U.S. ATLANTIC SALMON ASSESSMENT COMMITTEE

ASSESSMENT 1990/01

Annual Report of the U. S. Atlantic Salmon Assessment Committee

Woods Hole, Massachusetts

29 January - 2 February 1990

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1 Introduction

1.1 Executive Summary

The 1990 Annual Meeting of the U.S. Atlantic Salmon Assessment Committee was held January 29 - February 3, at Woods Hole, MA. The committee addressed terms of reference established at the previous (1988) meeting. Stocking data, listed by age/life stage and river, and tagging data were presented for all New England programs. A total of 5,487,700 juvenile salmon were stocked; of which 706,900 carried coded wire tags (CWTs) or Carlin tags. Adult salmon returns were listed by river, origin, smolt age, and sea age. A total of 3,605 salmon were documented to have returned to all U.S. rivers in 1989. That number includes a complete tally for all programs except the Maine rivers. The numbers for Maine rivers include only trap and angling catches. A total of 625 fish with CWTs and 193 fish with Carlin tags returned to U.S. rivers. The angling catch of the state of Maine was reported at 1,007 fish. No angling catches occurred in other river systems.

General program updates included: (1) proposed methodology to revise historical adult return data for Maine rivers to reflect returns unaccounted for due to fishway inefficiency and lack of effective sampling infrastructure in some rivers; (2) discussion of recent trends in grilse/salmon ratios on the Penobscot River; (3) details of fry stocking, adult returns, studies of smolt emigration past hydro facilities, and research planning on the Merrimack River; (4) information on a recent agreement between utility companies on the Connecticut River and the Connecticut River Atlantic Salmon Commission relating to goals of downstream fish passage at hydro facilities; (5) a description of research studies initiated on the Connecticut River by the Northeast Anadromous Fisheries Research Laboratory and program cooperators, (6) discussion of the stocking program and assessment studies occurring on the Pawcatuck River program, (7) description of the standardized salmon database [called "OASIS"] being developed by the U.S. Fish and Wildlife Service to compile Atlantic salmon data throughout New England, including standardized forms and life stage definitions, which were discussed, modified, and accepted by the committee.

Historical data (1980 - 1988) of detailed stocking and adult returns in U.S. rivers were presented. This dataset is not complete as of this writing but is anticipated for completion by 1991. Preliminary compilations indicate that nearly 27 million juvenile fish have been stocked and at least 33,486 adults have returned during this time period.

Studies and information regarding freshwater and marine factors in salmon survival were reviewed. Research presented included the examination of: life stage transition analyses for juveniles, density dependent growth and mortality, angling by-catch, redd counts as a predictive index, comparison of return rates for the St.John and Penobscot Rivers' hatchery smolts, smolt survival in relation to hydro facilities, correlation between scale growth patterns and marine survival, correlations between sea surface temperatures and marine survival, and estimates of marine survival for Pawcatuck River smolts.

The committee reviewed stated research needs from the 1988 meeting, updated the status of those needs, and added new items to the list. Over 20 needs were listed. Terms of reference for the 1991 meeting were proposed along with refinements in the document format, meeting procedure, and yearly meeting schedule of the committee.

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

The members of the U.S. Atlantic salmon Assessment Committee strived to accomplish two major goals at this, the second, annual meeting. The first goal was to assemble a comprehensive summary of the New England Atlantic salmon program activities for 1989. This summary is a document which can, and should, be used by all who need information about the program. The second goal was to improve the content and format for future meetings and reports. I believe that we were successful in both cases.

This year's report contains the information which is most often needed, such as summaries of stocking, marking and adult returns. It also includes a general update on the current river programs, and the beginning of a historical section which presents stocking and adult return information from 1980 to 1988. The very important section on research needs and data deficiencies which participants felt were important to address provides a ready partial reference of "work to be done". The collection of data for this report was somewhat hampered by the lack of attendance at the meeting. Less than half of the members attended due to lack of funds, out-of-state travel restrictions, and schedule conflicts.

Plans were made to expand the scope of future reports to include studies from organizations which presently do not participate in the meetings. We also plan to work collectively during the year to address the tough biological questions and problems facing the Atlantic salmon programs. By addressing these issues, we hope to make the meetings and the annual document more inclusive and meaningful to those involved in salmon restoration. More importantly, we hope to bring Atlantic salmon restoration in the United States closer to reality.

Standardization of biological terms and data compilation was begun and will be implemented where possible to help eliminate some of the inconsistencies which have been evident in the past.

I sincerely want to thank those who participated in this year's meeting for their strong and interest and perseverance. I would also like to thank the program administrators for supporting the Assessment Committee and and for supporting those involved in the anadromous fish restoration programs in New England. Without that support, the questions will not get answered. We hope that support continues and grows.

2 STATUS OF PROGRAM

2.1 STOCKING

2.1.1 Total Releases

In 1989 nearly 5.5 million juvenile Atlantic salmon were released into 15 rivers in New England (Table 1). Three of the rivers, the Merrimack River, the Pawcatuck River, and the Connecticut River, are outside the state of Maine. The total releases numbered nearly 1.5 million more than in the previous year.

Information presented within tables depicting Atlantic salmon stocking efforts is rounded to the nearest 1000 fish for fry releases and to the nearest 100 fish for all other juvenile releases. This rounding practice will become standard operating procedure in the future. However, unless otherwise noted, the practice will only be utilized within the status section of the report.

TABLE 1. ATLANTIC SALMON STOCKING SUMMARY FOR NEW ENGLAND IN 1989 BY RIVER SYSTEM AND BY PROGRAM.

RIVER SYSTEM	NUMBER OF FISH					RIVER TOTAL
	FRY	0+PARR	1PARR	1SMOLT	2SMOLT	
St. John (USA)[1]						
Aroostook	313000	242200	0	0	10000	565200
St. Croix	0	0	0	50600	0	50600
Dennys	12000	0	0	12100	0	24100
Pleasant	26000	2500	0	7300	0	35800
East Machias	30000	6500	8000	15300	0	59800
Machias	49000	13800	28000	23100	0	113900
Narraguagus	29000	10000	7000	22100	4900	73000
Union	0	0	0	20400	0	20400
Penobscot	77000	104100	179600	351300	65300	777300
Ducktrap	17000	0	0	0	0	17000
Sheepscot	29000	13600	10000	10200	0	62800
Saco	0	37800	49600	9900	0	97300
Merrimack	1033000	60000	88600	58200	0	1239800
Pawcatuck	0	379900	35900	6400	0	422200
Connecticut	1242000	272900	116300	221000	0	1852200
	=======	=======	======	=======	======	=======
GRAND TOTAL	2855000	1143300	523000	809900	80200	5411400
St. John (Canada)[2]						
Upper St. John	66000	0	0	0	10300	76300
	=======	=======	======	=======	======	=======
GRAND TOTAL	66000	0	0	0	10300	76300
PROGRAM						
Maine Program						
USA	580000	430500	282200	524300	80200	1897200
CANADA	66000	0	0	0	10300	76300
Merrimack River Program	1033000	60000	88600	58200	0	1239800
Pawcatuck River Program	0	379900	35900	6400	0	422200
Connecticut River Program	1242000	272900	116300	221000	0	1852200
	=======	=======	======	=======	======	=======
GRAND TOTAL	2921000	1143300	523000	809900	90500	5487700

1 Fish were released into waters of the United States draining into the Upper St. John River.
2 Fish were released into waters of Canada draining into the Upper St. John River.

2.1.2 Summary of Tagged and Marked Fish

In order to address the contribution of salmon of United States origin to the ocean commerical fishery and to carry out various research/management studies, nearly 15% of the fish comprising the releases were marked (Table 2). The marks included coded wire tags and carlin tags.

TABLE 2. SUMMARY OF ATLANTIC SALMON TAGGING PROGRAMS FOR NEW ENGLAND IN 1989.

PROGRAM	NUMBER OF CODED WIRE TAGS		NUMBER OF CARLIN TAGS	
	PARR	SMOLTS	PARR	SMOLTS
Maine Program				
Penobscot River	0	202000	0	50000
Merrimack River Program	88600	56200	0	0
Connecticut River Program	94700	215400	0	0
TOTAL	183300	473600	0	50000

2.2 ADULT RETURNS

2.2.1 Total Returns

Atlantic salmon returns to U.S.A rivers in 1989 were slightly improved over those observed in 1988, (Table 3). Returns to southern New England rivers (Connecticut, Pawcatuck, Merrimack) were 20% higher, although this only represented an increase of 32 fish. Returns to Maine rivers were variable, with increases in some rivers (e.g., Penobscot) and decreases in others (e.g., St. Croix, Union, Saco). The sport catch of Atlantic salmon in Maine rivers was 250% higher (1,007 in 1989 vs 402 in 1988) due to improved runs and excellent angling conditions throughout the season. As in previous years, the estimated number of Atlantic salmon caught and released by anglers exceeded the number caught and killed.

Adult returns reported in Table 3 (actual trap catches and reported angling catches) are not indicative of the total salmon runs in U.S.A rivers.

Adult returns to the Aroostook River in Maine (227 in 1989 vs 156 in 1988) were not included in 1989, since most of these fish originated from Canadian salmon habitat in the St. John River drainage. However, the Assessment Committee agreed to include the Aroostook River returns in future years.

