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Interception in Nova Scotian Coastal Waters of Nova Scotia Salmon Returning to Home Rivers

by

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ABSTRACT

Returns from approximately 270,000 tagged smolts released to East River, Sheet Harbour and Liscomb rivers, 1975-'79 and the LaHave and Medway rivers, 1971-'79 were used to determine the proportional losses from Fishery Statistical Districts 16/17/19 and 26/27/28 to other District commercial fisheries in Nova Scotia and the relative importance of these intercepted stocks to the landings of those other Fishery Districts. Of the total projected Nova Scotia commercial harvest of stocks originating in Districts 26/27/28, 44.7% was taken in the "home" Districts, 38.4% was landed in Districts 22/23/25 and 9.5% was caught in District 9. Of the total from Districts 16/17/19, 38.2% was taken in "home" waters, 31.4% was in Districts 22/23/25 and 20.3% was in District 9. Districts 9 and 15 appear to be 90-94% dependent, Districts 22/23/25 41% dependent and Districts 30/31/32 39% dependent on salmon stocks originating from Districts 26/27/28 and 16/17/19 collectively. Both the shortcomings of commercial statistics and a potential mechanism influencing the approach of salmon to home rivers from off-coast waters are discussed.

RESUME

L'objectif de ce document est d'estimer les pourcentages de saumon que contribuent les districts statistiques des pêches 16, 17 et 19 d'une part et 26, 27 et 28 d'autre part aux pêches commerciales des autres districts de la Nouvelle-Ecosse. Pour ce faire, on a étudié les recaptures des quelques 270 000 smolts étiquetés et relachés dans les rivières East, Sheet Harbour et Liscomb de 1975 à 1979 et de 1971 à 1979 dans les rivières LaHave et Medway. Une proportion de 44,7 % de la capture néo-écossaise commerciale totale estimiée de saumons nés dans les districts 26, 27 et 28 a été effectuée dans ces mêmes districts, 38,4 % ont été capturés dans les districts 22, 23 et 25 et 9,5 % dans le district 9. Du total estimé de captures des saumons nés dans le districts 16, 17 et 19, 38,2 % ont été capturés dans ces mêmes districts, 31,4 % dans les districts 22, 23 et 25 et 20,3 % dans les district 9. Les districts 9 et 15 semblent dépendre à 90-94 % des stocks de saumon provenant des districts 26, 27 et 28 ainsi que des districts 16, 17 et 19; les districts 22, 23 et 25 semblent dépendre à 41 % de ces mêmes stocks tandis que les districts 30, 31 et 32 semblent en dépendre à 39 %. On discute tant des insuffisances des statistiques commerciales que d'un mécanisme qui influe peut-être sur l'orientation des saumons qui se dirigent vers leurs rivières natales depuis les eaux situées au large des côtes.

INTRODUCTION

Recently there have been intensive efforts to define and promote adjustments in the fishing season opening that would reduce the interception of Atlantic salmon of mainland origin in Newfoundland (Anon, 1981). In Nova Scotia, interception of mainland stocks in mainland areas distant from their river origin has been recognized but to date is unquantified. Recent efforts to strive toward discrete stock management and accordingly to minimize the interception of migrating salmon in mixed stock fisheries to permit allocation of a greater proportion of the allowable catch to salmon fisheries close to or in the rivers of origin dictate new requirements for information on strength of stocks and the impact of local fisheries on the stocks originating in local and distant Fishery Statistical Districts. This document is an attempt to delineate areas of Nova Scotia which intercept stocks originating in Districts 16/17/19 (incl. East River, Sheet Harbour and Liscomb rivers) and Districts 26/27/28 (incl. LaHave and Medway rivers) (Figure 1).

METHODS

The approach taken in estimating the numbers and weights of Atlantic salmon of specific origins that contributed to catches in homewater and distant Fishery Districts of Nova Scotia was adapted from Côté (1981). It equates the number of tag returns of an age-class from home district sport fisheries as a ratio of the sport catch (numbers or weight) from those districts to the number of tag returns from each designated commercial fishery as a ratio of "X", where "X" is the number or weight of salmon from the "home district" caught in the designated commercial fishery, e.g.,

$$\frac{\text{\# 1-SW tags in sport catch, Dist. 26/27/28}}{\text{total 1-SW sport catch, Dist. 26/27/28}} = \frac{\text{\# 1-SW tags in commercial catch, Dist. 9}}{\text{"X" (the 1-SW commercial catch Dist. 9 originating Dist. 26/27/28)}}$$

Assumptions

1. Hatchery-reared and tagged smolts, sometimes released to a river different than that from which their parents were collected, follow the same ocean migration routes as salmon endemic to the river(s) being assessed.

