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Status of the Exploits River stock of Atlantic salmon (*Salmo salar L.*) in 2000

État du stock de saumon atlantique (*Salmo salar L.*) de la rivière Exploits en 2000

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Abstract

The Exploits River was the site of an Atlantic salmon enhancement colonization program from 1957-1993. Counts at fishways and angling data provided the basis for assessing the status of the salmon population and determining percent of conservation egg deposition achieved. The 1999 freshwater escapement to the Exploits, of 31,038 was 124% of the average 1992-98 escapement and 388% of the 1987-1991 mean. In 1999 the Exploits River received 50% of it's conservation egg deposition. A total of 1,951 small salmon were retained in the recreational fishery with a total of 1,283 hook-and-released fish. The Exploits River in addition to a conservation egg deposition has a management target of 13,000 spawners which was achieved in 1999 and is used to manage the recreational fishery. This requirement is addressed within the context of the Exploits River achieving its conservation egg deposition.

Résumé

De 1957 à 1993, la rivière Exploits a fait l'objet d'un programme de mise en valeur par ensemencement du saumon atlantique. Le dénombrement aux passes migratoires et les données de la pêche à la ligne ont permis d'évaluer l'état de la population de saumon et de déterminer le pourcentage de l'objectif de ponte de conservation atteint. Les 31 038 géniteurs qui ont frayé dans l'Exploits en 1999 représentent 124 % de la moyenne des échappées pour 1992-1998 et 388 % de celles des années 1987 à 1991. En 1999, la ponte dans la rivière Exploits a atteint 50 % de l'objectif de conservation. En tout, 1 951 petits saumons ont été conservés dans le cadre de la pêche récréative tandis que 1 283 captures avec remise à l'eau ont été enregistrées. À l'objectif de conservation dans la rivière Exploits s'ajoute un objectif de gestion de 13 000 géniteurs. Celui-ci, qui a été atteint en 1999, sert à gérer la pêche récréative. Cet objectif est examiné dans le contexte de l'atteinte des objectifs de ponte pour la rivière Exploits.

Introduction

The Exploits River is the largest watershed in insular Newfoundland, encompassing a drainage area of 11,272 km^2 (Porter et al. 1974). The river flows in a northeasterly direction, entering the ocean in SFA 4 (Fig. 1). Prior to the inception of enhancement activity (O'Connell and Bourgeois, 1987) less than 10% of watershed area was available to anadromous Atlantic salmon due to the presence of natural and man-made obstructions (Taylor and Bauld, 1973). The Exploits River requires 95.9 million eggs (56,670 small salmon) to meet it's conservation egg deposition requirement (Table 1). However, to date, only 53% of the colonizable habitat within the watershed has been stocked. The intent of this document is to review the status of the stock in 2000.

Background

Stocking Activities

For details of the fry stockings conducted in the various sections of the Exploits River (Fig.2), refer to Tables 2 - 4. With respect to the middle Exploits, 187,668 m^2 (egg requirement 45,040,320) of river habitat (Table 1) did not receive the required five years of stocking to establish a self-sustaining run.

Management measures implemented in 1992, which remained in place for 2000

1. Moratorium on commercial salmon fishing in insular Newfoundland.

2. Moratorium on the northern cod fishery affecting Salmon Fishing Areas (SFA's) 1-9 implemented on July 15, 1992. This measure eliminated by-catch of salmon in cod fishing gear.

Other management measures

In 1994, due to the low egg deposition in the upper Exploits (Table 4) and expected low returns in 1995 from the last year of fry stocking, concern was expressed with respect to future returns to Red Indian Lake fishway. The increase in angling effort and catch (Table 5) realized on the Exploits in 1994 further reduced the rate of increase of spawners in the upper Exploits. In an effort to increase escapement at Red Indian Lake in 1995 DFO included in the Exploits River Management Plan an adult transfer from Grand Falls to a location within Red Indian Lake. The requirement for this transfer remained in place for 1998 but was removed in 1999.

Industrial Activity

In September of 1995 Abitibi-Price, the operators of Grand Falls pulp and paper located in Grand Falls immediately downstream of the Grand Falls fishway, began

operation of an Aeration Settlement Basin as a secondary waste water treatment process. This process reduced the Total Suspended Solids (TSS) and Biological Oxygen Demand (BOD) within the effluent.

In the fall of 1996 Abitibi-Price altered the forebay/penstock intakes at the Grand Falls generating station. Prior to this construction the forebay emptied water to three penstock pipes through a series of trash racks. The new construction in 1996 altered this arrangement to remove these penstocks and create an approximate 475 meter by 60 meter by 8 meter canal. Associated with this construction was the installation of a 181 meter long set of floating louvres and associated bypass to deflect smolt and kelts from this canal. The present configuration at the Grand Falls generation station requires an optimun flow of 214 m^3 sec^{-1} for the five Francis type turbines with an associated power production of 45 megawatts.

A monitoring program to test the fish guidance efficiency (FGE) of the louvre array was conducted in 1997 – 2000 with the following data collected in the bypass:

Year	No. Smolt	No. Parr	No. Kelt	Period of Enumeration
1997	28,161	N/A	N/A	June 13 – July 13
1998	32,241	1,047	77	May 13 – July 15
1999	27,107	961	125	May 6 – July 20
2000	24,185	1,040	57	May 30 – July 12

Year	No. Smolt in Bypass	Smolt FGE %	Estimated smolt in canal	Mean flow over dam during smolt enumeration
1997	28,161	25.0	115,444	No data
1998	32,241	23.4	137,782	27 cms
1999	27,107	54.0	50,198	42 cms
2000	24,185	70.3	34,402	63 cms

Methods

Adult Counts

Fish are enumerated at three fishway locations on the Exploits; i) Bishop Falls fishway which enumerates all fish entering the river at the community of Bishop Falls on the main stem of the river in the lower Exploits ii) Grand Falls fishway on the main stem of the Exploits at the community of Grand Falls-Winsor which enumerates all fish entering the middle and upper Exploits and iii) Red Indian Lake fishway at the outflow of Red Indian Lake which enumerates all fish entering the upper Exploits (see Fig. 2).

Fry Stocking

Fry stocking was conducted in riverine habitat utilizing mainly helicopters with some distribution via vehicle (in accessible locations). Stocking was conducted such that the habitat that was stocked received 75 fry per $100m^2$ of habitat. Fry were stocked along the river banks in areas of low flow with depth less than 30 cm in areas where gravel/cobble substrate was present. If suitable habitat was available, fry were stocked at one quarter kilometer intervals on opposite sides of the river. The number of fry released in individual drops ranged from 5,000 - 50,000 depending on the available habitat to be stocked. Releases in excess of 25,000 fry/drop were only conducted on the main stem of the middle Exploits.

