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Assessment of the Nepisiguit River Salmon Stock in 1983

by

T.G. Lutzac
Fisheries Research Branch
Department of Fisheries & Oceans
P.O. Box 5030
Moncton, N.B. E1C 9B6

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ABSTRACT

This is the first biological assessment of the Nepisiguit River salmon resource. The stock was reduced to critical levels by heavy metal mining pollution in the late 1960's. Continued overfishing since the mid 1970's has slowed the rate of recovery in spite of a stocking program. Marked Nepisiguit fish returning as adults from hatchery distributions have been used to provide an estimate of the numbers of Nepisiguit River salmon and grilse harvested in the mixed stock commercial salmon fishery of Nepisiguit Bay. We have been unable however, to assess the success of the stocking program to date. In 1983, spawning requirements were 1574 salmon and 2567 grilse. These were not met. The deficit was calculated to be 1100 salmon and 1900 grilse. Atlantic salmon returns to the Nepisiguit River will decrease in 1984 and again in 1985. Spawning requirements will not be met without any homewater fisheries. It is recommended that a restoration plan be developed for this stock.

RÉSUMÉ

La présente est la première évaluation biologique du stock de saumon dans la rivière Népisiguit. Vers la fin des années '60 ce stock a été fortement réduit par des polluants en provenance des mines de métaux lourds. Depuis le milieu des années '70 la récupération du stock a été ralentie par une surexploitation continue, et cela malgré un programme de repeuplement. Des saumons d'écloserie marqués et libérés dans la Népisiguit ont permis, lors de leur migration potamique, une évaluation du taux d'exploitation de ce stock par la pêche commerciale des stocks mixtes dans la baie Népisiguit. Toutefois il nous a été impossible jusqu'à date d'évaluer le succès du programme de repeuplement. Les besoins en géniteurs pour 1983 étaient de 1 574 saumons et 2 567 castillons, et ceux-ci n'ont pas été satisfaits. Les calculs indiquent un déficit de 1 100 saumons et 1 900 castillons. Les retours de saumons à la rivière Népisiguit seront à la baisse en 1984 et de nouveau en 1985. Les besoins en géniteurs ne seront pas satisfaits, même sans la pêche dans les eaux d'origine. Nous préconisons qu'un plan pour rebâtir ce stock soit développé.

INTRODUCTION

The Nepisiguit River is situated in New Brunswick between Restigouche and Miramichi watersheds and empties northeasterly into the Bay of Chaleur via Nepisiguit Bay (Figure 1). It has the potential to be the third largest producer of Atlantic salmon in the "Gulf" portion of the Maritimes next to the Miramichi and Restigouche systems (Anon 1978). Only the lower 37 percent of habitat however, is currently accessible to salmon. A barrier waterfall at river kilometer 32 restricts potential production to about 18,000 fish.

The river's salmon population was reduced to critical levels by pollution from heavy metal mining activities in the late 1960's. Despite the ban on commercial salmon fishing and angling restrictions (1972-80) and the initiation of a juvenile salmon stocking program in 1974, the Nepisiguit River salmon resource has been slow to recover. A counting fence has been operated five kilometers above the river's mouth since 1981.

This report is the first biological assessment of the Nepisiguit River salmon stock. Specifically, the following are estimated: (i) the egg deposition required to bring Nepisiguit salmon to optimal harvest levels; (ii) 1983 homewater harvests including an estimate of commercial catch in the mixed stock fishery of Nepisiguit Bay; (iii) spawning escapement in 1983; and (iv) a forecast of Atlantic salmon available for harvest in 1984 and 1985.

