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The Status of the Atlantic Salmon Stock of the Northwest River, Bonavista Bay (SFA 5), Newfoundland, 2000

État du stock de saumon atlantique de la rivière Northwest, baie de Bonavista (SPS 5), Terre-Neuve, en 2000

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ABSTRACT

Returning adult anadromous salmon (*Salmo salar* L.) have been counted annually in the Northwest River from 1995 to 2000 utilizing a portable counting weir. During this time frame the river has failed to attain its conservation egg deposition requirement. The percentage of the requirement achieved has ranged between a high of 55 % in 1996 and most recently a low of 27% in 2000. A mark-recapture study estimated the smolt production to be 11,175 in 2000.

RÉSUMÉ

Chaque année de 1995 à 2000, les saumons adultes anadromes (*Salmo salar* L.) qui remontent dans la rivière Northwest ont été comptés à l'aide d'une barrière de dénombrement portative. Durant cette période, la ponte nécessaire pour satisfaire les besoins de conservation n'a jamais été atteinte dans cette rivière; la proportion dans laquelle ces besoins de conservation ont été comblés a atteint un sommet de 55 % en 1996 et son plus faible niveau, soit 27 %, en 2000. Une étude de marquage-recapture a permis d'estimer la production de smolts à 11 175 en 2000.

INTRODUCTION

The Northwest River, with an axial length of 60 kilometres and a drainage area of 689 km^2, is the largest of three watersheds that empty into Clode Sound, Bonavista Bay, Salmon Fishing Area (SFA) 5 (Fig. 1). The lower reach (1.8 km) of the watershed lies within Terra Nova National Park (TNNP) and the headwaters lie within the Bay du Nord Wilderness Area.

Historically anadromous Atlantic salmon (*Salmo salar* L.) only had access to the lower 3.2 km of the watershed due to an 8 m waterfall (Northwest Falls) which was believed to be a complete obstruction to upstream fish passage. In 1948, stream remedial activities provided a means of fish passage above Northwest Falls allowing anadromous salmon access to the majority of the watershed (Jacques Whitford Environment, 1995).

This report documents the stock status of the Northwest River Atlantic salmon population from 1995 to- 2000.

Management Measures

In 1988 the lower 1.8 km of the Northwest River was gazetted into Terra Nova National Park. Enactment of the National Parks Act directly affected angling pressure on the river, as the act requires that each angler possess a park salmon license, retain no more than one salmon per day, register each retained salmon, and retain a maximum of five salmon per season. In addition it confers park officials with the authority to open and close the river within the park. Since 1990, such management options have shortened the length of the angling season on several occasions. Linehan and O'Connell (1995) documents in-season closures between 1990 and 1995.

Management restrictions 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, which should have eliminated by – catch of salmon in cod – fishing gear. In 1998 a limited inshore index cod fishery was permitted in Sept. – Oct. and in 1999 a limited 9,000 t (total allowable catch) fishery was permitted. In 2000 a 7 t fishery was permitted.

3. Moratorium on the cod fishery in SFAs 10-14A implemented in August of 1993 further reduced the by-catch of Atlantic salmon.

In 1992 recreational fishery quotas for retained salmon were introduced for each SFA. The quotas were assigned for each SFA as a whole and not administered on a river by river basis. TNNP honoured this policy and closed the park section of the Northwest River when the Bonavista Bay quota was reached. These quotas were eliminated in 1994 and the season catch for salmon was lowered from eight to six. (O'Connell *et* al. 1995). TNNP was unaffected by this policy as the seasonal catch limit per individual was already five.

In 1995 park officials seta catch quota of 100 small salmon for the section of the river within TNNP. The quota required that no more than seventy small salmon be taken in July and no more than thirty be taken in August (Linehan and O'Connell 1995).

Prior to 1995, angling within the park started on the same day as other rivers in SFA 5 (third Saturday in June) but closed one week earlier (fourth Sunday in August).

In 1996 the recreational fishery on the Northwest River was closed. With the exception of a brief catch and release fishery outside the park in 1997, it has not reopened.

