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Mainland Gulf Nova Scotia Atlantic Salmon (*Salmo salar*) Stock Status

by

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ABSTRACT

Angling catches and catch-per-unit of effort (CPUE) in the angling fisheries form the basis of the review of the status of Atlantic salmon stocks of mainland Gulf Nova Scotia rivers. Angling catches and CPUE of large salmon (>= 63 cm fork length) were down in most rivers in 1993 relative to previous years but effort increased. Returns and escapements in 1993 and the average for the 1985 to 1992 period are presented for River Philip, East River (Pictou Co.) and West River (Antigonish Co.), the three larger river systems. Returns were estimated from assumed exploitation rates. Relative to the target egg depositions for these rivers (2.4 eggs per m^2 of spawning and rearing area), escapements in 1993 met or exceeded the targets in River Philip and West River, but there was a 49% probability that the escapement of large salmon in East River was below target. The average escapement of both small and large salmon between 1985 and 1992 exceeded the targets in all three rivers. Juvenile salmon densities in the surveyed rivers are generally as high or higher than densities noted in the Margaree River (Gulf Cape Breton Island, Nova Scotia) where the target egg depositions have been exceeded.

RESUME

Les captures absolues et les prises par unité d'efforts (PUE) dans les pêches récréatives sont à la base de l'évaluation de l'état de stock du Saumon atlantique des rivières de la Nouvelle-Écosse, Golfe du Saint-Laurent. Les captures ainsi que les PUE de grand saumon (longueur à la fourche égale ou supérieure à 63 cm) en 1993 étaient inférieures à celles des années antérieures mais l'effort totale a augmenté. Des estimations totales des retours et des géniteurs (survivants) en 1993 ainsi qu'en moyenne depuis 1985 à 1992 sont présentées pour les trois plus grandes rivières de la région, River Philip, East River (conté de Pictou) et West River (conté d'Antigonish). Les dépôts d'oeufs par les géniteurs de 1993 ont dépassé le niveau cible (2.4 oeufs par m^2 d'habitat de fraie et d'élevage) pour River Philip et West River. Il y avait une grande chance, 49% de probabilité, que le niveau cible n'a pas été atteint dans East River en 1993. DE 1985 à 1992, le nombre moyen annuel de géniteurs de petit saumon et de grand saumon a été supérieur au niveau cible. En moyenne depuis 1985 à 1992, les nombres de géniteurs de petit saumon et de grand saumon ont été supérieurs aux niveaux cibles. Les densités de juvéniles dans les rivières étudiées sont égales ou supérieures à celles déterminées pour la rivière Margaree (région du Golfe, Cap Breton, Nouvelle-Écosse) où les dépôts d'oeufs ont été supérieures au niveau cible.

INTRODUCTION

The rivers in the mainland Gulf Nova Scotia (Fig. 1) have several characteristics in common:

1 - generally smaller river systems of less than 700 km^2 drainage area,
2 - fall run rivers with the majority of salmon entering in September and October. Some rivers had summer runs in the past (ex. River Philip),
3 - run components are predominantly large salmon with a smaller but variable small salmon component,
4 - presence of other salmonids including brown trout (*Salmo trutta*) and brook trout (*Salvelinus fontinalis*),
5 - salmon in some of these rivers have been actively exploited by First Nations people for food.

The stock status report for these rivers is comparable to the first assessment presented in 1991 (Chaput and Jones MS1991b) which estimated the returns to the river based on angling catches and exploitation rates in the angling fishery. This method assumes that the angling catches reflect the abundance of salmon in the river, high angling catches representing higher abundance. Studies on other river systems including the Miramichi River, the Restigouche River and the Margaree River support this assumption (Chaput et al. MS1994a, MS1994b; Claytor et al. MS1994). Since angling catches are used, the returns represent the population which was available to the fishery and would not include any portion of the population which returned to the river after the angling season.

The following terms are used in the document:

Small Salmon - adult salmon of fork length less than 63 cm. Generally referred to as grilse. Usually salmon which have spent only one winter at sea. May contain some previous spawning salmon.

Large Salmon - adult salmon of fork length greater than or equal to 63 cm. Generally referred to as multi-sea-winter salmon. Contains varying proportions of one-sea-winter, two-sea-winter and three-sea-winter maiden (first time) spawners as well as previous spawners.

Early versus Late

Early - refers to the time period from the spring up to and including Aug. 31.
Late - after Aug. 31.

This stock status report considers the following points:

1 - harvests by user group for each size group of salmon,
2 - estimates of returns to three main rivers based on the angling catches and exploitation rates,
3 - estimates of escapement,
4 - target spawning requirements of the rivers, and
5 - spawning escapements relative to the target.

Input from industry, user groups and other government agencies was obtained during a stock assessment workshop. The minutes of the workshop are provided in Appendix A. Minutes from the peer review held on Feb. 11 are provided in Appendix B. There were no specific comments related to the Gulf mainland Nova Scotia document. Summary sheets for the three main rivers (River Philip, East River and West River) are in Appendix C.

1 - Harvests

Atlantic salmon in Gulf Nova Scotia have been harvested by three user groups: commercial, recreational and aboriginal food fisheries. Commercial fisheries have been closed since 1985. Aboriginal food fisheries have harvested both small and large salmon using various gear, including gillnets, spears, snares. There has not been any retention of large salmon (>= 63 cm fork length) in the recreational fisheries since 1985.

Commercial Fisheries

Commercial harvest of Atlantic salmon from Districts 11 & 12 (Northumberland Strait) and for Gulf NS Zone 6 are presented in Table 1. The commercial fishery catch in the Northumberland Strait District 13 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 in Zone 6.

Aboriginal Food Fishery Harvests

In 1993, food fishery agreements were signed with two First Nations in Nova Scotia: Pictou Landing Band and Mill Cove Band. The terms of the agreements included allocations by size (numbers of fish) and fishing location:

Pictou Landing Band Agreement

River	Small Salmon	Large Salmon
East R. (Pictou)	110	260
West R. (Pictou)	8	16
Merigomish Harbour (includes Sutherlands, French and Barneys rivers)	10	30
River John	10	24
Other Gulf NS rivers	10	22
Total	148	352

Mill Cove Band Agreement

River	Small Salmon	Large Salmon
River Philip	0	50
Wallace River	0	50
Total	0	100

Food fishery harvests have occurred on several river systems in the fall of the year, mostly in October. Harvests in 1993 from the mainland Gulf Nova Scotia rivers were 400 large salmon and 4 small salmon. The largest proportion of the total catch of large salmon, 35%, was taken from East River (Pictou) (Table 2).

The 1992 food fishery harvests for all of Salmon Fishing Area (SFA) 18 were estimated at 2,784 kg, consisting of about 586 large salmon and 65 small salmon (Locke et al. MS1993b). Most of this harvest was from East River and the Merigomish Harbour rivers (Sutherlands, French and Barneys).

Recreational Fisheries

Recreational catches since 1984 are available from the provincial license stub return system (O'Neil et al. 1991). Prior to 1984, recreational fisheries catch data were collected by the Dept. of Fisheries and Oceans (DFO) Conservation and Protection officers (O'Neil and Swetnam 1984; Swetnam and O'Neil 1984). Angling seasons for Atlantic salmon in the mainland Gulf Nova Scotia rivers are from Sept. 1 to Oct. 31.

Catches

Angling catches for the years 1984 to 1993, summarized from license stub returns, are presented in Table 3. The 1993 data are preliminary. Catches for three rivers, River Philip, East River (Pictou) and West River (Antigonish) are summarized back to 1977 in Table 4.

Catches of both small and large salmon in 1993 were generally down from 1992 and from the previous 5-year mean catch (Table 3). The few rivers where catches were up in 1993 also had increased effort (for example Wallace and Waugh). The catches in the three larger river systems were also down in 1993, except for large salmon catches in River Philip (Table 4, Fig. 2). Lower catches than those of 1993 have been observed since 1986 except for East River where large salmon catches in 1993 were the lowest recorded since 1985. Small salmon catches for East River were at the lowest level recorded since 1986 while for River Philip they were the second highest ever, after 1992 (Fig. 2). The small salmon catches for West River have fluctuated from year to year since 1986.

Abundance Indices

The catch-per-unit of effort (CPUE) was down in all rivers relative to 1992 and to the previous 5-year mean, except for West River (Pictou) where the CPUE was up from the mean (Table 3). In the three main rivers, the CPUE of large salmon was down in 1993 but has not fluctuated greatly since 1987 (Fig. 3). In all these rivers, the largest CPUE was recorded in 1986 and prior to 1985, there were large annual oscillations in the large salmon abundance (Fig. 3, Table 5). The small salmon CPUE has varied less than that of the large salmon but abundance was down in 1993 relative to 1992 (Fig. 3).

Volunteer anglers have participated in a logbook program since 1989 on three main rivers of mainland Gulf Nova Scotia and the CPUE from the logbooks is compared to that from the license stubs (Fig. 4). The logbook CPUE and the license stub CPUE tend to be positively correlated for both small and large salmon abundance in all three rivers (Fig. 4). The lower abundance of large salmon in 1993 relative to 1992 is evident in both data sets except for the large salmon CPUE from West River (Antigonish Co.) where the 1993 CPUE of the logbooks was greater than in 1992.

Catch Composition

The angling catch in SFA 18 (excluding Cape Breton rivers) has averaged 72% large salmon in the last five years (Table 3). The proportion of large salmon by river is consistent, ranging between 68% (River Philip) and 76% (West River Pictou) since 1989.

Timing of Catches

Small and large salmon runs in the Northumberland Strait and the Bay St. George rivers occur in the fall of the year, in September through November. Logbook anglers have the highest success rate in October, especially for large salmon (Fig. 5).

Salmon counts at the South River counting fence between 1982 and 1987 also indicate the lateness of the run-timing in these rivers. In 1982, the first salmon was counted on Sept. 4 and the largest count (50% of the run) occurred during the second week of November (Chadwick et al. 1985).

Other Removals

Broodstock have been collected from East River (Pictou) for the stocking of eggs in a streamside incubation box for Middle River (Pictou). The number of fish removed from East River is low, generally less than 10 large salmon. Salmon from River Philip have been collected for the aquaculture industry of Scotia-Fundy region.

Illegal fishing (poaching) is known to occur in almost all the rivers. Estimates for 1993 were 77 small salmon and 677 large salmon (Table 6). Unreported catches for 1992 from all SFA 18 were estimated at 73 small salmon and 694 large salmon, representing altogether about 3,240 kg (Locke et al. 1993b).

2 - Estimation of Returns

Methods

Returns of Atlantic salmon to some rivers have been estimated previously based on angling catches and exploitation rates borrowed from other rivers (Chaput and Jones MS1991b). Estimates of returns in recent years were obtained using the angling catch from license stubs. These are hook and release estimates and tend to overestimate the large salmon harvest relative to historical kill values. Analyses of the catches of small and large salmon from Margaree River indicated that license stub values tended to be from 1.3 to 2.3 times higher for small salmon and 2.4 to 6.0 times higher for large salmon than the values obtained by DFO officers (Claytor and O'Neil MS1990). The exploitation rates for large salmon, which are estimated from mark and recapture programs, correspond to "kill" harvest rates since the tags are removed by the anglers but the large salmon are released back to the river. The exploitation rates used in these analyses were derived for the fall salmon fisheries in the Margaree River and they were estimated to have varied between 0.09 and 0.27 for large salmon and 0.13 to 0.39 for small salmon (Chaput and Jones MS1991a).

The returns for a given year and the average returns between 1985 and 1993 were calculated as follows (sample SAS program in Appendix D):

1. Angling catch from license stub returns for a given year was adjusted by a bias factor selected at random from a uniform distribution for small salmon (range: 1.3 to 2.3) and large salmon (range 2.4 to 6.0) separately.
2. Exploitation rate for a given year (1985 to 1993) was selected from a uniform distribution ranging between 0.13 to 0.39 (average 0.26) for small salmon and 0.09 to 0.27 (average 0.18) for large salmon.
3. Returns to the river were calculated using the adjusted angling catch (from 1) divided by the exploitation rate (from 2) for each year.
4. Average returns were calculated for the 1985 to 1992 period.
5. Confidence intervals were determined by resampling 1000 times, steps 1 to 4. The probability that the 1993 returns were greater than the average returns for 1985 to 1992 was determined directly from the resampled data. Point estimates of the returns are the median values. Confidence intervals are the 5th and 95th percentiles of the resampling distributions.

