U.S. Atlantic Salmon
Assessment Committee

ANNUAL REPORT 1991/3

Annual Report of the U.S. Atlantic

Salmon Assessment Committee Report

No. 3 - 1990 Activities

Turners Falls, Massachusetts
January 28 - February 1, 1991

Prepared for
U.S. Section to NASCO

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1 INTRODUCTION

1.1 Executive Summary

The 1991 Annual Meeting of the U.S. Atlantic Salmon Assessment Committee was held January 28 - February 1 at the Northeast Anadromous Fish Research Lab, Turners Falls, MA. This was the third such meeting. The Committee addressed terms of reference established at the 1990 meeting plus topics such as program and study reviews. A discussion/problem solving session was implemented this year for the first time. Committee members presented papers and data addressing fry and parr stocking assessment studies. A summary of these discussions is presented in Section 4 of this report. One of the goals of these discussions was to develop a format for future problem solving forums.

Stocking data, listed by age/life stage and rivers, and tagging data were summarized for all New England programs. A total of 5,374,000 juvenile salmon (fry, parr and smolts) were stocked. Of those, 60,300 parr and 814,200 smolts carried coded wire tags (CWT) and 49,900 smolts received Carlin tags. An additional 217,500 parr and smolts were marked with ventral fin clips.

A total of 4442 salmon were documented to have returned to U.S. waters in 1990, of which 3923 were counted in Maine. Since many of Maine's rivers do not have counting facilities, and the facilities that do operate are not 100% effective, a system was implemented to estimate total adult returns in Maine. The estimated run using this method was 6,100 adults.

There were 838 fish with CWT and 149 with Carlin tags which returned to U.S. rivers in 1990. The angling catch in Maine waters reached 1,414, which is up from the 1007 angled in 1989.

General program updates included: 1) a summary of factors influencing the survival of hatchery-reared smolts in Maine; 2) effects of predators and predator abundance of salmon survival; 3) incidence of precosity in hatchery parr; 4) changes in smolt programs and smolt sizes at the federal hatcheries in Maine 1980 - 1990; 4) updates of the New England restoration programs; 5) smolt movement past hydro-electric dams; 6) information regarding fry and parr survival assessment.

The compilation of historical (1980 - 1989) stocking and adult return data continued with the addition of the 1989 data and proofing of the previous entries. For that 10-year period, there were 32,370,200 juvenile salmon stocked in New England waters with a total documented return of 39,138 adults.

The data deficiencies and research needs were reviewed and updated. Committee members selected five informational needs which they felt were most important. These are listed on the following page, but are not necessarily in priority order.

1) Develop basin-wide program to enumerate smolt production;

2) Conduct study to compare adult return rates of 2-year old smolts produced in a 2-year smolt program with 1-year old smolts produced in a 1-year smolt program.

3) Conduct a time-of-smolt release study in which the level of smoltification in the fish is standardized among groups by photoperiod manipulation or other techniques. Past studies (such as comparing March releases with May releases) have compared fish that are in very different stages of smoltification.

4) Develop and implement a program designed to determine post smolt movement and mortalities for fish of New England origin.

5) Continue program to retrieve coded wire tags from West Greenland and Canadian commercial fisheries.

Larry Stolte, U.S. Fish & Wildlife Service, Concord, New Hampshire took over as Chairman of the committee at the conclusion of the meeting. Terms of Reference were established, and the dates of January 27 - 31, 1992 were selected for the 1992 meeting.

1.2 Background

The U.S. became a charter member of the North Atlantic Salmon Conservation Organization (NASCO) in 1984. NASCO is charged with the international management of Atlantic salmon stocks on the high seas. Three Commissioners for the U.S. are appointed by the President and work under the auspices of the U.S. State Department. The Commissioners felt they needed advice and input from scientists involved in salmon research and management throughout New England and asked the New England Atlantic Salmon Committee (NEASC) to create such an advisory committee. NEASC is comprised of State and Federal fishery agency chiefs who designated personnel from their staff to serve on the "NASCO Research Committee", which was formed in 1985.

The NASCO research Committee met semi-annually to discuss the terms of reference for upcoming meetings of the International Counsel for the Exploration of the Seas (ICES) and NASCO, as well as respond to inquiries from NASCO Commissioners.

In July of 1988, the Research Committee for the U.S. section to NASCO was restructured and called the U.S. Atlantic Salmon Assessment Committee, to focus on annual stock assessment, proposal and evaluation of research needs and serve the U.S. section to NASCO.

A key element of the proposal was development of an annual Assessment Meeting with the main goal of producing an assessment document for the U.S. Commissioners. Additionally, the report would serve as guidance, with regard to research proposals and recommendations to the State and Federal fishery agency chiefs through the New England Atlantic Salmon Committee (NEASC).

The first Assessment Meeting was held December 12-16, 1988 in Woods Hole, MA and produced the document Annual Report of the U.S. Atlantic Salmon Assessment Committee. Members of the Assessment Committee met for a second annual meeting from January 29-February 2, 1990 in Woods Hole, MA. The results of this second meeting are contained in this report. This meeting reviewed the 1989 season, but was delayed until January to allow adequate time for data compilation. This later meeting date is proposed as an annual event with at least one annual preparatory meeting planned in September.

1.3 Relationship of ICES to NASCO

ICES, the official research arm of NASCO, is responsible for providing scientific advice to be used by NASCO members as a basis for formulating biologically sound management recommendations for the conservation of North Atlantic salmon stocks. ICES delegates responsibilities for the collection and analysis of scientific data on salmon to various study groups. The Working Group on Atlantic Salmon and the Anadromous and Catadromous Fish Committee, which are composed of representatives of member countries are examples.

"Terms of Reference" constitute the task assignments given to the Atlantic Salmon Working Group by ICES from recommendations received from NASCO, the EEC, member countries of ICES, the ANACAT Committee or the Working Group itself. Opportunities for development of Terms of Reference are available to the Atlantic Salmon Assessment Committee by submission of issues of interest through the U.S. Commissioners to NASCO or the appropriate channels.

1.4 Chairman's Comments

Participants at this, the third annual, meeting of the Atlantic Salmon Assessment Committee worked to assemble a complete and accurate summary of the New England Atlantic salmon program. The ever continuing process to improve the report format, content and data compilation was also addressed at the meeting.

I want to thank those who contributed towards the meeting for their time and effort during this busy period for overworked and understaffed offices. Participation and attendance were high, which is a tribute to the participants for their dedication.

This year, we attempted to incorporate a fact finding/problem solving session into the meeting format. Our discussions regarding fry and parr stocking assessment went well and were believed by meeting participants to be beneficial. One of the goals of this session was to establish a forum whereby committee members could assemble available information and address a specific problem or question at next year's meeting or one specially held during the year.

One very disturbing aspect of the salmon program came out during discussions about the financial status of the New England fish and wildlife agencies. Everyone was aware that finances were not good, but I believe that most of us were surprised at how bad they really are. Most agencies are facing serious decreases in operations, with some also facing deep cuts in personnel. Unless the trend in budget cuts for the agencies is reversed, the present levels of activities in anadromous fish restoration cannot be maintained, much less expanded to address the many informational deficiencies which we have identified in this paper.

Lastly, I have been Chairman of this committee for two years now, and felt that it was time for some new ideas and leadership. There were high points and low points, but it was certainly a "learning experience". I sincerely want to thank all of you for your advice and support while I was Chairman.

Jerry Marancik

Jerry Marancik
Chairman, U.S. Atlantic Salmon
Assessment Committee

2 STATUS OF PROGRAM

2.1 Stocking

2.1.1 Total Releases

In 1990 approximately 5.4 million juvenile Atlantic salmon were released into 15 rivers of New England (Table 1). This total is nearly equal to the number of juveniles released during the previous year (roughly 5.5 million juvenile salmon). The Connecticut, Merrimack and Penobscot Rivers received the greatest share of the total; 38%, 21%, and 19%, respectively. The stocking of salmon fry constituted over 50% of the releases.

TABLE 1. ATLANTIC SALMON STOCKING SUMMARY FOR NEW ENGLAND IN 1990 BY RIVER SYSTEM AND BY PROGRAM.[1]

River System	Number of Fish						River Total
	FRY	0+PARR	1 PARR	1+PARR	1SMOLT	2SMOLT	
St. John (USA)							
Aroostook	29,000	0	0	0	27,500	0	56,400
St. Croix	255,000	0	0	0	65,800	0	320,800
Dennys	20,000	0	0	0	25,800	0	45,800
Pleasant	30,000	0	0	0	10,500	0	40,500
East Machias	42,000	0	10,100	0	10,100	0	62,200
Machias	75,000	10,100	17,600	0	26,100	0	128,800
Narraguagus	0	0	0	0	16,800	0	16,800
Union	0	0	0	0	20,400	0	20,400
Penobscot	265,000	166,500	155,300	0	413,200	15,900	1015,900
Ducktrap	18,000	0	0	0	0	0	18,000
Sheepscot	27,000	10,100	10,000	0	17,500	0	64,600
Saco	0	30,100	47,800	0	10,600	0	88,500
Merrimack	952,000	0	5,600	29,700	116,900	0	1104,200
Pawcatuck	0	83,500	55,000	0	7,500	0	146,000
Connecticut	1,265,000	281,900	25,000	0	475,000	0	2,046,900
GRAND TOTAL	2,978,000	582,200	326,400	29,700	1,243,100	15,900	5,175,800
St. John (CANADA)							
Upper St.John	110,000	21,000	9,900	0	0	9,600	150,500
Aroostook	40,000	0	0	0	0	7,600	47,600
GRAND TOTAL	150,000	21,000	9,900	0	0	17,200	198,100
PROGRAM							
Maine Program							
USA	761,000	216,500	240,800	0	644,200	15,900	1,878,700
CANADA	150,000	21,000	9,900	0	0	17,200	198,100
Merrimack River Program	952,000	0	5,600	29,700	116,900	0	1,104,200
Pawcatuck River Program	0	83,500	55,000	0	7,500	0	146,000
Connecticut River Program	1,265,000	281,900	25,000	0	475,000	0	2,046,900
GRAND TOTAL	3,128,000	603,200	336,300	29,700	1,243,100	33,100	5,373,900

[1] The distinction between U.S.A. and Canadian stocking of the St. John River Basin is based on the sources of the fish. Fish received from hatcheries located in Canada are reported as Canada and hatcheries located in the U.S. are reported as U.S.A.

2.1.2 Summary of Tagged and Marked Fish

Nearly 68% of the smolts (approximately 864,000) and 6% of the parr (approximately 60,000) that were released were marked with coded wire tags (CWT) or Carlin tags in order to address the contribution of salmon of United States origin to the ocean commercial fisheries and to carry out various research/management studies (Table 2). In addition, a number of smolts and parr were released bearing only fin-clips as marks in order to conduct specific program studies.

TABLE 2. SUMMARY OF JUVENILE ATLANTIC SALMON MARKING PROGRAMS FOR NEW ENGLAND IN 1990[1]

	Number of Coded Wire Tags[2]		Number of Carlin Tags		Number of Fin Clips Only	
	PARR	SMOLTS	PARR	SMOLTS	PARR	SMOLTS
Maine Program	0	220,100	0	49,900	100,600	113,500
Merrimack River	35,300	116,900	0	0	0	0
Pawcatuck River	0	0	0	0	0	3,400
Connecticut River	25,000	477,200	0	0	0	0
Total	60,300	814,200	0	49,900	100,600	116,900

1) All numbers rounded to nearest 100 fish
2) All fish marked with CWTs were also given adipose fin clips

A more comprehensive look at the Atlantic salmon marking program for 1990 is presented in Table 3. Information in this table also includes adult salmon releases which utilized floy tags or carlin tags as identifying marks.

Table 3. **ATLANTIC SALMON MARKING DATABASE**
NEW ENGLAND – 1990

Marking ~~Agency~~	Age	Life Stage	H/W	Stock Origin	Tag Type	Number Marked	Code or Serial	Aux Clip	Rel Date	Place of Release	Comment
USFWS	1	smolt	H	Connecticut	CWT	13600	7/17/38	AD	4/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	4400	7/18/12	AD	5/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	21900	7/18/25	AD	5/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	22800	7/18/22	AD	3/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	22400	7/18/18	AD	4/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	22800	7/18/16	AD	4/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	26300	7/18/11	AD	4/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	18600	7/18/12	AD	4/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	7200	7/18/26	AD	4/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	25700	7/18/13	AD	4/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	22700	7/18/17	AD	4/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	20400	7/18/23	AD	4/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	22800	7/18/24	AD	5/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	21000	7/18/21	AD	5/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	3600	7/17/61	AD	4/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	6700	7/17/63	AD	5/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	22300	7/17/37	AD	4/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	22400	7/18/19	AD	4/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	25400	7/17/36	AD	4/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	2100	7/17/63	AD	5/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	6600	7/17/61	AD	5/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	22100	7/17/15	AD	4/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	6300	7/18/27	AD	5/90	Connecticut R.	
							7/17/63				
USFWS	1	smolt	H	Connecticut	CWT	2000	7/18/23	AD	5/90	Narragansett Bay	
USFWS	1	smolt	H	Connecticut	CWT	1000	7/18/13	AD	5/90	Narragansett Bay	
USFWS	1	smolt	H	Connecticut	CWT	22400	7/18/20	AD	4/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	17600	7/17/62	AD	4/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	22100	7/18/14	AD	4/90	Connecticut R.	
USFWS	1	smolt	H	Connecticut	CWT	22000	7/17/35	AD	4/90	Connecticut R.	
Subtotal (smolt)						477200					
USFWS	1	parr	H	Connecticut	CWT	500	7/18/25	AD	5/90	Connecticut R.	
USFWS	1	parr	H	Connecticut	CWT	100	7/18/18	AD	4/90	Connecticut R.	
USFWS	1	parr	H	Connecticut	CWT	100	7/18/16	AD	4/90	Connecticut R.	
USFWS	1	parr	H	Connecticut	CWT	100	7/18/11	AD	4/90	Connecticut R.	
USFWS	1	parr	H	Connecticut	CWT	100	7/18/12	AD	4/90	Connecticut R.	
USFWS	1	parr	H	Connecticut	CWT	100	7/18/17	AD	4/90	Connecticut R.	
USFWS	1	parr	H	Connecticut	CWT	100	7/18/23	AD	4/90	Connecticut R.	
USFWS	1	parr	H	Connecticut	CWT	200	7/18/21	AD	5/90	Connecticut R.	
USFWS	1	parr	H	Connecticut	CWT	3700 ~~8000~~	7/17/61	AD	4/90	Connecticut R.	
USFWS	1	parr	H	Connecticut	CWT	4700 ~~6400~~	7/17/63	AD	5/90	Connecticut R.	
USFWS	1	parr	H	Connecticut	CWT	100 ~~200~~	7/17/37	AD	4/90	Connecticut R.	
USFWS	1	parr	H	Connecticut	CWT	200	7/18/19	AD	4/90	Connecticut R.	
USFWS	1	parr	H	Connecticut	CWT	2700 ~~3000~~	7/17/61	AD	5/90	Connecticut R.	
USFWS	1	parr	H	Connecticut	CWT	200	7/18/15	AD	4/90	Connecticut R.	

