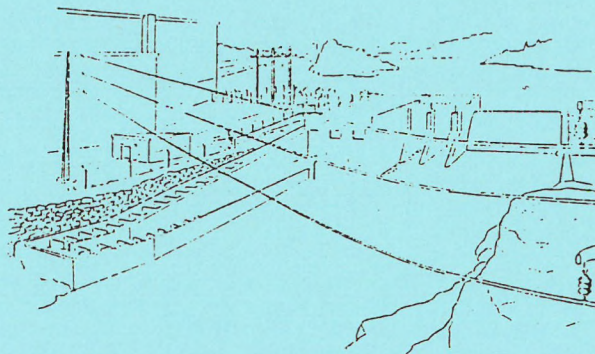


1998  
**BRUNSWICK FISHWAY REPORT**



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

**March, 1999**



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

**1998 Program Results**

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

Prepared by: Sandra J. Lary

In Cooperation With:  
Central Maine Power Company  
National Marine Fisheries Service (P.L. 89-304)

Maine Department of Marine Resources  
Stock Enhancement Division  
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## **EXECUTIVE SUMMARY**

In 1982, the hydroelectric facility owned by Central Maine Power Company on the Androscoggin River in Brunswick/Topsham was reconstructed. As a result of this process, a vertical slot, denil fishway with a trapping/sorting facility and a downstream passage facility capable of passing diadromous and resident fish species was constructed. In support of an ongoing cooperative agreement, Central Maine Power maintains the facility and Maine Department of Marine Resources' personnel operate the fishway. The fishway is operated from May through October as a tool to support the native diadromous fish restoration program in the Androscoggin River watershed.

In 1998, the Brunswick Fishway was opened on May 4 and upstream migrating adult river herring were first observed on May 7. A total of 25,189 adults were captured between May 16 and June 26; 20,805 fish were distributed into 3,209 acres of historic spawning habitat and an additional 4,322 adults were released into the Brunswick dam headpond.

Five adult American shad were captured at the fishway between May 24 and July 28 and, due to the low number of adults using the ladder, were released into the headpond. Observations of approximately 30 adult shad at the fishway entrance and in the lower pools between June 5 and July 30 indicates that the number of shad captured in the fishway may not be an accurate reflection of the actual number of returning adults. In fact, juvenile alosid surveys conducted in previous years indicate that natural reproduction by stocked adults was successful. In the five years since 1994, nearly 80 adult shad have been observed at the fishway, while only 14 have actually been captured. The water temperature when shad were captured or observed averaged 19.8°C. This past year was the first of a ten-year program in which no adult shad were transferred from the Connecticut River for release into historic spawning/nursery habitat. However, adult shad stocking will be resumed and shad fry stocking may be initiated in 1999.

The diversity and movement of other members of the diadromous and resident fish community were also monitored at the fishway. Six additional species of fish captured included Atlantic salmon, American eel, striped bass, white sucker, smallmouth bass and brown trout. Thirty-four Atlantic salmon were passed upstream between June 24 and October 13. Approximately 15 juvenile American eel (yellow) were observed in the fishway between July 11 and July 30, while only one was captured. Two striped bass were captured and numerous others were observed from August through October, feeding on emigrating juvenile alewives near the project tailrace.

Fish species other than river herring and American shad were identified during the upper and lower Androscoggin River watershed juvenile alosid survey. A total of 14 different species were found at the upper and lower watershed sampling locations. Nine species were captured in the upper watershed and ten in the lower. Of these species, chain pickerel, largemouth bass, yellow perch and brown trout were found only in the upper watershed. Redfin shiner, spottail shiner, American eel, white sucker and pumpkinseed were found only in the lower watershed.

Downstream emigration of juvenile river herring began in July and continued through October. Sampling conducted to determine juvenile growth and emigration timing in the upper and lower reaches of the river included the sampling of 201 juveniles at the fishway.

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## **INTRODUCTION**

The Androscoggin River, with a drainage area of approximately 3,460 square miles, is the third largest river watershed in Maine. 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 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 their riverine areas. Atlantic salmon, which could ascend the earliest built, low-head dams at Brunswick, were captured 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 without fish passage capabilities, in combination with severely polluted waters, virtually eliminated all opportunity for fish to live and reproduce in the main stem and most tributaries. Since the early 1970s, substantial improvement in water quality and the provision of fishways at some of the dams have greatly enhanced the prospects for successful fish restoration to the Androscoggin River.

In 1982, the Brunswick denil fishway was 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. Passage at the three hydro-power projects provides access for diadromous and resident species as far upstream as Lewiston Falls. Since 1983, over 365,000 adult river herring captured at the Brunswick Fishway have been distributed 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 which prevents access to alewife spawning and nursery habitat areas. In the five years since 1994, nearly 80 adult shad have been observed at the fishway, while only 14 have actually been captured, indicating that the fishway may be inadequate for the passage of American shad. Since 1987, 5,200 prespawner American shad have been transferred from the Merrimack and Connecticut Rivers for release into the Androscoggin River below Lewiston Falls, and juvenile surveys indicate that natural reproduction by the adults has been successful. Over 650 Atlantic salmon have passed the Brunswick Fishway since 1983, averaging 44 Atlantic salmon captured annually. Of those 650, 623 were sea-run origin Atlantic salmon while the remainder were landlocked.



## **BRUNSWICK FISHWAY OPERATION**

The fishway at Brunswick was officially opened for its 16th consecutive season on May 4, 1998. Prior to its opening, the CMP maintenance crew checked out all equipment (pumps, compressors, pneumatic gates and electrical components) for serviceability. Only minor maintenance was required at the facility since extensive work was done in 1997. The attraction water diffusion chamber was also inspected and cleaned. During the end of the alewife run, a high water event occurred which required closure of the fishway from June 15 to June 17.

The trapping and sorting facilities at Brunswick functioned well throughout the season, except that the fishway water attraction valve required adjustments to the computer program. As in previous years, the leaf buildup in the fall periodically caused very low water levels in the fishway due to their matting against the racks. During the first week of October, juvenile alewife mortality was observed at the project site. Approximately 50-100 juvenile alewives were observed daily, impinged against the trash racks or on the rocks below the dam.

## **FISH RESTORATION**

### **RIVER HERRING:**

The 1998 river herring run increased from those of 1996 and 1997 (10,198 and 5,540 adults, respectively) to a total of 25,189. The fishway was opened on May 4 and river herring were first observed on May 7. Adult river herring were captured at the fishway between May 16 and June 26 (Table 1), when the water temperature averaged 18.2°C and flows averaged 5301 cfs (Figures 1 and 2). The run peaked on May 22 - 23 when 43% of the total run occurred (11,030 adults). The water temperature averaged 18.4°C and flows 4535 cfs during these two days. A total of 20,805 adult river herring were distributed into 3,209 acres of lake and riverine habitat at an average density of 7.8 fish per acre. Stocking densities in five ponds ranged from 6.0 to 9.1 fish per acre, while stocking densities in the streams and rivers were higher, averaging 9.5 fish per acre. These density figures do not include the 4,322 adults released into the Brunswick headpond for upriver migration (Tables 2 and 3). From the 101 adult river herring collected for analysis, we determined that 43.6% were females, while 56.4% were males. The average weight and length of the females was 168 gm and 25.8 cm, respectively; the average weight and length of the males, 139 gm and 25.8 cm, respectively (Table 4). In 1998, Sabattus Pond, a significant and historic spawning and nursery habitat area of 1,787 acres, was available for river herring restoration. This rise from 1,512 acres in 1997 to 3,209 in 1998 represents a 42% increase in available habitat. Due to the increased habitat, the number of adult returns that could be transported to upstream spawning habitat also increased (Table 5; Figure 3). In previous years, adult returns have been higher than the habitat available for stocking at the target stocking density of six fish per acre.