Salmon returns to the Penobscot, St. Croix, Union, Kennebec, Androscoggin, and Saco Rivers in Maine were primarily of hatchery origin (e.g., from parr and smolt releases). Adult returns to all other Maine rivers were primarily of wild origin, principally from natural reproduction with limited numbers likely originating from fry releases. Returns to the Merrimack River, although numbering only 84 fish, were contributed by fry releases (67%), parr releases (1%), and smolt releases (32%).

TABLE 3. 1989 NEW ENGLAND ATLANTIC SALMON RETURNS (TRAP AND ANGLING CATCHES).

RIVER	METHOD OF CAPTURE	NUMBER OF ATLANTIC SALMON BY SEA AGE				TOTAL
		1-S-W	2-S-W	3-S-W	P.S.	
Connecticut River	Trap	2	106	1	0	109
Pawcatuck River	Trap	0	6	0	0	6
Merrimack River	Trap	3	79	2	0	84
Penobscot River	Trap	813	1864	4	38	2719
	Rod	121	244	1	2	368
St. Croix River	Trap	118	107	0	9	234
	Rod	7	0	0	0	7
Dennys River	Rod	1	11	0	0	12
East Machias River	Rod	14	16	0	1	31
Machias River	Rod	7	9	0	0	16
Pleasant River	Rod	closed in 1989				
Narraguagus River	Rod	4	35	0	0	39
Union River	Trap	4	22	0	0	26
	Rod	0	3	0	1	4
Ducktrap River	Rod	0	0	0	0	0
Sheepscot River	Rod	3	2	0	0	5
Kennebec River	Trap	1	14	0	0	15
	Rod	0	2	0	0	2
Androscoggin River	Trap	1	17	0	0	18
Saco River	Trap	2	13	0	1	16
	Rod	0	3	0	0	3
TOTAL		1099	2447	7	52	3605

2.2.2 Returns of Tagged Salmon

Returns of coded wire and Carlin tagged salmon to U.S.A rivers in 1989 are shown in Table 4, sorted by age and river of return.

Table 4. 1989 Coded wire (CWT) and Carlin tag returns to USA rivers.

River	Tag Type	Age Group 1SW	2SW	3SW	Total
Connecticut	CWT	1	48	0	49
Merrimack	CWT	2	2	0	4
Penobscot	CWT	98	471	1	570
	Carlin	32	156	4	192
Other ME	CWT	0	2	0	2
rivers	Carlin	0	1	0	1
Total	CWT	101	523	1	625
	Carlin	32	157	4	193

2.2.3 SPORT FISHERY

Sport fishing for Atlantic salmon is not permitted in the Connecticut or Pawcatuck rivers. Sport fishing is permitted in parts of the Merrimack watershed, however, there were no reported angler catches in 1989.

The sport catch of Atlantic salmon in Maine during 1989 was considerably higher than either 1988 or 1987. The primary reason for this increase was the excellent angling conditions that occurred throughout the season, although adult returns for most rivers were also generally higher. Of particular interest was the sport catch in the "wild" rivers (Dennys, E. Machias, Machias, Narraguagus) of eastern Maine, where 27% of the "wild" rod catch in 1989 was 1 SW salmon. These rivers have historically produced very few grilse, therefore the grilse/salmon ratio for 1989 was unprecedently high (Table 5). These data mirror observations on the Penobscot River in recent years and lend support to the theory that whatever factor(s) are responsible for the unusually high grilse/salmon ratios in Maine hatchery stocks are also having the same affect on wild stocks.

Table 5. 1989 Sport Catch of Atlantic Salmon in Maine.

River	Number of Atlantic Salmon 1SW	2SW	3SW	P.S.	Total No. Kept	Est. No. Rel.	Total Catch	(1988)
St. Croix	7	(grilse only)			7	8	15	(9)
Dennys	1	11	0	0	12	1	13	(9)
E. Machias	14	16	0	1	31	1	32	(14)
Machias	7	9	0	0	16	2	18	(9)
Pleasant	Closed in 1989				0	0	0	(0)
Narraguagus	4	35	0	0	39	5	44	(48)
Union	0	3	1	0	4	0	4	(3)
Penobscot	121	244	1	2	368	500	868	(304)
Ducktrap	0	0	0	0	0	0	0	(0)
Sheepscot	3	2	0	0	5	0	5	(1)
Kennebec	0	2	0	0	2	0	2	(2)
Saco	0	3	0	0	3	3	6	(3)
TOTAL	157	325	2	3	487	520	1,007	(402)

2.3 GENERAL PROGRAM UPDATE

2.3.1 Maine Program

Revised Estimates of Adult Returns to the Penobscot River

The Penobscot River salmon run has traditionally been reported as the sum of the trap catch at the Veazie fishway and the sport fishery harvest below Veazie. This method underestimates the actual run size. On the St. John River in New Brunswick, actual returns to the river are calculated utilizing a combination of returns to the Mactaquac migration channel, counts at the trap at the base of the dam, estimates of the native food fishery, estimates of sport catch, by-catch and commercial catch, etc. where applicable (Marshall 1988). There exists a need to similarly adjust Penobscot River adult salmon run estimates.

In 1978, when the Bangor Dam was permanently breached, the Maine Atlantic Salmon Commission moved its Penobscot River fish counting facility up to the Veazie Dam. The new fishway trapping facility is located approximately 3 miles further upstream than the one used from 1969-1977, and there is a small amount of spawning and nursery habitat below the dam.

Natural reproduction has been documented for several years in this area, as well as in several tributaries to the Penobscot River below the Veazie Dam.

For the past 3 years a study has been undertaken (conducted by Bangor Hydro Electric Co. and the Maine ASRSC) to evaluate the efficiency of the Veazie fishway. Since preliminary results for the period 1987-1989 indicate that the fish passage efficiency of the Veazie fishway is only 75%, then adult returns to the Penobscot River would have been significantly underestimated in recent years.

Another factor which could lead to an underestimation of the total salmon run in the Penobscot River is the number of rod caught and released fish. It has been assumed that all released fish were eventually taken at the Veazie fishtrap. If a delayed mortality is assumed to have occurred, in some years, another significant number of fish would not be included in the estimated total run in the Penobscot.

In summary, adult returns to the Penobscot River have been consistently underestimated due to fish passage inefficiency. Fish passage efficiency at the Bangor Dam fishway probably ranged from 60-70% in the early 1970's to 50% or less in the last few years that it was operational. Recent data indicate that the efficiency of the Veazie fishway may be on the order of 75%.

If the Penobscot River salmon run size is recomputed using these assumptions, the adult returns would increase significantly. For example, the reported 1989 adult returns of 3,087 would be revised upward to 4,028, an increase of 30 percent. This revision methodology will be developed and applied to the historical Penobscot River database prior to next year's meeting.

Trends in Grilse/Salmon Ratios in the Penobscot River

Grilse/salmon ratios in the Penobscot River in recent years (1987-89) have been the highest since the restoration program began in the late 1960s. Ratios for hatchery and wild origin salmon are shown in Figures 1 and 2. There appear to be differences in the trend observed in wild origin salmon, which may be attributable to the small numbers of fish involved (vs numbers of hatchery origin salmon). However, the trend of increasing grilse/salmon ratios

FIGURE 1. PENOBSCOT RIVER GRILSE/SALMON RATIO (HATCHERY ORIGIN)