METHODS

Egg deposition requirement

Egg deposition requirements for the Nepisiguit River salmon stock were estimated from the following data:

Required egg deposition rate		= 2.4 eggs/m^2	(Elson 1975)
Accessible rearing area		= 3,973,000 m^2	(Anon 1978)
Fecundity		= 1760 eggs.kg^{-1}	(Elson 1974)
Salmon:	mean weight	= 4.3 kg	
	percent female	= 71 percent	
Grilse:	mean weight	= 1.5 kg	
	percent female	= 16 percent	

Percent salmon	= 38 percent
Percent grilse	= 62 percent

The mean weights were calculated from $\log_{10}$ weight $= -5.1803 + 3.2787 \log_{10}$ length (Elson and Tuomi 1975) using mean lengths of salmon (n=293) and grilse (n=355) sampled at the Nepisiguit River counting fence, 1982-83. The Nepisiguit fence is a portable design modified from Anderson and MacDonald (1978).

Sex ratios of salmon (n=51) and grilse (n=131) from June through the end of August were estimated from internal sexing of angled samples (pooled data 1977-82). Sex ratios of salmon (n=234) and grilse (n=520) passing through the counting fence in the September through November interval were determined by external sexing (1982-83). Sex ratios of early and late run (after August) were different. All fish measured at the Nepisiguit River counting fence > 63.0 centimetres length were assumed to be salmon.

Homewater harvest in 1983

Commercial Fishery:

Commercial catches of Atlantic salmon in Nepisiguit Bay from 1967-83 are given in Table 1. The commercial fishing season was 13 June - 31 July in 1983. Trapnet landings in Statistical Districts 64 and 65 (Figure 2) were divided into Nepisiguit and non-Nepisiguit portions. The catch of Atlantic salmon destined for the Nepisiguit River was determined by comparing the unmarked:marked ratios of fish taken in the commercial fishery to the same ratios at the Nepisiguit River counting fence through the end of August. It was assumed that fish arriving at the fence after the end of August were not available to the commercial fishery. Juvenile salmon were marked in previous years with adipose fin-clips or modified carlin tags and total numbers of marked and unmarked salmon and grilse trapped were reported. All three licences in FSD 64 and two of five operating in FSD 65 participated in the 1983 study. The total catch of the latter area was determined by extrapolation. Since reported catch included both killed and released fish, the total recorded catch was adjusted to the total kill (logbook values) maintaining the same ratios of unmarked to marked fish as noted above.

Spawning escapement in 1983

The number of spawners above the counting fence was calculated using the total number of salmon or grilse released from the traps, angling harvest data collected by

DFO wardens and a five percent non-fishing mortality subtracted from this estimate. The percentage of salmon harvested was determined from samples collected at a weigh in station in 1982. Total number of spawners below the counting fence was determined from redd counts. It was assumed that all salmon and grilse spawning below the fence were of late run origin and that the ratio of grilse to salmon and percent females were the same below as at the counting fence. The number of two redds per female was assumed to be similar to data collected on the Bartholomew River in 1977 (unpublished data).

RESULTS

i) Egg deposition requirement

Egg deposition requirements for salmon and grilse were calculated as follows:

	Eggs per kg.		Percent female		Mean weight (kg)		Percent salmon or grilse	Egg deposition per fish
Salmon	1760	x	0.71	x	4.3	x	0.38	2042
Grilse	1760	x	0.16	x	1.5	x	0.62	261
Total egg deposition per fish								2303

Number of salmon and grilse required for spawning are 1,574 and 2,567 respectively.

ii) Homewater harvest in 1983

a) Commercial fishery:

The technique used to derive the number of fish destined for the Nepisiguit River is summarized below and in Table 2.

For FSD 65, total number of unmarked salmon caught on two reporting licenses = 174

By extrapolation, total number of unmarked salmon caught on five licenses = 435

Extrapolated total number of marked salmon caught on five licenses = 38

Total catch (Table 2) = 473

Total salmon kill = 462

Adjustment factor = $\frac{\text{Total kill}}{\text{Total catch}}$ =0.977

Kill, wild salmon = 435 x 0.977 = 425

Kill, marked salmon = 38 x 0.977 = 37

Total kill (logbook value) = 462

The calculated total kill of wild and marked Atlantic Salmon in FSD's 64 and 65 is shown in Table 2.