These estimates of returns represent the returns from the point where the angling fishery begins. Removals of fish below such a fishery, such as food harvests in the estuary would not be included in the estimation of returns.

Results

The estimated returns of small and large salmon for 1985 to 1993 and the average annual returns between 1985 and 1992 for the three main rivers are summarized below and in Table 7.

River	Returns (Median)		Confidence Intervals (90%)			
			Small		Large	
	Small	Large	Lower	Upper	Lower	Upper
1993						
Philip	383	493	235	698	271	1027
East (Pictou)	129	290	78	242	156	630
West (Ant.)	159	325	101	300	179	691
Average 1985 to 1992						
Philip	300	465	237	378	352	609
East (Pictou)	238	642	190	294	487	842
West (Ant.)	230	363	183	291	283	480
Diff: (1993-Avg.) / Avg.			Prob. that 1993 > Avg.		Prob. that 1993 > Avg.	
Philip	+28%	+6%	0.73		0.58	
East (Pictou)	-46%	-55%	0.08		0.04	
West (Ant.)	-31%	-10%	0.18		0.41	

The 1993 returns of large salmon and of small salmon to River Philip were higher but not significantly above average returns. West River returns in 1993 were not significantly different from the average returns. The returns of both small and large salmon were significantly below the average returns to East River (Pictou). The actual returns to East River (Pictou) in 1993 were 429 large salmon (290 plus the 139 large salmon harvested by the First Nation assuming all those fish were going into East River), which would still have been significantly below the average return.

3 - Estimation of escapements

Methods

Escapement refers to fish which were not harvested in fisheries or otherwise removed from the river. No adjustments were made for illegal removals or losses due to disease and predation. The escapements were calculated from the estimate of returns to the river minus the removals. Harvests of fish which have already spawned would not be considered as removals for calculating spawning escapement. In this analysis, only the removals that occurred in the river within the boundaries of the angling fishery were considered.

The escapement of small salmon was calculated by subtracting the angling catch (after adjustment) from the returns. The escapement of large salmon is calculated using the estimated returns minus 5% mortality from hook and release (using adjusted angling catch). Confidence intervals and the probability that the escapements in 1993 were greater than the average between 1985 to 1992 were determined from resampling (see Section 2).

Results

The estimated escapements of small and large salmon for 1993 and the average escapements between 1985 and 1993 for the three main rivers are summarized below and in Table 7.

River	Escapement (Median)		Confidence Intervals (90%)			
			Small		Large	
	Small	Large	Lower	Upper	Lower	Upper
1993						
Philip	280	488	151	591	267	1023
East (Pictou)	95	287	50	202	154	626
West (Ant.)	116	323	64	251	177	686
Average 1985 to 1992						
Philip	229	461	168	303	349	605
East (Pictou)	181	636	137	236	482	837
West (Ant.)	175	359	130	235	280	476

River	Escapement (Median)		Confidence Intervals (90%)			
			Small		Large	
	Small	Large	Lower	Upper	Lower	Upper
Diff: (1993-Avg.) / Avg.			Prob. that 1993 > Avg.		Prob. that 1993 > Avg.	
Philip	+23%	+6%	0.66		0.58	
East (Pictou)	-45%	-54%	0.12		0.04	
West (Ant.)	-32%	-12%	0.22		0.41	

The escapements of both small and large salmon in 1993 were not significantly above the average escapement for 1985 to 1992 in River Philip. There was no change in escapement of large and small salmon in West River (Ant.) in 1993 relative to the previous 8 years. Large salmon escapement in East River (Pictou) was significantly below the average escapement for that river.

4 - Target Spawning Requirements

The conservation spawning requirement was based on 2.4 eggs/m^2 of spawning and rearing area in the river. Rearing habitat surveys have been conducted on only two rivers in mainland Gulf NS (River Philip and South River). For the rivers which were not directly surveyed, the amount of rearing area was calculated as follows (Anon. 1978):

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

For example, for East River (Pictou Co.):
where Surveyed River was River Philip, NS.

$$\text{Rearing Area} = 500\ km^2 \times \frac{962{,}000\ m^2}{650\ km^2}$$

$$= 755{,}000\ m^2.$$

On the basis of this rearing area, the egg requirements were calculated as habitat area X 2.4 eggs/m^2.

Habitat areas and egg requirements for some of the rivers are summarized below.

Estimation of Habitat Areas for Mainland Nova Scotia Rivers				
River	Reference River	Drainage Area (km^2)	Habitat Area (m^2)	Egg Requirements
River Philip	River Philip	650	962,000	2.31 million
East River (Pictou)	River Philip	500	755,000	1.81 million
Sutherlands River	River Philip	45	66,600	0.16 million
Barneys River	River Philip	131	193,880	0.47 million
French River	River Philip	110	162,800	0.39 million
West River (Ant.)	South River	325	154,400	0.37 million
South River	South River	200	95,000	0.23 million
Pomquet River	South River	147	70,000	0.17 million
Afton River	South River	50	23,800	0.06 million

The egg requirements can be translated to spawner requirements using the average biological characteristics of the stocks; the average weight of small salmon and large salmon, the sex ratio, and the fecundity (eggs per kg body weight of female salmon). Biological characteristics of the salmon stocks were obtained from samples collected from angling logbooks in East River, from broodstock seining in East River (Pictou) and from counting fence samples at South River. Because biological characteristics for a river were not available, we assumed that they were similar to those of the nearest sampled stock. The objective was to obtain all egg depositions from large salmon, the small salmon target is to ensure an equal male to female ratio in the escapement. A detailed calculation for East River (Pictou) is shown in Table 8. The biological characteristics and the spawner requirements (# of fish) are summarized in the following table.

	Small Salmon		Large Salmon	
	Estimated	Sample Size	Estimated	Sample Size
East River (Pictou)				
Percent Female	5%	43	60%	124
Mean Weight (kg)	1.7	37	6.1	59
Fecundity (eggs/kg)	1764		1764	
Eggs/Spawner	150		6456	
Spawner Requirements			Small Salmon	Large Salmon
East River (Pictou) (Ref. River: East River Pictou)			59	281
River Philip (Ref. River: East River)			75	358
Sutherlands River (Ref. River: East River Pictou)			5	25
Barneys River (Ref. River: East River Pictou)			15	73
French River (Ref. River: East River Pictou)			13	60
	Small Salmon		Large Salmon	
	Estimated	Sample Size	Estimated	Sample Size
South River				
Percent Female	3%	32	50%	221
Mean Weight	1.3	14	3.7	59
Fecundity	1,764		1,764	
Eggs/Spawner	69		3,263	
Spawner Requirements			Small Salmon	Large Salmon
South River (Ref. River: South River)			0	70
West River (Ref. River: South River)			0	113
Pomquet River (Ref. River: South River)			0	52
Afton River (Ref. River: South River)			0	18

Escapements Relative to the Target

Using the escapements of small and large salmon from section 3, the proportions of the spawner target met in 1993 and on average between 1985 and 1992 are as follows.

River	Proportion of Spawner Target		Probability Spawner Target Met or Exceeded	
	Small	Large	Small	Large
1993				
Philip	3.73	1.36	1.00	0.76
East (Pictou)	1.61	1.02	0.86	0.51
West (Ant.)	N/A	2.85	N/A	1.00
Average 1985 to 1993				
Philip	3.05	1.29	1.00	0.94
East (Pictou)	3.07	2.27	1.00	1.00
West (Ant.)	N/A	3.17	N/A	1.00

The escapements of large salmon in 1993 exceeded the target requirements in River Philip and West River (Ant.). The escapement of large salmon to East River in 1993 was equal to the target requirement in 1993. Since 1985, the escapements of large salmon have on average met or exceeded the target in all three rivers. Small salmon targets have been met or exceeded in all three rivers. The 1993 escapement of small salmon in East River was probably met.

7 - Other indicators of escapement status

Juvenile salmon densities have been shown to be positively correlated to spawning escapement estimates in the Miramichi and Restigouche rivers (Locke et al. MS1993a). The densities of fry are correlated to the spawning escapement the year before and densities of parr to the spawning escapement two years before.

Juvenile salmon surveys have been conducted by DFO Science on numerous rivers within mainland Nova Scotia over the years (Table 9). The rivers and the years when they were sampled by DFO are in the following table.

River	Years Sampled
Philip	1986, 1987, 1988, 1993
Wallace	1978, 1993
River John	1993
East River (Pictou)	1978, 1992, 1993
Sutherlands River	1992
French River	1978, 1992
Barneys River	1992
West River (Ant.)	1978, 1986, 1987, 1988, 1991, 1992, 1993
Pomquet	1992
Afton	1992

The successive removal method was used to sample the fish populations within a closed site partitioned by upstream and downstream barrier nets (Chaput and Claytor 1989). Population estimates were obtained using the formulation of Zippin (Zippin 1956) and the densities were estimated as the population estimate divided by the area (100 m^2) of the closed site. Fork length (cm) and whole weight (0.1g) were obtained from all parr and from a subsample of the fry. An index of the extent of habitat utilization, the Percent Habitat Saturation (PHS) was determined based on the relationship between the territory size requirements of individual fish and the densities of juveniles in the site (Grant and Kramer 1990). The PHS value of the salmon juveniles in the site is calculated as follows:

$$PHS = 100 * \sum D_i * T_i * 1.19$$

where D_i = density (#/m^2) of size class i

T_i = territory size (m^2) for size class i predicted from the territory size/body size regression (Grant and Kramer 1990).

In 1992 and 1993, some sites were sampled using a fixed-effort sampling in an open site. Fish were sampled by systematically sampling across the stream from bank to bank moving upstream after every pass. The relationship between the catch-per-unit of effort, expressed as catch of fry or of parr per 300 seconds of electroshocking time, and the density of fry or parr (as #/100m^2) was determined by fixed-effort sampling within the closed sites prior to the removals for population estimation. There was a significant and well-defined relationship between the

CPUE of fry and parr and the density of each in the stream (unpublished data). Sites which were sampled by the fixed-effort method are identified in Table 9.

Analysis of the data for all years and sites is not yet complete but for those rivers and years where the data are available, the densities of both fry and parr have been moderate to very high (Table 9). The PHS values for sites on several rivers have frequently exceeded 50%, indicating that the habitat is very productive and well utilized (Table 9). The densities and PHS values obtained were as high and frequently higher than those from the Margaree River where target spawning escapement has been exceeded in the last 9 years (Chaput et al. MS1994a). Based on this information, we would conclude that the spawning escapements have been adequate in most of these rivers.

Three other salmonids were encountered during electrofishing surveys in the Gulf Nova Scotia rivers: brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*) (Table 10). These other salmonids are potential competitors to Atlantic salmon juveniles. The relationships between salmon juveniles, brown trout and brook trout juveniles have been examined at one site on River Philip (Randall et al. 1989).

CONCLUSIONS AND RECOMMENDATIONS

The estimated returns and escapements of small and large salmon in 1993 were above average in two of the three main rivers in Gulf mainland Nova Scotia. Both these estimates are based on angling catches as reported from angler license stub returns which are then weighted by estimates of probable exploitation rates in the angling fishery. The adjustments to the angling catches and the exploitation rates were derived from studies of the angling fishery of the Margaree River in Gulf Cape Breton. Although the Margaree River also has a strong late-run component (Chaput et al. 1994a), the run timing in the mainland rivers appears to be even later and the exploitation rates which were derived for the Margaree River and applied to the mainland rivers may be too high. They could also be too low, exploitation rates on small rivers and small stocks may be proportionally higher than on larger river systems.

The angling fishery closes on Oct. 31 and the returns which are estimated correspond to returns up to and including that date. Any fish which enter the river after Oct. 31 were not accounted for and this proportion may vary annually. Low precipitation in the fall can delay the migration of salmon into these smaller river systems and anglers report a strong relationship between numbers of salmon in the river and water conditions, high water tends to bring in more fish (pers. comm. anglers at the assessment meeting, Pictou NS, Feb. 1, 1994).

Better estimates of the returns to the rivers would require mark/recapture programs in order to estimate the exploitation rate for a given year or to estimate the returns independently of the angling catches. Returns after Oct. 31 may be a large component of the total run into the

river, the extent of which can only be determined by running trapnets within tidal waters and or counting fences in the rivers themselves.

The estimates of the illegal removals were very high relative to the estimated total returns to the river. For example, illegal removals in River Philip in 1993 represented 22% of the estimated escapement of large salmon in River Philip. This estimate of illegal removals is not contradictory to the angling group's perception of the extent of the illegal activity which takes place in these smaller rivers. Illegal fishing activity is difficult to quantify although an approach which will be taken in the future is to table the number of seizures of gear and fish and the apprehensions and the total time spent by enforcement officers each year. This should provide an indication of the relative size of the illegal activity.