### **AMERICAN SHAD:**

Five American shad were captured at the fishway between May 24 and July 28 and released into the Brunswick headpond, rather than taken to spawning habitat (Table 6). During this period, the average water temperature was 19.3°C. Unlike the previous ten years (1987-1997), 1998 was the first year that the Androscoggin River received no adult American shad from the Connecticut River at Holyoke, MA for its restoration program (Table 7).

Since 1994, approximately 79 adult shad have been observed at the fishway, while only 14 have actually been captured, indicating that those captured in the fishway may not be an accurate

reflection of the number of adults returning to the Androscoggin River, and that the fishway may be inadequate for shad passage. Juvenile alosid surveys conducted in previous years indicate that natural reproduction by stocked adults was successful. In 1998, a total of 30 adult shad were observed at the Brunswick Fishway between June 5 and July 30 outside its entrance and in the lower portion below the sharp turn halfway up the ladder (Table 8). During this period, the average water temperature was 19.8°C. On June 9, six adult shad were observed in the lower fishway during dewatering and cleaning of the fishway. On July 21, approximately 20 adult shad were observed in the river beside the fishway, swimming to the entrance and then dropping back downstream. On July 30, the fishway entrance was closed and dewatered in order to trap and capture any adult shad that might have been in the lower fishway but were not moving up the ladder and into the trap. A gate was constructed and dropped into the lower portion of the fishway, and the fishway slowly dewatered. Although no shad were available that day, this method of trapping and capturing fish present in the fishway may be tested further in 1999.

#### ATLANTIC SALMON:

Other than providing upstream passage past the first three dams on the river, an active Atlantic salmon restoration program is not in place for the Androscoggin River. However, an average of 44 fish are captured annually at Brunswick and adults and juveniles may utilize spawning and nursery habitat present in this portion of the river. Since 1983, a total of 653 Atlantic salmon have been captured at the fishway, 623 of which have been sea-run in origin (Table 9; Figure 4). In 1998, the first of 34 Atlantic salmon was passed into the headpond on June 24, the last on October 13, at river temperatures of 20.0°C and 12.3°C, respectively. Of these salmon, four were sea-run in origin and the remaining 30 were landlocked. The landlocked salmon were stocked both upstream and downstream of Brunswick in 1998 by the Maine Department of Inland Fisheries & Wildlife. The majority of the salmon migrated during June and July (27 total), with the average temperature 20.0°C - 22.0°C (Table 10; Figure 5). No salmon were captured during the month of August when the average temperature was 23.5°C. One salmon was captured in September and six in October. Salmon may have been migrating upstream in November, but there is no data as the fishway was closed on November 1, 1998. Before being released, all salmon were examined for tags, clips and/or identifying marks; measured for fork and total length; and scale sampled. The average fork length for the salmon captured in 1998 was 571 mm.

#### AMERICAN EEL:

One American eel was captured at Brunswick in 1998. Approximately 15 juvenile American eels (yellow) were observed in the fishway between July 11 and July 30; however, they are rarely captured in the trap since upstream migrating juveniles are often small enough to pass through the trap grating. American eel juveniles released above Brunswick may use the fish passage facilities located at the next two dams to reach and utilize upstream habitat for an average of 20 years to grow to adulthood before emigrating to reproduce in the Sargasso Sea. It is from August through October that the adults migrate downstream from the freshwater to the saltwater habitat.

#### STRIPED BASS:

Two striped bass were captured at Brunswick in 1998, but many more were observed in the fishway and trapping area. All were juvenile fish ranging from 12 to 18 inches. Many striped bass were also observed feeding in the tailrace as schools of juvenile alosids passed through the turbines and downstream facility from August to October.



#### OTHER SPECIES:

Data are collected on a daily basis to characterize the migratory and resident fish species using the Brunswick Fishway ladder. Most native species are passed to the upstream headpond from the sorting tank through the 10" flexible pipe into the fishway above the gates, with the exception of sea lamprey and striped bass, which are netted from the stocking tank and returned to the river below the dam. Other non-indigenous species such as carp are also returned to the river below the dam; however, brown trout are passed upstream. In 1998, three other fish species totaling 23 fish were captured at the Brunswick Fishway (Table 11). These included four white suckers, nine smallmouth bass and ten brown trout, all of which were passed upstream through the fishway. In the previous three years, species such as brook trout, creek chub, sea lamprey and brown trout were also captured (Table 12).

Additional data on the fish community were collected biweekly via beach seining during the juvenile alosid survey in the upper and lower river reaches. In the upper Androscoggin juvenile alosid survey above the Brunswick dam, fish community species other than river herring included smallmouth bass, white perch, killifish, common shiner, minnow sp., largemouth bass, yellow perch, chain pickerel and brown trout. In the lower Androscoggin juvenile alosid survey conducted below the Brunswick dam, the following species were captured: smallmouth bass, white perch, killifish, common shiner, minnow sp., redbfin shiner, spottail shiner, American eel, white sucker and pumpkinseed. A total of 14 different species were found in both areas combined. Nine species were captured in the upper watershed and ten in the lower. Of these, chain pickerel, largemouth bass, yellow perch and brown trout were found in the upper watershed, but were not captured in the lower watershed. Redfin shiner, spottail shiner, American eel, white sucker and pumpkinseed were found in the lower watershed, but were not captured in the upper watershed (Table 13).

#### JUVENILE RIVER HERRING:

Young-of-the-year alewives were taken from the fishway hopper from August 3 through October 24, 1998 with water temperatures ranging from 25.5° to 10.3°C, respectively. A total of 201 juveniles averaged 98 mm total length during the sampling period (Table 18). On several occasions, schools of varied sizes were observed passing downstream by the counting window. They were often being preyed upon by smallmouth and striped bass. Overall, in the upper riverine areas of the Androscoggin, 301 juveniles were captured by beach seining and ranged in size from 56 mm to 138 mm. In upper lakes and ponds, 111 juveniles were captured ranging in size from 35 mm to 110 mm; in the lower river, 38 juveniles ranged from 31 mm to 75 mm in length.

#### JUVENILE AMERICAN SHAD:

For the first time in ten years, no adult shad were present in spawning and nursery areas as a result of adults stocked from other systems and other than the five captured adults passed into the Brunswick dam headpond. Therefore, no juvenile shad were captured during the 1998 sampling activities.