Table 3.(cont.) **ATLANTIC SALMON MARKING DATABASE**
NEW ENGLAND – 1990

Marking Agency	Age	Life Stage	H/W	Stock Origin	Tag Type	Number Marked	Code or Serial	Aux Clip	Rel Date	Place of Release	Comment
USFWS	1	parr	H	Connecticut	CWT	400 ~~4600~~	7/18/27	AD	5/90	Connecticut R.	
							7/17/63				
USFWS	1	parr	H	Connecticut	CWT	200	7/18/20 ✓	AD	4/90	Connecticut R.	
USFWS	1	parr	H	Connecticut	CWT	300	7/17/62 ✓	AD	4/90	Connecticut R.	
USFWS	1	parr	H	Connecticut	CWT	300	7/18/14	AD	4/90	Connecticut R.	
USFWS	1	parr	H	Connecticut	CWT	300	7/17/35 ✓	AD	4/90	Connecticut R.	
Subtotal (parr)						25000					
Total – Connecticut River						25400 ~~602200~~					
CT DEP	4	adult	H	Connecticut	Floy	501300 299	3100		11/90	Connecticut R.	Color=Pink
							3500				
Total – Floy Tags Connecticut River						299					
USFWS	1	smolt	H	Merrimack	CWT	11300	7/18/9	AD	4/90	Merrimack R.	
							7/18/10				
USFWS	1	smolt	H	Merrimack	CWT	5900	7/18/9	AD	5/90	Merrimack R.	
							7/18/10				
USFWS	1	smolt	H	Merrimack	CWT	20400	7/18/8	AD	4/90	Merrimack R.	
USFWS	1	smolt	H	Merrimack	CWT	14800	7/18/9	AD	4/90	Merrimack R.	
USFWS	1	smolt	H	Merrimack	CWT	3700	7/18/8	AD	4/90	Merrimack R.	
							7/18/10				
USFWS	1	smolt	H	Merrimack	CWT	100	7/18/9	AD	3/90	Merrimack R.	
USFWS	1	smolt	H	Merrimack	CWT	200	7/18/9	AD	4/90	Merrimack R.	
USFWS	1	smolt	H	Merrimack	CWT	9750	7/18/2	AD	4/90	Merrimack R.	
USFWS	1	smolt	H	Merrimack	CWT	36050	7/18/1	AD	4/90	Merrimack R.	
							7/18/3				
USFWS	1	smolt	H	Merrimack	CWT	12200	7/18/4	AD	4/90	Merrimack R.	
							7/18/5				
							7/18/6				
							7/18/7				
USFWS	1	smolt	H	Merrimack	CWT	2500	7/18/4	AD	4/90	Merrimack R.	
							7/18/5				
Subtotal (smolt)						116900					
USFWS	1	parr	H	Merrimack	CWT	2500	7/18/8	AD+RV	5/90	Merrimack R.	
							7/18/10				
USFWS	1	parr	H	Unionr	CWT	3100	7/18/8	AD+RV	5/90	Merrimack R.	
USFWS	1+	parr	H	Merrimack	CWT	4100	7/18/1	AD+LV	10/90	Merrimack R.	
							7/18/2				
USFWS	1+	parr	H	Merrimack	CWT	4000	7/18/4	AD+LV	10/90	Merrimack R.	
USFWS	1+	parr	H	Merrimack	CWT	6000	7/18/5	AD+LV	10/90	Merrimack R.	
							7/18/6				
USFWS	1+	parr	H	Merrimack	CWT	200	7/18/6	AD+LV	10/90	Merrimack R.	
USFWS	1+	parr	H	Merrimack	CWT	3100	7/18/5	AD+LV	11/90	Merrimack R.	
							7/18/6				

2

Table 3. (cont.) **ATLANTIC SALMON MARKING DATABASE**
NEW ENGLAND - 1990

Marking Agency	Age	Life Stage	H/W	Stock Origin	Tag Type	Number Marked	Code or Serial	Aux Clip	Rel Date	Place of Release	Comment
USFWS	1+	parr	H	Merrimack	CWT	3400	7/18/2	AD+LV	12/90	Merrimack R.	
							7/18/3				
USFWS	1+	parr	H	Merrimack	CWT	2400	7/18/4	AD+LV	12/90	Merrimack R.	
							7/18/5				
USFWS	1+	parr	H	Merrimack	CWT	2800	7/18/6	AD+LV	12/90	Merrimack R.	
USFWS	1+	parr	H	Merrimack	CWT	3700	7/18/5	AD+LV	12/90	Merrimack R.	
Subtotal (parr)						35300					
Total - Merrimack River						152200					
USFWS	1	smolt	H	Penobscot	CWT	25039	7/17/52	AD	4/90	Penobscot R.	
USFWS	1	smolt	H	Penobscot	CWT	25330	7/17/53	AD	4/90	Penobscot R.	
USFWS	1	smolt	H	Penobscot	CWT	25684	7/17/54	AD	4/90	Penobscot R.	
USFWS	1	smolt	H	Penobscot	CWT	25098	7/17/55	AD	4/90	Penobscot R.	
USFWS	1	smolt	H	Penobscot	CWT	25595	7/17/56	AD	4/90	Penobscot R.	
USFWS	1	smolt	H	Penobscot	CWT	25270	7/17/57	AD	5/90	Penobscot R.	
USFWS	1	smolt	H	Penobscot	CWT	25440	7/17/58	AD	5/90	Penobscot R.	
USFWS	1	smolt	H	Penobscot	CWT	25450	7/17/59	AD	5/90	Penobscot R.	
Total - CWT's, Penobscot River						202906					
DFO	2	smolt	H	St. John	CWT	5034	62/2/29	AD	4/90	Upper St. John R.	
DFO	2	smolt	H	St. John	CWT	4599	62/4/4	AD	4/90	Upper St. John R.	
[illegible]O	2	smolt	H	St. John	CWT	4396	62/17/17	AD	4/90	Aroostook R.	
[illegible]O	2	smolt	H	St. John	CWT	3175	62/60/2	AD	4/90	Aroostook R.	
Total - CWT's, St. John River						17204					
USFWS	2	smolt	H	Penobscot	Carlin	116	292100		5/90	Penobscot R.	Color=Green
							292299				
USFWS	1	smolt	H	Penobscot	Carlin	24984	750200		4/90	Penobscot R.	Color=Green
							775199				
USFWS	1	smolt	H	Penobscot	Carlin	24770	775200		5/90	Penobscot R.	Color=Green
							799999				
ASRSC	MSW	adult	H	Penobscot	Floy	109	9000		4/90	Penobscot R.	Color=Orange
							9163				
ASRSC	MSW	adult	H	Penobscot	Carlin	15	292069		6/90	Penobscot R.	Color=Green
							292099				
ASRSC	MSW	adult	H	Penobscot	Floy	20	9164		9/90	Penobscot R.	Color=Orange
							9201				
ASRSC	MSW	adult	H	Penobscot	Floy	76	1201		6/90	Penobscot R.	Color=Yellow
							1276				
ASRSC	MSW	adult	H	Penobscot	Floy	23	1277		7/90	Penobscot R.	Color=Yellow
							1300				
ASRSC	MSW	adult	H	Penobscot	Floy	98	1301		7/90	Penobscot R.	Color=Yellow
							1400				
ASRSC	MSW	adult	H	Penobscot	Floy	96	1502		6/90	Penobscot R.	Color=Yellow
							1600				

Table 3.(cont.) **ATLANTIC SALMON MARKING DATABASE**
NEW ENGLAND - 1990

Marking Agency	Age	Life Stage	H/W	Stock Origin	Tag Type	Number Marked	Code or Serial	Aux Clip	Rel Date	Place of Release	Comment
ASRSC	MSW	adult	H	Penobscot	Floy	80	1701		9/90	Penobscot R.	Color=Yellow
							1783				
ASRSC	MSW	adult	H	Penobscot	Floy	98	2001		9/90	Penobscot R.	Color=Yellow
							2101				
Total - Carlin Tags and Floy Tags Penobscot River						**50485**					
ASRSC	MSW	adult	H	Penobscot	Floy	4	587		6/90	Saco River	Color=Yellow
							590				
ASRSC	MSW	adult	H	Penobscot	Floy	2	1610		10/90	Saco River	Color=Yellow
							1611				
ASRSC	MSW	adult	H	Penobscot	Floy	17	1676		7/90	Saco River	Color=Yellow
							1699				
Total - Floy Tags Saco River						23					
USFWS	1	smolt	H	Penobscot		11300		RV	4/90	Narraguagus R.	
USFWS	1	smolt	H	Penobscot		5450		RV	5/90	Narraguagus R.	
USFWS	1	smolt	H	Penobscot		10066		LV	5/90	Union R.	
USFWS	1	smolt	H	Penobscot		10333		RV	5/90	Union R.	
USFWS	1	smolt	H	Penobscot		32767		RV	5/90	St. Croix R.	
USFWS	1	smolt	H	Penobscot		32997		LV	5/90	St. Croix R.	
USFWS	1	parr	H	Penobscot		80710		RV	6/90	Penobscot R.	
USFWS	1	smolt	H	Penobscot		10623		LV	4/90	Saco R.	
USFWS	1	parr	H	Penobscot		10000		RV	5/90	Sheepscot R.	
DFO	1	parr	H	Penobscot		9900		RV	6/90	Upper St. John R.	
USFWS	1	smolt	H	Union		3400		AD	3/90	Pawcatuck R.	
Total						217546					

4

2.2 Adult Returns

2.2.1 Total Documented Returns

Documented Atlantic salmon returns to rivers in the United States totalled 4,442 in 1990 (Table 4). This figure is roughly 23% greater than that recorded for 1989.

Table 4. DOCUMENTED ATLANTIC SALMON RETURNS TO NEW ENGLAND RIVERS IN 1990.[1]

RIVER	NUMBER OF ATLANTIC SALMON BY SEA AGE				TOTAL FOR 1990	TOTAL FOR 1989
	1-S-W	2-S-W	3-S-W	P.S.		
PENOBSCOT	523	2773	17	28	3341	3087
UNION RIVER	1	20	0	0	21	30
NARRAGUAGUS RIVER	1	49	0	1	51	39
PLEASANT RIVER[2]	-	-	-	-	-	-
MACHIAS RIVER	0	2	0	0	2	16
EAST MACHIAS	1	46	0	1	48	31
DENNYS RIVER	1	31	0	1	33	12
ST. CROIX RIVER	18	85	0	9	112	241
KENNEBEC RIVER	1	45	0	0	46	17
ANDROSCOGGIN	7	177	0	1	185	19
SHEEPSCOT RIVER	1	8	0	0	9	5
DUCKTRAP RIVER	0	2	0	0	2	0
SACO RIVER	4	69	0	0	73	19
MERRIMACK RIVER	27	219	2	0	248	84
PAWCATUCK RIVER	0	8	0	0	8	6
CONNECTICUT RIVER	1	262	0	0	263	109
TOTAL	586	3796	19	41	4442	3606

[1] These are considered minimum numbers; reflecting only trap counts and rod catches.

[2] Unknown number of salmon returned but were not documented.

Significant increases in run sizes from those recorded in 1989 occurred in the Connecticut, Merrimack, Androscoggin, and Saco Rivers. The increases for these four rivers amounted to 539 salmon. Moderate increases were observed in most other rivers except for three, the Union, Machias, and St. Croix Rivers, where decreases were observed.

It is important to realize that the information within Table 4 represents only minimum documented salmon returns. Salmon returns are obtained utilizing fish counts at traps associated with fish passage facilities and rod catches (fish killed) downstream from the traps.

Rivers having no trapping facilities present real problems in obtaining return information. In these situations rod harvest information becomes the return information. Rod catches obviously do not reflect the total run in any of the rivers. Reporting of rod catches is not even likely complete. Fish passage inefficiencies at salmon traps associated with fish passage facilities are known to occur.

