

Serial No. 2809  
(B.g.14)ICNAF Res.Doc. 72/82  
(also ICES/ICNAF Salmon  
Doc. 72/18)ANNUAL MEETING - JUNE 1972Distant and Local Exploitation of a Labrador  
Atlantic Salmon Population by Commercial FisheriesR. F. Peet and J. D. Pratt  
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Since 1969 Atlantic Salmon smolt and adults have been tagged at Sandhill River located at lat. 53°35'N, Long. 56°21'W in southeastern coastal Labrador (Fig. 1). The river drainage area is approximately 623 square miles and almost the entire system is open to anadromous fish species.

The project is part of the Canadian investigation into the origin of salmon stocks being exploited by the large commercial fishery off West Greenland. Sandhill River was chosen as the site of operations after evaluation of reconnaissance surveys and population counts at selected rivers along the coasts of Labrador and northern Newfoundland during 1966 and 1967. Annual tagging began in 1969 and complete smolt and adult run counts have been obtained since 1970.

Comparison of samples of the Sandhill Atlantic Salmon population in terms of size and age composition with samples from both small and large rivers along the Labrador coast showed that the Sandhill population was typical of most anadromous Salmon populations produced by rivers in the northern area.

Materials and Methods

Collections and counts of smolt and adults are achieved by use of a dual purpose counting fence. The river at the project site is 410 feet wide and the fence is 500 feet long running in the form of a "W" with the base upstream. The fence contains 3 adult and 3 smolt traps.

Anaesthetized smolt are tagged with a Carlin type wire-tied tag attached to the fish under the anterior portion of the dorsal fin. The anaesthetic used is tertiary amyl alcohol at a concentration of 96

ml per 2 gallons (Bell, 1967). Details of the tagging procedure and materials used are as described by Saunders (1968). Adults are tagged without anaesthetic using a wire-tied Atkins type tag which is attached to the back through the proximal anterior pterygiophores of the dorsal fin.

Throughout the smolt and adult runs, fish are measured, weighed and scale sampled for size and age composition analysis.

Results and Discussion

## a.) Sampling

Table I summarizes the population assessments at Sandhill River since 1969. Since 1970 a complete adult and smolt count has been obtained.

Table II gives the results of length, weight and age sampling. Approximately ninety percent of the adult spawning escapement of Sandhill River is composed of grilse while most of the remaining percentage is composed of 2 seayear virgin salmon. About one percent are repeat spawners most of which are alternate as opposed to successive year spawners that are undertaking a second spawning migration.

Table I. Summary of Atlantic Salmon smolt production and adult spawning escapements. Sandhill River, 1969-1971

Year	Smolt Production			Adult Escapement		
	No. Tagged	Total Run	No./100 yd <sup>2</sup>	No. Tagged	Total Run	G:S Ratio
1969	6741	54,600 <sup>2</sup>	1.8	399	942 <sup>1</sup>	95:5
1970	8014	55,000	1.8	516	3759	95:5
1971	10,511	55,000	1.8	391	3754	93:7

1: Partial census only; no estimate possible.

2: Mark-recapture estimate based on partial count only.

Table II. The results of sampling the Atlantic Salmon population of Sandhill River for fork length, weight and age, 1967-1971.

Stage	Sample Size	Avg. length (cm)	Avg. weight (gm)	Years in F.W.						
				2	3	4	5	6	7	
Smolt	25,433	16.1	36.5	0.2	5.4	60.0	29.3	4.9	0.2	
grilse	1,783	53.8	1720		13.7	67.6	16.8	1.8		
virgin 2 seayear	185	72.0	3900		17.3	74.0	8.6			
Successive spawner <sup>1</sup> (spawned once as a grilse)	6	63.4	2690	16.7	16.7	50.0	16.7			
alternate spawner <sup>1</sup> (spawned once as a grilse)	12	76.5	4810	25.0	66.7	8.3				
virgin 3 seayear	3	79.2	5550		66.7	33.3				

1. A successive spawner is a fish which returns each year to respawn.
2. An alternate spawner is a fish which spends 1 full year in the sea before returning to respawn.

