DIADROMOUS FISH SURVEY
OF THE
PRESUMPSCOT RIVER

FEBRUARY 2004

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OF THE
PRESUMPSCOT RIVER

Prepared for
COASTAL CONSERVATION ASSOCIATION,
FRIENDS OF CASCO BAY AND
FRIENDS OF THE PRESUMPSCOT RIVER

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1.0 INTRODUCTION

Normandeau Associates, Inc. was contracted by the Coastal Conservation Association (CCA), Friends of Casco Bay (FOCB) and Friends of the Presumpscot River (FOPR) to conduct a fisheries survey in the lower Presumpscot River during spring 2003. The primary objective of this fish survey was to qualitatively determine whether diadromous fish species were present in the river reach between Cumberland Mills Dam downstream to the I-95 bridge, and to determine the presence and distribution of diadromous fish in this river reach. A secondary objective was to determine the distribution of resident fish species in this stretch of river. Because of the limitations of gear type (e.g. an electrofishing boat was used to sample the river) and number of sampling dates (sampling was only conducted on six days between 5/24/03 and 6/12/03), it was not possible to establish quantitative estimates of the number of diadromous fish present in the river during spring 2003. Additionally, other diadromous fish species may have been present in the river during spring 2003 and avoided capture either due to the limited sample dates or the limitations of the sampling gear (see Methods section for a discussion of the limitations of using an electroshocking boat to capture diadromous fish species).

Cumberland Mills Dam, located 9.6 miles upstream of Casco Bay, is currently the lowermost dam on the Presumpscot River because of the recent removal of Smelt Hill Dam, which was located at head of tide approximately 2.5 miles upstream of Casco Bay.

2.0 METHODS

Normandeau had proposed to use a combination of sampling gear to capture diadromous fish in the Presumpscot River including floating gill nets, electrofishing and jigging. However, the Maine Inland Fish and Wildlife has restrictions on gill nets and would not allow their use; therefore an electroshocking boat was used as the primary capture method. In most instances, gill nets are more effective at capturing certain diadromous fish species in rivers, including American shad, river herring and striped bass, because the nets can be set to capture fish throughout the water column. Typically, these species reside in deeper water in pools (>5 ft) or in the channel during the day, which cannot be effectively sampled with electrofishing gear. A shock boat is most effective in shallow water less than 5 or 6 ft deep, however, the channel depth in Presumpscot River was deeper than six ft in much of the river segment sampled. Most of the shad and river herring captured were found in the deeper channel areas. The field biologists noted that some of the temporarily stunned fish were able to avoid capture and identification. Because of this capture bias, the fish collections are qualitative; catch-per-effort or an estimate of the abundance of shad, river herring and other fish species collected cannot be determined.

During sampling, the field biologists would sample a river reach with the shock boat moving downstream with the current, electrofishing the main channel areas and deeper pools where most of the diadromous fish were captured. One of the problems with sampling in this manner is many fish are able to detect the electric field as the boat approaches, and most escape capture. Capture was further hampered by water depth and visibility, because the crew could not see the entire water column in many of the areas sampled.

The section of the Presumpscot River sampled in this study was located between the Cumberland Mills Dam and the I-95 bridge (Figure 2-1). This section of the Presumpscot River was divided into six river reaches. River reach 1 extended from Cumberland Mills Dam downstream to the power lines that cross the river near 789 Warren Ave; river reach 2 extended from the power lines downstream to the Constitution Drive culvert; and river reach 3 went from the culvert downstream to the Route 302 bridge (near the mouth of Mill Brook). River reach 4 began at the Rte. 302 bridge and continued downstream to Minnow Brook; river reach 5 extended from Minnow Brook down to Meader Brook; and river reach 6 went from Meader Brook downstream to the I-95 bridge.

The river reaches upstream of Mill Brook (reaches 1-3) were not as wide and typically had higher water velocities than river reaches 4 through 6, which had wider, deeper channel areas. River reach 1 was shallow compared to the other river reaches sampled and the bottom could be seen throughout most of its length. This was also the case for some sections of river reach 2. In river reach 1, the crew could not safely get the shock boat up to the base of the Cumberland Mills Dam due to fast-moving shallow water and obstructions (rock and wood debris). Therefore, approximately 200 meters of this river reach downstream from the dam could not be sampled.

The sampling began when an established run of river herring were observed ascending Mill Brook. River herring migrating up Mill Brook encounter a fishway at the outlet of Highland Lake that allows the fish access to the lake, which is currently their principal spawning area. Volunteers from the three funding organizations CCA, FOCB and FOPR monitored Mill Brook for the start of the run. Once fish were observed ascending the brook, the electrofishing survey was initiated and sampling continued at approximately twice per week, for a total of 6 sampling events.

All resident fish species stunned and captured during the electroshocking surveys were quickly netted and placed into holding tanks on the boat. Diadromous fish species captured (American shad, river herring and American eels) were not held in the tanks, but instead were quickly identified, sexed and released. None of the fish captured (diadromous or resident fish species) were measured or weighed to limit handling stress. Shad and river herring were photographed prior to their release and their sex and spawning condition was noted as either green, ripe or spent. Additionally, the capture location of most of the shad and river herring was recorded with a GPS. The locations of shad or river herring that were temporarily stunned by the shock boat but evaded capture by the biologist netting the fish were also recorded, but only if the fish could be clearly seen and positively identified. Some fish that were temporarily stunned by the shock boat evaded capture and could not be positively identified. Resident fish species captured were identified, enumerated and released unharmed.

Other data collected from each river reach sampled included date and time of capture, Secchi disk readings, water temperature, dissolved oxygen (mg/l) and conductivity. Additionally, water quality data were collected by staff of FOCB at six sites along the Presumpscot River between Rte 302 and the Sappi Mill in Westbrook. Surface water and water column profiles were collected on 2 June and 21 August 2003. Unattended diurnal hourly samples were collected at the FOCB Buoy, located 300 yards downstream of the Sappi Mill discharge between 2 June and 6 June 2003 and between 21 August and 26 August 2003. All samples were collected using a calibrated YSI 6600 multi-parameter data sonde. Data parameters collected included temperature (°C), conductivity (µS/cm), dissolved oxygen (mg/l), dissolved oxygen percent saturation (%), pH and Chlorophyll *a*.