METHODS

Adult Salmon Counting Fence

An adult salmon counting fence (upstream migration) of the type described by Anderson and McDonald (1978) has been installed at Stick Pool approximately 0.6 kilometres upstream of the mouth of the Northwest River each year since 1995. Prior to being released upstream of the fence, salmon were counted and classified as large (≥ 63 cm) or small (< 63 cm) based on comparison with a 63 cm marker on the floor of the trap. During periods of favourable water conditions and when the necessary equipment was operable, salmon were counted and measured with a Silhouette Imaging and Counting System (SIACS) (Pippy *et* al. 1997). Water depth was measured daily in the early afternoon each season since 1995 from a location on shore adjacent to the salmon trap. Water temperatures were recorded daily at the trap.

Table 1. provides the periods that the counting fence was operational between 1995 and 2000. All non- operational periods cited were due to high water events. Salmon counts were not corrected to compensate for the two 1995 washouts as these events occurred in the fall when migrating adult salmon numbers were greatly reduced (approximately 7 small and 1 large salmon per week during the first event and 2 salmon per week during the second.). The 1996 washout however, occurred during the peak of the salmon run so a correction factor based upon the average number of salmon counted in the three day periods before and after the event was used to estimate the number of salmon that may have bypassed the trap (see discussion).

Total Returns/Spawning Escapement

Total adult salmon returns and spawning escapements for the Northwest River during 1995-2000 are provided in Table 2. Total returns were calculated by adding the fence count at Stick pool to the number of known removals below the fence. Spawning escapements were calculated by subtracting the number of known removals and mortalities above the fence from the Stick pool fence count.

Biological Characteristics

Between 1990 and 1995 TNNP staff collected biological information by sampling all small salmon angled within the park (n = 619). Total length, fork length, and weight were recorded

and scale samples were taken for determination of sea age (Table 3). In 1995 all fish captured within the park were gutted and sexed when presented for registration. Ovaries were preserved, so that eggs could later be counted and measured. A description of sampling methods and an analysis of collected data is contained in Linehan and O'Connell (1995), which determined that the Northwest River stock has a fecundity value of 1,767 eggs/kg. Since the closure of the recreational fishery, biological data collected within the park has been limited to the fork length measurements supplied by the SIAC system (n=1,018) (Table 3).

Habitat Determinations

The amount of available parr rearing habitat within the Northwest River watershed has been previously quantified (Table 4).

Recreational Fishery

Catch and effort data from the recreational fishery (Table 5) on the Northwest River were collected by two sources: (i) DFO staff (1974 to 1997) (O' Connell *e*t al. 1998) and (ii) TNNP staff (1990 to 1996) (Linehan and O'Connell 1995). Table 6. provides the percentage of the total number of retained salmon that were caught on the lower 1.8 km. of the river (within TNNP).

Conservation Egg Deposition Requirement

The calculated conservation egg deposition requirement for the Northwest River watershed is 4,070, 512 eggs (Linehan and O'Connell 1995). This is estimated to be the egg production potential of 1,726 small salmon based on the above biological characteristics (Table 7).

Table 2 provides the percentage of conservation target achieved each year that the counting fence has been maintained. This value was calculated by dividing the potential egg deposition (based on spawning escapement) by the conservation egg deposition requirement and multiplying by 100. The values for the mean weight (3.13 kg.) and the percentage of female large salmon (77%) that were used in this calculation were derived from rivers in SFA 4 (O'Connell *et* al. MS 1997).

Smolt Population Estimate

A mark-recapture study was undertaken to estimate the smolt population in Northwest River in 2000. Portable partial counting weirs (Anderson and McDonald, 1978) were used to collect smolt for the purpose of marking with a second weir established downstream to collect marked and unmarked smolt. The capture site was below Northwest Falls and approximately 3.7 km from the river's mouth. The recapture site was just within the park boundary approximately 1.7 km from the mouth. Marks were applied using polyethylene streamer tags (Hallprint Tags Ltd. Holden Hill, Australia size number 13p). Mean travel time between the two sites was just over 24 hours for marked smolt. Length and weight measurements as well as scale samples to determine freshwater Atlantic salmon ages were taken from a sample of smolt (n = 18) collected at the upstream trap (Table 8). A Peterson estimate was used to estimate the smolt population size.