b.) Tagging

Table III summarizes the tag-recapture data for Sandhill River. The survival of smolt to year 1 grilse in terms of tagged smolt released showed a substantial increase in 1970/71 over that of 1969/70 (i.e. 1.35% compared to 0.709%). This may be partly due to the fact that the fence facilities were not complete in 1969 and fyke nets were used for trapping and tagging. Almost all smolt which were collected by fyke nets were tagged. The remainder of the smolt run was estimated by a mark recovery method (Table 1). Use of nets probably resulted in a larger mortality of tagged smolt after release, although holding tests lasting up to 3 days duration showed no significant difference in immediate mortality between tagged and control fish in 1969. In 1970, permanent trap and fence facilities were used which greatly reduced the handling of fish and physical damage caused by traps. Examination of the survival of untagged smolt to year 1 grilse in which fyke net caught smolts were deleted from consideration, also supports the hypothesis that fyke nets may have been the main causative factor in the poorer survival of fish tagged in 1969 compared to 1970. The annual survivals for untagged fish calculated in this way were almost identical between years (11.3% in 1969/70 and 11.1% in 1970/71).

Table III. A summary of Atlantic Salmon tagging operations, Sandhill River, 1969-1971. (Returns compiled to February 29, 1972.)

Year	Type Tag & series	Stage and no. tagged	Returns Yr. of tagging		Returns Year 1		Returns Year 2		
			Home R. Home angled	Fishery	Home R. Home angled/fence	Comm. Fishery Home/Greenland	Home R. Home angled/fence	Comm. Fishery Home/Greenland	
1969	Green Carlin (L1900-14643) (L14700-14915)	Smolt (6741)	15		32	15	4	34	2**
		Adult (399)			2	12	3	1	2
1970	Green Carlin (L14644-14699) (L14916-22999)	Smolt (8014)	40		71	34	34	1	
		Adult (516)					17	15	
1971	Green Carlin (L23000-33699)	Smolt (10511)							
		Adult (391)							

\* Includes strays and place of recapture not known.

\*\* 1 of these fish was counted through Sandhill fence in 1970.

Of special interest is the large return of both Carlin and Atkins tags from Greenland in 1971, a substantial increase over 1970. Whether this can be attributed specifically to better tag recovery by authorities, increased availability of tagged fish because of better survival, or to an increase in exploitation of northern Canadian fish stocks is difficult to determine. Most probably it is a combination of the latter two of these factors as preliminary reports of the poundage landed in Greenland for 1971 show an increase of approximately 500 metric tons compared to previous years, and it is probable that the permanent fence facility promotes better tagged smolt survival. It is not felt that there has been a greater effort on the part of Danish authorities to return Canadian tags in 1970 compared to 1969.

If better survival of smolt tagged in 1970 is the major factor involved in the increase in tag returns from Greenland in 1971 as compared to the return in 1970 from smolt tagged in 1969, then the increase in year 1 tag returns in 1971 from the local commercial fishery and spawning escapement compared to the number of year 1 tags returned in 1970 from the 1969 tagging should also be proportional. This is not the case as the increase in returns from Greenland in 1971 is approximately 7 times that of 1970 while returns from the local commercial fishery and the spawning escapement in 1971 were approximately twice those of 1970.

With the knowledge that the Danish catch increased by a significant amount in 1971 over 1970, it seems that the main factor contributing to the large return of tags from Greenland in 1971 over 1970 is an increase in exploitation of northern Canadian fish stocks off Greenland.

Estimates based on 2 years of returns from the 1969 smolt tagging show that the adult population of Sandhill River is composed of approximately 66% grilse and 33% 2 seayear or older fish. In compiling this percentage composition, the 1970 Greenland year 1 returns were grouped with 1971 year 2 returns, as these fish were destined to be 2 seayear or older salmon. This is a much larger proportion of 2 seayear fish than was determined by sampling the adult spawning run to the river (Table I). River samples show that the run that survives to spawn is composed of an average of 93.8% grilse and 6.2% two seayear or older fish. Estimates of exploitation of virgin fish by commercial fisheries based on smolt tag returns show that approximately 66% of the grilse return to the river to spawn, 2%

are angled, while 32% are taken by commercial fisheries. Only 10% of the 2 seayear or older fish return to the river while 90% are taken by commercial fisheries.

