EVALUATING SPAWNING REQUIREMENTS, RETURNS, ESCAPEMENTS AND SURPLUSES TO CONSERVATION LEVELS OF ATLANTIC SALMON FOR SELECTED GULF NOVA SCOTIA RIVERS

by

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ABSTRACT

The status of the Atlantic salmon resources from four rivers in Gulf Nova Scotia was described relative to spawning requirements, returns and escapements in recent years, and estimates of surpluses to spawning requirements between 1986 and 1990. The rivers reviewed, East River (Pictou Co.), Afton River, Pomquet River, and Margaree River, all have fall runs of salmon which are composed of predominantly MSW fish. Current knowledge of habitat rearing areas, stock characteristics and stock status vary from river to river, with the most complete information available for the Margaree River. Between 1986 and 1990, returns exceeded spawning requirements in all the rivers.

RESUME

L'état des stocks de saumon de l'Atlantique de quatre rivières de la Nouvelle-Ecosse du Golfe du Saint-Laurent a été évalué par rapport aux géniteurs requis, retours de géniteurs et échappements. Des estimés de retours en surplus du nombre de géniteurs requis pour les années 1986 à 1990 ont été présentés. Les trois rivières qui ont fait l'objet de cette étude, notamment la rivière East (comté de Pictou), les rivières Afton et Pomquet et la rivière Margaree, partagent des caractéristiques communes dont une remontée d'adultes à l'automne qui consiste en grande majorité de saumons pluribermarins. Le niveau des connaissances par rapport à la quantité d'habitat disponible à l'élevage de juvéniles, les caractéristiques biologiques des stocks et l'état des stocks varie selon la rivière. Ces connaissances sont plus complètes pour le stock de la rivière Margaree. Entre 1986 et 1990, les retours de saumon de l'Atlantique ont été supérieurs aux cibles de géniteurs requis pour les trois rivières.

INTRODUCTION

This document describes the present status of the Atlantic salmon stocks in four Gulf Nova Scotia rivers on which Native food fisheries may be prosecuted. The four rivers (East River (Pictou Co.), Pomquet and Afton Rivers, and Margaree River) have the following characteristics in common:

1 - Fall runs with the majority of salmon entering in September and October (the Margaree River also has a summer component but it is much smaller than the fall component).
2 - Run components are predominantly multi-sea-winter salmon (MSW) with a smaller but variable grilse component.
3 - Salmon in these rivers have not in recent years been actively exploited by Native peoples for food.

Each river was treated separately, addressing the following items:

1 - description of river including units of fluvial rearing habitat,
2 - description of biological characteristics of the stock,
3 - estimation of spawning requirements under the following assumptions:
    a) 2.4 eggs per m^2 of fluvial rearing habitat,
    b) all eggs to come from MSW salmon,
    c) 1SW (salmon < 63 cm fork length) requirement to assure 1:1 sex ratio on the spawning ground,
4 - recent harvests,
5 - estimation of recent river returns and escapements,
6 - estimation of surplus to spawning requirements by 1SW and MSW groups.

EAST RIVER (PICTOU)

Geographic Location

The East River (Pictou) is located along the southern Northumberland Strait shore and flows into Pictou Harbour at 45°39'N by 62°41'W (Fig. 1). It is the most easterly of the three rivers flowing into Pictou Harbour and is the most productive in terms of Atlantic salmon angling catch. The East River was not directly surveyed for the quantity of rearing habitat. The units (1 unit = 100 m^2) of rearing habitat were calculated as follows (Anon. 1978):

$$\text{Rearing Units (East River)} = \text{Drainage Area (East River)} \times \frac{\text{Rearing Area of Surveyed River}}{\text{Drainage Area of Surveyed River}}$$

where Surveyed River was River Philip, NS.

$$\text{Rearing Units} = 500 \text{ km sq.} \times \frac{9{,}620 \text{ units}}{650 \text{ km sq.}}$$

$$= 7{,}550 \text{ units.}$$

Biological Characteristics

Biological characteristics of the East River stock were obtained from samples collected by logbook anglers and from broodstock seining conducted for the years 1983 to 1990 (Table 1). Over 75% of MSW

salmon smolted at age 2 in contrast to grilse which had 36% age 2 smolts (Table 1). Salmon enter East River in late fall as shown by the timing of the angling catches which peak in the latter half of October (Fig. 2).

Spawning Requirements

The spawning requirements for East River were estimated at 281 MSW and 59 1SW salmon (< 63 cm fork length) (Table 2).

Harvests in Recent Years

Commercial harvest of Atlantic salmon from Districts 11 & 12 (Northumberland Strait) within Gulf NS Zone 6 (Fig. 1) are presented in Table 3. Since 1985, the commercial Atlantic salmon fishery has been closed in Zone 6.

Angling catch from East River since 1977 is summarized in Table 4. Hook and release of all MSW salmon (≥ 63 cm) has been mandatory since 1984. The maximum number of 1SW angled (includes kept and released 1SW) was 129, in 1988. The largest hook and release estimate was 661, recorded in 1989 (Table 4). Since 1984, MSW hook/release values were obtained from Nova Scotia angler license stub returns. These may overestimate MSW harvest relative to historical kill values by as much as 6 times (Claytor and O'Neil 1991). Catch per unit effort estimated from the license stub returns was similar to that obtained from volunteer angling logbooks in 1989, but logbook anglers reported a higher CPUE in 1990.