Ratios of 8.57:1 and 2.23:1 were used for unmarked:marked salmon and unmarked:marked grilse respectively.

For FSD 65:

8.57:1 = x:37 where x is the number of unmarked or wild Nepisiguit salmon and 37 is the number of marked Nepisiguit salmon.

x = 317

The calculated total kill of wild and marked Nepisiguit River salmon and grilse is shown in Table 3.

b) Recreational fishery:

Sport fishery statistics for the Nepisiguit indicate a kill of 176 salmon and 117 grilse in 1983 (Table 4). The total fence counts were 293 salmon and 305 grilse (Table 5). Forty-six and thirty-four percent of all angled salmon and grilse were captured above the counting fence in 1982.

iii) Spawning escapement in 1983

Spawning escapement=fence count salmon - (no. salmon angled above fence + losses due to non-fishing mortality)

= 293 - ([176 x 0.46] + [293 x 0.05])

= 197 salmon and similarly, 250 grilse.

A total of 414 Atlantic salmon redds were counted below the fence. At two redds per female, there were 207 female spawners. A total of 92 salmon and 150 grilse were counted through the fence from September through November. Percent female was 74 and 6 percent respectively. The number of salmon and grilse which spawned below the fence were estimated from the equations below:

1) $x:y = 92:150 \quad y = 1.63x$

2) $0.74x+0.06y = 207$

where x = number of spawning salmon
y = number of spawning grilse

Solving for x and y, there were 247 salmon and 403 grilse spawners below the fence. Therefore, the total number of spawners was 444 salmon and 653 grilse. Total returns to the Nepisiguit River can then be calculated as:

	Salmon	Grilse
Estimated commercial harvest	450	148
Estimated sport fishing harvest	176	117
Non-fishing mortality	15	15
Spawning escapement	444	653
Total returns (excluding bycatch)	1085	933
Required spawning escapement	1574	2567
Spawning surplus or deficit	-1130	-1914

DISCUSSION

The 1983 Atlantic salmon run to the Nepisiguit River counting fence was down 56 percent from 1982 (Table 5), a 22 percent decline for salmon and a 69 percent decline for grilse. There were insufficient returns in 1983 to meet spawning requirements. Spawning escapement in 1983 was only 28 percent of the target for salmon and 25 percent for grilse.

Samples of adult Atlantic salmon at the counting fence over the past two years have shown a very high percentage of fish leaving freshwater as two year old smolts. Two year old smolt production was 83 percent of the total in 1982. The figure increased to 91 percent in 1983 (Table 6). This is likely the minimum possible smolt age in these latitudes. Year class data for 1982 and 1983 adult returns appear in Table 7. The corresponding weighted age 0+ parr data (1977-80) shows a continuous decline, one which did not reverse until 1982 (Tables 7,8).

These data suggest that the unmarked or wild portion of the Atlantic salmon run to the Nepisiquit River will decline in 1984 and again in 1985, and that the wild salmon component of the 1984 run will be down compared to 1983 levels. We are unable to predict the trend for wild grilse in 1984. Spawning requirements will not be met without any homewater fisheries.

We recommend that a restoration plan be developed for this stock.

ACKNOWLEDGEMENTS

For the past three field seasons, the Nepisiguit Salmon Association has sponsored data collection projects focusing on the Nepisiguit River Atlantic salmon resource and have provided much of the basic data summary used in the preparation of this report. With Bob Baker as president, this organization was the first public group in the Maritimes to assume shared responsibility with this department in the restoration and development of a potentially major salmon resource. The Employment Development Branch of Employment and Immigration Canada and Development Branch of this department have provided the necessary funding and administrative controls. Mark Hambrook provided the technical supervision. Drs. Bob Randall and Mike Chadwick reviewed the manuscript.

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Table 1. Estimated numbers of Atlantic salmon landed in the commercial salmon fishery of Nepisiguit Bay, 1967-83. Numbers were taken from fishermen's logbook summaries or estimated from weight data contained in annual Atlantic Salmon Commercial Catch Statistics - Maritime Provinces reports.

