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An Update on the Status of Salmonid Resources in the Morell, Valleyfield, Dunk, West, and Mill Rivers - Prince Edward Island

by

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ABSTRACT

An update of the status of the Morell River Atlantic salmon resource and the Atlantic salmon and brook trout populations of the Mill, Dunk, and Valleyfield Rivers is presented. Current return rates of Atlantic salmon to the Morell River indicate that there is no surplus in the wild (both small & large salmon) and hatchery return large salmon component of the run. However, a surplus of hatchery return small salmon continues to be realised.

Atlantic salmon enhancement efforts have expanded from the Morell and Mill Rivers to include the Valleyfield, West, and Dunk Rivers but none of these rivers are currently meeting targeted spawning requirements.

It is recommended that, until wild populations reach a level that exceed minimum spawning requirements, harvest of salmon from Prince Edward Island (P.E.I.) rivers be restricted to adipose clipped (hatchery) small salmon. Research into the levels of wild salmon production on the Morell River and the establishment of target levels for trout populations in P.E.I. rivers are also recommended.

RESUME

On fait ici le point sur l'état de la population de saumon de l'Atlantique de la rivière Morell et des populations de saumon de l'Atlantique et d'omble de fontaine des rivières Mill, Dunk et Valleyfield. Les taux actuels de remontées de saumon de l'Atlantique dans la Morell révèlent qu'il n'y a pas de surplus parmi les remontées de saumons sauvages (grands et petits) et les remontées de grands saumons d'écloserie. Toutefois, les remontées de petits saumons d'écloserie restent excédentaires.

Les activités de mise en valeur du saumon de l'Atlantique entreprises dans la Morell et la Mill ont été étendues aux rivières Valleyfield, West et Dunk, mais les besoins de géniteurs ciblés n'ont été atteints dans aucune de ces rivières.

On recommande de limiter la récolte du saumon dans les rivières de l'Île-du-Prince-Édouard aux petits saumons à nageoire adipeuse entaillée (saumons d'écloserie), cela jusqu'à ce que les populations de saumon sauvage atteignent un niveau supérieur aux besoins minimaux en géniteurs. On préconise aussi d'étudier les niveaux de production de saumon sauvage dans la Morell et d'établir des niveaux-cibles en ce qui concerne les population de truite des rivières de l'Î.-P.-É.

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Introduction

By the early 1800's salmon had been extirpated from many P.E.I. streams (Dunfield, 1985). Commercial landings for all rivers flowing into St. Peter's Bay averaged only 200-600 fish annually thereafter (Table 1). The salmon population on the Morell River had been reduced to the point where angling catches averaged only 16 fish per year in the 1960's and 3 fish per year in the 1970's (Table 2).

In the early to mid-1980's an effort to restore the Atlantic salmon populations of Prince Edward Island rivers was begun (Bielak et al., 1991). Through the combined efforts of the Federal and Provincial governments, and volunteer groups Atlantic salmon enhancement programmes were initiated on the Morell and Mill Rivers. These programmes included habitat improvement, selective breeding of early run salmon, and the development of the semi-natural pond rearing of Atlantic salmon smolts. Semi-natural rearing ponds were constructed at Profitt's Pond and Mooney's Pond and operated by the O'Leary Wildlife Federation and the Morell River Coop in collaboration with the Department of Fisheries and Oceans.

The completion of the second semi-natural rearing pond, Mooney's Pond, combined with facility upgrades and refinement in fish culture practices at the Cardigan Salmonid Enhancement Centre (SEC) resulted in an expansion of Atlantic salmon enhancement efforts to the Valleyfield, West, and Dunk Rivers. The initiation of a joint federal/provincial Watershed Improvement/Recreation Fisheries Development Programme has provided resources for the expansion of Atlantic salmon and brook trout enhancement in Prince Edward Island Rivers.

The following gives an update on the status of the Atlantic salmon resource in the Morell River and status of stocking efforts and stock monitoring on the West, Dunk, Mill, and Valleyfield Rivers.

The Morell River

The Morell River is historically and currently the most important Atlantic salmon river in Prince Edward Island. The Morell River system (Figure 1) discharges into St. Peter's Bay and has a drainage basin of 171 km^2. The salmon population on the Morell had been reduced to the point where angling catches averaged only 16 fish per year in the 1960's and 3 fish per year in the 1970's (Table 2).