RESULTS AND DISCUSSION

Smolt Estimate

A smolt population estimate of 11,181 smolt was derived from the mark-recapture study. The upper and lower 95% confidence limits were 19,149 and 6,329 respectively. The sample of smolt aged in 2000 revealed that 17%, 50% and 33% were of 2^+, 3^+ and 4^+ river ages respectively. Therefore eggs deposited in 1995 to 1997 yielded most of the 2000 smolt production. During this period the average egg deposition was 46% of the required conservation egg deposition.

Adult Salmon Returns

Values for total returns and spawning escapement are based upon direct counts from the Stick Pool counting fence with the following exceptions. The value of 596 small salmon in 1996 includes an estimate of 15 salmon per day during a 4 day mid-summer high-water event which rendered the counting fence inoperable. The value of 203 large salmon includes an estimate of 5 fish per day for this same period. The daily estimates were based on the average daily numbers of large and small salmon passing through the fence on the days surrounding the data gap. Salmon returns presented for 1997 were taken from Jacques Whitford Environment (1998) and collected from a trap located at the Northwest Falls fishway. Although this trap was upstream of Stick Pool, it received more salmon than were counted at the lower trap (465 compared to 408 small salmon and 183 compared to 115 large salmon). There are three possible explanations for the higher count at Northwest falls:

1. An early run of salmon could have entered the river before the lower fence was operational.

2. On July 13th the upper and lower traps had counts of 23 and 8 salmon respectively. A gap caused by a bent piece of conduit was discovered and immediately corrected at the lower fence on July 14th. At this time there would have been an unknown number of salmon between the two traps.

3. Fish that had ascended the fishway could have fallen back over the falls and come up again causing them to be recounted. Of 227 salmon that were individually tagged above the fishway (all had disc tags and 60 had radio transmitters), seven (3%) descended the falls and were recounted on a second ascent. Of these seven, three (1%) of the tagged fish) were captured ascending for a third time (Jacques Whitford Environment 1998). Extrapolating the number of salmon that were counted twice (10 out of 227) for the whole returning adult population implies that the upper fence count may only have exceeded the true number of returns by 23 fish. Therefore fish falling back over the falls is likely a contributing, but not a complete explanation for the higher count at Northwest Falls.

The Northwest River has not achieved its conservation egg deposition since monitoring of adult salmon numbers began in 1995. In 2000 the Northwest River achieved 27% of this value compared to an average of 42% for the 1995-1999 time series. The mean spawning escapement for this period was 603 adults (small and large) with the 2000 escapement being 376 adults. Less

salmon have returned to the river since 1997 than in 1995 when the recreational fishery was still open.

The majority of small salmon in the Northwest River spend either three (32.2%) or four (54.6 %) years in the river before smoltification and going to sea (Linehan et al 1995). This might suggest that the absence of commercial fishing since 1992 should have resulted in an increase in salmon returns beginning in 1997. Obviously this has not occurred as salmon numbers are limited by many factors other than legal fishing. There is some unquantified evidence to suggest that one of these factors, illegal fishing has increased in recent years. Net marks have been frequently reported on salmon passing through the Stick Pool trap. In 2000 an estimated 15% of salmon passing through the trap had net markings (Kerry Arnold unpubl.). In addition, reports persist that poaching in the Clode Sound area and on the three rivers which flow into Clode Sound has increased dramatically since the closure of the recreational fishery in 1996. The Northwest River salmon population is not replacing itself and this is cause for concern about the future of the stock. Continued monitoring of adult salmon returns in 2001 will provide a smolt to adult survival ratio and thereby allow further insight into the extent that the population is being limited in the marine and freshwater environments.

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Table 1. Northwest River Atlantic salmon counting fence operational periods.

YEAR	OPERATIONAL PERIOD
1995	June 16 - Nov. 1 (excluding Sept. 11 – 20 and Sept. 28 -Oct. 2)
1996	May 17 - Oct. 26 (excluding July 17-21)
1997	June 14 – Oct. 30
1998	May 25 – Oct. 2
1999	June 6 – Sept. 18
2000	June 10 – Oct. 1

Table 2. Adult salmon count, total returns, spawning escapement and % conservation egg deposition achieved for Northwest River.