#### ENVIRONMENTAL DATA:

Air temperature, water temperature and headpond level data collected at the Brunswick Fishway from May 1998 through October 1998 are shown in Tables 22 through 27.



**Table 1: Adult River Herring Captured, Water Temperature and Flow at the Brunswick Fishway, 1998**

<b>Date</b>	<b>Number</b>	<b>Tempt (c)</b>	<b>Flow (cfs)</b>	<b>% Total Run</b>
5.16.98	2262	15.6	6730	9
5.17.98	1669	16.9	6650	7
5.18.98	3136	16.3	6550	12
5.19.98	1745	17.6	5110	7
5.22.98	5134	18.5	4860	20
5.23.98	5896	18.3	4210	23
5.24.98	1304	18.3	3640	5
5.28.98	1398	19.3	3490	6
5.29.98	2573	19.0	3650	10
6.3.98	38	18.4	3600	0.2
6.4.98	4	17.9	4470	0.02
6.11.98	29	19.1	4050	0.1
6.26.98	1	20.8	11900	0.004
<b>98 Total/Av.</b>	<b>25189</b>	<b>18.2</b>	<b>5301</b>	

Note: Flow Data from USGS Station 01059000

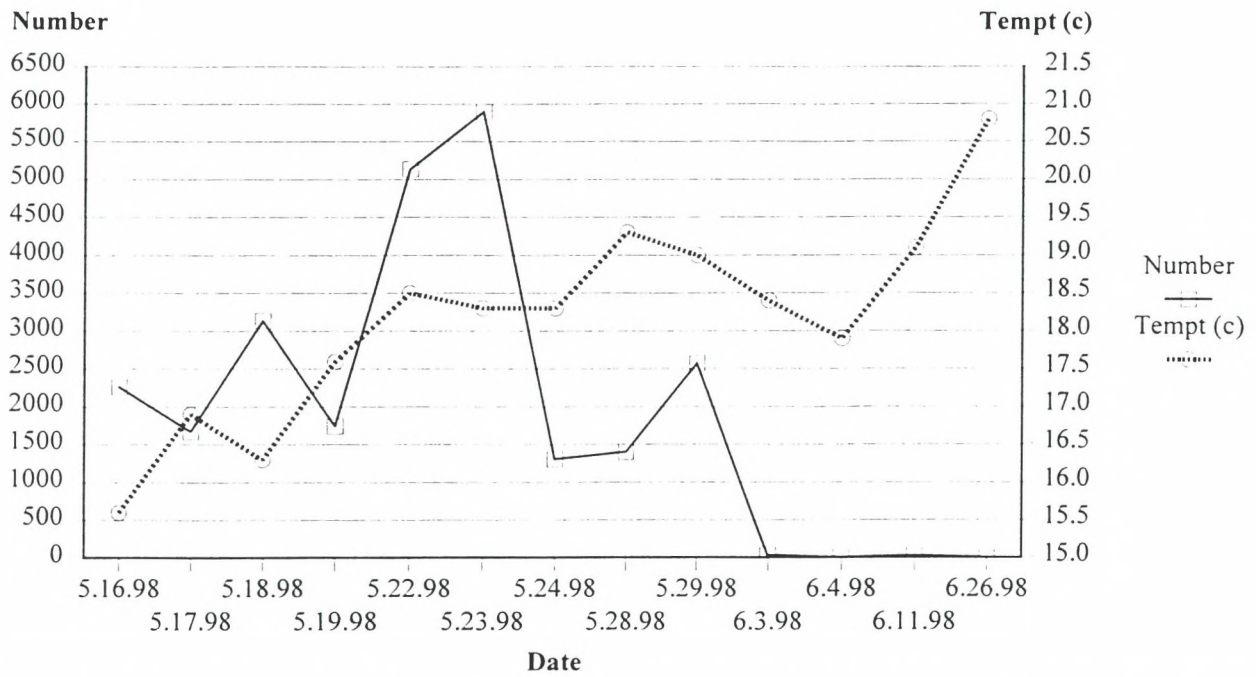


Figure 1: Number of adult river herring captured and water temperature at the Brunswick fishway, 1998

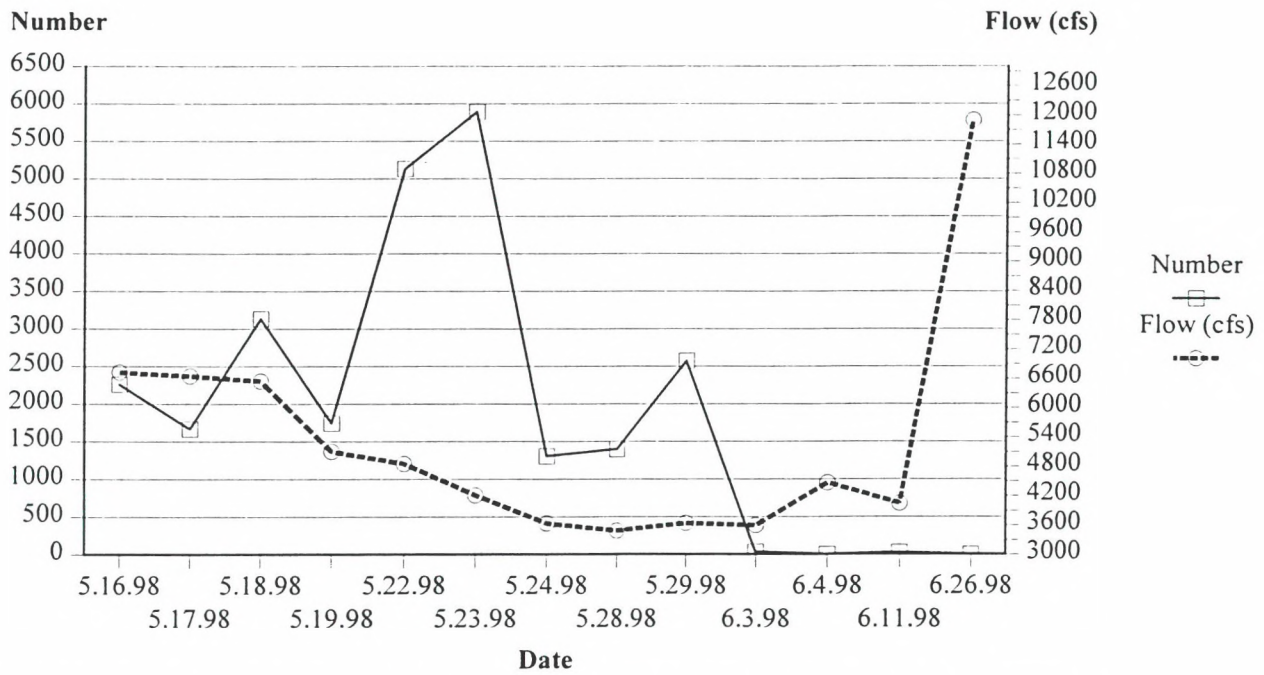


Figure 2: Number of adult river herring captured and water flow at the Brunswick fishway, 1998