Juvenile surveys have proven valuable in assessing the relative spawning escapement in recent years, especially when the densities of juveniles are compared to those from a river, such as the Margaree River, where returns, escapements and juvenile abundance are known. Such surveys should be continued in the future, especially in the absence of other methods of estimating escapement. Angling catches are often very small or not recorded in many small rivers and these do not correspond to the abundance of salmon. For example, angling catches are essentially non-existent from Afton River yet juvenile densities in that small river system were very high in 1992.

The abundance index based on the volunteer angler logbook data matches the abundance index based on the catch-per-unit of effort from the license stub returns. Logbooks are especially useful for determining the annual variation in accessibility of salmon to anglers. They would also be useful in estimating the returns to the river if estuary tagging programs were initiated as has been the case for the Margaree River salmon assessment (Chaput et al. 1994a).

The habitat areas for most of these rivers have not been quantified. The habitat area estimate for River Philip was obtained from a task force report, the actual survey data for this river have not been located. Even gross estimates of total bottom accessible area which could be obtained from topographic maps would be better than the prorated method of estimating habitat areas. Several river systems also have lacustrine habitat which could be used by juvenile salmon for rearing. Translating the egg requirement to spawners also requires biological characteristics data. Small salmon characteristics are readily obtained from angling catches but large salmon characteristics are presently deficient. There is good information for South River because all salmon passing through the fence between 1984 and 1987 were measured and the sex ratio determined. Broodstock collection excursions have also provided an opportunity to sample the large salmon component from East River (Pictou) and River Philip. Samples of the First Nation food fishery is the best source for updating the biological characteristics of the large salmon.

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Appendix A. Minutes of the mainland Gulf shore Nova Scotia stock workshop.

Pictou, N.S. (NS DofF, Aquaculture & Inland Fisheries Division)
0900-1630 Hours, Tuesday, 1 February 1994

Chairperson:

Mike Chadwick	DFO, Science, Moncton

Recording Secretary:

John Peppar	DFO, Science, Moncton

Attendees:

Max Blouw	Saint F.X. University, Biology, Antigonish
Peter Gay	Cumberland County River Enhancement Association
Darren Tower	Cumberland County River Enhancement Association
Bob Ferguson	Pictou County Rivers Association
Richard Kell	Pictou County Rivers Association
Harris MacKay	Pictou County Rivers Association
Mike McAdam	Atlantic Salmon Federation
Nancy Adams	NS DofF, Aquaculture & Inland Fisheries, Pictou
Leroy MacEachern	DFO, Development, Antigonish
Ralph Young	DFO, C&P, Pictou
Leonard Forsyth	DFO, Science, Margaree SEC
Ross Claytor	DFO, Science, Moncton
Gerald Chaput	DFO, Science, Moncton
Kevin Davidson	DFO, Science, Moncton
Tim Lutzac	DFO, Science, Moncton
Ross Jones	DFO, Science, Moncton

1. Introduction - Purpose of Meeting and Framework of Workshops.

Mike Chadwick provided a general overview of the purpose of this meeting and an explanation of the "workshop" approach and its framework.

An overview was provided of the four major features associated with the **"Stock Workshop"** framework or approach:

1. **Roles of government and the public:** the public wants to participate, money is scarce, agencies must remove redundancy, horizontal links in resource management, combine enhancement and assessment, DFO focus on analysis and structure.
2. **Scientific basis for resource management:** what are the problems?, assemble knowledge, make a model, where is model sensitive?, ask an answerable question, develop test, document repeatable methods, improve model, ask another important question.

Appendix A (continued).

3. **Watershed management:** fine-scale information, in-season management, all stocks, knowledge accessible to everyone, identify problems in order of priority, best projects distinguish between alternative views of the resource, share tasks.

There is a different dynamic now, with more stakeholders involved in the stock assessment process. CAFSAC is gone. There will still be peer review of assessments, but these assessments will be developed and assembled through the stock workshop process first. Research documents will be prepared, with summary sheets provided for wider distribution.

2. Salmon Stock Status - Salmon Assessments.

Ross Claytor provided a general overview of how the salmon assessments are developed.

He outlined the **"Assessment Process"** as incorporating a framework of four basic components:

1. **Landings** (catches): from the First Nations, angling, and commercial fisheries.
2. **Targets** (spawning requirements): using the value of 2.4 eggs/square metre.
3. **Where we are now** (spawning escapements): total returns minus removals.
4. **Forecasts**: pre-season and in-season updates.

Mainland Gulf N.S. Salmon

Gerald Chaput presented information on the status of the Mainland Gulf Nova Scotia salmon stocks; a handout, detailing all material presented, was provided to attendees.

Points of Discussion

Landings

- First Nation catches need to be clarified and should be compiled; numbers set re: the agreements should be indicated in the table.
- Meeting between angler associations and First Nations needed -sharing of information derived from this meeting, encouragement to participate in future involvements, provide a focus of "what's going on?", etc.
- Need some form of table to indicate level of unreported removals (poaching, disease, etc.); an account of the number of apprehensions, nets seized, etc.

Appendix A (continued).

- Discrepancies associated with the combining of angling stub return data - 1984 was the first year of stub use, different system before 1984, plus, this year coincides with the beginning of hook and release, commercial fisheries closures, etc.; reporting of catch has likely changed, pre-1984 data certainly poorer, less reporting of catches (especially small salmon), etc.
- Angling catch per unit of effort (CPUE) low (except of West R. Pictou), indicates abundances down (below 1992 and 5-year mean); could be due to lateness of the run (many fish came in after angling).
- Need to examine data on run-timing vs discharge, and the possible effects on angling; has run-timing to these rivers changed over the years? Pictou Harbour Environmental Protection Plan (PHEPP)(Bob Christie) to monitor environmental data starting this year; future stock status meetings should include representatives from this group, Bob Christie needs to be contacted.

Target

- The 2.4 eggs per rearing area (accessible stream bottom area) is thought to be a conservative estimate; the 'real value' is likely above or below, likely below in many areas.
- The rearing area in River Philip needs to be measured.
- Biological characteristics data (sex ratio, weights, sea age, etc.) should be acquired from the First Nation catches (represents good First Nation project proposal for 1994), and from broodstock collections.

Returns

- There must be an attempt made to make hook and release angling data as similar to actual former catch data as possible; logbooks vs stubs quite often are very different in how such data are reported (what are stub returns actually recording?); good creel censuses are required to get better angling catch data, if data are to be comparable to historical catch data. A program to compare logbooks to licence stubs is needed on East, Philip and West Rivers.
- "Hook and Release" = fish played, brought in, tailed, and released (i.e., comparable to fish caught, etc.).
- A mark/recapture operation should be employed to derive exploitation rate; using a tagging study, creel survey, and fish trap or counting fence. The priority is River Philip and/or East or West Rivers. A creel survey of kelts might be useful for recovering tags.
- In conjunction with the study on East River, a study on Middle River should be done to evaluate the fishway, perhaps with a video camera. Smolts from Cobequid could be used to evaluate downstream passage.
- Electrofishing surveys from DFO (3 sites/river) and NS DofF should be summarized for 1995.

Appendix A (continued).

- Electrofishing should be done on Sutherlands River to evaluate spawning.

Forecast

- Assessments indicate rivers were above conservation requirements in 1993; should see similar situation in 1994, i.e., there should be some harvestable amount forcasted for 1994. How "Management" allocates such a surplus is not determined by "Science".

Mainland Gulf N.S. Trout and Striped Bass

Points of Discussion

Landings

- NS creel surveys (1991-1993) on Northumberland Strait rivers (32 sites on 11 rivers), should be summarized.
- Data collected from NS DofF trout creel survey conducted during the "week of opening" of the angling seasons each year should be compiled and presented, and included in report for next year.
- Licence stug returns, and catch and effort by county, need to be summarized for 1966-1993.
- Analysis of logbooks for anglers fishing Gulf rivers should be completed.
- Results of the 5-year sport survey should be summarized for 1970, 75, 80, 85, and 90, and compared to logbooks and licence stubs.

Target

- An inter-provincial team should develop a target for trout stocks in the Maritimes. A workshop is to be organized in the summer of 1994.
- Electrofishing surveys should summarize catches of all salmonids, by species.

Returns

- NS DofF electrofishing data should be tabled and included in report for next year.
- Trout stocking records should be summarized; by location and year, etc.; a monitering system is needed for future stocking programs, we need to know if the stocking is having a positive effect.
- Future meetings of stock status workshops should be linked to the RFAC meetings.

Appendix B. Minutes of peer review of anadromous stocks Gulf Region.

Minutes of Peer Review
Anadromous Stocks Gulf Region
February 21, 1994

Review Committee:

M. Chadwick (Chair)
J. Allard
S. Bates
A. Chiasson
R. Cunjak
J.-G. Godin

General Comments

1. The error associated with extrapolating information from one watershed to another should be estimated using the prorating techniques in hydrological studies. This type of error could be estimated from smaller watershed within rivers where the populations are well estimated.
2. In order to account for possible longterm trends, comparisons should be made with means over long time periods in addition to 5-year means.
3. A logbook program similar to the program in Nova Scotia should be considered for New Brunswick and PEI.
4. The mark-recapture experiments should be encouraged, but other independent estimates of stock abundance such as sport catch data and electrofishing should also be continued.
5. An introductory document summarizing terminology, the basics of mark-recapture experiments, and methods used in electrofishing, creel surveys, and fish fences should accompany next year's assessments. The stock assessment documents should have the same format.
6. Summary sheets should be pictoral, perhaps maps with pie graphs by watershed of catches, spawning requirements, and spawning escapements.
7. A description of multi-species factors such as the abundance and dynamics of other stocks should be included in the assessments.
8. With some minor changes all the assessments were suitable to be published as research documents; however future assessments should be put into a standardized format.
9. Estimate tag-loss function using brood-stock experiments at hatcheries for Miramichi, Restigouche, and Nepisiguit rivers. The tag loss rate contributes significantly to the error in population estimates.
10. More time is required for reviews in the future and reviewers should focus on 1 or 2 assessments for critical evaluation.

Appendix B (continued).

11. Techniques to summarize results from several estimators should be explored.
12. The decision of whether or not a value is a constant or a variable needs to be standardized. Variables are re-evaluated every year, where as constants can be aggregated over years to reduce the confidence interval.

Participants:

R. Claytor
G. Chaput
F. Mowbray
G. Atkinson
K. Davidson
M. Biron
D. Moore
R. Pickard
R. Jones
D. Caissie

Appendix C. Summary sheets.

STOCK: River Philip (SFA 18)
TARGET: 2.3 million eggs (358 large, 75 small salmon)

Year	1988	1989	1990	1991	1992	1993	MIN[2]	MAX[2]	MEAN[2]
Angling harvest[1]									
Large[1]	328	407	191	421	322	356	191	421	331
Small	169	114	155	164	179	171	76	179	156
Native harvest									
Large	-	-	-	-	-	50			-
Small	-	-	-	-	-	0			-
Total returns									
Large	458	566	279	578	461	493	279	578	468
small	384	254	362	360	398	383	169	398	352
Spawning escapement									
Large	452	561	276	573	457	438	276	573	464
Small	286	187	268	262	292	280	124	292	259
% of Egg target met (large)									
	126	157	77	160	128	136	77	160	130

[1] All angling catches are NS license stub estimates. MSW angling catch for 1986 to present is hook-and-release estimates.

[2] Min, Max are for 1986 to 1993. Mean for 1988 to 1992.

Recreational Catches : Angling catches of large salmon in 1993 were above 1992 and previous 5-year mean. Small salmon catches were below 1992 but above 5-year mean.

Methodologies: All the target eggs are to come from MSW salmon. Biological characteristics are based on data from East River (Pictou Co.) stock. Most of the angling catch occurs in October. Assessment of returns based on license stub angling catches adjusted to correspond to historical kill estimates which are then weighted by exploitation rates derived from fall angling fisheries in the Margaree River. Returns, escapements and percent of target based on median values from simulation which is why returns minus removals do not necessarily equal escapement.

State of the stock: Escapements and egg depositions by large salmon have exceeded target requirements in 5 of the last six years. Small salmon target escapement exceeded in all years.

Forecast: No forecast is available yet.

Appendix C (continued).