Habitat improvement coupled with the introduction of smolt stocking in 1985 resulted in the largest salmon run in decades in 1986. Salmon returns to the Leard's Pond continued to climb, peaking in 1988 at 1481 salmon and have fluctuated between 366 and 953 salmon since (Table 4, Figure 2).

Angling catch increased from 47 small (<63 cm forklength) salmon in 1985 to 781 small salmon in 1992 with a corresponding increase in fishing effort of 1100% (Table 2). Reliable estimates of both catch and effort are not available for 1993.

Recreational harvest of salmon from the Morell River is limited to small salmon only. The angling season is from June 15 - October 31 and is restricted to flyfishing only. The river is closed to angling for a period in May each year to prevent fishing mortality of smolts migrating downstream.

Morell River Spawning Requirements

Ducharme (1977) performed a habitat survey of the Morell River system and estimated that there were 2007 rearing units of salmon habitat (1 unit=100 m^2), 42% of which (843 units) are above the fish counting facility at Leard's Pond (Figure 1). Recent habitat improvement activities have resulted in the re-creation of salmon habitat in the river but, when the decrease in river width due to the removal of obstructions and channelization are considered, the overall change in available salmon habitat may be minimal. In any event, until a new survey of the river's habitat is completed (currently ongoing), the use of Ducharme's (1977) estimate will be used.

Assuming a requirement of 240 eggs per rearing unit, the total egg requirement for the Morell River is:

240 eggs/rearing unit x 2007 rearing units = 481,600 eggs

Assuming all eggs are to come from large (>63 cm forklength) female salmon only, the required number of spawners for the Morell river is:

Number of eggs required = 481,600
Mean fecundity = 4963 eggs/female (Table 5)
Mean % female = 69.0 (Table 6)

$$\text{Number of females required} = \frac{481{,}600}{4{,}963} = 97$$

$$\text{Total number of large salmon required} = \frac{100 \times \#\text{ females required}}{\%\text{ female}} = \frac{100 \times 97}{69.0} = 141$$

Number of large salmon males = 141-97 = 44
Male deficit (# of male small salmon required to achieve a one male to one female sex ratio) = 97-44 = 53

$$\text{Total number of small salmon required} = \frac{100 \times \#\text{ of males required}}{\%\text{ males (Table 6)}} = \frac{100 \times 53}{80.8} = 66$$

Spawning requirement = 141 large salmon & 66 small salmon

Spawning requirement for the portion of the river above
Leard's Pond fishway (42% of total requirements) = 59 large salmon and 28 small salmon.

Additional Requirements

In addition to natural spawning requirements, there is a requirement for 117 large salmon and 54 small salmon broodstock (400,000 eggs) for the Cardigan (SEC) for support of salmon enhancement programmes on the Morell and other P.E.I. rivers. These fish are collected from the trap at Leard's Pond Fishway.

Current Status

Returns of both hatchery and wild large salmon salmon to the Leard's Pond fishway (Table 4) have not met the spawning requirements for the portion of the river above Leard's Pond (59 large salmon & 28 small salmon - see above) since 1990 and fell well short of meeting both spawning requirements and SEC broodstock requirements (ie. a total of 176 large salmon & 82 small salmon).

The number of wild salmon and small salmon returns have shown limited increase despite large numbers of spawners (predominatly small salmon) being available to spawn. Based on the average sex ratios and fecundities of Morell small salmon (Tables 5 & 6) and the number of fish released above Leard's Pond (Table 7), annual egg depositions of 169,000 to 497,000 could have been realised in that portion of the Morell River above Leard's Pond during the 1986 to 1993 period (Table 7, Figure 3). The first returns from these spawnings were realized in 1990 when the number of returning wild small salmon increased to 44 from 12 in 1989 (1981-1989 mean = 4; Table 4). A corresponding increase was observed for large salmon salmon in 1991. The 1988 peak in total returns resulted in a corresponding peak in wild returns in 1992 of 64 small salmon. These numbers of wild returns from such high potential egg depositions are disappointing and indicate that the wild production in this stretch of the river (ie. above Leard's Pond) is low and can not currently support an appreciable harvest of any sort; at least not if the goals of establishing a healthy, self-sustaining wild population and the provision of wild broodstock for enhancement of other P.E.I. rivers are to be realized. Research into the causes for this low level of wild production and the level of wild production below Leard's Pond is warranted.

