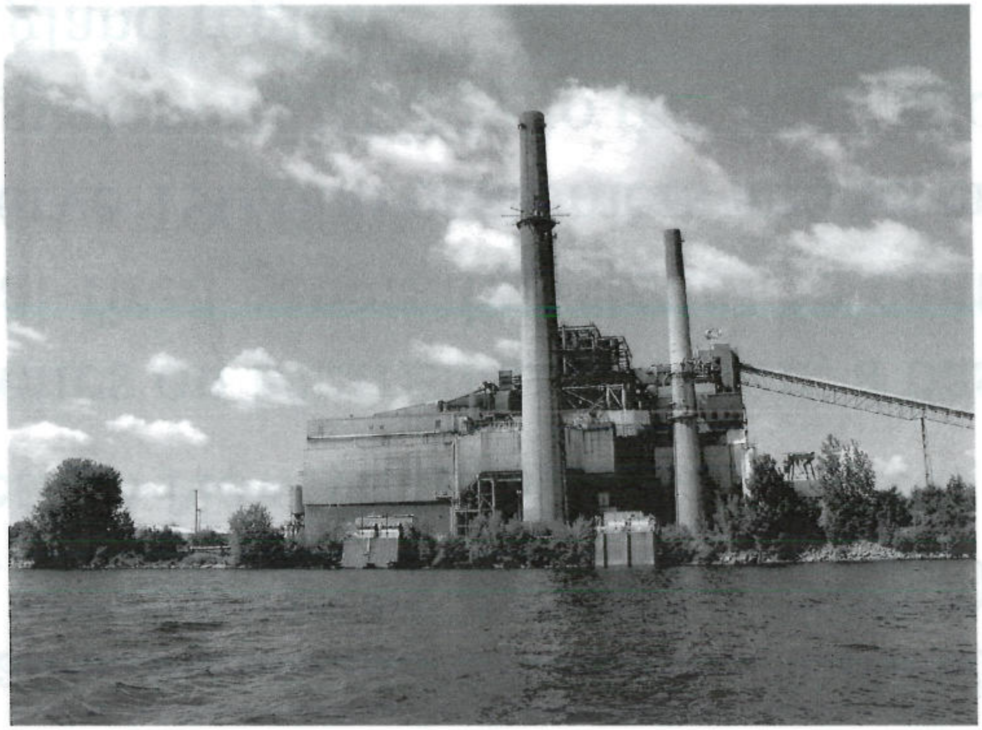
PSNH-EPA Merrimack Station Status Meeting

#100



5 October 2006

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PSNH and Merrimack Station Meeting NH's Energy Needs

- PSNH, a regulated electric utility, provides reliable, affordable electricity to 475,000 customers in New Hampshire.
- PSNH relies on Merrimack Station, a base-load, coal-fired generating station in central NH to serve 190,000 customers and to provide electric system reliability to the State and the New England region.

Merrimack Station provides critical value to the NH electric system.

- **System Reliability.** MK provides critical voltage support to the central region of NH as required by NERC;
- **Fuel Diversity**. MK Station provides essential fuel diversity in the State and Region as directed by the NH Energy Plan and the Federal EPAct. Coal is an abundant, affordable resource within the United States.
- **Energy Security.** Merrimack Station is critical to electric system restoration with its ability to re-energize the system in the event of a system-wide blackout.
- **Regional Supply and Energy Demands.** With New England's lack of new capacity and increasing demand, ISO New England has warned repeatedly that rolling blackouts will be necessary to prevent longer and more widespread power failures in the future unless there is a significant increase in electrical capacity.
- **Customer Cost, Economic Growth**. Reliable, affordable power is critical to the economic growth of the State.

New England is Facing an Electrical Capacity Shortage

"Electricity demand throughout New England is growing by the equivalent of one large power plant every year. While nearly 10,000 megawatts of new electric-generating resources came online in New England between 2000 – 2004, no significant new resources have been added since then. And as New England's electricity supplies decrease, the price of wholesale electricity will increase and reliability will be threatened."

Gordon van Welie, president and chief executive – ISO New England

The Providence Journal, May 13, 2006

Topics of Discussion

- **Merrimack Station Compliance with 316(a)**
  - Retrospective RIS Trends Analysis
  - Downstream Passage
  - Merrimack River Thermal Environment
  - Alternative Thermal Limits for Renewed 316(a) Variance

- Merrimack Station 316(b) Impingement Study
  - First Year Impingement Results

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Merrimack Station Compliance with 316(a): Overview

- CWA 316(a) allows retrospective analysis to demonstrate that facility operations are protective of "balanced indigenous population" (BIP)
- Historical and recent facility operations data show no significant changes in thermal discharge from 1968 to present
- Historical and recent electrofishing data show long-term stability in fish community in Hooksett Pool from 1972 to present
- In sum, data demonstrate that no prior appreciable harm to BIP from existing Merrimack Station thermal discharge

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Merrimack Station Compliance with 316(a): Alternative Thermal Limits for Renewed 316(a) Variance

- PSNH is seeking renewal of Station's existing 316(a) variance.
- 2006 Normandeau thermal study supports renewal with alternative thermal limits that protect BIP:
  - Evaluated historic temperature and river flow data to quantify relationship between background river temperature, flow and downstream thermal impacts.
  - Provides basis for alternative thermal limits and compliance monitoring locations that continue to protect BIP during key fisheries periods.

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BIP and "Representative Important Species"

- CWA Section 316(a) requires thermal component of discharge to "assure the protection and propagation of a *balanced, indigenous population* of shellfish, fish and wildlife in and on that body of water."
- "Representative important species" represent BIP:
  - EPA defines "representative important species" (RIS) as "those species which are: representative, in terms of their biological requirements, of a balanced, indigenous community of shellfish, fish, and wildlife in the body of water into which the discharge is made."

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Representative Important Species

- Current RIS selected by Merrimack TAC committee members (USEPA, USFWS, NHFG, NHDES) who were all present and voted for unanimous approval on 10 September 1992
  - Resident
    - smallmouth bass
    - largemouth bass
    - pumpkinseed
    - yellow perch
  - Migratory
    - American shad
    - alewife
    - Atlantic salmon (smolts)

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Retrospective RIS Trends Analysis: Goals

- Electrofish sampling is widely used by fisheries managers to assess quality and abundance of fish populations (Hardin and Connor 1992)

- Evaluation of trends over time for evidence of fish community degradation (significant decreasing trend) reasonably attributable to Station thermal discharges

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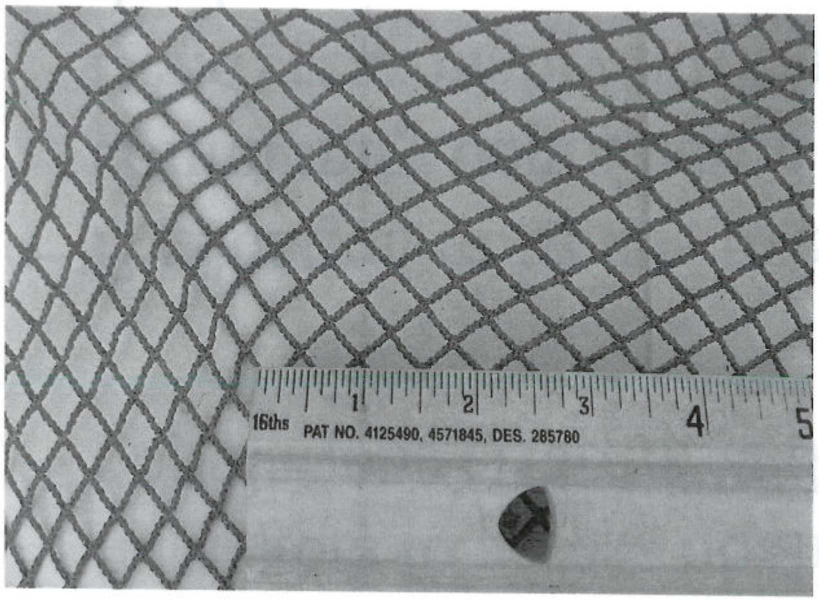
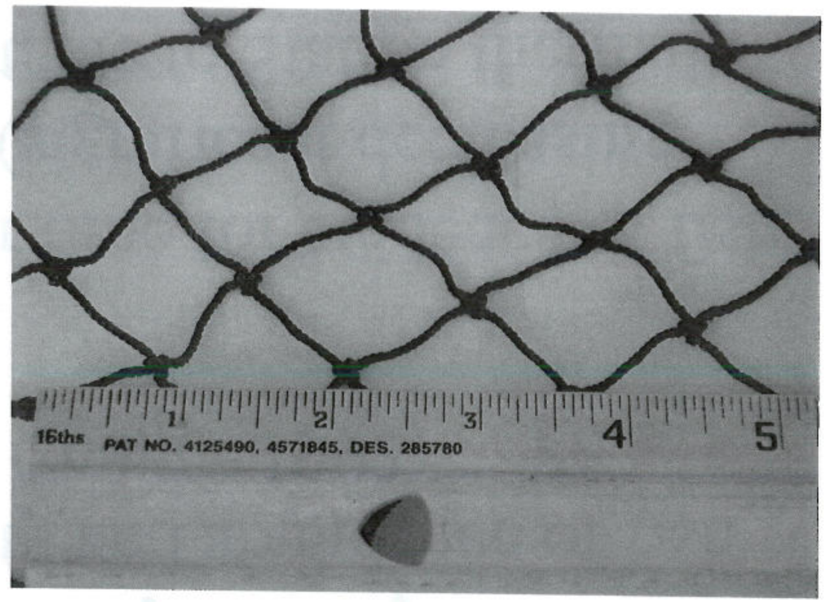
Trapnet Mesh Comparison



¾" stretch mesh

used prior to 1994/1995

and in 2004-2005



2" stretch mesh

used in 1994/1995

and in 2004-2005 gear comp

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Retrospective RIS Trends Analysis: Electrofish Sampling