STOCK: East River (Pictou Co.) (SFA 18)
TARGET: 1.8 million eggs (281 large, 59 small salmon)

Year	1988	1989	1990	1991	1992	1993	MIN[2]	MAX[2]	MEAN[2]
Angling harvest[1]									
Large	422	670	299	440	371	203	203	670	397
Small	129	87	109	121	111	57	57	129	97
Native harvest									
Large	-	-	-	-	-	139			-
Small	-	-	-	-	-	-			-
Total returns									
Large	585	942	407	619	523	429	407	942	615
small	303	196	247	270	251	137	137	303	253
Spawning escapement									
Large	579	933	403	614	519	287	287	933	610
Small	223	143	182	200	184	95	95	223	186
% of Egg target met (large)									
	206	332	143	219	185	102	102	332	217

[1] All angling catches are NS license stub estimates. MSW angling catch for 1986 to present is hook-and-release estimates.

[2] Min, Max are for 1986 to 1993. Mean for 1988 to 1992.

Recreational Catches : Angling catches of large salmon were down 50% from 1992 and previous 5-year mean. Small salmon catches were also down 50%.

Methodologies: All the target eggs are to come from MSW salmon. Biological characteristics are based on data from East River (Pictou Co.) stock. Most of the angling catch occurs in October. Assessment of returns based on license stub angling catches adjusted to correspond to historical kill estimates which are then weighted by exploitation rates derived from fall angling fisheries in the Margaree River. Returns, escapements and percent of target based on median values from simulation which is why returns minus removals do not necessarily equal escapement.

State of the stock: Escapements and egg depositions by large salmon have exceeded target requirements in 5 of the last six years. Small salmon target escapement exceeded in all years except 1993.

Forecast: No forecast is available yet.

Appendix C (continued).

STOCK: West River (Antigonish Co.) (SFA 18)
TARGET: 0.4 million eggs (113 large, 0 small salmon)

Year	1988	1989	1990	1991	1992	1993	MIN[2]	MAX[2]	MEAN[2]
Angling harvest[1]									
Large	126	218	200	294	277	235	126	476	245
Small	67	90	152	65	136	72	65	152	103
Native harvest									
Large	-	-	-	-	-	-			-
Small	-	-	-	-	-	-			-
Total returns									
Large	175	316	284	414	398	325	175	649	317
small	147	200	342	146	312	159	147	342	229
Spawning escapement									
Large	173	314	281	410	395	323	173	645	315
Small	108	147	253	108	233	116	108	253	170
% of Egg target met (large)									
	153	278	249	363	350	286	153	571	278

[1] All angling catches are NS license stub estimates. MSW angling catch for 1986 to present is hook-and-release estimates.

[2] Min, Max are for 1986 to 1993. Mean for 1988 to 1992.

Recreational Catches : Angling catches of large salmon in 1993 were down 13% from 1992 but up 5% from previous 5-year mean. Small salmon catches were 30% below the 5-year mean.

Methodologies: All the target eggs are to come from MSW salmon. Biological characteristics are based on data from South River (Antigonish Co.) stock. Most of the angling catch occurs in October. Assessment of returns based on license stub angling catches adjusted to correspond to historical kill estimates which are then weighted by exploitation rates derived from fall angling fisheries in the Margaree River. Returns, escapements and percent of target based on median values from simulation which is why returns minus removals do not necessarily equal escapement.

State of the stock: Escapements and egg depositions by large salmon have exceeded target requirements in all years since 1986.

Forecast: No forecast is available yet.

Appendix D. Sample SAS program for incorporating uncertainty in returns, escapements and probabilities of meeting or exceeding target spawners.

```
** MAINNS93.SAS   bootstrap estimating returns and escapements;
OPTIONS LINESIZE = 120 PAGESIZE = 90 NOCENTER;
*********************************************************
  this is the simulation step
*********************************************************;
proc iml;

/*eastmsw = {162 620 389 422 670 299 440 371 203}; * East R. MSW 85-93 Stub;
east1sw = {40 89 83 129 87 109 121 111 57}; * East R. 1SW 85-93 Stub;
** East River spawner requirements;
%let entete = 'East River estimates';
%let msw = 281;
%let gril = 59;*/

/*WESTMSW = {122 476 198 126 218 200 294 277 235}; * West R. MSW 85-93 Stub;
WEST1SW = {34 126 84 67 90 152 65 136 72}; * West R. 1SW 85-93 Stub;
eastmsw = westmsw;
east1sw = west1sw;
** West River spawner requirements;
%let entete = 'West River estimates';
%let msw = 113;
%let gril = 0;*/

philipm = {69 338 337 328 407 191 421 322 356}; * R. Philip MSW 85-93 Stub;
philipg = {12 111 76 169 114 155 164 179 171}; * R.Philip 1SW 85-93 Stub;
eastmsw = philipm;
east1sw = philipg;
** River Philip spawner requirements;
%let entete = 'River Philip estimates';
%let msw = 358;
%let gril = 75;

a2 = 1:8;
a1 = 1:12;
perm = 1000;* number of simulations;

mswret = j(perm, 12, 0);
gswret = j(perm, 12, 0);
mswesc = j(perm, 12, 0);
gswesc = j(perm, 12, 0);
target = j(perm, 4, 0);
```

Appendix D (continued). Sample SAS program for incorporating uncertainty in returns, escapements and probabilties of meeting or exceeding target spawners.

```
x1sw = j(1, 9, 0);* dimensions the 1SW adjustment factor
                  1 replicates for each year;
xmsw = j(1, 9, 0);* dimensions the MSW adjustment factor
                  1 replicates for each year;
er1sw = j(1, 9, 0);* dimensions the 1SW adjustment factor
                  1 replicates for each year;
ermsw = j(1, 9, 0);* dimensions the MSW adjustment factor
                  1 replicates for each year;

*****************************************************************;
do nperm = 1 to perm;* loop for the NPERM bootstrap replications;
catdifm2 = 0; retdifm2 = 0; escdifm2 = 0;
catdif12 = 0; retdif12 = 0; escdif12 = 0;
targ93g = 0; targg = 0; targ93m = 0; targm = 0;

*** adjustment factor for MSW catch and 1SW catch from license stubs***:
x1sw = uniform(x1sw)*0.9 + 1.3;
xmsw = uniform(xmsw)*3.6 + 2.4;
er1sw = uniform(er1sw)*0.26 + 0.13;
ermsw = uniform(ermsw)*0.18 + 0.09;

*** estimated catches, returns, escapements by size group by year *****;
catchmsw = eastmsw/xmsw;
avgcatm = catchmsw[1,a2][,+]/8;
catdifm = catchmsw[1,9]-avgcatm;
if catdifm > 0 then catdifm2 = 1;
retmsw = catchmsw/ermsw;
avgretm = retmsw[1,a2][,+]/8;
retdifm = retmsw[1,9]-avgretm;
if retdifm > 0 then retdifm2 = 1;
escmsw = retmsw - (catchmsw*0.05);
avgescm = escmsw[1,a2][,+]/8;
escdifm = escmsw[1,9]-avgescm;
if escdifm > 0 then escdifm2 = 1;
if escmsw[1,9]>=&msw then targ93m = 1;
if avgescm >= &msw then targm = 1;
catch1sw = east1sw/x1sw;
avgcat1 = catch1sw[1,a2][,+]/8;
catdif1 = catch1sw[1,9]-avgcat1;
if catdif1 > 0 then catdif12 = 1;
```

Appendix D (continued). Sample SAS program for incorporating uncertainty in returns, escapements and probabilties of meeting or exceeding target spawners.

```
ret1sw = catch1sw/er1sw;
avgret1 = ret1sw[1,a2][,+]/8;
retdif1 = ret1sw[1,9]-avgret1;
if retdif1 > 0 then retdif12 = 1;
esc1sw = ret1sw - catch1sw;
avgesc1 = esc1sw[1,a2][,+]/8;
escdif1 = esc1sw[1,9]-avgesc1;
if escdif1 > 0 then escdif12 = 1;
if esc1sw[1,9]>=&gril then targ93g = 1;
if avgesc1 >= &gril then targg = 1;

mswret[nperm, a1] = retmsw||avgretm||retdifm||retdifm2;
gswret[nperm, a1] = ret1sw||avgret1||retdif1||retdif12;
mswesc[nperm, a1] = escmsw||avgescm||escdifm||escdifm2;
gswesc[nperm, a1] = esc1sw||avgesc1||escdif1||escdif12;
target[nperm, {1 2 3 4}] = targ93m||targm||targ93g||targg;
end;

create boot1 from mswret;
append from mswret; close boot1;
create boot2 from gswret;
append from gswret; close boot2;
create boot3 from mswesc;
append from mswesc; close boot3;
create boot4 from gswesc;
append from gswesc; close boot4;
create boot5 from target;
append from target; close boot5;
quit;
run;

proc univariate data = boot1;  title &entete;
proc univariate data = boot2; title &entete;
proc univariate data = boot3; title &entete;
proc univariate data = boot4; title &entete;
proc univariate data = boot5; title &entete;
```

Table 1. Commercial salmon landings for Zone 6 (1967-1984) in kg (Claytor et al. 1987).

	Northumberland Strait - NS Fisheries Statistical District				Gulf Cape Breton - NS Fisheries Statistical District			Gulf NS Zone 6
Year	11	12	13	Subtotal	2	3	Subtotal	total (kg)
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 2. Native catch estimates for Mainland Gulf Shore N.S. rivers provided by First Nation Bands and DFO fisheries officers, 1993.

	Total			Small			Large		
Location:	***No***	***lbs***	***kgs***	***No***	***lbs***	***kgs***	***No***	***lbs***	***kgs***
	Provided by First Nation Bands:								
With Agreements:									
East River	139		625.5	0		0.0	139		625.5
Merigomish Hbr.	72		312.4	4		6.4	68		306.0
River John	23		103.5	0		0.0	23		103.5
Without Agreements:									
Afton River	15		74.9	0		0.0	15	165	74.9
Barney's River	30		149.8	0		0.0	30	330	149.8
	Provided by DFO Fisheries Officers:								
River Philip	50		225.0	0		0.0	50		225.0
Wallace	50		225.0	0		0.0	50		225.0
Waugh	25		112.5	0		0.0	25		112.5
Total:	404		1828.6	4		6.4	400		1822.2

Table 3. Annual summaries of catch and effort for Mainland Gulf Shore N.S. rivers from 1984-93 using license stub returns. Mean = (1988 to 1992). The 1993 data are preliminary.