	1989		1990	
	License	Logbook	License	Logbook
Roddays	1705	195	1394	110
1SW (K & R)	86	5	108	14
MSW	661	66	299	39
CPUE				
1SW	0.050	0.026	0.077	0.127
MSW	0.388	0.338	0.214	0.355

1SW (K & R) is comprised of kept and released 1SW

A native food fishery took place during 1990 in Pictou Harbour where about 500 kg of salmon were caught (pers. comm., DFO Conservation and Protection Branch, Pictou NS).

Estimates of Returns in Recent Years

Returns in recent years were calculated using the license stub estimates of angling catch (Claytor and O'Neil 1990) and exploitation rates derived for the fall fishery in Margaree River (Chaput and Jones 1991). The average returns to East River between 1986 and 1990 were calculated as follows:

1. Angling catch for a given year was adjusted down by a bias factor selected at random from a uniform distribution ranging between 1.3 to 2.2 for 1SW and 2.3 to 5.6 for MSW (Claytor and O'Neil 1990).
2. Exploitation rate for a given year (1986 to 1990) was selected from a uniform distribution ranging between 0.13 to 0.39 for 1SW and 0.09 to 0.27 for MSW (Chaput and Jones 1991).
3. Returns to the river were calculated using adjusted angling catch divided by exploitation rate.

4. Escapement to the river was calculated for 1SW by subtracting angling catch from returns. Escapement of MSW salmon was calculated using estimated returns minus 5% mortality from hook and release (using adjusted angling catch).

5. Averages were calculated for adjusted angling catch, returns and escapement for 1986 to 1990.

6. Overall average returns and 95% confidence intervals (± 2 std. dev.) were estimated from 100 simulations of steps 1 to 5 above.

For the period 1986 to 1990, the average return of 1SW to East River was 218 whereas average escapement was 161 (Table 5). MSW returns averaged 673 fish, with escapement averaging 667 fish (Table 5).

Estimates of Surplus to Spawning Requirements

Estimates of surplus to spawning requirements were obtained by subtracting the spawning requirements for East River from the average return (step 5 above). An overall estimate of surplus to spawning requirements was obtained by averaging over 100 simulations as in Step 6 above. Between 1986 and 1990, surplus to spawning requirements averaged 159 1SW (95% C.I. = 84 to 234) and 392 MSW (95% C.I. = 67 to 717) (Table 5).

POMQUET RIVER, AFTON RIVER (District 13)

Geographic Location

Pomquet River and Afton River flow into St. George's Bay, NS, at 45°37'N by 61°48'W and 45°38'N by 61°44'W, respectively (Fig. 1). They are comparatively small rivers. The Pomquet River has an estimated drainage area of 147 km^2 whereas the Afton River has a drainage area of less than 50 km^2. Other St. George's Bay rivers in close proximity for which data on the salmon stocks are available include: South River, at 45°37'N by 61°55'W; and West River (Antigonish Co.), at 45°38'N by 61°58'W (Fig. 1). Habitat surveys have not been conducted for the Pomquet, Afton nor West Rivers, however, the South River has been surveyed. The South River has a drainage area of 200 km^2 and 950 units of rearing habitat (4.75 units/km^2). Based on the South River data, the Pomquet River (147 km^2 drainage area) has an estimated 700 units, the Afton River (50 km^2) has 238 units and the West River (325 km^2) has 1544 units of rearing habitat.

Biological Characteristics

Biological characteristics of the Afton and Pomquet River stocks are unknown but are probably most similar to those of the South River stock (Table 6). Over 60% of MSW salmon smolted at age 2 in contrast to 1SW which had 43% age 2 smolts (Table 6). Salmon enter South River in late fall, as determined by counting fence monitoring, and the same migration timing is assumed for the Afton and Pomquet Rivers. The salmon from West River also enter in late fall, as indicated by the timing of the angling fishery (Fig. 3).

Spawning Requirements

Biological characteristics used in the calculation of spawning requirements were borrowed from South R. stock characteristics (Table 6). The spawning requirements for the Pomquet River and Afton Rivers combined are estimated at 70 MSW salmon (Table 7). Spawning requirements for the South River (Table 8)

and the West River (Table 9) are estimated to be 70 MSW and 114 MSW salmon, respectively.

Harvests in Recent Years

The commercial harvest of Atlantic salmon from District 13 (St. George's Bay) is presented in Table 3. The commercial fishery in St. George's Bay normally took place during June through August whereas Atlantic salmon enter the rivers in St. George's Bay in late fall. The District 13 commercial catch in 1983 was estimated to have been comprised of approx. 80% non-local origin (Claytor et al. 1987). Since 1985, the commercial Atlantic salmon fishery has been closed.

Angling catch from Pomquet River (Table 10) has been very small and no angling catch has ever been recorded from the Afton River. Maximum angling catch registered from the West River since 1977 was 151 1SW (1990) and 476 MSW salmon (1986) (Table 11). As with the statistics gathered for East River, MSW releases since 1984 may be biased upwards. Catch per unit effort estimated from volunteer angling logbooks from West River for 1989 and 1990 were similar to that from the license returns, suggesting that the bias from license stub returns in recent years may not be as large as previously estimated.