2.2.2 ESTIMATED TOTAL RETURNS.

Nearly 4,000 adult Atlantic salmon were counted at fishway traps or were known to have been taken in sport fisheries in Maine in 1990. Most Maine salmon rivers do not have trapping facilities and existing fish passage facilities are not 100% effective in passing Atlantic salmon. As a result, the reported trap and sport fishery catches (Table 4) underestimate salmon returns to Maine rivers. The Assessment Committee incorporated other biological data collected in Maine to estimate total returns of Atlantic salmon (Table 5). Using adjusted estimators, approximately 6,100 salmon returned to Maine rivers in 1990.

On the Penobscot and St. Croix rivers, the re-release of trap caught salmon marked by fin clip and/or radio tags below the lowermost trapping facilities suggest that fish passage facilities at those dams capture approximately 75% of the adult salmon reaching the dam. On the Saco River, salmon are marked and released at a trap at the lowermost dam, but many salmon ascend the spillway and are captured unmarked at the next upstream dam. A Petersen estimate was determined for the Saco River, based upon the captures of marked and unmarked salmon at the second dam. Trap efficiencies of 90% and 50% are used for the Androscoggin and Aroostook, and the Union rivers, respectively.

The ICES Working Group uses sport fishery data to estimate adult returns to rivers without trapping facilities. The ICES method assumes a reporting rate of 80% and an exploitation rate of 20%. This method has limitations, especially on rivers with low sport fishery catches and/or reporting rates, such as the Machias and Pleasant. Redd count data are collected on several smaller rivers, where accurate counts are possible. There are limited data from rivers in Maine and other areas to indicate that an assumption of two redds per female is reasonable, especially since 2SW females predominate among spawners. Where redd count data are available, they are believed to be a more valid index of run size than the sport fishery. A sex ratio of 1:1 is used among spawners, which approximates that observed at trapping facilities in Maine. For both the redd count and ICES methods, a 10% mortality rate is assumed for salmon caught and released by anglers. For the Kennebec River, a 40% exploitation rate is used, because the sport fishery occurs below a dam without fish passage facilities. The estimated salmon runs for Maine rivers with and without trapping facilities are presented in Table 5.

Table 5. Estimated total number of Atlantic salmon returns to the State of Maine in 1990.

A. RIVERS WITH TRAPPING FACILITIES

River	Rod Catch Rel.	Rod Catch Harvest[1]	Rod Catch Est.Kill[2]	Trap Catch Total	Trap Catch Adj.Total[3]	Est. Run[4]
Aroostook	0	0	0	64	71	71
St. Croix	4	2	3	110	147	150
Union	0	0	0	21	42	42
Penobscot	675	388	570	2,953	3,954	4,410
Androscoggin	0	0	0	185	206	206
Saco	3	14	18	67	105	123
Subtotal	682	404	591	3,400	4,525	5,002

B. RIVERS WITHOUT COUNTING FACILITIES

River	Rod Catch Rel.	Rod Catch Harvest	Rod Catch Est.Kill[2]	Redd Count	#of Spawners	Est.Run[4]
Dennys	1	33	33	91	92	133
E.Machias	35	48	65	-	-	325*
Machias	0	2	3	113	114	117
Pleasant	-	-	-	-	-	UNK
Narraguagus	10	51	65	202	202	267
Ducktrap	0	2	3	37	38	41
Sheepscot	0	9	11	-	-	55*
Kennebec	60	46	65	-	-	163*[4]
Misc(Marine)	-	1	1	-	-	1
Subtotal	105	192	246	-	-	1,101
GRAND TOTAL	787	596	794	-	-	6,103

[1] Rod kill below lowest trapping facility
[2] Assumed 80% reporting rate for sport fishery and 10% delayed mortality for released fish.
[3] Assumed fish passage efficiencies of: 90% for Androscoggin and Aroostook, 75% for Penobscot and St. Croix, and 50% for Union.
[4] See text for explanation.
* Estimated run size computed using ICES method from rod catch

2.2.3 RETURNS OF TAGGED SALMON

Returns of coded-wire and Carlin tagged Atlantic salmon to rivers in the United States in 1990 are shown in Table 6. The information has been sorted by river of return and sea age.

Table 6. Summary of 1990 Coded Wire Tagged (CWT) And Carlin Tagged Adult Atlantic Salmon Returns To USA Rivers.

RIVER	TAG TYPE	AGE GROUP 1SW	2SW	3SW	P.S.	TOTAL
Connecticut River	CWT	1	226[1]	0	0	227
Merrimack River	CWT	3	110	1	0	114
Penobscot River	CWT	118	352	1	3	474
	Carlin	2	140	2	0	144
Other Rivers in Maine	CWT	1	21	0	0	22
	Carlin	0	5	0	0	5
	Total CWT	123	709	2	3	837
	Carlin	2	145	2	0	149

1) Sixteen (16) of these fish had adipose fin clips but upon thorough examination were found not to have a CWT. All adipose fin clipped fish should have had CWTs.

2.2.4 Spawning Escapement, Broodstock Collection, and Egg Take

Egg sources for the New England Atlantic salmon program came from sea-run salmon, captive salmon broodstock, and reconditioned kelts. Sea-run Atlantic salmon broodstock were collected in Maine from traps at the Veazie Dam on the Penobscot River and Ellsworth Dam on the Union River. On the Merrimack River, broodstock were collected at the Essex Dam near the town of Lawrence. Adult salmon returning to the Connecticut River were collected at two tributary sites, Leesville Dam on the Salmon River and Rainbow Dam on the Farmington River, and at one mainstem location, Holyoke Dam. On the Pawcatuck River, broodstock were collected at the Potter Hill Dam. Broodstock collections in Maine included 543 from Veazie and 20 from Ellsworth. On the Merrimack River 226 salmon were captured for the broodstock program. For the Connecticut River 36 salmon for broodstock were taken from the Leesville trap, 37 from the Rainbow trap, and 170 from the Holyoke trap. On the Pawcatuck River 6 broodstock salmon were taken at the trap. The number of spawners and eggs supporting the hatchery programs is given in the Table 7.

Salmon entering a counting/trapping facility, yet allowed to proceed upstream, included 18 on the Connecticut, 16 on the Merrimack, 2 on the Pawcatuck, and 869 on the Penobscot rivers.

Table 7. 1990 SUMMARY OF ATLANTIC SALMON EGG PRODUCTION IN NEW ENGLAND HATCHERIES

Source River	Salmon Type	Number of Females	Total Egg Take	Number of Eggs/Female
Penobscot	Sea-run	300	2,041,700	6,805
Union	Sea-run	14	103,000	7,360
Merrimack	Sea-run	118	861,200	7,298
Connecticut	Sea-run	129	1,105,900	8,573
Pawcatuck	Sea-run	2	11,000	5,500
Penobscot/ Union	Domestic	553	1,464,000	2,647
Merrimack	Domestic	N/A	2,115,000	N/A
Connecticut	Domestic	426	2,664,600	6,255
Merrimack	Kelts	N/A	97,000	N/A
Connecticut	Kelts	57	498,500	8,745

N/A=Not Available

2.2.5 Sport Fishery

The documented sport catch of Atlantic salmon in Maine during 1990 was considerably higher than 1989 (Table 8). The primary reasons for this increase were larger salmon runs and excellent angling conditions throughout the fishing season. As in previous years, the number of salmon caught and released was substantially higher than the number of fish caught and retained.

An interesting highlight to the E. Machias River rod catch was the increased incidence of salmon originating from aquaculture facilities. About 20% of the total catch was determined (by scale analysis and length/weight information) to have originated from the salmon farming industry.

Exploitation rates varied from 0% (on rivers with no sport catch) to about 25%. The overall statewide exploitation rate for Maine rivers was about 13%.

Table 8. Documented 1990 Sport Catch of Atlantic Salmon in Maine

River	No. of Salmon Harvested 1SW	2SW	3SW	P.S.	Total Harvested	Est.No. Released	Total Angled	(1989)
St.Croix	2	0	0	0	2	4	6	(15)
Dennys	1	31	0	1	33	1	34	(13)
E.Machias	1	46	0	1	48	35	83	(32)
Machias	0	2	0	0	2	0	2	(18)
Pleasant	0	0	0	0	0	0	0	(0)
Narraguagus	1	49	0	1	51	10	61	(44)
Union	0	0	0	0	0	0	0	(4)
Penobscot*	45	348	12	11	416	675	1,091	(868)
Ducktrap	0	2	0	0	2	0	2	(0)
Sheepscot	1	8	0	0	9	0	9	(5)
Kennebec	1	45	0	0	46	60	106	(2)
Saco*	0	16	0	0	16	3	19	(6)
Misc(Marine)	0	1	0	0	1	0	1	(0)
TOTAL	52	548	12	14	626	788	1,414	1,007

*The Penobscot (28 fish) and Saco (2 fish) sport catches include salmon previously captured in fishway trapping facilities.

2.3 GENERAL PROGRAM UPDATE

2.3.1 Connecticut River

There were no major changes in the Connecticut River program during 1990. The main thrust of restoration was the stocking of various age groups of salmon into the watershed.

Hatchery Smolt Production and Stocking

The rearing and release of 477,200 1-year smolts remained the major management effort in the Connecticut River program. With the exception of approximately 22,100 smolts released into the West River and 3,500 smolts released into the White River, all smolts produced from the White River National Fish Hatchery (WRNFH) in Vermont and the Kensington State Salmon Hatchery (KSSH) in Connecticut were released downstream of the lowermost mainstem dam. These smolts were the largest released to date and exhibited very good physical appearance. Although managers remain concerned about the low returns recorded from hatchery reared smolts, returns from 1989 and 1990 releases should be good indicators of whether length, general condition, and lower river releases have a significant influence on return rates.

The Connecticut River Atlantic Salmon Commission (CRASC) continued to experiment with different smolt release strategies. In order to maximize the opportunity to gain information from returning salmon, all hatchery smolts received a coded wire tag (CWT). Smolts were released from late March through the first week of May.

Smoltification indicators such as Na+/K+ ATPase activity, condition factor, and saltwater tolerance have been examined in fish from the 1-year smolt program at both WRNFH and KSSH as part of a three-year research effort conducted by the University of Rhode Island (URI) through a contract with the Northeast Anadromous Fish Research Laboratory (NAFRL). Although research findings are not expected until after the 1991 smolt year, preliminary data suggest the peak in observed Na+/K+ ATPase activity might have occurred after smolt releases were completed.

CRASC cooperated with NAFRL in the second year of a three-year study on the possible effect of the lower Connecticut River on the survival of emigrating salmon smolts. The study will compare returns from smolts released at rivermile 10 with smolts placed into a floating net pen at the same location and towed about one mile into Long Island Sound prior to their release.

Fry Production, Stocking, and Survival

During 1990, 192,000 feeding fry and 1,066,000 unfed fry were stocked into the Connecticut River basin. The number of fry stocked was significantly increased after 1986, and ranged between 1.1 and 1.3 million during the last four years. Restoration needs require significant increases in the fry program while maintaining the current level of smolt production. Egg incubation space is currently fully utilized and additional incubation space is needed if gains in fry production are to be realized.

Evaluations of the techniques used for stocking fry were conducted by state and federal agencies through the monitoring of survival rates, density, and production within selected index sites throughout the watershed. The State of Connecticut continued evaluating an alternate year stocking scheme and comparing survival rates between fry stocked during different months. Massachusetts continued with the second year of a fry stocking program in the Westfield River. Vermont continued to evaluate fry/parr survival rates in selected streams within the White and West River drainages. The University of Vermont completed a study evaluating the effects of density and prior feeding on stocked fry survival.

CRASC has identified the enumeration of wild smolts emigrating from the Connecticut River watershed as an important information need. Limited monitoring occurs at fish ladder counting windows in Vermont and Connecticut. During 1990, the Fry Stocking Assessment Subgroup began to develop a smolt estimation method using the survival data obtained during the annual fall electrofishing efforts. The USFS began a test monitoring of wild smolts emigrating from the upper White River. Although the auger-type smolt traps tested failed to operate under certain conditions, wild smolts were collected during the period April 27 through May 10. Modifications to the traps are expected to increase their efficiency and effectiveness in 1991.

Adult Salmon Releases

During late November 1990, 299 (4-year old) post-spawned, captive broodstock salmon were released into the Connecticut River estuary (rivermile 10) by the State of Connecticut. Each fish was marked with a pink Floy tag. Tag returns from distant fisheries and homewater fishways will be monitored for recovery of these tags. It is against regulations to possess any of these fish.

Adult Returns

A total of 263 salmon were recorded in the river. All but 18 of the 188 salmon recorded at Holyoke were retained for fall spawning. Of those 18 salmon released, 16 were recorded at Turners Falls, 10 at Vernon, 5 at Bellows Falls, and 1 at Wilder. The first salmon to migrate into the West River since 1798 was confirmed in 1990.

Miscellaneous

Agreements were reached with two hydroelectric companies operating the five lowermost dams on the Connecticut River: New England Power Company (NEPCO) and Northeast Utilities Service Company (NUSCO), through their respective Memoranda of Agreement, have committed to provide downstream fish passage within the next five years. NUSCO will also complete studies and provide implementation schedules as required at the Northfield Mountain Pumped Storage Project by 1993.

The Genetics Subgroup of CRASC held a series of meetings to investigate concerns on the genetic management of the Connecticut River Atlantic salmon population. Although some recommendations from the Subgroup are still being considered by CRASC, recommendations were adopted to deliberately cross all former lines of broodstock distinction (e.g., egg type, year class, and holding station) in an effort to thoroughly mix genes present in the population and maximize effective population size. This effort was initiated during the 1990 Fall spawning. Starting with the 1991 year class, egg and fish rearing lots will no longer be identified with the separate descriptive designations used in the past.