		No.	Small		Large		Unk.	Total		Rods			
Year	River	Angler	Obs.	Est.	Obs.	Est.	Obs.	Obs.	Est.	Obs.	Est.	CPUE	% Large
	East: Pictou Co.												
1984		70	14	14	39	40	0	53	54	423	474	0.125	73.6
1985		63	38	40	153	162	1	192	203	373	398	0.515	80.1
1986		152	84	89	582	620	0	666	709	1094	1151	0.609	87.4
1987		202	80	83	377	389	0	457	472	1214	1286	0.376	82.5
1988		200	110	129	360	422	0	470	551	1072	1300	0.438	76.6
1989		240	72	87	554	670	0	626	757	1365	1705	0.459	88.5
1990		223	86	109	237	299	0	323	408	1069	1394	0.302	73.4
1991		232	94	121	343	440	0	437	561	1152	1526	0.379	78.5
1992		162	88	111	295	371	0	383	482	745	967	0.514	77.0
1993		183	41	57	147	203	0	188	259	692	986	0.272	78.2
	+/- 1992	13%	-53%	-49%	-50%	-45%	.	-51%	-46%	-7%	2%	-47%	2%
	+/- Mean	-13%	-54%	-49%	-59%	-54%	.	-58%	-53%	-36%	-28%	-35%	-1%
	River John												
1984		5	1	1	0	0	0	1	1	20	22	0.050	0.0
1985		6	2	2	55	58	0	57	60	55	59	1.036	96.5
1986		21	29	30	146	154	0	175	184	179	188	0.978	83.4
1987		47	24	25	69	70	0	93	95	224	237	0.415	74.2
1988		47	44	52	101	118	0	145	170	211	256	0.687	69.7
1989		59	15	18	82	99	0	97	117	214	267	0.453	84.5
1990		47	49	62	33	42	0	82	104	232	303	0.353	40.2
1991		36	28	36	66	85	0	94	121	151	200	0.623	70.2
1992		42	12	15	55	69	0	67	84	128	166	0.523	82.1
1993		46	16	22	58	80	0	74	102	166	236	0.446	78.4
	+/- 1992	10%	33%	47%	5%	16%	.	10%	21%	30%	42%	-15%	-5%
	+/- Mean	-0%	-46%	-40%	-14%	-3%	.	-24%	-14%	-11%	-1%	-15%	13%
	River Philip												
1984		53	24	25	57	60	0	81	85	275	308	0.295	70.4
1985		60	11	12	65	69	0	76	81	291	311	0.261	85.5
1986		103	107	111	325	338	0	432	449	608	640	0.711	75.2
1987		160	71	76	317	337	0	388	413	1055	1118	0.368	81.7
1988		167	144	169	280	328	0	424	497	1012	1227	0.419	66.0
1989		144	94	114	336	407	0	430	520	999	1248	0.430	78.1
1990		147	123	155	151	191	0	274	346	873	1139	0.314	55.1
1991		166	128	164	329	421	0	456	585	1112	1473	0.410	72.0
1992		175	142	179	256	322	0	398	500	934	1213	0.426	64.3
1993		211	124	171	258	356	0	382	527	1224	1743	0.312	67.5
	+/- 1992	21%	-13%	-4%	1%	11%	.	-4%	5%	31%	44%	-27%	5%
	+/- Mean	32%	-2%	9%	-5%	7%	.	-4%	8%	24%	38%	-22%	1%
	Wallace												
1984		25	1	1	4	4	0	5	5	48	54	0.104	80.0
1985		28	5	5	16	17	0	21	22	80	85	0.263	76.2
1986		71	16	16	113	115	0	129	131	222	234	0.581	87.6
1987		79	11	11	48	50	0	59	61	269	285	0.219	81.4
1988		81	14	16	28	33	0	42	49	243	295	0.173	66.7
1989		67	10	12	27	33	0	37	45	191	239	0.194	73.0
1990		54	11	14	23	29	0	34	43	198	258	0.172	67.6
1991		104	31	40	69	89	0	100	128	302	400	0.331	69.0
1992		104	23	29	67	84	0	90	113	327	425	0.275	74.4
1993		176	21	29	72	99	0	93	128	631	899	0.147	77.4
	+/- 1992	69%	-9%	0%	7%	18%	.	3%	13%	93%	112%	-47%	4%
	+/- Mean	115%	18%	31%	68%	85%	.	53%	69%	150%	178%	-36%	10%

Table 3. Continued ...

Year	River	No. Angler	Small Obs.	Small Est.	Large Obs.	Large Est.	Unk. Obs.	Total Obs.	Total Est.	Rods Obs.	Rods Est.	CPUE	% Large
	Waugh												
1984		3	0	0	0	0	0	0	0	7	8	0.000	.
1985		4	0	0	1	1	0	1	1	5	5	0.200	100.0
1986		15	9	10	27	29	0	36	39	32	34	1.125	75.0
1987		23	0	0	7	7	0	7	7	45	48	0.156	100.0
1988		21	8	9	19	22	0	27	32	65	79	0.415	70.4
1989		24	4	5	4	5	0	8	10	74	92	0.108	50.0
1990		17	14	18	14	18	0	28	35	75	98	0.373	50.0
1991		41	15	19	83	106	0	98	126	204	270	0.480	84.7
1992		27	11	14	15	19	0	26	33	94	122	0.277	57.7
1993		34	13	18	21	29	0	34	47	143	204	0.238	61.8
	+/- 1992	26%	18%	29%	40%	53%	.	31%	42%	52%	67%	-14%	7%
	+/- Mean	31%	25%	38%	-22%	-15%	.	-9%	-0%	40%	54%	-28%	-1%
	West: Antigonish Co.												
1984		20	17	17	2	2	0	19	19	96	107	0.198	10.5
1985		33	32	34	115	122	0	147	156	211	225	0.697	78.2
1986		72	116	126	438	476	0	554	602	498	524	1.112	79.1
1987		117	80	84	188	198	0	268	282	699	741	0.383	70.1
1988		89	57	67	107	126	0	164	192	377	457	0.435	65.2
1989		99	74	90	180	218	0	254	307	420	525	0.605	70.9
1990		126	120	152	158	200	0	278	351	536	699	0.519	56.8
1991		132	51	65	229	294	0	280	359	553	732	0.506	81.8
1992		144	108	136	220	277	0	328	412	576	748	0.569	67.1
1993		133	52	72	170	235	0	222	306	585	833	0.379	76.6
	+/- 1992	-8%	-52%	-47%	-23%	-15%	.	-32%	-26%	2%	11%	-33%	14%
	+/- Mean	13%	-37%	-29%	-5%	5%	.	-15%	-6%	19%	32%	-28%	12%
	West: Pictou Co.												
1984		1	0	0	0	0	0	0	0	1	1	0.000	.
1985		8	2	2	4	4	0	6	6	29	31	0.207	66.7
1986		12	4	4	4	4	0	8	8	36	38	0.222	50.0
1987		45	14	15	25	26	0	39	41	233	247	0.167	64.1
1988		49	21	25	37	43	0	58	68	257	312	0.226	63.8
1989		60	12	15	50	60	0	62	75	340	425	0.182	80.6
1990		51	27	34	30	38	0	57	72	193	252	0.295	52.6
1991		91	35	45	118	151	0	153	196	484	641	0.316	77.1
1992		89	25	31	100	126	0	125	157	317	412	0.394	80.0
1993		110	30	41	109	150	0	139	192	442	630	0.314	78.4
	+/- 1992	24%	20%	32%	9%	19%	.	11%	22%	39%	53%	-20%	-2%
	+/- Mean	62%	25%	37%	63%	79%	.	53%	69%	39%	54%	11%	11%
	Other Rivers												
1984		2	0	0	0	0	0	0	0	5	5	0.000	.
1985		9	0	0	4	4	0	4	4	14	14	0.286	100.0
1986		14	6	6	7	7	0	13	13	30	31	0.433	53.8
1987		22	12	12	16	17	0	28	29	69	72	0.406	57.1
1988		12	2	2	8	9	0	10	11	36	43	0.278	80.0
1989		12	16	19	3	3	0	19	22	43	53	0.442	15.8
1990		18	11	14	10	12	0	21	26	50	64	0.420	47.6
1991		28	8	10	16	20	0	24	30	76	102	0.316	66.7
1992		22	18	23	14	17	0	32	41	122	158	0.262	43.8
1993		30	2	2	7	10	0	9	12	84	120	0.107	77.8
	+/- 1992	36%	-89%	-91%	-50%	-41%	.	-72%	-71%	-31%	-24%	-59%	78%
	+/- Mean	63%	-82%	-85%	-31%	-18%	.	-58%	-54%	28%	43%	-69%	53%

Table 3. Continued ...

Year	River	No. Angler	Small Obs.	Small Est.	Large Obs.	Large Est.	Unk. Obs.	Total Obs.	Total Est.	Rods Obs.	Rods Est.	CPUE	% Large
	Mainland N.S. Totals:												
1984		179	57	58	102	106	0	159	164	875	979	0.182	64.2
1985		211	90	95	413	437	1	504	533	1058	1128	0.476	82.1
1986		460	371	392	1642	1743	0	2013	2135	2699	2840	0.746	81.6
1987		695	292	306	1047	1094	0	1339	1400	3808	4034	0.352	78.2
1988		666	400	469	940	1101	0	1340	1570	3273	3969	0.409	70.1
1989		705	297	360	1236	1495	0	1533	1853	3646	4554	0.420	80.6
1990		683	441	558	656	829	0	1097	1385	3226	4207	0.340	59.8
1991		830	390	500	1253	1606	0	1642	2106	4034	5344	0.407	76.3
1992		765	427	538	1022	1285	0	1449	1822	3243	4211	0.447	70.5
1993		923	299	412	842	1162	0	1141	1573	3967	5651	0.288	73.8
	+/- 1992	21%	-30%	-23%	-18%	-10%	.	-21%	-14%	22%	34%	-36%	5%
	+/- Mean	26%	-24%	-15%	-18%	-8%	.	-19%	-10%	14%	27%	-29%	3%

* - "Other Rivers" includes Barney's, French, Middle: Pictou Co., Pomquet, Pugwash, Shinimikas, South, Sutherland, Tidnish, Tracadie, and Wright.

Table 4. Historical catch and effort data for 3 index Gulf N.S. rivers using DFO fisheries officer estimates (1977-1983) and license stub returns (1984-1993).

Year	River	Small Salmon	Large Salmon	Effort Roddays	CPUE Small Salmon	CPUE Large Salmon	CPUE Total Salmon
	East River Pictou						
1977		0	25	88	0.000	0.284	0.284
1978		0	85	120	0.000	0.708	0.708
1979		0	10	100	0.000	0.100	0.100
1980		2	148	600	0.003	0.247	0.250
1981		2	38	150	0.013	0.253	0.267
1982		12	1	416	0.029	0.002	0.031
1983		7	31	345	0.020	0.090	0.110
1984		14	40	474	0.030	0.084	0.114
1985		40	162	398	0.101	0.407	0.508
1986		89	620	1151	0.077	0.539	0.616
1987		83	389	1286	0.065	0.302	0.367
1988		129	422	1300	0.099	0.325	0.424
1989		87	670	1705	0.051	0.393	0.444
1990		109	299	1394	0.078	0.214	0.293
1991		121	440	1526	0.079	0.288	0.368
1992		111	371	967	0.115	0.384	0.498
1993		57	203	986	0.058	0.206	0.264
	River Philip						
1977		4	96	840	0.005	0.114	0.119
1978		0	22	190	0.000	0.116	0.116
1979		7	20	720	0.010	0.028	0.038
1980		4	6	20	0.200	0.300	0.500
1981		5	8	25	0.200	0.320	0.520
1982		37	78	1050	0.035	0.074	0.110
1983		11	87	873	0.013	0.100	0.112
1984		25	60	308	0.081	0.195	0.276
1985		12	69	311	0.039	0.222	0.260
1986		111	338	640	0.173	0.528	0.702
1987		76	337	1118	0.068	0.301	0.369
1988		169	328	1227	0.138	0.267	0.405
1989		114	407	1248	0.091	0.326	0.417
1990		155	191	1139	0.136	0.168	0.304
1991		164	421	1473	0.111	0.286	0.397
1992		179	322	1213	0.148	0.265	0.413
1993		171	356	1743	0.098	0.204	0.302
	West River Antigonish						
1977		1	0	2	0.500	0.000	0.500
1978		6	53	298	0.020	0.178	0.198
1979		0	6	35	0.000	0.171	0.171
1980		37	43	300	0.123	0.143	0.267
1981		2	18	89	0.022	0.202	0.225
1982		5	0	140	0.036	0.000	0.036
1983		4	28	46	0.087	0.609	0.696
1984		17	2	107	0.159	0.019	0.178
1985		34	122	225	0.151	0.542	0.693
1986		126	476	524	0.240	0.908	1.149
1987		84	198	741	0.113	0.267	0.381
1988		67	126	457	0.147	0.276	0.422
1989		90	218	525	0.171	0.415	0.587
1990		152	200	699	0.217	0.286	0.504
1991		65	294	732	0.089	0.402	0.490
1992		136	277	748	0.182	0.370	0.552
1993		72	235	833	0.086	0.282	0.369

Table 5. Annual summaries of catch per unit effort for 3 Index Gulf N.S. rivers using license stub returns and logbooks. Mean(logbook) = (1989 to 1992). Mean(license) = (1988 to 1992). 1993 results are preliminary.