- Decade by decade analysis of RIS CPUE
- Data available for 1972-76, 1994-95, 2004-05
- EPA suspended biological monitoring requirements 1979-1992
- Trends analyzed are based on confirmed and comparable annual collection data using consistent electrofishing gear, stations, months, and monthly effort so that any differences between decades or stations were not influenced by changes in sampling design
  - Collection data from August and September of each year used for seasonal consistency of design
  - Data set is verified, robust, diverse and consistent
  - Data from 1967-1969 were not used because sampling stations were different, sampling was in March only, and effort (transect length) was not specified
  - No sampling in the 1980's

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Efish CPUE for RIS caught in Hooksett Pool

Common Name	Year						
	1972	1973	1974	1976	1995	2004	2005
Alewife	0	0	0	0	0	8.0	0
American Shad	0	0	0	0	0	0	0
Atlantic Salmon	0	0	0	0	0	0	0
Pumpkinseed *	39.17	21.28	23.72	18.94	0.56	1.4	1.8
Largemouth Bass	5.61	0.89	6.67	2.44	5.56	19.1	12.2
Smallmouth Bass	0.72	4.39	3.17	5.22	1.44	10.7	3.8
Yellow Perch	8.72	5.89	4.22	1.17	0.22	1.3	5.2
Black Crappie	0	0	0	0	0	0.1	0.2
Bluegill	0	0	0	0	54.39	6.4	11.2
Rock Bass	0	0	0	0	0.28	0.4	0.1
Total	66.89	38.44	52.56	40.11	138.2	95.6	44.6

*Note: pumpkinseed decline is attributed to introduction of bluegill

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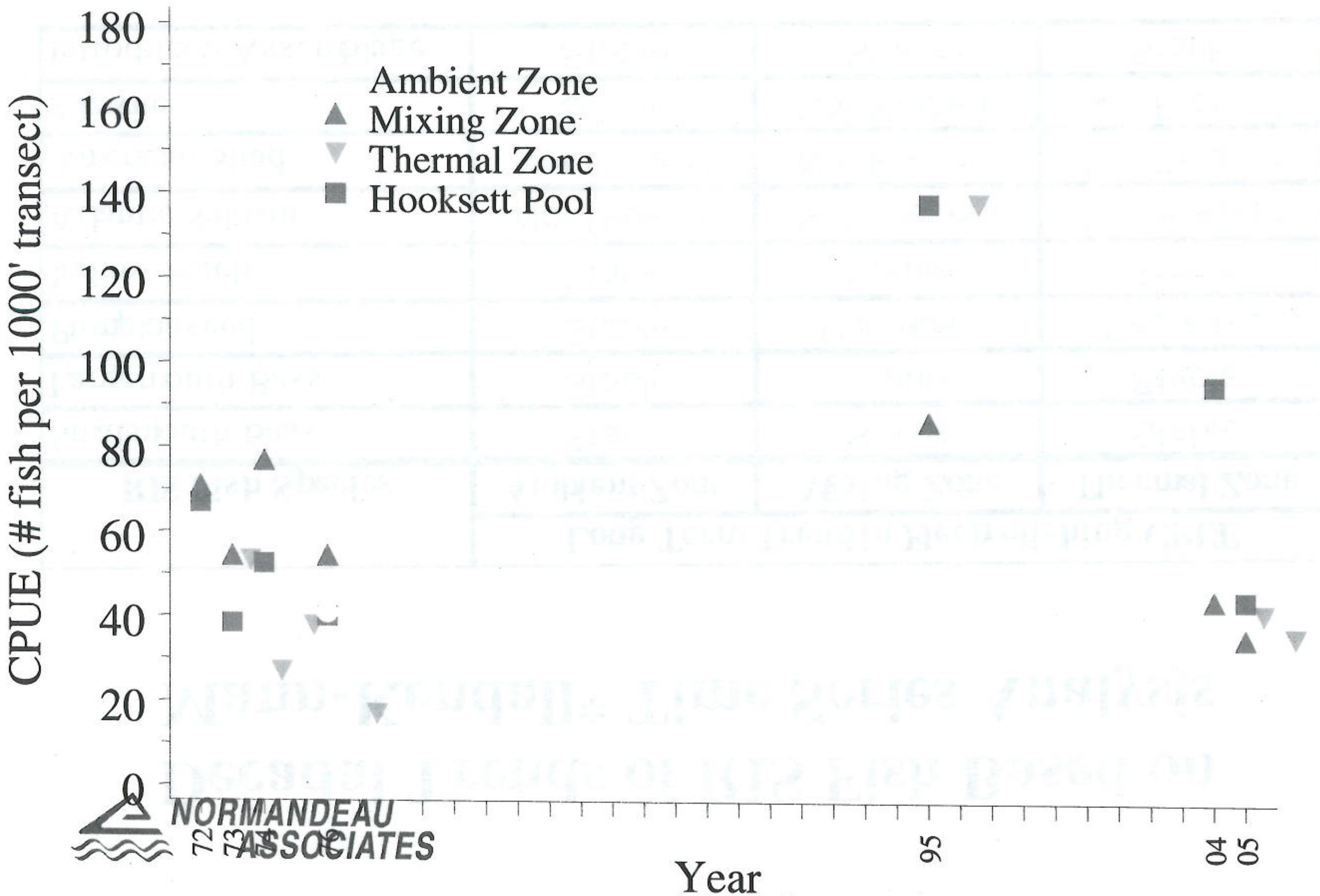
Hooksett Pool Efish CPUE
(Total Catch)



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Decadal Trends of RIS Fish Based on Mann-Kendall* Time Series Analysis

RIS Fish Species	Long Term Trend in Electrofishing CPUE		
	Ambient Zone	Mixing Zone	Thermal Zone
Smallmouth Bass	Stable	Stable	Stable
Largemouth Bass	Stable	Stable	Stable
Pumpkinseed	Stable	Decrease	Decrease
Yellow Perch	Stable	Stable	Stable
Atlantic Salmon	Not Present	Not Present	Not Present
American Shad	Not Present	Not Present	Not Present
Alewife	Stable	Not Present	Not Present
Introduced Assemblage	Stable	Stable	Stable

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*Significant trend if Kendall Tau with $p < 0.05$

Fish Species Richness

Year	Number of Taxa Caught by Electrofishing			
	Ambient Zone	Mixing Zone	Thermal Zone	Hooksett Pool
1972	12	10	11	12
1973	11	12	9	13
1974	13	12	11	15
1976	11	11	11	12
1995	11	7	9	14
2004	17	9	8	18
2005	14	8	9	15

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Downstream Passage: Overview

- Is there effective downstream passage for migratory RIS during critical periods of migration past Merrimack Station?
  - **Spring migration of Atlantic Salmon smolts**
  - Autumn migration of juvenile clupeids

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Spring Migration of Atlantic Salmon Smolts -- Historic Studies

- Historic data indicates that most smolts in River migrate from late April through May
  - Lawrence Dam study (1993) showed more than 96% of wild salmon passed through dam between May 5 and June 2
  - Studies of downstream movements of radio-tagged smolts showed no delay in migration due to thermal plume from Station (Saunders 1992)
  - Travel time between Eastman Falls Dam and Garvin's Falls Dam and Garvin's Falls Dam and Amoskeag Dam did not differ significantly (Mann-Whitney test)