Year	Adult Salmon		Total Returns		Spawning Escapement		% Conservation egg deposition requirement achieved
	Small	Large	Small	Large	Small	Large	
1995	396	135	498	135	396	134	37%
1996	593	203	593	203	592	195	55%
1997	466	182	466	182	466	182	46%
1998	540	104	540	104	540	104	42%
1999	314	93	314	93	313	92	28%
2000	272	106	272	106	270	106	27%

Table 3. Fork length, weight, and river age of returning Atlantic salmon in the Northwest River.

Year	Life Stage	Fork Length (cm)			Weight (kg)			River Age		
		Mean (n.)	S.D.	Range	Mean (n.)	S.D.	Range	Mean (n.)	S.D.	Range
1990	1SW	54.2(36)	4.03	42.5-62.0	1.80(37)	.330	1.0-2.8	3.76(37)	0.6	3-5
	Repeat	59.2(12)	3.51	52.0-65.5	2.29(13)	.460	1.4-3.1	3.55(11)	0.7	3-5
	2SW	-	-	-	-	-	-	-	-	-
	Small	55.1(47)	4.27	42.5-62.0	1.90(49)	.395	1.0-2.8	3.71(48)	0.7	3-5
	Large	65.5(1)	-	-	3.1(1)	-	-	-	-	-
1991	1SW	53.7(23)	2.9	46.0-58.0	1.63(24)	.240	1.1-2.1	3.83(24)	0.6	3-5
	Repeat	60.8(5)	2.8	56.5-64.0	2.53(5)	.694	1.5-3.5	3.4(5)	0.6	3-4
	2SW	-	-	-	-	-	-	-	-	-
	Small	54.4(27)	3.7	46.0-62.0	1.72(28)	.363	1.1-2.6	3.8(29)	0.6	3-5
	Large	64.0(1)	-	-	3.5(1)	-	-	3.0(1)	-	-
1992	1SW	53.6(134)	4.39	38.2-61.7	1.71(134)	.370	.65-2.6	3.6(134)	.7	3-6
	Repeat	57.63(12)	4.94	46.5-63.0	2.21(12)	.546	1.2-3.1	3.6(120	.8	2-5
	2SW	-	-	-	-	-	-	-	-	-
	Small	53.9(146)	4.49	38.2-62.5	1.74(146)	.393	.65-2.7	3.6(145)	.7	3-6
	Large	63.0(1)	-	-	3.1(1)	-	-	3.0(1)	-	-
1993	1SW	53.7(137)	4.07	41.8-62.0	1.72(139)	.380	1.0-2.6	3.7(136)	.7	2-6
	Repeat	57.0(8)	6.14	44.8-62.0	2.16(8)	.601	1.3-3.2	3.4(7)	.5	3-4
	Small	53.8(148)	4.27	41.8-62.0	1.74(149)	.404	1.3-3.2	3.7(144)	.7	2-6
	Large	_	-	-	-	-	-	-	-	-
1994	1SW	54.6(117)	3.33	43.5-61.5	1.74(116)	.340	.75-2.6	3.8(113)	.6	2-6
	Repeat	57.9(28)	5.28	40.0-63.0	2.18(28)	.556	1.3-3.3	3.7(27)	.6	3-5
	Small	54.6(141)	4.15	36.0-61.5	1.76(140)	.381	.567-2.83	3.8(134)	.6	2-6
	Large	63.0(7)	-	-	2.86(7)	.236	2.5-3.3	3.43(7)	.5	3-4
1995	1SW	53.6(79)	3.16	45.5-61.0	1.70(79)	.301	.80-2.5	3.9(79)	.7	3-5
	Repeat	58.9(13)	5.75	42.0-64.0	2.39(13)	.640	.90-3.5	3.9(13)	.6	3-5
	Small	53.6(90)	4.29	37.5-62.0	1.71(90)	.369	.70-2.6	3.9(90)	.7	3-5
	Large	63.4(4)	0.48	63.0-64.0	3.08(4)	.298	2.8-3.5	3.5(4)	.6	3-4
1996 SIACS	Small	48.6(38)	9.81	31.0-62.3						
	Large	68.66(5)	4.98	63.3-68.19						
1997 SIACS	Small	55.34(349)	5.95	34.3-62.9						
	Large	68.19(108)	5.18	63.1-90.3						
1998 SIACS	Small	56.15(437)	5.07	33.90-63.0						
	Large	67.73(81)	4.46	63.1-67.73						