Angling Statistics

Prior to 1994 angling statistics were reported for seven locations (Bourgeois et.al. 1998). Angling catch and effort data prior to 1994 were supplied by DFO staff and from 1994 to 1996 the data were collected by DFO staff and River Monitors. Beginning in 1997 angling statistics are those of the license stub with the 1997-1999 angling data below Bishop Falls collected by DFO staff and river monitors in angling creels.

As the license stub angling data are not collected by river section the authors had to devise a method to allocate the angling catch to the various sections of the watershed. The only complete angling data for the middle Exploits is for the 1994-96 time period. Due to changing management plans none of the three years of data are comparable. Also due to differences in the size of the runs it was felt that the 1996 data best reflected the present situation for the middle Exploits. An exploitation rate of .035 was observed for the middle Exploits in 1996 and this rate will be used to estimate the catch of the middle Exploits from 1997 onwards. The weakness of these estimates is that the population and angling habits in the middle Exploits are changing and the estimates are based on a single exploitation rate in 1996. This will likely lead to underestimation of the angling catch. In addition it is difficult to apportion the retained catch and hook-and-release catch within the middle Exploits. The catches will be apportioned based on the ratios observed in the angling catch for each given year.

The angling below Bishops Falls from 1997-1999 was collected by DFO staff and through angling creels. There was no data collection for the area below Bishops Falls in 2000 and therefore the angling below Bishop Falls was calculated using the mean catch below Bishop Falls for 1997-1999 as a portion of the total angling.

Biological Characteristics

Biological characteristic data presented in Tables 5 and 6 were collected from various locations within the Exploits watershed as detailed in the various tables.

Egg Depositions

Habitat determinations and conservation egg depositions are detailed in Table 1. Conservation egg requirement was calculated based on 2.40 egg/m^2 and 7 smolts/ha of standing water. Smolt production of 7 smolt/ha was divided by 1.9% to convert this to eggs (O'Connell et al., 1991).

Spawning escapement was calculated by subtracting angling catches and known removals from counts at fishways without inclusion of an estimate for poaching and disease but including a 10% hook and release mortality. In 1992 and 1993 spawning surveys on various tributaries of the lower Exploits were utilized in calculating egg deposition.

Egg deposition was calculated based on a length fecundity relationship and mean length of female fish. Data collected from broodstock from 1984-1991 were used to determine mean female length and percent female fish in the run. Calculations use a mean female length of 52 cm, a mean no. of eggs per female of 2198, and that females comprise 77% of the run. **Caution:** Mean length of female fish may have changed since the commercial fishing moratorium in 1992.

The equation " Total Eggs = (14.67 *Mean Fish Length) – 5335.4" was solved to determine the mean number of eggs/female fish.

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

Egg depositions for the various sections of the watershed were calculated by apportioning the recreational catch based on previous angling history.

2000 Management Plan for Exploits River

The following Management Plan was announced for the 2000 angling fishery based on the classification of rivers/tributaries into one of four classes with limits as follows:

Class	Retention Limit	Daily catch and release	Area
1	6 Fish	4 Fish	Tributaries of the lower Exploits
2	4 Fish	4 Fish	Main stem of Exploits River below Stoney Brook
3	2 Fish	4 Fish	Tributaries of middle Exploits from Red Indian Lake dam to Grand Falls Fishway
4	0 Fish	2 Fish	Main stem of Exploits River from Grand Falls fishway to Red Indian Lake dam and the watershed above Red Indian Lake dam.

Season Dates June 15 to September 7

On July 28,2000 a variation order altered the retention limit for the main stem of the Exploits River below Grand Falls from 4 fish to 2 fish. The area above Grand Falls was designated hook-and-release only.

The recreational fishery on the Exploits River was managed by a management target of 13,000 spawners. The rationale for this target was due to previous enhancement efforts and the unlikelyhood of the Exploits River achieving its conservation target in the near future.

Results and Discussion

Table 1 details the accessible rearing area and conservation egg deposition requirement for the Exploits River. The use of fixed parameters, such as 2.40 eggs/m^2 of fluvial habitat and 7 smolts/ha of standing water habitat, has certain limitations (see O'Connell & Dempson, 1991 for discussion on this topic).

Fishway Counts and Biological Characteristics

Table 8 details the 1975 - 2000 counts from the various fishways on the Exploits whilst Tables 6 - 7 detail smolt and adult biological characteristics.

Freshwater Escapement

The 2000 freshwater escapement of 12,385 (count at Bishops Falls fishway + retained angling below the fishway + 10% of hook-and-released fish below Bishops + other known removals) to the Exploits was 53% of the 1992-99 freshwater escapement. The 1992-2000 freshwater escapement plus bycatch(unknown) is equal to watershed adult production.

Recreational Fishery Statistics

Table 5 details the angling statistics for the Exploits watershed which revealed a total angling catch 1,859 (1,101 small retained and 758 hook-and-released). In 1995 the recreational fishery was managed by a retention season and a retention quota whilst in 1996 the fishery was managed by a retention season making comparisons with previous years difficult. The 1997 season prior to the closure of the retention fishery was only managed by season dates. The 1998 recreational fishery was managed by a retention quota for various parts of the season, season dates and through the limitation of hook-and-release angling. The 1999 recreational fishery was managed as per the outlined management plan. The 2000 recreational fishery was modified as follows; On July 28,2000 a variation order altered the retention limit for the main stem of the Exploits River below Grand Falls from 4 fish to 2 fish. The area above Grand Falls was designated hook-and-release only.

The total recreation catch below Bishop Falls was 47%, 28% and 11% of the total recreational catch for 1997-1999 respectively. As of 2000 the angling catch below Bishops Falls will be 28% of the total catch and the angling catch above Grand Falls will be 3.5% of the number of fish released at Grand Falls.

Run Timing

Run timing (cumulative percent of run to date) for Bishop Falls fishway is presented in Table 9. The date for 50 percent of the escapement to Bishop Falls fishway was the week of July 20 which was one week later than the last four years.

Egg Deposition and Percent of Conservation Egg Achieved

Total Watershed

In 2000 the Exploits River watershed achieved 22% of it's conservation egg deposition requirement. The mean value for 1992 to 1998 was 42% with the mean value for 1987-1991 being 30%. The 1996, 1998 and 1999 egg depositions achieved 69%, 49% and 47% of the conservation egg deposition requirements respectively which are the highest recorded for the watershed. The 2000 egg deposition for the Exploits River was the lowest since the 1992 moratorium.