Parr from the 1991 smolt class held at the WRNFH have been exposed to serious outbreaks of both Ichthyophthirius sp. and furunculosis during the late summer and fall of 1990. The U.S. Fish and Wildlife Service (USFWS), in consultation with CRASC, decided to reduce CWT placement from approximately 300,000 to 60,000 in order to reduce the potential effects stress could have on the survival of these parr. Prevalence testing for furunculosis will occur before and after tagging (February) and again prior to stocking. Improvements to the riverbed water infiltration system scheduled for the summer of 1991 are expected to significantly improve water supply and disease related problems experienced at the hatchery.

The USFS began habitat improvement projects within selected streams in the Green Mountain National Forest. The goal of these projects is to improve the quality of habitat for fry-stocked salmon through the placement of boulders and woody debris, creation of low flow channels, and stabilization of eroding stream banks. Preliminary post-improvement data indicate improved habitat supported a higher density of parr than did pre-improved habitat.

The USFWS continued radio telemetry studies of hatchery smolt emigration in the lower Connecticut River. NAFRL also began a pilot study through URI on the effects of Vibrio immunization of smolts on marine survival. The USFWS cooperated with the U.S. Army Corps of Engineers (COE) to conduct a study of radiotagged smolts at two COE flood-control dams on the West River in Vermont to evaluate possible migratory delays of wild smolts.

State and federal agencies were involved in the Federal Energy Regulatory Commission (FERC) hydroelectric relicensing process on several tributaries slated for Atlantic salmon restoration. The agencies seek to require that upstream and downstream fish passage facilities be provided as part of their FERC license.

2.3.2 Maine Program

The Maine Atlantic Sea-Run Salmon Commission (ASRSC) began revising the statewide Atlantic Salmon Management Plan. As part of the revision, a draft Wild Atlantic Salmon Stock Protection Policy and a draft Mission Statement were prepared.

An ASRSC staff member spent three weeks in West Greenland as part of the annual international effort to collect biological data and CWT from the commercial Atlantic salmon catch.

A genetic stock identification study was initiated and will include comparisons of wild salmon from three Maine rivers, current Penobscot River hatchery stocks, and a wild population from a Canadian river.

A study designed to evaluate the survival of hatchery-reared smolts released from the West Enfield Smolt Release Ponds continued. Radio tagged smolts were released from these ponds in an effort to evaluate hatchery smolt migration routes and attrition of smolts during the freshwater phase of smolt migration in the Penobscot River.

A fry stocking study was initiated on two small tributaries to the East Branch, Penobscot River where spawning and rearing habitat is under utilized. The study is designed to evaluate survival of fry that are stocked at different densities. Fry will be stocked in each stream on an alternate year schedule to compare densities of 0+ and 1+ parr and differential survival throughout the growing season.

On the St. Croix River, the ASRSC and USFWS utilized an electrofishing boat to sample lower mainstem rearing habitat to determine the extent of utilization by juvenile salmon.

The ASRSC prepared a draft, 5-year operational plan for salmon restoration within the Saco River drainage. The Saco River Salmon

Club obtained necessary funding and prepared design criteria for a hatchery to produce non-feeding Atlantic salmon fry. This private hatchery is expected to be contributing to the Saco River restoration program in 1993.

ASRSC and USFWS biologists examined streamside egg incubation boxes in use on the Miramichi River in New Brunswick, Canada, to determine their applicability in Maine Atlantic salmon restoration programs.

The ASRSC sampled juvenile salmon populations at 44 sites on five wild salmon rivers in Downeast Maine.

The National Marine Fisheries Service provided the ASRSC with initial funding for a 5-year study designed to evaluate the status of the Atlantic salmon population and salmon habitat in the Narraguagus River.

The Downeast Salmon Federation, a consortium of salmon fishing clubs, has proposed constructing and operating a fry hatchery facility on the Pleasant River. During 1990, the hatchery design was approved by the Maine Technical Advisory Committee.

The ASRSC and USFWS continued to be active in the relicensing of hydro-electric projects, especially on the Penobscot and Saco Rivers. Of particular importance is upgrading upstream passage facilities at Veazie, Milford, Great Works, and Howland in the Penobscot drainage. State-of-the-art downstream passage is also needed at these facilities.

Georgia-Pacific Corporation cooperated with state and federal agencies in Maine and Canada to accomplish significant fish passage improvements at Woodland and Grand Falls on the St. Croix River. A draft, 5-year St. Croix River Operational Plan was prepared by the St. Croix River Fisheries Steering Committee in late 1990.

Maine's rivers with wild salmon populations as well as the Penobscot and St. Croix Rivers continue to be the principal areas of focus for rehabilitation and restoration efforts. Data needs include habitat and stock assessments, spawning success, smolt production, and assessment of smolt and postsmolt mortality.

Due to the rapid expansion of the aquaculture industry in recent years (from 1 company in 1986 to 19 in 1990), the effects of the salmon farming industry upon restoration programs in Maine need to be evaluated.

2.3.3 Merrimack River

Efforts to re-introduce Atlantic salmon to the Merrimack River Basin continued at levels similar to those of the previous five years. However, a major fish cultural change has been initiated. The Nashua National Fish Hatchery (NFH) is presently undergoing a change from the production of smolts to the production of captive brood stock. This initiative is designed to allow for the production of 6,000,000 eggs necessary to sustain a fry release program totalling at least 3,000,000 fish annually. The target year for achieving this stocking level is 1994. The Nashua NFH will continue to hold sea-run salmon for egg production. The eggs produced, except for those required to maintain the captive brood stock program, will be incubated at other culture facilties.

The culture program in 1994 is expected to resemble the following:

Nashua NFH	6,000,000 captive eggs 1,000,000 sea-run eggs
North Attleboro National Fish Hatchery (NFH)	100,000 smolts 2,300,000 non-feeding fry
Berlin State Fish Hatchery (SFH)	800,000 non-feeding fry

The new program direction was influenced by two important factors. First, the performance of smolts produced by the Nashua NFH has not been satisfactory. Second, the fry release program is producing adult returns at acceptable levels, but it is not believed to be utilizing the smolt production capabilities of the habitat.

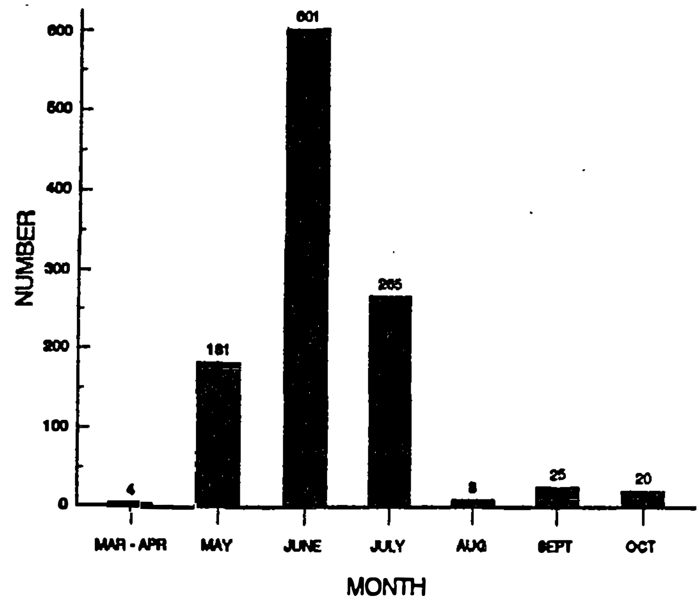
Program Status

Atlantic salmon river returns (trap catches, rod catch, and all other known sources) now total 1104 fish. Annual returns have ranged from 23 (fall returns only - 1982) to 248 salmon. Returns have been recorded in each month from March through October (Figure 1.) The majority of the salmon (all data combined) were observed in June (54%) with returns averaging 24% in July and 16% in May. In 1990 successful salmon trapping operations were conducted in August, and are likely to continue.

FIGURE 1 ATLANTIC SALMON RETURNS

MERRIMACK RIVER

1982 - 1990



FISH PASSAGE FACILITY
OPERATED IN AUGUST ONLY IN 1990

The actual timing of the observed river returns (all known sources) is related to the sea age structure of the populations. Greater than 50% of the total 1SW salmon returns have occurred in July while approximately 60% of the observed 2SW and 3SW salmon have occurred during June.

In almost all years salmon returns have been composed of 1SW, 2SW, and 3SW salmon. Sixteen percent of the total known returns have been 1SW salmon, 80% have been 2SW salmon, and slightly less than 4% were 3SW salmon. Little difference in the age at maturity has been noted from returns of fry, parr, or smolt releases.

All juvenile salmon stocking components have contributed to returns. Of the 1104 returns recorded, 44% are of fry origin, 4% of parr origin, and 52% of smolt origin. The low contribution from the parr releases suggests that their value to the program is negligible. This is highlighted even more dramatically when one considers that over 500,000 stocked parr have contributed only 45 known adult returns (0.09 adults/1,000 parr stocked). Comparable returns for stocked fry and stocked smolts are 0.33 adults/1000 fry released and 0.63 adults/1000 smolts released, respectively.

Sex ratios of returning salmon (all years combined) tend to approximate equal-sized female and male components. However, salmon originating from fry-plants have greater female components (63% for 2SW salmon) than do salmon from smolt stocking origins (52% for 2SW salmon). In both groups the females are larger than the males for all sea ages except for the 2SW salmon. In the latter case fish sizes are fairly equal between the sexes. Information regarding fish sizes in relation to sex and origin at stocking (fry or smolt stocking origins) as well as fecundity in relation to stocking origin is presented in Table 9.

Table 9. **Selected statistics (fish size and fecundity) for salmon returns to the Merrimack River as related to origin at stocking (all returns).**

	Fry origin		Smolt origin	
	Males	Females	Males	Females
Total Length (mm)				
1-S-W	681	650	596	657
2-S-W	759	764	761	751
3-S-W	789	843	731	792
Weight (Kg)				
1-S-W	1.69	2.31	1.81	2.59
2-S-W	4.08	4.13	4.17	4.04
3-S-W	4.65	5.90	3.90	5.22
Fecundity (eggs/Kg)				
1-S-W		666		412
2-S-W		398		396
3-S-W		409		386

The freshwater age distribution of the adults originating from the fry stocking program has varied between the fry plants. However, based on all known adult returns of fry stocking origin, 6% have been contributed by yearling smolts, 77% by age two smolts, and 17% by age three smolts.

Studies

Studies to determine the timing and number of smolts migrating in the basin are continuing. The Ayers Island Dam smolt trap located on the Pemigewasset River was in full operation from April 1 through June 30, 1990. A total of 133 wild smolts was captured in the trap. The first smolt was captured on May 4 and the last smolt was captured on June 18. The largest number of smolts was captured during the period from May 27 to June 6 when water temperatures equaled or exceeded 15 degrees C and there was no spill over the dam or through waste gates. Other studies to enumerate smolts migrating in the basin are being conducted by the U.S. Forest Service and the U.S. Fish and Wildlife Service. Studies have been conducted by Public Service Company of New Hampshire (PSNH) to determine the routes of passage of smolts at 5 mainstem hydroelectric facilities located on the Pemigewasset and Merrimack Rivers. Two hundred and five (205) hatchery reared smolts (ages 1+ and 2+) were fitted with internal radio transmitters, and were released into the rivers during the 1989-1990 study. Of the 205 smolts released, 145 (71%) were recorded moving past at least one dam. Overall, at least 399 passages occurred at the five dams. Bypasses installed specifically as fish passage measures accounted for 5% of all passages. Turbine passage accounted for 32% of the known passages. In 1989, 87% of all passages were via spillways and/or waste gates, while in 1990 those routes accounted for only 46% of all passages. Turbines accounted for 8% and 49% of all passages in 1989 and 1990, respectively. With the exception of one dam located in the headwaters of the basin (Ayers Island Dam) smolts passed dams regardless of spill conditions occurring when fish encountered the stations. Without spill, fish encountering Ayers Island are likely to be delayed. Approximately 65% of all fry are released annually in areas upstream from Ayers Island Dam. A delay in migration past this dam because of low river flow could result in a reduction in the number of smolts entering the marine environment. Conversely, if significant spill occurs at the dam during the period of smolt migration, then it is likely that smolts will have greater success in reaching the marine environment both as a result of unimpeded migration and the likelihood of increased spill at downstream dams.

A similar study is being conducted by Consolidated Hydro Inc. at a mainstem dam (Pawtucket Dam) in Lowell, Massachusetts. The results of these studies are not yet available but a final report is being prepared.

2.3.4 Pawcatuck River

The Rhode Island Division of Fish and Wildlife has been involved with restoration of Atlantic salmon in the Pawcatuck River since 1979, when the first juvenile releases were made. The first return of adult salmon occurred in 1982. Since then, 124 salmon have returned to the river. Currently, salmon cannot reach suitable spawning sites due to dams. Several fishways have been built but more are needed. All adult returns are trapped and taken to a state hatchery for spawning. Juveniles produced at this facility are stocked into the watershed each year along with juveniles produced at the North Attleboro NFH and Nashua NFH. Juvenile salmon from a private hatchery in Maine were released in 1990. Emphasis is placed on parr, rather than fry or smolt releases.

Various research projects are conducted including assessment of parr releases and studies on smolt physiology in cooperation with the University of Rhode Island Department of Zoology.

The Division's goal is to establish a run of salmon partially sustained by natural reproduction and that will support a limited entry sport fishery. The Division maintains that a run of 200 adults is sufficient to achieve this goal. The largest return to date is 38 salmon.

A summary of Pawcatuck River releases and adult returns for the period 1979-1990 is presented in Table 10.