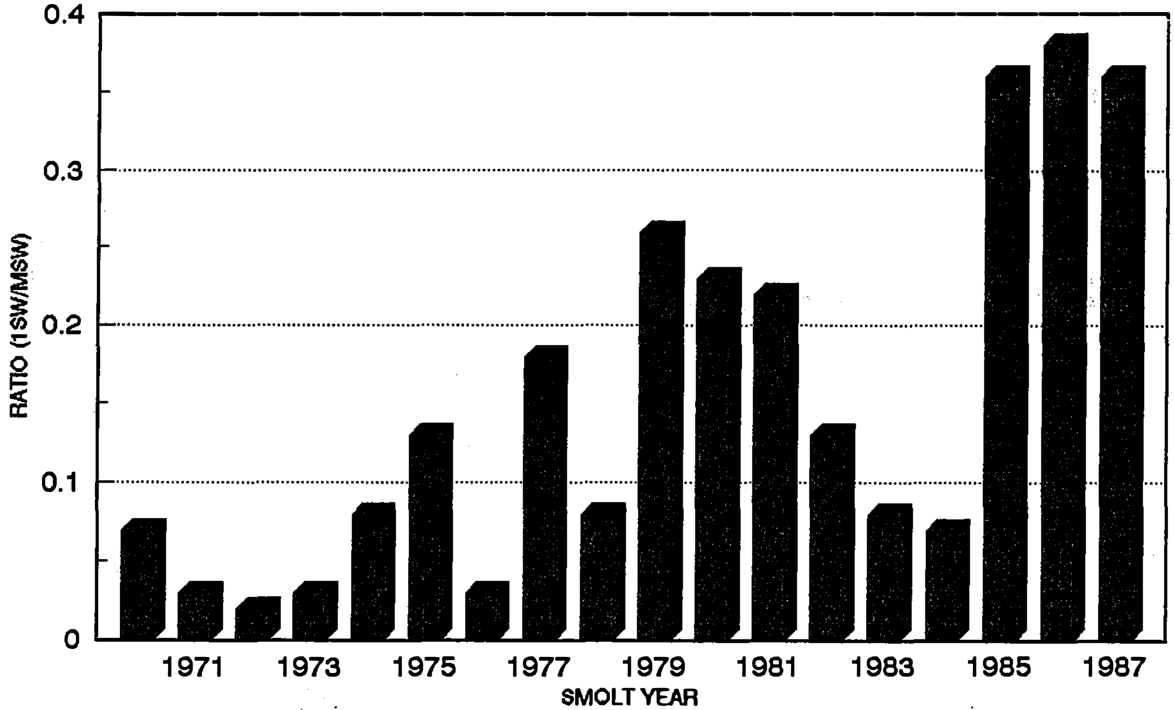
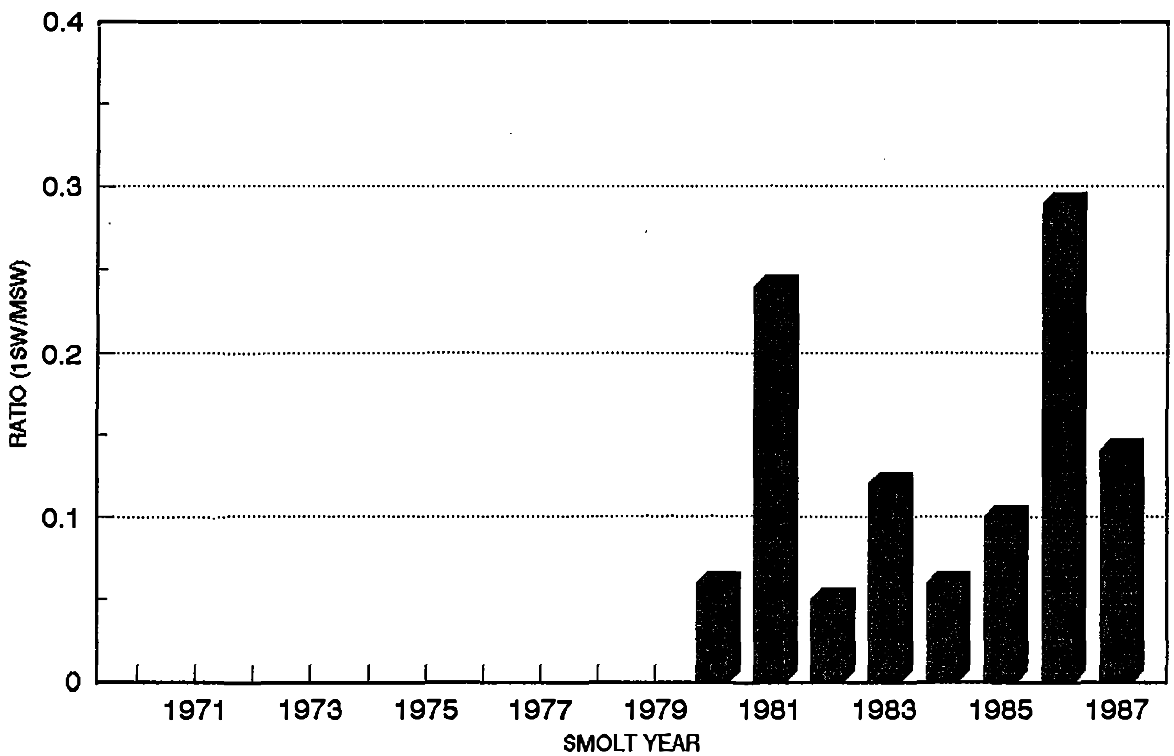


FIGURE 2. PENOBSCOT RIVER GRILSE/SALMON RATIO (WILD SALMON ONLY)



in the Penobscot River in recent years appears to also be occurring in several of Maine's so-called "wild run" rivers and this phenomenon has also been documented for several rivers in Canada (e.g. St. John, Mirimachi, LaHave, etc.). It appears, therefore, that in recent years either the survival of 1SW salmon (or the proportion of the population maturing after 1SW) has been increasing, or the survival of 2SW salmon (or the proportion of the population maturing after 2SW) has been decreasing.

Grilse/salmon ratios are rather meaningless unless these data can be compared to the number of smolts in each year class. Since the production of wild smolts in the Penobscot drainage is unknown, this analysis can only be conducted for releases of hatchery-reared smolts.

Returns of 1SW and MSW salmon to the Penobscot River - expressed as returns per 1,000 smolts released - are shown in Figure 3 and Table 6. Comparing the trends observed during the past 20 years, it appears that high grilse returns have been associated with high MSW returns (1979) as well as with low MSW returns (1986 & 1987).

Table 6 Penobscot River Returns per 1,000 Hatchery Smolts Released, 1970-1988

YEAR	NO. 1SW/1000 SMOLTS	NO.MSW/1000 SMOLTS
1970	0.74	10.99
1971	0.16	4.59
1972	0.14	7.14
1973	0.34	10.07
1974	0.41	5.19
1975	0.68	5.36
1976	0.19	6.73
1977	0.36	1.98
1978	0.97	12.28
1979	2.23	8.45
1980	1.52	6.66
1981	0.78	3.56
1982	0.57	4.41
1983	0.54	6.46
1984	0.39	5.90
1985	0.92	2.55
1986	1.27	3.39
1987	1.32	3.73
1988	1.26	----

In conclusion, it is postulated that the trend in MSW returns is independent of grilse returns.

There has been speculation that perhaps the decrease in 2SW salmon returns may be caused by the shift to a 1-year smolt rearing program in Maine. If this were the case, how would the similar grilse/salmon trends in Maine "wild run" rivers be explained? Figure 4 is a summary of grilse/salmon ratios compared to the percentage of total releases that were 1-year smolts. The percentage of any given smolt class that matures after 1SW does not appear to be related to the proportion of 1-year smolts that were released (R^2 =.20).

FIGURE 3. PENOBSCOT RIVER RETURNS PER 1,000 HATCHERY SMOLTS RELEASED, 1970-1988

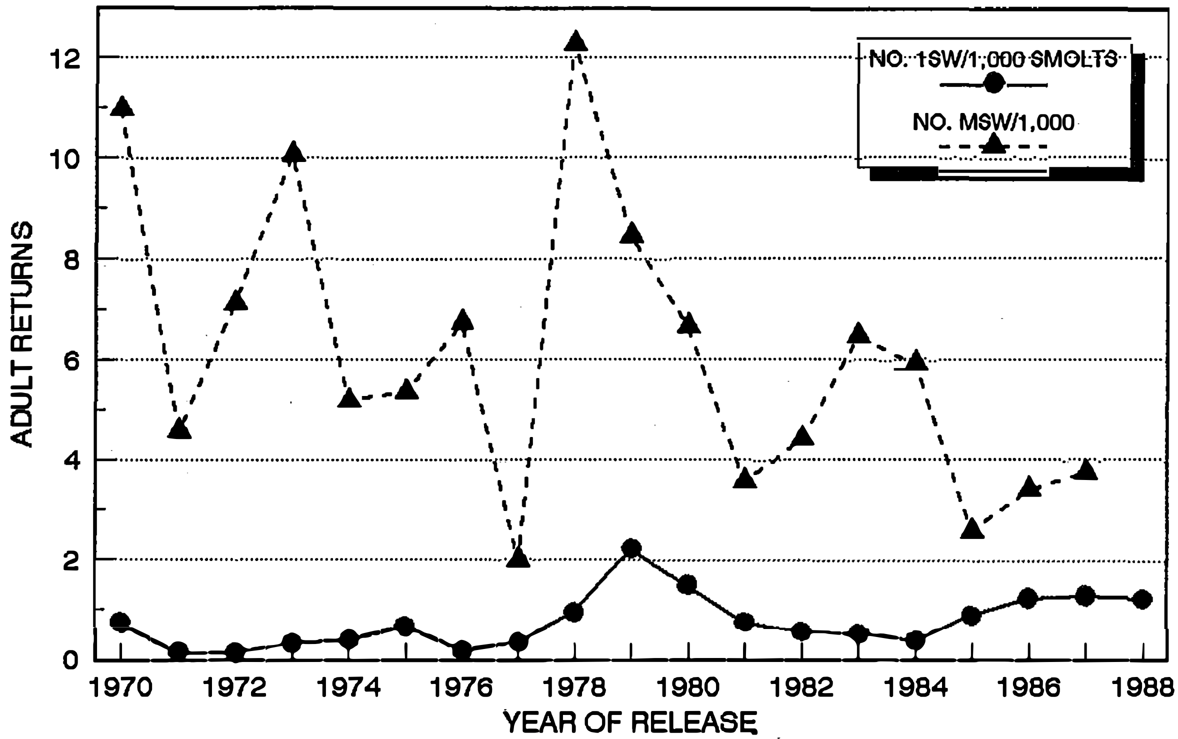
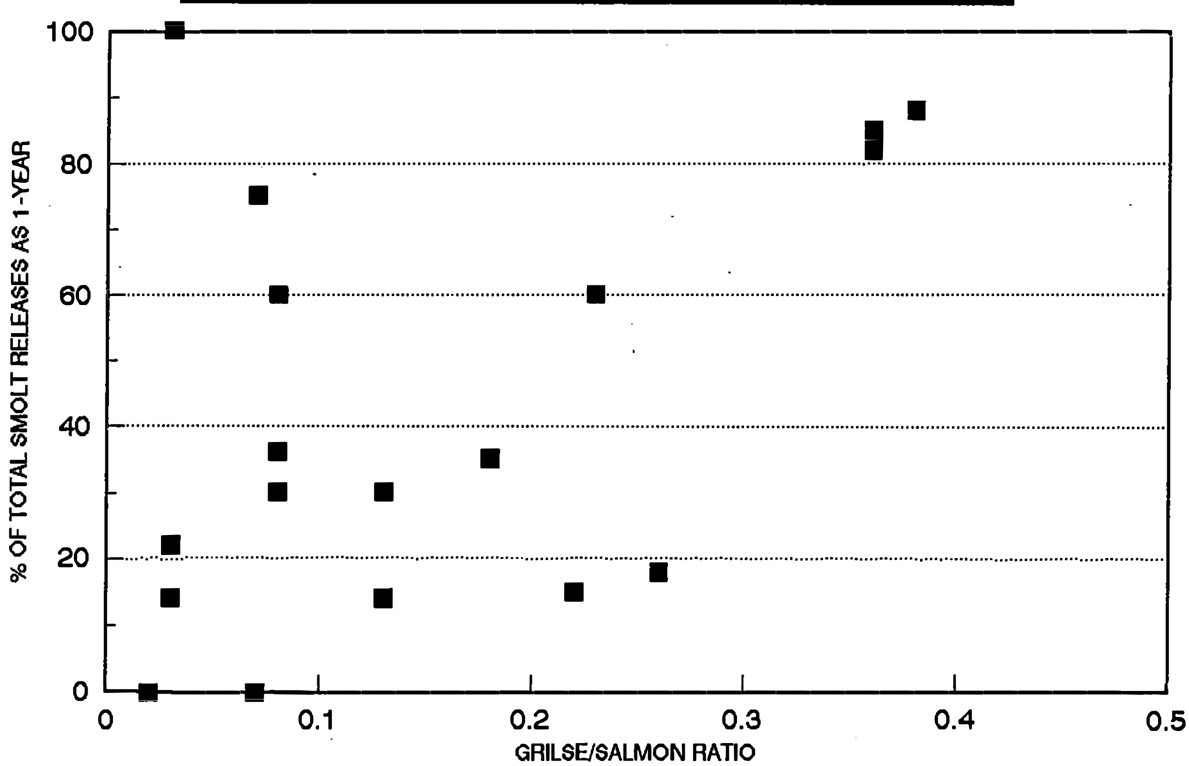


