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Marine Migration of Atlantic Salmon Kelts Tagged in Maine, U.S.A.

by

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Development of a fishery of significant proportions for Atlantic salmon (Salmo salar) off the West Greenland coast has given impetus to the study of marine salmon movements. Too little is known about the impact of the Greenland fishery on the salmon stocks of countries on both sides of the North Atlantic. Determination of the composition of the Greenland catch in terms of country of origin is only one phase of the assessment of that fishery. Knowledge of movements of tagged salmon will contribute to that assessment.

Biological statistics of the Greenland catch indicate that most of the salmon are taken during their second year of marine feeding (Hansen, 1965; Saunders, 1966). Few of the fish will spawn as grilse. The preponderance of second sea-year fish might indicate serious exploitation of stocks from large Greenland catches for areas like Maine which has few grilse. Maine spawning runs of native fish average about 2 percent grilse. Of the remaining 98 percent, about 9 percent is composed of repeat spawners.

Tag Returns

In 1962 the Maine Atlantic Salmon Commission began operating a trap in the Denil-type fishway at the Cherryfield Dam on the Narraguagus River in eastern Maine. Ascending adults are captured for tagging as they move through this fishway. Approximately 50-80 percent of the ascending run is captured, the remainder of the run by-passes the fishway via a spillway when water levels are suitable. During 1962-1965, a total of 788 spawning fish was tagged (Meister and Cutting, 1966). Based on estimated survival in the stream, we estimate the spawning survivors number no more than 580 fish. Percent tag recovery figures for tagged post-kelts in the sea and in the natal river are summarized in Table 1.

Table 1.

<u>Year tagged</u>	<u>Number tagged and released</u>	<u>Estimated survivors</u> ¹	<u>Tag recoveries</u>	<u>Percent recovery</u> ²	<u>River returns</u>	<u>Percent river returns</u> ²
1962	206	151	9	5.96	16	10.60
1963	166	123	4	3.25	7	5.69
1964	225	160	7	4.38	16	10.00
1965	191	146	10	6.85	-	-
Totals	<u>788</u>	<u>580</u>	<u>30</u>	$\bar{x} = 5.17$		

- 1) Estimated survival in stream \pm 10 percent
- 2) Based on estimate survival figures

The total estimated survivors is at best a maximum figure. The percentage of tagged fish surviving the migration back into salt water is not known exactly. Furthermore, tagged fish returns to the river indicate that tag loss in some years may exceed 50 percent. On this basis, the known commercial exploitation of Maine-tagged post-kelts is at least 5 percent of the kelts returning to the marine environment, and quite likely the rate may fall in the range of 10-15 percent. In like manner, for each Convention Area tag return, there is about one tag return to the river. Commercial fisheries may be harvesting half of the post-kelts available in the ocean.

Recovery Locations and Rate of Movement

Maine-tagged post kelts are widely distributed along the western North Atlantic Ocean. The Convention area distributions of the tag recoveries is presented in Table 2. The pattern of tag returns has been essentially similar for the study period.

Information reported with the tag returns permits a preliminary assessment of where and when the post-kelts are migrating. The returns can logically be grouped into 7 geographic areas. The straight-line distances from the tagging site to recovery site were calculated. The estimation of rate of movement requires a determination of the actual period of time spent in the marine environment. Most kelts have left the Narraguagus River in the spring by 1 May, so that date was chosen as being representative of the migrants. The number of days at large after 1 May and the rate of movement in statute miles per day were calculated for each fish. Group means were then established (Table 3).

The average rate of movement of Maine's kelts seems to be about 10 to 12 statute miles per day. This rate includes the acclimation period in the estuary when actual marine migration will be little. The information falls well within the rates of travel for feeding salmon from salmon tagging projects on both sides of the Atlantic Ocean (Table 4).

Table 4.

<u>Tagging site</u>	<u>Percent recaptures</u>	<u>Rate of Movement (miles per day)</u>	<u>Reference</u>
Tadoussac, Quebec, Canada	1.8	--	Lagueux, 1953
Seven Islands, Quebec, Canada	14.2	0.4-17.3	Belding & Prefontaine, 1961
Francis Harbour Light, Labrador, Canada	15%(salmon) 7%(grilse)	5.8-17.0	Blair, 1957
Cape Charles, Labrador, Canada	17.1%(Salmon) 8.3%(grilse)	--	Blair, 1957
St. Anthony, Newfoundland	18.5	1.0-32.4	Belding & Prefontaine, 1961
Boravista, Newfoundland	42.7(salmon) 39.2(grilse)	1.1-26.2 0.8-32.5	Blair, 1956
Ireland	--	4.3-11.1	Went, 1965
Co. Waterford, Ireland	33.9	Most less than 10	Twomey & O'Riordan, 1963
Ireland	12.2-43.2	Most less than 15	Went, 1964

Table 2.