In 1971, the majority (Table III) of 2 seayear fish tagged as smolt in 1969 were taken by the local commercial fishery while only 4, also destined to become 2 seayear salmon in 1971, were taken the previous year (1970) in Greenland. It will be interesting to note the number of 2 seayear fish taken in local waters in 1972 considering the large return in 1971 from West Greenland of 34 fish destined to be 2 seayear or older salmon which were tagged as smolt in 1970. If the catch of these fish is small in comparison to 1971, then it is possible that there is an inverse relationship between exploitation in Greenland and subsequent exploitation in home waters. However, it has been noted in past years that whenever there has been an increase in the West Greenland catch there has been a corresponding increase in the number of 2 seayear salmon caught in home waters during the following year, and it is now known that the 1971 catch of salmon off West Greenland is the highest on record. This may mean that there will be a record return of tags from the 1970 smolt tagging in 1972. Whichever pattern emerges, one conclusion which may be drawn is that not many two seayear fish will survive to return to the local river for spawning.

The distribution of recoveries from 1969 and 1970 tagging shows that northern fish are taken by commercial fisheries along the east coast of the Great Northern Peninsula of Newfoundland, mostly from Canada Bay North and along the Labrador coast as far as Sandhill Cove in Table Bay (Fig. 2 & 4). Figure 1 shows the commercial salmon collection centers along the coast and the percentage of the Labrador salmon catch that each accounts for averaged over a ten year period. Very few tags were returned from the large commercial fishery in the Packs Harbour area north of Sandhill River which accounts for an average of 35% of the total Labrador Salmon catch.

The 1971 catch of tagged salmon was divided such that most of the 2 seayear fish were taken from mid June to early July while the 1 seayear fish (i.e. grilse) were taken from the second week in July to late July. While returns at present are not sufficient to accurately

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show the timing of the migration through the local commercial fisheries, the pattern of tag returns and the distribution of the Labrador commercial fishery suggests that the path of migration of returning tagged fish is generally northwards from the White Bay area along the Labrador coast to Sandhill River and agrees with the hypothesis of Lindsay and Thompson (1932) as to the probable migration routes of Salmon from the northern population which are caught in the various commercial fisheries off the northern coasts of Newfoundland and Labrador.

Tag recaptures from smolt tagging in Greenland were distributed from Disko Bay in the north to Cape Farewell in the south and fish were taken from early August to late October. Most tagged fish (43%) were taken in September and the main area of concentration was south of Godthab where 62% of the tags were taken in ICMF areas 1D, 1E and 1F (Fig. 2).

The fishery is divided into two components, the offshore drift net fishery and the coastal gill net fishery. At present it is not possible to give an accurate breakdown of the return of tags by component as two-thirds of the returns did not list the method of recapture.

Results from adult tagging (Table III) show that recovered spawners do not make a substantial contribution either to commercial fisheries or the spawning escapement of Sandhill River as they do in some rivers in insular Newfoundland. However, the pattern of returns (Fig. 3 & 5) and the area of exploitation are similar to those of the grilse and two seayear virgin fish which were tagged as smolt (Fig. 2 & 4). There was an increase in tag returns from Greenland between 1970 and 1971 as occurred with the returns from smolt tagging in these years (i.e. only 3 Atkins tags were taken in Greenland in 1970 as opposed to 12 in 1971). This corroborates that there might have been a greater degree of exploitation of northern stocks in 1971.

Tagging of smolt and adults further south in Newfoundland at Salmon River in Hare Bay and Indian River in Halls Bay within the north-eastern section of the island indicates that these populations are composed mainly of grilse and do not make large contributions to distant fisheries as compared to Sandhill River. No recoveries of smolt tags from these rivers have been made in West Greenland but adults tagged at Salmon River have been recovered. Most of the respawners at Salmon River are alternate year spawners while at Indian River most respawners are successive year spawners. Homewater exploitation of these populations is considerable.

Sixty to eighty percent of the total annual recoveries from smolt tagging are taken by local commercial and sports fisheries while 80% to 97% of the total annual recaptures from adult tagging are also taken by the local commercial fishery. The distributions of fish tagged as smolt and adults were similar within the commercial fishery with the majority being harvested along the coast at a distance less than fifty miles from their natal river. However, it is felt that the results from tagging at these two rivers cannot be taken as representative of the entire northeast coast of the island. Further smolt tagging is required in salmon producing streams on the other coasts and in larger watersheds before it can be concluded that most of the streams of insular Newfoundland produce mainly grilse populations which are not harvested by distant commercial fisheries, in particular the Greenland Commercial Fishery.