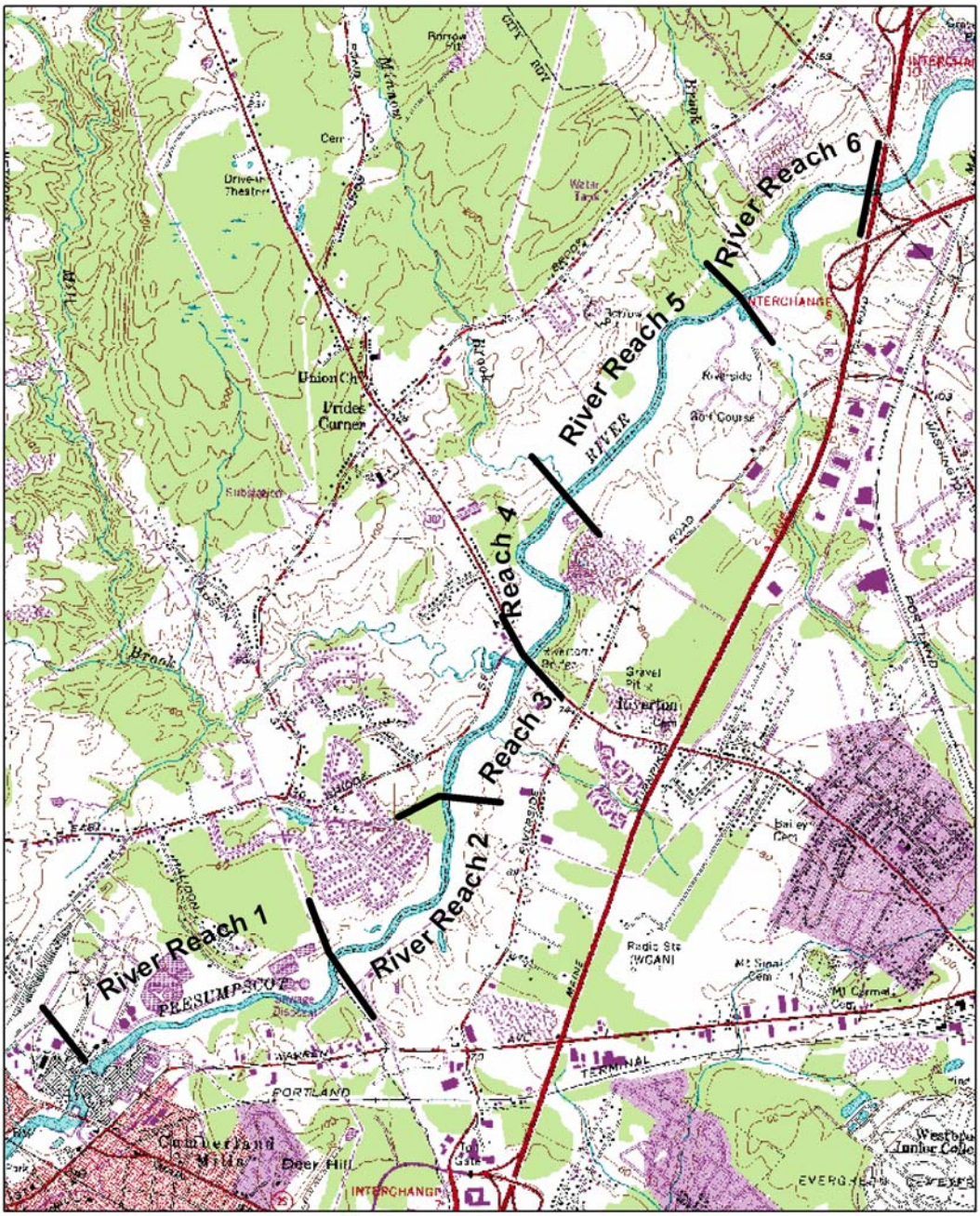

Figure 2-1: **Locations of River Reaches Sampled in the Presumpscot River with an ElectroShocking Boat during Spring 2003.**

3.0 RESULTS

3.1 DIADROMOUS FISH

The Presumpscot River electrofishing survey began on May 24, 2003 and ended on June 12, 2003, with a total of six sampling events (2 sampling events/week). Numbers of diadromous fish captured or identified during this survey are presented in Table 3-1. There were 175 juvenile American eels captured over the six sampling dates, along with 15 river herring and 10 American shad. Five of the shad were not netted, but the biologists were able to positively identify the fish. Of the 15 river herring reported, 9 were not netted and the 6 that were netted were alewives. As with the shad, the field biologists were able to identify the 9 river herring not netted because they were stunned by the boat shocker and observed at close range. Shad and river herring are difficult to capture using electroshocking gear because many quickly "break out" of the electric field by swimming in rapid, erratic movements or they get stunned and quickly sink out of sight.

Table 3-1. Diadromous Fish Captured in the Presumpscot River during Spring, 2003.

Common Name	Scientific Name	Total Captured
American eel	*Anguilla rostrata*	175
Alewife	*Alosa pseudoharengus*	15[1]
American shad	*Alosa sapidissima*	10[2]

[1] Nine of these alewives were identified as being stunned by the shock boat but were not netted

[2] Five of these shad were identified as being stunned by the shock boat but were not netted

Field crews sampled river reaches 1 through 3 on May 24, the first sampling date, and captured a total of 36 juvenile eels, 1 alewife and 3 American shad (Table 3-2). American eel was the only diadromous fish species captured in river reach 1 on May 24 (35 juvenile eels collected). In river reach 2, two shad were collected, a green female and a ripe male along with one ripe male alewife and 1 juvenile eel (Table 3-2). One shad was identified (fish was not netted) in river reach 3 on May 24 about 400 yds upstream of the mouth of Mill Brook and this fish was the only diadromous fish captured or identified in reach 3 on this date. No water quality data were collected on May 24 because of a faulty meter.

On the second sampling event on May 29, river flows and turbidity had increased due to heavy rains, which made sampling difficult. River reaches 1 through 3 were sampled again but catches were low due to the high flows and reduced visibility. One ripe alewife male was caught in reach 1 near the Sappi treatment plant and 2 juvenile eels were also captured in reach 1 on this date (Table 3-2). No diadromous fish were captured in river reaches 2 or 3 on May 29, 2003. Surface water temperatures on May 29 ranged from 14.6 to 15.2ºC, with Secchi readings of 3 ft, reflecting the turbid conditions (Table 3-3). Dissolved oxygen readings were good in all three reaches sampled and surface readings ranged from 9.82 mg/l in reach 3 to 10.47 mg/l in reach 1.

The third sampling effort was conducted on June 4 and the high river flows and turbidity observed on May 29 had subsided. Secchi readings had increased from 3 ft on May 29 to 5 ft on June 4, indicating that water clarity had improved after the high flows subsided. River reaches 1, 3, 4, 5, and 6 were sampled on June 4 and diadromous fish were collected in reaches 1, 3, 4 and 6 (Table 3-2). Only

Table 3-2. Diadromous Fish Collected on Presumpscot River during Spring 2003.