FIGURE 4. PENOBSCOT RIVER 1-YEAR SMOLT RELEASES VS GRILSE/SALMON RATIO, 1970-1987 SMOLTS



Stock-Recruitment Study

The Maine Atlantic Sea-Run Salmon Commission staff is conducting an ongoing evaluation of the accuracy of using redd counts in the Fall of year N as a predictive index of autumn age 1+ parr populations at five index sites in year N + 2. Four year classes have been studied to date, and there appears to be an emerging linear trend with redd counts, for a range of 93-243 redds in the main stem of the Dennys River. This project is planned for a 10 year study term.

2.3.2 Merrimack River

The effort to restore Atlantic salmon to the Merrimack River basin continued as fry were stocked in nearly all suitable rearing habitats to some degree (Table 7).

During the fall sampling period at the fry stocking index sites, it was noted that the 0^+ parr densities were down at four sites (Souhegan, Piscataquog, Mad, and Smith Rivers), up at one site (Pemigewasset River), and about the same at one site (Baker River) when compared to the 0^+ parr densities of the previous year. Densities of 1^+ parr were down at four sites (Mad, Smith, Baker, and Pemigewasset Rivers) and up at two sites (Souhegan and Piscataquog Rivers) when compared to the previous year's data.

TABLE 7. DISTRIBUTION OF ATLANTIC SALMON FRY INTO THE MERRIMACK RIVER BASIN IN 1989.

	NUMBER OF FRY STOCKED	STOCKING LOCATION
	78,200	SOUHEGAN RIVER
	60,000	CONTOOCOOK RIVER
	89,800	PISCATAQUOG RIVER
	5,400	SUNCOOK RIVER
	72,000	SMITH RIVER
	92,200	BAKER RIVER
	500,600	PEMIGEWASSET RIVER
	70,400	MAD RIVER
	64,800	PEMIGEWASSET RIVER (EASTMAN FALLS DAM TO AYERS ISLAND DAM)
	==========	
TOTAL	1,033,400	

The Atlantic salmon run (trap catch at the Essex dam fish-lift) commenced on May 22nd and continued until July 21st. A fall trapping operation did not occur. Over 50% of the run occurred during the month of June.

Public Service Company of New Hampshire continued to study the pathways that smolts were taking in passing five Merrimack River mainstem dams.

In late 1989 the U.S. Fish and Wildlife Service and the U.S. Forest Service developed a joint study that will be implemented in 1990. This study will focus on developing estimates of smolt production contributed by the fry stocking program. The work will be centered in the headwater reaches of the river.

Some characteristics of the salmon returns are presented in Table 8. Differences were noted between those of the previous seven years, but are probably not indicative of any real change. Although not shown in the table, major differences in the rate of return for two-sea-winter salmon were observed between the fish of North Attleboro NFH origin and those of Nashua NFH origin. From the 1987 North Attleboro NFH smolt release, 0.03% returned to the river as two-sea-winter salmon. This compared to a return rate of 0.003% for smolts released from the Nashua NFH.

TABLE 8. A COMPARISON OF SELECTED ATLANTIC SALMON POPULATION CHARACTERISTICS IN RELATION TO FISH ORIGIN (LIFE-HISTORY STAGE AT STOCKING) FOR 1989.

CATEGORY		ORIGIN OF ADULT FISH		
		FRY	PARR	SMOLT
RUN COMPONENT BY SEA AGE - %				
	GRILSE	0	0	11
	TWO-SEA-WINTER	98	100	85
	THREE-SEA-WINTER	2	0	4
PERCENT FEMALE RUN COMPONENT		53	100	41
PERCENT FEMALE RUN COMPONENT BY SEA AGE				
	GRILSE	0	0	0
	TWO-SEA-WINTER	52	100	43
	THREE-SEA-WINTER	100	0	100
AVERAGE FECUNDITY (EGGS PER LB)		843	870	880
AVERAGE FECUNDITY (EGGS PER LB) BY SEA AGE				
	GRILSE	---	---	---
	TWO-SEA-WINTER	844	870	879
	THREE-SEA-WINTER	807	---	885

2.3.3 Pawcatuck River

This program continued to rely on the stocking of hatchery parr. Fish were obtained from Pawcatuck River returns, N. Attleboro NFH, Lamar Tech Center, and Ocean Products, Inc. (a private aquaculture company that provided surplus parr). A smolt physiology study with the University of Rhode Island utilized 6,400 age 1 smolts. Returning adults were trapped and taken to the Perriville State Trout Hatchery where approximately 55,000 eggs were spawned.

Electrofishing surveys of freshwater juvenile population were continued as in the past years for analysis of survival and growth trends. Results are presented elsewhere in this report.

2.3.4 Connecticut River

The Connecticut River Atlantic Salmon Commission (CRASC) has moved to address the lack of any downstream fish passage facilities. In 1989 CRASC released a program goal statement for downstream fish passage that sets a standard of no delay, mortality, or injury. Both major utility companies have been working with CRASC in technical discussions on the companies' capabilities of meeting the operational dates adopted by CRASC.

The Northeast Anadromous Fisheries Research Laboratory (NAFRL) conducted two studies contained within the research term of reference developed during the 1988 Salmon Assessment Committee meeting. The University of Rhode Island, under contract to NAFRL, studied smoltification at U.S.FWS White River National Fish Hatchery (WRNFH) and Kensington State Salmon Hatchery (Connecticut). Preliminary results indicate that juvenile salmon from both facilities underwent smoltification. The timing and magnitude of smoltification as determined by the Na+ K+ ATPase activity were different.

One tagged lot of smolts (22,500) from WRNFH was placed into a 15 x 15 meter net pen in the lower Connecticut River and towed about 2 km into Long Island Sound and released. One purpose of this study is to compare return rates of salmon that were not subjected to river related mortality. Both the smoltification and pen release studies will continue in 1990.

2.3.5 General Program Information

Standardized Atlantic Salmon Database

A standardized Atlantic salmon database for Region 5 of the U.S. Fish & Wildlife Service is currently under development. The database, which utilizes the R:Base for DOS software package, is referred to as OASIS (Operational Atlantic Salmon Information System). In order to have functional, standardized databases for the New England salmon programs, it is necessary to develop consistent life stage definitions. These definitions will be used in OASIS and other applications. The committee agreed on the following definitions:

Life Stage Name	Life Stage Definition (OASIS input name)
Green egg	The stage from spawning until faint eyes appear. (GreenEgg)
Eyed Egg	The stage from the appearance of faint eyes until hatching. (EyedEgg)
Unfed Fry	The period from hatching until first feeding. (UnfedFry)
Fed Fry	The period from first feeding to August 14 of the same year. (FedFry)
0+ Parr	The period from August 15 to December 31 of the year of hatching. (0PParr)
1 Parr	The period from January 1 to August 14 one year after hatching. (1Parr)
1+ Parr	The period from August 15 to December 31 one year after hatching. (1PParr)
2 Parr	The period from January 1 to August 14 two years after hatching. (2Parr)