The Morell's hatchery return small salmon population continues to exceed spawning requirements confirming that it can be "artificially" maintained at levels which support current recreational and other potential harvests. Stocking rates in 1993 were lower than expected due to unforeseen problems at Mooney's Pond. Nevertheless, over 19,000 smolts were stocked into the Morell and, given a return rate of 3.5%, approximately 700 adipose clipped small salmon could return to the Morell in 1994.

The Mill, Valleyfield, Dunk, and West Rivers

This group of rivers, along with the Morell, were targeted through the P.E.I Salmon Zonal Management Committee as being the most desirable for Atlantic salmon enhancement. With an increase in parr and smolt production at the Cardigan SEC and the semi-natural rearing ponds increased, stocking activities on these systems has expanded (Table 8).

Atlantic salmon returns to the West and Valleyfield Rivers were up considerably from levels recorded since 1986 (Table 9). Salmon returns to the Mill River are down 90% from levels recorded in 1990. Trout counts on the Mill River have shown a corresponding drop. No appreciable returns of salmon are expected on the Dunk River until 1994. Atlantic salmon spawning requirements (Table 10) were not met in any of these rivers in 1993 and wild production is very limited.

Brook trout numbers on these systems, although down considerably on the Mill River, are high compared to most mainland Maritime populations. In the absence of targeted requirements for brook trout on these systems, it is difficult to make any meaningful assessment of the the status of these populations.

Recommendations

In summary we suggest the following:

a) that the 1992 management recommendation for the Morell River (Davidson and Bielak, 1992) be expanded to the West, Dunk, Mill, and Valleyfield Rivers - ie. - until wild populations reach a level that exceed minimum spawning requirements, harvest of salmon be restricted to adipose clipped (hatchery) small salmon.

b) that the level of wild salmon production in the Morell River be investigated

c) that target levels for brook trout in P.E.I. rivers be established

References

Bielak, A.T, R.W. Gray, T.G. Lutzac, M.J. Hambrook and P. Cameron (1991). Atlantic salmon restoration in the Morell River, P.E.I. and the Nepisiguit, N.B., Canada. (122-139): In D. Mills (Editor). Proceedings of a Joint Conference on Strategies for the Rehabilitation of Salmon Rivers, London 1990. Published by The Atlantic Salmon Trust, The Institute of Fisheries Management and the Linnean Society of London. 210p.

Davidson, K.G. and A.T. Bielak. 1992. An update on the biological characteristics and status of Atlantic salmon in the Morell River, Prince Edward Island. CAFSAC Res. Doc. 92/40: 11p.

Ducharme, L.J. (1977). Atlantic salmon enhancement in the Morell River, Prince Edward Island, Fisheries and Marine Service (Maritimes Region). Technical Report Series: MAR/T-77-2. 19p.

Dunfield, R.W. (1985). The Atlantic Salmon in the history of North America. Canadian Special Publications in Fisheries and Aquatic Sciences. 80:181p.