Species	Date	Time	Number	Sex	Sex Condition	Area	Comment
American eel	5/24/2003	11:00 AM	3			Region 1†	
American eel		11:20 AM	5				
American eel		11:55 AM	15				
American eel		12:30 PM	3				
American eel		12:40 PM	9				
American shad		1:08 PM	1	F	Green	Region 2	Netted
American shad		1:25 PM	1	M	Ripe		Netted
American eel		1:53 PM	1				
Alewife			1	M	Ripe		Netted
American shad		2:19 PM	1			Region 3	Missed - 400 yds upstream of Mill Brook
American eel	5/29/2003	12:40 PM	2			Region 1	Netted. Flows are higher than on 5/24/03 and visibility into water is diminished
Alewife			1	M	Ripe	Caught at SAPPI Treatment	
American eel	6/4/2003	11:30 AM	9			Region 4	
American eel		12:02 PM	9				
American eel		1:04 PM	21			Region 1	
American eel		1:39 PM	9				
American eel		2:55 PM	23				
American shad		3:22 PM	1			Region 3	Observed, not netted
American shad		3:37 PM	1				Netted
Alewife		3:50 PM	1	M	Spent	Mouth of Mill Brook	Netted
River herring			6			Mouth of Mill Brook	Observed, not netted
River herring		4:09 PM	1			Region 6	Observed, not netted
American eel	6/6/2003	12:00 PM	2			Region 3	
American shad			1	M	Ripe		Netted
American shad			1				Observed, not netted
Alewife			1	F	Spent		Netted
American eel		1:54 AM	42			Region 1	
American eel	6/9/2003	12:16 PM	4			Region 2	
American eel		12:39 PM	3			Region 3	
American eel		3:00 PM	5			Region 2	
American eel		3:56 AM	8			Region 1	

Table 3-2 (Continued)

Species	Date	Time	Number	Sex	Sex Condition	Area	Comment
American shad		4:17 PM	1			Region 1, under power lines	Observed, not netted
River herring	6/12/2003	2:20 PM	1			Region 2	Observed, not netted
American shad			1	M			Netted
American shad			1				Observed, not netted
American eel		2:35 PM	2			Region 3	
Alewife			1	M			Netted
River herring			2				Observed, not netted

†Key:

Region 1 – Tailrace to power lines (crossing near 789 Warren Ave, Portland)

Region 2 – Power lines to culvert (drainage from Constitution Dr, Westbrook)

Region 3 – Culvert to Rte 302 bridge

Region 4 – Rte 302 bridge to Minnow Brook

Region 5 – Minnow Brook to Meader Brook

Region 6 – Meader Brook to Rte 95 Bridge

Table 3-3. Water Quality Data Collected on the Presumpscot River, Spring 2003

Date	River Reach[1]	Depth	Temp (C)	DO mg/l	Conductivity	Secchi (ft)	Comments
05/29/03	1	surface	14.6	10.47	100.0	3.0	River height High
	2	surface	14.9	10.60	112.3	3.0	
	2	bottom	14.7	9.93	112.5	3.0	
	3	surface	15.2	9.82	112.2	3.0	
06/04/03	4	surface	17.4	9.47	109.3	5.0	River height Mid
	4	bottom	17.0	9.49	113.7	5.0	
	1	surface	16.9	10.30	90.0	5.0	
	1	bottom	16.6	10.12	90.8	5.0	
	5	surface	17.5	9.77	114.3	5.0	
	6	surface	17.7	9.20	116.4	4.5	
06/06/03	3	surface	19.2	9.64	114.6	5.0	River height Mid
	3	bottom	18.6	8.69	114.4	5.0	
	1	surface	18.4	10.10	87.5	4+	visibility to bottom
	2	surface	19.4	9.55	117.8	5.0	
	5	surface	19.5	9.26	115.4		
06/09/03	2	surface	18.0	8.66	118.0	4.0	River height Low
	3	surface	18.0	8.78	123.0	4.0	
	1	surface	17.8	9.83	85.0	4+	visibility to bottom
06/12/03	1	surface	19.4	9.20	77.2	6.0	Pool below dam
	3	surface	20.5	9.24	97.4	5.5	

[1] Reaches depicted in the order sampled; see times in Table 3-2.

juvenile eels were captured in reach 1 (53 juvenile eels) and reach 4 (18 juvenile eels) but in reach 3, two shad and seven river herring were recorded. All the river herring were either captured or identified (six were not netted) near the mouth of Mill Brook, and the one alewife netted was a spent male. The two shad captured in reach 3 were recorded upstream of the mouth of Mill Brook. One of these shad was identified (not netted) and the other shad that was netted and photographed was inadvertently released by the crew before they recorded its sex and condition (see Photo 4 in Appendix). One river herring was observed in river reach 6, the only diadromous fish recorded from this reach. Field crews suspected the deeper water and larger pools found in river reaches 4 through 6 contributed to the low catches, because the shock boat is not as effective in water deeper than 5 or 6 ft. Surface water temperatures on June 4 ranged from 16.9ºC in river reach 1 up to 17.7ºC in reach 6 and surface dissolved oxygen levels ranged from 9.20 mg/l in reach 6 to a high of 10.30 mg/l in reach 1 (Table 3-3).

On June 6, the field crew sampled river reaches 1 through 3 and captured diadromous fish in reach 1 and 3. A total of 42 juvenile eels were collected from reach 1, no diadromous fish were captured from reach 2 and two shad, one alewife and two eels were captured or identified from reach 3 (Table 3-2). Two shad were recorded upstream of Mill Brook; one ripe male shad was netted but the other shad was not netted. The alewife captured was a spent female collected upstream of Mill Brook. Surface water temperatures on June 6 ranged from 18.4ºC in reach 1 up to 19.5ºC in reach 5. Dissolved oxygen was highest in reach 1 (10.1 mg/l) and lowest in reach 2 (9.55 mg/l). Secchi

readings were 4 to 5 ft in all three reaches sampled on June 6 and visibility extended to the river bottom in reach 1 (Table 3-3).

The fifth sampling effort occurred on June 9 and river reaches 1 through 3 were sampled. Eels were the only diadromous fish captured in river reaches 2 and 3 on June 9 – nine juvenile eels were captured in reach 2 and three juvenile eels were taken in reach 3. However, one shad was identified in river reach 1 (under the power lines) on this date along with 8 juvenile eels (Table 3-2). Water temperature in the three reaches averaged 18ºC on June 9 and dissolved oxygen ranged from 9.83 mg/l in reach 1 to 8.66 mg/l in reach 2. Secchi readings on this date were 4 ft, and visibility in reach 1 extended to the river bottom.

The sixth and final sample effort occurred on June 12 in river reaches 2 and 3. Two shad were recorded from river reach 2 and of these, one male shad was netted (sex condition was not recorded). One alewife was also identified from reach 2 on this date (Table 3-2). Two river herring and 2 juvenile eels were recorded from reach 3 on June 12; one male alewife was netted and the second river herring was observed but not netted. Surface water temperature was 19.4ºC in reach 1 and 20.5ºC in reach 3 and dissolved oxygen ranged from 9.20 to 9.24 mg/l (Table 3-3).