	1989		1990	
	License	Logbook	License	Logbook
Roddays	525	84	699	122
1SW (K & R)	88	14	151	40
MSW	215	40	200	38
CPUE				
1SW	0.168	0.170	0.216	0.328
MSW	0.410	0.476	0.286	0.311

1SW (K & R) comprises kept and released 1SW

Estimates of Returns in Recent Years

Estimates of returns in recent years for the Pomquet and Afton Rivers are based on the returns to the counting fence at South River between 1981 and 1987 and from the angling catch at West River (Antigonish Co.) between 1986 and 1990. Angling catches, adjusted down by bias factors of 1.3 to 2.2 for 1SW and 2.3 to 5.6 for MSW salmon (Claytor and O'Neil 1990), were divided by exploitation rates derived for the fall fishery in the Margaree River (0.09 to 0.27 for MSW salmon and 0.13 to 0.39 for 1SW (Chaput and Jones 1991)).

Returns to the South River fence between 1982 and 1987 ranged between 22 and 150 MSW salmon and averaged 134 MSW and 21 1SW between 1984 and 1986 (Table 12). In spite of numerous and complete washouts in 1987, 34 MSW salmon and 17 1SW were sampled (Table 12). Asuming an optimal smolt production value of 3 per unit of fluvial habitat, South River would be expected to produce 2,850 smolts. Between 1984 and 1987, smolts counted through South River fence ranged from 2,900 to over 6,000 (Table 12).

Returns and escapements to the West River were estimated from angling statistics (as described above for the East River). For the period 1986 to 1990, the average return and escapement of 1SW to the West River have been 201 and 154, respectively (Table 13). MSW return and escapement have averaged 323 and 321, respectively (Table 13).

Estimates of Surplus to Spawning Requirements

Between 1984 and 1987, the escapement to the South River was estimated to have been approximately twice spawning requirements. If the same holds true for the Pomquet and Afton Rivers, this would indicate that 70 MSW salmon were surplus to those rivers. With such a small spawning stock size, there is probably no surplus to conservation. Estimates of surplus to spawning requirements for the West River were obtained by subtracting the spawning requirements for the West River from estimated returns. Overall estimate of surplus was obtained by averaging over 100 simulations as in Step 6 above. Between 1986 and 1990, surplus to spawning requirements for the West River averaged 151 1SW (95% C.I. = 142 to 312) and 199 MSW (95% C.I. = 69 to 387) (Table 13).

MARGAREE RIVER (District 2)

The status of the Margaree River Atlantic salmon stock has been assessed on an annual basis since 1985.

Geographic Location

The Margaree River flows directly into the southeastern portion of the Gulf of St. Lawrence at 46°30'N by 61°10'W (Fig. 1). The Margaree River is the largest river in Gulf NS, with a drainage area of 1,178 sq. km. Habitat surveys conducted during the 60's and 70's gave an estimated rearing area of 27,976 units.

Biological Characteristics

Biological characteristics of the Margaree River salmon stock have not been updated since those presented in the 1970's. Recent biological sampling has indicated that about 80% of MSW salmon were of smolt age-2 whereas 1SW salmon were between 55 and 67% smolt age-3 (Claytor and Jones 1990). In contrast to other rivers in Gulf NS, salmon enter the Margaree River from June through October, with the fall run contributing over 75% to the total returns (Chaput and Jones 1991).

Spawning Requirements

The spawning requirements for Margaree River are estimated at 1,036 MSW and 582 1SW salmon (Table 14).

Harvests in Recent Years

The commercial harvest of Atlantic salmon from Districts 2 & 3 (Gulf Cape Breton Island shore) is summarized in Table 3. The commercial Atlantic salmon fishery has been closed since 1985.

The angling catch from the Margaree River since 1947 is summarized in Table 15. Catch per unit effort values from volunteer angling logbooks from the Margaree River for 1989 and 1990 were similar to those from the license returns; suggesting that the bias from license stub returns in recent years may not be as large as that estimated previously.

	1989		1990	
	License	Logbook	License	Logbook
Roddays	13,234	399	12,977	665
1SW (K & R)	553	20	511	61
MSW	1,549	56	1,213	80
CPUE				
1SW	0.042	0.050	0.039	0.092
MSW	0.117	0.140	0.093	0.120

1SW (K & R) comprises kept and released 1SW

Estimates of Returns in Recent Years

Estimates of returns in recent years for the Margaree River were obtained from angling catches as described for the East River (Pictou). The angling catches were obtained by DFO Conservation and Protection Branch prior to 1987. Since 1987, the angling catches have been estimated with on-site creel surveys. License stub data were not used because summer and fall catch components were not available. Exploitation rates by the summer angling fishery were assumed to range between 0.206 and 0.379.

Between 1986 and 1990, MSW returns to the Margaree River averaged 3,975 while 1SW returns averaged 1,240 fish (Table 16). Eescapements averaged 3,934 MSW and 891 1SW during the same time period (Table 16).

Estimates of Surplus to Spawning Requirements

Estimates of surplus to spawning requirements for the Margaree River were obtained by subtracting the spawning requirements from escapement estimates. An overall estimate of surplus to spawning was obtained by averaging over 100 simulations as in Step 6 above. Between 1986 and 1990, surplus to spawning requirements for the Margaree River averaged 658 1SW (95% C.I. = 457 to 859) and 2409 MSW fish(95% C.I. = 1661 to 4217) (Table 16).

DISCUSSION AND CONCLUSIONS

Description and quantification of habitat type in most of the rivers above has not been done. A major assumption of this analysis is that the ratio of rearing to drainage area is the same for these rivers and for nearby surveyed streams.

