiner
White catfish
Spottail Shiner
Rainbow Smelt
Crayfish