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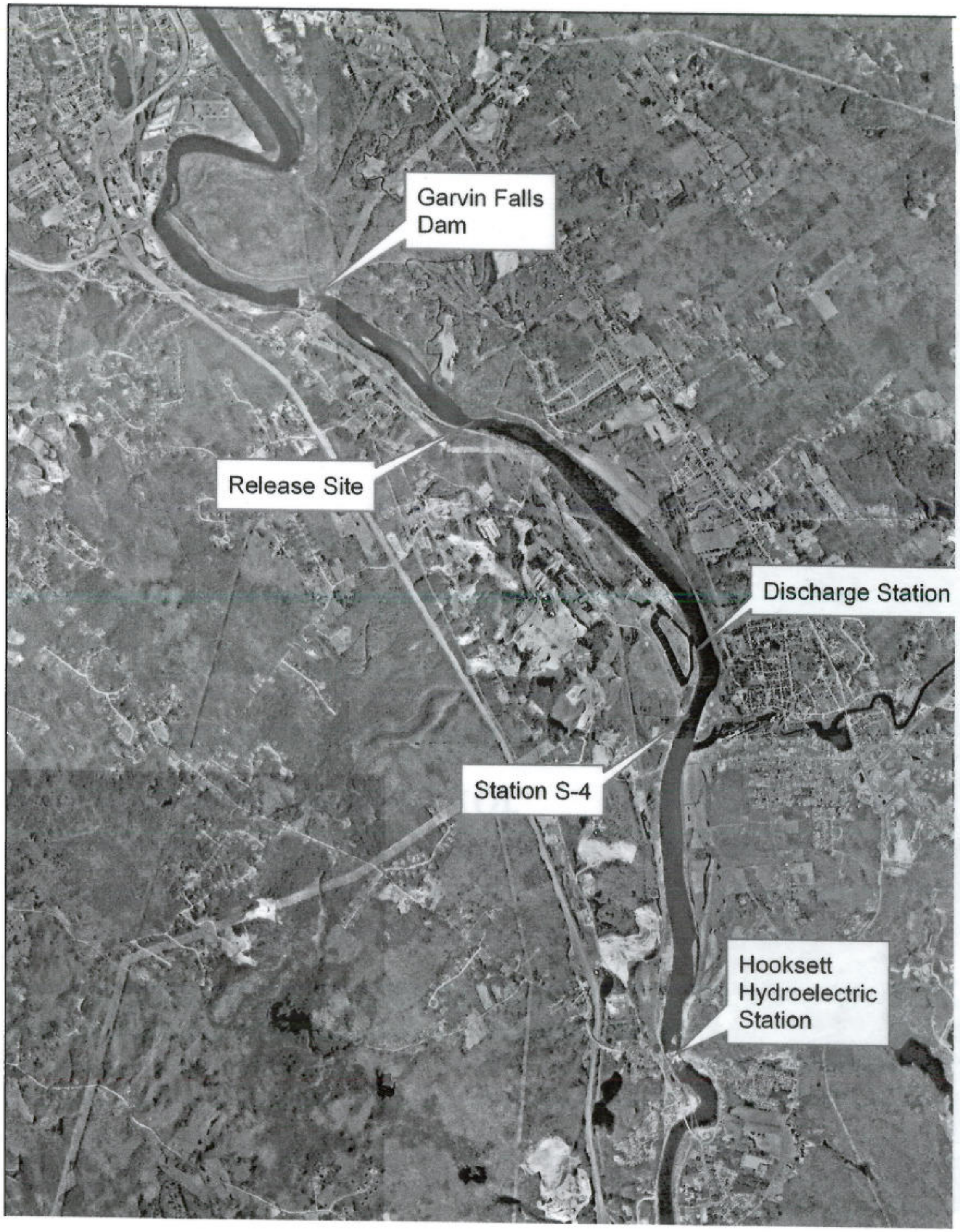
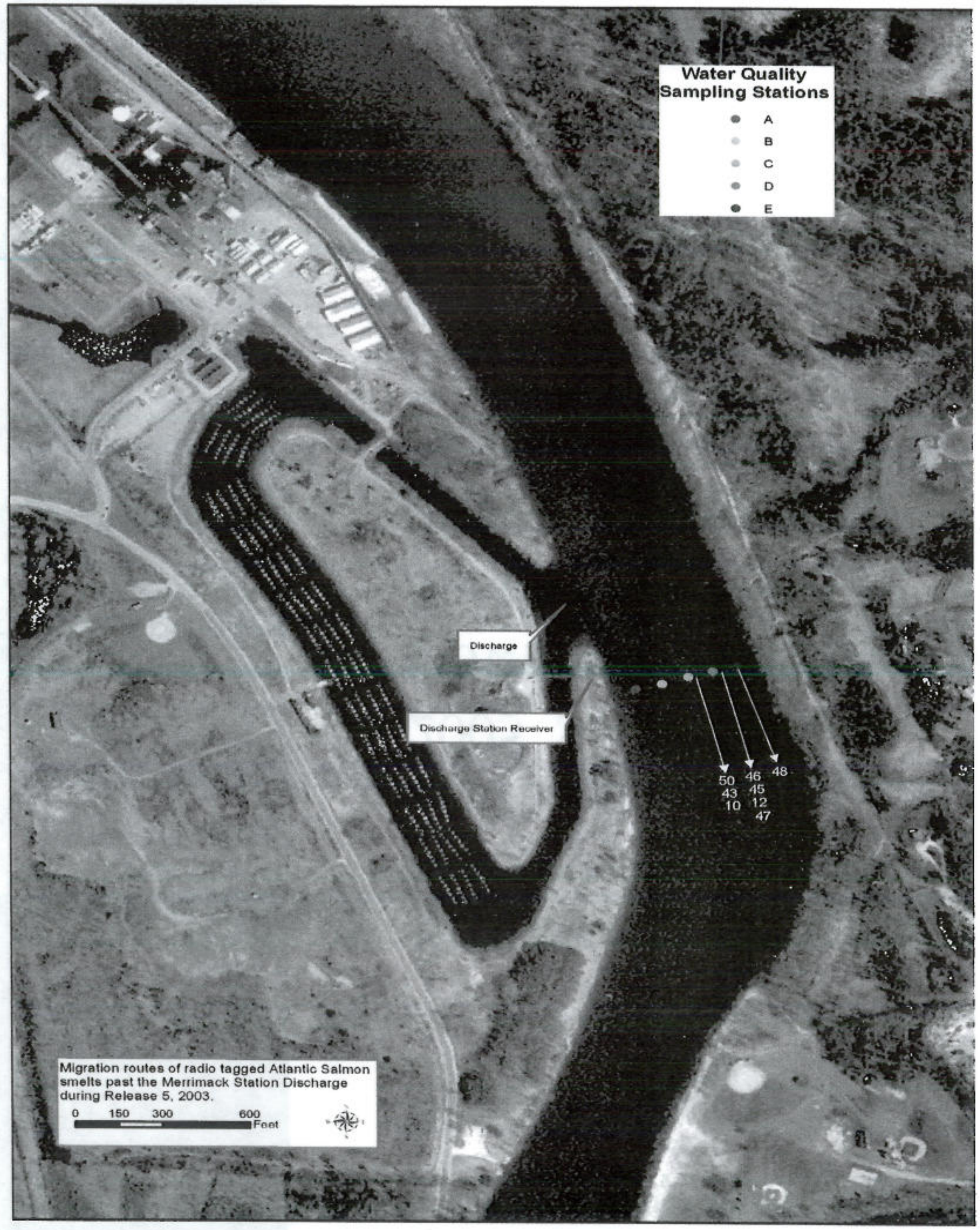


Release and Tracking Stations for Normandeau 2003 and 2005 Salmon Smolt Downstream Passage Studies performed in response to resource agency (EPA, USFWS, NHFG) comments at a meeting 10 May 2002

Downstream Passage: Sampling Stations Used to Observe Selected Passage Routes for Downstream Migrating Smolts Past Merrimack Station Thermal Plume During 2003 and 2005.



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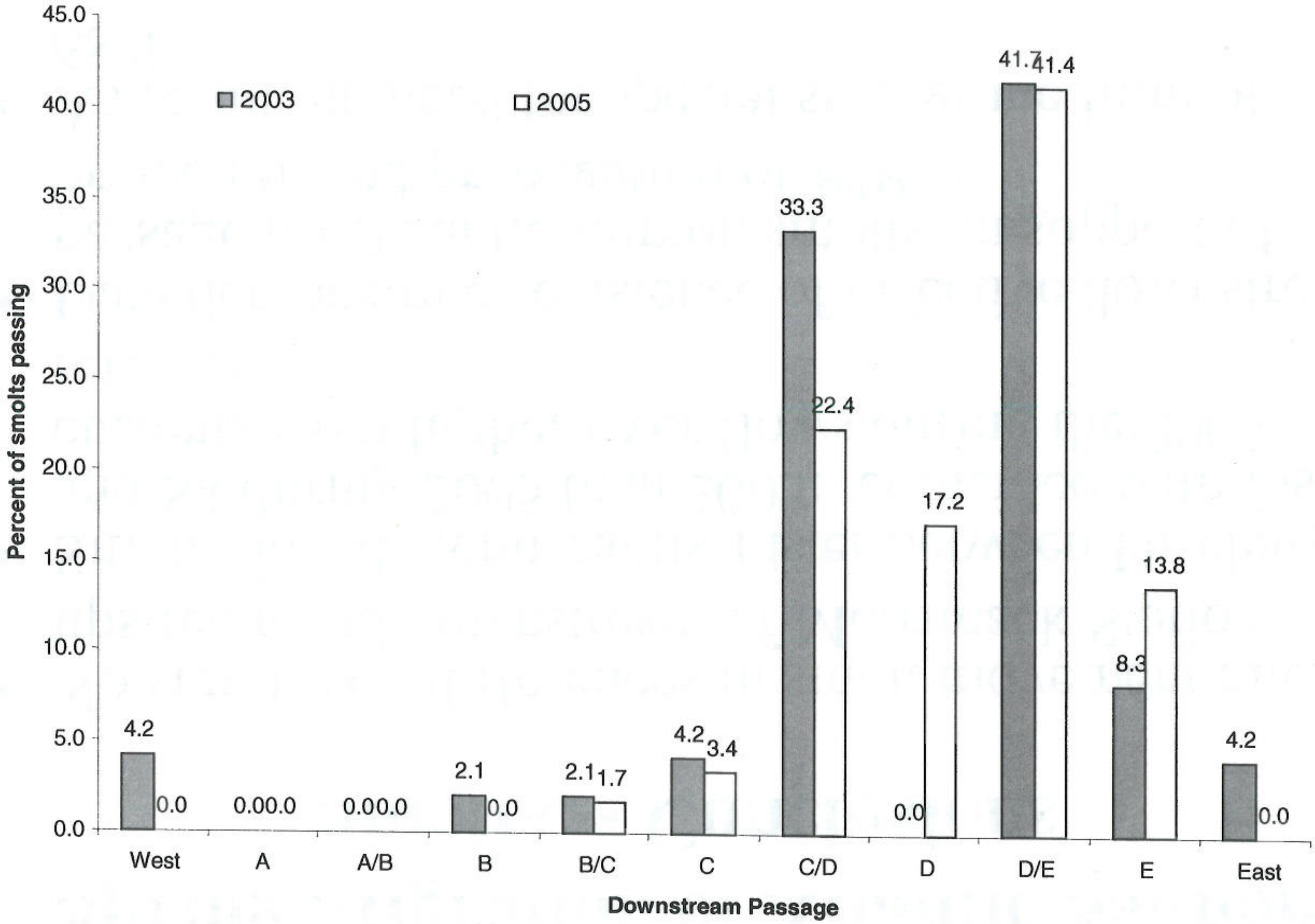
Smolt Downstream Passage



Percentage of smolt passage for 2003 and 2005 Atlantic salmon smolts released during Merrimack Station study.