2+ Parr	The period from August 15 to December 31 two years after hatching. (2PParr)
3 Parr	The period from January 1 to August 14 three years after hatching. (3Parr)
3+ Parr	The period from August 15 to December 31 three years after hatching. (3PParr)
4 Parr	The period from January 1 to August 14 four years after hatching. (4Parr)
4+ Parr	The period from August 15 to December 31 four years after hatching. (4PParr)
1 Smolt	The period from January 1 to June 30 of the year of migration. The migration year is one year after hatch. (1Smolt)
2 Smolt	The period from January 1 to June 30 of the year of migration. The migration year is two years after hatch. (2Smolt)
3 Smolt	The period of January 1 to June 30 in the year of migration. The migration year is three years after hatch. (3Smolt)
4 Smolt	The period from January 1 to June 30 in the year of migration. The migration year is four years after hatch. (4Smolt)
Post Smolt	The period from July 1 to December 31 of the year the salmon became a smolt. (PostSmolt)
1W Salmon	A salmon that has passed one December 31st since bescoming a smolt. (1WSalmon)
2W Salmon	A salmon that has passed two December 31sts since becoming a smolt. (2WSalmon)
3W Salmon	A salmon that has passed three December 31sts since becoming a smolt. (3WSalmon)
4W Salmon	A salmon that has passed four December 31sts since becoming a smolt. (4WSalmon)
Kelt	The stage after a salmon spawns. For captive salmon, this stage lasts until death. For wild fish, this stage lasts until it returns to homewaters to spawn again. (Kelt)
Previous Spawner	A salmon that has returned from the sea for at least the second time. (PrevSpwn)
Captive Broodstock	A salmon held in captivity through sexual maturity for broodstock purposes. (Captiv)

Among other tasks, this database will compile stocking and tagging information for U.S. Atlantic salmon programs. There are currently two tables and a data entry form in this section of the database (described in Section 10). The stocking table contains information regarding the number, type, life stage and size of the stocked salmon, and applied tags or marks. The site table contains detailed information on the sites where fish are stocked. The entry form, which resembles the standard hatchery "trip sheet", is used to enter the stocking information for each trip.

The database will be used for the first time in 1990 at the national fish hatcheries in Maine and Connecticut. The content and format are expected to undergo several refinements as it is put into practice.

The OASIS database contains a section for adult salmon returns to New England rivers. Suggested standardized column descriptions and types are presented in Section 10 for an adult returns table.

3 Terms of Reference

3.1 Marine Factors

An analysis presented at the 1988 assessment meeting indicated that marine survival patterns in several U.S. and Canadian salmon stocks were syncronized. This result was consistent with the hypothesis of a broad scale environmental driving force. Temperature was empirically identified as a plausible mechanism, possibly affecting survival through growth and distribution effects. The Assessment Committee suggested that a retrospective analysis of post smolt growth patterns with respect to sea temperature and survival would be appropriate.

Consequently, new analyses were presented which correlated circuli spacing to marine survival in the 1973 to 1986 Penobscot River hatchery smolt classes. Scale circuli were enumerated and spacing measured in the first summer and first winter growth zones using image processing techniques. Circuli patterns exhibited considerable inter-annual variation. Several indices of growth rate were extracted from the scales including total circuli count in the first summer zone and mean spacing in particular areas of the first year. These growth indices were then correlated with estimates of smolt survival. The strongest significant correlation was found between sea survival and a growth index which combined early post-smolt and first winter growth. Specifically, mean circuli spacing in the first 8 circuli of the first summer zone combined with circuli spacing of the first winter zone, were significantly correlated to the estimates of marine survival ($r=.877$, $p<.05$). This suggests that survival is influenced by the accumulated growth effects during the first sea year, particularly the first winter. A predation effect would have been manifested by independence of growth indicies and survival rates.

A second set of analyses examined the same estimates of marine survival with respect to sea surface temperatures in the Northwest Atlantic. Sea surface temperature anomalies for 5 degree latitude by 5 degree longitude cells were calculated from a number of data sources by monthly intervals. The temperature indices were then correlated to the Penobscot River survival estimates. A matrix of correlation coefficients of survival vs. cell temperatures for each month was produced. Three temperature-survival trends emerged from the analysis. First, survival appears to be negatively correlated with spring mid-Atlantic bight temperatures. Second, survival appears to be positively correlated with temperature in the Gulf of St. Lawrence and south of Newfoundland in mid summer. Third, survival appears to be negatively correlated with temperature in the Labrador Sea in late summer to early fall. Taken together, the results suggest that smolt survival is associated with the distribution of sea surface temperatures and that this effect is not limited to the period immediately after entry into seawater. Investigation of the linkages between temperature driven distribution and potential forage species of post smolts will be continued.

Estimates of marine survival were provided for the Pawcatuck River, RI for smolt classes 1980 to 1987. These estimates did not track those made for other systems. A declining trend involving an order of magnitude decrease was evident. In light of the syncronized survival trends for major New England and Canadian rivers, these estimates suggest a river specific problem. The decline is associated with a change in broodstock from which the smolt were derived. The 1980 to 1982 smolt classes were derived from parents, at least one of which was a sea run return to the Penobscot River, ME. The 1985 to 1987 smolt classes were derived from parents from the U.S.FWS captive broodstock program. The process of producing captive broodstock may be a negative selection against anadromy.

3.2 Habitat Issues

The Assessment Committee initiated a review of the designation and evaluation of Atlantic salmon habitat throughout New England as a Term of Reference for the 1990 meeting. This review is partially completed and is based on responses from only some of the involved agencies. This information is summarized below.

All responding agencies designate salmon habitat via an inventory of physical habitat within the drainages targeted for salmon restoration. Inventories are conducted during summer low flow periods. Stream length is measured and separated into incremental transects or plots. Stream width, canopy cover, streambank condition,bottom type, depth, and other habitat features are measured within each transect cell. Habitat criteria developed by the U.S.FWS are used to evaluate salmon suitability for identifying spawning, rearing, adult holding and resting pools, and non-usable habitat. The State of Connecticut further delineates and quantifies rearing habitat as "fry" and "parr" habitat. All other agencies lump all juvenile salmon habitat as "rearing" habitat, at least on paper. The final product is a tally of salmon habitat in number of units (100 sq.m. or yds) listed by habitat type and total by stream.

This information provides the basis for fry and parr stocking strategies and estimates of smolt production within each river basin. No agency other than the U.S. Forest Service has used the inventory to consider habitat improvement. The Forest Service has examined the inventory data, the literature, identified factors potentially limiting smolt production, and implemented habitat enhancement in selected streams in the Green Mountain region of the Connecticut River basin. The State of Connecticut expressed an interest in investigating habitat restoration and enhancement at sometime in the future when greater homewater returns warrants such action.

Additional papers and research initiatives are being prepared to address alternative methods for evaluating and enhancing salmon habitat, including:

1. Selection and preference of microhabitat by juvenile Atlantic salmon in Vermont and New Hampshire streams using a stream habitat classification system.

2. Habitat utilization and use of cover by juvenile Atlantic salmon in Vermont and New Hampshire streams using a stream habitat classification system.

3. Salmonid densities and habitat characteristics of two New Hampshire streams (stratifying habitat within a basin to determine numbers of fish by species).

4. Density and biomass of Atlantic salmon by habitat type in several Vermont streams including pre- and post-evaluations of habitat enhancement projects.

5. Managing riparian forest in the Green Mountain and White Mountain National Forests to restore and enhance salmon habitat.

3.3 Juvenile Salmon Issues

The Rhode Island Division of Fish and Wildlife has continued its population studies of juvenile salmon in the Pawcatuck River watershed. Springtime pre-smolt electrofishing surveys were conducted and produced a mean density estimate of 2.12 smolts per unit (100 sq. yds.) and a total smolt population estimate of 11,363. Mean length of smolts was 167 mm. Scale analysis indicated that 28% of the smolts were age one and 72% were age two. The mean instantaneous mortality rate from summer, 1+ parr to spring 2 smolt, was Z= 0.0048 (SE= .0012). Summer 1+ parr had averaged 148.52 mm in length and spring 2 smolt averaged 173.14. The mean instantaneous rate of growth in weight was G= 0.00174 (SE= .00024).

A fry stocking experiment (125 fry/unit) in Breakheart Brook was evaluated. The estimated instantaneous rate of mortality was Z= 0.00632 (SE= .00093). This corresponds to a six month survival rate of 31.6%. The instantaneous rate of growth in weight was G= 0.00366 (SE= .00041). Mean length at smoltification was 168.3 mm. Estimated smolt production from this release was only 0.59 per unit compared to a long-term average of 1.842 per unit for 0+parr plants. This low production is due primarily to high mortality of fry immediately after stocking. These results are similar to those of a fry stocking project on the Falls River two years earlier (Gibson 1987). Both studies indicate that fry are less effective than fall 0+ parr in producing smolt. The Pawcatuck River may contain more predators than northern salmon streams. Fall parr, due to their size, are far less vulnerable to predation.

Life stage transition analyses were used to examine the relationship between parr numbers and subsequent smolt production, emphasizing a test of density dependence. The following equation was adapted from Peterman (1981):

S= a*P^b*exp(E)

where:

S= number of smolts (Peterman used "adults")
P= number of parr (Peterman used "smolts")
a= survival rate parameter
b= density dependent parameter
E= error term

and applied to data for the Pawcatuck river. A plot of smolt density vs. stocked parr density appears in Figure 1. Although only 21% of the variance in smolt density was explained by stocked parr density, parameter estimates for the above equation were significant. There was strong evidence that mortality of stocked parr through the smolt stage is density dependent (b<1.0). Addition of other explanatory variables suggested that smolt production has a density independent component linked to habitat. The fitted curve suggests that smolt production approaches and asymptote of about 2.0 per rearing unit and that parr densities above 30.0 result in only marginal increases.