Since 1984, the imposition of hook and release regulations has resulted in a significant change in the type of angling data collected. Problems associated with the use of hook and release data with exploitation rates derived for 'kill' data have already been discussed (see Chaput and Jones 1991) and include:

1 - fish not landed and handled to remove hook do not necessarily directly correspond to fish which would have been landed and killed historically,

2 - the possibility of multiple captures of fish as a result of hook and release,

3 - license stub data may not be reliable because such data are difficult to validate.

Logbook data and license stub data have corresponded more closely in 1989 and 1990 than previously reported by Claytor and O'Neil (1990) for the 1987 and 1988 data. This may represent a changed attitude on the part of the angling fraternity and validation of such data remains difficult but essential.

On the basis of the data available, we estimated that all of the Gulf Nova Scotia rivers examined had a surplus to spawning requirements between 1986 and 1990. However, for the smaller rivers such as the Pomquet and the Afton Rivers, the stock size is relatively small (less than 100) and it is undoubtedly wiser not to harvest the small surplus available.

The average surpluses estimated since 1986 occurred over a period when significant changes in management were introduced. The escapements in the early 1980's, which generated the observed surpluses since 1986, may have been below the spawning requirement levels for some rivers and substantially above requirements for others. The idea that escapement at present spawning requirement levels will provide surpluses on a continual basis needs to be examined. More specifically, a stock/recruitment relationship for Atlantic salmon of Gulf Nova Scotia rivers needs to be formulated.

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Table 1. Biological characteristics of the Atlantic salmon East River (Pictou Co.) stock.

	1SW	MSW
% female	5	60
N	43	124
% age 2 smolts	36	76
N	44	100
Mean length (cm)	55.6	79.7
N	45	124
Mean Weight (kg)	1.7	6.1
N	37	59

Table 2. Estimation of Atlantic salmon spawner requirements for the East River (Pictou Co.).

Rearing Units		7,550	units
Optimal Egg Deposition		240	eggs/unit
Total Egg Requirements		1,812,000	
Biological Characteristics			
Fecundity		1,764	eggs/kg
1SW	% female	5	
	mean wt. (kg)	1.7	
MSW	% female	60	
	mean wt. (kg)	6.1	
Eggs per spawner 1SW	= eggs/kg * mean wt(kg) * % female		
	= 1764 * 1.7 * 5%		
	= 150		
Eggs per spawner MSW	= 1764 * 6.1 * 60%		
	= 6,456		
Required number of MSW	= 281 -->>	168	female
		112	male
Deficit males	= 56		
1SW spawners to obtain deficit males	= 56 / 95%		
	= 59		
Spawning Requirements: MSW	281		
1SW	59		

Table 3. Commercial Atlantic salmon landings for Zone 6 (1967-1984) in kg (values from Claytor and Jones 1990).

Year	Northumberland Strait - NS Fisheries Statistical District				Gulf Cape Breton - NS Fisheries Statistical District			Gulf NS Zone 6 total (kg)
	11	12	13	Subtotal	2	3	Subtotal	
1967		10,503	29,885	40,388	10,728	2,124	12,852	53,240
1968	1,175	9,495	14,949	25,619	10,480	2,057	12,537	38,156
1969		9,968	11,050	21,018	7,831	1,598	9,429	30,447
1970		4,605	13,015	17,620	12,760	114	12,874	30,494
1971		1,689	5,597	7,286	4,485	255	4,740	12,026
1972		5,155	18,714	23,869	7,026	996	8,022	31,891
1973		2,562	15,788	18,350	8,043	1,297	9,340	27,690
1974		5,742	17,437	23,179	11,213	3,045	14,258	37,437
1975		2,080	9,824	11,904	10,670	1,057	11,727	23,631
1976		1,606	5,845	7,451	9,954	956	10,910	18,361
1977		4,137	9,171	13,308	11,490	1,423	12,913	26,221
1978		2,940	15,907	18,847	10,691	678	11,369	30,216
1979		169	4,549	4,718	3,117	82	3,199	7,917
1980		2,534	11,932	14,466	9,088	858	9,946	24,412
1981		1,822	8,283	10,105	4,978	479	5,457	15,562
1982		2,805	13,680	16,485	8,704	1,475	10,179	26,664
1983		1,863	9,770	11,633	11,621	1,026	12,647	24,280
1984		1,097	7,850	8,947	5,291	902	6,193	15,140

Table 4. Recreational fishery harvest and effort from the East River (Pictou), 1977 to 1990. Harvest and effort statistics are Redbook series.

Year	1SW			MSW	Effort	CPUE	
	Sept	Oct	Total		Rod-days	1SW	MSW
1977	0	0	0	25	88	0.000	0.284
1978	0	0	0	85	120	0.000	0.708
1979	0	0	0	10	100	0.000	0.100
1980	0	2	2	148	600	0.003	0.247
1981	0	2	2	38	150	0.013	0.253
1982	2	10	12	1	416	0.029	0.002
1983	0	7	7	31	345	0.020	0.090
1984	4	8	14	40	474	0.030	0.084
1985	4	21	40	162	398	0.101	0.407
1986	10	61	89	620	1151	0.077	0.539
1987	3	60	83	389	1286	0.065	0.302
1988			129	422	1300	0.099	0.325
1989			86	661	1705	0.050	0.388
1990			108	299	1394	0.077	0.214

* Total 1SW and MSW include kept and released fish.