Water quality data collected by FOCB from the Presumpscot River in June and August 2003 are presented in Appendix 2.

3.2 RESIDENT FISH

Six resident fish species were captured from the six river reaches sampled during the Presumpscot River study (Table 3-4). There were a total of 228 white suckers collected, 111 golden shiners, 90 smallmouth bass, 22 brown trout, 5 threespine sticklebacks and 1 fourspine stickleback.

White suckers and smallmouth bass were captured on all six dates sampled during the study and they were found in all river reaches except river reach 6 (Table 3-5). River reach 6 was only sampled on June 4 and the field crew focused sampling in the deeper channel areas of this reach to target

Table 3-4. Resident Fish Captured in the Presumpscot River during Spring 2003.

Common Name	Scientific Name	Number Captured
White sucker	*Catostomus commersoni*	228
Golden shiner	*Notemigonus crysoleucas*	111
Smallmouth bass	*Micropterus dolomieu*	90
Brown trout	*Salmo trutta*	22
Threespine stickleback	*Gasterosteus aculeatus*	5
Fourspine stickleback	*Apeltes quadracus*	1

diadromous fish species. Few fish were captured in reaches 4 through 6 and it was suspected that most fish escaped the shock boat because of the deeper water present in these river sections.

Brown trout were captured on most sampling dates and were found in river reaches 1 through 4 during the study. Golden shiners were only collected from river reaches 1 and 2 (Table 3-5). Capture of threespine and fourspine sticklebacks occurred in river reach 1. Water quality data for the dates sampled are presented in Table 3-3.

Table 3-5. Resident Fish Collected on Presumpscot River during Spring 2003

Species	Date	Time	Number	Area	Comment
White sucker	5/24/2003	11:00 AM	11	Region 1†	
White sucker		11:20 AM	8		
Smallmouth bass			2		
White sucker		11:55 AM	4		
Smallmouth bass			2		
Golden shiner			1		
White sucker		12:30 PM	4		
White sucker		12:40 PM	4		
Smallmouth bass			3		
Golden shiners			100		
Brown trout			1		
Three-spined stickleback			5		
White sucker		1:53 PM	25	Region 2	
Brown trout			4		
White sucker		2:19 PM	20	Region 3	
Brown trout			2		
White sucker	5/29/2003	12:40 PM	17	Region 1	
Smallmouth bass			2		
Golden shiner			3		
White sucker		1:50 PM	2	Region 2	
No catch		2:35 PM	0	Region 3	
White sucker	6/4/2003	11:30 AM	7	Region 4	
Brown trout			2		
White sucker		12:02 PM	8		
Smallmouth bass			1		
Brown trout			2		
White sucker	6/4/2003	1:04 PM	13	Region 1	
Smallmouth bass			19		
Brown trout			1		
White sucker		1:39 PM	2		
Smallmouth bass			4		
White sucker		2:34 PM	4		
White sucker		2:55 PM	11	Region 1	
Smallmouth bass			2		
Four-spined stickleback			1		
White sucker		4:09 PM	3	Region 5	
White sucker		4:44 PM	2		
White sucker	6/6/2003	12:00 PM	8	Region 3	

Table 3-5 (Continued)

Species	Date	Time	Number	Area	Comment
Smallmouth bass			1		
Brown trout			1		
White sucker		1:54 PM	25	Region 1	
Smallmouth bass			18		
Brown trout			1		
White sucker		3:15 PM	4	Region 2	
Smallmouth bass			2		
Brown trout			3		
White sucker	6/9/2003	12:16 PM	14	Region 2	
Smallmouth bass			6		
Golden shiner			7		
Brown trout			3		
White sucker		12:39 PM	8	Region 3	
Smallmouth bass			5		
White sucker		3:56 PM	14	Region 1	
Smallmouth bass			17		
Brown trout			1		
White sucker		3:00 PM	2	Region 2	
Smallmouth bass			5		
White sucker	6/12/2003	2:20 PM	3	Region 2	
Brown trout		2:35 PM	2		
White sucker			5	Region 3	
Smallmouth bass			1		
Brown trout			2		

†Key:

Region 1 – Tailrace to power lines (crossing near 789 Warren Ave, Portland)

Region 2 – Power lines to culvert (drainage from Constitution Dr, Westbrook)

Region 3 – Culvert to Rte 302 bridge

Region 4 – Rte 302 bridge to Minnow Brook

Region 5 – Minnow Brook to Meader Brook

Region 6 – Meader Brook to Rte 95 Bridge

4.0 DISCUSSION

The capture of American shad in the Presumpscot River in spawning condition offers strong evidence that the shad in this river are members of a remnant population that may have persisted since the river was dammed. It has been documented that shad were present in the Presumpscot River both prior to and after the river was dammed in the early 1730s. Other diadromous fish species that historically ascended the Presumpscot River include river herring, American eel and Atlantic salmon (The Presumpscot River Plan Steering Committee and Land & Water Associates 2002).

The presence of shad in the Presumpscot River in spawning condition, suggesting that these fish could be a remnant population, is further supported by data from the Smelt Hill Dam's fish lift in 1995 and 1996 that documented adult shad moving upstream during the spawning season. American shad ascending the Presumpscot River past Smelt Hill Dam were documented in 1995 and 1996 when shad were lifted via the Smelt Hill Dam's fish lift. One shad was counted in the lift in 1995 and thirty-one shad were lifted in 1996, the last year the lift was operational before flooding destroyed it (The Presumpscot River Plan Steering Committee and Land & Water Associates 2002). After the 1996 flood, the gates on the Smelt Hill Dam were periodically opened to allow shad and other diadromous fish access above the dam, but there is no record of the species or numbers of fish passed upstream when the gates were opened. The fish lift began operation in 1990, however, no data exist on the numbers or species of fish observed using the lift until CMP assumed ownership in 1995. Although the numbers of shad lifted were low in 1995 and 1996, the fish lift's efficiency at attracting and eventually passing shad is unknown, so it is not possible to estimate how many shad were present below the dam in those years.

Previous investigators have suggested that shad return to their natal rivers, but in many studies there was no direct evidence. However, Melvin et al (1986) proved that site fidelity of spawning shad in the Annapolis River in Canada was 97%, demonstrating that only a small percentage of shad strayed from this river during the spawning season. Although the present study offers no direct evidence that the adult shad captured in 2003 in the Presumpscot River were born in the stretch of river below Smelt Hill Dam prior to its removal, indirect evidence suggests that this is occurring, given that numbers of adult shad that do return to the river.

