Egg Depositions in Some Newfoundland Rivers

by

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Abstract

Egg deposition rates for Atlantic salmon (Salmo salar L.) were calculated for four insular Newfoundland rivers. Compared with a target deposition rate of 2.4 eggs/m^2 (Elson 1975), Terra Nova River was shown to be underseeded. Deposition rates obtained for Middle Brook, Northeast River and Salmon Brook (to a lesser extent) greatly exceeded 2.4 eggs/m^2. Extensive rearing of juveniles occurs in standing waters on these systems which leads to artificially inflated values when deposition rates are expressed in terms of stream habitat.

Résumé

Les taux de déposition d'oeufs de saumon atlantique (Salmo salar L.) ont été calculés dans quatre rivières de l'île de Terre-Neuve. Comparé à un taux de déposition cible de 2,4 oeufs/m^2 (Elson 1975), celui de la rivière Terra Nova est insuffisant. Les taux de déposition dans le ruisseau Middle, la rivière Northeast et le ruisseau Salmon (à un degré moindre) dépassent de beaucoup 2,4 oeufs/m^2. On pratique dans les eaux mortes de ces réseaux un élevage intensif de juvéniles, ce qui conduit à des valeurs artificiellement élevées quand les taux de déposition sont exprimés en fonction de l'habitat du cours d'eau.

Introduction

Adult Atlantic salmon (Salmo salar L.) are enumerated each year at fishways located on eight insular Newfoundland rivers (Fig. 1). Recreational harvest statistics are also collected on these rivers. Using these data, Chadwick (1982a) developed regressions which suggest that the recreational fishery can be used as an index of spawning escapements. In the present paper, fishway counts and angled catches were used in conjunction with biological characteristic data for these stocks and the amount of accessible stream rearing habitat to calculate egg deposition rates for four of these rivers.

Methods

For Terra Nova River, spawning escapements were calculated for the section above the lower fishway (lower fishway count minus the recreational count above the fishway). Since angling data were not available in terms of catch above and below fishways on Middle Brook, Northeast River and Salmon Brook, spawning escapements were calculated utilizing recreational catches and exploitation rates as follows:

River Escapement   = Recreational catch
                       Exploitation rate

Spawning Escapement = River escapement - Recreational catch.

For Middle Brook and Northeast River, exploitation rates given in Chadwick (1982a) were used. For Salmon Brook, exploitation rates were determined using fishway counts and recreational catches as outlined in Chadwick (1982a) and applied accordingly. Spawning excapements were determined in terms of total recreational catch (exploitation rates for grilse and salmon were assumed to be the same). Biological stock characteristic data (mean female weight and sex ratio) were therefore combined and weighted in terms of fishway counts (for Northeast River, these data were only available for grilse). When stock characteristic data were not available for a given year or when sample sizes were small (N<10), means based on all available data were used. For all rivers, stock characteristic data were obtained by sampling recreational catches.

Egg depositions were calculated as follows:

- Spawning escapement x % female = No. of female spawners
- No. of female spawners x mean weight of females = total weight of females
- Total weight of females x 1540 eggs/kg (Chadwick 1982b) = egg deposition
- Egg deposition ÷ accessible rearing area (m^2) = No. of eggs/m^2.

For Terra Nova River, these calculations were carried out separately for grilse and salmon and the results combined to give the total egg deposition.

The amount of accessible classical parr rearing habitat (Elson 1957) available for each river was taken from river survey files. The target total egg deposition for each river was calculated by multiplying the amount of rearing area by the deposition rate of 2.4 eggs/m^2 recommended by Elson (1975).

Results and Discussion

While adult counts at the lower fishway and also the upper fishway (a colonization enhancement project) on Terra Nova River have stabilized in recent years (unpublished data), it is evident that the egg deposition rate since 1978 (0.95-1.50 eggs/m^2) fell substantially short of the target requirement of 2.4 eggs/m^2 (Table 1). These values may be underestimates to some degree since it is known that during high water levels some fish bypass the lower fishway.

Deposition rates for Middle Brook (10.2-15.2 eggs/m^2) and Northeast River (4.3-8.1 eggs/m^2) greatly exceeded the target requirement (Tables 2 and 3 respectively). It is suspected that extensive parr rearing in standing waters occurs on these rivers (both systems are characterized by a large amount of standing water habitat relative to stream rearing habitat). Values obtained for Northeast River may be underestimates since (1) some spawning has been observed below the fishway on that river and (2) mean weights were only available for grilse. Egg deposition rates (2.4-3.1 eggs/m^2) for Salmon Brook (a tributary of the Gander River) were somewhat closer to the target deposition (Table 4); however, Pepper (1976) demonstrated that parr rearing in standing waters occurs on this system. It is obvious that egg deposition requirements based on stream rearing habitat are rather meaningless for these systems. Chadwick (1982c) came to a similar conclusion for Western Arm Brook.