Table 10. A Summary of Salmon Releases, Estimated Smolt Production, and Adult Returns in the Pawcatuck R. 1979-1990

Year	0+ Fry	0+ Parr	1+ Parr	Hatchery Smolt	Total	Wild 1/ Smolt	2/ Adults
1979	0	136000	0	0	136000	0	0
1980	0	1000	0	0	1000	5194	0
1981	0	2000	108000	800	110000	4202	0
1982	2200	1000	0	0	3200	8191	38
1983	0	650	0	0	650	675	38
1984	0	23000	0	0	23000	542	26
1985	8000	51032	1400	0	60432	5036	1
1986	0	50741	15000	0	65741	5792	0
1987	3000	46240	4660	1000	54900	8840	1
1988	150000	59647	7100	5400	222147	7835	6
1989	0	377943	35789	6500	422232	11363	6
1990	0	83500	55000	7500	146000	9170	8

1/ Wild smolt (fry and parr survivors) estimates derived from densities at index stations and an estimate of total area stocked

2/ Adult returns enumerated at the Potter Hill fishtrap

Of the 8 known returning adult salmon to the Pawcatuck, six were trapped at the Potter Hill facility during May and June, while two were observed by Division personnel attempting to jump a dam upriver of the trap site. Five salmon had spent 2 years in freshwater while one had spent only one year. At spawning, four fish were males and two were females which produced 11,000 eggs.

2.3.5 General Program Information

Effects of Predators:

The potential impact to migrating smolts and returning adult salmon by various predator populations was identified as a research need at the 1990 meeting of the Assessment Committee. A number of potential predators have been identified such as striped bass, pollock, codfish, bluefish, cormorants, other sea birds, and seals. Population levels of these predators have been estimated by various agencies and were summarized by the committee.

Striped Bass

Juvenile indices of striped bass abundance have been collected in the Hudson River since 1965 and in the Chesapeake Bay since 1954. It is generally assumed that these indices represent year class strengths in striped bass and that they are a good predictor of future stock size. The trapnet fishery in Rhode Island is correlated with both the Chesapeake and Hudson indices at a lag of three years (Figure 2). It does not appear that striped bass can account for the declines in survival rates noted in the Penobscot River from 1978-1985 (anonymous 1990), and in the Connecticut River from 1978-1986 (Rideout et al. 1988), and in the Pawcatuck River from 1985-1988 (Gibson 1989). Striped bass abundance during this period appears to have been falling to its lowest level ever. River herring stocks seem to be improving at the same time at least in some rivers, and may serve as a predation buffer during some of the smolt outmigration period.

Bluefish

Several time series of estimates of bluefish abundance along the Atlantic coast have been developed by several fisheries agencies. Recruitment estimates for Atlantic coast bluefish have shown no trend from 1974 to 1989. Adult bluefish stock estimates have fluctuated erratically although the overall pattern shows a decline from 1975 to 1990. The decline in adult stock suggests that bluefish have not been responsible for the reduction in salmon smolt survival. In addition, the arrival of most bluefish in New England waters generally occurs after the period of smolt migration.

Codfish

Abundance of 2+ codfish on Georges Bank and in New England has undergone a drastic decline from 1978 to 1989. The huge decline in abundance coupled with a limited inshore appearance in late winter suggests that codfish have had no impact on salmon smolt survival.

Pollock

Small pollock are common in inshore areas in the spring and have increased in abundance (Figure 3) coincident with falling survival rates of salmon smolts. Young pollock would seem to be a likely predator of salmon smolts.

Figure 2.- Estimated Trends in Striped Bass Abundance in RI Area 1968-1993

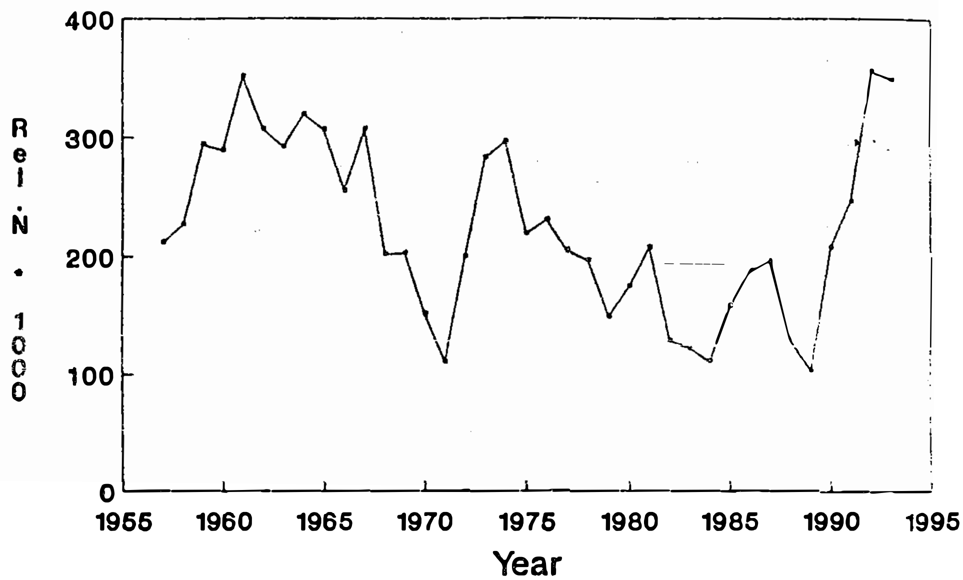
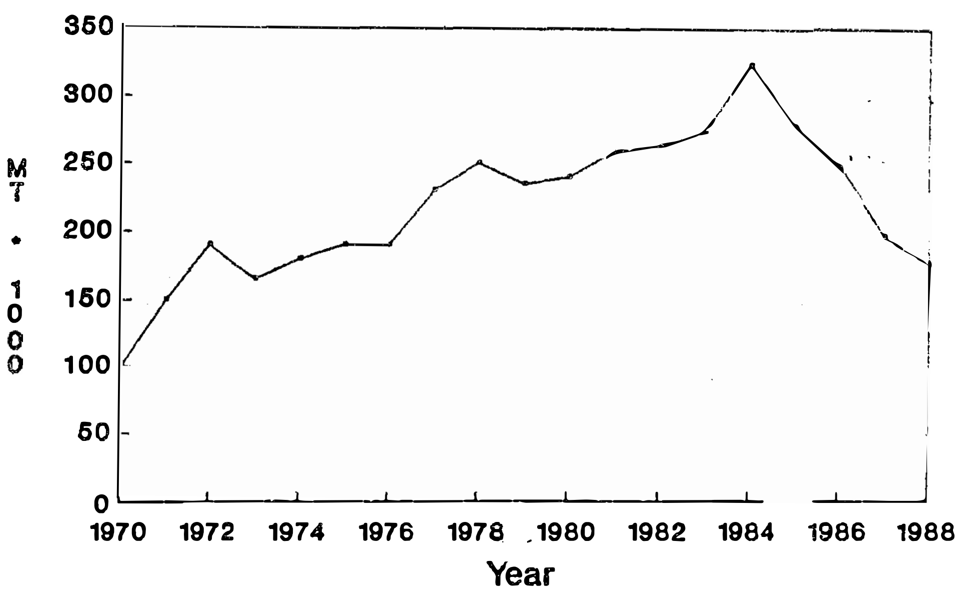


Fig. 3.- Biomass Estimates of Pollock in the New England Region, 1978-1988

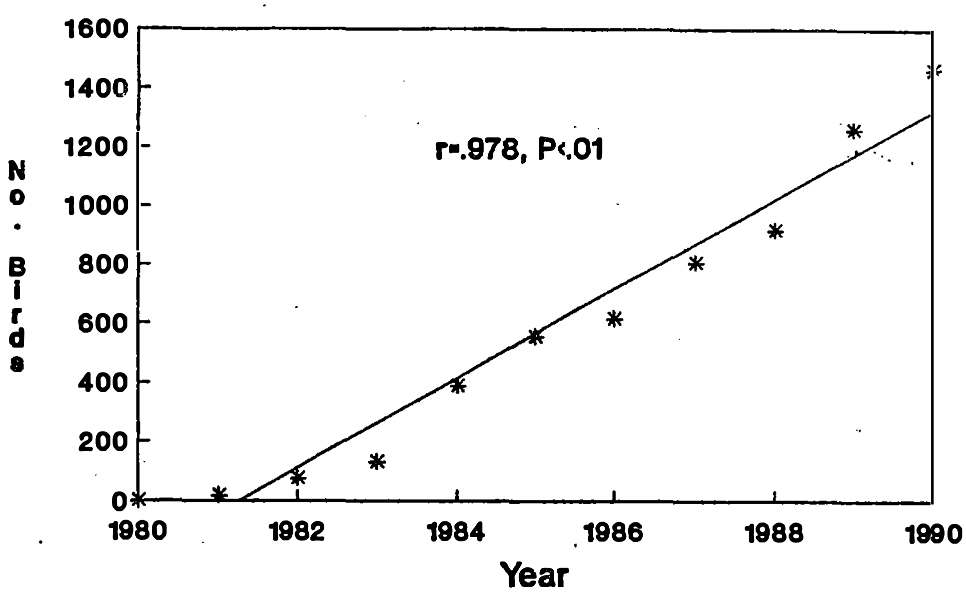


Data from NMFS VPA analyses

Cormorant

Cormorant census data for Narragansett Bay has shown a dramatic increase from 1980 to 1990 (Figure 4). In 1980, no cormorants were counted in the nesting bird census, but by 1990, 1464 were counted. If these findings are representative of the region, then they indicate a large expansion in population size of a piscivore known to consume salmon smolts. Additional studies of regional census data for this species is warranted.

Fig. 4 - Census Count of Cormorants in the Narragansett Bay Area 1980-90



RIDFW census data

Seals

Current information concerning harbor seal populations is dated. However, it is known that the population has increased significantly in recent years. Seals have become a serious problem to the salmon aquaculture industry. Incidents are common and some losses have been valued at over $100,000. The West Coast experience with Stellar sea lions indicates that marine mammals can become a serious predator on returning adult salmonids.

Summary

The available data on seasonal fish predators indicate that, with the exception of pollock, their abundance has declined over the period of time where salmon smolt survival has been in decline. The increases in fish eating birds, particularly cormorants, is also a possible explanation. Cormorants are known predators on salmon smolts and a range expansion into Southern New England could be damaging to salmon restoration efforts.

Hooking Mortality of Angler Caught and Released Sea-Run Atlantic Salmon

The need to determine the extent of angling related mortality for caught and released sea-run salmon was identified at the 1990 Annual Meeting of the U.S. Atlantic Salmon Assessment Committee. This information is necessary to adequately determine the effects of angling on Atlantic salmon restoration programs, in terms of establishing acceptable harvest quotas, upriver fish passage efficiencies, and estimating total return rates to home waters.

A literature search was conducted in order to compile available information regarding angling mortalities. The U.S. Fish and Wildlife Service, Office of Information Transfer conducted a computer literature search on the subject of "hooking/handling stress and mortality in salmonids".

While numerous papers were identified, only one addressed mortality of sea-run Atlantic salmon caught on artificial flies.

Currie (1985) reported two mortalities out of 160 (1.3%) Atlantic salmon and grilse caught and released on the North Pole Stream, New Brunswick, Canada between 1982-1984. Both of these fish were hooked in sensitive areas, one in the eye and one in the gills. The remaining fish were hooked in the jaw, inside the mouth, on the nose or in the belly. Currie concluded that mortalities are generally caused by the location of the embedded hook, rather than handling.

Warner (1979) found a 4.1% mortality of landlocked Atlantic salmon hooked with artificial flies and released in experiments performed in a hatchery. Mortalities were slightly higher for fish hooked in critical areas (gills and esophagus) than in areas such as the roof of the mouth. Total mortality ranged from a low of 4.1% with flies to a high of 6% with worms and treble hooks.

The Assessment Committee identified additional sources of information and recommended that this item remain listed as a research topic.

3 TERMS OF REFERENCE

3.1 Describe 1990 stocking and adult returns of U.S. Atlantic salmon rivers. Evaluate the status of the stocks.

This information is presented in Sections 2.1 and 2.2.

3.2 Review methodology and parameterization of salmon homewater run estimates for U.S. Rivers.

No new information was presented at this meeting. Estimated numbers of adult returns in Maine are presented in Section 2.2.2.

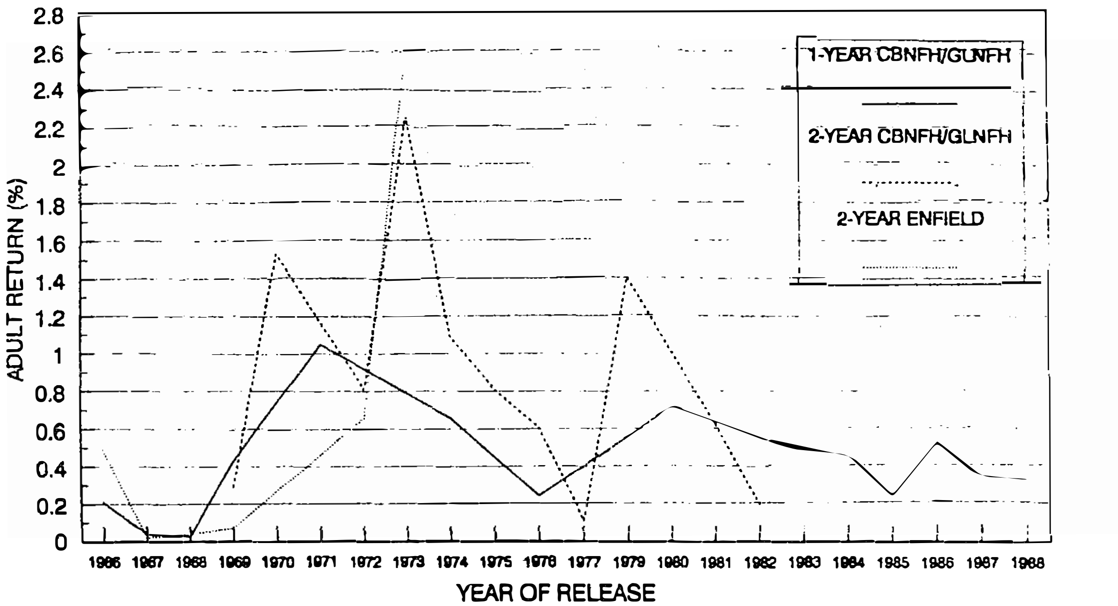
3.3 <u>Evaluate the effects of hatchery practices and sea growth on age of maturity for U.S. salmon stocks.</u>

The Committee investigated the hatchery practices that could be considered to have a significant influence on the age at maturity and survival of Atlantic salmon smolts and their growth in the marine environment. Age at maturity is believed to have important consequences on stock genetics and population growth. Maine has been releasing tagged hatchery reared smolts since 1966. The data collected in the last 25 years has clearly demonstrated that there is no single "key" element in the hatchery rearing/stocking procedure that will insure maximum survival and returns of adults to homewaters. What has been determined is that a number of suspected influences could not be shown to affect survival while other factors do affect survival to varying degrees. There is not any single activity or combination of activities that can be expected to guarantee a substantial improvement in the return of adult salmon.