The 1998 and 1999 egg depositions were based on the observed sex ratio collected from recreational catches. The 2000 egg depositions were based on the observed sex ratio data from 1992-1999 with the length information coming from the data collected in 2000.

Lower Exploits

Table 2 details the number of spawners and subsequent egg deposition and the percent conservation egg deposition achieved for the lower Exploits for the period 1957-2000.

In 2000 the lower Exploits achieved 64% of its conservation egg deposition which is 49% and 130% of the 1992-1999 mean and the 1987-1991 mean respectively. The egg deposition for Great Rattling Brook can no longer be calculated due to cessation of the count at Camp 1 fishway in 1997.

Middle Exploits

The middle Exploits requires a deposition of 64.2 million eggs to meet its total conservation requirement (Table 1); however 187,668 100m^2 of habitat in the main stem of the river (egg requirement $45x10^8$) have not received adequate stocking to be producing a self-sustaining run of adults. Furthermore it is questionable if smolt production in the order of 3 smolts per unit should be expected from this habitat (the main stem of the middle Exploits River is fast flowing and 1 - 2 metres deep in many areas).

The middle Exploits received 16% of its conservation egg deposition in 2000 (Table 3) which is 60% and 130% of the 1992-1998 mean and the 1987-1991 mean respectively.

Figure 3 details the count at Grand Falls and the percent of the fish released at Bishop Falls that were enumerated at Grand Falls. Since 1994 approximately 40% of the fish passing through Bishop Falls were enumerated at Grand Falls which is indicative of the increasing adult production in the area above Grand Falls (see text Table below):

Time period	% of count at Bishop Falls enumerated at Grand Falls
1975-1978	3.3%
1979-1983	26.8%
1984-1988	26.8%
1989-1993	31.5%
1994-1998	42.8%
1999-2000	48.2%

The returns to Grand Falls since 1999 were the first returns that were due entirely to natural spawning.

Upper Exploits

The upper Exploits requires 15.4 million eggs, but only received 2% of this conservation requirement in 2000(Table 4). With the cessation of stocking in 1991 and extremely low natural egg depositions in 1990-1994 returns during the next few years are expected to be very low. The 2001 returns are expected to improve due to egg depositions. However the authors strongly recommend that measures be undertaken to increase the egg deposition in the upper Exploits.

Stock Development

The Exploits watershed was the site of very intensive stock enhancement from 1957 -1993 primarily focused on developing runs of salmon to areas of the watershed previously inaccessible to anadromous Atlantic salmon. During the 1959 - 1963 time frame, mean escapement through Bishop Falls was 1,100 adult salmon with the 1992 - 1997 mean being 24,135. This is indeed a tremendous accomplishment; however the conservation egg requirement in terms of adults (small salmon) is 56,670 salmon. As a result of management changes that have occurred since the project's inception the only management option left to increase spawning escapement is through regulation of the recreational fishery. The recreational fishery on the Exploits River (Table 5) operated prior to 1995 without any restrictions except control of the season dates. An important consideration of the last management change (i.e. the moratorium on commercial salmon fishing) was to ensure that no reallocation of fish occurred between the commercial and recreational fisheries, which failed on the Exploits River (see Table 5).

As a result of increased spawning from 1992 to 1997 coupled with the cessation of fry stocking in 1993 the future development of the Exploits stock needs addressing. The stock must now be managed in a fashion to achieve it's conservation egg deposition. Based on the 1992 – 1997 spawning escapements the watershed is achieving approximately 48% of it's required egg deposition. In an effort to assure additional spawners the present management target of 13,000 adults must be increased to enable timely development of the Exploits stock. Recruit to spawner ratios (see Bourgeois et al. 1997) for the Exploits stock indicate that a recruit to spawner ratio of 1:1 is very easily achievable. With a view to increasing spawner escapement without total closure of the recreational fishery a required spawning escapement for 2001 of 18,000 adults appears to be easily achievable.

Management Considerations

The Exploits River is managed for a Management Target of 13,000 spawners. A spawning escapement of 13,000 spawners would yield approximately 5,000 spawners for the lower Exploits watershed. This section of the watershed requires approximately 6,600 spawners. It is highly questionable how the tributaries of the lower Exploits can sustain a Class 1 designation without managing this section of the watershed for target.

Increase the required spawning escapement from 13,000 adults to 18,000 adults for the 2001 season. One of DFO'S objectives on the Exploits River is to increase spawning escapement above Red Indian Lake. To further address the escapement above Red Indian Lake it is recommended that the recreational fishery immediately below the dam remain closed. Continue an angling creel for the section of the watershed below Bishop Falls for 2001. This data is critical for determination of freshwater escapement for the Exploits River.

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Table 1: Rearing area and conservation egg deposition for sections of the Exploits River.

Exploits River	Riverine Habitat (m^2)	Lacustrine Habitat (ha)	Target Egg Deposition
Lower	57,552	6,915	16,360,112
Middle	234,873	21,178	64,171,941
main stem	187,668	0	45,040,320
tributaries	47,205	21,178	19,131,621
Upper	55,437	5,665	15,384,617
Total	347,862	33,758	95,916,670

Table 2. Egg depositions Lower Exploits.

Year	No. Fry Stocked	No. Spawners	Total Eggs	% Conservation Target Achieved
1960		1,677	2,838,255	17
1961		1,203	2,036,029	12
1962		1,212+	2,051,262	13
1963		1,269	2,147,732	13
1964		1,886+	3,191,980	20
1965		1,371	2,320,363	14
1966		1,412+	2,389,754	15
1967		2,033	3,440,771	21
1968		2,021+	3,420,462	21
1969		1,454	2,460,837	15
1970		1,222+	2,068,186	13
1071		1,229	2,080,033	13
1972		843	1,426,744	9
1973		*	*	*
1974		2,647+	4,479,942	27
1975		8,826	14,937,652	91
1976		2,987	5,055,378	31
1977		5,027	8,507,996	52
1978		2,810	4,755,813	29
1979		5,482	9,278,066	57
1980		4,611+	7,803,933	48
1981		5,401	9,140,976	56
1982		5,135	8,690,782	53
1983		3,252+	7929175	48
1984		11,857	20,067,498	123
1985		9,664	16,355,933	100
1986		5,777	10,752,976	66
1987	195,127	3,466	10,220,961	62
1988	870,979	2,796	9,685,188	59
1989	990,614	2,620	7,571,870	46
1990	627,525	2,324	7,397,832	45
1991	692,911	3,079	5,593,484	34
1992	76,480	9,721	16,452,404	101
1993	0	15,162	25,661,079	157
1994	0	8,683	16,811,545	103
1995	0	9,106	19,760,891	121
1996	0	15,869	34,394,574	210
1997	0	6,669	11,711,013	72
1998	0	13,568	23,825,915	146
1999	0	13,319	21,876,146	134
2000	0	5,737	10,535,522	64

+ = partial count* = no data

Table 3. Details of egg deposition Middle Exploits.