Year tagged	Recapture year	Month	Convention Subarea Divisions							Totals
			1B	1C	1F	3K	3L	3Ps	4X	
1962	1963	June	-	-	-	-	-	2	1	3
		July	-	-	-	-	2	1	2	5
		October	1	-	-	-	-	-	-	1
1963	1964	June	-	-	-	-	-	2	-	2
		July	-	-	-	-	1	-	-	1
		November	1	-	-	-	-	-	-	1
1964	1965	June	-	-	-	-	-	-	1	1
		July	-	-	-	-	-	2	-	2
		August	-	-	-	-	1	-	-	1
		September	-	-	-	-	-	-	1	1
		October	-	-	-	1	-	-	-	1
		November	-	-	-	1	-	-	-	1
1965	1966	June	-	-	-	-	-	2	-	2
		July	-	-	-	-	-	3	1	4
		August	-	-	1	-	-	-	-	1
		November	-	1	-	-	1	-	-	2
		December	-	-	-	-	1	-	-	1
Totals			2	1	1	2	6	12	6	30

Table 3.

Geographic Area	Convention area	Distance from tagging site in statute miles	Time at sea (days) from 1 May	Rate of Movement (miles/day) from 1 May	Group mean days at large	Rate of Travel (miles/day)
Bay of Fundy	4X	152	91	1.7		
		144	79	1.8	87	1.8
		165	90	1.8		
Western Nova Scotia	4X	171	148	1.2	148	1.2
Central Nova Scotia	4X	189	56	3.0	52	4.2
Southern Newfoundland	3Ps	254	48	5.3		
		697	58	12.0		
		697	46	15.2		
		705	62	11.4		
		697	76	9.2		
		697	51	13.7		
		747	76	9.8	62	11.7
		697	64	10.9		
		699	46	15.2		
		699	71	9.8		
Southeastern Newfoundland	3L	705	62	11.4		
		699	65	10.8		
		699	61	11.5		
		841	70	12.0		
		830	73	11.4		
		830	64	13.0	78	11.0
		830	107	7.8		
		1070	165	6.5		
		1038	200	5.2		
		965	210	4.6	200	5.1 (adjusted - 13.4) ¹
Greenland	1B, C, F	958	224	4.3		
		2215	155	14.3		
		2215	197	11.2		
		2087	209	9.8	173	12.3
1839	133	13.8				