Table 5. Estimates of returns, escapements and surplus to spawning requirements of Atlantic salmon for the East River (Pictou Co.), 1986 to 1990.

	Mean	95% C.I.
1SW		
Adjusted Catch	57	49 - 65
Returns	218	143 - 293
Escapement	161	89 - 233
Surplus to Requirements	159	84 - 234
MSW		
Adjusted Catch	121	86 - 156
Returns	673	348 - 998
Escapement	667	345 - 991
Surplus to Requirements	392	67 - 717

Table 6. Biological characteristics of the Atlantic salmon South River stock.

	1SW	MSW
% female	3	50
N	32	221
% age 2 smolts	43	63
N	23	134
Mean length (cm)	54.4	76.7
N	35	224
Mean Weight (kg)	1.3	3.7
N	14	59

Table 7. Estimation of Atlantic salmon spawner requirements for the Pomquet and Afton Rivers. Biological characteristics are those from the South River, NS stock.

Rearing Units			950 units
Optimal Egg Deposition			240 eggs/unit
Total Egg Requirements		228,000	
Biological Characteristics			
Fecundity			1,764 eggs/kg
1SW	% female		3
	mean wt. (kg)		1.3
MSW	% female		50
	mean wt. (kg)		3.7
Eggs per spawner 1SW	=	eggs/kg * mean wt(kg) * % female	
	=	1764 * 1.3 * 5%	
	=	69	
Eggs per spawner MSW	=	1764 * 3.7 * 50%	
	=	3,263	
Required number of MSW	=	70 -->>	35 female
			35 male
Deficit males	=	0	
Spawning Requirements:	MSW	70	
	1SW	0	

Table 8. Estimation of Atlantic salmon spawner requirements for the South River, NS.

Rearing Units				950 units
Optimal Egg Deposition				240 eggs/unit
Total Egg Requirements			228,000	
Biological Characteristics				
Fecundity				1,764 eggs/kg
1SW	% female			3
	mean wt. (kg)			1.3
MSW	% female			50
	mean wt. (kg)			3.7
Eggs per spawner 1SW	=	eggs/kg * mean wt(kg) * % female		
	=	1764 * 1.3 * 5%		
	=	69		
Eggs per spawner MSW	=	1764 * 3.7 * 50%		
	=	3,263		
Required number of MSW	=	70 --->>		35 female
				35 male
Deficit males	=	0		
Spawning Requirements:	MSW	70		
	1SW	0		

Table 9. Estimation of Atlantic salmon spawner requirements for the West River (Antigonish Co.), NS.

Rearing Units				1,544 units
Optimal Egg Deposition				240 eggs/unit
Total Egg Requirements			370,560	
Biological Characteristics				
Fecundity				1,764 eggs/kg
1SW	% female			3
	mean wt. (kg)			1.3
MSW	% female			50
	mean wt. (kg)			3.7
Eggs per spawner 1SW	=	eggs/kg * mean wt(kg) * % female		
	=	1764 * 1.3 * 5%		
	=	69		
Eggs per spawner MSW	=	1764 * 3.7 * 50%		
	=	3,263		
Required number of MSW	=	114 -->>		57 female
				57 male
Deficit males	=	0		
Spawning Requirements:	MSW	114		
	1SW	0		

Table 10. Recreational fishery harvest and effort from the Pomquet River, 1977 to 1990. Harvest and effort statistics are Redbook series.

	1SW					CPUE	
					Effort		
Year	Sept	Oct	Total	MSW	Rod-days	1SW	MSW
1977	-	-	-	-	-	-	-
1978	-	-	-	-	-	-	-
1979	-	-	-	-	-	-	-
1980	-	-	-	-	-	-	-
1981	-	-	-	-	-	-	-
1982	0	2	2	0	2	1.000	0.000
1983	-	-	-	-	-	-	-
1984	0	0	0	0	2	0.000	0.000
1985	0	0	0	0	1	0.000	0.000
1986	0	1	1	2	6	0.167	0.333
1987	0	3	5	3	38	0.132	0.079
1988	-	-	0	0	1	0.000	0.000
1989	-	-	1	0	5	0.200	0.000
1990	-	-	-	-	-	-	-

* Total 1SW and MSW include kept and released fish.

Table 11. Recreational fishery harvest and effort from the West River (Antigonish), 1977 to 1990. Harvest and effort statistics are Redbook series.

	1SW					CPUE	
					Effort		
Year	Sept	Oct	Total	MSW	Rod-days	1SW	MSW
1977	0	1	1	0	2	0.500	0.000
1978	4	0	6	53	298	0.020	0.178
1979	0	0	0	6	35	0.000	0.171
1980	0	37	37	43	300	0.123	0.143
1981	0	2	2	18	89	0.022	0.202
1982	0	5	5	0	140	0.036	0.000
1983	0	4	4	28	46	0.087	0.609
1984	5	10	17	2	107	0.159	0.019
1985	0	25	34	122	225	0.151	0.542
1986	15	71	126	476	524	0.240	0.908
1987	18	40	84	198	741	0.113	0.267
1988			67	126	457	0.147	0.276
1989			88	215	525	0.168	0.410
1990			151	200	699	0.216	0.286

* Total 1SW and MSW include kept and released fish.

Table 12. Atlantic salmon smolts passing downstream (1984-1987) and Atlantic salmon adults returning to the South River counting fence, 1981 to 1987.