Year	No. Fry released	No. Spawners	Total Eggs	% Conservation Target
1967	0	0	768600	1.2
1968	153720	0	841700	1.3
1969	168340	0	1644600	2.6
1970	328920	0	1479730	2.3
1971	295946	0	1612530	2.5
1972	322506	0	2053445	3.2
1973	410689	0	1779000	2.8
1974	355800	31	1151541	1.8
1975	212610	650	8318580	13.0
1976	1292625	79	6959439	10.8
1977	1346786	27	6909123	10.8
1978	1366410	0	3629785	5.7
1979	725757	47	9486634	14.8
1980	1870494	2246	10924779	17.0
1981	902694	2586	11323125	17.6
1982	788254	1229	5434846	8.5
1983	385322	810	6273147	9.8
1984	792193	3750	13244055	20.6
1985	507902	2981	11068070	17.2
1986	511734	0	5333120	8.3
1987	1066624	80	5472359	8.5
1988	1048799	5	7868733	12.3
1989	1570892	0	8758425	13.6
1990	1751685	2	7441949	11.6
1991	1487248	267	10067154	15.7
1992	1605761	1441	12578250	19.6
1993	1692970	5174	14769418	23.0
1994	0	5947	11,514,253	17.9
1995	0	5405	15,565,836	24.3
1996	0	12,477	27,372,177	42.7
1997	0	5,492	9,644,157	15.0
1998	0	12,626	22,171,728	34.5
1999	0	13,680	22,469,080	35.0
2000	0	5,682	10,434,519	16.3

Note: Egg target is 64 million (45 for main stem and 19 for tributaries)

Table 4. Details of egg deposition Upper Exploits.

Year	No. Fry Released	No. Spawners	Total Eggs	% Conservation 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	3,326,500	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	28	47389	0.31
1992	0	141	238637	1.6
1993	0	585	990089	6.4
1994	0	633	1071327	7.0
1995	0	1102	1865091	12.1
1996	0	1846	4001032	26.0
1997	0	698	1512850	9.8
1998	0	453	981,835	6.4
1999	0	641	1,052,827	6.8
2000	0	199	365,447	2.4

Table 5. Angling statistics for Exploits River.

Year	Lower Exploits (ret.)	Middle Exploits(ret.)	Upper Exploits(ret.)	Total Catch	Retained	Total Released Catch	Total Effort
1975	1,619			1,619			5,702
1976	1,934			1,934			5,775
1977	1,852			1,852			6,944
1978	1,840			1,480			5,031
1979	1,431			1,431			8,363
1980	1,790			1,790			7,427
1981	1,861			1,861			7,515
1982	1,733			1,733			9,630
1983	1,353			1,353			5,079
1984	2,424			2,424			9,459
1985	2,998			2,998			8,600
1986	2,057			2057			8,123
1987	1,935			1935			5,891
1988	1,731			1731			6,181
1989	577			577			3,813
1990	917			917			5,869
1991	1,045			1045			5,931
1992	1,408			1408		199	4,347
`1993	1,655			1655		3,039	7,896
1994	2,962	110	0	3072		1,175	16,330
1995	1,334	2	0	1,336		1,603	10,089
1996	1,787	128	0	1,915		3,313	11,987
1997	2,891	105	0	2,996		2,169	No data
1998	1,088	130	0	1,218		1,802	No data
1999	2,712	273	0	2,985		2,638	No data
2000	976	125	0	1,101		758	No data

Table 6. Biological characteristics of Exploits River smolt.

YEAR	FORK LENGTH			WEIGHT			RIVER AGE		
	MEAN (NO.)	S.D	RANGE	MEAN (NO.)	S.D	RANGE	MEAN (NO.)	S.D	RANGE
1984	16.4(954)	2.3	12.0-26.8	57.6(39)	9.4	38.2-76.8	3.5(938)	0.6	2.0-6.0
1985	16.6(280)	1.9	10.6-26.7	42.7(252)	15.8	12.4-169.0	3.2(276)	0.5	2.0-5.0
1986	15.4(1378)	2.3	6.70-26.7	34.1(1212)	14.8	7.8-207.0	3.6(1299)	0.7	2.0-7.0
1987	17.3(779)	2.3	10.8-28.4	51.3(776)	22.4	15.6-228.1	3.4(780)	0.7	2.0-6.0
1988	16.3(823)	3.1	10.3-26.7	46.4(823)	29.7	12.8-333.8	3.7(805)	0.8	2.0-7.0
1989	15.7(600)	2.8	10.1-26.3	43.6(593)	23.2	13.7-176.8	3.4(613)	0.7	2.0-5.0
1990	16.2(557)	3.0	8.8-33.9	46.7(555)	27.8	8.1-246.0	3.4(552)	0.7	2.0-5.0
1991	17.5(100)	2.8	12.3-28.4	52.2(100)	27.3	21.6-190.7	3.3(98)	0.7	2.0-5.0
1992	16.5(173)	1.5	12.9-21.6	42.3(170)	11.7	18.2-104.6	3.4(173)	0.6	2.0-5.0
1993	16.6(201)	1.9	12.8-23.0	46.4(201)	16.0	20.6-119.0	3.3(197)	0.6	2.0-5.0
1994	15.9(215)	1.8	9.2-21.0	38.3(215)	12.4	10.7-79.0	3.5(214)	0.6	1.0-5.0
1995	15.7(189)	1.9	11.2-23.7	34.6(199)	14.5	13.2-124.4	3.2(199)	0.7	1.0-5.0
1996	16.2(265)	1.7	12.6-21.7	39.9(265)	12.6	17.4-99.5	3.4(266)	0.6	2.0-5.0
1997	14.8(278)	1.8	8.7-21.0	34.1(278)	11.9	7.1-93.0	3.2(276)	0.6	2.0-7.0
1998	15.8(206)	1.8	7.9-21.4	38.4(206)	12.5	5.4-96.1	3.3(2040	0.6	2.0-5.0
1999	15.8(269)	2.0	8.4-25.3	34.6(269)	14.5	5.9-135.7	3.4(269)	0.6	2.0-5.0
2000	15.79(239)	2.7	8.6-25.7	34.4(239)	15.3	6.8-115.8	3.1(239)	0.6	2.0-5.0

Sample Locations
1984 - Bishops Falls forebay, Lake Ambrose, Lloyd's River
1985 - Bishops Falls forebay
1986 - Bishops Falls forebay, Badger Brook, Great Rattling Brook, Stoney Brook, Little Red Indian Brook, Red Indian Lake, Noel Paul's Brook
1987 - 1990 Bishops Falls forebay, Badger Brook, Great Rattling Brook, Stoney Brook, Little Red Indian Brook, Red Indian Lake, Noel Paul's Brook, Three Brooks, Little Rattling Brook, Greenwoods Brook
1991 - 1993 & 1995 Bishops Falls forebay
1994 - Bishops Falls forebay, Stoney Brook
1996-2000 Bishops Falls forebay

Table 7. Biological Characteristics Exploits River Adults.