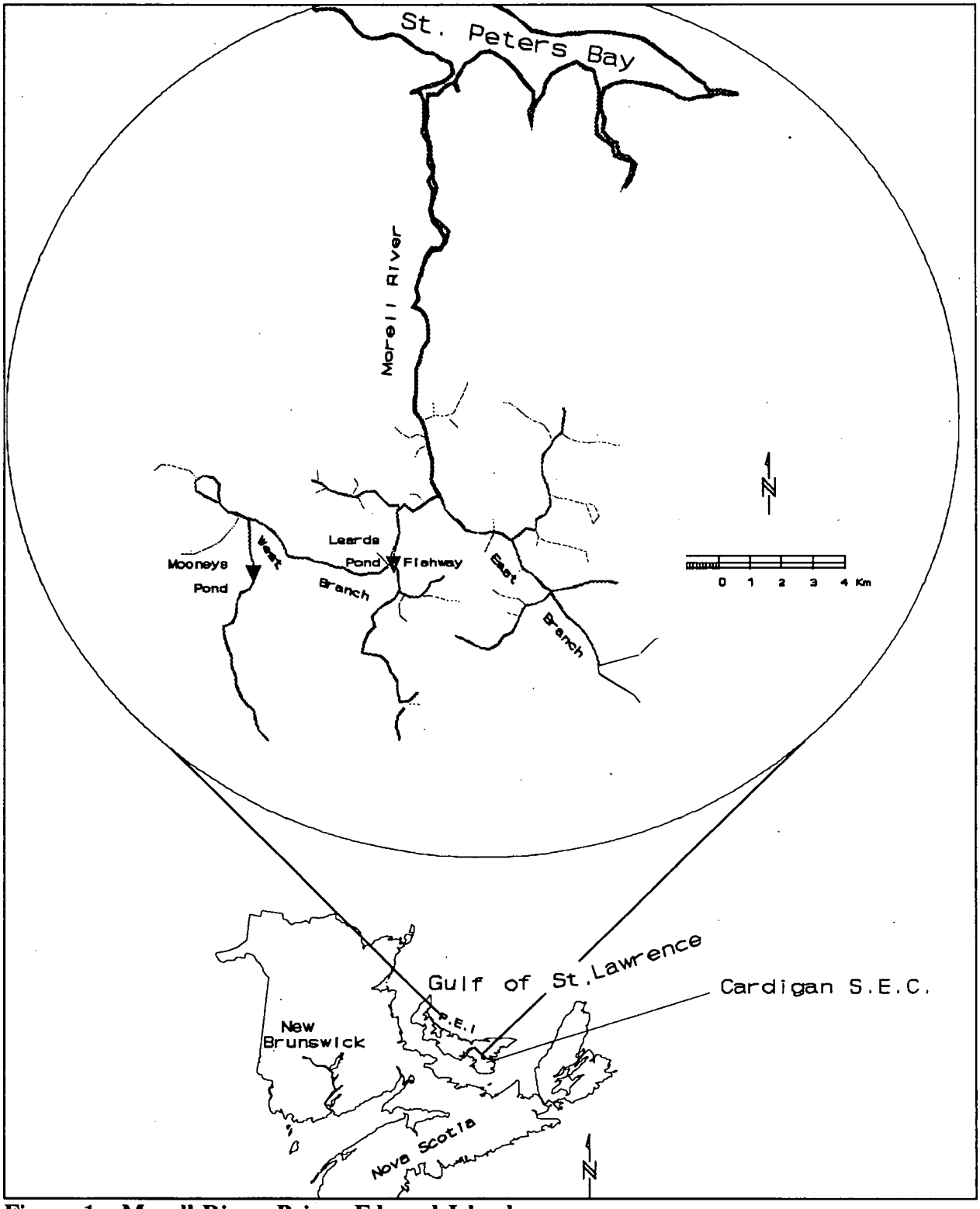

Figure 1 - Morell River, Prince Edward Island

Figure 2: Returns to the Leard's Pond fishway on the Morell River
Prince Edward Island - 1981-1993