A new study of density effects on growth and mortality was begun in the fall of 1989 when very large numbers of 0+ parr became available. The objective of these studies is to better define the stocking rate-smolt production curves in the region of high initial densities.

The early season angler survey was continued in 1989. This survey, conducted during the first month of trout season, is designed to assess the interception of salmon smolts by anglers. A roving type design is employed whereby anglers are interviewed and observed while fishing in the Wood River, a major tributary to the Pawcatuck and a popular trout stream. In 1989, a total of 125 anglers were interviewed or observed for a total of 78.03 rod-hours of effort. Nineteen salmon smolts were caught yielding a CPUE of 0.243 fish per rod-hour. A summary of the survey results is found in Table 5. CPUE has varied from 0.243 to 0.754 with a mean of 0.375. Supplemental angling by Division personnel during these surveys has caught 40 salmon smolts. Of these, 13 sustained life threatening injuries (32.5%). These studies suggest that the typical trout angler during the early season will catch a smolt for every 2.67 rod hours of effort with a survival expectation of 0.325 Although estimates of the total fishing effort expended during the smolt migration by trout anglers are unavailable, the potential for significant impact is apparent.

3.4 Adult Return Issues

Comparison of Return Rates for St. John and Penobscot River Hatchery Reared Smolts

Research Recommendation #7 from the 1988 Assessment Committee Meeting was to "evaluate adult return rate records for Canadian hatchery programs similar to U.S. programs and compare data." This issue was examined, but the fact that there are no "similar" hatchery programs that are directly comparable confounded the analyses. Canadian hatchery programs utilize significantly different stocks, rearing regimes, stocking methods and, most importantly, non-comparable methods to estimate homewater returns.

Figure 5 compares returns of MSW salmon from hatchery-reared smolts released in the St. John River, N.B. with "similar" smolts released in the Penobscot River. There are many differences between these two programs. The St. John River salmon run contains a large grilse component, whereas the Penobscot does not. It is extremely difficult to categorize a Mactaquac Hatchery smolt and/or a Green Lake NFH smolt (e.g. age, size, condition, rearing regime et al.). Adult returns to the St. John and Penobscot Rivers are determined in different ways. On the St. John River actual returns to the river are calculated utilizing a combination of returns to the Mactaquac migration channel, counts at the trap at the base of the dam, estimates of the native food fishery, estimates of sport catch, by-catch and commercial catch, etc. where applicable (Marshall 1988). Canadian scientists estimate that only about 50% of the salmon entering the St. John River reach the Mactaquac Dam, which is located 1.5 miles above the head-of-tide. Adult returns from hatchery smolts released at Mactaquac, therefore, are calculated. On the Penobscot River, adult returns are enumerated at the Veazie Dam and added to the actual known rod kill of Atlantic salmon below the dam.

Despite a strong case for the non-comparability of these two programs, the graph on the following page attempts to compare adult returns of MSW salmon to each river system from hatchery-reared smolts released in the same years. These data reveal that large salmon returned to each river at similar rates, and, in fact, in recent years the return rate for Penobscot smolts exceeded that for St. John River smolts. If the Penobscot River rate of return is adjusted for non-reporting of sport catches, mortality of rod caught and released fish, fish passage inefficiency, the Penobscot River smolts generally survived at a higher rate.

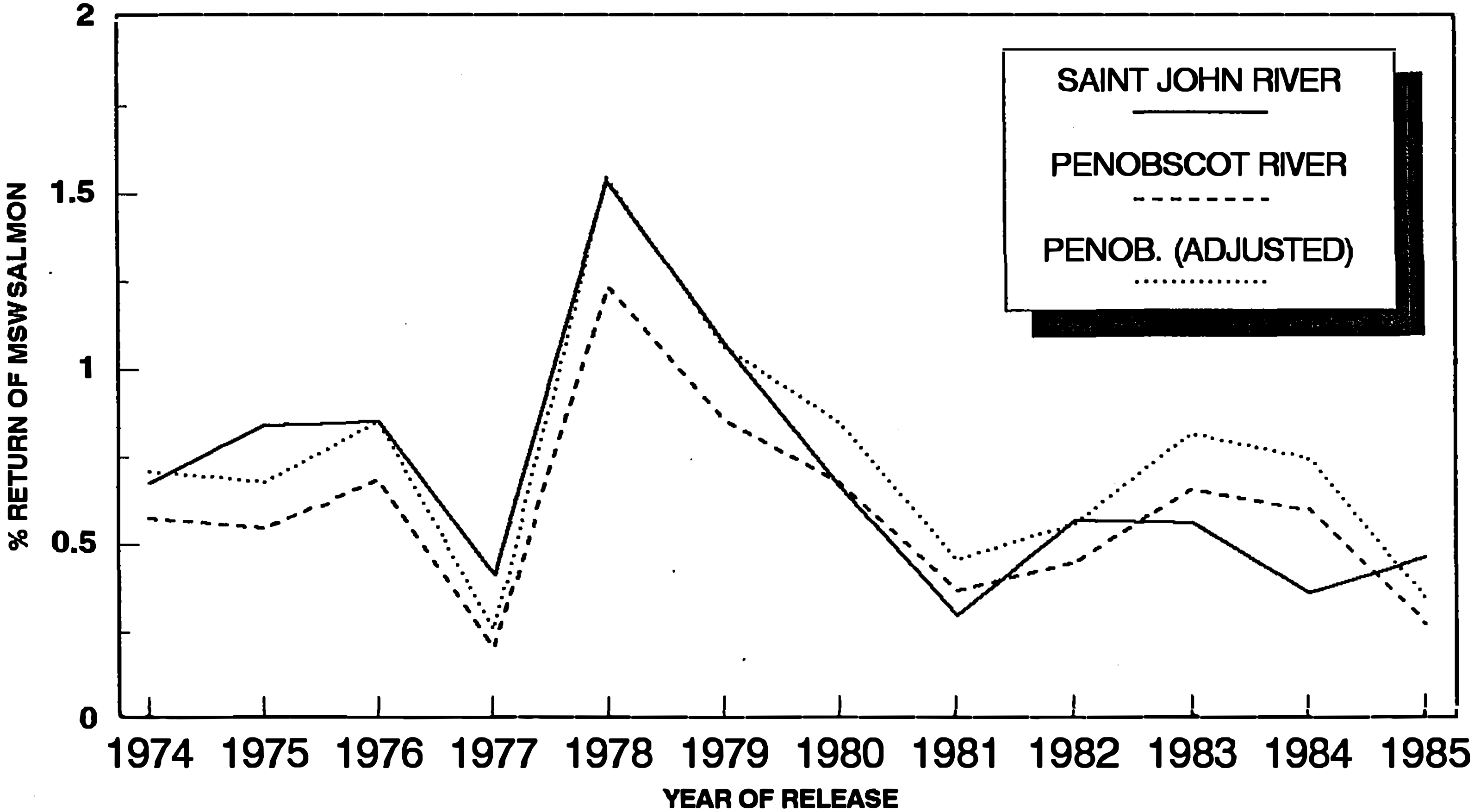
Hatchery reared smolts released in the St. John River in Canada during the period 1974-1985 had similar performance to hatchery smolts released in the Penobscot River in the U.SA, when performance is defined as homewater returns of MSW salmon. Considering that all St. John hatchery smolts are stocked below all hydroelectric dams and most Penobscot smolts are stocked above a minimum of 3 hydroelectric dams, survival of U.S.FWS hatchery-reared smolts stocked in Maine was superior to similar smolts released in Canada.

3.5 Water Resource Use Impacts

Comparison of survival of tag lots in the Penobscot River

Carlin and CWT tagged smolts have been stocked into the Penobscot River to assess the survival of cohorts stocked above a varying number of hydroelectric dams. Returns to date from Carlin tagged smolts stocked in 1986 and 1987 have been inconclusive (Table 9). Returns from CWT groups and stocked in 1986 and 1987 (Table 10) are significantly higher for the groups stocked at Eddington (Chi-square test, $P < 0.001$). CWT tagged smolts continue to survive at a higher rate than those fitted with Carlin tags, even after Carlin tag returns are adjusted for previously documented tag loss of 27%.

FIGURE 5. % RETURN OF MSW SALMON TO THE SAINT JOHN AND PENOBSCOT RIVERS, 1974-1985.



ST. JOHN RIVER DATA FROM MARSHALL (1988)

These are preliminary data from 2 years of a continuing study, which will be analyzed and presented when completed.

Table 9. **Adult Returns From 1986 and 1987 Carlin Tagged Penobscot River Smolt Releases.**

Mark/Tag Color	Hat. Age	No. Rel.	Site (No. dams)	Adult Returns (Distant)	1SW	MSW	Total (ADJ)	(% Home)
Carlin-G	GL1	25K	Milf (3)	(31)	12	57	69 (95)	(0.38)
Carlin-G	GL1	25K	GW (2)	(58)	11	80	91 (125)	(0.50)
Carlin-G	GL1	25K	Vz (1)	(50)	10	59	69 (95)	(0.38)
Carlin-G	GL1	25K	Edd (0)	(62)	14	79	93 (127)	(0.51)
Carlin-B	GL1	25K	Milf (3)	(20)	13	30	43 (59)	(0.24)
Carlin-G	GL1	25K	GW (2)	(32)	8	29	37 (51)	(0.20)
Carlin-B	GL1	25K	Vz (1)	(41)	6	48	54 (74)	(0.30)
Carlin-G	GL1	25K	Edd (0)	(30)	14	50	64 (88)	(0.35)

Table 10. **Adult Returns From 1986 and 1987 CWT Penobscot River Smolt Releases.**

Mark/Tag Color	Hat. Age	No. Rel.	Site (No. dams)	Adult Returns (Distant)	1SW	MSW	Total (ADJ)	(% Home)
CWT+A	GL1	25.8	Edd (0)	(26)	48	152	200	(0.78)
CWT+A	GL1	75.7	Pis (4)	(60)	106	335	441	(0.58)
CWT+A	GL1	25.2K	Edd (0)	(17)	37	169	206	(0.82)
CWT+A	GL1	75.6K	Pis (4)	(38)	69	304	373	(0.49)

Note: Approx. miles above Bangor dam:

Eddington	2.2	above 0 dams
Above Veazie	10.4	above 1 dam
Above Great Works	12.2	above 2 dams
Costigan	17.7	above 3 dams
Greenbush	22.6	above 3 dams
Piscataquis	35.8	above 4 dams
Piscataquis/Medford	42.5	above 4 dams

4 Research

4.1 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.