Year	Downstream	Upstream		Fence Operation Dates		Fall
	Smolts	1SW	MSW	In	Out	Fence Washouts
1981	-	22	9	22 May	26 Oct.	10-13 Oct.
1982	-	47	63	6 May	29 Nov.	23 Sept.
1983	-	-	-	5 May	7 Aug.	-
1984	2993	25	22	27 April	29 Nov.	-
1985	3157	20	135	2 May	20 Nov.	-
1986	3604	19	245	1 May	19 Nov.	-
1987	6216	17	34	2 May	12 Nov.	numerous

Table 13. Estimates of returns, escapements and surplus to spawning requirements of Atlantic salmon for the West River (Antigonish Co.), 1986 to 1990.

	Mean	95% C.I.
1SW		
Adjusted Catch	47	50 - 68
Returns	201	142 - 312
Escapement	154	87 - 249
Surplus to Requirements	151	142 - 312
MSW		
Adjusted Catch	52	45 - 79
Returns	323	183 - 501
Escapement	321	181 - 497
Surplus to Requirements	199	69 - 387

Table 14. Estimation of Atlantic salmon spawner requirements for the Margaree River.

Rearing Units			27,976 units
Optimal Egg Deposition			240 eggs/unit
Total Egg Requirements		6,714,240	
Biological Characteristics			
Fecundity			1,764 eggs/kg
1SW	% female		11
	mean wt. (kg)		1.7
MSW	% female		75
	mean wt. (kg)		4.9
Eggs per spawner 1SW	=	eggs/kg * mean wt(kg) * % female	
	=	1764 * 1.7 * 11%	
	=	330	
Eggs per spawner MSW	=	1764 * 4.9 * 75%	
	=	6,483	
Required number of MSW	=	1036 -->>	777 female
			259 male
Deficit males	=	518	
1SW spawners to obtain deficit males	=	518 / 89%	
	=	582	
Spawning Requirements: MSW		1,036	
1SW		582	

Table 15. Angling catch of Atlantic salmon by season and size group from the Margaree River, NS, 1947 to 1990. Data for 1947 to 1986 and DFO C & P statistics. Data for 1987 to 1990 are DFO Science creel estimates.

	1SW			MSW Salmon		
Year	Summer	Fall	Total	Summer	Fall	Total
1947	16	20	36	156	207	363
1948	64	42	106	276	428	704
1949	25	16	41	75	257	332
1950	48	63	111	77	243	320
1951	13	8	21	177	247	424
1952	37	46	83	85	119	204
1953	27	22	49	121	170	291
1954	37	31	68	165	133	298
1955	30	23	53	100	158	258
1956	16	12	28	66	24	90
1957	15	21	36	38	98	136
1958						
1959						
1960						
1961	18	11	29	31	18	49
1962	25	21	46	273	137	410
1963	23	64	87	49	163	212
1964	77	43	120	135	154	289
1965	43	43	86	89	165	254
1966	48	44	92	22	143	165
1967	47	51	98	114	151	265
1968	30	34	64	53	145	198
1969	106	108	214	76	63	139
1970	47	38	85	54	161	215
1971	13	8	21	40	54	94
1972	22	20	42	53	52	105
1973	97	69	166	69	48	117
1974	34	26	60	30	77	107
1975	14	22	36	4	60	64
1976	43	53	96	9	73	82
1977	37	32	69	53	87	140
1978	9	16	25	20	138	158
1979	532	65	597	21	60	81
1980	100	67	167	2	138	140
1981	729	170	899	29	110	139
1982	602	89	691	65	114	179
1983	37	31	68	45	104	149
1984	81	67	148	27	94	121
1985	116	107	223	144	168	312
1986	196	99	295	269	414	754
1987	306	97	403	242	561	803
1988	367	222	589	190	178	368
1989	151	57	208	152	311	463
1990	191	61	252	272	1421	1693

Note: 1986 Total MSW catch includes 71 for which season unknown

Table 16. Estimates of returns, escapements and surplus to spawning requirements of Atlantic salmon for the Margaree River.

	Mean	95% C.I.
1SW		
Returns	1240	1039 - 1441
Escapement	891	570 - 972
Surplus to Requirements	658	457 - 859
MSW		
Returns	3975	2697 - 5253
Escapement	3934	2656 - 5212
Surplus to Requirements	2409	1661 - 4217