Spring Migration of Atlantic Salmon Smolts -- Conclusions

- No significant differences in smolt movement rates upstream and downstream of Merrimack Station
- Smolt moved significantly faster between Discharge and S4 during 2005 than 2003: coincided with faster currents from higher river flows during the 2005 releases
- Data demonstrates existence of effective downstream passage for Atlantic salmon smolts, in support of protection and propagation of BIP
- As result, no need for special springtime limit of 68°F

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Downstream Passage: Overview

- Is there effective downstream passage for migratory RIS during critical periods of migration past Merrimack Station?
  - Spring migration of Atlantic Salmon smolts
  - **Autumn migration of juvenile clupeids**

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Autumn Migration of Juvenile Clupeids -- Historic Studies

- Historic data indicate that downstream migration of juvenile clupeids (e.g., shad and alewives) in Merrimack River starts at end of September
- Lowell Project (1991): Peak migration occurred during first two weeks of October
- Lawrence Project (1993): Peak migration occurred during mid-October
- Amoskeag Project (2002): Collected juvenile shad and alewives in late October

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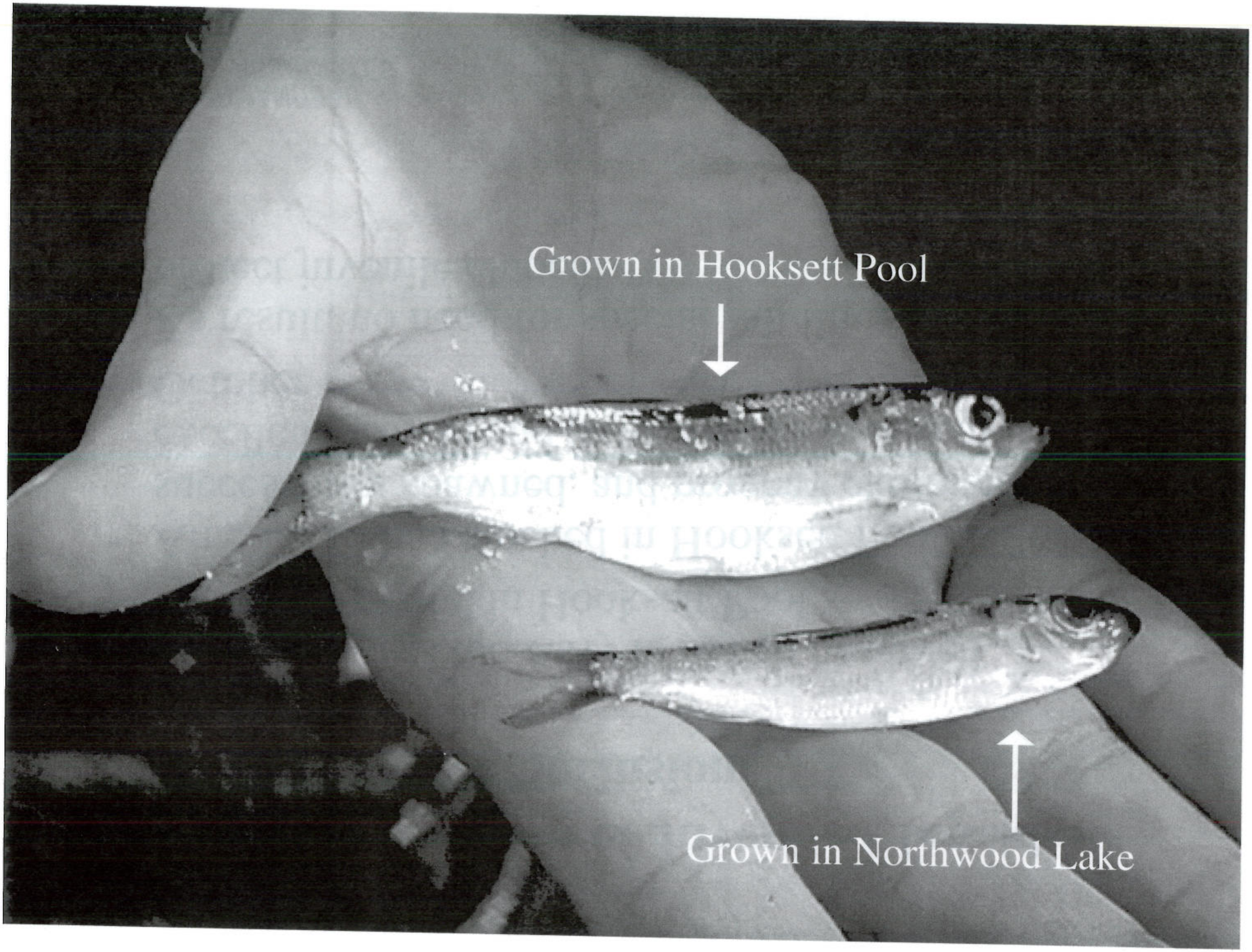
Grown in Hooksett Pool
Grown in Northwood Lake

Autumn Migration of Juvenile Clupeids – Conclusions

- September 7 is too early to match observed migration period in Hooksett Pool
- American Shad stocked in Hooksett Pool in 2002 successfully spawned, and progeny exhibited excellent growth and passed downstream in late October
- As result, no need for special fall limit of 78°F to protect juvenile clupeids

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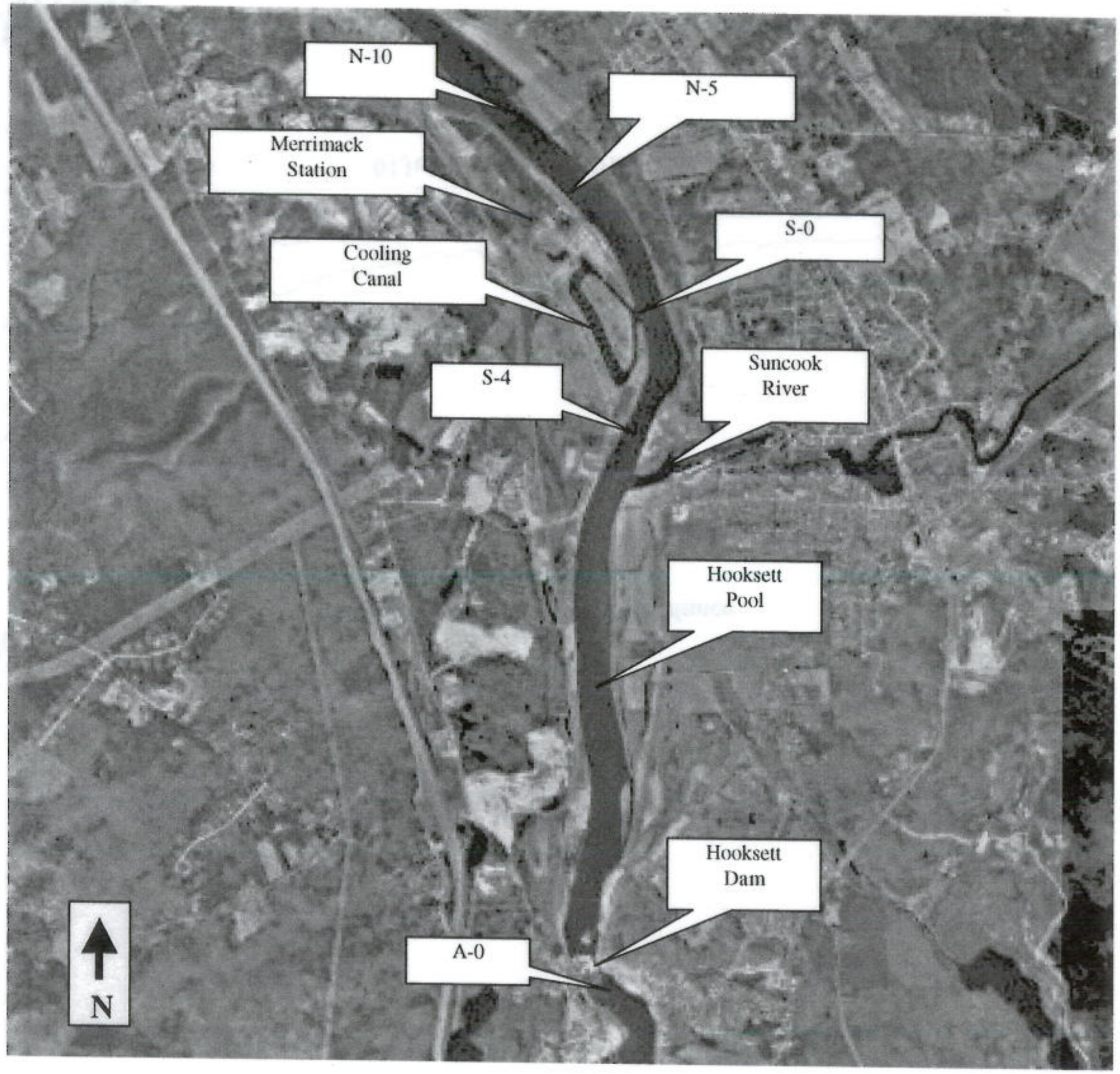
Merrimack River Thermal Environment

- Thermal impact of Station discharge on Merrimack River varies jointly with ambient temperature and river flow.
- Typical north temperate seasonal cycle of ambient temperature (peak in early August).
  - Downstream instream temperature dominated by ambient temperature cycle, with some influence from Station discharge.
- River flow typical of north temperate rivers (highest in spring, lowest in late summer/early fall).
  - Downstream instream temperature highly influenced by river flow.

Merrimack Station – Site Map and Temperature Monitoring Station Locations



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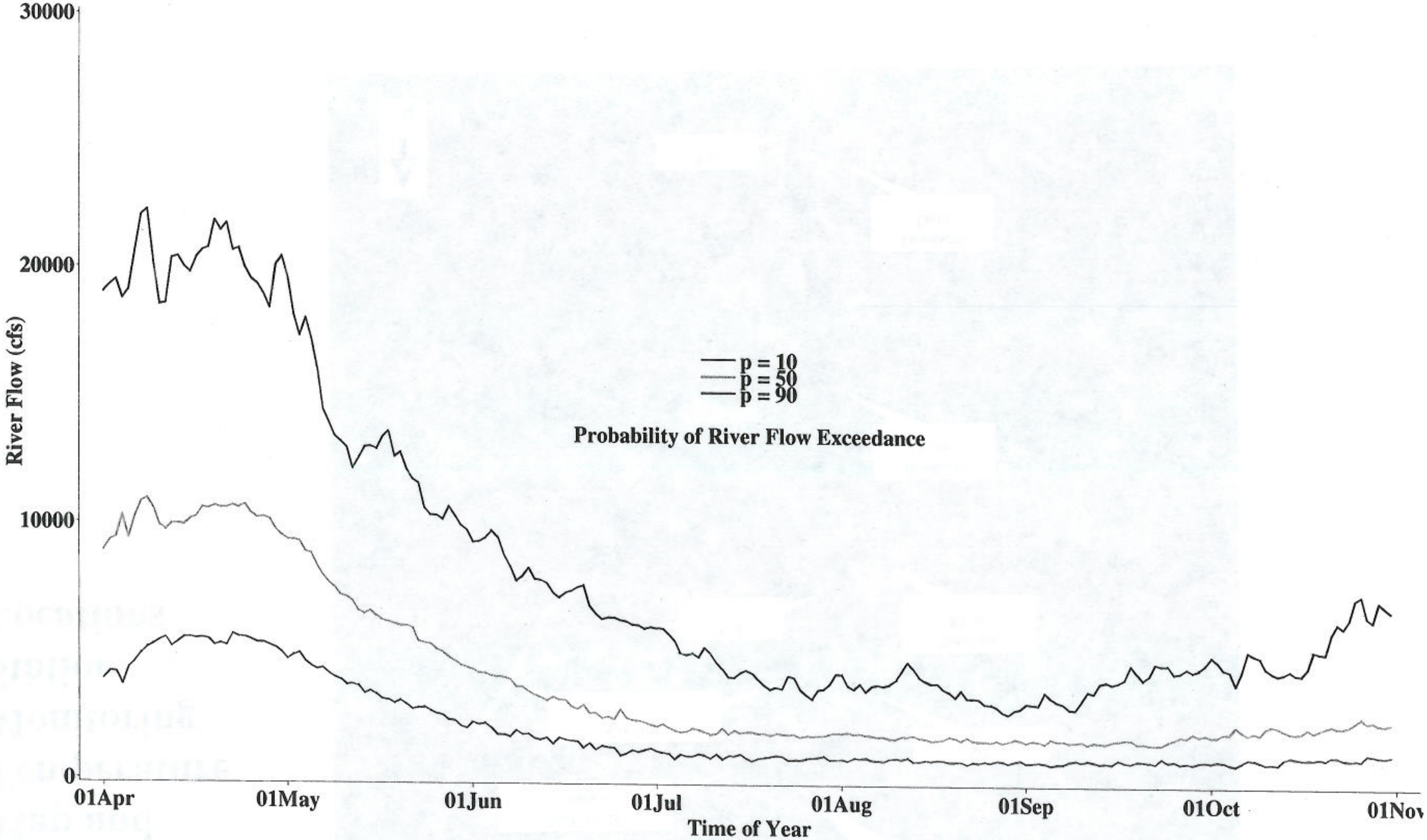
Expected Daily Merrimack River Flow at Merrimack Station