	Fisheries Statistical District	
	64	65
1967	8998	3506
1968	4240	3996
1969	3858	3141
1970	3668	1287
1971	1044	1520
Commercial ban in place 1972-80 inclusive		
1981	792	2576
1982	551	940
1983	416	1162

Table 2. Reported catch and landings of unmarked and marked Atlantic salmon in the commercial trapnet fishery of Nepisiguit Bay, 1983. Total landings are divided into unmarked and marked portions based on unmarked to marked ratios in the reported catch, some of which were released. Marked fish (adipose fin-clipped or marked with modified carlin tags) were released as juveniles in the Nepisiguit River. All three licenses in District 64 reported, but catch in District 65 was extrapolated from data on two of the five licences operating.

Statistical District		Reported catch			Adjustment	Landings		
		Unmarked	Marked	Total	Factor	Unmarked	Marked	Total
64	salmon	443	16	459	0.599	265	10	275
	grilse	206	1	207	0.681	140	1	141
65	salmon	435	38	473	0.977	425	37	462
	grilse	440	30	470	1.489	655	45	700

Table 3. Estimated landings of Nepisiguit River salmon and grilse in the commercial trapnet fishery of Nepisiguit Bay, 1983. Marked fish (adipose fin-clipped or marked with modified carlin tags) were released as juveniles.

	Statistical District		
	64	65	Total
Salmon wild	86	317	403
marked	10	37	47
Grilse wild	2	100	102
marked	1	45	46
Total	99	499	598

Table 4. Numbers of bright Atlantic salmon angled in the Nepisiguit River system below Grand Falls and percent composition of large salmon, 1965-83.

Year	Large salmon	Grilse	Total	Percent large salmon
1965	20	473	493	4.1
1966	38	407	445	8.5
1967	46	410	456	10.1
1968	5	189	194	2.6
1969	5	38	43	11.6
1970	0	2	2	0
1971	1	16	17	5.9
1972	10	16	26	38.5
1973	95	0	95	100.0
1974	140	28	168	83.3
1975	95	77	172	55.2
1976	100	335	435	23.0
1977	38	28	66	57.6
1978	69	40	109	63.3
1979	6	44	50	12.0
1980	103	135	238	43.3
1981	179	130	309	57.9
1982	187	130	317	59.0
1983	176	117	293	60.1
Overall averages (1965-82)	63.2	138.8	201.9	31.3

Table 5. Salmon and grilse returns to the Nepisiguit River counting fence, 1982-83.

	Salmon			Grilse		
	Unmarked	Marked	Total	Unmarked	Marked	Total
1982	236	141	377	784	211	995
1983	264	29	293	235	70	305

Table 6. Smolt age for unmarked Atlantic salmon at the Nepisiguit River counting fence, 1982-83.

	Smolt age				Percent 2-year smolt		
	2		3				
	No.	%	No.	%	large salmon	grilse	total
1982	632	82.8	131	17.2	13.0	69.9	82.9
1983	299	91.4	28	8.6	46.1	45.3	91.4

Table 7. Mean weighted density of age 0+ Atlantic salmon (number per 100 square meters of salmon habitat) as determined by electrofishing, in the Nepisiguit River system below Grand Falls. Figures shown are the sum of densities weighted according to percent accessible nursery area per tributary and mainstream (Table 8).

Year	Mean weighted density
1977	19.8
1978	9.3
1979	6.9
1980	4.8
1981	2.2
1982	3.9
1983	5.5

Table 8. Distribution of salmon nursery area(m^2) in the Nepisiguit River system below Grand Falls (Turner, unpublished, 1968).