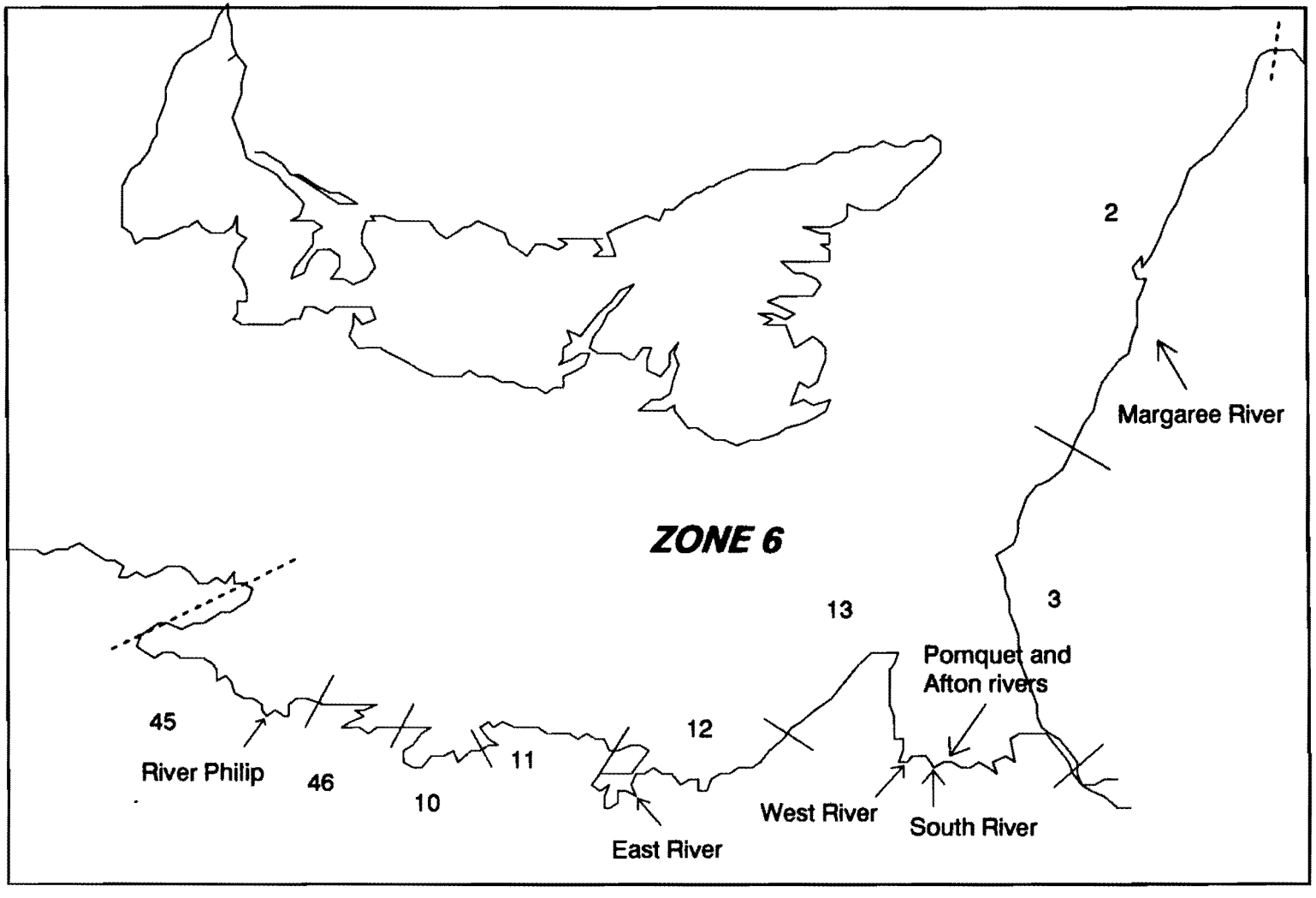

Figure 1. Gulf Nova Scotia coastline indicating Atlantic salmon rivers mentioned in text as well as statistical districts.

