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Status of the Exploits and Rocky River stocks of Atlantic salmon (Salmo salar L.) in 1992

by

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# Abstract

The Exploits and Rocky rivers are the location of two of the largest enhancement projects within the Newfoundland Region. The Exploits River has been the site of enhancement activities since 1957 with stocking presently ongoing, whereas, the Rocky River received stocking during the 1984 - 1987 period. Both enhancement projects are colonization projects (i.e. establishment of anadromous Atlantic salmon stocks in habitat not previously utilized by anadromous salmon) with predetermined time frames for completion. Results obtained from fishway counts provided the basis for target egg depositions and a smolt fence on the Rocky River provided data on smolt to adult survival. The 1992 escapement on the Exploits revealed a three-fold increase over 1991 and a 1.7% increase over the previous 5 year mean. The 1992 escapement on the Rocky River was 20% above the 1991 escapement and 16% above the previous 5 year mean.

#### Résumé

Les rivières Exploits et Rocky sont le siège de deux des plus importantes entreprises de mise en valeur du saumon dans la région de Terre-Neuve. L'Exploits fait l'objet de mesures de mise en valeur depuis 1957, l'empoissonnement s'y poursuivant actuellement, tandis que la Rocky a reçu des stocks de poisson de 1984 à 1987. Dans les deux cas, les programmes entrepris sont des programmes de colonisation (c.-à-d. d'implantation de stocks de saumon de l'Atlantique anadrome dans un habitat qui n'était pas précédemment utilisé par ce poisson) se déroulant selon un échéancier donné. Les dénombrements effectués aux passes migratoires ont permis d'établir la ponte-cible, tandis qu'un barrage à saumoneau installé sur la Rocky a servi à recueillir des données sur la survie du stade de saumoneau à celui d'adulte. Dans l'Exploits, les échappées de 1992 étaient trois fois supérieures à celles de 1991 et en hausse de 1,7 % par rapport à la moyenne des cinq années antérieures. Dans la Rocky, les échappées de 1992 étaient supérieures de 20 % à celles de 1991 et de 16 % à la moyenne des cinq années antérieures.

### Introduction

The Exploits River is the largest watershed in insular Newfoundland encompassing a drainage area of 11,272 km<sup>2</sup> (Porter et al. 1974). The river flows in a northeasterly direction, entering the sea in SFA 4 (Fig. 1). Due to natural obstructions, less than 10% of watershed area was available to anadromous Atlantic salmon (Taylor and Bauld, 1973). The Exploits River requires 95.9 million eggs to meet its required target egg deposition (Bourgeois & Murray, 1992), however, to date, only 53% of the colonizable habitat within the watershed has been stocked.

The Rocky River is the largest watershed on the Avalon Peninsula encompassing a drainage area of 296 km<sup>2</sup> (Porter et al. 1974) flowing to the sea in SFA 8 (Fig. 1). A natural falls at the mouth of this river, overcome by fishway construction, made this watershed inaccessible to anadromous Atlantic salmon, prior to 1987. The Rocky River requires 3.4 million eggs to meet its target deposition (Bourgeois et al. 1992).

The intent of this document is to review the status of these two enhanced stocks in 1992 and to discuss any possible changes in stock status due to management changes affecting marine exploitation.

# Background

For details of the stocking conducted on these watersheds refer to Tables 2-5. With respect to the Exploits River, 187,668 riverine units (egg requirement 45,040,320) of habitat in the middle Exploits are not, at present, producing adults, thus, reducing the egg requirement to 19,131,621 eggs for the middle Exploits. The Rocky River, during its stocking phase, received between 23%-64% of its target egg requirement.

Management changes implemented in 1992 that impacted marine exploitation of salmon are as follows:

- 1. Moratorium on commercial salmon fishing along the coast of insular Newfoundland.
- 2. Moratorium on the cod fishery in areas 2J, 3K and 3L implemented on July 15, 1992. This removed all cod traps from these NAFO areas.

## Methods

Biological characteristic data, habitat determinations, and target spawning requirements are those determined by Bourgeois & Murray (1992) and Bourgeois et al. (1992).

Target egg requirement was calculated based on 240 egg/m<sup>2</sup> and 7 smolts/ha of standing water. Smolt production of 7 smolt/ha was divided by 1.9% to convert this to eggs, as per O'Connell et al. (1991).

In order to calculate the egg deposition in areas where stocking occurred, an estimate of egg-to-fry survival of 20% (Sturge, 1968) was used. The number of fry released was back calculated to indicate the required number of eggs to produce those fry. Sturge (1968), in his work, gave a range of 10-30% for egg-to-fry survival and indicated that a figure of 20% appeared to be a reasonable value.