Note: Weight and length measurements from 1990-1995 are from Linehan and O'Connell (1995)

Table 4. Available parr rearing habitat in the Northwest River.

	Total	Below Falls	Above falls
Available fluvial habitat	3,994 units[1]	683 units[3]	3,311 units
Available lacustrine habitat	8,489 hectares[2]	0	8,489 hectares

[1] Porter *et* al (1974)
[2] O'Connell and Dempson (1991)
[3] Jacques Whitford Environment (1995)
Note: A unit of fluvial habitat measures 100 m^2

Table 5. Atlantic salmon recreational fishery catch for Northwest River, 1974-1996.
Ret. = retained fish; Rel. = released fish

	Effort	Small Salmon			Large Salmon			Total Salmon			
Year	Rod Days	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	Ret.	Rel.	Tot.	CUPE***
1974	1134	65	-	65	0	****	0	65	-	65	0.06
1975	609	38	-	38	5	-	5	43	-	43	0.07
1976	1359	160	.	160	2	.	2	162	.	162	0.12
1977	1712	275	.	275	11	.	11	286	.	286	0.17
1978	2370	336	.	336	4	.	4	340	.	340	0.14
1979	571	57	.	57	0	.	0	57	.	57	0.10
1980	1471	185	.	185	4	.	4	189	.	189	0.13
1981	1047	148	.	148	1	.	1	149	.	149	0.14
1982	1165	165	.	165	5	.	5	170	.	170	0.15
1983	1517	145	.	145	45	.	45	190	.	190	0.13
1984	1600	232	.	232	0	.	0	232	.	232	0.15
1985	1072	320	.	320	*	.	0	320	.	320	0.30
1986	1077	300	.	300	*	.	0	300	.	300	0.28
1987	318	79	.	79	*	.	0	79	.	79	0.25
1988	1040	260	.	260	*	.	0	260	.	260	0.25
1989	65	9	.	9	*	.	0	9	.	9	0.14
1990	456	64	.	64	*	.	0	64	.	64	0.14
1991	464	30	.	30	*	.	0	30	.	30	0.06
1992	630	148	0	148	*	0	0	148	0	148	0.23
1993	858	133	73	206	*	0	0	133	73	206	0.24
1994	1658	164	1	165	*	3	3	164	4	168	0.10
1995	708	97	0	97	*	0	0	97	0	97	0.14
1996	24	0	7	7	*	0	0	0	7	7	0.29
1997					Fishery Closed						
1998					Fishery Closed						
1999					Fishery Closed						
2000					Fishery Closed						

Table 6. Location of recreational Atlantic salmon catch in Northwest River.

Year	Total small salmon catch	Total within Park (% of total)
1990	64	62 (97%)
1991	30	28 (93%)
1992	148	148 (100%)
1993	133(+73 released)	150 (73%)
1994	164(+4 released)	147 (88%)
1995	97 (all retained)	97 (100 %)
1996	7 (all released)	0 (Fishery closed)
1997		

Fishery closed in 1997

Table 7. Conservation egg deposition requirement for Northwest River watershed.

	# of eggs		
	Above falls	Below Falls	Total
Available fluvial habitat	782,640	163,920	946,560
Available lacustrine habitat	3,123,952	0	3,123,952
Total (small salmon requirement in parenthesis)	3,906,592 (1,656)	163,920 (70)	4,070,512 (1,726)

Table 8. Length, weight, and river age of Northwest River Atlantic salmon smolt.