Even though the data collected during this study is qualitative because many of the fish could avoid the sampling gear, it did document the presence of spawning adult shad and river herring, and juvenile American eels in the reach between Mill Brook and Cumberland Mills Dam. The only section of the river not sampled between Mill Brook and Cumberland Mills Dam was approximately 200 yds of river just downstream of the dam, which could not be sampled due to obstructions in the river that prohibited boat access.

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APPENDIX 1

Photos of Anadromous Fish Captured in the Presumpscot River, Spring 2003

Photo 1. **Alewife collected on May 24, 2003 in the Presumpscot River near culvert draining under Constitution Drive.**

Photo 2. **Alewife collected on May 29, 2003 in the Presumpscot River near the Sappi treatment plant in Westbrook, Maine.**

Photo 3. **American Shad collected on May 24, 2003 in the Presumpscot River near power line crossing, 789 Warren Ave., Portland, Maine.**

Photo 4. **American Shad collected on May 24, 2003 in Presumpscot River. House on Independent Drive in background.**

Photo 5. **American Shad captured on June 4, 2003 in the Presumpscot River upstream of Mill Brook.**

Photo 6. **Alewife captured on June 4, 2003 in the Presumpscot River near the mouth of Mill Brook.**

Photo 7. Shock boat sampling the Presumpscot River, June 6, 2003.

Photo 8. American Shad captured on June 6, 2003 in the Presumpscot River upstream of Mill Brook.

APPENDIX 2

Appendix 2. Water Quality (surface or water column profiles) collected by FOCB at six locations in the Presumpscott River during June and August.

Site Name	Date M/D/Y	Time hh:mm:ss	Depth m	Secchi/depth m	Temp °C	SpCond uS/cm	Cond uS/cm	DO Conc mg/L	DO % %	pH
Old Steamboat Landing	6/2/2003	10:05	0.0	0.5	16.5		97	9.7	99.0	8.05
(profile)	6/2/2003		1.0		16.5		95	9.6	98.5	7.79
	6/2/2003		2.0		16.5		95	9.6	98.1	7.73
	6/2/2003		3.0		16.5		95	9.6	97.9	7.69
	6/2/2003		4.0		16.5		95	9.6	97.8	7.69
	6/2/2003		5.0		16.5		95	9.5	97.5	7.62
Mill Brook	6/2/2003	10:30	0.0	*	14.5		85	10.4	101.0	7.78
Above Mill Brook	6/2/2003	10:40	0.0	*	16.9		99	9.5	98.3	7.54
50 Yards above Sappi Discharge	6/2/2003	11:10	0.0	*	16.4		89	9.7	99.3	7.76
Sappi Discharge-depth	6/2/2003	11:20	0.0	*	17.0		102	9.8	101.3	7.83
Sappi Discharge-surface	6/2/2003	11:25	0.0	*	17.5		150	9.8	102.6	7.77
FOCB Bouy	6/2/2003	11:50	0.0	*	16.7		94	9.8	100.2	7.77

* = No Secchi data recorded
Note: 6/2/03 data was hand written on a field data sheet and not logged as a data file as the 8/21/03 data.
Also, Chlorophyll a was not recorded on 6/2/03 because sonde was not equiped w/ chl probe.
FOCB Buoy was located 300 yards dwnstream of the Sappi discharge.

Site Name	Date M/D/Y	Time hh:mm	Depth m	Secchi/depth	Temp °C	SpCond uS/cm	Cond uS/cm	DO Conc mg/L	DO % %	pH	Chlorophyll ug/L
Mill Brook	8/21/2003	10:30	0.0	BSV-0.3	21.5	134.6	125.7	8.3	94.0%	7.09	1.4
Above Mill Brook	8/21/2003	10:33	0.0	BSV-0.5	25.9	87.2	88.7	7.8	96.0%	7.31	1.4
Old Steamboat Landing-surface	8/21/2003	10:41	0.0	BSV-1.2	25.7	87.6	88.8	7.9	96.9%	7.36	0.6
Old Steamboat Landing-depth	8/21/2003	10:42	1.0		25.7	87.5	88.7	7.9	96.9%	7.33	1.8
Sappi Discharge-depth	8/21/2003	11:35	1.5		25.8	80.3	81.5	8.4	103.2%	7.67	1.7
Sappi Discharge-surface	8/21/2003	11:37	0.0	BSV-1.5	26.3	80.0	81.9	8.2	101.6%	7.51	0.8
FOCB Bouy	8/21/2003	11:38	0.0	BSV-1.3	27.2	130.0	135.6	8.1	102.0%	7.67	1.4

BSV = At the bottom, disk still visible.

Appendix 2 Continued. Diurnal Water Quality Data Collected in the Presumpscott River at the FOCB Buoy 300 yards downstream of Sappi Discharge between 2 June and 6 June 2003.

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Cond uS/cm	DO Conc mg/L	DO % %	pH
6/2/2003	12:00:40	16.9	115.4	97.6	9.9	102.6	7.3
6/2/2003	13:00:40	16.9	109.3	92.5	10.2	105.0	7.3
6/2/2003	14:00:40	17.2	109.4	93.1	10.2	105.8	7.3
6/2/2003	15:00:40	17.1	103.6	88.0	10.2	105.4	7.3
6/2/2003	16:00:40	17.3	108.9	92.9	10.1	105.0	7.4
6/2/2003	17:00:40	17.3	108.6	92.5	10.1	104.9	7.3
6/2/2003	18:00:40	17.2	108.6	92.4	10.0	104.4	7.3
6/2/2003	19:00:40	17.1	109.4	92.9	10.0	103.5	7.3
6/2/2003	20:00:40	17.0	116.5	98.7	10.0	103.0	7.3
6/2/2003	21:00:40	16.9	114.0	96.2	9.9	102.4	7.3
6/2/2003	22:00:40	16.8	116.8	98.6	9.9	102.2	7.3
6/2/2003	23:00:40	16.9	119.9	101.3	9.9	102.4	7.3
6/3/2003	0:00:40	16.8	118.5	100.0	9.9	102.5	7.3
6/3/2003	1:00:40	16.7	118.2	99.6	10.0	102.6	7.3
6/3/2003	2:00:40	16.6	117.2	98.5	10.0	102.7	7.3
6/3/2003	3:00:40	16.5	116.9	97.9	10.0	102.7	7.3
6/3/2003	4:00:40	16.4	117.9	98.5	10.1	102.8	7.3
6/3/2003	5:00:40	16.2	117.9	98.2	10.1	102.9	7.3
6/3/2003	6:00:40	16.1	116.4	96.6	10.1	102.8	7.3
6/3/2003	7:00:40	16.0	119.3	98.9	10.2	103.3	7.3
6/3/2003	8:00:40	16.1	121.8	101.0	10.3	104.1	7.4
6/3/2003	9:00:40	16.1	120.7	100.2	10.3	104.9	7.4
6/3/2003	10:00:40	16.3	121.8	101.5	10.4	105.8	7.4
6/3/2003	11:00:40	16.7	128.6	108.2	10.4	106.7	7.5
6/3/2003	12:00:40	17.0	131.3	111.1	10.4	107.4	7.5
6/3/2003	13:00:40	17.0	125.2	106.1	10.4	107.6	7.4
6/3/2003	14:00:40	17.4	131.1	112.1	10.3	107.9	7.5
6/3/2003	15:00:40	17.4	125.8	107.6	10.3	107.2	7.4
6/3/2003	16:00:40	17.5	126.0	108.0	10.2	107.1	7.5
6/3/2003	17:00:40	17.5	125.5	107.5	10.2	106.5	7.5
6/3/2003	18:00:40	17.3	124.3	106.0	10.2	105.8	7.5
6/3/2003	19:00:40	17.2	123.9	105.4	10.1	104.9	7.5
6/3/2003	20:00:40	17.1	123.4	104.9	10.0	104.0	7.5
6/3/2003	21:00:40	17.1	124.3	105.6	10.0	103.7	7.5
6/3/2003	22:00:40	17.2	124.2	105.6	10.0	103.4	7.4
6/3/2003	23:00:40	17.2	124.2	105.7	10.0	103.3	7.5