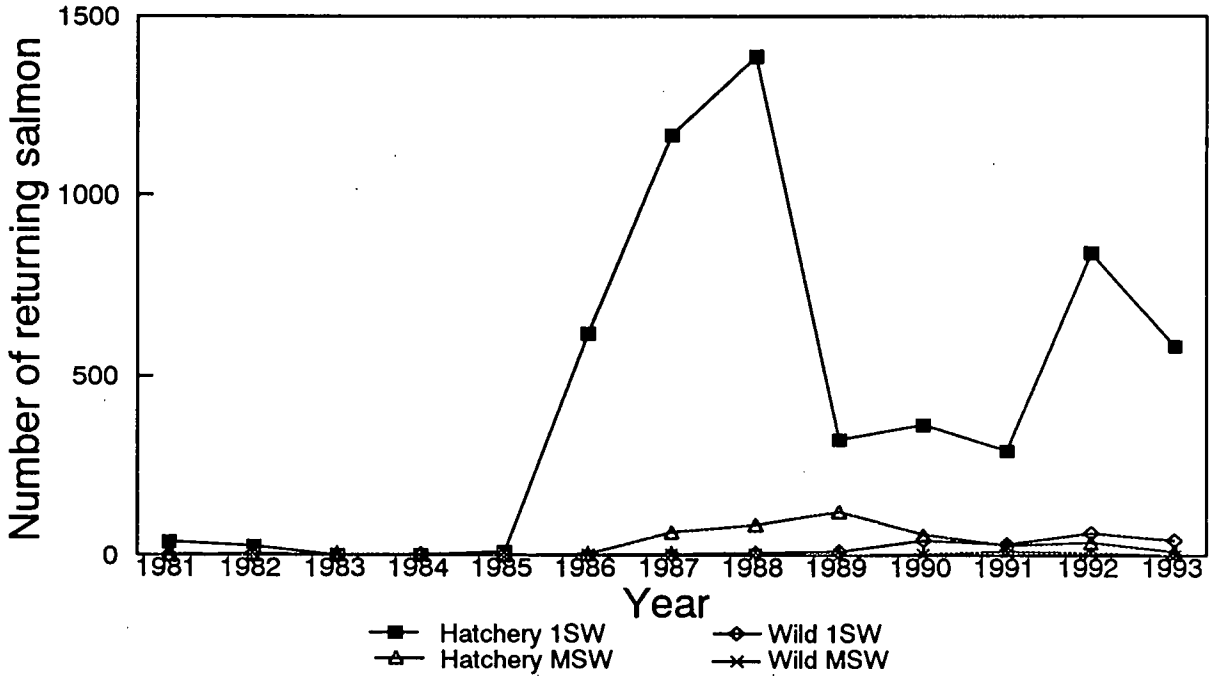

Figure 3: Potential egg deposition for female salmon and grilse released
above Leard's Pond - 1981-1993

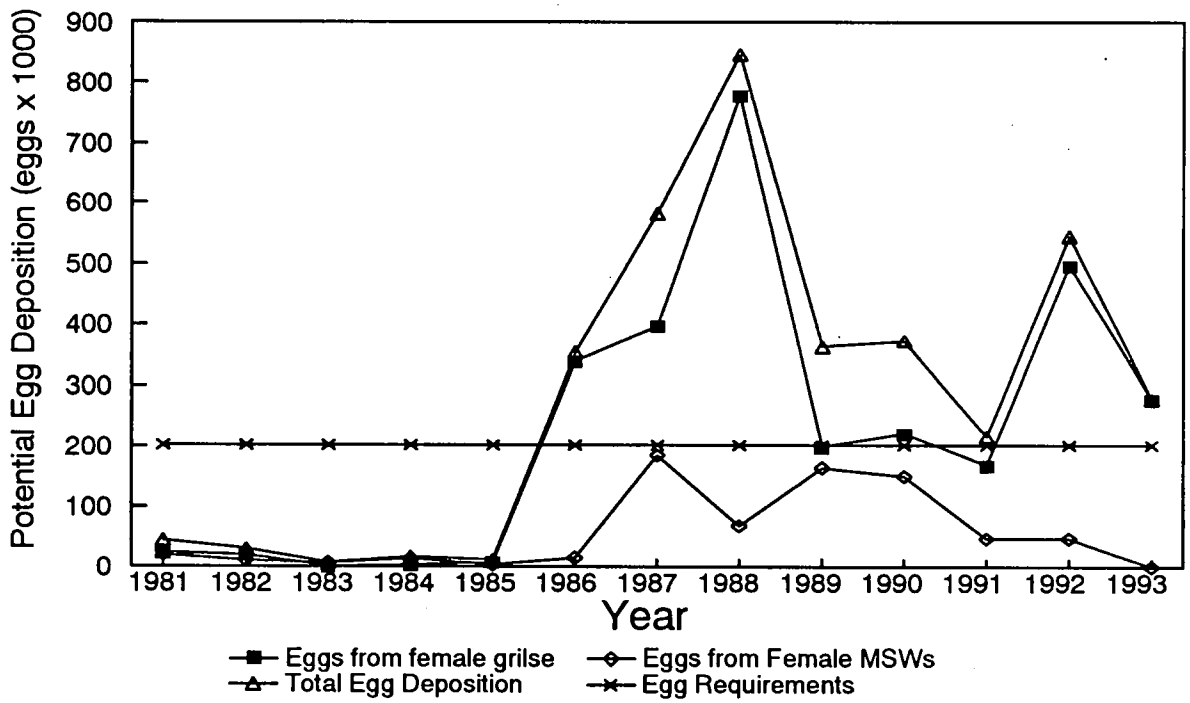

TABLE 1: SOME HISTORICAL LANDINGS FOR COMMERCIALLY CAUGHT ATLANTIC SALMON IN ST. PETER's BAY, PRINCE EDWARD ISLAND

	LANDINGS	
YEAR	WEIGHT (KG)	NO. OF FISH[1]
1879	909	252
1883	1536	427
1888	710	197
1890	2136	593
1893	727	202
Averages	1244	334

1 Numbers based on average weight of 3.6 kg/fish

TABLE 2: SUMMARY OF SPORT CATCHES, MORELL RIVER, P.E.I. (1955-1993)