¹ Assumed migration to Greenland and return

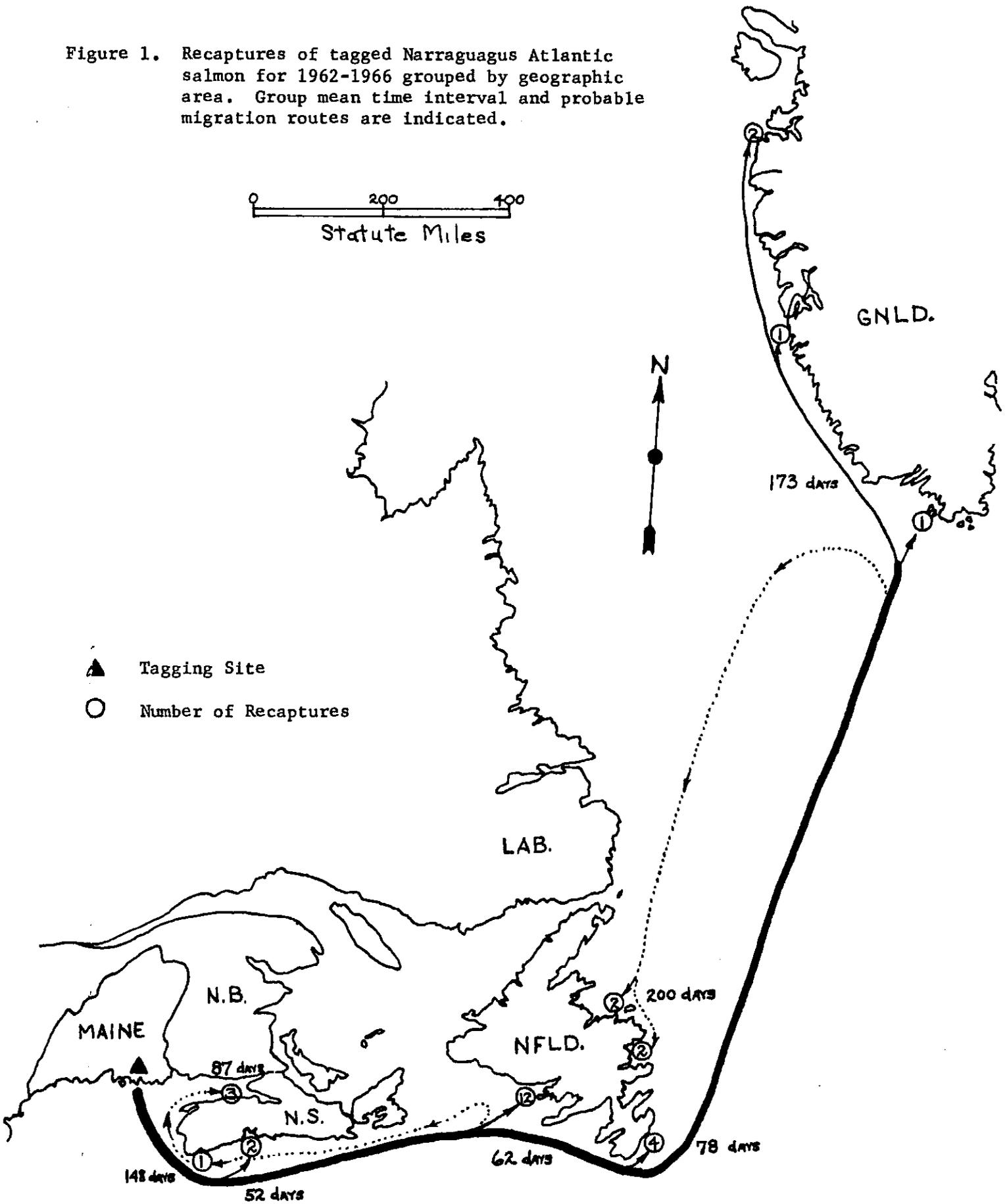
Discussion

Atlantic salmon movements in the western North Atlantic have been studied using tagged salmon. Adult fish are usually captured in commercial fishing gear in the salt water. Subsequent distribution of tag returns has been the major means of assessing migration routes and rates.

Study of the salmon populations in the Gulf of St. Lawrence indicates movement into the Gulf both via the Cabot Strait and the Strait of Belle Isle (Belding, 1939; Belding and Prefontaine, 1961). Results from kelt tagging in Quebec support movement from the Gulf by way of the Cabot Strait (Lagueux, 1953). Huntsman (1939) reports the movement of kelts from New Brunswick and Nova Scotia rivers to the east coast of Newfoundland, but the recaptures mostly occurred later than the year after tagging. Murray (1958) reports information which might indicate a clockwise movement of feeding salmon around Newfoundland. However, tagging experiments in Labrador (Blair, 1957) and in northeastern Newfoundland (Belding and Prefontaine, 1961) point to the movement of salmon southwesterly through the Strait of Belle Isle. Kelts released into the Annapolis River, Nova Scotia, (Bay of Fundy) have been recaptured on the east coast of Newfoundland (Huntsman, 1938), and the movement pattern is suggestive of a similarity with the returns from Narraguagus kelts.

Figure 1 is a map indicating the 7 geographic areas for the Maine tag returns. The group mean number of days at large since 1 May and the number of tag returns are presented. Apparently the feeding kelts take about 50 days to reach the Halifax area on the south-central Nova Scotian coast. Another 10 to 20 day's feeding finds them along the southern Newfoundland coast. Cape Race, Newfoundland, is circumnavigated during the following 10-20 days. Thereafter, from late summer until well into autumn, the fish drop from sight. Late autumn finds them along the Greenland coast where there are some recaptures. By early winter, some fish have turned back toward the natal river, have reached a weight of 15 to 20 pounds (7-9kg.), and appear in the fishery along the northeastern Newfoundland coast. Table 2 has an adjusted rate of travel listed for this latter group of fish. The adjusted figure assumes a migration to the vicinity of Greenland and return to Newfoundland. The recalculated rate of movement is much more realistic when compared to the other listed rates of movement.

Figure 1. Recaptures of tagged Narraguagus Atlantic salmon for 1962-1966 grouped by geographic area. Group mean time interval and probable migration routes are indicated.



The recaptures of tags in Convention Area 4X seem to be a separate group of fish. Of the 3 of 5 fish for which we have recapture data, these salmon have mended well, grown in weight, and been captured in commercial gear not too distant from the natal river. It seems very likely that this group includes salmon which will spawn in consecutive years. Consecutive-year spawners are not uncommon in Maine waters. Assuming for the moment that this group includes spawners which returned to the sea in the fall and estimating a distance of travel at the indicated rate of movement of 11 miles per day for the interim period before capture, we would point toward a feeding migration to the vicinity of Newfoundland then a return journey toward the natal river.

Apparently the Maine-tagged salmon are moving easterly along the southern and easterly coasts of Newfoundland during July and early August. Results from the Bonavista, Newfoundland, tagging experiment would indicate a westerly movement through the same area but during the month of June for feeding salmon returning to the Gulf of St. Lawrence by the Strait of Belle Isle but return, after a feeding migration in the North Atlantic Ocean, to the natal river along the eastern and southern coast of Newfoundland (Murray, 1958).

Belding and Prefontaine (1961) report a progressive northerly movement of the peak of the salmon run along the easterly coast of Newfoundland. In 1938, the peak passed St. Anthony about June 24th. In the same year, the peak passed Port-aux-Basques on the southwestern tip of Newfoundland about the first of June. It appears that the movement of Maine post-kelts does not coincide with the peak movements either on the southern or easterly Newfoundland coasts.

These findings provide a base for more detailed studies on salmon migrations in the Atlantic Ocean. The Maine salmon program in 1966 was expanded to provide 200 percent more tagged kelts per year. The excellent cooperation received from Canadian and Danish fisheries personnel has given very useful information to date. We know that continued cooperation will permit even greater strides in the international understanding of Atlantic salmon migrations in the North Atlantic.

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