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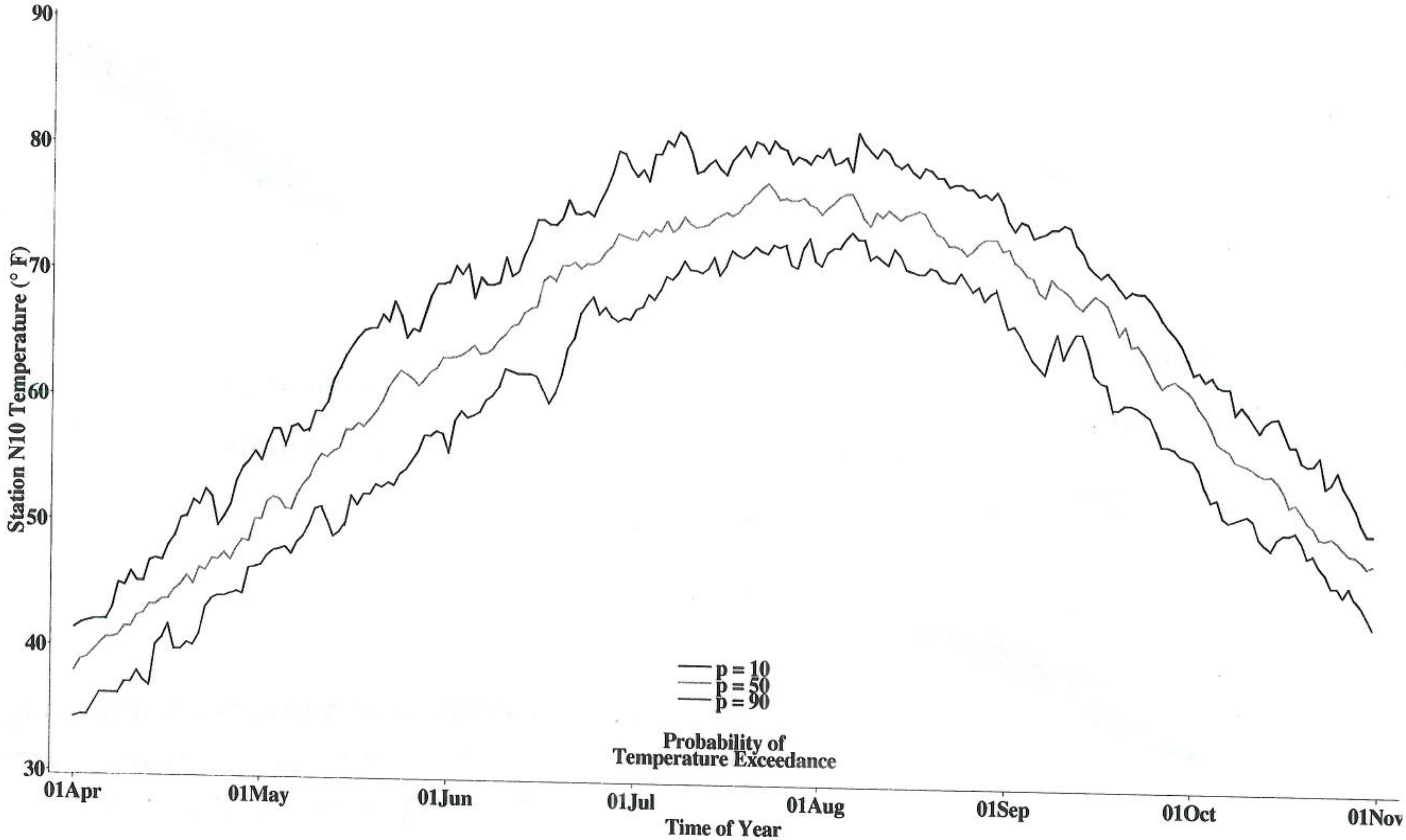
Expected Daily Merrimack River Temperature at Upstream Ambient Station N-10



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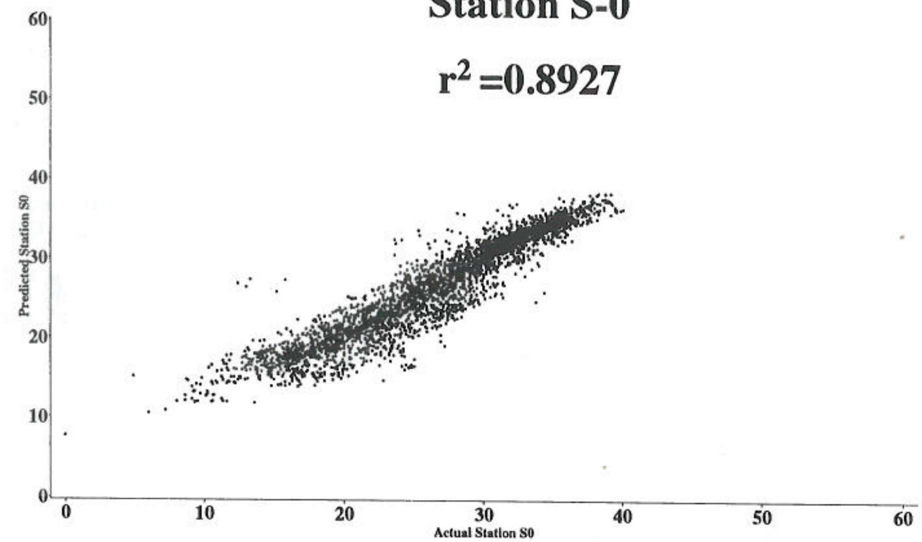
Comparison of the Predictability of Temperature at Downstream Stations S-0, S-4, and A-0 Using Ambient Temperature, River Flow and Merrimack Station Generation

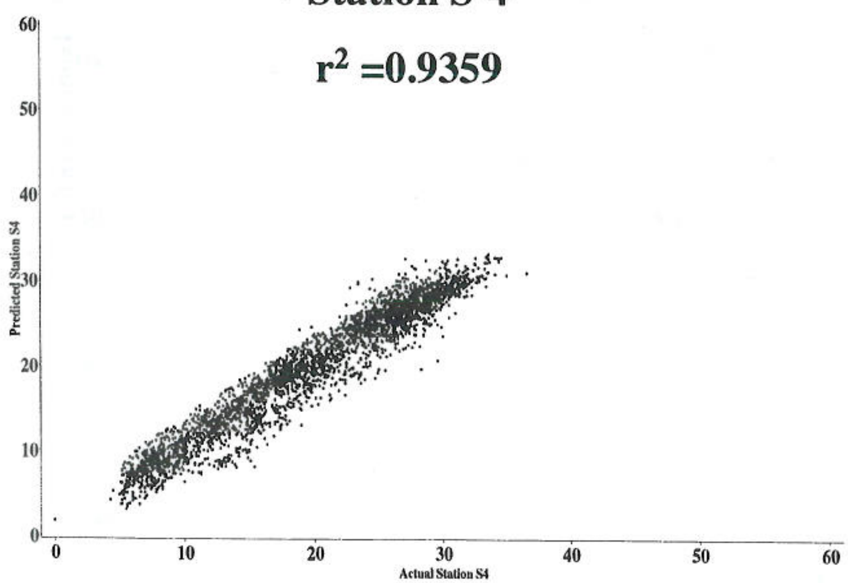
Station S-0

$r^2 = 0.8927$



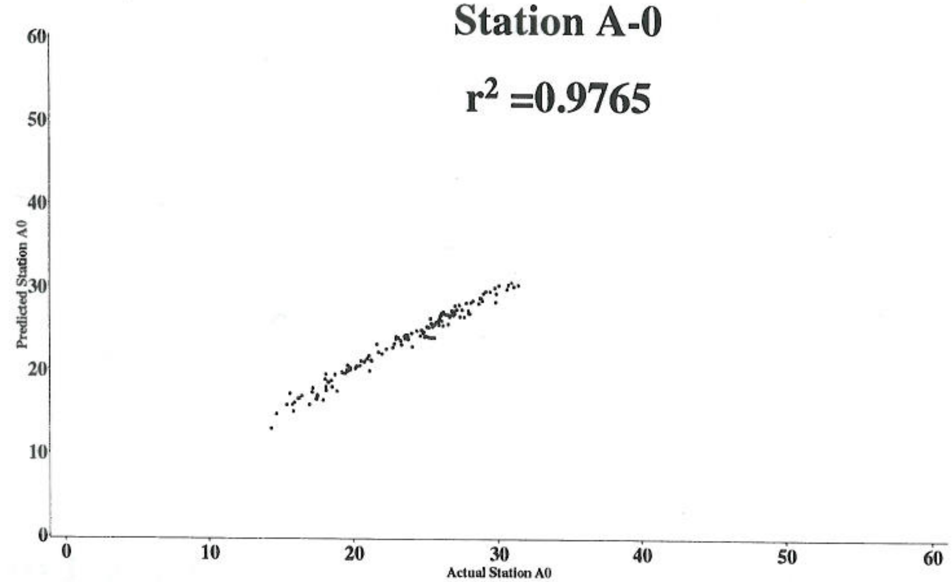
Station S-4

$r^2 = 0.9359$



Station A-0

$r^2 = 0.9765$



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Merrimack River Thermal Environment: 2006 Thermal Study Conclusions

- Downstream river thermal environment is largely determined by upstream ambient conditions.
- Instream river temperature was most reliably predicted at foot of Hooksett Dam (Station A-0):
  - Station A-0 is representative of completely mixed river thermal environment.
- Instream river temperature was less reliably predicted in mixing zone (Station S-4), and least reliably predicted at end of cooling canal (Station S-0).