The Maine studies could not demonstrate that the following factors influence adult return rate: hatchery diet, fin condition, type of rearing pool, smolt stamina, smolt age, Carlin tag color/attachment, night vs. day release, stocking method, <u>Vibrio</u> vaccination, terramycin diet, addition of salt to transport water, and river discharge. Factors that have been shown to affect survival include: origin or strain, covering hatchery pools, river and site of smolt release, furunculosis carriers, blood type, the tag applicator, time of smolt release, and smolt size.

While hatchery smolt survival to the adult return stage has declined in recent years (Figure 5), this has also been apparent for wild smolts in Maine. Similar trends have been observed for other New England programs and also in many Canadian rivers. Therefore, the reason for these lower return rates would seem to be oceanic in nature. The Assessment Committee agreed that Atlantic salmon restoration programs in New England should continue to emphasize actions that have been demonstrated to be beneficial to improved smolt survival (e.g. minimum and maximum smolt size, timing of smolt releases, methods used to reduce handling and stress, etc.). Additionally, other possibilities for increasing smolt survival should be examined (e.g. genetics, broodstock selection and breeding programs, effective use of self-release facilities, conditioning of smolts, etc.).

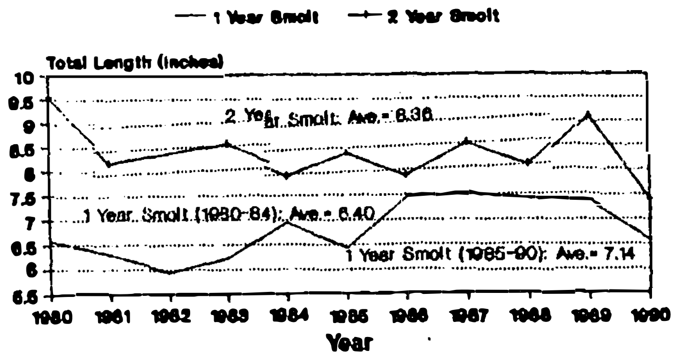
Figure 5. **ADULT RETURNS BY SMOLT AGE AT RELEASE FOR CARLIN-TAGGED, HATCHERY-REARED SMOLTS RELEASED IN MAINE, 1966-1988.**



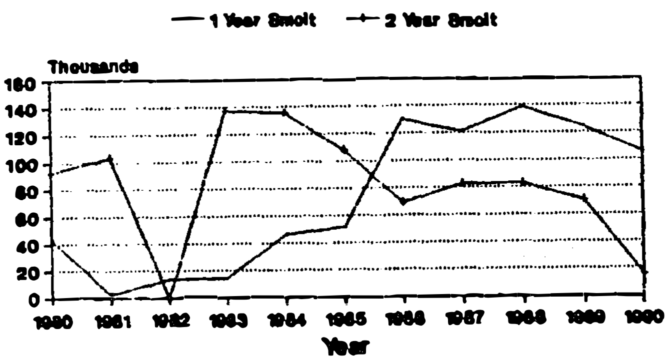
CBNFH RELEASES 1966-1977.
GLNFH RELEASES 1979-1988.
NO CARLIN-TAGGED SMOLTS RELEASED IN 1978.

In the past decade Craig Brook NFH and Green Lake NFH have reduced 2 year smolt production from 50% to 8%. Concurrently, 1 year old forced-growth smolt production has increased from 50% to 92%. This has resulted in a decrease in average smolt length from 198 to 180 mm (Figure 6). During this same period, the home return rate of adults to the Penobscot River decreased from 0.61% to 0.49%. This equates to a decrease of 120 adult returns for each 100,000 smolts stocked. However, even with the decrease in return rate, a net gain in number of fish returning has occurred simply because larger numbers of yearling smolts have been produced and released. Further analysis is needed to determine if smolts are currently released at optimum sizes.

Figure 6. **Average Size of 1 & 2 Year Smolts**
Craig Brook National Fish Hatchery
1980 - 1990 (trip sheet data)



One and Two Year Smolt Production
Craig Brook National Fish Hatchery
1980 - 1990



Length-frequency data do not exist for previous years' stockings but weight data is available. A method to reconstruct length-frequency information from weight samples was tested on 1990 fish, for which length frequency and weight data exist. The reconstructed length-frequency curve did not accurately present the tails of the actual length-frequency curve and the method was determined to be unsuitable for estimating the length-frequency distribution of past years' stockings. Length-frequency data will be collected for all future smolt releases in Maine.

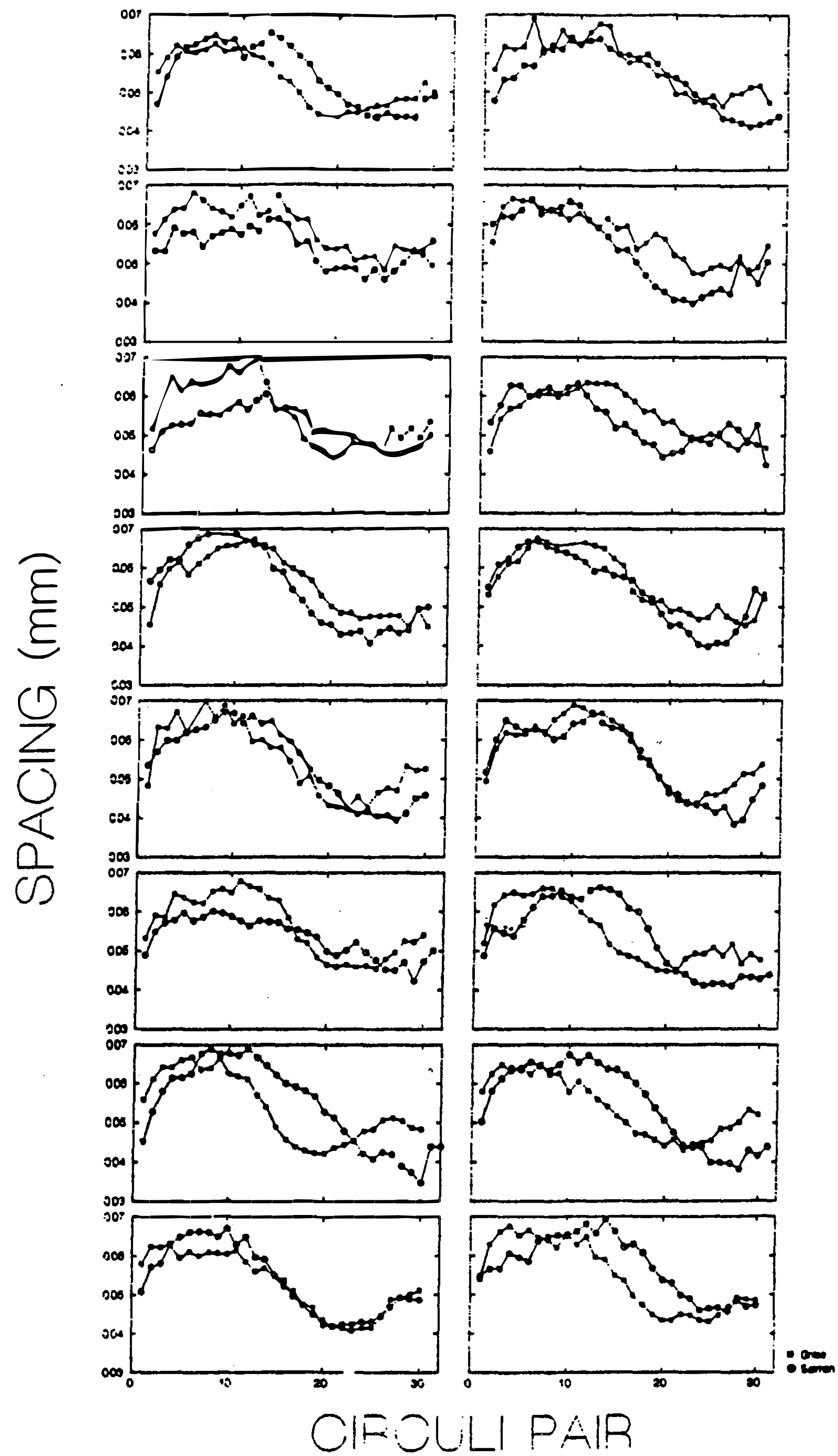
The constant water temperature (10C) and the Kensington State Salmon Hatchery (KSSH) in Connecticut does not produce the growth necessary to produce a high percentage of 1 year smolts. In many years 60% of hatchery production are parr (<150 mm TL). There is concern that many of the males could become sexually mature, fail to survive or smoltify. A survey of 0+ parr in October 1990 found no precocious parr; however, there is some indication that maturation could occur later in the year. There is also reason to believe that many parr destined to mature precociously were part of the typical 0+ parr plants conducted out of KSSH (and other hatcheries) prior to the survey. If precocious males suffer high mortality rates in the streams, this fact may partially explain the poor performance of parr plants. Further monitoring of this factor is warranted.

The Committee investigated the effect of marine growth on the age at maturity of Penobscot River fish. Circuli spacing was examined on scales from salmon that returned, 1973 - 1988. Table 10 shows return rates for grilse and salmon to the Penobscot River by smolt year. Figure 7 shows the circuli spacing vs. circuli pair for grilse and salmon returns. There is a consistent pattern of slower growth in the summer and faster growth in the winter for fish returning as grilse. The aquaculture industry has been successful in delaying maturation through reductions in winter feeding. The study results suggest that growth rate during the first summer at sea affects age at maturity. However, the relationship is counter-intuitive in that higher growth for grilse during this period does not increase the grilse:salmon ratio. The Committee believes that this data is worthy of additional examination and evaluation.

Table 10. **Smolt releases and adult returns in the Penobscot River.**

Smolt		Returns			Return Rate	
Year	Release	1sw	2sw	G/S	1sw	2sw
1973	109080	31	917	0.034	0.00028	0.00841
1974	100241	45	563	0.080	0.00045	0.00562
1975	110556	75	581	0.129	0.00068	0.00526
1976	226900	44	1547	0.028	0.00019	0.00682
1977	340800	123	671	0.183	0.00036	0.00197
1978	209300	203	2570	0.079	0.00097	0.01228
1979	292700	652	2454	0.266	0.00223	0.00838
1980	586000	888	3886	0.229	0.00152	0.00663
1981	199600	155	705	0.220	0.00078	0.00353
1982	315700	179	1387	0.129	0.00057	0.00439
1983	446000	239	2868	0.083	0.00054	0.00643
1984	618000	244	3620	0.067	0.00039	0.00586
1985	580500	534	1477	0.362	0.00092	0.00254
1986	589200	749	1993	0.376	0.00127	0.00338
1987	539175	716	2005	0.357	0.00133	0.00372
1988	687179	867	2519	0.344	0.00126	0.00367

Figure 7. **Circuli spacing versus circuli pair for grilse and salmon returns, for the smolt years 1973 to 1988, to the Penobscot River. Smolt year increases from left to right and by row.**



3.4 Provide information on methodology to increase return rate of hatchery salmon releases.

No new information provided at 1991 meeting.

3.5 Review tagging statistical methodology for evaluation of stocking groups.

No new information provided at 1991 meeting.

4. DISCUSSION TOPIC

A special work session was held to discuss issues related to fry and parr stocking. Fry stocking is an increasingly important component of restoration programs to seed vacant habitat and increase adult returns. Parr, by-products of yearling smolt production, are also being stocked in increasingly large numbers. Papers were presented on fry and parr stocking evaluations conducted by State and Federal agencies in several river systems. The following factors were identified that may impact the success of fry and parr plants.

Lifestage at Stocking - Although fed fry performed somewhat better than unfed fry in some situations, there is little evidence that survival of fed and unfed fry is consistently different. Stocking of underyearling and yearling parr generally produced fewer 1+ parr than fry stocking. Parr stocked in the Merrimack River produced adult returns at only 27% of the rate of fry plants per 1,000 stocked. Genetic implications of stocking fed fry and parr, rather than unfed fry, were recognized.

Stock Origin and Broodstock Type - Although genetic and marine survival differences may exist between different stock origins and broodstock types, no differences could be demonstrated in the freshwater performance of stocked fry in the West River, Vermont.