Tributary	Nursery area	Percent
Mainstream	3,522,907	88.7
Pabineau River	256,014	6.4
Gordon Meadow Brook	196,226	4.9

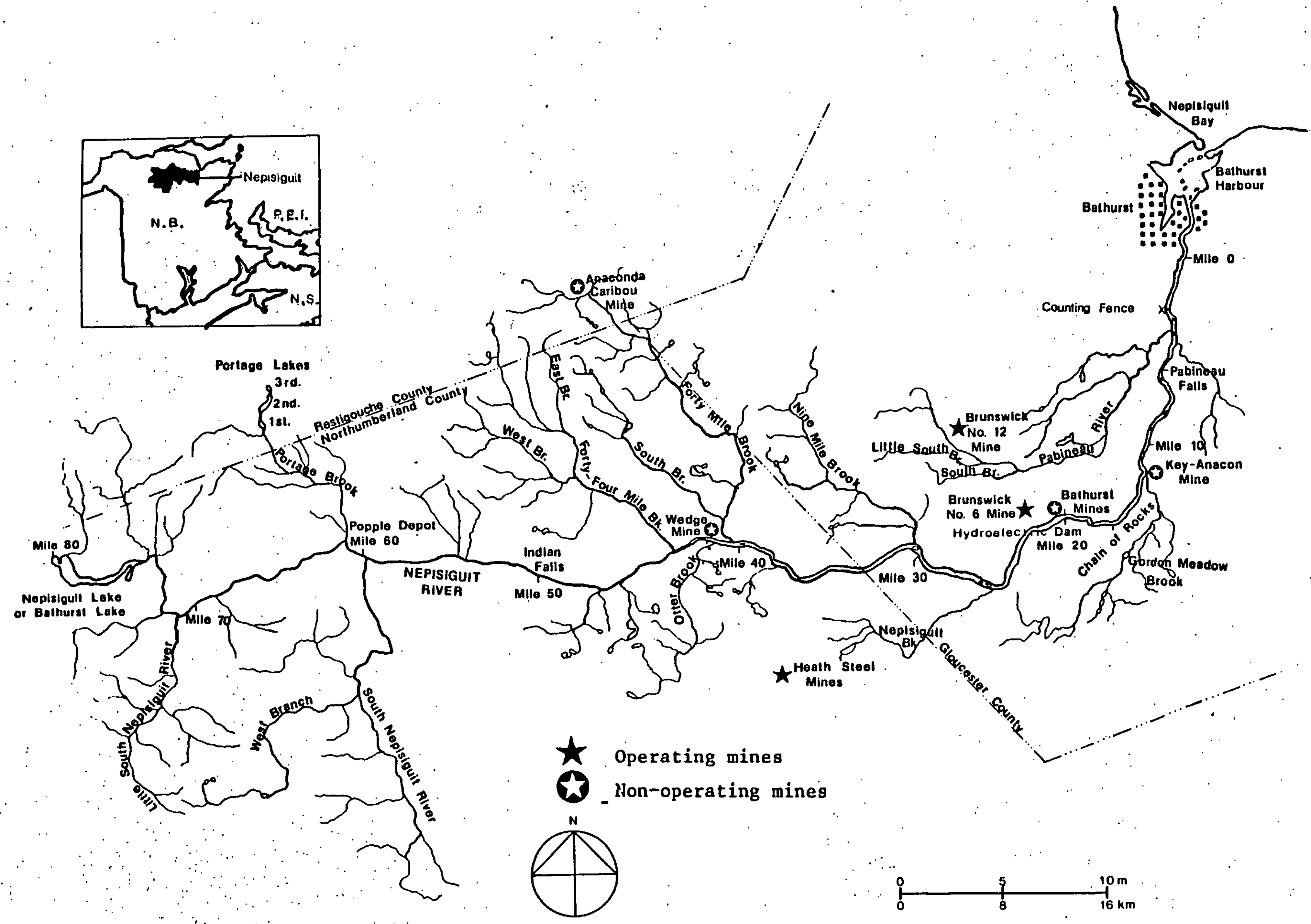

Figure 1. Map of Nepisiguit River system showing location of hydroelectric dam, heavy metal mining and counting fence.