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Predicted Total Number of Days of Compliance Exceedance in the Merrimack River at Three Downstream Monitoring Stations (Station S-0, S-4, or A-0) during the Spring/Summer/Fall Monitoring Period (May 1–October 31) at Merrimack Station Based on Thermal Discharge Criteria Proposed by the Resource Agencies

Probability of Flow (Q) Occurrence (%)	Probability of Temperature Occurrence at Station N-10 (%)														
	1 (highest T)			10 (higher T)			50 (median T)			10 (lower T)			1 (lowest T)		
	S-0	S-4	A-0	S-0	S-4	A-0	S-0	S-4	A-0	S-0	S-4	A-0	S-0	S-4	A-0
1 (highest Q)	184	88	4	179	43	0	165	0	0	134	0	0	126	0	0
10 (higher Q)	184	104	33	176	69	5	156	5	0	132	0	0	118	0	0
50 (median Q)	183	113	75	176	82	23	155	10	0	130	0	0	116	0	0
10 (lower Q)	181	113	93	175	84	45	154	11	3	130	0	0	114	0	0
1 (lowest Q)	181	114	102	175	85	57	154	11	10	130	0	0	114	0	0

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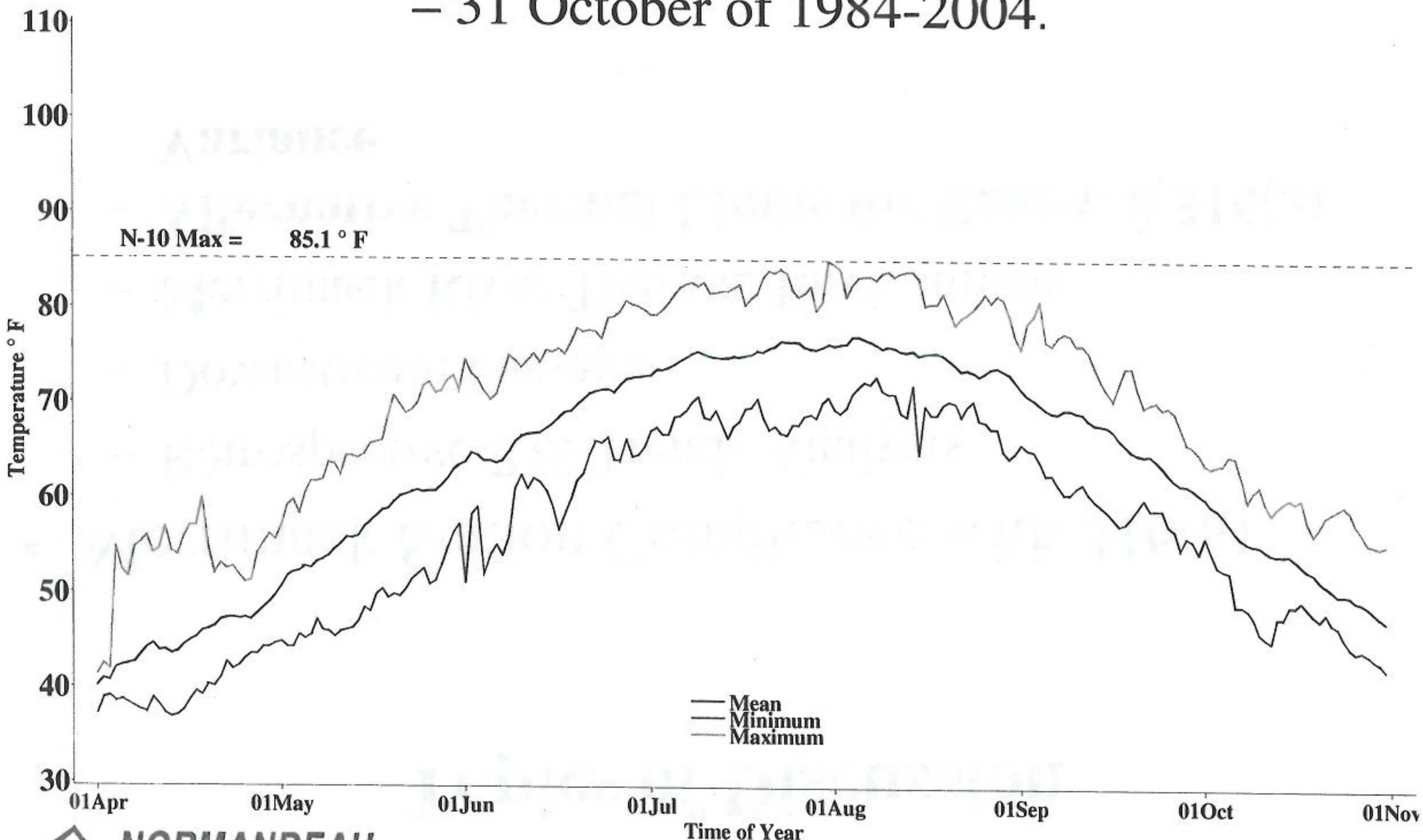
Measured Averaged Daily Maximum, Minimum and Mean Water Temperature in the Upstream Ambient Zone (Station N-10) at Merrimack Station for 1 April – 31 October of 1984-2004.



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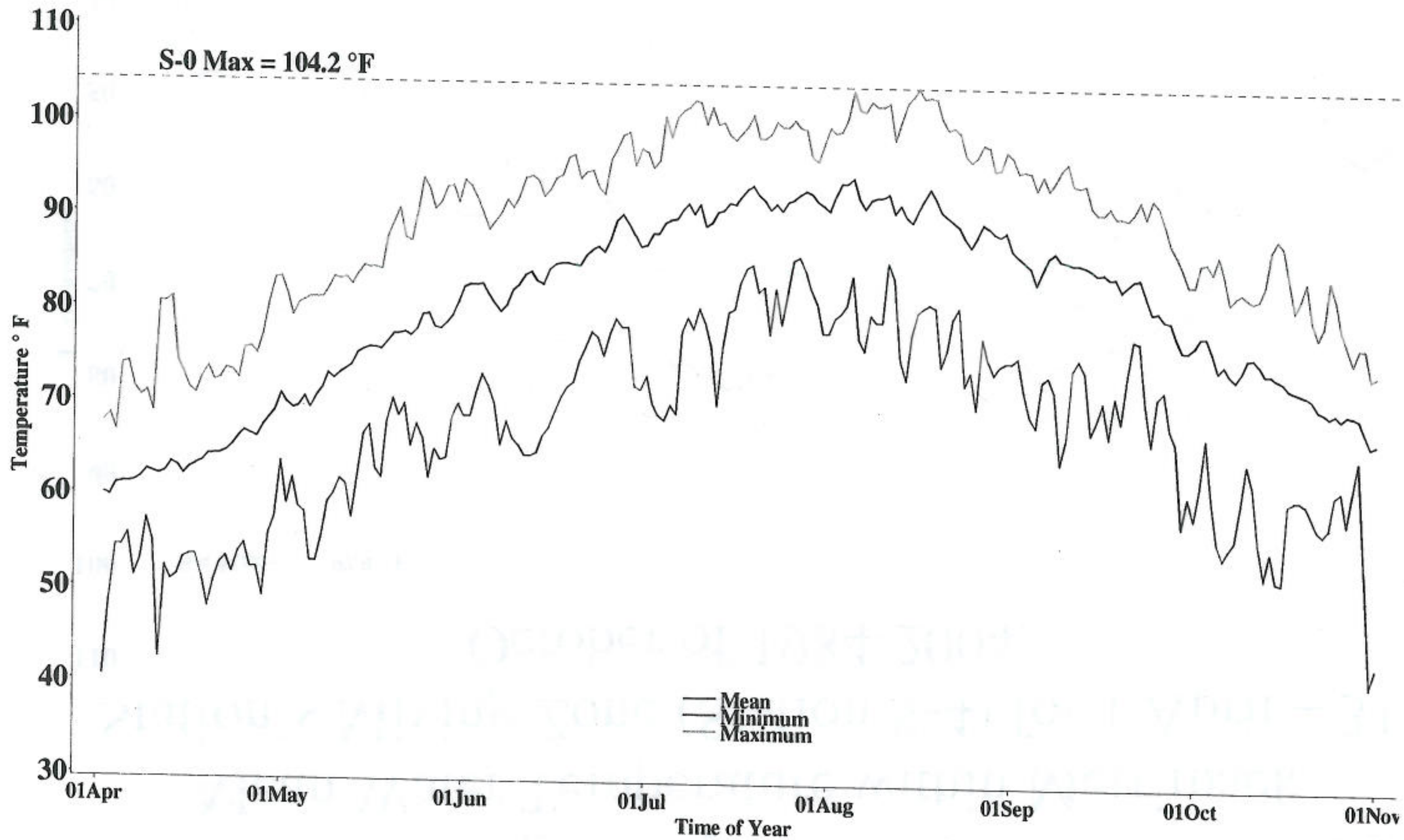
Measured Average Daily Maximum, Minimum, and Mean Water Temperature at the End of Merrimack Station's Cooling Canal (Station S-0) for 1 April – 31 October of 1984-2004