2. Salmon stocks from rivers adjacent to those for which tagging data are available behave in a like fashion.

3. No further tag loss occurs between the time of first appearance in distant Nova Scotia fisheries and the home river sport fishery.

4. Tag reporting rates for sport and commercial fisheries of different Fishery Districts in Nova Scotia are similar.

Data

A total of 1,891 tag returns (Table 1), largely summarized in reports of Newbould and McLean (1981) and Newbould (1977) were used in the analysis. These originated from joint hatchery smolt evaluation and enhancement programs, the latter of which was directed by R.W. Gray, biologist, Freshwater and Anadromous Division, Resource Branch, Halifax, involving the release of 149,558 smolts to the LaHave and Medway rivers, 1971-'74 and 1976-'79 (App. 1) and 119,589 smolts to East River, Sheet Harbour and Liscomb River, 1975-'79 (App. 2).

Sport and commercial catches were drawn from the Redbook series compiled by various authors since 1972. The number of commercial salmon in District 23 in 1976 was estimated as the mean of 1974-'75 and 1977-'78 catches.

Groupings of Districts was based firstly on proximity of rivers for which there was tagging data, e.g., 26/27/28 and 17/ 19. Adjacent Districts containing salmon producing rivers which were potentially physically and biologically similar and for which it might be assumed that salmon stocks would behave similarly to tagged lots were also included - hence the inclusion of District 16 in 16/17/19. Districts 22/23/25, St Margaret's and Mahone bays were grouped because of their small area, lack of significant salmon producing rivers and common 1-SW component in the commercial fisheries. Districts 30/31/32 were grouped because of their proximity and small commercial landings. Districts 1 and 4 were also grouped because of their proximity and to combine single tag returns to each. Districts 7, 9, 15 and 20 which reported tags were treated separately.

Where the mean weights of 2-SW fish in the sport catch exceeded 4.5 kg, the number of 3-SW fish (Table 2) was estimated from the total numbers and weights by solving two equations in two unknowns assuming mean weights of 4.5 kg for 2-SW fish and 8.2 kg for 3-SW fish (Atlantic Salmon Review, 1978). Similarly for commercial statistics in which the mean weight of fish was less than 4.5 kg, the total weight of 1-SW fish was estimated from a mean weight of 1.8 kg/fish. These estimated fish were then reassigned to their respective smolt-classes (Table 3). Because of mean weights less than 4.5 kg for District commercial catches, 3-SW fish could not be extracted for reassignment to appropriate smolt classes. This omission was judged to be of minor consequence.

Numbers of tagged fish were as well converted directly to weights for the derivation of weighted total percentage contributions because of the paucity of 3- and 4-SW tag returns and the potential error in estimating separately the numbers of untagged fish of each sea-age category in the sport and commercial fisheries. Assigned weights were 1.8, 4.5 and 8.2 kg/ fish for 1-SW, 2-SW and 3-SW fish, respectively (Atlantic Salmon Review, 1978).

RESULTS

Reported annual commercial catches (kg) of salmon in Nova Scotian Atlantic coast Fishery Statistical Districts 1 through 32 which returned tags are totalled for the 1972-'80, 1976-'80 and 1977-'80 periods relative to the respective contributions of the 1971-'74, 1976-'79 and 1975-'79 smolt classes (Table 3). Based on the 1972-'80 totals the Districts in descending order of catches were 1/4 (33% of total); 22/23/25 (28%); 7 (13%); 16/17/19 (9%); 26/27/28 (7%); 20 (5%); 9 (2%); 30/31/32 (2%); and 15 (1%).

Weights of salmon contributed by each of Districts 26/27/28 and 16/17/19 to all Fishery Districts or District groupings for three different time periods appear at the top of Table 4. Districts 26/27/28 provide the longest continuum of data (1972-'80) and the least difference between individual District or total weights derived by either numbers or weighed weights. The 1972-'80 time series for stocks originating in District 26/27/28 indicates when calculated by weight that of their total commercial harvest in Nova Scotia, 44.7% was taken in the home Districts, 38.4% was taken in District 22/23/25, 2.4% was taken in District 20 etc. With the exception of the 9.5% to District 9, Cape Breton, the proportion decreased with increasing distance from the "home" Districts (Table 4). For the 1976-'80 time series of District 16/17/19 data, the greatest single proportion (38.2%) was taken in "home waters". Immediately adjacent Districts 20 and 15 took small proportions, 3.5 and 3.3% respectively. More outlying districts, e.g. Districts 22/23/25 and District 9 took substantial proportions, e.g., 31.4% and 20.3% respectively. The 1977-'80 time series shows comparable proportions.