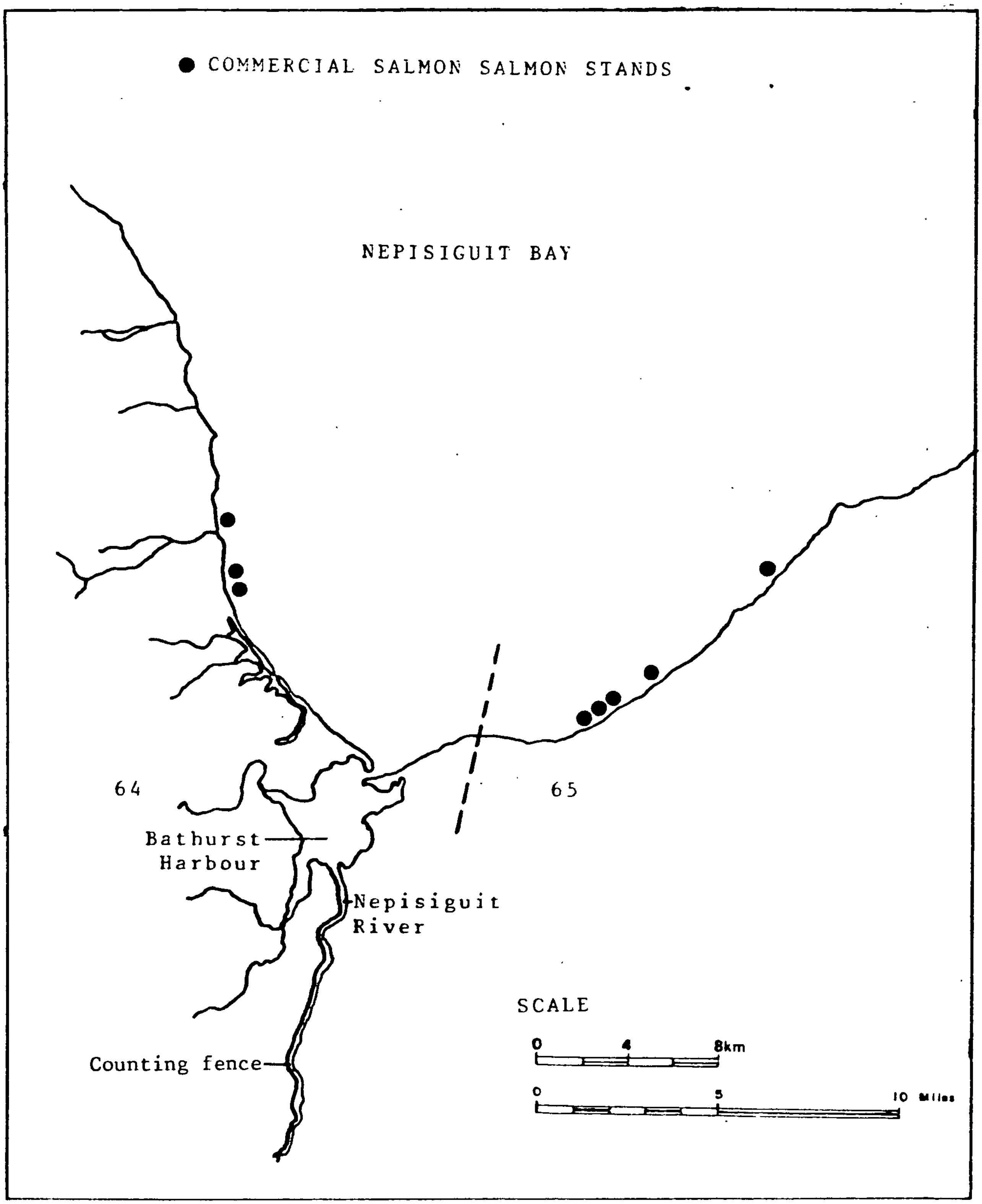

Figure 2. Location of operational commercial salmon stands in Statistical Districts 64 and 65, in 1983. The dashed line divides the two areas.