(continued)

Appendix 2 Continued.

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Cond uS/cm	DO Conc mg/L	DO % %	pH
6/4/2003	0:00:40	17.2	123.1	104.7	10.0	103.5	7.5
6/4/2003	1:00:40	17.1	122.4	103.8	10.0	103.5	7.5
6/4/2003	2:00:40	17.0	121.1	102.6	10.0	103.4	7.5
6/4/2003	3:00:40	17.0	120.9	102.3	10.0	103.6	7.5
6/4/2003	4:00:40	16.8	119.4	100.8	10.0	103.5	7.5
6/4/2003	5:00:40	16.7	119.9	100.9	10.1	103.8	7.5
6/4/2003	6:00:40	16.6	118.8	99.9	10.1	103.7	7.5
6/4/2003	7:00:40	16.6	119.2	100.1	10.2	104.2	7.5
6/4/2003	8:00:40	16.6	119.9	100.7	10.2	105.0	7.5
6/4/2003	9:00:40	16.5	112.1	93.8	10.3	105.6	7.4
6/4/2003	10:00:40	16.7	116.3	97.9	10.4	106.7	7.5
6/4/2003	11:00:40	17.0	123.8	104.9	10.4	107.6	7.6
6/4/2003	12:00:40	16.7	113.8	95.8	10.4	107.4	7.5
6/4/2003	13:00:40	17.0	122.8	104.0	10.4	107.5	7.6
6/4/2003	14:00:40	17.1	124.0	105.4	10.4	107.9	7.6
6/4/2003	15:00:40	17.3	122.4	104.4	10.4	108.1	7.6
6/4/2003	16:00:40	17.4	122.9	105.0	10.3	107.7	7.7
6/4/2003	17:00:40	17.4	123.0	105.2	10.3	107.5	7.7
6/4/2003	18:00:40	17.4	123.0	105.2	10.3	107.1	7.6
6/4/2003	19:00:40	17.3	124.0	105.8	10.2	106.0	7.6
6/4/2003	20:00:40	17.3	122.9	104.7	10.1	104.9	7.6
6/4/2003	21:00:40	17.2	123.3	104.9	10.0	104.1	7.6
6/4/2003	22:00:40	17.1	123.4	104.9	10.0	103.6	7.6
6/4/2003	23:00:40	17.1	123.2	104.7	10.0	103.6	7.5
6/5/2003	0:00:40	17.2	123.6	105.1	10.0	103.4	7.6
6/5/2003	1:00:40	17.2	123.1	104.7	10.0	103.4	7.6
6/5/2003	2:00:40	17.2	120.3	102.3	9.9	103.3	7.5
6/5/2003	3:00:40	17.2	120.5	102.5	9.9	103.2	7.5
6/5/2003	4:00:40	17.2	122.3	104.1	9.9	103.3	7.6
6/5/2003	5:00:40	17.2	122.4	104.2	9.9	103.2	7.6
6/5/2003	6:00:40	17.2	123.4	105.1	9.9	103.1	7.6
6/5/2003	7:00:40	17.2	124.8	106.3	10.0	103.5	7.6
6/5/2003	8:00:40	17.2	125.1	106.6	10.0	103.5	7.6
6/5/2003	9:00:40	17.0	117.0	99.2	10.0	103.6	7.5
6/5/2003	10:00:40	17.4	126.4	107.9	10.0	104.0	7.6
6/5/2003	11:00:40	17.1	114.5	97.3	10.0	104.2	7.5
6/5/2003	12:00:40	17.4	123.7	105.7	10.1	104.8	7.6
6/5/2003	13:00:40	17.5	127.0	108.9	10.1	105.3	7.6
6/5/2003	14:00:40	17.4	120.6	103.0	10.1	105.2	7.6
6/5/2003	15:00:40	17.5	125.2	107.2	10.0	104.9	7.6
6/5/2003	16:00:40	17.5	124.1	106.3	10.0	104.9	7.6
6/5/2003	17:00:40	17.5	125.5	107.5	10.0	104.5	7.6
6/5/2003	18:00:40	17.4	126.2	107.9	10.0	103.9	7.6

(continued)

Appendix 2 Continued.

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Cond uS/cm	DO Conc mg/L	DO % %	pH
6/5/2003	19:00:40	17.4	126.2	107.9	9.9	103.4	7.6
6/5/2003	20:00:40	17.4	126.9	108.4	9.9	102.8	7.6
6/5/2003	21:00:40	17.3	129.2	110.0	9.9	102.8	7.6
6/5/2003	22:00:40	17.2	129.2	109.8	9.9	102.9	7.6
6/5/2003	23:00:40	17.1	129.8	110.3	9.9	103.1	7.6
6/6/2003	0:00:40	17.2	129.1	109.9	10.0	104.1	7.6
6/6/2003	1:00:40	17.1	126.7	107.6	10.0	103.9	7.6
6/6/2003	2:00:40	17.1	125.8	106.7	10.0	104.0	7.6
6/6/2003	3:00:40	17.1	125.3	106.3	10.1	104.2	7.6
6/6/2003	4:00:40	17.0	124.9	106.0	10.1	104.3	7.6
6/6/2003	5:00:40	17.0	124.5	105.6	10.1	104.6	7.6
6/6/2003	6:00:40	17.0	124.6	105.7	10.1	104.5	7.6
6/6/2003	7:00:40	17.1	123.7	104.9	10.1	104.5	7.6
6/6/2003	8:00:40	17.1	123.4	104.8	10.2	105.3	7.6
6/6/2003	9:00:40	17.0	113.0	95.9	10.2	105.8	7.5
6/6/2003	10:00:40	17.5	121.0	103.6	10.2	107.1	7.6

Appendix 2 Continued. Diurnal Water Quality Data Collected in the Presumpscott River at the FOCB Buoy 300 ft downstream of Sappi Discharge between 21 August and 26 August 2003.

