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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.-ded. 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 $11,272 \mathrm{~km}^{2}$ (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 $296 \mathrm{~km}^{2}$ (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 $240 \mathrm{egg} / \mathrm{m}^{2}$ and $7 \mathrm{smolts} / \mathrm{ha}$ 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.

## 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 $\mathrm{m}^{2}$ and 7 smolts/ha of standing water, has certain limitations (see $\mathrm{O}^{\prime}$ 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$\left.{ }^{2}\right)$ | Lacustrine habitat (ha') | 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 |  | $3,404,730$ |

Table 2. Details of egg deposition Lower Exploits.

| Year | No. fry released G. R. B. | No. Spawners G.R.B. | No. Spawners Other | $\begin{aligned} & \text { Total Eggs } \\ & \text { G.R.B. } \end{aligned}$ | Total Eggs Other | $\begin{aligned} & \text { \% Target } \\ & \text { Egg } \\ & \text { G.R.B. } \end{aligned}$ | \% 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 | 8667088 | 5921918 | 83 | 110 | 92 |
| 1976 | 0 | 2016 | 1027 | 3411999 | 1738156 | 33 | 32 | 33 |
| 1977 | 0 | 3576 | 1390 | 6052237 | 2352519 | 58 | 44 | 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 | 66 | 63 |

[^0]Table 3. Details of egg deposition Middle Exploits.

| Year | No. Fry Released | Spawners Released | Natural Egg Deposition | Fry to Egg Equiv. | Total Eggs | \%Targe 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 |

Table 4. Details of egg deposition Upper Exploits.

| Year | No. Fry <br> Released | Natural <br> Spawning | Fry to egg | \% Target egg <br> 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 5. Details of egg deposition Rocky River 1983-1992.

| Year | No. Released <br> Fry | Fry to Egg | Released <br> Adults | Fishway <br> Count | Total Eggs | \% Target <br> 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 6. Details of smolt enumeration 1990-1992.

| Year | Smolt | Percentage at 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 <br> $(\%)$ | 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 | $2^{+} \& 3^{+}$ |  |
| 1989 | 0.02 | $2^{+}$ |  |



Figure 1. Salmon Fishing Area's in Newfoundland.


[^0]:    * indicates no data
    + indicates incomplete data (i.e. partial count)