A problem in the short time-series or perhaps in the catch statistics of recent years is apparent when values in Tables 3 and 4 are used to derive the percentage composition of District 26/27/28 and Districts 16/17/19 stocks in the various Districts.

The longest time series provides expected values totalling less than 100%. Raw values, although potentially spurious, suggest that District 9 and to some extent Districts 22/23/25 rely heavily on the interception of stocks from Districts 26/27/28. Reduced interception would presumably increase that proportion of fish originating in Districts 26/27/28 which could be harvested in home districts or permitted to escape into home rivers.

The shorter, more recent time series gives values exceeding 100% (Table 4). Raw scores for Districts 16/17/19 data show also that District 9 and 15 in particular and, to a lesser extent, Districts 22/23/25 and 20 rely on interception. All stocks, not just those of LaHave parentage, contributed to theoretical "overshooting" of home river districts. Reduced interception would presumably increase the proportion of total production reaching "home districts" fishermen or river escapements.

The short time-series data bring into question not only the assumptions (constant tag reporting between Districts) but the accuracy of both the reported commercial and sport statistics. For example, values in excess of 100% could be the result of either incomplete reporting of commercial statistics or over-reporting of sport catches relative to tag returns.

Raw scores were then adjusted by increasing commercial landings for the 1977-'80 period to the point where contributions from Districts 26/27/28 and 16/17/19 together comprised less than 100% (footnote methods in Table 5). Original commercial landings then became 74% of the final except in Districts 16/17/19, District 15 and District 9 which proportions decreased to 48,47 and 22% respectively (Table 5). Total landings of all Districts experienced a 51% increase. Total adjusted proportions indicate that District 9 and 15 were nearly totally dependent (90-94%), and Districts 22/23/25 were 41% dependent on salmon stocks originating in Districts 26/27/28 and Districts 16/17/19. Substantial commercial fisheries on stocks of undetermined origin in District 7 remain unaddressed.

DISCUSSION

The analysis has delineated the prime areas of interception for stocks of Districts 26/27/28 and 16/17/19, the relative magnitude of the impact of each of the distant Nova Scotia Districts on those stocks and the relative importance of those stocks to intercepting fisheries.

Independent evidence from a correlation analysis of catch effort data (kg/unit/day) for commercial salmon gear and fish traps of Cape Breton and the eastern and southern shores of Nova Scotia, 1970-'80 corroborates the evidence for areas intercepting stocks of Districts 26/27/28 in particular. Significant positive correlations between measures of stock abundance (Table 6) suggest at minimum that the stocks being exploited are in the same relative abundance. If, however, the correlation is positive and one area has no positive correlation with a measure of abundance in its 'homewater' production, the correlation could be interpreted as the harvesting of the same stock in two different areas.

The significant sport fisheries, 1970-'80 for SE Nova (designated area; Table 6) were contained in Districts 17 and 19 - eleven year total of 1,726 2-SW and 14,654 1-SW fish. District 20, 488 2-SW and 630 1-SW fish basically represented Hfx while Districts 25, 27, and 28 at 3,763 2-SW and 14,924 1-SW fish represented the major sport harvest from SW Nova. Correlation coefficients for SE Nova commercial catch/effort and sport landings ranged from - 0.11 to 0.21 (P. 05 = 0.60). Those of the Halifax commercial catch/effort and the small numbers of sport fish landed in District 20 ranged from - 0.02 to - 0.21 while those of SW Nova and 2-SW sport landings ranged from 0.78 to 0.79 (P. 01 = .74). Hence commercial fisheries in SW Nova might be interpreted to utilize "home" District stocks, while those commercial fisheries of Hfx and SE Nova could be interpreted as originating elsewhere. The fact that catch/effort data SE Nova STN is associated with all C/f data for all of the Hfx and SW Nova gear and that all Halifax gear is in turn correlated with one or the other or both of the SW Nova gear and LaHave data (Table 6) strongly suggests the importance of Districts 26/27 and 28 production to easterly mainland commerical fisheries.