**Table 2. Adult River Herring Distribution in the Androscoggin Watershed by Site, 1996-98**  
**(Source: Androscoggin / Kennebec)**

<b>Habitat</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>
Sabattus Pond	-	-	10,783 / 0
Taylor Pond	3,014 / 765	0 / 3,801	4,336 / 0
Tripp Pond	1,362 / 3,167	-	-
Lower Range Pond	1,192 / 601	0 / 1,723	1,852 / 0
Androscoggin River	736 / 0	-	-
Sabattus River	1,365 / 994	837 / 2,286	1,611 / 0
Marshall Pond	689 / 0	0 / 711	930 / 0
Bog Brook	403 / 0	359 / 0	788 / 0
Durham Boat Ramp	-	0 / 1,807	-
Loon Pond	-	-	505 / 0
<b>TOTAL</b>	<b>8,761 / 5,527=14,288</b>	<b>1,196 / 10,328=11,524</b>	<b>20,805 / 0</b>
Brunswick Headpond (passed upstream)	1,040 / 0	4,824 / 0	4,322 / 0
<b>TOTAL PASSED</b>	<b>9,801 / 5,527=15,328</b>	<b>6,020 / 10,328=16,348</b>	<b>25,127 / 0</b>



**Table 3. 1996-1998 Adult River Herring Stocking Densities**

<b>Habitat</b>	<b>Acres</b>	<b>1996 Densities (fish/acre)</b>	<b>1997 Densities (fish/acre)</b>	<b>1998 Densities fish/acre)</b>
Sabattus Pond	1,787	-	-	6.0
Taylor Pond	625	6.0	6.1	6.9
Tripp Pond	768	5.9	6.0	-
Lower Range Pond	290	6.2	5.9	6.4
Androscoggin River	-	n/a	-	-
Sabattus River	~275	n/a	8.9	5.9
Marshall Pond	102	6.8	7.0	9.1
Bog Brook	60	6.7	6.0	13.1
Durham Boat Ramp	500	-	3.6	-
Loon Pond	70	-	-	7.2
<b>AVERAGE</b>		<b>6.3</b>	<b>6.2</b>	<b>7.8</b>

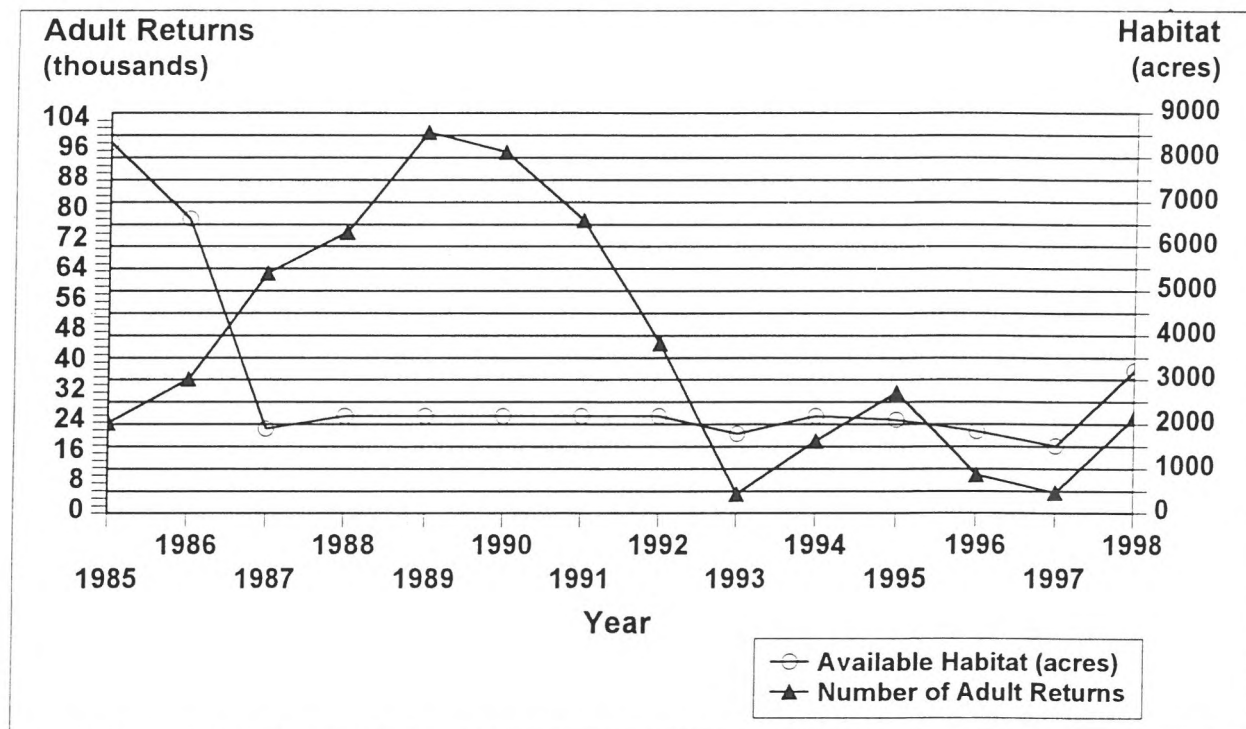
**Table 4. Adult River Herring Sampled at Brunswick Fishway, 1998**

<b><u>Date</u></b>	<b><u>Sex</u></b>	<b><u>No.</u></b>	<b><u>Av. length (cm)</u></b>	<b><u>Av. weight (gm)</u></b>
5-19-98	F (47%)	24	23.87	173
	M (53%)	27	24.85	142
5-23-98	F (40%)	20	27.7	163
	M (60%)	30	26.6	135

**Note:** 62 samples were taken at the fishway; the remaining 39 samples were from mortalities incurred during distribution

**Table 5: Adult River Herring Habitat Availability, Returns and Distribution in the Androscoggin River Watershed 1985 through 1998**

Year	Habitat (Acres)	Returns	No. stocked (Androscoggin and Kennebec)
1998	3,209	25,189	20,805
1997	1,512	5,540	11,524
1996	1,845	10,198	14,288
1995	2,105	32,002	10,591
1994	2,192	19,190	14,549
1993	1,785	5,202	7,448
1992	2,192	45,050	12,351
1991	2,192	77,511	13,574
1990	2,192	95,574	11,725
1989	2,192	100,895	13,814
1988	2,192	74,341	13,183
1987	1,902	63,523	11,892
1986	6,618	35,471	17,763
1985	8,345	23,895	37,773



**Figure 3: Adult Alewife Returns and Habitat Availability in the Androscoggin River Watershed 1985 through 1998**

**Table 6. American Shad Captured at the Brunswick Fishway, 1993-1998**

Year	Date	No.	Water Temp. (°C)
1998	5/24	1	18.3
	6/3	1	18.4
	6/4	1	17.9
	6/5	1	17.0
	7/28	1	25.0
1997	6/9	1	17.9
	7/1	1	23.2
1996	6/11	1	18.8
	6/25	1	20.4
1995	6/3	1	19.1
	6/8	1	20.5
	6/10	1	21.8
1994	6/22	1	22.2
1993	6/7	1	15.3
<b>Total #</b>		<b>14</b>	
<b>Av. T</b>			<b>19.7</b>
<b>Min / Max T</b>			<b>15.3 / 25.0</b>