Date M/D/Y	Time hh:mm:ss	Temp °C	Cond uS/cm	SpCond uS/cm	DO Conc mg/L	DO % %	pH	Chlorophyll ug/L
8/21/2003	12:00:39	26.1	89.3	87.4	8.4	104.0	7.5	1.8
8/21/2003	13:00:40	26.2	89.9	87.8	8.4	104.5	7.5	1.7
8/21/2003	14:00:39	26.4	91.7	89.4	8.4	104.6	7.5	1.6
8/21/2003	15:00:39	26.5	91.2	88.7	8.4	104.7	7.6	1.4
8/21/2003	16:00:39	26.5	87.5	85.0	8.4	104.3	7.5	0.9
8/21/2003	17:00:39	26.3	80.4	78.4	8.3	103.0	7.4	1.6
8/21/2003	18:00:40	26.2	79.7	77.9	8.2	101.3	7.4	2.2
8/21/2003	19:00:39	26.1	79.2	77.6	8.1	99.6	7.3	1.8
8/21/2003	20:00:39	26.2	86.3	84.3	8.0	98.4	7.4	1.6
8/21/2003	21:00:39	26.2	86.1	84.2	7.9	97.5	7.4	1.3
8/21/2003	22:00:39	26.2	86.2	84.2	7.9	97.1	7.3	1.6
8/21/2003	23:00:40	26.4	87.3	85.0	7.8	97.1	7.4	1.9
8/22/2003	0:00:39	26.4	88.2	85.9	7.8	97.0	7.3	1.5
8/22/2003	1:00:39	26.4	88.1	85.9	7.8	96.8	7.3	1.3
8/22/2003	2:00:39	26.3	87.2	85.1	7.8	96.5	7.3	1.1
8/22/2003	3:00:39	26.3	86.4	84.4	7.8	96.3	7.3	1.7
8/22/2003	4:00:40	26.2	85.2	83.2	7.8	96.0	7.3	2.0
8/22/2003	5:00:39	26.2	85.9	84.1	7.8	96.0	7.3	2.1
8/22/2003	6:00:39	26.2	86.0	84.2	7.8	95.8	7.3	2.9
8/22/2003	7:00:39	26.1	86.9	85.1	7.8	96.0	7.3	1.2
8/22/2003	8:00:39	26.0	86.3	84.6	7.9	96.8	7.3	1.4
8/22/2003	9:00:40	26.1	88.4	86.5	8.0	98.7	7.4	1.4
8/22/2003	10:00:39	26.3	90.4	88.2	8.1	100.6	7.4	1.7
8/22/2003	11:00:39	26.5	90.9	88.3	8.2	102.0	7.5	0.7
8/22/2003	12:00:40	26.7	90.3	87.5	8.3	103.0	7.5	1.3
8/22/2003	13:00:39	26.8	88.6	85.7	8.3	103.4	7.5	1.2
8/22/2003	14:00:39	26.9	87.9	84.9	8.3	103.5	7.6	1.0
8/22/2003	15:00:39	27.0	87.6	84.4	8.2	103.3	7.6	1.9
8/22/2003	16:00:40	27.0	87.4	84.1	8.2	102.6	7.6	1.6
8/22/2003	17:00:39	27.1	87.7	84.4	8.1	101.6	7.6	1.5
8/22/2003	18:00:39	27.0	87.5	84.3	8.0	100.0	7.5	0.7
8/22/2003	19:00:40	27.0	86.5	83.4	7.8	97.9	7.4	2.0
8/22/2003	20:00:39	27.0	86.4	83.2	7.7	96.8	7.4	1.4
8/22/2003	21:00:39	27.0	87.7	84.5	7.6	95.7	7.4	1.8
8/22/2003	22:00:39	27.0	92.8	89.3	7.6	95.6	7.5	1.2
8/22/2003	23:00:40	27.0	88.0	84.8	7.6	95.2	7.4	1.9

(continued)

Appendix 2 continued

Date M/D/Y	Time hh:mm:ss	Temp °C	Cond uS/cm	SpCond uS/cm	DO Conc mg/L	DO % %	pH	Chlorophyll ug/L
8/23/2003	0:00:39	27.0	87.5	84.3	7.6	95.3	7.4	1.7
8/23/2003	1:00:39	26.9	87.0	84.0	7.6	95.2	7.4	1.5
8/23/2003	2:00:40	26.7	87.1	84.3	7.6	95.1	7.4	1.2
8/23/2003	3:00:39	26.6	86.9	84.4	7.6	95.0	7.4	1.3
8/23/2003	4:00:39	26.4	87.3	84.9	7.6	94.9	7.4	1.8
8/23/2003	5:00:40	26.3	87.7	85.5	7.7	94.9	7.4	0.9
8/23/2003	6:00:39	26.2	86.1	84.3	7.7	94.9	7.4	1.1
8/23/2003	7:00:39	26.1	85.3	83.6	7.7	94.9	7.4	1.3
8/23/2003	8:00:39	26.0	85.4	83.9	7.8	95.7	7.4	1.5
8/23/2003	9:00:39	26.0	88.0	86.3	7.9	97.4	7.5	1.4
8/23/2003	10:00:39	26.1	88.9	87.0	8.0	99.2	7.5	1.6
8/23/2003	11:00:39	26.3	90.7	88.4	8.1	101.0	7.6	1.0
8/23/2003	12:00:40	26.4	91.3	88.9	8.2	101.6	7.6	1.0
8/23/2003	13:00:39	26.5	91.0	88.5	8.2	101.7	7.6	1.4
8/23/2003	14:00:39	26.6	89.8	87.2	8.2	102.5	7.7	1.1
8/23/2003	15:00:39	26.5	88.1	85.6	8.2	102.5	7.7	1.0
8/23/2003	16:00:40	26.6	87.4	84.9	8.2	101.7	7.7	1.7
8/23/2003	17:00:39	26.5	87.6	85.1	8.1	100.8	7.7	1.1
8/23/2003	18:00:39	26.4	87.8	85.5	8.0	99.2	7.6	1.4
8/23/2003	19:00:39	26.3	87.1	85.1	7.9	97.2	7.5	1.2
8/23/2003	20:00:39	26.2	87.3	85.4	7.8	96.1	7.5	1.2
8/23/2003	21:00:39	26.1	86.5	84.7	7.7	95.5	7.4	1.8
8/23/2003	22:00:39	26.1	86.5	84.7	7.7	95.4	7.4	1.4
8/23/2003	23:00:39	26.1	85.5	83.7	7.7	95.3	7.4	1.9
8/24/2003	0:00:40	26.0	85.5	83.9	7.7	95.3	7.4	1.2
8/24/2003	1:00:39	25.8	85.1	83.8	7.8	95.4	7.4	1.1
8/24/2003	2:00:39	25.6	84.5	83.5	7.8	95.2	7.4	0.5
8/24/2003	3:00:40	25.5	83.0	82.2	7.8	95.0	7.4	0.8
8/24/2003	4:00:39	25.4	83.3	82.6	7.8	94.9	7.4	1.2
8/24/2003	5:00:39	25.3	82.7	82.2	7.8	94.8	7.3	1.9
8/24/2003	6:00:40	25.2	82.4	82.1	7.8	94.8	7.3	1.9
8/24/2003	7:00:39	25.1	81.8	81.7	7.8	95.0	7.3	1.2
8/24/2003	8:00:40	25.0	81.6	81.5	7.9	95.8	7.3	1.5
8/24/2003	9:00:39	25.2	87.1	86.9	8.1	97.7	7.4	0.8
8/24/2003	10:00:39	25.2	82.7	82.3	8.2	99.6	7.4	1.1
8/24/2003	11:00:39	25.3	84.2	83.7	8.3	101.2	7.5	0.8
8/24/2003	12:00:39	25.4	84.0	83.3	8.4	102.0	7.5	1.7
8/24/2003	13:00:40	25.5	84.3	83.4	8.4	102.3	7.6	1.1
8/24/2003	14:00:39	25.6	83.0	82.1	8.4	102.4	7.6	1.2
8/24/2003	15:00:39	25.6	82.7	81.8	8.4	102.3	7.6	1.3
8/24/2003	16:00:39	25.6	82.8	81.8	8.3	101.7	7.6	1.2
8/24/2003	17:00:39	25.6	82.4	81.5	8.2	100.8	7.6	0.9
8/24/2003	18:00:40	25.4	82.5	81.8	8.1	99.2	7.5	1.9