Interestingly, the Louisburg fishery (District #7 or bascially Sydney SGN of Table 6) from which there was only one mainland tag recovered was not significantly correlated with any data sets, including District 7 and 8 sport fisheries totaling 724 2-SW and 2381 1-SW fish, 1970-71 and 1973-'80. Highest correlation coefficients of 0.58, 0.55, 0.54 and 0.54 (P. 05 = 0.60) for Millbank, New Brunswick; Halifax; Victoria and Inverness counties Nova Scotia respectively, suggest that the abundance of Gulf of St. Lawrence stocks may be pertinent to the success of the Louisburg fishery.

Unfortunately, the vagaries of the tagging data and/or catch statistics, particularly in a short time series preclude the derivation of definitive impact values. However, generalized use of the perceived impacts should contribute to a policy of constraint in commercial fishing activities in those Districts whose catch was comprised of greater than 25% intercepted fish. Potential landings in Districts 16/17/19 and 26/27/28 might then be increased by 75-100% through say, 50% cutbacks in District 22/23/25 and elimination of fisheries in Districts 9 and 15.

The necessary manipulation of catch statistics so that stocks represented by tagged fish comprised less than 100% of District landings suggest that Districts 26/27/28 and 1/4 are providing both complete commercial catch records and tag returns. Commercial landings in Districts 16/17/19 and 15 and 9 are likely incomplete - especially in recent years, and tag returns are likely reasonable. In Districts 22/23/25 and 20 there would appear to be both a withholding of catch information and tags as it is unlikely that more than 50% of the catch could originate from their relatively few "home" rivers and more distant Nova Scotia, New Brunswick or U.S. stocks. Gray et al (1980) have suggested that these Districts have a significant unreported by-catch.

Speculation that the high stray rates for fish of homewater Districts 16/17/19 might be largely attributable to the 69% of tag returns orginating from East River Sheet Harbour where river entry may be on occasion impeded by inappropriate attraction waters to a fish ladder and trap for upriver trucking was considered. However, in the two years when return data for the Liscomb River were also involved, an apparent greater number of strays relative to homewater returns for East River fish in 1979 (both East and Liscomb river strays had relatively equal proportions of fish going to Districts 22/23/25) were offset in 1980 by nearly equal stray rates of 1-SW fish and a somewhat greater rate of straying for Liscomb 2-SW fish.

Loc. captured	1979		1980			
	1-SW		1-SW		2-SW	
	East	Lisc.	East	Lisc.	East	Lisc.
Districts 16/17/19	3	3	5	5	9	8
Other Nova Scotia	22	6	12	14	1	5

Differential coastal migration patterns exhibited by distant yet geographically proximate stock-groups suggest an hypothesis for the pronounced "overshooting" (57% of returns from non-homewaters) exhibited by presumably westward-migrating stocks homing to Districts 16/17/19. That is, homeward-bound stocks approaching Nova Scotia from offshore make a dispersed contact with the coast of SE Nova, SW Nova and Halifax (Fig. 1). Coasting then occurs from headland to headland enroute to homewaters. Stocks from Districts 26/27/28 exhibited the same dispersed contact but without significant "overshooting" (only 4% of returns from westward non-homewaters). One explanation for the relative absence of straying of either stock to the west of District 30 could be a physiochemical barrier to salmon migration caused by on-shore northerly currents depicted by Dadswell (1979) in the vicinity of Districts 28 to 33 during salmon migration.

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Table 1. Numbers of tags returned from fish released to the LaHave and Medway rivers representing Fishery Statistical Districts 26/27/28, 1971-'79, and from fish released to East River Sheet Harbour and Liscomb River representing Districts 16/17/19 (source, in part: Newbould and McLean, 1981; Newbould, 1977).

Capture location[2]	Districts 26/27/28						Districts 16/17/19					
	1971-'79			1976-'79			1975-'79			1976-'79		
	1-SW	2-SW	3-SW	1-SW	2-SW	3-SW	1-SW	2-SW	3-SW	1-SW	2-SW	3-SW
Greenland	185	5	1[1]	96	2	1[1]	81	1	1	78	1	1
Newfoundland	109	14	2	58	8	1	100	6		95	4	
Dist. Maritimes	2[3]	4[3]		0	2		6[4]			6		
30/31/32	2	3		2	2		1			1		
26/27/28	17	46	4	4	35	1	2			2		
22/23/25	89	16		59	13		38	8	1	27	6	
20	3	2		1	1		7			3		
16/17/19	1	2		1	1		24	19	1	19	19	
15							4	1		3	1	
9	32			19			33	3		30	3	
7								1			1	
1/4	1						1			1		
Angled, Home	160	36	1	88	26	2[1]	48	4		37	2	
Total			737			423			391			340

[1] - one 4-SW fish.