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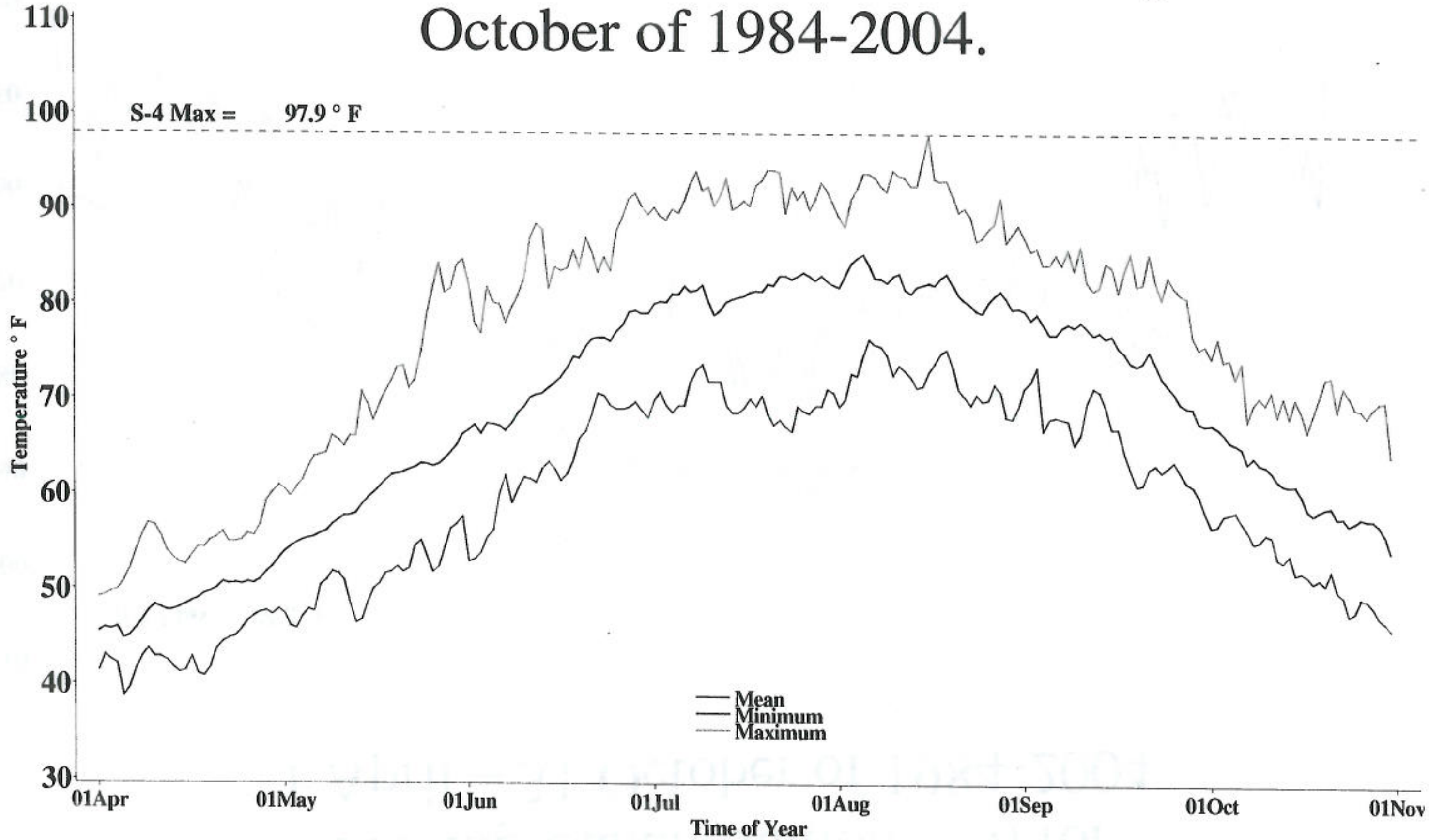
Measured Average Daily Maximum, Minimum and Mean Water Temperature within Merrimack Station's Mixing Zone (Station S-4) for 1 April – 31 October of 1984-2004.



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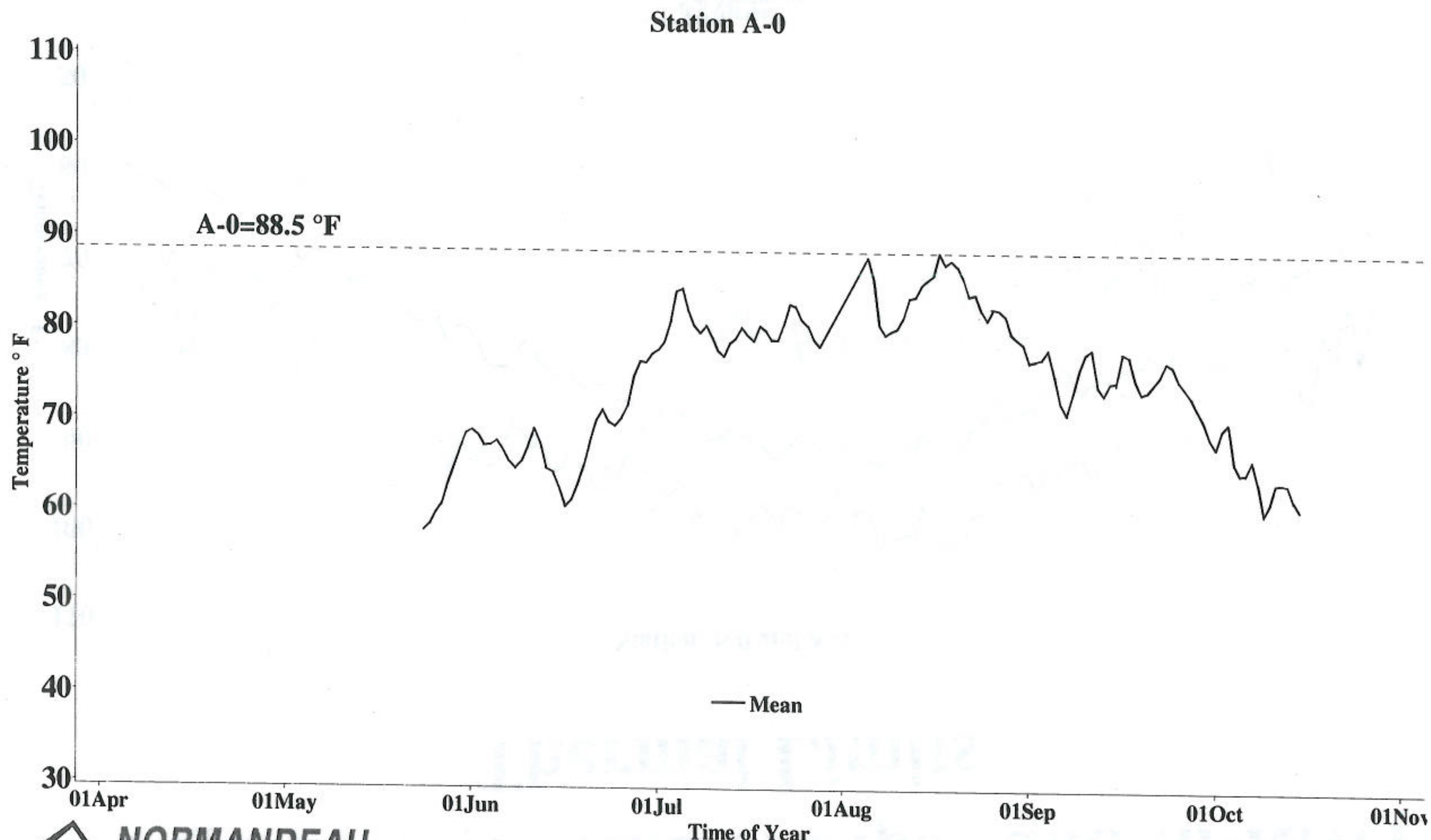
Daily Mean River Water Temperature Observed at the Foot of Hooksett Dam for 24 May – 15 October 2002



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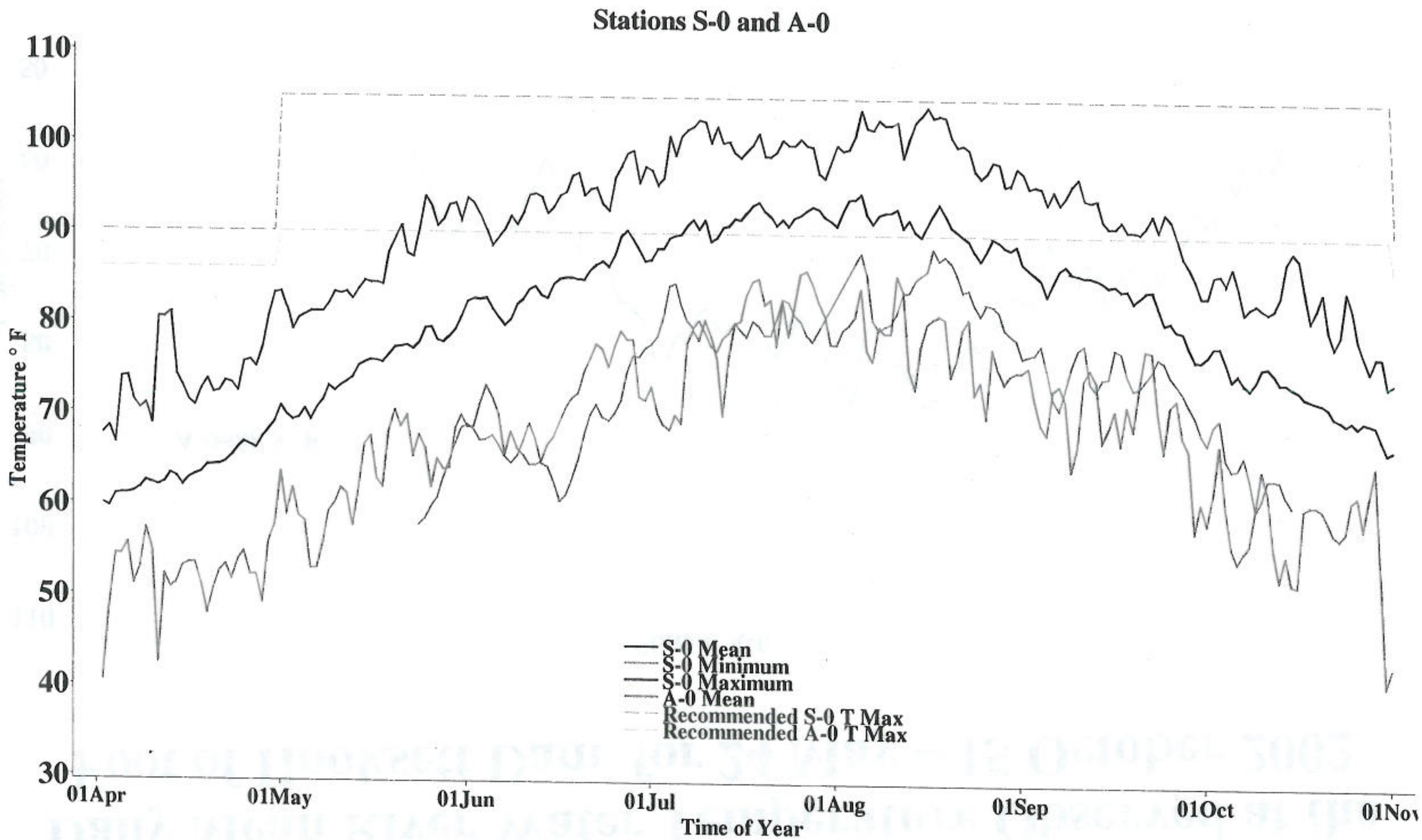
Comparison of "End of Pipe" and In-River Thermal Limits