	ANGLING RECORD[1]			
YEAR	Small Salmon	Large Salmon	TOTAL	EFFORT (Rod-Days)
1955			21	18
1956			29	87
1957			3	52
1958			9	52
1959			4	34
1960			4	44
1961			15	45
1962			13	50
1963			51	280
1964			12	46
1965			12	115
1966			10	N/A
1967			26	206
1968			10	192
1969			12	214
1970	0	13	13	204
1971	0	0	0	83
1972	0	7	7	138
1973	2	0	2	168
1974	0	2	2	78
1975	0	0	0	0
1976	6	1	7	250
1977	0	0	0	105
1978	0	0	0	60
1979	1	2	3	54
1980	5	1	6	119
1981	108	4	112	914
1982	73	8	81	2088
1983	7	2	9	686
1984	7	0	7	675
1985	47	N/A[2]	47	1007
1986	236	N/A	236	2725
1987	476	N/A	476	N/A
1988	643	N/A	643	4994
1989	167	N/A	167	4506
1990	768	N/A	768	9000
1991	657	N/A	657	11,552
1992	781	N/A	781	11,700
1993	N/A	N/A	N/A	N/A

1 - Does not include fish hooked and released

2 - Introduction of mandatory hook and release for large salmon salmon

Note: 1955-1990 are from Bielak et al. (1991) and are based on estimates provided by DFO Fisheries Officers. 1991&1992 numbers were collected by the Morell River Coop via a mail-out angler survey.

TABLE 3: DISTRIBUTION OF JUVENILE ATLANTIC SALMON IN THE MORELL RIVER, P.E.I. - (1978 - 1991).

Year of Release	Genetic Stock	Rearing Location	Juvenile Stage at Release: Parr 0+	Parr 2+	Smolt 1+	Smolt 2+	Total Number Released	
1978	N.W. Miramichi	Cardigan SEC	14,943				14,943	
1979	N.W. Miramichi	Cardigan SEC	23,012				23,012	
	Restigouche		9,681				9,681	
1981	N.W. Miramichi	Cardigan SEC				691	691	
1982	Miramichi (EM)[1]	Cardigan SEC	34,764			3,645	38,409	
1983	Miramichi (EM)	Cardigan SEC	9,000				9,000	
1985	Miramichi Mixed[2]	Cardigan SEC				10,428	21,425	
		Profitt's Pond				10,997		
1986	N.W. Miramichi(EM)	Cardigan SEC				1,529	14,058	
		Profitt's Pond				12,529		
1987	N.W. Miramichi(EM)	Cardigan SEC				3,055	23,305	
		Profitt's Pond				22,250		
1988	Miramichi Mixed	Cardigan SEC			5,907		20,097	
		Profitt's Pond		1,208		12,982		
1989	Morell (HR) (small salmon)[3]	Profitt's Pond			1,560		20,650	22,210
1990	Morell Mixed (HR)	Mooney's Pond		398		48,475	59,810	
		Profitt's Pond		681		10,256		
1991	Morell Mixed (HR)	Mooney's Pond		2,051		35,745	37,796	
1992	Morell Mixed (HR)	Mooney's Pond		2,349		41.422	43,771	
1992[4]	Morell Mixed (HR)	Mooney's Pond		1,225			1,225	
1993	Morell Mixed (HR)	Cardigan SEC			19,379		19,379	

1 EM = Early migrating stock
2 MIXED = Both early and late migrating stock were taken for transfer because of the small number of eggs available
3 HR = Progeny from previous hatchery stocking in the Morell River
4 released in the fall due to a fish die-off in Mooney's Pond