Spawning escapement was calculated by subtracting angling counts from fishway counts without inclusion of an estimate for poaching and disease.

Spawning surveys were utilized on the lower Exploits to assist in determining egg depositions: surveys were conducted on Stoney, Little Rattling and Three Brooks to confirm spawning escapement. These surveys covered 97%, 30% and 45% of the watersheds, respectively. With respect to Stoney, 3 minor tributaries of West Stoney were not surveyed when 15% of the watershed was surveyed by helicopter and no evidence of spawning was

observed. The coverage of Little Rattling Brook consisted of the lower 30% of the main stem of the system only. The Three Brooks system received 15% coverage on foot (approximately 40% of the main stem) with an additional 30% of the watershed receiving helicopter coverage revealing no spawning habitat. These findings were adjusted to reflect the entire watershed by dividing the actual redd counts by the percentage of the watershed that was surveyed. An additional adjustment of 20% was applied for human error.

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# **Results and Discussion**

Table 1 details the accessible rearing area and target egg deposition for the Exploits and Rocky Rivers. The use of fixed parameters, such as 240 eggs  $m^2$  and 7 smolts/ha of standing water, has certain limitations (see O'Connell & Dempson, 1991 for discussion on this topic).

### Exploits River

The count at the Bishop's Falls fishway of 12,852 (12,538 small and 314 large) adults is 2.4 times that of 1991 and 1.7 times that of the previous five year mean. This increase can be attributed to the changes in commercial exploitation of salmon. It should be noted that net marks on fish at the Bishop's Falls facility were commonplace, thus, suggesting an illegal harvest was ongoing. Accepting the above, the river escapement (production less bycatch in cod traps and/or exploitation in the Labrador/West Greenland fisheries) to the Exploits River was 13,548.

Analysis of biological characteristic data revealed no significant differences in size composition of the 1992 run as compared to the runs of 1985 - 1991. This is based on data collected from the Bishop's Falls fishway.

In 1992 the smolt run was observed to be bi-modal. Peaks of the run occurred on June 10 and July 16. However, there was no quantitative data collected. This was evidenced by presence of large numbers of smolt (> 80,000) in the Bishop's Falls forebay.

# Lower Exploits

Table 2 details the number of spawners and subsequent egg deposition and % target egg deposition achieved for the lower Exploits by year. This can be further broken down into Great Rattling Brook and the various other tributaries within the lower Exploits.

Spawning surveys of tributaries of the lower Exploits, other than Great Rattling Brook, revealed a total of 669, 59, and 564 redds on Stoney, Little Rattling and Three Brooks, respectively. After adjustments, the redd counts are 862, 246 and 940 for Stoney, Little Rattling and Three Brooks, respectively. Note:Large landlocked salmon are known to inhabit these tributaries. It is likely some of the redds enumerated were those of landlocked salmon. The work of Pratt (1968) has shown that redd surveys reveal between .97 and 1.25 redds per female, depending upon the time the spawning surveys are conducted. Assuming a previously used 1:1 redd:female ratio (Pratt, 1968) and a sex ratio of 2.7:1 (as recorded for 1992 broodstock based on 1978 observations) in favour of females, then the survey accounted for 2,805 adults. The findings of this survey contrast the 5,975 adults assumed to have spawned in the lower Exploits, excepting the area above Camp 1 fishway on Great Rattling Brook. This 65% difference in number of fish spawning within this area is suggestive that the calculated spawning escapement for said area for 1960-1991 is, at best, an overestimate. The authors have difficulty in explaining the disappearance of these fish. However, poaching is one possibility. While these fish are included in the lower Exploits escapement, they may have been migrating to the middle and/or upper Exploits and this is suggested by the lower count at Grand Falls as compared to Camp 1 in 1992.

The escapement to the lower Exploits was 2.1 times the 1991 escapement and 1.6 times the previous 5 year mean.

Smolt ages, as determined from 50 adults sampled at Camp 1 fishway, revealed 81% of the run resulted from the 1991 smolt run. The other 19% of the run was accounted for by repeat spawning grilse. From 1986-1991, repeat spawners comprised an average of 14% (range of the 3.9%-25.3%) of the run to Camp 1 fishway.

# Middle Exploits

The middle Exploits requires a deposition of 64.2 million eggs to meet its total seeding requirements (Table 3), however, it only requires 19.2 million eggs to meet the seeding requirements of the areas stocked.