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Alternative Thermal Limits for Renewed 316(a) Variance: Overview

- Data demonstrate that existing thermal environment in lower Hooksett Pool resulting from Station's operations is protective of BIP.
- Data demonstrate that there is adequate downstream passage for migratory RIS under existing conditions.
- Alternative thermal limits proposed by PSNH will preserve present operating conditions while continuing to be protective of BIP.

Proposed Instream Alternative Thermal Limits for Renewed 316(a) Variance

- Data supports following instream alternative thermal limits that are protective of BIP:
  - Compliance monitoring point = foot of Hooksett Dam (Station A-0).
  - T Max at Station A-0 of 92°F daily average for 1 May – 31 October, and 86°F for rest of year.
  - Waiver provisions due to emergency conditions.

Proposed "End of Pipe" Alternative Thermal Limits for Renewed 316(a) Variance

- If Agencies desire "end of pipe" alternative thermal discharge limits to protect BIP:
  - End of pipe = end of cooling canal (Station S-0).
  - T Max at Station S-0 of 105°F daily average for 1 May – 31 October, and 86°F for rest of year.
  - Waiver provisions due to emergency conditions.

Adverse Effects of Agencies' Proposed Thermal Limits on Plant Operation

- PSNH proposes that ambient water temperature at Hooksett Pool tailrace not be permitted to exceed 92°F as result of Station's thermal discharge.
- Any other thermal limit could result in generation curtailment or even Station shutdown scenario, and would impact New England electric system reliability and diversity, and market pricing.

Adverse Effects of Agencies' Proposed Thermal Limits on Station Operation: End of Pipe

- If Agencies' proposed thermal limits were implemented at <u>end of cooling canal</u> (Station S-0) for 1 May – 31 October period:
  - Station would have to shut down one or both generation units for at least 154 of 184 days (84% of the time) under average conditions.
  - Station would have to shut down one or both units for all 184 days under extreme warm and dry conditions

Adverse Effects of Agencies' Proposed Thermal Limits on Station Operation: Instream

- If Agencies' proposed thermal limits were implemented at foot of Hooksett Dam (Station A-0) for 1 May – 31 October period:
  - Station would not have to modify operations under average conditions.
  - Station would have to shut down one or both units for 102 of 184 days (55%) under extreme warm and dry conditions.

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Merrimack Station Compliance with 316(b): Overview

- EPA has already made "Best Professional Judgment"-based determination of "Best Technology Available" for Station under 316(b):
  - In May 1979 letter to PSNH from Leslie A. Carouthers, EPA stated that "we have concluded that, under present conditions, the location, design, and capacity of the [Merrimack Station] intake structure does reflect the best technology available for minimizing adverse environmental impact as required by Section 316(b) …."

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316(b): Merrimack Station Impingement Studies -- Purpose and Activities

- Undertaken pursuant to Phase II Existing Facilities Rule, in support of Comprehensive Demonstration Study due in January 2008.
- Results presented represent first year (June 2005 to June 2006) of two-year impingement sampling program:
  - Total impingement abundance
  - Cumulative impingement abundance
  - Impingement survival
- Program is ongoing and entering 2nd year

316(b): Merrimack Station Impingement Studies -- Results to Date

- Annual total number of fish impinged at Merrimack Station (June 2005 – June 2006)
  - Units 1 and 2 combined
  - Scaled from days sampled up to the monthly and annual total based on intake volumes
  - Adjusted upward for collection efficiency
- In sum, total of **2,741** fish impinged at Station during entire one-year period
  - 1,088 alive if returned to the river

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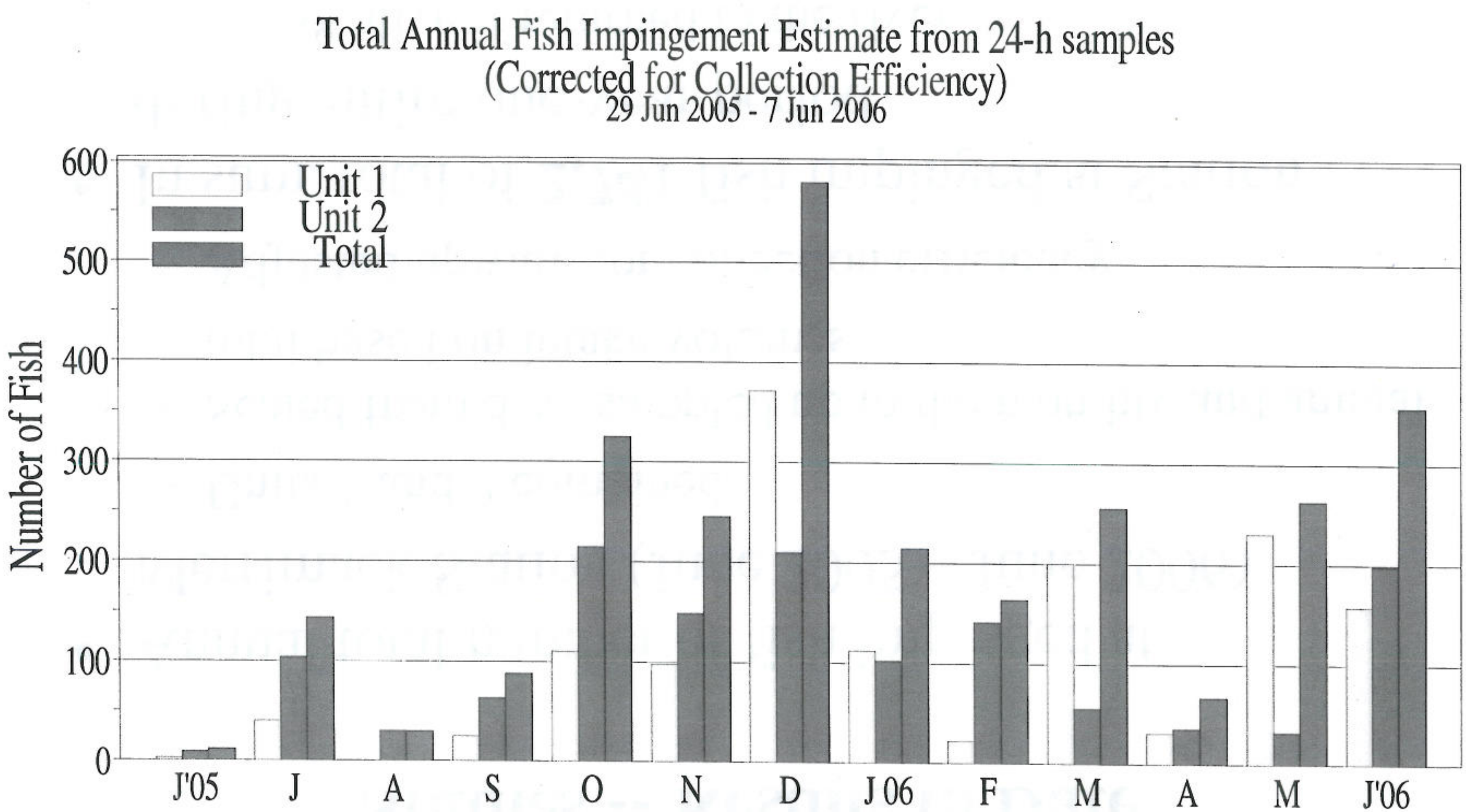
Monthly Adjusted Fish Impingement



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- Adjusted from 24 hr samples
- Corrected for collection efficiency

Species Composition
Merrimack Station Impingement June 2005-June 2006

Species	Unit 1		Unit 2		Total	
	%	N	%	N	%	N
Alewife	0.0	0	0.0	0	0.0	0
American Shad	0.0	0	0.0	0	0.0	0
Atlantic Salmon	0.0	0	0.0	0	0.0	0
Largemouth bass	1.3	2	11.8	14	5.9	16
Pumpkinseed	11.3	17	0.8	1	6.7	18
Smallmouth bass	2.0	3	2.5	3	2.2	6
Yellow perch	14.7	22	0.8	1	8.6	23
Introduced Assemblage	40.7	61	49.6	59	44.6	120
Other	30.0	45	34.4	41	32.0	86
Total	100.0	150	100.0	119	100.0	269

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Merrimack Station Impingement Survival

	Feb-06	Mar-06	May-06
24 Hour Survival	**21%**	**53%**	**45%**
Standard Error (±)	8%	5%	10%
Mortality Factor	79%	47%	55%
N (fish recaptured)	70	109	26

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