[2] - numbers are Fishery Statistical Districts.

[3] - 1 (Dist 34), 1 (Dist 37), 3 (Dist 40), 1 (Dist 2).

[4] - 3 (4W), 1 (Dist 2), 1 (Matamek), 1 (Magdalen Isl.).

Table 2. Annual sport catches, 1972-'80, from the 1971-'74 and 1976-'79 smolt-classes of Statistical Districts 26 / 27 / 28 and the 1976-1980 sport catches from the 1975-'79 smolt classes of Districts 16 / 17 / 19.

Years	Dist. 26/27/28			Dist. 16/17/19		
	1-SW	2-SW	3+-SW[1]	1-SW	2-SW	3+-SW
1972	501	-	-			
1973	829	215	-			
1974	1600	202	14			
1975	1001	391	25			
1976	-	170	29	1841		
1977	2339	-	29	1113	185	
1978	319	269	-	269	124	32
1979	1869	230	0	1587	111	6
1980	1694	652	4	2487	204	0

[1]Values calculated from 2 equations in 2 unknowns, where individual fish weights were assumed to be: 2-SW = 4.5 kg and 3-SW = 8.2 kg.

Table 3. Weight of commercial salmon landed (kg) in Fishery Statistical Districts of Nova Scotia resultant of smolt classes 1971-'79.

	Districts								
Year	30/31/32	26/27/28	22/23/25	20	16/17/19	15	9	7	1/4
1972 (1-SW only)	16	252	252	254	205	0	138	62	662
1973	295	1,272	3,994	1,058	2,394	853	396	2,025	9,996
1974	1,388	1,164	7,732	2,595	2,264	108	924	14,516	14,474
1975	1,606	2,008	13,416	3,032	4,886	787	405	7,166	14,528
1976 (1-SW only)	0	367	903	398	359	0	191	115	77
1976 (2^+-SW only)	156	2,612	3,488	1,456	3,322	437	507	1,995	15,193
1977 (1-SW only)	0	373	3,182	329	543	46	188	0	507
1977 (2^+-SW only)	574	3,280	12,320	1,986	2,337	226	547	9,543	11,405
1978	1,346	2,749	11,822	1,806	3,924	58	1,137	2,159	13,491
1979	382	1,960	6,320	236	1,173	309	449	635	3,355
1980	708	5,675	22,871	3,147	4,405	403	1,298	5,248	13,655
Total '72-'80 excl. '76-1-SW & '77-2-SW	5,897	18,065	73,077	13,913	23,116	3,001	5,442	33,806	85,861
Total '76-'80 excl. '76-2-SW	3,010	14,404	57,418	7,902	12,741	1,042	3,810	17,700	42,490
Total '77-'80 excl. '77-2-SW	2,436	10,757	44,195	5,518	10,045	816	3,072	8,042	31,008

Table 4. Top. Estimated weight of Atlantic salmon contributed by stocks of Districts 26 / 27 / 28 and 16 / 17 / 19 to those and other Districts of Nova Scotia during the periods 1972-'80, 1976-'80 and 1977-'80. Bottom. Proportions of total Nova Scotia landings originating from rivers of Districts 26 / 27 / 28 and 16 / 17 / 19 which appeared in those and other Districts and/percentage contribution that those stocks made to total landings in those and various Districts.