TABLE 4: SALMON RETURNS TO THE LEARD's POND FISHWAY, MORELL RIVER: 1981-1993

	TOTAL		SMALL SALMON				LARGE SALMON			
Year	N(wild)	% Wild	Total Small Salmon	Wild Small Salmon	% Small Salmon	% Wild	Total Large Salmon	Wild Large Salmon	% Large Salmon	% Wild
1981	45(6)	13.3	39	0	87	0	6	6	13	100
1982	36(7)	19.4	33	6	92	18.2	3	1	8	33.3
1983	4(1)	25	2	1	50	50	2	0	50	0
1984	9(5)	55.6	5	3	56	60	4	2	44	50
1985	15(3)	20	14	2	93	14.3	1	1	7	100
1986	626(3)	<1	620	1	99	<1	6	2	1	33.3
1987	1236(4)	<1	1168	2	96	<1	68	2	5	3.0
1988	1481(10)	<1	1394	8	94	<1	89	2	6	2.3
1989	460(12)	2.6	335	12	73	3.6	125	0	27	0
1990	472(48)	10.2	409	44	87	10.8	63	4	13	6.3
1991	366(44)	12.0	327	33	89	10.1	39	11	11	28.2
1992	953(72)	7.6	907	64	95	7.6	46	8	5	21
1993	639(44)	6.9	628	44	98	7.5	11	0	2	0
Average	432(13)	<14.6	395	10	83	15.4	37	3	17	32.4

TABLE 5: MEAN LENGTHS, WEIGHTS, AND FECUNDITIES FOR FEMALE SALMON SAMPLED FROM THE MORELL RIVER, P.E.I. - 1989

Age	Mean Length in cm. (N)	Mean Weight in kg (N)	Mean Fecundity (N)
Small salmon	56.1 (68)	1.51 (17)	3143 (68)
Large salmon	73.8 (24)	4.08 (24)	4963 (24)

TABLE 6: SEX RATIOS FOR LARGE AND SMALL SALMON SAMPLED FROM THE LEARD'S POND FISHWAY DURING 1986 - 1990.

	SMALL SALMON				LARGE SALMON			
	MALES		FEMALES		MALES		FEMALES	
YEAR	N	%	N	%	N	%	N	%
1986	520	84.8	93	15.2	N/A	—	N/A	—
1987	471	82.3	101	17.7	5	12.8	34	87.2
1988	547	76.0	173	24.0	11	37.9	18	62.1
1989	196	87.5	28	12.5	15	37.5	25	62.5
1990	131	72.8	49	27.2	29	37.7	48	62.3
TOTAL	1865	80.8	444	19.2	45	31.0	100	69.0

TABLE 7: TOTAL RETURNS, NUMBERS RELEASED ABOVE LEARD'S POND, AND POTENTIAL EGG DEPOSITION IN THE MORELL RIVER ABOVE LEARD'S POND FROM FEMALE SMALL AND LARGE SALMON: 1981-1993

Year	Total Returns		Total Released Above Leard's Pond		Egg Deposition Above Leard's Pond		
	Small Salmon	Large Salmon	Small Salmon	Large Salmon	Small Salmon	Large Salmon	Total
1981	39	6	39	6	23,535	20,546	44,081
1982	33	3	33	3	19,914	19,914	30,187
1983	2	2	2	2	1,206	6,849	8,055
1984	5	4	5	4	3,017	13,698	16,715
1985	14	1	14	1	8,448	3,424	11,872
1986	620	6	278[2]	3[3]	339,444	14,889	354,333
1987	1168	68	658	54	397,074	184,921	581,995
1988	1394	89	1290	20	778,458	68,489	846,947
1989	335	125	330	48	199,140	164,374	363,514
1990	409	63	368	44	222,071	150,677	372,748
1991	327	39	280	14	168,968	47,942	216,910
1992	907	46	824	14	497,248	47,942	545,190
1993	628	11	461	0	278,193	0	278,193

1 - based on sex ratios and average fecundities presented in Tables 5 & 6
2 - 108 females
3 - all females

TABLE 8: A SUMMARY OF THE DISTRIBUTIONS OF JUVENILE ATLANTIC SALMON TO THE WEST, DUNK, MILL, AND VALLEYFIELD RIVERS. 1985-1993