Year	Length (g)		Weight		River Age (No.)		% at Freshwater Age		
	Mean (No.)		Mean (No.)	Range	Mean (No.)	Range	2^+	3^+	4^+
2000	16.09(18)	11.7-20.0	41.02(18)	14.8 – 76.6	3.17(18)	2-4	17	50	33

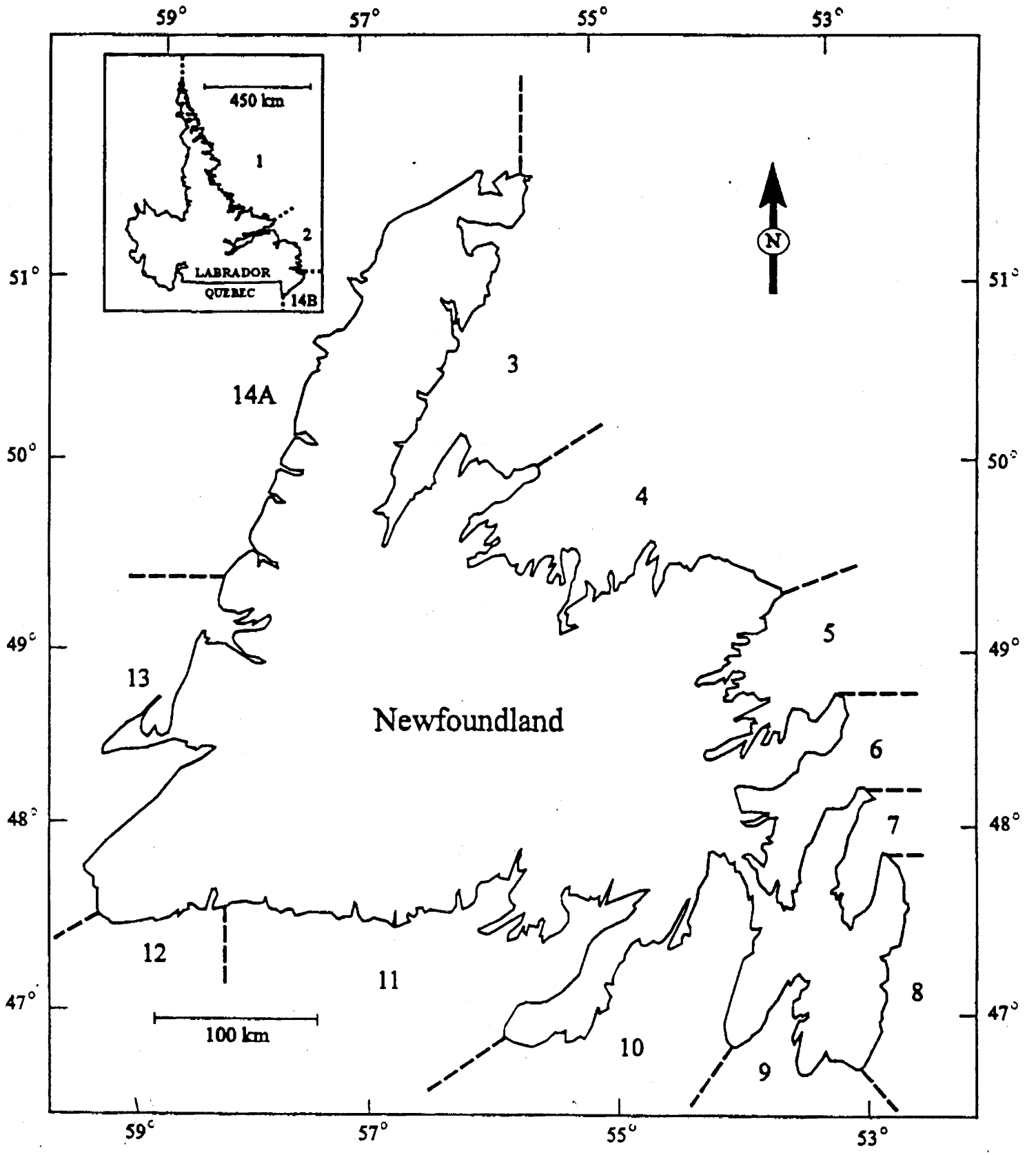

Fig. 1. Map showing the 14 Salmon Fishing Areas of the Newfoundland Region.