The escapement to the middle Exploits was 1.7 times the 1991 escapement and 1.1 times the previous 5 year mean. Analysis of scale characteristics of Noel Paul's broodstock revealed 5.2% of the fish were repeat spawners and this compares to an average of 13% (range 2.7%-24.3%) for the 1985-1991 period.

The middle Exploits received an egg deposition of 4.36 million eggs from natural spawning. This is 22.7% of its required 19.2 million target. In the spring of 1993, it is anticipated that the middle Exploits will receive 1.5 million fry (to be distributed in areas previously unstocked) and will, therefore, achieve 18.4% of its 64.2 million egg target. With respect to the above-referenced egg depositions, they have to be considered as overestimates as angling occurs in this section. However, no fish were reported as being angled.

A total of 1,078 fish were removed from Grand Falls fishway for use as broodstock at the Noel Paul's facility.

### Upper Exploits

The upper Exploits requires an egg deposition of 15.4 million eggs but only received 1.6% of this target in 1992 (Table 4). This is the first year that returning adults were released into the upper watershed. It is very likely that some of the broodfish removed at Grand Falls were destined for the upper watershed.

#### Rocky River

The 1992 escapement to Rocky River was 20% above the 1991 escapement and 16% above the previous 5 year mean, and accounted for 32% of the required egg target (see Table 5). Table 6 details smolt enumeration and age structure of this 1992 escapement. The 1992 returns, as determined from a sample of 24 adults, revealed that 71% of the run is based on returns from natural spawning with 29% of the run resulting from stocked fry (i.e.  $4^+$  and  $5^+$  smolt).

Smolt to adult returns to the river were 1.8% and 3.2% for the 1990 and 1991 smolts, respectively. This 44% increase from 1991 to 1992 can, in part, be attributed to the moratorium. The data presented here appear to indicate that the marine survival on the 1990 and 1991 smolt classes varied very little, if one assumes that approximately 40% of the 1991 adult returns were harvested in the commercial fishery.

Table 7 provides insight into the egg/fry-to-smolt survival on the Rocky River. The egg-to-smolt figures compare favourably to other watersheds. There appears to be little difference between the egg and fry-to-smolt survival figures for fry and eggs for 1987. This suggests stocked fry survive as well as fry resulting from naturally spawned eggs.

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Table 1: Rearing area and target egg deposition, Exploits & Rocky rivers.

Exploits River	Riverine habitat (m <sup>2</sup> )	Lacustrine habitat (ha <sup>2</sup> )	Target egg deposition
Lower	57,552	6,915	16,360,112
Middle	234,873	21,178	64,171,941
Upper	55,437	5,665	15,384,617
Total	347,862	33,758	95,916,670
Rocky River	10,823	2,191	3,404,730

Year	No. fry released G. R. B.	No. Spawners G.R.B.	No. Spawners Other	Total Eggs G.R.B.	Total Eggs Other	% Target Egg G.R.B.	% Target Egg Other	% Target Egg Total
1957	0	610	*	1032401	*	10	*	*
1958	0	786	*	1330274	*	13	*	*
1959	0	329	*	556819	*	5	*	*
1960	0	771	892	1304887	1509674	12	28	18
1961	0	624	577	1056095	976549	10	18	13
1962	0	1212	*	2051262	*	20	*	*
1963	0	577	691	976549	1169490	9	22	14
1964	0	1886	*	3191980	*	31	*	*
1965	0	777	594	1315041	1005321	13	19	15
1966	0	1412	+228	2389754	385881	23	7	18
1967	0	1204	829	2037722	1403049	20	26	22
1968	0	2021	*	3420462	*	33	*	*
1969	0	1182	272	2000488	460349	19	9	16
1970	0	1222	*	2068186	*	20	*	*
1071	0	1163	66	1968331	111702	19	2	13
1972	0	729	114	1233803	192940	12	4	9
1973	0	*	*	0	*	*	*	*
1974	0	*	2692	0	4556102	*	85	*
1975	0	5121	3499	<b>8</b> 667088	5921918	83	110	92
1976	0	2016	1027	3411999	1738156	33	32	33
1977	0	3576	1390	6052237	2352519	58	<b>4</b> 4	53
1978	0	2065	711	3494930	1203339	33	22	30
1979	0	3102	2465	5250011	4171914	50	78	60
1980	0	4556	*	7710848	*	74	*	*
1981	0	4763	+ 1535	8061187	2597926	77	48	67
1982	0	2918	2218	4938598	3753876	47	70	55
1983	0	3252	*	5503880	*	53	*	*
1984	0	6176	5696	10452633	9640252	100	179	127
1985	0	5952	3712	10073522	6282412	96	117	103
1986	0	2742	3026	5616360	5121384	54	95	68
1987	195127	230	3236	4744161	5476801	45	102	65
1988	870979	896	+ 1900	6469514	3215674	62	60	61
1989	990614	46	2562	3215478	4336083	31	81	48
1990	627525	11	2313	3483172	3914660	33	73	47
1991	692911	1044	2009	1766928	3400152	18	70	35
1992	76480	3762	2805	6367035	3528779	61	<b>6</b> 6	63

Table 2. Details of egg deposition Lower Exploits.