Contributing Fishery Districts	Years	Methods	Contribution by Weight to District Landing									Total
			30/31/32	26/27/28	22/23/25	20	16/17/19	15	9	7	1/4	
26/27/28	72-80	no's	1,030	17,370	14,328	872	647	-	3,617	-	117	37,981
		wt	1,064	16,820	14,444	896	672	-	3,583	-	112	37,591
16/17/19	76-80	no's	278	554	16,352	1,915	20,258	1,807	11,147	716	278	53,305
		wt	280	560	17,530	1,962	21,314	1,821	11,349	701	280	55,797
26/27/28	77-80	wt	988	13,559	12,916	494	494	-	2,682	-	-	31,133
16/17/19	77-80	wt	282	564	11,845	846	18,755	1,551	10,576	705	282	45,406
			% of Total Landings/% Contribution to District(s) Totals									
			30/31/32	26/27/28	22/23/25	20	16/17/19	15	9	7	1/4	Total
26/27/28	72-80	no's	2.7/17.5	45.7/96.2	37.7/19.6	2.3/6.3	1.7/2.8	-	9.5/66.5	-	0.3/0.1	100/
		wt	2.8/18.0	44.7/93.1	38.4/19.8	2.4/6.4	1.8/2.9	-	9.5/65.8	-	0.3/0.1	100/
16/17/19	76-80	no's	0.5/9.2	1.0/3.8	30.7/28.5	3.6/24.2	38.0/159.0	3.4/173.4	20.9/292.6	1.3/4.0	0.5/0.7	100/
		wt	0.5/9.3	1.0/3.9	31.4/30.5	3.5/24.8	38.2/167.3	3.3/174.8	20.3/297.9	1.3/4.0	0.5/0.7	100/
26/27/28	77-80	wt	3.2/40.6	3.6/126.0	41.4/29.2	1.6/9.0	1.6/4.9	-	8.6/87.3	-	-	100/
16/17/19	77-80	wt	0.6/11.6	1.2/5.2	26.1/26.8	1.9/15.3	41.3/186.7	3.4/190.1	23.3/344.3	1.6/8.8	0.6/0.9	100/

Table 5. Adjusted commercial landings for various Fishery Districts of Nova Scotia which accommodate estimated contributions of stocks from Districts 26/27/28 and 16/17/19, 1977-'80.

	Districts								
	30/31/32	26/27/28	22/23/25	20	16/17/19	15	9	7	1/4
District Landings 1977-'80	2,436	10,757	44,195	5,518	10,045	816	3,072	8,042	31,008
Adj. for 26/27/28[1]	3,297	14,558	59,813	7,468	13,595	1,104	4,158	10,884	41,966
Adj. for 16/17/19[2]	3,297	14,558	59,813	7,468	20,839	1,723	14,101	10,884	41,966
% of Adjusted Landings									
26/27/28	30.0	93.1[3]	21.6	6.6	2.4	-	19.0	-	
16/17/19	8.6	3.9	19.8	11.3	90.0[4]	90.0[4]	75.0[4]	6.5	0.7

[1]Assumed all District landings underreported by an amount equal to adjust the estimated 13,554 value (126.0% of the catch of 10,757) of Dists. 26/27/28 from 100% back to 93.1% (1972-'80), i.e. (10,757 x 1.260)/0.931 = 14,558.

[2]Assumes Districts 16/17/19/, 15 and 9 underreported by an amount necessary to reduce % contributions > 100 to something < 100%, i.e. (13,595 x 1.380)/0.90 where 1.380 = 18,755/13,595.

[3]Selected proportion (Table 6) to which landing originally exceeding 100% was adjusted.

[4]Arbitrarily selected proportions to which landings originally exceeding 100% were adjusted.

Table 6. Correlation coefficients among catch/effort data (kgs/unit day) for salmon trap nets (STN), salmon gill nets (SGN), commercial fish traps (CFN) of Cape Breton, eastern and southern Nova Scotia[1], total kg of sport landings in the LaHave and St. Mary's rivers and numbers of 2-SW salmon at Millbank, New Brunswick 1970-1980. (P .05 = .60, P .01 = .74).

Variables	Inv STN	Syd STN	Syd SGN	SE Nova STN	SE Nova SGN	Hfx STN	Hfx SGN	Hfx CFN	SW Nova STN	SW Nova SGN	Millbank	LaHave	St. Mary's
Inv. STN		.87	.54	.68	.48	.50	.67	.53	.41	.30	.61	.38	.36
Syd. STN			.54	.76	.44	.60	.84	.57	.58	.45	.33	.30	.32
Syd. SGN				.23	.09	.49	.55	.42	.06	.08	.58	.18	.45
SE Nova STN					.61	.76	.76	.77	.87	.77	.04	.65	.21
SE Nova SGN						.36	.37	.45	.24	.14	.11	.09	-.44
Hfx STN							.70	.83	.71	.78	.23	.62	.16
Hfx SGN								.79	.73	.57	.23	.47	.26
Hfx CFN									.67	.56	.30	.77	.02
SW Nova STN										.93	-.21	.67	.33
SW Nova SGN											-.23	.63	.36
Millbank												.17	.17
LaHave													.37
St. Mary's													

1. from Fig. 1
   Inv. = Districts 2, 3
   Syd STN = " 1, 4
   Syd SGN = " 6, 7
   SE Nova = " 8, 9, 14, 15, 16, 17, 19
   Hfx = " 20, 21, 22, 23
   SW Nova = " 25, 26, 27, 28, 30, 31, 32