Summary and Conclusions

- 1.) Smolt tagging studies have shown that a large component of the Sandhill River Atlantic salmon population is composed of 2 seayear virgin fish.
- 2.) Nine tenths of the 2 seayear salmon produced by Sandhill River are taken by the Greenland and homewater commercial fisheries while very few return to the natal river for spawning.
- 3.) One-third of the grilse produced are taken by the homewater commercial fisheries while two-thirds return to the river to spawn.
- 4.) Salmon tag returns in 1971 from West Greenland have increased 6 to 7 fold over the 1970 West Greenland recaptures per number of smolts tagged. Most of the increase in 1971 is attributed to a record harvest off Greenland which may cause a decline in the number of 2 seayear salmon taken in homewater catches and in spawning escapements in 1972. Tag returns from 2 seayear salmon within the homewaters during 1972 will determine the validity of this assumption.
- 5.) Smolt tag recaptures within the Greenland Fishery were distributed from Disko Bay in the north to Cape Farewell in the south and fish were taken from early August to late October. There have been returns from both offshore drift nets and coastal set gill nets but the proportionate recovery by type of gear is not presently known.

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- 6.) Smolt tag recoveries within the homewater fishery were distributed from the east coast of the Great Northern Peninsula of Newfoundland north along the Labrador coast to Sandhill Cove in Table Bay. Two seayear fish are taken from mid June to early July while grilse are harvested somewhat later from the second week in July to late July.
- 7.) Kelt tagging studies show that recovered kelt also enter the West Greenland and local commercial fisheries but their contribution to the fisheries or spawning escapement is insignificant in comparison to the contribution of virgin fish. The distribution of tag returns from adult tagging follows the same pattern as the returns from smolt tagging.
- 8.) Tagging of smolt and adult river populations further south in Newfoundland shows that they are predominantly grilse populations which do not make a large contribution to the West Greenland Fishery but do make significant contributions to the homewater coastal fisheries. However more widespread smolt tagging is required before the exact nature and utilization of insular populations can be determined.

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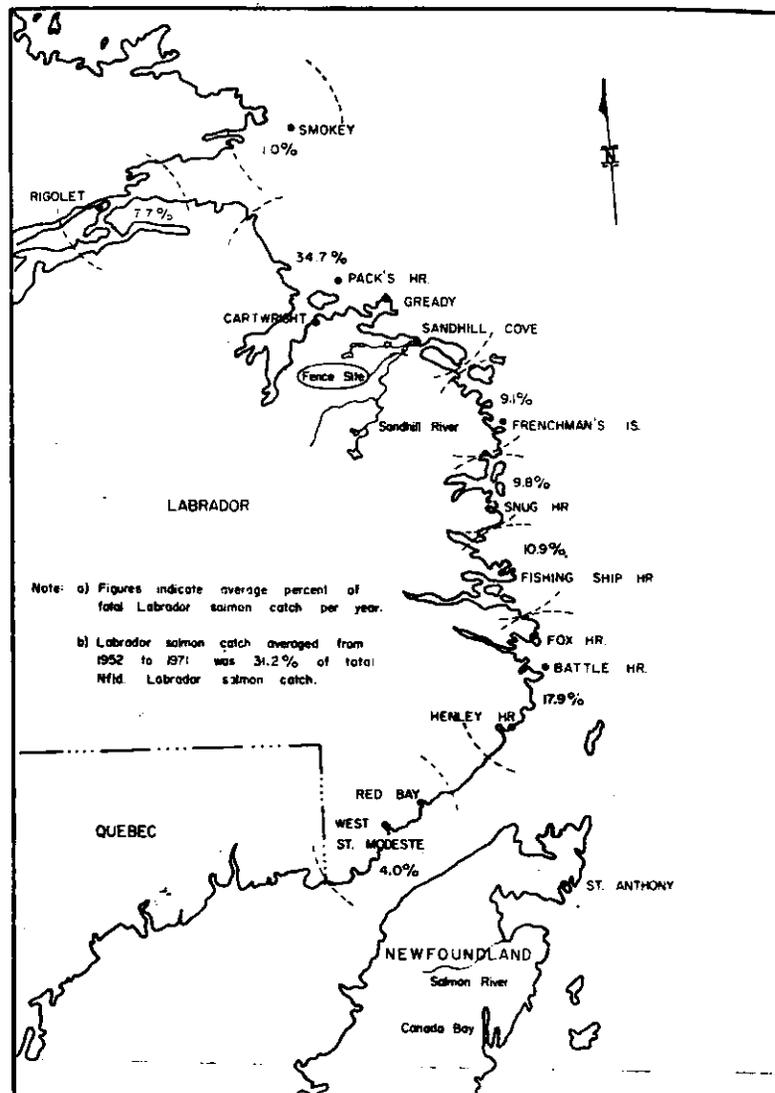