Based on a target egg deposition rate of 2.4 eggs/m^2, it is apparent that Terra Nova River is presently underseeded. Elson's (1975) analysis of stock-recruitment relationships for Pollett River included angling removals; egg requirements presented above for Newfoundland rivers did not account for this factor. Chadwick (1982c) suggested that Elson's optimal smolt production based on 2.4 eggs/m^2 might be an artifact and that the optimal egg requirement could be considerably higher on many salmon rivers. There is an obvious need to quantify juvenile production in standing waters for Middle Brook, Northeast River, and Salmon Brook and to define egg deposition in terms of standing water habitat. Of the eight rivers with fishways, only the four considered above possessed adequate information suitable for the calculation of egg depositions. In order to improve the data base and to allow for more accurate and representative calculations, in future angling data should be collected above and below fishways and biological stock characteristic sampling should be expanded, especially for the large salmon component of the catch.

References

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Table 1. Egg depositions for Terra Nova River above the lower fishway, 1978-1981. Gr. = Grilse; S = Salmon. Number of fish in parentheses.

		1978	1979	1980	1981	1982
Fishway Count	Gr.	810	569	842	1115	963
	S	20	170	40	90	19
Recreational Catch (No.)	Gr.	57	32	37	44	24
	S	4	0	0	0	0
Spawning Escapement (No.)	Gr.	753	537	805	1071	939
	S	16	170	40	90	19
Percent Female	Gr.	84.4(54)	76.5(13)	67.7(21)	84.0(42)	*78.1(143)
	S	*60.0(6)	*60.0(6)	*60.0(6)	*60.0(6)	*60.0(6)
$\bar{X}$ Weight of Females (kg)		1.50(54)	1.45(13)	1.60(21)	1.43(42)	1.48(143)
		5.69(6)	5.69(6)	5.69(6)	5.69(6)	5.69(6)
Total Egg Deposition (No.)		1,552,200	1,811,113	1,553,145	2,454,368	1,771,365
No. of Eggs/m^2		0.95	1.11	0.95	1.50	1.08

Fecundity (Gr. and S) = 1,540 eggs/kg (Chadwick 1982b)
Accessible Rearing Area = 1,633,500 m^2
Required Egg Deposition Rate = 2.4/m^2 (Elson 1975)
Required Total Egg Deposition = 3,920,400
*Mean of all available data

Table 2. Egg depositions for Middle Brook. Number of fish in parentheses.

	1978	1980	1981	1982
Fishway Count	1,428	1,794	2,453	1,301
Recreational Catch (No.)	392	544	587	512
Exploitation Rate (Chadwick 1982a)	0.22	0.24	0.20	*0.25
Spawning Escapement (No.)	1390	1714	2348	1536
Percent Female	90.6(14)	70.4(40)	78.2(33)	*75.7(104)
$\bar{X}$ Whole Wt of Females (kg)	1.70(14)	1.59(40)	1.42(33)	*1.50(104)
Total Egg Deposition	3,296,952	2,954,618	4,015,262	2,685,957
No. of Eggs/m^2	12.5	11.2	15.2	10.2

Fecundity = 1,540 eggs/kg (Chadwick 1982b)
Accessible Rearing Area = 264,000 m^2
Required Egg Deposition Rate = 2.4 eggs/m^2 (Elson 1975)
Required Total Egg Deposition = 633,600
*Mean of all available data

Table 3. Egg depositions for Northeast River, Placentia, 1978-1982. Number of fish in parentheses.

	1978	1979	1980	1981	1982
Fishway Count	422	491	467	396	[a]112
Recreational Catch (No.)	161	138	252	349	150
Exploitation Rate (Chadwick 1982a)	0.29	0.23	0.36	0.51	*0.38
Spawning Escapement (No.)	394	466	448	335	245
[1]Percent Female	93.9(62)	85.7(12)	90.2(37)	89.6(86)	*90.8(198)
[1]$\bar{X}$ Whole Wt. of Females (Kg)	1.53(62)	1.43(12)	1.58(37)	1.52(86)	*1.53(198)
Total Egg Deposition (No.)	871,714	871,926	983,246	702,615	524,160
No. of Eggs/m^2	7.2	7.2	8.1	5.8	4.3

Fecundity = 1,540 eggs/kg (Chadwick 1982b)
Accessible Rearing Area = 121,700 m^2
Required Egg Deposition Rate = 24 eggs/m^2 (Elson 1975)
Required Total Egg Deposition = 292,080

[1]These data were available for grilse only.

[a]Partial count.
*Mean of all available data

Table 4. Egg depositions for Salmon Brook. Number of fish in parentheses.