Stocking Density - Survival of stocked fry is density dependent. Results from the West River indicate that a stocking density approximately 30/100 m^2 produces 1+ parr densities near stream carrying capacity with much higher survival rates than higher density stocking. Optimum stocking density varies for different streams and river systems depending on biotic and abiotic factors. It was agreed that adequate data existed on several river systems to generate stock recruitment curves to determine optimum fry stocking densities.

Stocking Date and Method - Stocking fry before stream temperatures reach 7-10 degrees C decreases survival. Stocking dates of fry and parr are often determined by hatchery demands rather than fish needs. Programs should be designed or adjusted to produce and stock fry when stream conditions are optimal. Scatter planting of fry is necessary for maximum survival, especially in fed fry. Little information exists on optimum timing of parr releases.

Data Standardization and Deficiencies - There is a need to better standardize habitat estimation, stocking evaluation, and smolt production estimation techniques to facilitate comparison between rivers and programs. Microhabitat used by stocked fry should be determined. It would be desirable to mark stocked fry and estimate basin-wide production of smolts to better evaluate fry stocking.

RECOMMENDATIONS:

- Increase egg production and incubation capability to saturate vacant habitat with fry.
- Minimize parr production as a by-product of smolt production
- Evaluate parr stocking date and method
- Adjust densities and methods to maximize total basin-wide smolt production from fry stocking.
- Examine existing data and continue studies to refine river specific fry stocking devices
- Develop basin specific fry production strategies.
- Evaluate techniques to mark stocked fry.
- Enumerate smolt production from fry stocking.

5 RESEARCH

5.1 Current Research Activities

Fish Culture and Genetics

1. Reproductive performance of sex reversed and female monosex Atlantic salmon populations.

2. Development of a data base of genetic characteristics for trout broodstocks used in the management of United States fisheries.

3. Modular water reconditioning systems for application in National Fish Hatcheries.

   Contact on Study Nos. 1-3:
   Dr. Garland Pardue, phone 717-724-3322

4. Effect of level of feed grade lecithin on performance of early feeding ATS.

5. Dietary requirements for choline by swim-up ATS fed two sources of protein.

6. Growth and survival of young ATS fed different forms of vitamin E.

7. Comparative responses of ATS fry and fingerlings to oxidized dietary lipids.

8. Qualitative aspects of lipid oxidation in diets of ATS.

9. Effect of excess linoleic acid on growth of ATS.e

10.eReassessment of the W3 fatty acid requirement of ATS.e

11.eMinimum requirement of dietary phosphorus for ATS ande Lake trout fingerlings and larger fish.e

12.eEnzymatic treatment of feedstuffs to improve the nutritionale availability of phytin phosphorus, a poorly digested form ofe phosphorus found in many plant protein feedstuffs.e

Contact on study Nos. 4-12:e
Dr. James Meade, Tunison National Fishery Laboratory;e
phone: 607-753-9391e

Fish Ecology

1.e Dennys River Stock-Recruitment Study Using Redd Counts as ane Index of Stock and Large Parr as an Index of Recruits.e

2.e Enumeration of Adult Returns and Calibration of Redd Countse as an Index of Egg Deposition.e

3.e Evaluation of Atlantic Salmon Parr Assessment Methodologies.e

4.e Coded Wire Tagging Studies for Wild Atlantic Salmon Parr.e

5.e Narraguagus River Habitat Studies:e

    1)e Aquatic Entomology Studies as an Indicator ofe Water Qualitye

    2)e Water Chemistry and Contaminant Assessmentse

    3)e Assessment and Inventory of Atlantic Salmone Habitats in the Narraguagus Rivere

6.e Development of Video Based Fishway Monitoring Methodologies.e

Contact on Study Nos. 1-6:e
Kenneth F. Beland, Maine Atlantic Sea Run Commission.e
phone: 207-941-4449e

7.e Ontogeny of Feeding-behavior in Atlantic salmon alevins.e

Contact: D.J. Coughline
Boston University
Marine Program
2 Cummington Street
Boston, MA 02215

8.e Smolt Status of Migrating Atlantic Salmon Trapped ine Headwater Tributaries of the Merrimack River.e

9. An Evaluation of the Atlantic Salmon in the Merrimack River.

   Contact on Study Nos. 8 and 9:
   Dr. Garland Pardue, phone 717-724-3322
   National Fishery Research and Development Lab.,
   Wellsboro, PA;

10. The Effect of Density and Feeding on Survival of Stocked Salmon Fry.

11. Food Habits of Stocked Fry.

    Contact on Study Nos. 10 and 11:
    Dr. George La Bar, University of Vermont,
    phone: 802-656-2695.

12. Evaluation of Alternate-year Atlantic Salmon Fry Stocking in Sandy Brook, Colebrook, Connecticut.

    Contact: Robert Orciari, CT Division of Environmental Protection, Division of Inland Fisheries;
    phone: 203-486-0226.

13. Use of habitats by Atlantic salmon and trout on National Forests in New Hampshire and Vermont.

14. Refinement of Atlantic salmon HSI model.

15. Downstream mortality of Atlantic salmon smolts in the Penobscot River.

16. Testing models of Habitat Evaluation Procedures for Atlantic salmon.

17. Impacts of acid precipitation on Atlantic salmon in streams.

18. Feeding behavior of Atlantic salmon fry.

19. Stream studies of growth of young Atlantic salmon.

    Contact:
    Dr. Donna Parrish, Conte Anadromous Fish Research Laboratory, Turners Falls, MA; phone 413-863-9475

Fish Physiology

1. Changes in the elemental composition and water and solute compartments of anadromous and non-anadromous Atlantic salmon before and during smoltification.

2. Effects of continuous swimming at different velocities on growth morphology, smoltification, and stamina of Atlantic salmon.

Contact: Dr. Garland Pardue; phone: 717-724-3322

3. Endrocronological studies of Atlantic salmon smoltification.

Contact: Dr. Stacey Sowers, University of New Hampshire; phone: 603-862-2103.

4. Endrocronological studies of Atlantic salmon smoltification.

Contact: Dr. Steve McCormack, Conte Anadromous Fish Research Lab, Turners Falls, MA., phone: 413-863-9475.

5.2 Research Needs and Data Deficiencies

The committee will track the progress of research relevant to the research goals of the salmon restoration program. When data needs are satisfied or perhaps become irrelevant as needs and program directions change, items will be removed from the list. Parenthetical dates refer to the first year the committee identified the need for development of the research or data and will be followed by comments on progress to date.

1. Develop a standardized report form and database to compile stocking and tagging information for all U.S. Atlantic salmon programs. (1988) Work in progress, database definition established, historical data is being entered.

2. Attempt to adopt a standard definition of a hatchery smolt for all U.S. Atlantic salmon programs (1988) Standardized definition based on objective characteristics not developed. Presented as Term of Reference for 1992 meeting.

3. Form a "Fry & Parr Stocking Working Group" to compile all appropriate data relevant to stocking, survival, growth, and sampling of hatchery fry and parr from all U.S. programs. (1988) Working group has been formed and is progressing.

4. Review available information and pursue further research, as necessary, on the value of "training" hatchery smolts prior to release. This might include physical conditioning (e.g. high water velocity challenges) and predator avoidance conditioning. (1988) No new information.

5. Estimate incidence of parr percosity and determine sex ratios in hatchery and wild populations. (1990) Some data presented - 1991 - more work is necessary.

6. Review in-river movement related to water temperature, flows, and water use (i.e. diversions). Compile data and determine need for future work. (1988) No new information. Will be deleted from 1992 list.

7. Refine estimates of spawning escapement and exploitation rates using redd count techniques. (1988) Preliminary information presented 1991 - work is continuing.

8. Consider development of a counting fence on a river with wild stocks. Parameters to be monitored and objectives would include: a. enumerate and collect biological data on all smolts; b. apply CWTs to all/many departing smolts; c. enumerate and collect biological data on all adults; d. conduct comprehensive redd counts upstream of trap; e. calculate exploitation rates for river population; f. use data to better estimate run size for other rivers; h. use data to better evaluate hatchery stocks. (1988) Work in progress - preliminary results expected 1992.

9. Determine rates of mortality of rod caught and released salmon. (1990) Preliminary information provided - 1991.

10. Develop basin-wide program to enumerate smolt production (1991).

11. Review in-river movement of smolts relative to water temperature, flows, and water use (i.e. diversions). (1988) Information presented 1991 - work continuing.

12. Analyze trends in striped bass populations relative to salmon returns - trends. (1988) Information presented 1991 - Not necessary to pursue in immediate future.

13. Conduct field study investigating food habits and population size (mark & recapture) of striped bass in an estuary of a salmon restoration river. (1988) No new information.

14. Analyze trends in population size and food habits of harbor seals in New England. (1988) Information presented 1991 - not necessary to pursue in immediate future.

15. Monitor population sizes of riverine fish predator, e.g. smallmouth bass, northern pike. (1988) No new information.

16. Analyze trends in population size and food habits of cormorants. (1988) Information presented in 1991.

17. Develop and implement a program designed to determine post-smolt movement and mortalities for fish of New England origin (1991).

18. Sample for post-smolts on Georges Bank and other areas where post-smolts might be found. (1988) No new information.

19. Review historical data on river-ocean water temperature differential at "salmon river" estuaries, review literature on the biological preferences of such by smolts, and analyze trends relative to adult return rates. (1988) No new information.

20. Analyze salmon scales for growth patterns during first year at sea to determine if food availability or predation is a major factor in post-smolt mortality. (1988) Accomplished and reported this meeting; analysis to continue.

21. Review the designation and evaluation of Atlantic salmon habitat throughout New England and consider potential for habitat restoration and enhancement. (1988) Progress has been made.

22. Continue program to retrieve coded wire tags from West. Greenland and Canadian ocean commercial fishery (1991).

23. Conduct study to compare adult return rates of 2-year old smolts produced in a 2-year smolt program with 1-year smolts produced in a 1-year smolt program (1991).

24. Determine impacts of salmon aquaculture industry on wild and restoration salmon (1991).

25. Determine genetic composition of Atlantic salmon stocks in New England. Monitor at appropriate intervals (1991).

26. Conduct time-of-release study on which the level of smoltification in the fish is standardized among groups by photoperiod manipulation or other techniques. (Research proposal presented 1990).

5.3 New Research Proposals

No new research proposals were presented or discussed at meeting.

6 HISTORICAL DATA (1980 -1989)

6.1 Stocking

As shown in Table 12, nearly 32.5 million juvenile Atlantic salmon were released into New England rivers during the 10-year period.

TABLE 12. ATLANTIC SALMON STOCKING SUMMARY FOR NEW ENGLAND BY PROGRAM 1980 THROUGH 1989

NUMBER OF FRY ROUNDED TO NEAREST 1000 - ALL OTHER ENTRIES ROUNDED TO NEAREST 100

YEAR / PROGRAM	NUMBER OF FISH						
	FRY	0+PARR	1PARR	1+PARR	1SMOLT	2SMOLT	TOTAL
1980							
Maine	0	0	0	0	399900	282000	681900
Merrimack	126000	0	0	0	2300	30100	158400
Pawcatuck	0	1000	0	0	0	0	1000
Connecticut	286000	0	11500	0	0	51800	349300
TOTAL	412000	1000	11500	0	402200	363900	1190600
1981							
Maine	252000	0	70700	0	24700	232700	580100
Merrimack	57000	0	0	0	2600	97400	157000
Pawcatuck	0	2000	108000	0	800	0	110800
Connecticut	168000	182000	1900	3600	5300	73300	434100
TOTAL	477000	184000	180600	3600	33400	403400	1282000
1982							
Maine	349000	118900	256500	0	135000	259700	1119100
Merrimack	50000	57600	0	124200	0	67300	299100
Pawcatuck	2000	1000	0	0	0	0	3000
Connecticut	292000	9400	25100	9600	28100	180800	545000
TOTAL	693000	186900	281600	133800	163100	507800	1966200
1983							
Maine	20000	20300	57400	0	368000	170300	636000
Merrimack	8000	5000	0	20000	47000	61600	141600
Pawcatuck	0	700	0	0	0	0	700
Connecticut	226000	104400	293800	400	89100	8900	722600
TOTAL	254000	130400	351200	20400	504100	240800	1500900
1984							
Maine	134000	34400	22500	0	657700	137200	985800
Merrimack	519000	0	5300	24000	24000	44100	616400
Pawcatuck	0	23000	0	0	0	0	23000
Connecticut	625000	150200	241200	0	312300	0	1328700
TOTAL	1278000	207600	269000	24000	994000	181300	2953900

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Table 12. (cont.)

YEAR / PROGRAM	NUMBER OF FISH FRY	0+PARR	1PARR	1+PARR	1SMOLT	2SMOLT	TOTAL
1985							
Maine	472000	105900	61700	0	663200	108700	1411500
Merrimack	148000	0	0	5800	62500	111000	327300
Pawcatuck	8000	51000	1400	0	0	0	60400
Connecticut	422000	103100	123200	0	282300	0	930600
TOTAL	1050000	260000	186300	5800	1008000	219700	2729800
1986							
Maine	576000	53500	70700	0	710700	69500	1480400
Merrimack	524000	0	31500	0	40100	64100	659700
Pawcatuck	0	50700	15000	0	0	0	65700
Connecticut	162000	188400	282800	0	302200	0	935400
TOTAL	1262000	292600	400000	0	1053000	133600	3141200
1987							
Maine	969000	117900	190900	0	637500	82800	1998100
Merrimack	1078000	0	111700	0	141100	0	1330800
Pawcatuck	3000	46200	4700	0	1000	0	54900
Connecticut	1101000	383200	345300	0	205800	0	2035300
TOTAL	3151000	547300	652600	0	985400	82800	5419100
1988							
Maine	858000	863700	102800	0	850900	87100	2762500
Merrimack	1718000	0	129300	0	90500	0	1937800
Pawcatuck	150000	59600	7100	0	5400	0	222100
Connecticut	1310000	72200	75200	0	395300	0	1852700
TOTAL	4036000	995500	314400	0	1342100	87100	6775100
1989							
Maine	580000	430500	282200	0	524300	80200	1897200
Merrimack	1033000	60000	88600	0	58200	0	1239800
Pawcatuck	0	379900	35800	0	6500	0	422200
Connecticut	1242000	272900	116300	0	221000	0	1852200
TOTAL	2855000	1143300	522900	0	810000	80200	5411400
GRAND TOTAL	15468000	3948600	3170100	187600	7295300	2300600	32370200

2

6.2 Adult Returns

The documented returns of adult salmon to New England rivers for the 10-year period of 1980 - 1989 are presented in Table 13. The majority of returns has been contributed by the Penobscot River.