				Numbers Stocked by Location			
Year	Rearing Location	Stage Stocked	Date Stocked	West River	Dunk River	Mill River	Valleyfield River
1985	Cardigan SEC	2+ smolt	June 6	0	0	1,609	0
	Profitt's Pond	2+ smolt	May 21-30	0	0	733	0
1986	Profitt's Pond	2+ parr	May 15-28	0	0	580	0
		2+ smolt	" "	0	0	2,417	0
1987	Profitt's Pond	2+ parr	May 6-19	0	0	595	0
		2+ smolt	" "	0	0	2,555	0
1988	Cardigan SEC	1+ smolt	May 23	1,390	0	0	0
	Profitt's Pond	2+ parr	May12-13	0	0	349	0
		2+ smolt	" "	0	0	3,079	
1989	Cardigan SEC	1+ parr	May 8-12	0	0	0	2,491
		1+ smolt	" "	0	0	0	6,299
		2+ smolt	May 15	1,324	0	0	0
	Profitt's Pond	2+ parr	May 12-16	0	0	74	0
		2+ smolt	" "	0	0	2,991	0
1990	Cardigan SEC	0+ parr	Nov. 16-Dec. 10	0	0	0	89,003
		1+ smolt	May 27-30	0	0	0	738
	Profitt's Pond	2+ parr	May 4-8	0	0	25	0
		2+ smolt	" "	0	0	3,082	0
1991	Cardigan SEC	0+ parr	Nov. 13-15	0	0	0	55,723
		0+ parr	Nov. 20-23	50,750	0	0	0
		1+ smolt	May 7-June 5	0	0	0	5,259
	Profitt's Pond	2+ parr	May 6-10	0	0	159	0
		2+ smolt	" "	0	717	1,873	0
	Mooney's Pond	2+ smolt	May 10-11	0	1,300	0	0
1992	Cardigan SEC	0+ parr	Nov. 12	0	0	0	32,494
		2+ smolt	May 13-16	0	0	0	1,693
	Profitt's Pond	2+ parr	May 4-5	0	0	169	0
		2+ smolt	" "	1,260	0	3,657	0
	Mooneys' Pond	1+ parr	Sept. 21-Oct. 1	0	0	0	10,014
			Sept. 28-29	10,173	0	0	0
		2+ smolt	May 13-16	0	0	0	10,307
			May 11-20	10,221	0	0	0
1993	Cardigan SEC	0+ parr	Oct. 13	0	0	0	14,467
		1+ parr	June 16-23	0	0	0	28,898
		1+ parr	May 28-June 22	0	17,225	0	0
	Profitt's Pond	2+ parr	May 3-4	0	0	200	0
		2+ smolt	" "	0	5,325	2,772	0

TABLE 9: COUNTS OF ATLANTIC SALMON AND SPECKLED TROUT OBTAINED FROM THE SCALE'S POND FISHWAY ON THE DUNK RIVER, AND COUNTING FENCE FACILITIES ON THE WEST, MILL, AND VALLEYFIELD RIVERS. 1986-1993

		West River		Dunk River		Mill River		Valleyfield River	
Year		Trout	Salmon	Trout	Salmon	Trout	Salmon	Trout	Salmon
1986	upstream							723	0
	downstream							—	—
1987	upstream			937				—	—
	downstream			—				—	—
1988	upstream			1,507				—	—
	downstream			—				—	—
1989	upstream	—	31 small salmon 19 large salmon	4,189				1,220	0
	downstream	—	—	—				—	—
1990	upstream	3,935	25 small salmon 23 large salmon	—		2,594	176	2,173	36 small salmon
	downstream	2,986	—	—		—	—	—	—
1991	upstream	—	—	1,733		4,221	—	1,565	5 small salmon
	downstream	—	—	—		—	—	—	—
1992	upstream	—	—	1,132		—	—	741	25 small salmon
	downstream	—	—	—		—	—	—	—
1993	upstream	2,151	250 small salmon* 12 large salmon	1,295	0	219	22	1,027	84 small salmon
	downstream	1,006	10 adults 66 parr	—	—	—	—	—	—

* - 248 hatchery return, 2 wild. All large salmon were hatchery return.

TABLE 10: CALCULATED SPAWNING REQUIREMENTS FOR THE MORELL, VALLEYFIELD, MILL, DUNK, AND WEST RIVERS - PRINCE EDWARD ISLAND

River	Drainage Basin (km^2)	Habitat Available (rearing units*)	Spawning Requirements**
Morell River	171	2,007	141 large salmon & 66 small salmon
" " above Leard's Pond		843	59 large salmon & 28 small salmon
Valleyfield River	94	1,275	90 large salmon & 42 small salmon
West River	239	3,286***	231 large salmon & 108 small salmon
Dunk River	218	2,703***	190 large salmon & 89 small salmon
Mill River	137	1,699***	119 large salmon & 56 small salmon

* - 1 rearing unit = 100 m^2

** - based on the biological characteristics of the Morell River salmon

*** - based on the average number of rearing units/km^2 for the Morell and Valleyfield Rivers (12.4 rearing units/km^2) times the total area of the drainage basin - eg. habitat available for the West River = 12.4 X 239 = 3,286