**Table 7. Adult American Shad Distribution in the Androscoggin Watershed, 1987- 1998**

Year	Number distributed	Source			Mortality during transport
		Androscoggin	Connecticut	Merrimack	
1998	5	5	-	-	n/a
1997	221	2	219	-	13%
1996	312	2	310	-	37.8%
1995	1,090	3	1,087	-	9.8%
1994	707	1	706	-	38%
1993	580	1	579	-	20%
1992	566	-	566	-	15%
1991	357	-	357	-	31%
1990	354	1	353	-	21%
1989	414	-	414	-	25.5%
1988	513	-	513	-	1.2%
1987	92	-	-	92	11%
<b>TOT.</b>	<b>5,206</b>	<b>15</b>	<b>5,104</b>	<b>92</b>	<b>Av.=21.7%</b>



**Table 8. American Shad Observations at the Brunswick Fishway, 1994-1998**

<b>Year</b>	<b>Date</b>	<b>Observation</b>	<b>Water Temp. (°C)</b>
<b>1998</b>	6/5	1 dead in fishway	17.0
	6/7	1 dead in fishway	17.5
	6/9	6 in lower fishway	17.4
	6/11	1 in fishway window	19.1
	7/21	Approx. 20 at fishway entrance	23.8
	7/30	1 dead in fishway	23.8
<b>1997</b>	6/9	School (more than 3) in fishway turning pool	17.9
	6/10	Approx. 36 at fishway entrance	-
<b>1996</b>	-	-	-
<b>1995</b>	-	Alterations made to fishway turning pool	-
<b>1994</b>	6/20	Less than 10 in lower fishway	23.7
<b>Total</b>		<b>Approx. 79 fish observed</b>	
<b>Av. T</b>			<b>20.0</b>
<b>Min T</b>			<b>17.0</b>
<b>Max T</b>			<b>23.8</b>

**Table 9. Number, Origin and Lengths of Sea-Run Androskoggin Atlantic Salmon,  
1983-1998**

Age	Sea-Run Hatchery				Sea-Run Wild				Av. 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	*	4	*	*	*	*	*	*	737	4
Totals	26	503	6	2	5	80	0	1		623

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

SW - # Sea Winters/number of years at sea  
Repeat - repeat spawner

TL - total length measured; all others are fork length  
\* - 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 10. Atlantic Salmon - Androscoggin River, Brunswick Fishway, May-October 1998**

Date	Fork Length (mm)	Total Length (mm)	Clips/Marks	Water Temp. (°C)
6/24	-	584	Right and left pelvic	20.0
	-	457	Adipose	
	-	558	Right pelvic	
	-	584	None	
6/25	-	584	Right pelvic	20.2
6/26	-	584	Right pelvic	20.8
	-	559	Right pelvic	
6/29	-	473	Adipose	19.6
	584	610	Right pelvic	
	565	584	Right pelvic	
6/30	438	467	Adipose	18.8
<b>7/1</b>	<b>768</b>	<b>787</b>	<b>None</b>	<b>19.0</b>
7/3	387	406	None	21.0
<b>7/5</b>	<b>711</b>	<b>754</b>	<b>None</b>	<b>20.1</b>
	445	470	Adipose	
	597	629	Adipose	
7/8	546	591	Right pelvic	20.8
	540	565	None	
	445	470	Adipose	
	546	572	None	
	432	457	Adipose	
7/11	584	622	Adipose	21.0
7/13	622	638	None	21.7
7/17	572	597	None	22.3
7/18	578	584	Left pelvic	23.0
7/23	-	-	None	25.4
7/28	454	476	Adipose	25.0
9/18	600	620	None	19.5
10/7	545	570	Right pelvic	14.0
<b>10/8</b>	600	615	None	14.2
	640	660	None	
	<b>770</b>	<b>790</b>	<b>None</b>	
<b>10/10</b>	<b>698</b>	<b>763</b>	<b>None</b>	<b>14.3</b>
10/13	610	630	Right pelvic	12.3
<b>Total no. fish</b>	<b>34</b>			
<b>Average</b>	<b>571</b>	<b>585</b>		<b>19.7</b>
<b>Min. T</b>				<b>12.3</b>
<b>Max. T</b>				<b>25.4</b>

Note: Those in **bold** are sea-run origin Atlantic salmon while the remainder were landlocked origin.