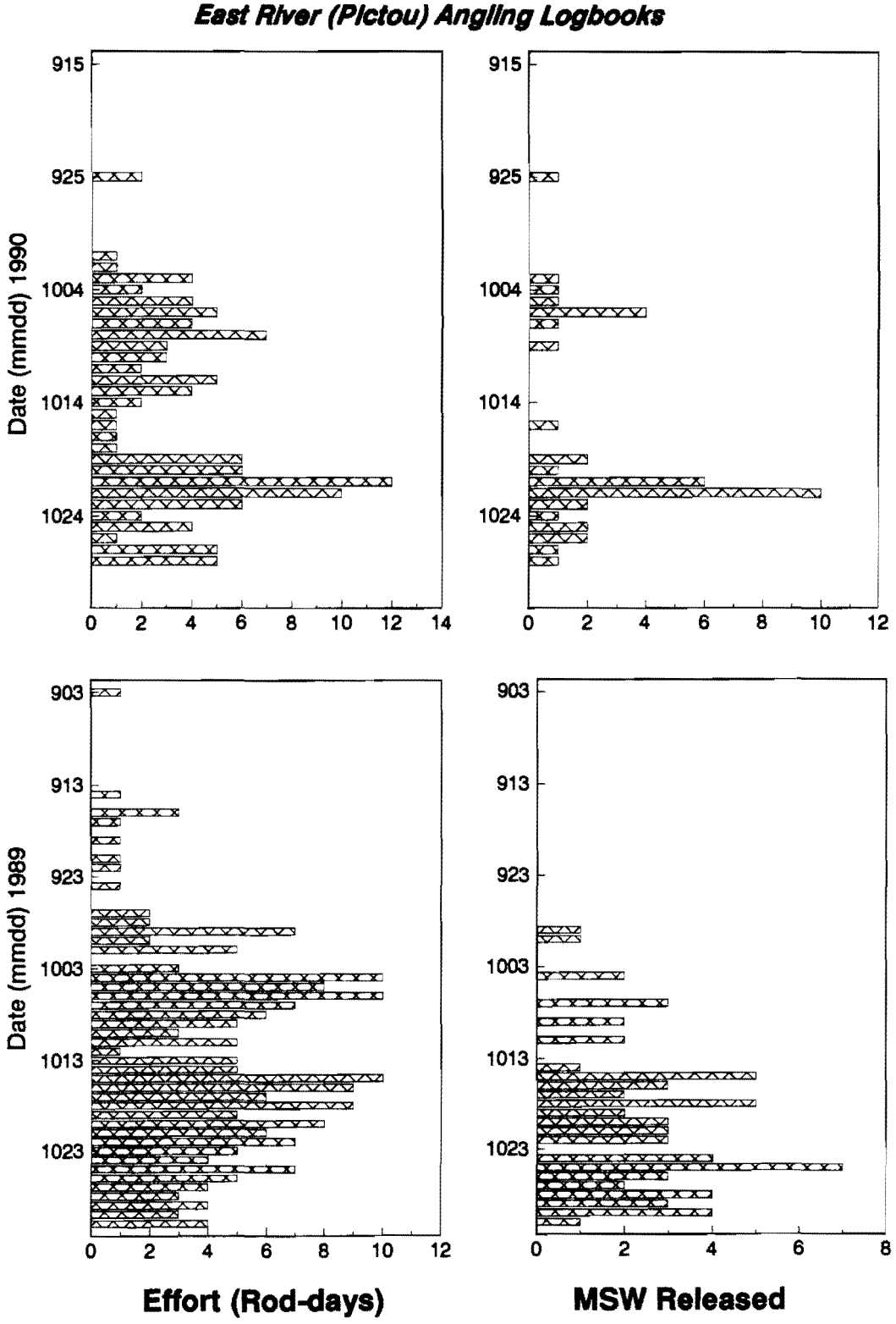

Figure 2. Timing of effort and MSW salmon releases from East River (Pictou) based on volunteer angling logbooks, 1989 and 1990.

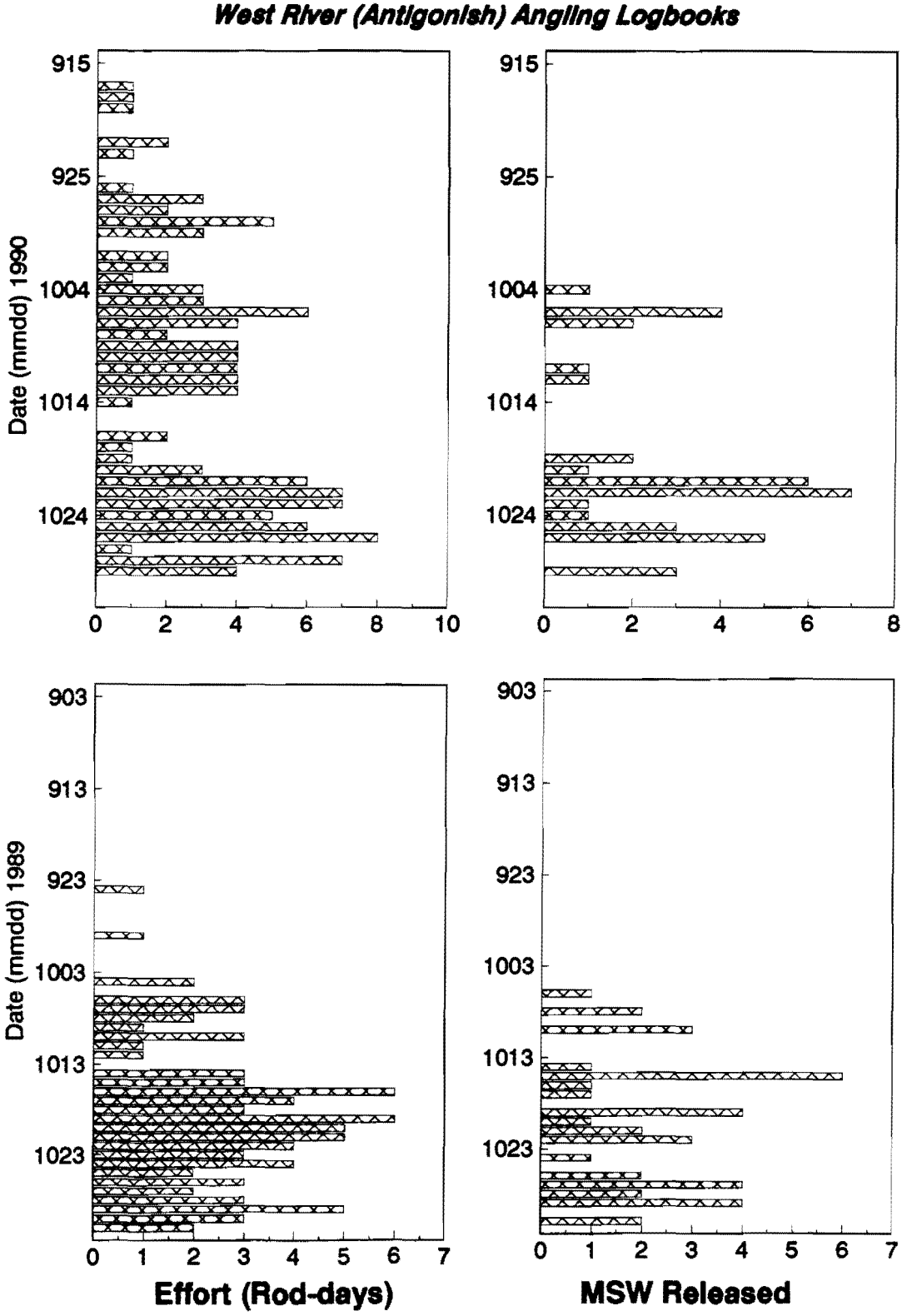

Figure 3. Timing of effort and MSW salmon releases from West River (Antigonish) based on volunteer angling logbooks, 1989 and 1990.