\* indicates no data
+ indicates incomplete data (i.e. partial count)

Year	No. Fry Released	Spawners Released	Natural Egg Deposition	Fry to Egg Equiv.	Total Eggs	%Target Egg Achieve
1967	0	0	0	768600	768600	1.2
1968	153720	0	0	841700	841700	1.3
1969	168340	0	0:	1644600	1644600	2.6
1970	328920	0	0	1479730	1479730	2.3
1971	295946	0	0	1612530	1612530	2.5
1972	322506	0	0	2053445	2053445	3.2
1973	410689	0	0	1779000	1779000	2.8
1974	355800	31	88491	1063050	1151541	1.8
1975	212610	650	1855455	6463125	8318580	13.0
1976	1292625	79	225509	6733930	6959439	10.8
1977	1346786	27	77073	6832050	6909123	10.8
1978	1366410	0	0	3628785	3629785	5.7
1979	725757	47	134164	9352470	9486634	14.8
1980	1870494	2246	6411309	4513470	10924779	17.0
1981	902694	2586	7381855	3941270	11323125	17.6
1982	788254	1229	3508236	1926610	5434846	8.5
1983	385322	810	2312182	3960965	6273147	9.8
1984	792193	3750	10704545	2539510	13244055	20.6
1985	507902	2981	8509400	2558670	11068070	17.2
1986	511734	0	0	5333120	5333120	8.3
1987	1066624	80	228364	5243995	5472359	8.5
1988	1048799	5	14273	7854460	7868733	12.3
1989	1570892	0	0	8758425	8758425	13.6
1990	1751685	2	5709	7436240	7441949	11.6
1991	1487248	295	842091	8028805	8870896	13.8
1992	1605761	1582	4361745	7456600	11818345	18.4
1993	1491320	0	0	0	0	*

Table 3. Details of egg deposition Middle Exploits.

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Year	No. Fry Released	Natural Spawning	Fry to egg	% Target egg Deposition
1975	0	0	952665	6.19
1976	190533	0	892390	5.80
1977	178478	0	155580	1.01
1978	31116	0	0	0.00
1979	0	0	0	0.00
1980	0	0	3326500	21.62
1981	665300	0	4460735	28.99
1982	892147	0	2041055	13.27
1983	408211	0	1992570	12.95
1984	398514	0	4403050	28.62
1985	880610	0	8189350	53.23
1986	1637870	0	11078265	72.01
1987	2215653	0	14895245	96.82
1988	2979049	0	19275305	125.29
1989	3855061	0	18345255	119.24
1990	3669051	0	13471645	87.57
1991	2694329	0	0	0.00
1992	0	141	238637	1.6

Table 4. Details of egg deposition Upper Exploits.

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Year	No. Released Fry	Fry to Egg	Released Adults	Fishway Count	Total Eggs	% Target Egg
1983	0	1538875	0	*	1538875	45
1984	307775	2172500	0	*	2172500	64
1985	434500	970000	0	*	970000	28
1986	194000	1998225	00	*	1998225	59
1987	399645	0	124	81	799687	23
1988	0	0	0	319	1232431	36
1989	0	0	0	177	683825	20
1990	0	0	0	418	1614910	47
1991	0	0	0	227	876996	26
1992	0	0	0	283	1093348	32

Table 5. Details of egg deposition Rocky River 1983-1992.

\* indicates no data

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Table 6.	Details of smolt	enumeration	1990-1992.
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Year	Smolt	Percentage at age			age
	Count	2+	3+	4+	5+
1990	8,287	1	66	29	4
1991	7,732	16	70	13	1
1992	7,813	1.5	76	21	1.5

Table 7. Details of egg/fry to smolt survival 1985 - 1989.

Year	egg to smolt survival (%)	fry to smolt survival (%)	smolt classes
1985		0.08	5+
1986		1.3	4+ & 5+
1987		1.6	3+, 4+ & 5+
1987	0.86		2+, 3+ & 4+
1988	0.58		2 <sup>+</sup> & 3 <sup>+</sup>
1989	0.02		2+

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Figure 1. Salmon Fishing Area's in Newfoundland.