Year	Life Stage	Fork Length			Weight			River Age		
		Mean (no.)	S.D.	Range	Mean (no.)	S.D.	Range	Mean (no.)	S.D.	Range
1984	1SW	49.63 (1735)	2.77	39.00-60.00	1.18 (1735)	0.21	0.51-2.40	3.22 (1501)	0.46	2-5
	Repeat	56.17 (65)	4.99	46.50-76.00	1.83 (65)	0.60	0.80-4.80	3.32 (53)	0.55	2-5
	2SW	65.00 (1)			2.20 (1)					
	small	49.91 (1960)	3.00	38.50-62.00	1.21 (1958)	0.24	0.55-2.80	3.22 (1550)	0.46	2-5
	large	67.56 (8)	4.95	63.00-76.00	2.97 (8)	0.90	2.20-4.80	3.00 (3)	0.00	3.00
1985	1SW	50.96 (3604)	2.75	37.00-67.00	1.35 (3604)	0.21	0.55-2.96	3.46 (3111)	0.56	2-7
	Repeat	54.11 (102)	3.38	48.00-63.00	1.56 (101)	0.30	0.98-2.64	3.25 (80)	0.52	2-4
	2SW	53.50 (1)			1.40 (1)					
	small	51.10 (3851)	2.80	37.00-62.50	1.36 (3850)	0.22	0.55-2.96	3.45 (3188)	0.57	2-7
	large	64.40 (7)	1.73	63.00-67.00	2.22 (7)	0.41	1.60-2.84	3.50 (4)	0.58	3-4
1986	1SW	52.23 (243)	5.17	41.10-66.50	1.42 (238)	0.44	0.65-2.90	3.56 (242)	0.60	2-5
	Repeat	66.74 (69)	6.43	44.30-81.00	3.00 (68)	0.74	1.00-4.30	3.19 (67)	0.47	2-4
	2SW	68.10 (21)	2.48	64.50-73.80	3.13 (21)	0.42	2.60-3.99	3.14 (21)	0.57	2-5
	small	52.25 (2505)	3.13	29.90-62.90	1.45 (285)	0.44	0.45-3.20	3.54 (259)	0.60	2-5
	large	69.22 (80)	3.30	63.00-81.00	3.24 (79)	0.47	2.35-4.30	3.17 (72)	0.50	2-5
1987	1SW	50.13 (456)	6.42	27.70-74.00	1.22 (413)	0.54	0.40-3.85	3.47 (394)	0.61	2-6
	Repeat	63.40 (124)	6.81	38.30-77.00	2.50 (96)	0.84	0.50-4.60	3.31 (97)	0.57	2-5
	2SW	68.90 (3)	4.55	64.00-73.00	2.80 (1)			2.50 (2)	0.71	2-3
	small	51.29 (4225)	3.88	23.00-62.90	1.27 (507)	0.49	0.10-2.60	3.48 (443)	0.64	2-6
	large	69.61 (110)	3.59	63.00-78.00	3.30 (72)	0.61	2.00-4.60	3.25 (56)	0.58	2-4
1988	1SW	48.58 (475)	5.66	34.60-67.10	1.12 (426)	0.38	0.45-2.60	3.50 (448)	0.65	2-6
	Repeat	58.09 (35)	7.24	39.00-74.00	2.03 (31)	0.86	0.65-4.50	3.61 (28)	0.79	2-6
	2SW	66.20 (4)	6.13	60.50-72.80	2.87 (4)	0.90	2.10-3.99	3.25 (4)	0.50	3-4
	small	50.59 (5104)	3.74	25.40-62.50	1.12 (566)	0.45	0.30-2.40	3.65 (531)	0.83	2-8
	large	69.22 (16)	4.78	63.10-81.00	3.17 (16)	0.71	2.20-4.50	3.50 (6)	0.55	3-4
1989	1SW	51.97 (387)	5.68	37.60-68.80	1.38 (376)	0.42	0.55-3.00	3.53 (323)	0.63	2-7
	Repeat	56.73 (37)	8.08	41.00-75.00	1.87 (36)	0.75	0.70-4.20	3.33 (30)	0.55	3-5
	2SW	67.17 (3)	3.41	65.00-71.10	2.73 (3)	0.53	2.25-3.30	3.00 (3)	0.00	3-3
	small	52.45 (4332)	3.68	25.00-62.50	1.29 (479)	0.46	0.30-2.30	3.75 (398)	0.93	2-9
	large	67.01 (21)	3.10	63.00-75.00	2.78 (21)	0.55	2.00-4.20	3.42 (12)	0.51	3-4
1990	1SW	53.00 (340)	5.58	40.50-67.00	1.38 (338)	0.41	0.58-2.66	3.49 (320)	0.62	2-6
	Repeat	61.95 (52)	6.75	44.10-80.20	2.30 (52)	0.87	0.62-5.20	3.36 (44)	0.49	3-4
	2SW	66.50 (3)	2.60	63.50-68.00	2.85 (3)	0.45	2.34-3.12	3.67 (3)	0.58	3-4
	small	52.92 (3801)	3.63	29.20-62.90	1.41 (739)	0.37	0.20-2.66	3.56 (364)	0.75	2-9
	large	66.81 (36)	3.92	63.00-80.20	2.79 (34)	0.75	1.90-5.20	3.42 (24)	0.50	3-4

Table 7 Continued.