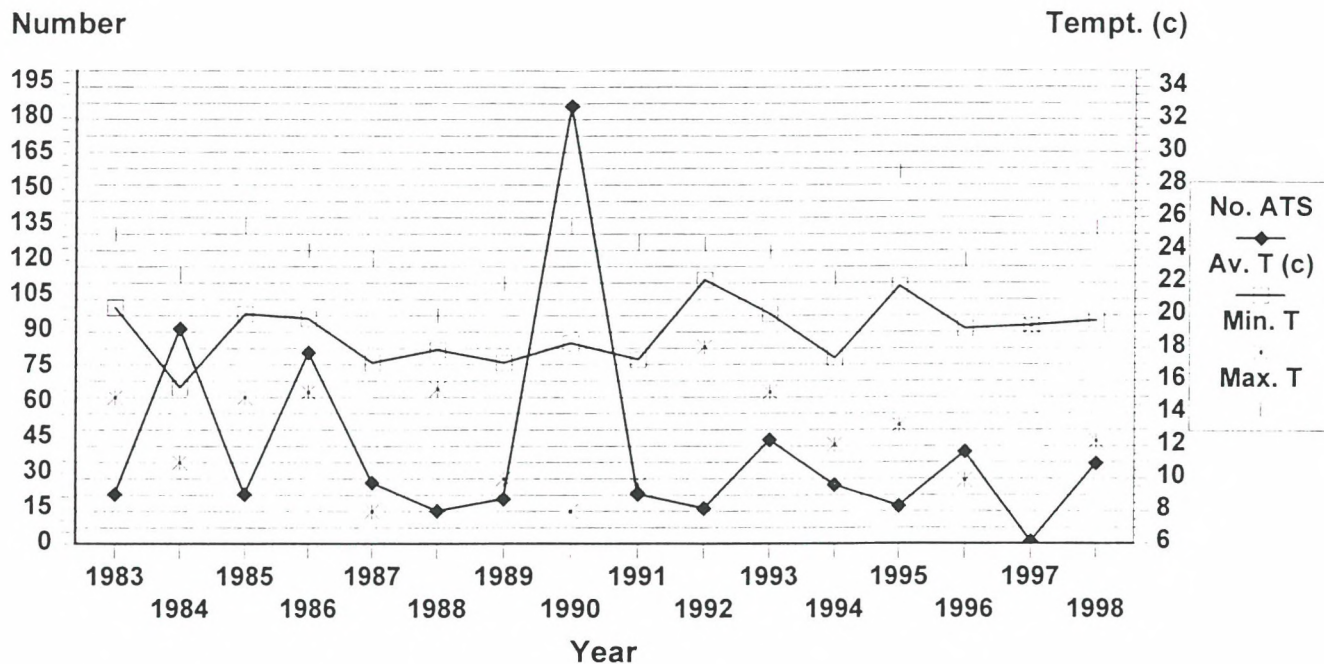


Figure 4. June-November 1983-1998

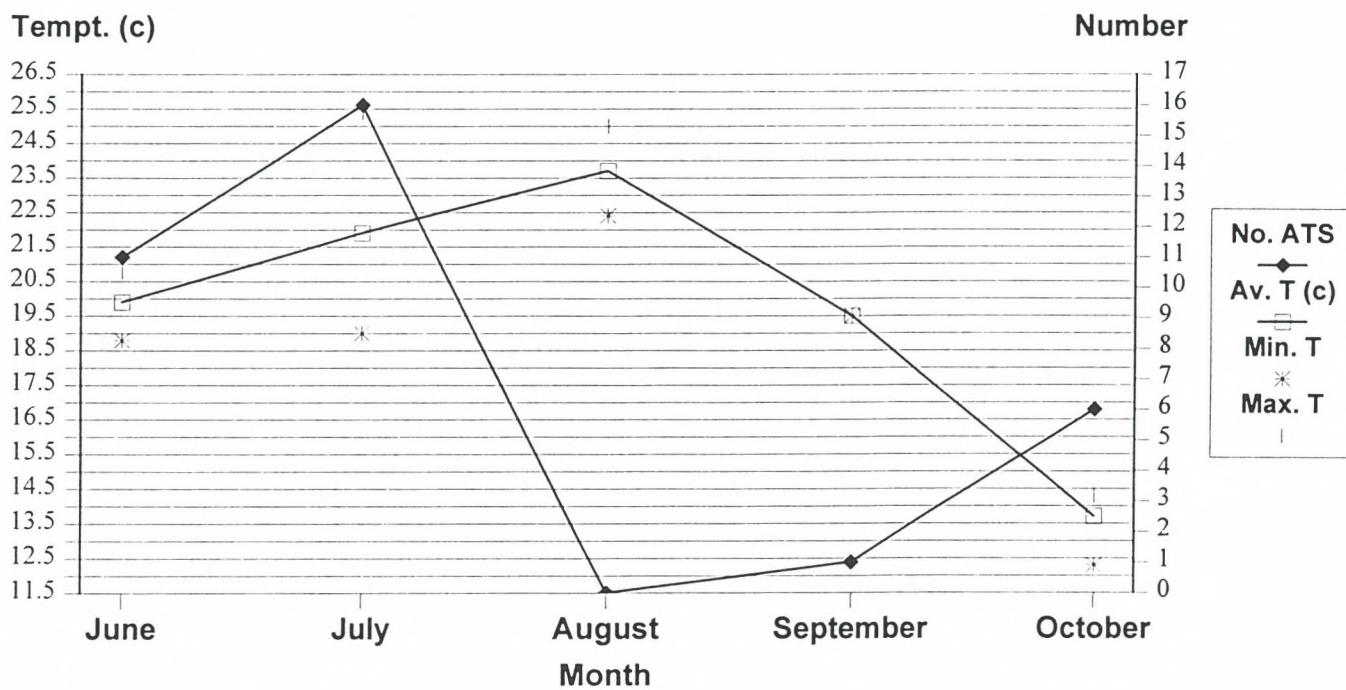


Figure 5. June-October 1998



**Table 11. Other Fish Species Captured at Brunswick Fishway, May - Oct 1998**

	May	June	July	Aug.	Sept.	Oct.	Species Total
<b>Atlantic salmon</b> ( <i>Salmo salar</i> )	0	11	16	0	1	6	<b>34</b>
<b>White Sucker</b> ( <i>Catostomus commersoni</i> )	3	0	1	0	0	0	<b>4</b>
<b>American Eel</b> ( <i>Anguilla rostrata</i> )	0	0	1	0	0	0	<b>1</b>
<b>Striped Bass</b> ( <i>Morone saxatilis</i> )	0	1	0	0	1	0	<b>2</b>
<b>Smallmouth Bass</b> ( <i>Micropterus dolomieu</i> )	5	0	3	0	1	0	<b>9</b>
<b>Brown Trout</b> ( <i>Salvelinus alpinus</i> )	3	3	3	0	0	1	<b>10</b>
<b>Monthly Total</b>	<b>11</b>	<b>15</b>	<b>24</b>	<b>0</b>	<b>3</b>	<b>7</b>	<b>60</b>

**Table 12. Other Fish Species Captured at Brunswick Fishway, 1995-1998**

	May	June	July	Aug.	Sept.	Oct.	Nov.	Species Total
<b>Atlantic salmon</b> ( <i>Salmo salar</i> )	0	33	27	10	6	13	1	<b>90</b>
<b>American Eel</b> ( <i>Anguilla rostrata</i> )	0	0	2	3	0	0	0	<b>5</b>
<b>Striped Bass</b> ( <i>Morone saxatilis</i> )	0	13	3	0	1	0	0	<b>17</b>
<b>Brook Trout</b> ( <i>Salvelinus fontinalis</i> )	0	1	0	0	0	0	0	<b>1</b>
<b>Creek Chub</b> ( <i>Semotilus atromaculatus</i> )	0	1	0	0	0	0	0	<b>1</b>
<b>White Sucker</b> ( <i>Catostomus commersoni</i> )	149	23	0	0	0	0	0	<b>172</b>
<b>Sea Lamprey</b> ( <i>Petromyzon marinus</i> )	0	1	0	0	0	0	0	<b>1</b>
<b>Smallmouth Bass</b> ( <i>Micropterus dolomieu</i> )	8	42	4	3	1	0	0	<b>58</b>
<b>Brown Trout</b> ( <i>Salvelinus alpinus</i> )	3	3	3	1	0	1	0	<b>11</b>
<b>Monthly Total</b>	<b>160</b>	<b>117</b>	<b>39</b>	<b>17</b>	<b>8</b>	<b>14</b>	<b>1</b>	<b>356</b>

**Table 13. Fish Community in Upper and Lower Androscoggin Watershed, 1995-1998**

<b>Upper</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>
Smallmouth bass	X	*	*	X
Largemouth bass	X			X
White perch	X			X
Yellow perch	X			X
Hornpout	X			
Creek chub	X			
Killifish	X			X
Common shiner	X			X
Minnow sp.				X
Chain pickerel	X			X
Sunfish	X			
Brown trout				X
<b>Lower</b>				
Smallmouth bass	X	X	*	X
Largemouth bass	X	X		
White perch	X	X		X
Yellow perch	X	X		
Creek chub		X		
Mummichug	X			
Killifish	X	X		X
Redfin shiner		X		X
Golden shiner		X		
Common shiner		X		X
Spottail shiner	X	X		X
Minnow sp.				X
American eel	X	X		X
White sucker		X		X
Pumpkinseed	X	X		X
Bluegill	X			