	1959	1973	1974	1978
Fishway Count	881	1,105	870	807
Recreational Catch (No.)	12	154	45	35
Exploitation Rate	0.014	0.12	0.05	0.04
Spawning Escapement (No.)	845	1129	855	840
Percent Female	*72.9(340)	*73.1(340)	*73.2(340)	72.0(44)
$\bar{X}$ Whole Wt of Females (kg)	*2.0(340)	*1.76(340)	*2.03(340)	1.85(44)
Total Egg Deposition	1,897,295	2,236,890	1,956,564	1,723,075
No. of Eggs/m^2	2.6	3.1	2.7	2.4

Fecundity = 1,540 eggs/kg (Chadwick 1982b)
Accessible Rearing Area = 722,079 m^2
Required Egg Deposition Rate = 2.4 eggs/m^2 (Elson 1975)
Required Total Egg Deposition = 1,732,990
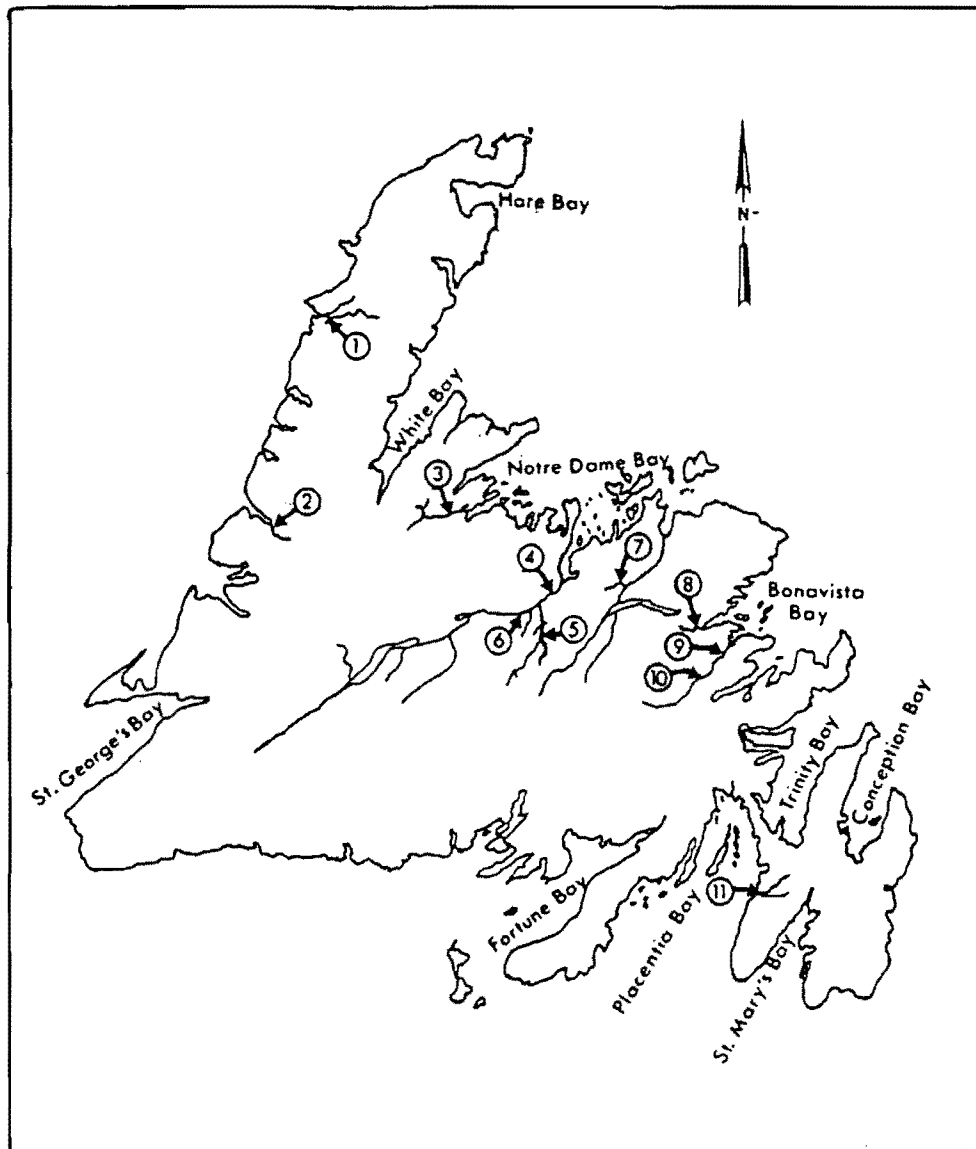*Mean of all available data

Fig. 1. The location of fishways on insular Newfoundland rivers.

1. Torrent River
2. Lomond River
3. Indian River
4. Bishop's Falls, Exploits River
5. Camp I, Great Rattling Brook, Exploits River
6. Grand Falls, Exploits River
7. Salmon Brook, Gander River
8. Middle Brook
9. Lower Fishway, Terra Nova River
10. Upper Fishway, Terra Nova River
11. Northeast River, Placentia