Stocking

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.

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 rates of parr percosity in hatchery and wild populations. (1990)

Adult Returns

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.

7. Refine estimates of spawning escapement and exploitation rates using redd count techniques. (1988) No new information.

8. Evaluate adult return rate records for Canadian hatchery programs similar to U.S. programs and compare data. (1988) Addressed 1990 meeting, to be dropped from list next year.

9. 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) Pending result of proposed research in wild run salmon river in Maine.

10. Determine rates of mortality of rod caught and released salmon. (1990)

Water Resource Use Impacts

11. Review In-river movement of smolts relative to water temperature, flows, and water use (i.e. diversions). (1988) No new information, the committee is aware of ongoing research.

12. Develop methodology to analyze snowpack and meteorological data to predict subsequent river flow for the purpose of planning smolt releases. (1988) No new information, and will be deleted from future consideration.

Predation

13. Analyze trends in striped bass populations relative to salmon returns trends. (1988) No new information.

14. Conduct a 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.

15. Analyze trends in population size and food habits of harbor seals in New England. (1988) No new information.

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

17. Analyze trends in population size and food habits of cormorants. (1988) No new information.

Marine Factors

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.

Habitat

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.

4.2 <u>New Research Proposals</u>

The Committee reviewed two research proposals and offered comments on their relevance and implementation.

The first proposal is a multi-disciplinary study of the production of the wild run salmon rivers in Washington County, Maine. The study consists of three components. Component one is an enumeration of the adult run to the river by means of a counting fence and redd count surveys. Adult return would be sampled and tagged before release for observation on the spawning grounds. Additionally, the application of video technology for adult run enumeration would be investigated. Component two consisted of analysis, calibration and verification of juvenile salmon assessment methods (specifically electro-shocking surveys) as a means to estimate juvenile and smolt production. Component three would include a revision of rearing habitat estimates and a number of habitat investigations, such as pH monitoring and water and contaminant chemistry.

The committee expressed concern over enumeration of smolt production on a yearly basis. The proposal as stands considers implementation of mark-recapture scheme to quantify out-migrant smolts that was modeled after studies in other river systems. Owing to the relatively small size of the salmon run in the Narraguagus River and the associated statistical properties of the smolt estimate, it would appear a significant proportion of the run would have to be handled in order to make the estimate. This was a risk the investigators were highly concerned about. The investigators wanted to investigate alternate estimation procedures before implementing a mark-recapture program.

The committee discussed the labile nature of some colored streamer tags in shallow water environments. Tag color scheme used in distant observation identification should be planned accordingly.

The second proposal was a description of a general framework to discern the effect of smoltification versus time of release on return rate. Without manipulation of smoltification in a hatchery, the onset of smoltification process for all releases tends to be in synchrony. Thus, if groups are at differing times they are also released at differing stages of smoltification. Under this regime smoltification is a confounding variable to time of release. Other salmon programs have approached the problem differently. Groups within the hatchery are artificially brought to smoltification at different rates so that when released at differing times to test time of release, all fish are at peak of smoltification. It was proposed future tests of release strategy be sensitive to this potential complication.

The point was made that under existing conditions, programs could not stock all fish during the optimal release period. It was felt some stockings could be adversely affected by this practice. To some degree this could be ameliorated by adjusting stocking location to decrease the migration time from the river.

It was suggested that U.S. programs initiate time-of-release tests using photoperiod modification in the hatchery so that the different test groups of fish smoltify at different times. Therefore, all fish are at the peak of migration at time of release.

There was considerable discussion of the concept of smolt training both in terms of smolt exercise and predator avoidance. The committee identified the need to develop a research strategy to evaluate the potential benefit, if any, of a training program.

5 HISTORICAL DATA (1980 - 1988)

5.1 STOCKING

As shown in table 1 nearly 27 million juvenile Atlantic salmon were released into New England rivers during the nine-year period.

TABLE 11. ATLANTIC SALMON STOCKING SUMMARY FOR NEW ENGLAND BY PROGRAM.[1]

PROGRAM	NUMBER OF FISH						TOTAL
YEAR	FRY	0+PARR	1PARR	1+PARR	1SMOLT	2SMOLT	
1980							
Maine	0	0	0	0	399900	282000	681900
Merrimack River	126000	0	0	0	2300	30100	158400
Pawcatuck River	0	1000	0	0	0	0	1000
Connecticut River	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 River	57000	0	0	0	2600	97400	157000
Pawcatuck River	0	2000	108000	0	800	0	110800
Connecticut River	168000	182000	1900	3600	5300	73300	434100
TOTAL	477000	184000	180600	3600	33400	404100	1282000
1982							
Maine	349000	118900	256500	0	135000	259700	1119100
Merrimack River	50000	57600	0	124200	0	67300	298900
Pawcatuck River	2000	1000	0	0	0	0	3000
Connecticut River	292000	9400	25100	9600	28100	180800	545000
TOTAL	693000	186900	281600	133800	163100	507800	1966000
1983							
Maine	20000	20300	57400	0	368000	170300	636000
Merrimack River	8000	5000	0	20000	47000	61600	141600
Pawcatuck River	0	700	0	0	0	0	700
Connecticut Riv r	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 River	519000	0	5300	24000	24000	44100	616400
Pawcatuck River	0	23000	0	0	0	0	23000
Connecticut River	625000	150200	241200	0	312300	0	1328700
TOTAL	1278000	207600	269000	24000	994000	181300	2953900

TABLE 11. CONTINUED.

PROGRAM / YEAR	FRY	0+PARR	1PARR	1+PARR	1SMOLT	2SMOLT	TOTAL
1985							
Maine	472000	105900	61700	0	663200	108700	1411500
Merrimack River	148000	0	0	5800	62500	111000	327300
Pawcatuck River	8000	51000	1400	0	0	0	60400
Connecticut River	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 River	524000	0	31500	0	40100	64100	659700
Pawcatuck River	0	50700	15000	0	0	0	65700
Connecticut River	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 River	1078000	0	111700	0	141100	0	1330800
Pawcatuck River	3000	46200	4700	0	1000	0	54900
Connecticut River	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 River	1718000	0	129300	0	90500	0	1937800
Pawcatuck River	150000	59600	7100	0	5400	0	222100
Connecticut River	1310000	72200	75200	0	395300	0	1852700
TOTAL	4036000	995500	314400	0	1342100	87100	6775100
GRAND TOTAL	12613000	2785300	2647200	187600	6485300	2221100	26939500

1 The number of fry released has been rounded to the nearest 1000 fish. All other releases rounded to the nearest 100 fish.

The bulk of the salmon releases have been contributed by the fry stocking efforts (slightly less than 50%) with the age 1 smolt releases at around 25%. Within the four major programs 43% of the releases have occurred in Maine (11,655,400 fish), 34% in the Connecticut River (9,094,600 fish), 21% in the Merrimack River (5,627,900 fish), and the remaining 2% in the Pawcatuck River (561,600 fish).

5.2 ADULT RETURNS

During the nine year period 33,486 adult salmon have returned to 16 rivers in New England (Table 2 and Figure 1). The majority (80%) of the returns have been contributed by the Penobscot River.

Table 12 KNOWN ATLANTIC SALMON RETURNS (TRAP AND/OR ROD) TO NEW ENGLAND RIVERS FROM 1980 THROUGH 1988 (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				TOTAL
		1-S-W	2-S-W	3-S-W	REPEAT	1-S-W	2-S-W	3-S-W	REPEAT	
Penobscot River										
1980		652	2570	2	38	0	18	2	0	3282
1981		888	2454	12	24	3	18	2	0	3401
1982		155	3886	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	1992	6	51	14	64	0	10	2853
		=====	=====	=====	=====	=====	=====	=====	=====	=====
	TOTAL	4356	20959	101	257	118	1009	17	39	26856
Union River										
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	47	0	0	0	0	0	0	47
		=====	=====	=====	=====	=====	=====	=====	=====	=====
	TOTAL	139	980	4	11	0	4	0	0	1138
Narraguagus River										
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		3	13	0	0	0	69	0	5	90
1984		0	10	0	0	0	57	0	1	68
1985		0	0	0	0	0	57	0	0	57
1986		0	20	0	0	2	23	0	0	45
1987		0	12	0	0	0	23	0	2	37
1988		0	12	0	0	0	24	0	1	37
		=====	=====	=====	=====	=====	=====	=====	=====	=====
	TOTAL	4	98	0	2	2	471	0	24	601
Pleasant River										
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		-	-	-	-	-	-	-	-	-
		=====	=====	=====	=====	=====	=====	=====	=====	=====
	TOTAL	4	12	0	0	6	137	0	2	161

TABLE 12 CONTINUED.