Upper - Above Brunswick dam at sites identified in Tables 14-17

Lower - At and below Brunswick dam at sites identified in Tables 18-21

X - Present      \* - Data not reported

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**Table 14. Lower Range Pond**

Date	Water T (°C)	Site	Number	Length (mm)		
07/22/98	27.6	L. Range Pd	1	35		
08/24/98	24.5	L. Range Pd	10	45,73,45,46,45,60,53,38,52,40		
<b>Total/Av.</b>			<b>11</b>	<b>48</b>		

**Table 15. Sabattus Lake**

Date	Water T (°C)	Site	Number	Length (mm)		
08/06/98	26.0	Sabattus L.	6	78, 78, 82, 71, 80, 84		
08/06/98	26.0	Sabattus L.	2	86, 78		
08/25/98	23.0	Sabattus L.	50	100,83,90,85,95,95,100,88,100,110,98,100,95,98,105		
08/25/98				95,97,100,95,95,98,77,95,100,100,80,96,95,100,100		
08/25/98				100,95,100,95,98,100,97,98,100,110,100,100,97,98		
08/25/98				100,100,95,100,98		
08/25/98	23.0	Sabattus L.	50	89,78,80,76,59,76,72,78,82,88,76,80,77,81,85,85,78		
08/25/98				78,72,85,81,86,76,79,79,83,76,84,81,79,82,88		
09/18/98	19.0	Sabattus L.	0			
<b>Total/Av.</b>			<b>108</b>	<b>74</b>		

**Table 16 . Sabattus River**

Date	Water T (°C)	Site	Number	Length (mm)
07/17/98	26.0	Sabattus R.	0	
07/31/98		Sabattus R.	0	
08/07/98		Sabattus R.	0	
09/08/98		Sabattus R.	0	

**Table 17 . Brookside**

Date	Water T (°C)	Site	Number	Length (mm)		
07/17/98		Brookside	0			
07/31/98		Brookside	0			
08/07/98		Brookside	0			
08/14/98	23.0	Brookside	50	85,75,78,81,77,81,84,81,81,81,82,85,85,81,83,81,90		
08/14/98				78,80,80,78,80,79,69,84,82,78,78,81,72,81,91,78,70		
08/14/98				90,80,80,74,80,82,74,78,86,82,81,82,71,80,74,82		
09/08/98		Brookside	50	64,89,97,96,98,97,96,95,93,98,99,101,95,94,90,93		
09/08/98				94,98,92,96,97,96,99,93,92,91,94,88,90,91,85		
09/08/98				100,90,90,91,92,95,99,90,91,95,100,92,90,82,100,93,95		
09/18/98	20.0	Brookside	0			
<b>Total/Av.</b>			<b>100</b>	<b>85</b>		

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**Table 18 . Brunswick Fishway**

Date	Water T (°C)	Site	Number	Length (mm)		
08/03/98	25.5	BFW	50	78, 56, 83, 80, 85, 80, 72, 89, 77, 77, 77		
08/03/98				78, 81, 80, 83, 67, 75, 92, 90, 78, 88, 85		
08/03/98				72, 73, 70, 86, 85, 66, 83, 81, 68, 83, 83		
08/03/98				84, 87, 74, 76, 83, 70, 66, 73, 80, 78, 75		
08/03/98				75, 84, 73, 62, 80, 83		
08/07/98	24.4	BFW	46	71, 79, 71, 83, 80, 76, 75, 66, 77, 79, 78		
08/07/98				78, 80, 79, 76, 74, 84, 84, 69, 78, 87, 78		
08/07/98				79, 59, 85, 74, 82, 78, 80, 86, 80, 80, 80		
08/07/98				80, 74, 75, 70, 82, 82, 76, 80, 78, 65, 62		
08/07/98				80, 58		
09/09/98	21.5	BFW	6	102, 96, 85, 90, 105, 105		
09/16/98	20.7	BFW	9	120, 111, 106, 120, 118, 121, 118, 119, 120		
09/18/98	21	BFW	50	150, 115, 105, 120, 120, 110, 111, 111, 115, 111, 121, 125, 115		
09/18/98				115, 116, 116, 111, 120, 115, 115, 114, 114, 115, 110, 115, 117		
09/18/98				116, 115, 110, 121, 120, 115, 110, 117, 123, 118, 105, 110, 122		
09/18/98				125, 112, 115, 102, 112, 121, 114, 108, 107, 110, 105		
09/18/98	19.5	BFW	2	114, 120		
09/19/98	19.5	BFW	0			
09/21/98	19.5	BFW	3	115, 114, 110		
10/14/98	12	BFW	18	138, 124, 131, 129, 137, 125, 100, 121, 115, 124, 105, 125, 99		
				105, 121, 100, 94, 111		
10/24/98	10.3	BFW	17	130, 130, 126, 127, 122, 133, 130, 122, 126, 130, 122, 125		
				132, 130, 120, 122, 130		
<b>Total/Av.</b>			<b>201</b>	<b>98</b>		



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Table 19. Zeke's

Date	Water T (°C)	Site	Number	Length (mm)			
08/26/98	24	Zeke's	13	50,40,31,35,33,31,33,29,32,35,33,33,40			
07/13/98	24.5	Zeke's	0				
09/22/98	20	Zeke's	0				
09/09/98	22	Zeke's	0				
07/28/98	26	Zeke's	25	63, 65, 67, 68, 56, 72, 74, 71, 60, 70, 56, 62			
07/28/98	26	Zeke's		63, 72, 75, 66, 64, 60, 68, 59, 65, 74, 65, 72			
07/28/98	26	Zeke's		67, 62, 73, 70, 70, 67, 59, 66, 60			
08/13/98	25	Zeke's					
<b>Total/Av.</b>			<b>38</b>	<b>69</b>			

Table 20. Driscoll Island

Date	Water T (°C)	Site	Number	Length (mm)
09/22/98	20	Driscoll Is.	0	
09/09/98	22	Driscoll Is.	0	
08/26/98	24	Driscoll Is.	0	
07/13/98	24.5	Driscoll Is.	0	
07/28/98	26	Driscoll Is.	0	

Table 21. Mustard Island

Date	Water T (°C)	Site	Number	Length (mm)
07/13/98	24.5	Mustard Is.	0	
09/22/98	20	Mustard Is.	0	
09/09/98	22	Mustard Is.	0	
08/26/98	24	Mustard Is.	0	
08/13/98	24	Mustard Is.	0	
07/28/98	27	Mustard Is.	0	
07/13/98	24.5	Mustard Is.	0	

TABLE 22. MAY 1998 - Brunswick Fishway Air and Water Temperatures/Headpond Levels