FIG. 1. LOCATION MAP OF LABRADOR AREA SHOWING MAIN COMMERCIAL SALMON FISHING AREAS

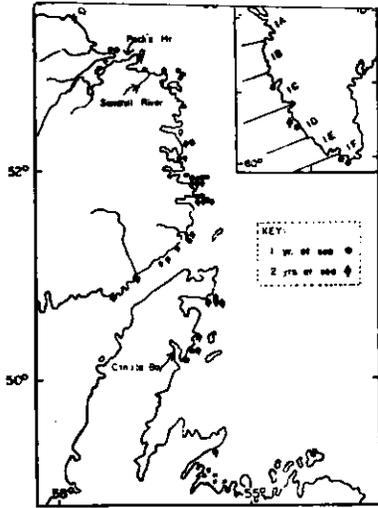


FIG. 2 DISTRIBUTION OF TAG RETURNS  
1969 SMOLT TAGGING (YRS 1 & 2)  
INSET SHOWS CNAF AREAS

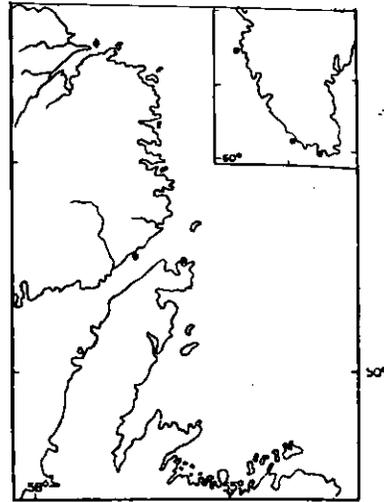


FIG. 3 DISTRIBUTION OF TAG RETURNS  
1969 ADULT TAGGING (YRS 1 & 2)

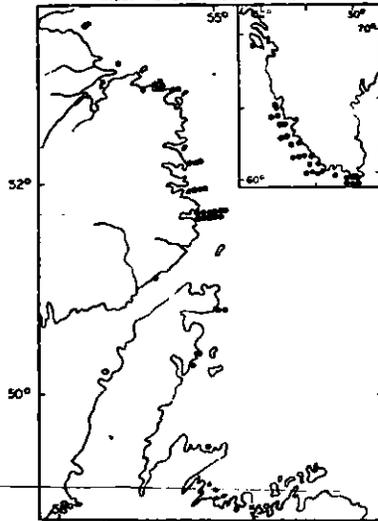


FIG. 4 DISTRIBUTION OF TAG RETURNS  
1970 SMOLT TAGGING (YR 1)

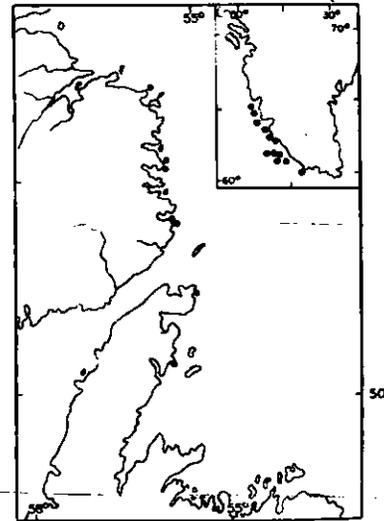


FIG. 5 DISTRIBUTION OF TAG RETURNS  
1970 ADULT TAGGING (YR 1)

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