		CPUE									
		Small Salmon		Large Salmon		Logbook			License Stubs		
Year	River	Log	Stub	Log	Stub	Small	Large	Rods	Small	Large	Rods
	East: Pictou Co.										
1984		.	0.030	.	0.084	.	.	.	14	40	474
1985		.	0.101	.	0.407	.	.	.	40	162	398
1986		.	0.077	.	0.539	.	.	.	89	620	1151
1987		.	0.065	.	0.302	.	.	.	83	389	1286
1988		.	0.099	.	0.325	.	.	.	129	422	1300
1989		0.026	0.051	0.338	0.393	5	66	195	87	670	1705
1990		0.127	0.078	0.355	0.214	14	39	110	109	299	1394
1991		0.066	0.079	0.209	0.288	6	19	91	121	440	1526
1992		0.106	0.115	0.545	0.384	7	36	66	111	371	967
1993		0.087	0.058	0.145	0.206	6	10	69	57	203	986
	+/- 1992	-18%	-50%	-73%	-46%	-14%	-72%	5%	-49%	-45%	2%
	+/- Mean	7%	-32%	-60%	-36%	-25%	-75%	-40%	-49%	-54%	-28%
	River Philip										
1984		.	0.081	.	0.195	.	.	.	25	60	308
1985		.	0.039	.	0.222	.	.	.	12	69	311
1986		.	0.173	.	0.528	.	.	.	111	338	640
1987		.	0.068	.	0.301	.	.	.	76	337	1118
1988		.	0.138	.	0.267	.	.	.	169	328	1227
1989		0.079	0.091	0.400	0.326	13	66	165	114	407	1248
1990		0.275	0.136	0.246	0.168	39	35	142	155	191	1139
1991		0.108	0.111	0.362	0.286	20	67	185	164	421	1473
1992		0.136	0.148	0.193	0.265	19	27	140	179	322	1213
1993		0.126	0.098	0.184	0.204	24	35	190	171	356	1743
	+/- 1992	-7%	-34%	-4%	-23%	26%	30%	36%	-4%	11%	44%
	+/- Mean	-15%	-21%	-39%	-22%	5%	-28%	20%	9%	7%	38%
	West: Antigonish Co.										
1984		.	0.159	.	0.019	.	.	.	17	2	107
1985		.	0.151	.	0.542	.	.	.	34	122	225
1986		.	0.240	.	0.908	.	.	.	126	476	524
1987		.	0.113	.	0.267	.	.	.	84	198	741
1988		.	0.147	.	0.276	.	.	.	67	126	457
1989		0.167	0.171	0.476	0.415	14	40	84	90	218	525
1990		0.322	0.217	0.322	0.286	38	38	118	152	200	699
1991		0.070	0.089	0.549	0.402	10	78	142	65	294	732
1992		0.171	0.182	0.358	0.370	21	44	123	136	277	748
1993		0.045	0.086	0.423	0.282	5	47	111	72	235	833
	+/- 1992	-74%	-52%	18%	-24%	-76%	7%	-10%	-47%	-15%	11%
	+/- Mean	-75%	-46%	-1%	-19%	-76%	-6%	-5%	-29%	5%	32%

Table 6. Unreported catch estimates for Mainland Gulf Shore N.S. rivers provided by DFO fisheries officers, 1993.

	Total			Small			Large		
Location:	***No***	***lbs***	***kgs***	***No***	***lbs***	***kgs***	***No***	***lbs***	***kgs***
Pictou Co:									
East River	50			5		8.0	45		202.5
MacLellans Brk	30			3		4.8	27		121.5
River John	75			8		12.8	68		306.0
Barney's	40			4		6.4	36		162.0
French	20			2		3.2	18		81.0
Sutherlands	15			2		3.2	14		63.0
West River	30			3		4.8	27		121.5
Cumberland Co:									
River Philip	130			13		20.8	117		526.5
Shinimikas	100			10		16.0	90		405.0
Wallace	50			5		8.0	45		202.5
Pugwash	30			3		4.8	27		121.5
Tidnish	5			1		1.6	5		22.5
Colchester Co:									
Waugh	50			5		8.0	45		202.5
French	40			4		6.4	36		162.0
Antigonish Co:									
Pomquet	20			2		3.2	18		81.0
Tracadie	25			3		4.8	23		103.5
South	10			1		1.6	9		40.5
Afton	0			0		0.0	0		0.0
West River	30			3		4.8	27		121.5
Total:				77		123.2	677		3046.5

Table 7. Estimated returns and escapements of large and small salmon for three rivers in Gulf mainland Nova Scotia for 1985 to 1993.

Year	Large Salmon			Small Salmon		
	Returns	Escapement	% of Target	Returns	Escapement	% of Target
East River (Pictou Co.)						
1985	224	222	79%	88	64	108%
1986	855	847	301%	204	151	256%
1987	540	536	191%	195	147	249%
1988	585	579	206%	303	223	378%
1989	942	933	332%	196	143	242%
1990	407	403	143%	247	182	308%
1991	619	614	219%	270	200	339%
1992	523	519	185%	251	184	312%
1993	429	287	102%	137	95	161%
Mean (85-92)	642	636	226%	238	181	307%
River Philip						
1985	97	96	27%	27	20	27%
1986	465	460	128%	250	184	245%
1987	477	472	132%	169	124	165%
1988	458	452	126%	384	286	381%
1989	566	561	157%	254	187	249%
1990	279	276	77%	362	268	357%
1991	578	573	160%	360	262	349%
1992	461	457	128%	398	292	389%
1993	493	488	136%	383	280	373%
Mean (85-92)	465	461	129%	300	229	305%
West River (Antigonish Co.)						
1985	174	172	152%	76	55	N/A
1986	649	645	571%	278	204	N/A
1987	279	277	245%	190	142	N/A
1988	175	173	153%	147	108	N/A
1989	316	314	278%	200	147	N/A
1990	284	281	249%	342	253	N/A
1991	414	410	363%	146	108	N/A
1992	398	395	350%	312	233	N/A
1993	325	323	286%	159	116	N/A
Mean (85-92)	363	359	318%	230	175	N/A

Table 8. Estimation of spawner requirements for East River (Pictou).

Habitat area (sq.m.)			755,000		
Optimal Egg Deposition (2.4 eggs/sq.m.)			2.4		
Total Egg Requirements			1,812,000		
Biological Characteristics					
Fecundity			1,764	eggs/kg	
Small salmon	% female		5		
	mean wt. (kg)		1.7		
Large salmon	% female		60		
	mean wt. (kg)		6.1		
Eggs per small salmon spawner	=	eggs/kg * mean wt(kg) * % female			
	=	1764 * 1.7 * 5%			
	=	150			
Eggs per large salmon spawner	=	1764 * 6.1 * 60%			
	=	6,456			
Required number of large salmon	=	281	---->>	168	female
				112	male
Deficit males	=	56			
Small spawners to obtain deficit males	=	56 / 0.95			
	=	59			
Spawning Requirements:	Large	281			
	Small	59			

Table 9. Results of electrofishing surveys on Mainland Gulf Shore N.S. rivers for 1986 to 1993.

County	River	Year	Month	Day	Site #	# of Sweeps	Life Stage	5 Min Catch	Catch	Mean Lgth	Est. Density	Territory Size	PHS	Total PHS
Antigonish County														
	Afton	1992	Aug.	12	1	0.5	Fry			.	21	.	.	
	Afton	1992	Aug.	12	1	0.5	Parr			.	15	.	.	.
	Afton	1992	Aug.	12	2	0.5	Fry			6.1	111	0.166	21.9%	
	Afton	1992	Aug.	12	2	0.5	Parr			11.3	50	0.829	48.9%	70.8%
	Afton	1992	Aug.	12	3	0.5	Fry			5.6	214	0.133	33.8%	
	Afton	1992	Aug.	12	3	0.5	Parr			10.9	54	0.755	48.9%	82.7%
	Pomquet	1992	Aug.	11	1	0.5	Fry			5.5	161	0.127	24.3%	
	Pomquet	1992	Aug.	11	1	0.5	Parr			9.4	22	0.513	13.2%	37.5%
	Pomquet	1992	Aug.	11	2	0.5	Fry			5.5	359	0.127	54.1%	
	Pomquet	1992	Aug.	11	2	0.5	Parr			9.2	89	0.485	51.4%	105.4%
	Pomquet	1992	Aug.	11	3	0.5	Fry			5.4	172	0.121	24.7%	
	Pomquet	1992	Aug.	11	3	0.5	Parr			9.2	51	0.485	29.2%	53.9%
	Pomquet	1992	Aug.	11	4	0.5	Fry			4.9	257	0.094	28.6%	
	Pomquet	1992	Aug.	11	4	0.5	Parr			9.3	99	0.499	58.9%	87.5%
	Pomquet	1992	Aug.	11	5	0.5	Fry			5.4	166	0.121	23.8%	
	Pomquet	1992	Aug.	11	5	0.5	Parr			8.6	96	0.406	46.7%	70.5%
	Pomquet	1992	Aug.	12	6	3	Fry		5	5.7	21	0.139	3.5%	
	Pomquet	1992	Aug.	12	6	3	Parr		30	9.9	27	0.587	19.0%	22.4%
	West	1993	Sept.	8	2	0.5	Fry	87		4.9				
	West	1993	Sept.	8	2	0.5	Parr	33		9.3				
	West	1993	Sept.	8	4	3	Fry	47	121	4.6	165	0.079	15.6%	
	West	1993	Sept.	8	4	3	Parr	23	38	8.8	51	0.432	26.3%	41.9%
	West	1992	Aug.	4	2	4	Fry		226	4.4	130	0.071	10.9%	
	West	1992	Aug.	4	2	4	Parr		42	9.4	38	0.513	23.2%	34.2%
	West	1992	July	30	4	3	Fry		249	4.2	201	0.063	14.9%	
	West	1992	July	30	4	3	Parr		85	8.2	86	0.359	36.6%	51.6%
	West	1991	Aug.	2	4	4	Fry		249	4.0				
	West	1991	Aug.	2	4	4	Parr		81	8.2				
	West	1988	July	28	4.2		Fry		274	3.8				
	West	1988	July	28	4.2		Parr		71	8.1				
	West	1987	July	22	4.1		Fry		485	3.5				
	West	1987	July	22	4.1		Parr		155	8.2				
	West	1987	July	22	4.2		Fry		240	3.5				
	West	1987	July	22	4.2		Parr		125	8.2				
	West	1986	June	4	4.1		Fry		29	2.7				
	West	1986	July	22	4.1		Fry		256	4.2				
	West	1986	July	22	4.1		Parr		42	8.8				
	West	1986	June	4	4.1		Parr		111	7.4				
	West	1986	July	22	4.2		Fry		240	4.2				
	West	1986	July	22	4.2		Parr		125	8.6				

Table 9. Continued ....

County	River	Year	Month	Day	Site #	# of Sweeps	Life Stage	5 Min Catch	Catch	Mean Lgth	Est. Density	Territory Size	PHS	Total PHS
Cumberland County														
	River Philip	1993	Sept.	15	1	3	Fry	1	0	4.7				
	River Philip	1993	Sept.	15	1	3	Parr	8	33	8.8	36	0.432	18.6%	18.6%
	River Philip	1993	Sept.	15	5	0.5	Fry	4		5.4				
	River Philip	1993	Sept.	15	5	0.5	Parr	3		9.3				
	River Philip	1993	Sept.	15	6	0.5	Fry	90		5.8				
	River Philip	1993	Sept.	15	6	0.5	Parr	33		8.8				
	River Philip	1988	July	24	1		Fry		216	3.7				
	River Philip	1988	July	24	1		Parr		25	8.9				
	River Philip	1986	June	6	1		Fry		70	3.1				
	River Philip	1986	Aug.	11	1		Fry		135	4.5				
	River Philip	1986	June	6	1		Parr		20	8.6				
	River Philip	1986	Aug.	11	1		Parr		24	9.7				
	River Philip	1986	Aug.	12	2		Fry		74	4.5				
	River Philip	1986	Aug.	12	2		Parr		28	8.7				
	River Philip	1986	Aug.	15	3		Fry		170	5.1				
	River Philip	1986	Aug.	15	3		Parr		52	9.5				
	River Philip	1986	Aug.	20	4		Fry		216	5.8				
	River Philip	1986	Aug.	20	4		Parr		25	10.8				
	Wallace	1993	Sept.	14	1	0.5	Fry	14		6.3				
	Wallace	1993	Sept.	14	1	0.5	Parr	10		10.2				
	Wallace	1993	Sept.	14	2	0.5	Fry	11		5.3				
	Wallace	1993	Sept.	14	2	0.5	Parr	3		10.2				
	Wallace	1993	Sept.	14	3	0.5	Fry	37		6				
	Wallace	1993	Sept.	14	3	0.5	Parr	31		9.8				
	Wallace	1993	Sept.	14	4	0.5	Fry	24		5.9				
	Wallace	1993	Sept.	14	4	0.5	Parr	26		9.6				
	Wallace	1993	Sept.	14	5	0.5	Fry	25		6.1				
	Wallace	1993	Sept.	14	5	0.5	Parr	14		11.1				
Pictou County														
	Barneys	1992	Aug.	13	1	0.5	Fry			5.4	228	0.121	32.7%	
	Barneys	1992	Aug.	13	1	0.5	Parr			9.1	118	0.471	66.3%	98.9%
	Barneys	1992	Aug.	13	2	0.5	Fry			5.7	209	0.139	34.6%	
	Barneys	1992	Aug.	13	2	0.5	Parr			10.1	41	0.618	30.1%	64.7%
	Barneys	1992	Aug.	13	3	3	Fry		129	5.4	183	0.121	26.2%	
	Barneys	1992	Aug.	13	3	3	Parr		42	10.3	54	0.651	42.2%	68.4%
	Barneys	1992	Aug.	13	4	0.5	Fry			5.4	79	0.121	11.4%	
	Barneys	1992	Aug.	13	4	0.5	Parr			11.3	20	0.829	19.9%	31.3%
	East	1993	Sept.	9	4	3	Fry	27	44	5	64	0.099	7.5%	
	East	1993	Sept.	9	4	3	Parr	17	19	8.1	27	0.348	11.4%	18.8%
	East	1993	Sept.	9	5	0.5	Fry	65		4.5				

Table 9. Continued ....