<u>DAY</u>	<u>AIR TEMP(°C)</u>	<u>WATER TEMP(°C)</u>	<u>HEADPOND LEVEL</u> (feet above sea level)
1	-	-	-
2	-	-	-
3	-	-	-
4	11.7	12.7	40.3
5	15.3	-	-
6	-	-	-
7	11.7	12.7	40.3
8	12.5	12.8	41.5
9	12.9	17.2	41.0
10	10.6	12.7	41.5
11	11.0	12.5	42.0
12	9.6	13.3	41.5
13	9.0	13.8	41.2
14	8.5	14.6	39.8
15	13.3	14.7	40.5
16	17.9	15.6	39.0
17	16.9	16.9	39.0
18	20.8	16.3	39.0
19	20.1	17.6	39.0
20	17.8	18.0	39.5
21	18.2	18.6	40.0
22	10.4	18.5	40.0
23	20.2	18.3	39.1
24	18.0	18.3	39.1
25	-	-	-
26	11.9	18.3	39.0
27	16.0	18.2	38.5
28	25.1	19.3	38.9
29	21.4	19.0	38.5
30	18.1	18.5	38.5
31	17.8	19.8	38.9
AV.	15.3	16.3	39.8
MIN.	9.0	12.5	38.5
MAX.	25.1	19.8	41.5

TABLE 23. JUNE 1998 Brunswick Fishway Air and Water Temperatures/Headpond Levels

<u>DAY</u>	<u>AIR TEMP (°C)</u>	<u>WATER TEMP(°C)</u>	<u>HEADPOND LEVEL</u> (feet above sea level)
1	18.4	19.8	38.9
2	15.1	18.8	39.0
3	13.6	18.4	38.3
4	13.0	17.9	38.5
5	13.7	17.0	39.5
6	13.9	17.2	38.3
7	17.8	17.5	38.0
8	12.8	17.2	38.7
9	14.2	17.4	38.4
10	19.2	18.1	38.5
11	17.1	19.1	38.0
12	17.7	18.8	39.0
13	17.2	18.0	39.2
14	17.1	16.1	41.0
15	14.1	-	46.0
16	-	-	-
17	14.6	-	-
18	21.3	-	-
19	-	-	-
20	-	-	-
21	-	-	-
22	-	-	-
23	-	-	-
24	17.3	-	39.0
25	22.3	20.2	41.5
26	21.8	20.8	41.3
27	-	-	-
28	-	-	-
29	19.5	19.8	39.6
30	21.4	18.8	41.0
AV.	16.2	16.5	39.6
MIN.	13.0	16.1	38.0
MAX.	22.3	20.8	46.0



**TABLE 24. JULY 1998 Brunswick Fishway Air and Water Temperatures/Headpond Levels**

<u>DAY</u>	<u>AIR TEMP (°C)</u>	<u>WATER TEMP(°C)</u>	<u>HEADPOND LEVEL</u> (feet above sea level)
1	17.7	19.0	40.3
2	21.0	19.3	40.7
3	22.7	21.0	41.0
4	-	-	-
5	20.3	20.1	41.2
6	23.5	20.2	39.0
7	21.7	20.6	40.5
8	19.8	20.8	41.0
9	21.4	20.6	40.9
10	22.3	21.2	38.8
11	15.8	21.0	39.0
12	20.0	20.9	40.3
13	25.2	21.7	41.4
14	28.0	21.8	40.8
15	29.1	21.8	40.3
16	26.6	22.0	39.0
17	25.3	22.3	39.4
18	25.3	23.0	38.7
19	27.7	23.7	38.7
20	19.9	23.9	38.7
21	27.7	23.8	38.8
22	25.4	24.9	38.9
23	26.6	25.4	38.7
24	26.5	24.5	38.7
25	-	-	-
26	24.2	23.8	38.3
27	25.3	24.2	39.0
28	26.1	25.0	38.6
29	23.2	24.4	38.9
30	24.3	23.8	36.5
31	21.4	23.7	37.8
AV.	23.6	22.4	39.4
MIN.	15.8	19.0	36.5
MAX.	29.1	25.4	41.4

**Table 25. AUGUST 1998 Brunswick Air and Water Temperatures/Headpond Levels**

<u>Day</u>	<u>Air Temp (°C)</u>	<u>Water Temp(°C)</u>	<u>Headpond Level (feet above sea level)</u>
1			
2	24.3	23.5	38.9
3	25.2	23.7	38.9
4	27.5	24.3	38.4
5	25.5	23.5	38.8
6	25.0	23.8	38.9
7	26.7	24.4	38.4
8			
9			
10	23.3	24.5	38.0
11	20.4	25.0	37.5
12	17.1	24.1	39.0
13	19.2	22.9	39.2
14	23.2	23.7	39.1
15			
16	21.7	23.9	38.9
17	21.7	24.5	38.5
18	24.4	24.3	38.5
19	20.9	24.0	38.7
20	23.4	23.2	39.2
21			
22			
23			
24	24.6	23.2	37.9
25	21.0	22.9	38.5
26	25.7	23.1	39.0
27			
28	25.4	23.5	38.0
29			
30			
31	20.8	22.4	39.0
AV.	23.2	23.7	38.6
MIN.	17.1	22.4	37.5
MAX.	27.5	25.0	39.2

**TABLE 26. SEPTEMBER 1998 Brunswick Air and Water Temperatures/Headpond Levels**

<u>Day</u>	<u>Air Temp (°C)</u>	<u>Water Temp(°C)</u>	<u>Headpond Level (feet above sea level)</u>
1	22.7	23.3	38.4
2			
3	19.6	22.4	38.2
4	19.0	22.7	37.3
5			
6			
7			
8	16.3	21.9	38.3
9	17.9	21.5	38.0
10	18.6	20.5	38.5
11	18.3	19.8	38.5
12			
13			
14	19.9	20.2	38.1
15			
16	20.7	20.7	38.4
17	18.5	20.1	38.1
18	13.2	19.5	38.6
19			
20			
21	17.5	19.5	38.9
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
AV.	18.5	21.0	38.3
MIN.	16.3	19.5	37.3
MAX.	22.7	22.7	38.9



**TABLE 27. OCTOBER 1998 Brunswick Air and Water Temperatures/Headpond Levels**

<u>Day</u>	<u>Air Temp (°C)</u>	<u>Water Temp(°C)</u>	<u>Headpond Level (feet above sea level)</u>
1			Not Recorded in October
2			
3			
4			
5		14.7	
6		14.3	
7		14.0	
8		14.2	
9		14.6	
10		14.3	
11		13.4	
12			
13		12.3	
14		12.3	
15		11.9	
16		11.3	
17		11.5	
18		12.0	
19		12.0	
20		11.9	
21		11.3	
22		10.8	
23		10.7	
24		10.6	
25		11.4	
26		10.5	
27		10.0	
28		9.8	
29		9.8	
30		9.6	
31			
AV.		12.0	
MIN.		9.6	
MAX.		14.7	



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 unwatering intermediate pool



**Fish Species Observed Using The Brunswick Fishway**

1983-1998

Brook trout

Brown trout

Smallmouth bass

Largemouth bass

Common sucker

Striped bass

American shad

Coho salmon

Carp

Sea lamprey

Rainbow trout

Chinook salmon

White perch

Yellow perch

Atlantic salmon

Alewife

American eel

Landlocked salmon

Sunfish (Bluegill)

Creek chub

White catfish