1991	1SW	52.51 (227)	5.47	35.00-64.10	1.43 (227)	0.40	0.50-2.40	3.60 (212)	0.65	2-6
	Repeat	56.57 (20)	3.20	47.40-61.50	1.82 (20)	0.27	1.10-2.30	3.72 (18)	0.75	3-5
	2SW	66.70 (1)			2.65 (1)					
	small	51.10 (1377)	4.42	26.60-61.80	1.36 (1372)	0.29	0.20-2.40	3.84 (273)	0.97	2-8
	large	64.60(3)	1.90	63.00-66.70	2.47 (3)	0.16	2.35-2.65	4.00 (1)		
1992	1SW	54.08 (243)	4.86	38.70-65.70	1.59 (243)	0.38	0.65-2.90	3.50 (423)	0.70	2-6
	Repeat	59.59 (40)	4.63	54.00-74.80	2.11 (40)	0.59	0.15-4.35	3.54 (52)	0.61	2-5
	2SW	68.57 (3)	3.86	64.20-71.50	3.27 (3)	0.64	0.25-3.80	3.17 (6)	0.41	3-4
	small	52.51 (1078)	3.68	29.00-62.80	1.48 (1077)	0.28	0.40-2.60	3.62 (271)	0.81	2-8
	large	68.20 (10)	4.29	63.00-74.80	3.04 (10)	0.90	1.35-4.35	3.63 (8)	0.74	3-5
1993	1SW							3.40 (94)	0.54	3-5
	Repeat							3.40 (10)	0.70	2-4
	small									
	large									
1994	1SW	54.43 (387)	2.99	46.00-63.00	1.69 (207)	0.35	0.91-2.90	3.38 (393)	0.62	2-5
	Repeat	58.75 (20)	3.27	51.00-63.00	2.19 (12)	0.62	1.36-2.99	3.20 (20)	0.62	2-5
	small	54.54 (407)	3.06	46.00-62.50	1.69 (216)	0.35	0.91-2.90	3.39 (403)	0.71	2-9
	large	63.00 (4)	0.00	63.00-63.00	2.87 (4)	0.25	2.49-2.99	3.25 (4)	1.26	2-5
1995	1SW	53.63 (56)	3.06	49.00-61.00	1.76 (32)	0.38	1.27-2.63	3.21 (56)	0.62	2-5
	Repeat	-	-	-	-	-	-	-	-	-
	small	53.63 (56)	3.06	49.00-61.00	1.76 (32)	0.38	1.27-2.63	3.21 (56)	0.62	2-5
	large									
1996	1SW	54.26 (56)	3.73	43.00-63.00	-	-	-	3.22 (59)	0.62	2-5
	Repeat	60.00 (5)	2.24	57.00-63.00	-	-	-	3.40 (5)	0.55	3-4
	small	54.45 (59)	3.70	43.00-61.00	-	-	-	3.25 (59)	0.60	2-5
	large	63.00 (2)	0.00	63.00-63.00	-	-	-	3.00 (2)	0.00	3-3
1997	-	-	-	-	-	-	-	-	-	-
1998	1SW	54.33(157)	3.42	46.50-63.00	-	--	-	3.14(156)	0.47	2-4
	Repeat	66.60(3)	5.75	60.00-70.50	-	-	-	3.67(3)	0.58	3-4
	small	54.29(161)	3.35	46.50-62.50	-	-	-	3.15(156)	0.48	2-4
	large	67.60(3)	4.03	63.00-70.50	-	-	-	3.33(3)	0.58	3-4
1999	1SW	54.46(123)	3.27	47.0-62.0	1.65(7)	0.46	0.91-2.27	3.37(125)	0.55	2-5
	Repeat	59.5(28)	2.95	52.0-63.0	2.50(1)	-	-	3.18(28)	0.48	2-4
	Small	55.19(147)	3.59	47.0-62.5	1.76(8)	0.53	0.901-2.49	3.34(149)	0.54	2-5
	Large	63.0(4)	0.00	0.0	-	-	-	3.25(4)	0.50	2-3
2000	1SW	51.47(56)	4.69	38.0-59.7	1.62(56)	0.44	0.6-2.5	3.64(55)	0.62	3-5
	Repeat	67.7(70)	4.94	53.0-78.7	3.44(70)	0.8	1.8-5.5	3.44(62)	0.59	2-5

7 Continued.

2SW	67.2(9)	2.5	64.0-71.0	3.28(9)	0.5	2.5-4.0	3.22(9)	0.44	3-4
Small	52.8(67)	5.41	38.0-62.5	1.77(67)	0.6	0.6-3.2	3.64(66)	0.62	3-5
Large	68.9(68)	3.70	63.3-78.7	3.56(68)	0.7	2.2-5.5	3.36(59)	0.55	2-4

-samples from 1984-1992 were Noel Paul's broodstock
-samples were collected from Grand Falls each year and from Great Rattling Brook from 1986-1990
-1993 samples from Camp 1, Grand Falls & Red Indian Lake fishways
-1994 – 1996 & 1998-99 angling samples from Lower Exploits and fishway mortalities
-2000 Bishop Falls fishway

Table 8. Counts at various counting facilities on the Exploits River.

Year	Count at Bishop Falls			Count at Grand Falls			Count at Red Indian Lake		
	small	Large	total	Small	large	total	small	large	total
1959	886	119	*1005						
1960	1013	157	1170						
1961	839	118	957						
1962									
1963	1202	65	1267						
1964									
1965	1228	203	1431						
1966	829	506	*1335						
1967	1372	710	2082						
1968									
1969	979	498	1477						
1970									
1971	961	300	1261						
1972	794	113	907						
1973	205	89	294						
1974	2538	411	2949	64	0	*64			
1975	9218	1439	10657	319	21	340			
1976	3991	460	4451	128	5	133			
1977	6148	581	6729	244	9	253			
1978	3790	303	4093	132	6	138			
1979	6715	277	6992	501	8	509			
1980				3062	23	3085			
1981	8114	1695	*9809	3809	227	4036			
1982	7605	181	7786	2321	67	2388			
1983				2182	37	2219			
1984	17219	529	17748	4993	50	5043			
1985	16652	183	16835	4992	11	5003			
1986	9697	355	10052	2243	67	2310			

Table 8 Continued.

1987	9014	310	9324	2211	41	2252			
1988	8974	147	9121	2535	34	2569			
1989	7192	89	7281	2737	70	2807			
1990	6629	122	6751	2697	118	2815			
1991	5245	99	5344	-	-	1614	29	0	29
1992	12538	314	12852	2609	64	2673	138	3	141
1993	21319	627	21946	5658	101	5759	571	14	585
1994	16168	916	17084	6430	196	6626	611	25	636
1995	15714	941	16655	N/A	N/A	6523	774	44	818
1996	29761	2053	31814	13489	906	14395	776	20	796
1997	13547	881	14428	5762	534	6296	170	24	194
1998	26442	1958	28400	12065	1217	13282	421	33	454
1999	28252	2235	30487	13530	1143	14673	602	39	641
2000	11817	683	12500	5523	523	6046	191	9	200

Table 9. Cumulative percent of run to date for Bishops Falls fishway 1990-2000.