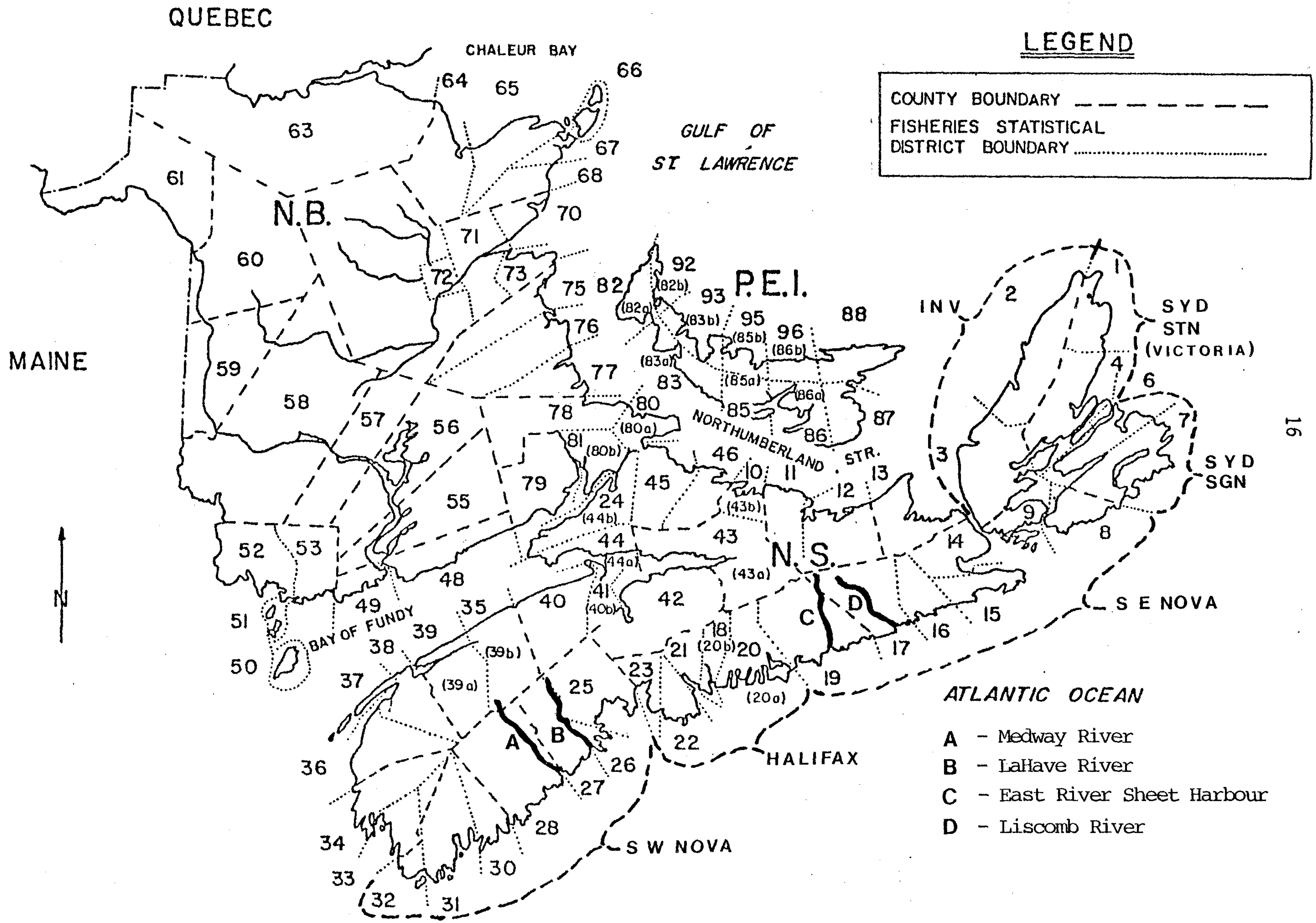

FIGURE 1. Fishery Statistical Districts of the Maritime Provinces and 4 study rivers.

App. 1. Tagged hatchery smolts and pre-smolts from which return information was used to assess the contribution of rivers of Statistical Districts 26/ 27/ 28 to Nova Scotia commercial fisheries, 1972-'80 (source: Newbould and McLean, 1981; Newbould, 1977).