STREAM SYSTEM / YEAR	HATCHERY ORIGIN				WILD ORIGIN				TOTAL
	1-S-W	2-S-W	3-S-W	REPEAT	1-S-W	2-S-W	3-S-W	REPEAT	
Machias River									
1980	0	9	0	0	0	46	0	23	78
1981	0	18	0	0	0	29	0	6	58
1982	0	0	2	0	2	48	0	4	56
1983	0	0	0	0	0	17	0	0	17
1984	0	12	0	0	3	13	0	5	33
1985	0	4	0	0	0	20	0	8	32
1986	4	13	0	0	0	26	0	3	46
1987	0	0	0	0	0	4	0	0	4
1988	0	0	0	0	0	6	0	2	8
TOTAL	4	56	2	0	5	209	0	51	327
East Machias River									
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
TOTAL	5	139	0	0	9	166	1	5	325
Dennys River									
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
TOTAL	9	222	0	0	13	248	3	0	495
St. Croix River									
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
TOTAL	451	679	38	3	303	468	39	1	1982

TABLE 12 CONTINUED.

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
Kennebec River									
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	4	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
TOTAL	4	72	3	1	0	2	0	0	86
Androscoggin River									
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	91
1987	2	20	3	0	0	1	0	0	26
1988	2	11	0	0	1	0	0	0	14
TOTAL	10	216	5	0	1	21	0	1	254
Sheepscot River									
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
TOTAL	3	7	0	0	9	106	2	0	127
Duck Trap River									
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
TOTAL	0	0	0	0	3	27	0	0	30

TABLE 12 CONTINUED.

STREAM SYSTEM / YEAR	HATCHERY ORIGIN				WILD ORIGIN				TOTAL
	1-S-W	2-S-W	3-S-W	REPEAT	1-S-W	2-S-W	3-S-W	REPEAT	
Saco River									
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
	=====	=====	=====	=====	=====	=====	=====	=====	=====
TOTAL	7	165	2	0	0	1	0	0	175
Merrimack River									
1980	-	-	-	-	-	-	-	-	-
1981	-	-	-	-	-	-	-	-	-
1982	4	13	0	0	3	3	0	0	23
1983	6	55	5	0	1	41	6	0	114
1984	57	26	1	0	20	9	3	0	116
1985	7	113	1	0	6	85	2	0	214
1986	20	46	4	0	4	29	0	0	103
1987	8	94	4	0	2	25	6	0	139
1988	5	15	2	0	5	37	1	0	65
	=====	=====	=====	=====	=====	=====	=====	=====	=====
TOTAL	107	362	17	0	41	229	18	0	774
Pawcatuck River									
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
	=====	=====	=====	=====	=====	=====	=====	=====	=====
TOTAL	1	108	1	0	0	0	0	0	110
Connecticut River									
1980	-	-	-	-	-	-	-	-	175
1981	-	-	-	-	-	-	-	-	529
1982	-	-	-	-	-	-	-	-	70
1983	-	-	-	-	-	-	-	-	39
1984	-	-	-	-	-	-	-	-	92
1985	-	-	-	-	-	-	-	-	310
1986	-	-	-	-	-	-	-	-	318
1987	-	-	-	-	-	-	-	-	353
1988	-	-	-	-	-	-	-	-	95
	=====	=====	=====	=====	=====	=====	=====	=====	=====
TOTAL									1981

6 Proposed Terms of Reference for 1991 Meeting

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

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

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

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

6.5 Review tagging statistical methodology for evaluation of stocking groups.

7 Participants

Vaughn Anthony	Nat. Marine Fisheries Service	Woods Hole, MA
Larry Bandolin	U.S. Fish & Wildlife Service	Sunderland, MA
Ed Baum	Maine Atlantic Sea-Run Sal. Comm.	Bangor, ME
Ken Beland	Maine Atlantic Sea-Run Sal. Comm.	Bangor, ME
Kevin Friedland	Nat. Marine Fisheries Service	Woods Hole, MA
Steve Gephard	CT DEP/Marine Fisheries	Waterford, CT
Mark Gibson	RI Div. of Fish & Wildlife	W. Kingston, RI
Jerry Marancik	U.S. Fish & Wildlife Service	E. Orland, ME
Ted Meyers	U.S. Fish & Wildlife Service	Turners Falls, MA
Larry Stolte	U.S. Fish & Wildlife Service	Concord, NH
Richard Seamans	Nat Marine Fisheries Service	Gloucester, MA

8 Papers Submitted

Bandolin, L. Atlantic Salmon Data Base Life Stage Definitions.

Bandolin, L. Atlantic Salmon Data Base Adult Returns Table.

Baum, E.T. 1989 Adult Atlantic Salmon Returns to New England Rivers.

Baum, E.T. 1989 Sport Harvest of Atlantic Salmon in Maine.

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Baum, E.T. Trends in Grilse/Salmon Ratios in the Penobscot River, 1970-1989.

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9 References

Marshall, T. L. 1988. Assessment of Atlantic salmon of the St. John River, N.B., 1987. CAFSAC res. Doc. 88/58.

Gibson, M.R. 1987. Atlantic salmon restoration studies. Rhode Division of Fish and Wildlife. Performance Report. Project Report. Project Number F-26-RIII-4. 10p.

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10 Appendix

10.1 Tables and forms of the OASIS database.

Data type and definitions contained in the Stocking Table of the "OASIS" database.

StkTrip# = stocking trip number assigned by hatchery
uniques number to each row

StkDate = date of delivery eg. 05/05/89

LifeStge = life stage according to established definitions
fry, 1PARR, 1SMOLT, OpPARR
The designation for O+Parr = OpPARR because RBAase
has trouble with numerical signs

#Stocked = number stocked

TagType = Primary tag: CWT, Carlin, Finclip

T#orCode = Code or series of Carlin and/or CWT

Clip = Finclip eg. RV, LV, adipose

LotYear = Lot year according to standard lot code definitions

Strain = Strain according to standard lot code definitions

Hatchery = Production hatchery

LotType = Lot type from FWS standard lot code

lbsfish = Pounds of fish stocked on each trip

#perlb = Number of fish per pound

sitecd = Unique code for each stocking location as
designated in site table

sitetemp = Water temperature at time of stocking

Delivery = Driver or agency delivering the fish

10.1 (continued)

Data type and definitions contained in the Site Table of the OASIS database.

State = State (or Province) in which fish are stocked

Sitecd = Unique code for each stocking location - used in stocking table

Stockloc = Stocking site or range of stocking points

Drainage = Primary drainage, e.g. Penobscot River

Subdrain = Subdrainage; secondary drainage, e.g. Piscataquis River

Trib = Tertiary drainage, e.g. Pleasant

Township = Township of stocking location

Rivmiles = Number of miles from stocking location to estuary

RivmilesT = Number of miles to confluence with next higher order drainage.

****

Program form used to enter data on OASIS stocking Database

ATLANTIC SALMON STOCKING TRIP RECORD

HATCHERY TRIP NUMBERDATE:

STOCKING LOCATION

SITE CODE: DRAINAGE:

SITE NAME: SUB-DRAINAGE:

TOWNSHIP: TRIBUTARY:

RELEASE SITE WATER TEMPERATURE: CENTIGRADE

LOAD DATA

LOT YEAR:
STRAIN:POUNDS OF FISH:
LOT TYPE:NO.FISH PER LB:
LIFESTAGE:(LBS X #/LB)=
TAG OR MARK TYPE:NO.FISH STOCKED
TAG NUMBERS OR CWT CODE:
FIN CLIP:

10.1 (continued)

Data type and definitions contained in the Adult Returns table of the OASIS database.

Column Name	Column Description
ReturnNo	Unique ID number assigned to each adult salmon (text 9)
Drainage	River of capture (text 4)
Markobs	Finclip observed at capture (text 3)
Metcap	Method of capture (fishway trap, angler catch) (text 1)
Tagobs	Tab number of observed tag (text 12)
Type	Tag type (Carlin, CWT, Floy, etc.) (text 12)
Origin	Origin of returning adult (text 2)
Rivrage	Freshwater age in years (text 6)
Sea-age	Ocean age in years (text 15)
Disposi	Disposition of salmon (text 8)

Appendix 10.2

U. S. ATLANTIC SALMON ASSESSMENT COMMITTEE MEETING
JANUARY 29 - FEBRUARY 2, 1990
WOODS HOLE, MASSACHUSETTS

Terms of Reference

1) Program summaries for current year to include:
   a) current year's stocking program with breakdowns by time, location, marks and life stage.
   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 - Provide information to the committee regarding historical stocking, marking and adult return data which is suitable to be incorporated into computerized historical database.

4) Water Resource Use Impacts - Provide information regarding effects of hydro-dams, pumped storage, and pollution discharge on juvenile and adult salmon survival.

5) Marine Factors - Present information regarding marine environmental factors which affect salmon survival and returns.

6) Predation - Provide information regarding freshwater, estuarine and marine predation on Atlantic salmon.

7) Habitat Issues - Review the designation and evaluation of Atlantic salmon habitat throughout New England as it affects salmon restoration, and consider potential for habitat restoration and enhancement.

8) Research Needs - Compile research needs to include those which have already been identified but not completed and new initiatives.