Date	Julian Day	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
9-Jun	160	0	0	0	0	0	0	0	0	0	0	0
15-Jun	166	0	0	0	0	0	0	0	1	0	0	0
22-Jun	173	0	0	0	1	0	0	3	2	12	4	1
29-Jun	180	2	0	0	1	2	3	14	8	26	17	4
6-Jul	187	16	2	2	14	16	16	44	26	46	40	21
13-Jul	194	39	7	22	31	39	47	**68**	**50**	**68**	**59**	47
20-Jul	201	**61**	29	47	46	**63**	**66**	83	59	83	74	**68**
27-Jul	208	77	**54**	**75**	**72**	76	82	91	70	92	87	83
Aug. 3	215	86	72	89	85	88	90	95	79	96	94	91
Aug. 10	222	92	80	95	94	93	94	97	89	97	97	95
Aug. 17	229	95	89	98	97	96	97	98	95	98	99	97
Aug. 24	236	98	94	99	99	98	98	99	97	99	100	99
Aug. 31	243	100	97	100	100	99	99	100	99	99	100	100
Sept. 7	250	100	99	100	100	99	100	100	99	100		
Sept. 14	257		100		100	100	100		100	100		
Sept. 21	264		100		100	100			100	100		
Sept. 28	271								100	100		
Oct. 5	278								100			
Oct. 12	285											

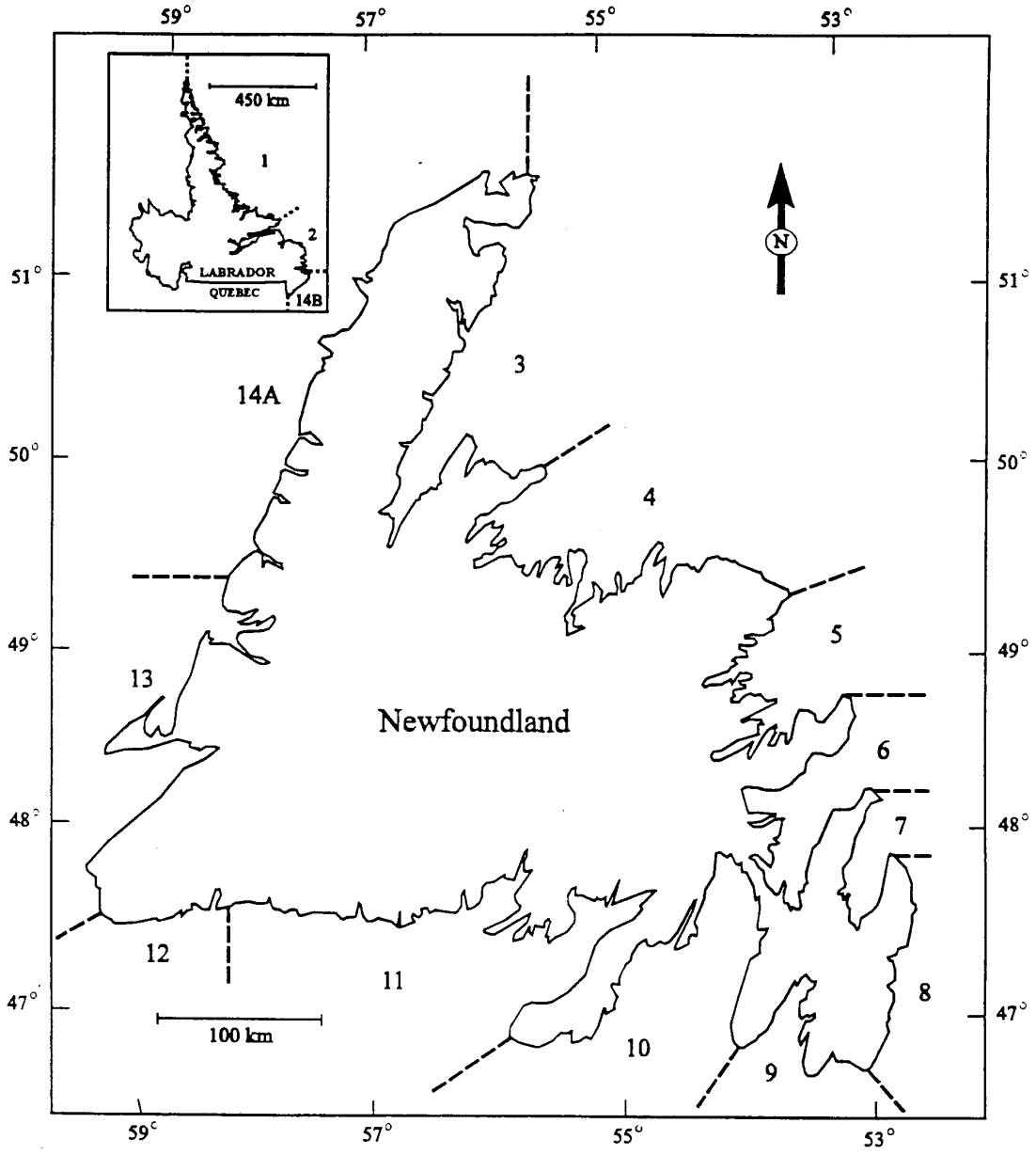

Fig. 1. Map showing the 14 Salmon Fishing Areas of the Newfoundland Region.