County	River	Year	Month	Day	Site #	# of Sweeps	Life Stage	5 Min Catch	Catch	Mean Lgth	Est. Density	Territory Size	PHS	Total PHS
	East	1993	Sept.	9	5	0.5	Parr	18		8.3				
	East	1993	Sept.	9	8	0.5	Fry	57		5.3				
	East	1993	Sept.	9	8	0.5	Parr	41		8.7				
	East	1992	Aug.	5	3	4	Fry		165	4.2	88	0.063	6.5%	
	East	1992	Aug.	5	3	4	Parr		49	8.6	34	0.406	16.7%	23.2%
	East	1992	Aug.	6	4	0.5	Fry	337		4.4	315	0.071	26.5%	
	East	1992	Aug.	6	4	0.5	Parr	93		7.7	64	0.305	23.1%	49.7%
	East	1992	Aug.	5	5	0.5	Fry			4.4	164	0.071	13.8%	
	East	1992	Aug.	5	5	0.5	Parr			7.8	37	0.315	13.8%	27.6%
	East	1992	Aug.	6	6	0.5	Fry			5.1	89	0.104	11.0%	
	East	1992	Aug.	6	6	0.5	Parr			.	15	.	.	11.0%
	East	1992	Aug.	7	7	4	Fry			4.2	217	0.063	16.2%	
	East	1992	Aug.	7	7	4	Parr			8.3	114	0.371	50.1%	66.2%
	French	1992	Aug.	7	1	0.5	Fry			5.6	215	0.133	34.0%	
	French	1992	Aug.	7	1	0.5	Parr			9.6	21	0.542	13.5%	47.5%
	French	1992	Aug.	7	2	0.5	Fry			5.6	131	0.133	20.6%	
	French	1992	Aug.	7	2	0.5	Parr			9.6	24	0.542	15.2%	35.8%
	French	1992	Aug.	7	3	3	Fry		91	5.5	156	0.127	23.5%	
	French	1992	Aug.	7	3	3	Parr		16	10.2	29	0.635	22.0%	45.5%
	River John	1993	Sept.	10	1	0.5	Fry	0		.				
	River John	1993	Sept.	10	1	0.5	Parr	27		9				
	River John	1993	Sept.	10	2	0.5	Fry	11		5.4				
	River John	1993	Sept.	10	2	0.5	Parr	34		8.6				
	River John	1993	Sept.	10	3	0.5	Fry	54		4.8				
	River John	1993	Sept.	10	3	0.5	Parr	27		8.9				
	River John	1993	Sept.	10	4	0.5	Fry	35		4.8				
	River John	1993	Sept.	10	4	0.5	Parr	10		8.9				
	River John	1993	Sept.	10	5	0.5	Fry	17		6.1				
	River John	1993	Sept.	10	5	0.5	Parr	9		9.7				
	River John	1993	Sept.	10	6	0.5	Fry	9		6.1				
	River John	1993	Sept.	10	6	0.5	Parr	11		10.4				
	Sutherlands	1992	Aug.	12	1	0.5	Fry			5.3	179	0.115	24.4%	
	Sutherlands	1992	Aug.	12	1	0.5	Parr			9.4	76	0.513	46.6%	71.0%
	Sutherlands	1992	Aug.	12	2	0.5	Fry			.	21	.	.	
	Sutherlands	1992	Aug.	12	2	0.5	Parr			.	15	.	.	.
	Sutherlands	1992	Aug.	12	3	0.5	Fry			4.5	393	0.075	35.0%	
	Sutherlands	1992	Aug.	12	3	0.5	Parr			8.7	53	0.419	26.5%	61.5%

Table 10. Summary of salmonid species captured (P) in the electrofishing surveys selected rivers in Gulf Nova Scotia.

River	Atlantic Salmon	Speckled Trout	Brown Trout	Rainbow Trout
River Philip	P	P	P	P
Wallace	P	-	P	-
River John	P	P	P	-
East R. (Pictou Co.)	P	P	P	-
French R.	P	P	P	-
Sutherlands R.	P	P	-	-
Barneys R.	P	P	P	-
West R. (Ant. Co.)	P	P	P	-
Pomquet River	P	P	P	-
Afton River	P	P	-	-

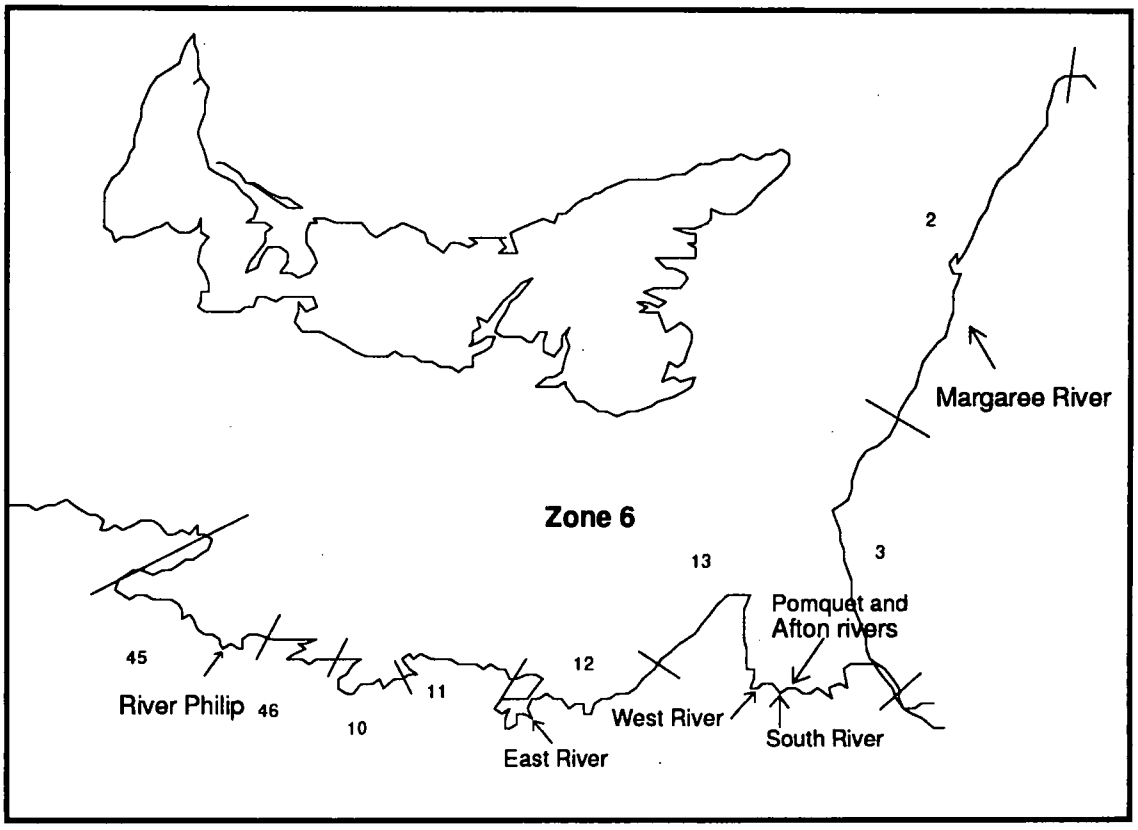


Figure 1. Gulf Nova Scotia coastline indicating Atlantic salmon rivers mentioned in text as well as statistical districts.

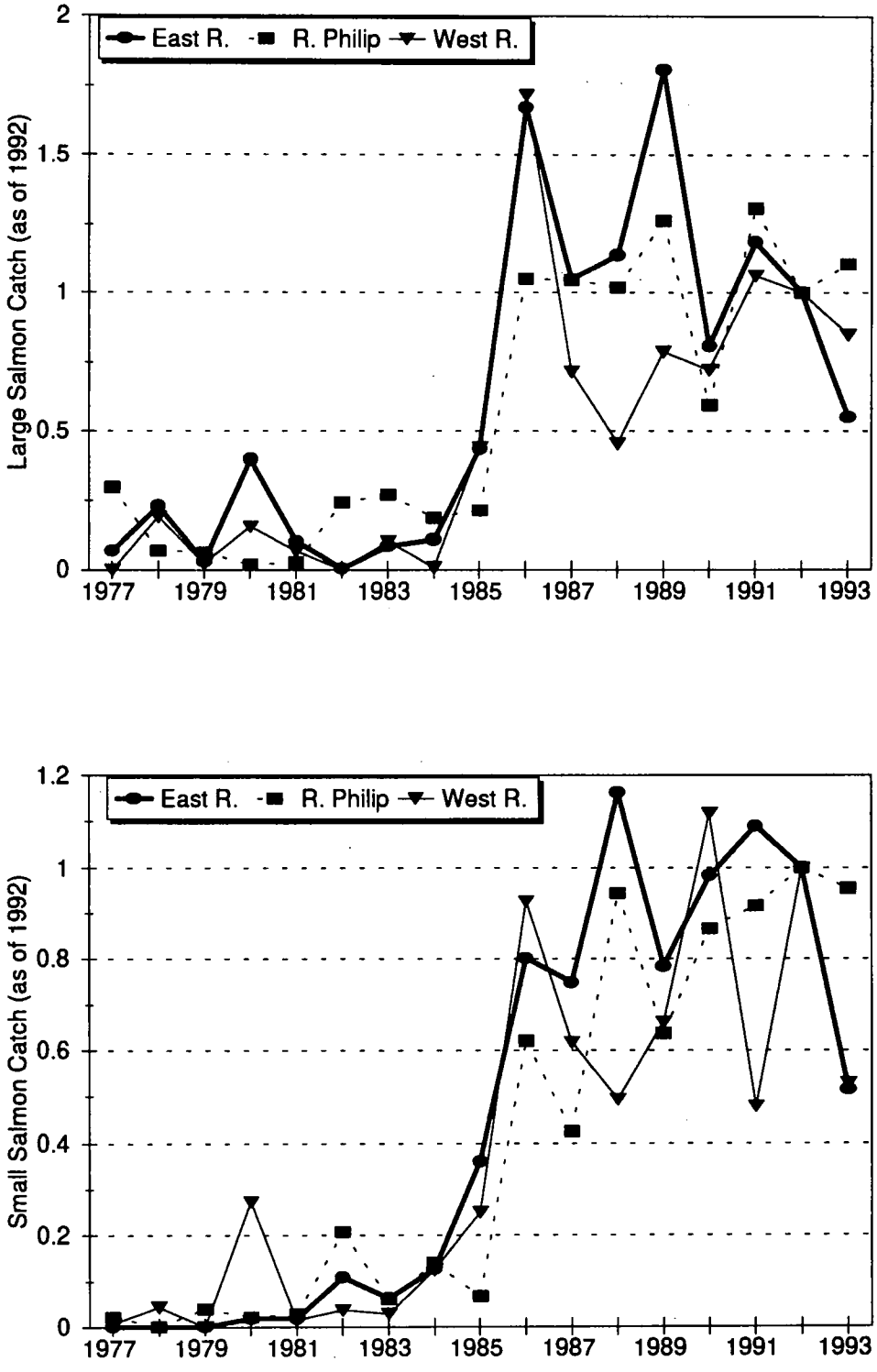


Figure 2. Large salmon catch (upper) and small salmon catch (lower) relative to the 1992 catch from River Philip, East River (Pictou) and West River (Ant.), 1977 to 1993.