TABLE 13. KNOWN HISTORICAL ATLANTIC SALMON RETURNS TO NEW ENGLAND RIVERS 1980 THROUGH 1989 INCLUDES TRAP AND / OR ROD CAUGHT SALMON

RETURNS FROM JUVENILES OF HATCHERY ORIGIN INCLUDE 0+PARR, 1PARR, 1+PARR, 1SMOLT, AND 2SMOLT RELEASES -- RETURNS OF WILD ORIGIN INCLUDE ADULTS PRODUCED FROM NATURAL REPRODUCTION AND ADULTS PRODUCED FROM FRY RELEASES

STREAM SYSTEM / YEAR	HATCHERY ORIGIN				WILD ORIGIN				
	1-S-W	2-S-W	3-S-W	REPEAT	1-S-W	2-S-W	3-S-W	REPEAT	TOTAL
PENOBSCOT									
1980	652	2570	2	38	0	18	2	0	3282
1981	888	2454	12	24	3	18	2	0	3401
1982	155	3888	20	20	13	55	1	3	4153
1983	179	705	6	13	5	51	1	1	961
1984	239	1387	6	45	25	107	2	0	1811
1985	244	2868	6	9	22	202	1	4	3356
1986	534	3620	14	8	17	332	3	1	4529
1987	749	1477	29	49	19	162	5	20	2510
1988	716	1993	6	52	14	64	0	10	2855
1989	867	2005	4	36	67	103	1	4	3087
TOTAL	5223	22965	105	294	185	1112	18	43	29945
UNION									
1980	42	197	0	1	0	0	0	0	240
1981	10	284	1	0	0	0	0	0	295
1982	30	118	1	7	0	0	0	0	156
1983	25	116	1	2	0	4	0	0	148
1984	3	37	0	0	0	0	0	0	40
1985	3	79	0	0	0	0	0	0	82
1986	7	59	1	0	0	0	0	0	67
1987	19	43	0	1	0	0	0	0	63
1988	0	45	0	0	0	2	0	0	47
1989	4	25	1	0	0	0	0	0	30
TOTAL	143	1003	5	11	0	6	0	0	1168
NARRAGUAGUS									
1980	0	0	0	0	0	112	0	3	115
1981	1	20	0	1	0	49	0	2	73
1982	0	11	0	1	0	57	0	10	79
1983	2	17	0	0	0	69	0	2	90
1984	0	10	0	0	0	57	0	1	68
1985	0	0	0	0	0	56	0	1	57
1986	0	20	0	0	2	23	0	0	45
1987	0	11	0	0	0	24	0	2	37
1988	1	10	0	0	2	24	0	1	38
1989	3	9	0	0	1	26	0	0	39
TOTAL	7	108	0	2	5	497	0	22	641

1

Table 13. (cont.)

STREAM SYSTEM / YEAR	HATCHERY ORIGIN 1-S-W	2-S-W	3-S-W	REPEAT	WILD ORIGIN 1-S-W	2-S-W	3-S-W	REPEAT	TOTAL
PLEASANT									
1980	0	0	0	0	0	5	0	0	5
1981	0	0	0	0	0	23	0	0	23
1982	4	8	0	0	0	6	0	1	19
1983	0	0	0	0	2	35	0	1	38
1984	0	0	0	0	1	16	0	0	17
1985	0	0	0	0	3	28	0	0	31
1986	0	0	0	0	0	19	0	0	19
1987	0	4	0	0	0	5	0	0	9
1988									
1989	0	0	0	0	0	0	0	0	0
TOTAL	4	12	0	0	6	137	0	2	161
MACHIAS									
1980	0	13	0	0	0	58	0	7	78
1981	0	19	0	0	0	31	0	3	53
1982	0	0	1	0	1	52	0	2	56
1983	0	0	0	0	0	16	0	1	17
1984	0	8	0	0	2	21	0	2	33
1985	0	5	0	0	0	25	0	2	32
1986	2	16	0	0	2	24	0	2	46
1987	0	0	0	0	0	4	0	0	4
1988	0	0	0	0	0	6	0	2	8
1989	3	4	0	0	4	5	0	0	16
TOTAL	5	65	1	0	9	242	0	21	343
EAST MACHIAS									
1980	0	24	0	0	2	34	0	2	62
1981	4	67	0	0	4	24	0	1	100
1982	0	15	0	0	0	22	0	0	37
1983	0	3	0	0	0	5	0	0	8
1984	0	9	0	0	3	33	0	2	47
1985	0	0	0	0	0	30	0	0	30
1986	0	5	0	0	0	8	0	0	13
1987	0	8	0	0	0	5	1	0	14
1988	1	8	0	0	0	5	0	0	14
1989	12	10	0	0	2	6	0	1	31
TOTAL	17	149	0	0	11	172	1	6	356
DENNYS									
1980	0	117	0	0	0	73	0	0	190
1981	6	74	0	0	0	43	3	0	126
1982	3	15	0	0	6	14	0	0	38
1983	0	0	0	0	0	28	0	0	28
1984	0	0	0	0	7	61	0	0	68
1985	0	6	0	0	0	14	0	0	20
1986	0	7	0	0	0	8	0	0	15
1987	0	0	0	0	0	1	0	0	1
1988	0	3	0	0	0	6	0	0	9
1989	1	10	0	0	0	1	0	0	12
TOTAL	10	232	0	0	13	249	3	0	507

Table 13. (cont.)

STREAM SYSTEM / YEAR	HATCHERY ORIGIN 1-S-W	HATCHERY ORIGIN 2-S-W	HATCHERY ORIGIN 3-S-W	HATCHERY ORIGIN REPEAT	WILD ORIGIN 1-S-W	WILD ORIGIN 2-S-W	WILD ORIGIN 3-S-W	WILD ORIGIN REPEAT	TOTAL
ST. CROIX									
1980									
1981	25	14	1	0	24	14	1	0	79
1982	28	1	0	0	56	13	1	0	99
1983	14	62	4	0	11	28	3	0	122
1984	138	50	5	0	39	11	1	0	244
1985	28	144	14	0	28	122	14	0	350
1986	34	116	13	0	33	116	13	0	325
1987	108	63	1	0	94	103	6	0	375
1988	76	229	0	3	18	61	0	1	388
1989	78	66	0	1	44	44	0	8	241
TOTAL	529	745	38	4	347	512	39	9	2223
KENNEBEC									
1980	1	3	0	0	0	0	0	0	4
1981	1	13	0	0	0	0	0	0	14
1982	1	22	1	0	0	0	0	0	24
1983	1	16	1	0	0	0	0	0	18
1984	0	1	0	0	0	0	0	0	1
1985	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0
1987	0	2	1	0	0	2	0	0	5
1988	4	15	0	1	0	0	0	0	20
1989	1	16	0	0	0	0	0	0	17
TOTAL	9	88	3	1	0	2	0	0	103
ANDROSCOGGIN									
1980									
1981									
1982									
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	26
1988	2	11	0	0	1	0	0	0	14
1989	1	17	0	0	0	1	0	0	19
TOTAL	11	233	5	0	1	22	0	1	273
SHEEPSCOT									
1980	0	0	0	0	2	27	1	0	30
1981	0	0	0	0	1	14	0	0	15
1982	0	0	0	0	1	14	0	0	15
1983	0	0	0	0	1	11	0	0	12
1984	0	0	0	0	1	20	1	0	22
1985	0	0	0	0	1	5	0	0	6
1986	0	0	0	0	1	10	0	0	11
1987	2	7	0	0	1	5	0	0	15
1988	1	0	0	0	0	0	0	0	1
1989	1	1	0	0	2	1	0	0	5
TOTAL	4	8	0	0	11	107	2	0	132

Table 13. (cont.)

STREAM SYSTEM / YEAR	HATCHERY ORIGIN 1-S-W	HATCHERY ORIGIN 2-S-W	HATCHERY ORIGIN 3-S-W	HATCHERY ORIGIN REPEAT	WILD ORIGIN 1-S-W	WILD ORIGIN 2-S-W	WILD ORIGIN 3-S-W	WILD ORIGIN REPEAT	TOTAL
DUCKTRAP									
1980									
1981									
1982									
1983									
1984									
1985	0	0	0	0	0	15	0	0	15
1986	0	0	0	0	3	12	0	0	15
1987	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	3	27	0	0	30
SACO									
1980									
1981									
1982									
1983									
1984									
1985	2	58	0	0	0	0	0	0	60
1986	0	36	1	0	0	0	0	0	37
1987	4	34	1	0	0	1	0	0	40
1988	1	37	0	0	0	0	0	0	38
1989	2	16	0	1	0	0	0	0	19
TOTAL	9	181	2	1	0	1	0	0	194
MERRIMACK									
1980									
1981									
1982	3	14	0	0	4	2	0	0	23
1983	7	54	5	0	1	41	6	0	114
1984	64	20	0	0	16	12	3	0	115
1985	8	112	1	0	5	85	2	0	213
1986	19	33	0	0	4	44	3	0	103
1987	8	94	4	0	2	26	5	0	139
1988	4	16	2	0	4	38	1	0	65
1989	3	24	1	0	0	55	1	0	84
TOTAL	116	367	13	0	36	303	21	0	856
PAWCATUCK									
1980									
1981									
1982	0	38	0	0	0	0	0	0	38
1983	1	37	0	0	0	0	0	0	38
1984	0	26	0	0	0	0	0	0	26
1985	0	1	0	0	0	0	0	0	1
1986	0	0	0	0	0	0	0	0	0
1987	0	1	0	0	0	0	0	0	1
1988	0	5	1	0	0	0	0	0	6
1989	0	6	0	0	0	0	0	0	6
TOTAL	1	114	1	0	0	0	0	0	116

Table 13. (cont.)

STREAM SYSTEM / YEAR	HATCHERY ORIGIN 1-S-W	2-S-W	3-S-W	REPEAT	WILD ORIGIN 1-S-W	2-S-W	3-S-W	REPEAT	TOTAL
CONNECTICUT									
1980	0	175	0	0	0	0	0	0	175
1981	0	529	0	0	0	0	0	0	529
1982	3	57	0	0	0	10	0	0	70
1983	0	39	0	0	0	0	0	0	39
1984	7	65	0	0	2	18	0	0	92
1985	0	293	0	0	0	17	0	0	310
1986	0	275	0	0	0	43	0	0	318
1987	0	343	5	0	0	0	5	0	353
1988	1	93	0	0	0	1	0	0	95
1989	1	58	0	0	1	48	1	0	109
TOTAL	12	1927	5	0	3	137	6	0	2090
GRAND TOTAL	6100	28197	178	313	630	3526	90	104	39138

7 TERMS OF REFERENCE FOR 1992 MEETING

The following Terms of Reference were identified by the Assessment Committee to be addressd in 1992.

1) Program summaries for current year to include:
   - a. current year's stocking program with breakdowns by time, location, marks and lifestage.
   - b. current year's returns by sea age, marked vs. unmarked, and wild vs. hatchery.
   - c. general summary of program activities including regulation changes, angling catch, and program direction.

2) Data needs for NASCO
   - a. summary of status of stocks for NASCO
   - b. summary of research for ANACAT

3) Historical Data - validate 199[illegible] stocking and return data and add to historic database.

4) Synthesize available data and model fry survival rates.

5) Develop a methodology to identify stocked hatchery smolts based upon minimum length criteria; e.g. compute an annual index of smolt survival probability based upon the length frequency distribution and associated survival rates.

6) Develop methodology to estimate homewater returns to U.S. rivers.

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9 PAPERS SUBMITTED

Baum, E.T. Factors Influencing the Survival of Hatchery-Reared Atlantic Salmon Smolts Released in Maine.

Baum, E.T., K.F. Beland, N.R. Dube, R.A. Spencer. Estimated Total Adult Atlantic Salmon Returns to Maine Rivers in 19

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Seamans, R. — Predation by Harbor Seals

Seamans, R. — Predation by Striped Bass

Stolte, L. — Merrimack River - Program Changes and the Influencing Factors

Stolte, L. — Atlantic Salmon Marking Database - New England

Trasko, F. — Fry Stocking in Maine - Methods and Survival

Trasko, F. — Assessment of Feeding Fry Stocking Densities As They Relate to Survival and Growth In Two Maine Streams.

Whalen, K.and G. LaBar Summary of Fry Survival Rates in the White River, Vermont during 1989-1990.

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11 APPENDICES

11.1 Terms of Reference for 1991 Meeting

1. Describe 1990 stocking and adult returns to U.S. Atlantic salmon rivers. Evaluate the status of the stocks.

2. Review methodology and parameterization of salmon homewater run estimates for U.S. Rivers.

3. Evaluate the effects of hatchery practices and sea growth on age of maturity for U.S. salmon stocks.

4. Provide information on methodology to increase return rate of hatchery salmon releases.

5. Review tagging statistical methodology for evaluation of stocking groups.