Year	River of Release	Stock Origin	Age	Numbers
1971	LaHave	Medway	1-yr	4,892
1971	Medway	Medway	1-yr	4,895
1971	Medway	Medway	1-yr	4,898
1972	Medway	Medway	2-yr	5,000
1972	LaHave	Medway	1-yr grilse parents	3,400
1972	LaHave	Medway	1-yr salmon parents	5,000
1973	LaHave	Medway	2-yr grilse parents	3,973
1973	LaHave	Medway	2-yr salmon parents	3,998
1973	LaHave	Medway	1-yr salmon parents	4,970
1974	LaHave	Medway	2-yr grilse parents	2,936
1974	LaHave	Medway	2-yr salmon parents	2,955
1974	LaHave	Medway	1-yr grilse parents	3,904
1974	LaHave	Medway	1-yr salmon parents	2,080
1974	LaHave	Medway	1 yr	3,974
1976	Medway	Medway	1-yr	5,764
1976	LaHave	Medway	1-yr	9,953
1976	LaHave	LaHave	2-yr	3,994
1976	LaHave	LaHave	1975 pre-smolt release	3,987
1976	LaHave	LaHave	1975 pre-smolt release	9,978
1977	Medway	LaHave	1-yr	4,483
1977	LaHave	LaHave	1-yr	9,891
1977	LaHave	LaHave	1-yr	9,915
1977	LaHave	LaHave	2-yr	2,000
1977	LaHave	LaHave	2-yr	2,000
1978	LaHave	LaHave	1-yr	2,345
1978	LaHave	LaHave	1-yr	2,477
1978	LaHave	LaHave	1-yr	2,399
1978	LaHave	LaHave	1-yr	2,414
1978	LaHave	LaHave	1-yr	3,894
1978	LaHave	LaHave	1-yr	3,928
1978	LaHave	LaHave	1-yr	4,890
1978	LaHave	LaHave	1-yr	396
1979	LaHave	LaHave	1-yr	1,999
1979	LaHave	LaHave	1-yr	1,996
1979	LaHave	LaHave	1-yr	1,995
1979	LaHave	LaHave	1-yr	1,985

App. 2. Tagged hatchery and wild smolts and pre-smolts from which return information was used to assess the contribution of rivers of Statistical Districts 16/ 17/ 19 to Nova Scotia commercial fisheries, 1976-'80 (source: Newbould and McLean, 1981).

Year	River of Release	Stock Origin	Age	Number
1975	East R. Sheet Hbr.	St. Mary's	2-yr	6,957
1975	East R. Sheet Hbr.	St. Mary's	2-yr	5,800
1975	East R. Sheet Hbr.	East R.	wild	250
1976	East R. Sheet Hbr.	St. Mary's	2-yr	12,899
1976	East R. Sheet Hbr.	St. Mary's	1975 pre-smolt release	9,994
1976	East R. Sheet Hbr.	East R.	wild	250
1977	East R. Sheet Hbr.	LaHave	1-yr	3,970
1977	East R. Sheet Hbr.	East R.	wild	430
1977	East R. Sheet Hbr.	St. Mary's	2-yr	10,736
1977	East R. Sheet Hbr.	St. Mary's	1976 pre-smolt release	4,000
1977	Liscomb	LaHave	1-yr	3,967
1977	Liscomb	St. Mary's	2-yr	4,000
1978	East R. Sheet Hbr.	East R. & St. Mary's	2-yr	5,000
1978	East R. Sheet Hbr.	East R.	2-yr	3,592
1978	East R. Sheet Hbr.	LaHave	1-yr	3,966
1978	Liscomb	East R.	2-yr	1,978
1978	Liscomb	East R.	2-yr	1,991
1978	Liscomb	St. Mary's	1-yr	3,860
1978	Liscomb	LaHave	1-yr	3,971
1979	East R. Sheet Hbr.	LaHave	1-yr	1,999
1979	East R. Sheet Hbr.	LaHave	1-yr	1,998
1979	East R. Sheet Hbr.	East R.	2-yr	4,000
1979	East R. Sheet Hbr.	East R.	2-yr	1,100
1979	East R. Sheet Hbr.	St. Mary's	2-yr	6,900
1979	Liscomb	LaHave	1-yr	1,996
1979	Liscomb	LaHave	1-yr	1,997
1979	Liscomb	East R. & St. Mary's	2-yr	1,000
1979	Liscomb	East R. & St. Mary's	2-yr	2,988
1979	Liscomb	St. Mary's	2-yr	4,000
1979	Liscomb	St. Mary's	2-yr	4,000