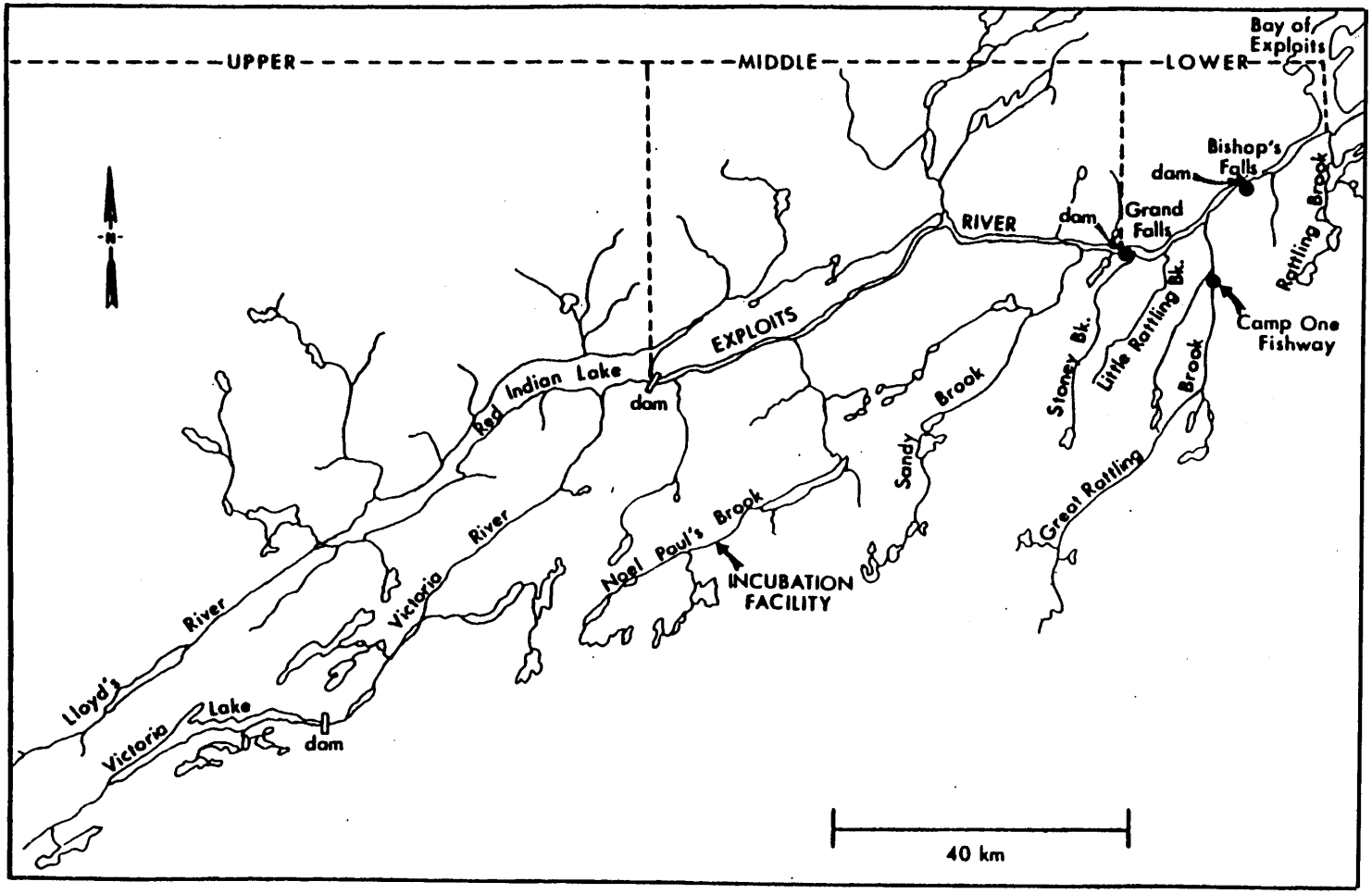

Fig. 2. Detailed map of the Exploits River system.

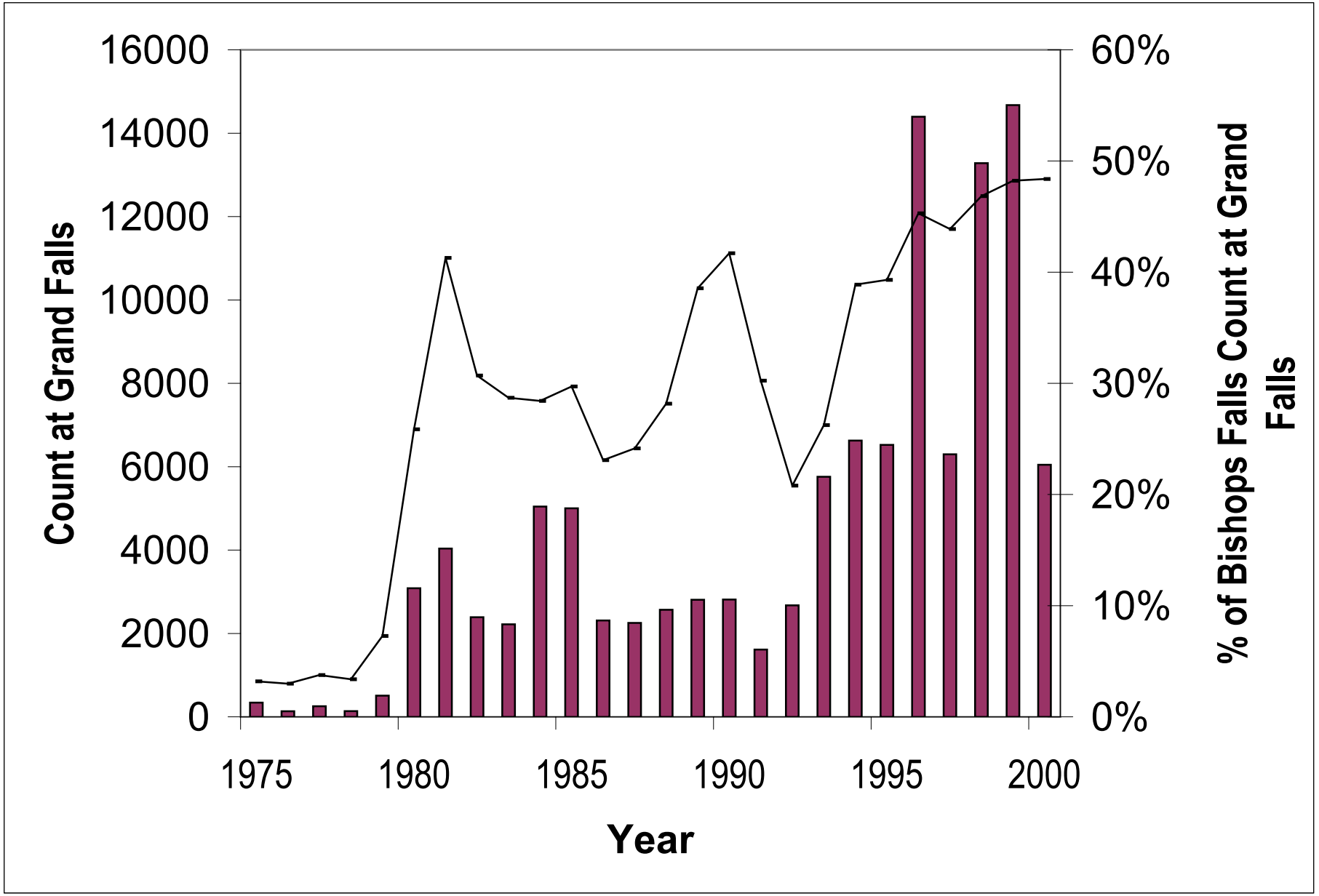

Figure 3. Count of fish at Grand Falls and % of count at Bishop Falls enumerated at Grand Falls.