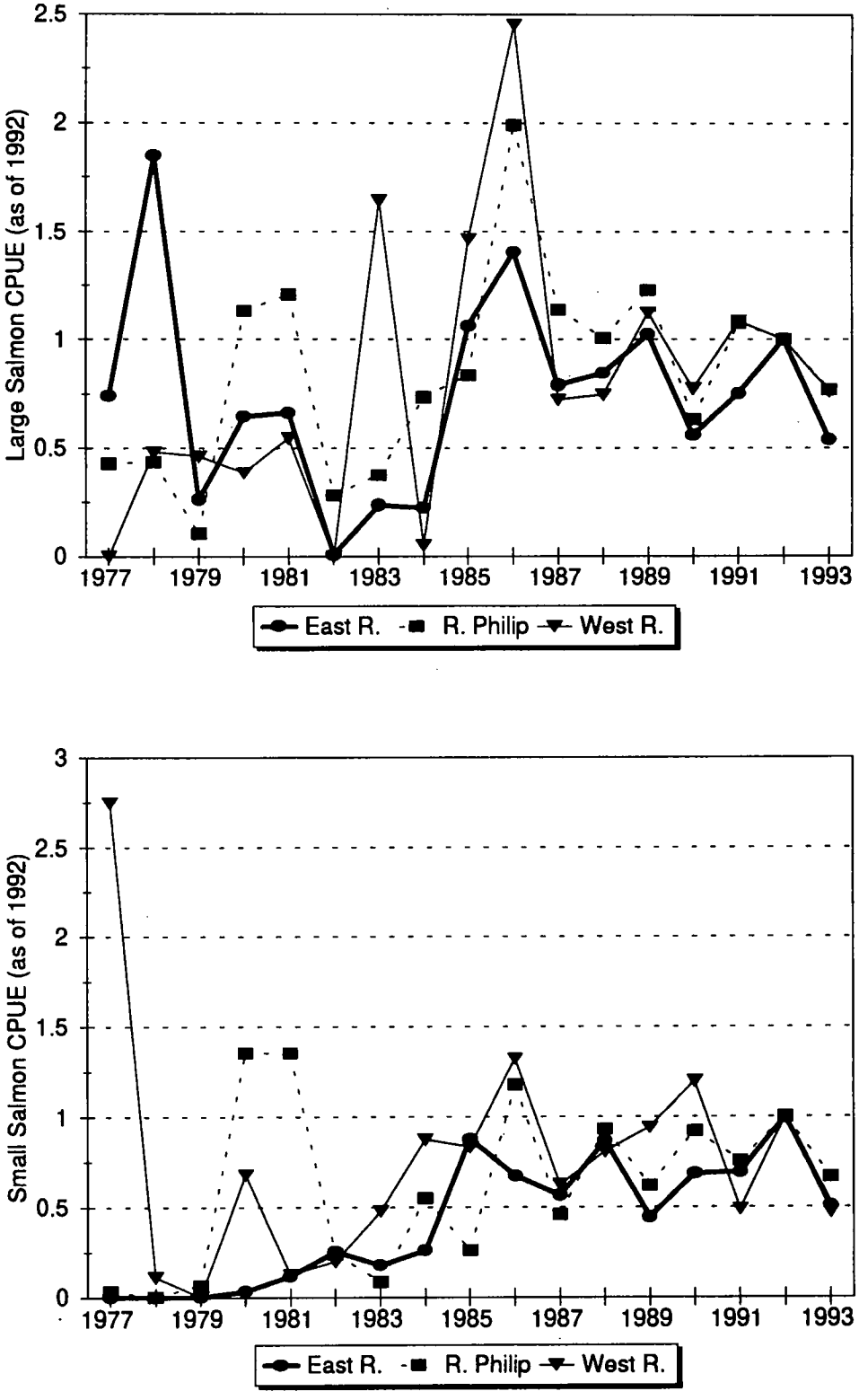


Figure 3. Large salmon (upper) and small salmon (lower) CPUE relative to 1992 for River Philip, East River (Pictou) and West River (Ant.), 1977 to 1993.

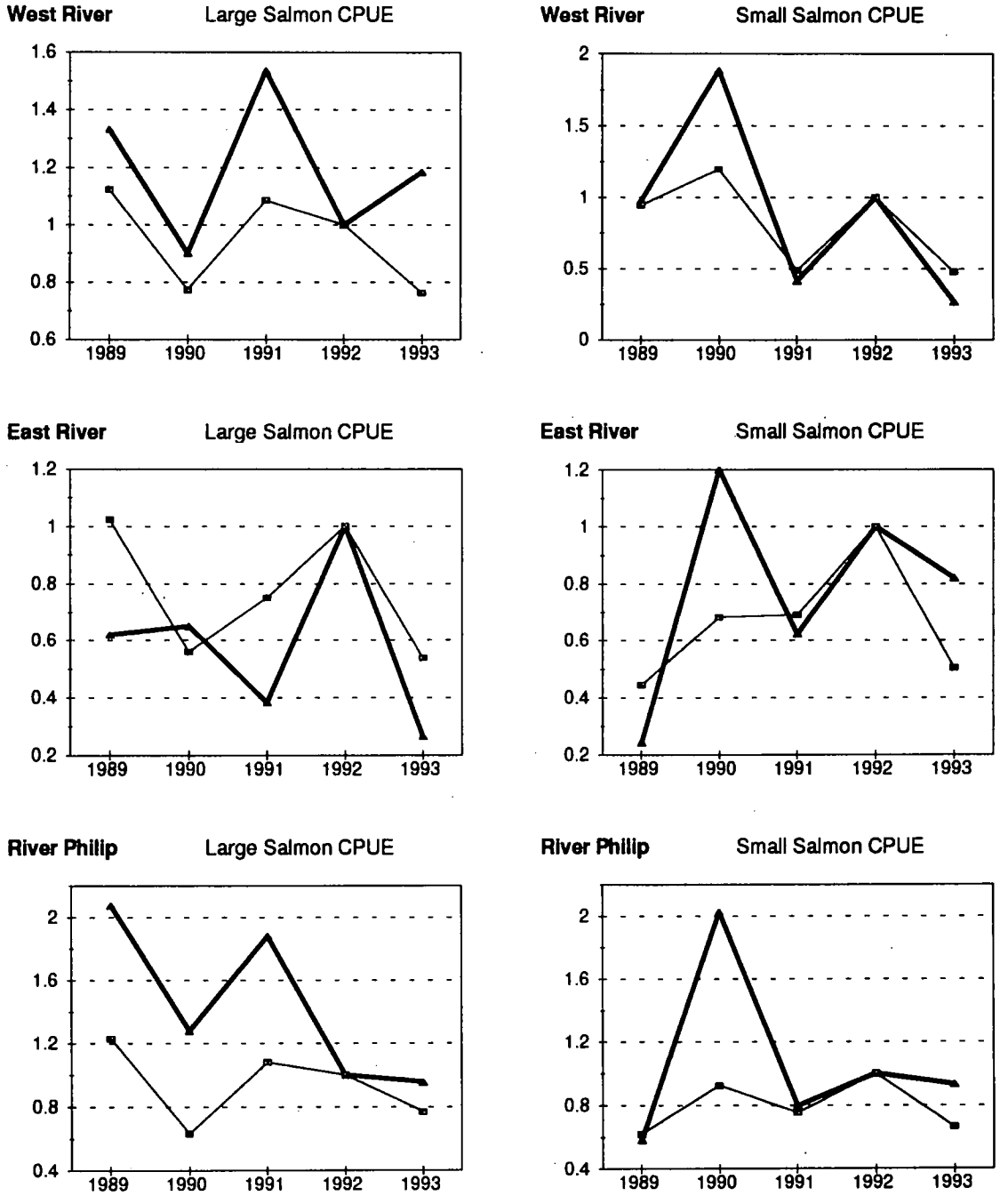
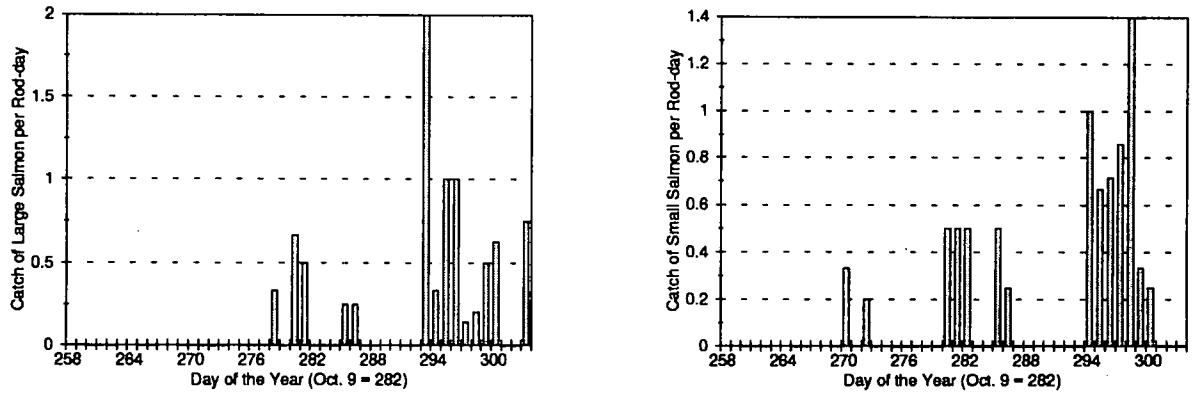
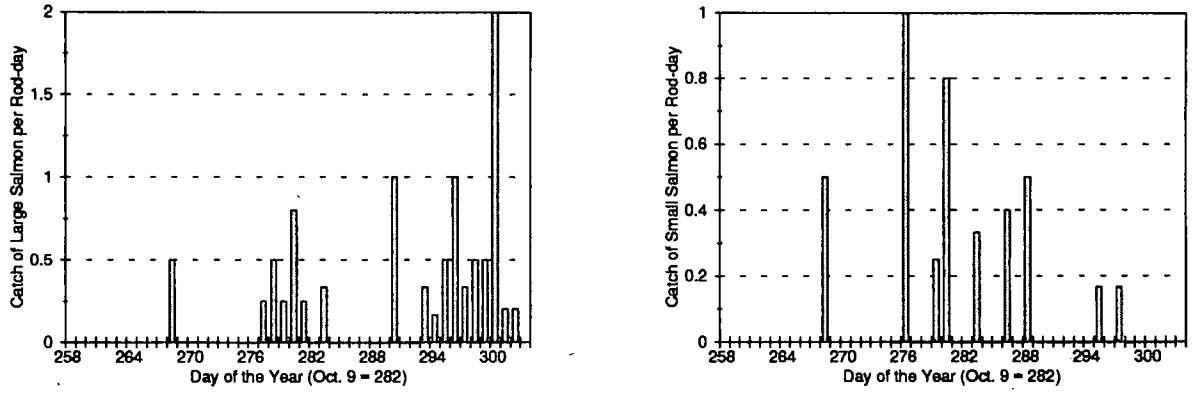


Figure 4. Abundance indices of large salmon and small salmon based on CPUE from logbooks (triangles) and license stub returns (squares) for three rivers of Gulf Nova Scotia.

West River (Ant.)



East River



River Philip

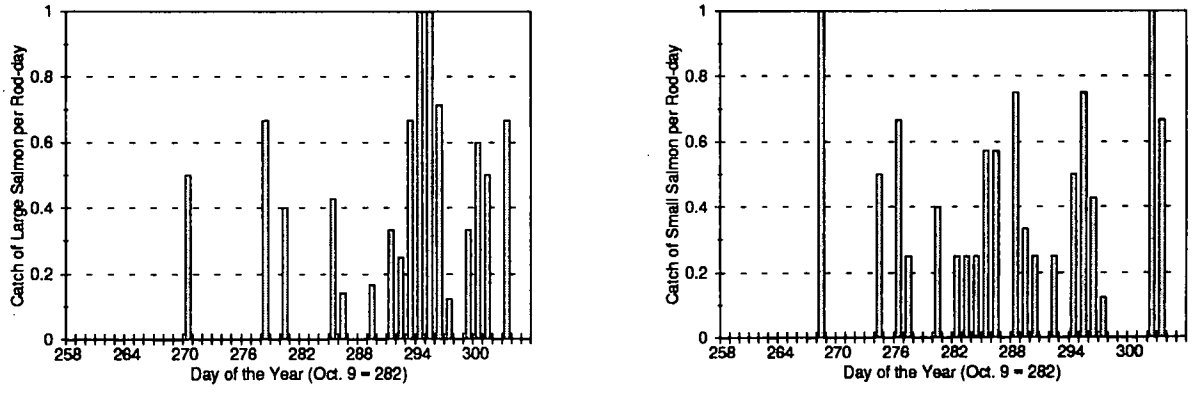


Figure 5. Run timing of small and large salmon into the West River (Ant.), East River (Pictou), and River Philip based on the logbook CPUE for 1990.