(continued)

Appendix 2 continued

Date M/D/Y	Time hh:mm:ss	Temp °C	Cond uS/cm	SpCond uS/cm	DO Conc mg/L	DO % %	pH	Chlorophyll ug/L
8/24/2003	19:00:39	25.3	82.6	82.1	8.0	97.4	7.4	1.8
8/24/2003	20:00:39	25.1	82.4	82.1	7.9	95.9	7.4	1.9
8/24/2003	21:00:39	25.1	82.5	82.4	7.9	95.1	7.3	0.8
8/24/2003	22:00:39	25.0	81.8	81.8	7.8	95.0	7.3	1.1
8/24/2003	23:00:40	25.0	81.1	81.1	7.9	95.2	7.3	1.5
8/25/2003	0:00:39	25.0	80.4	80.5	7.9	95.4	7.3	1.4
8/25/2003	1:00:39	24.8	79.0	79.3	7.9	95.4	7.3	1.3
8/25/2003	2:00:39	24.7	78.4	78.8	7.9	95.3	7.3	0.5
8/25/2003	3:00:39	24.7	78.8	79.3	7.9	95.2	7.3	1.5
8/25/2003	4:00:39	24.6	78.8	79.4	7.9	95.0	7.3	0.9
8/25/2003	5:00:39	24.5	79.0	79.7	7.9	94.9	7.3	1.3
8/25/2003	6:00:40	24.5	79.1	79.9	7.9	94.7	7.3	1.8
8/25/2003	7:00:39	24.4	79.6	80.5	7.9	94.7	7.3	1.6
8/25/2003	8:00:39	24.3	80.7	81.8	7.9	94.7	7.3	1.7
8/25/2003	9:00:40	24.2	82.9	84.1	8.0	95.3	7.3	0.4
8/25/2003	10:00:39	24.2	83.9	85.1	8.1	96.7	7.3	1.6
8/25/2003	11:00:39	24.2	84.0	85.3	8.3	98.8	7.4	1.1
8/25/2003	12:00:39	24.4	82.4	83.3	8.4	100.8	7.4	1.3
8/25/2003	13:00:39	24.6	82.2	83.0	8.5	101.6	7.5	0.6
8/25/2003	14:00:40	24.5	82.5	83.3	8.4	101.0	7.5	1.2
8/25/2003	15:00:39	24.4	81.6	82.5	8.3	99.6	7.4	1.4
8/25/2003	16:00:39	24.3	80.1	81.1	8.2	98.5	7.4	1.2
8/25/2003	17:00:39	24.3	79.6	80.7	8.2	97.3	7.3	1.5
8/25/2003	18:00:39	24.1	78.9	80.2	8.1	96.6	7.3	2.0
8/25/2003	19:00:40	24.1	79.4	80.8	8.1	95.9	7.3	1.4
8/25/2003	20:00:39	24.0	79.2	80.7	8.0	95.1	7.3	1.1
8/25/2003	21:00:39	24.0	79.2	80.8	8.0	94.7	7.3	1.8
8/25/2003	22:00:39	24.0	79.7	81.3	8.0	94.7	7.3	1.3
8/25/2003	23:00:39	23.9	79.1	80.8	8.0	94.6	7.3	1.9
8/26/2003	0:00:39	23.9	78.8	80.5	8.0	94.7	7.3	1.1
8/26/2003	1:00:39	23.8	78.2	80.1	8.0	94.7	7.3	0.9
8/26/2003	2:00:40	23.8	78.1	79.9	8.0	94.7	7.3	1.2
8/26/2003	3:00:39	23.8	77.5	79.4	8.0	94.6	7.3	0.7
8/26/2003	4:00:39	23.7	77.5	79.4	8.0	94.6	7.3	1.1
8/26/2003	5:00:40	23.7	77.4	79.4	8.0	94.5	7.2	1.7
8/26/2003	6:00:39	23.6	77.2	79.3	8.0	94.4	7.3	0.8
8/26/2003	7:00:40	23.6	77.1	79.2	8.0	94.5	7.3	1.1
8/26/2003	8:00:39	23.5	78.2	80.5	8.1	95.5	7.3	1.7
8/26/2003	9:00:39	23.6	80.7	83.0	8.2	96.9	7.3	1.3
8/26/2003	10:00:40	23.7	80.5	82.6	8.3	98.0	7.4	0.9
8/26/2003	11:00:39	24.0	84.3	86.0	8.4	99.7	7.5	2.2
8/26/2003	12:00:39	23.9	81.4	83.1	8.4	99.4	7.4	1.8
8/26/2003	13:00:40	23.9	81.1	82.8	8.4	99.3	7.4	0.9
8/26/2003	14:00:39	24.0	80.3	81.8	8.4	99.6	7.5	1.5
8/26/2003	15:00:40	24.2	79.8	81.0	8.4	100.4	7.5	1.7