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Migrations of the southwest Newfoundland stock of herring

as indicated by tag recaptures

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Introduction

Migration routes of fish have long been determined by tagging fish at one point along their migration route and subsequently recapturing the same fish at another point. The feasibility of tagging herring internally with magnetic tags was first demonstrated by Rounsefell and Dalgren (1933) and this method has since been successfully used to delineate the migration patterns of herring on the Pacific coast of Canada (Hart and Tester, 1937; 1938; 1939; 1940; Hart et al., 1941; Tester, 1944; Tester and Boughton, 1943) and in the northeast Atlantic area (Fridriksson and Aasen, 1950; 1952; Aasen et al., 1961; Dragesund and Haraldsuik, 1968). In the mid-1960's a large herring fishery developed in the southern Gulf of St. Lawrence and the southwest Newfoundland areas, and the seasonal pattern of fishing indicated a connection between the feeding and spawning herring in the southern Gulf and the overwintering herring along the southwest coast of Newfoundland (Hodder, 1969; 1970; Iles and Tibbo, 1970). In order to elucidate the relationships between the herring populations in these areas an extensive tagging program was initiated by the Fisheries Research Board of Canada, the first phase of which took place in March 1970 along southwest Newfoundland (Hodder and Winters, MS, 1970). This report presents results related to the migratory pattern of herring in the Gulf of St. Lawrence-Newfoundland area based on recaptures up to March 31, 1971 from the liberation of tagged herring in southwest Newfoundland in March 1970.

Tagging gear and methods

The overwintering population of herring along southwest Newfoundland is usually concentrated in small coves within the protected bays (Hodder, 1970). This type of distribution is ideal for bar-seining by which large quantities of herring can be barred for several days, thus assuring a continuous supply of live herring in good condition. A somewhat smaller seine was used inside the larger one to capture herring in sufficient quantities for each day's tagging. A small-meshed holding trap, 5 metres deep and supported on the surface by two diagonally secured 6 metre poles, was attached to the headrope of the seine and herring were transferred to the trap by depressing the headrope and allowing the herring to flow over it. The actual tagging operation was carried out in small boats equipped with plastic or canvas tagging tanks each capable of holding 50-75 live herring.

The tags, obtained from Bergen-Nautik, Norway, were made of #430 stainless steel and were 19 mm long, 4 mm wide and 1 mm thick with rounded ends. They were coded in lots of 100 tags with each tag in a lot having the same code number. A tagging team consisted of three persons - one to dip herring from the holding trap into the boat's tagging tank, one to remove the fish individually from the tank and hold it firmly in both hands while the third person using a pointed scalpel made a small incision in the belly just anterior and slightly above the pelvic fins. The metal tag, sterilized in alcohol, was then inserted anteriorly into the body cavity. Under good conditions an experienced team could apply up to 300 tags per hour. Use of a tagging gun was not possible due to severe weather conditions (snow and freezing temperatures).

The tags were recovered by magnetic separators normally found in the meal lines of reduction plants to remove metal debris. These magnets were checked regularly by designated employees of the plant who returned the recovered tags along with relevant recovery information to the Fisheries Research Board's Biological Stations at St. John's, Nfld., and St. Andrews, N.B. A reward of \$1.00 was paid for each tag returned.

#### Tagging operations

The tagging operation was scheduled to take place in the spring just prior to the disappearance of the overwintering herring from the south coast of Newfoundland. During March 3-5 and March 7-8, 1970, there were two liberations of 8400 and 4800 tagged herring respectively in Lapoile Bay and during March 11-13 an additional 11,800 herring were liberated in Roti Bay (Table 1 and Fig. 1) making a total release of 25,000 tagged herring. Samples of herring were randomly selected for length, sex and maturity data and approximately 55% of those sampled were classed as autumn spawners on the basis of gonad development. Water temperatures in the tagging localities ranged from 1 to 3°C in the upper 150 metres and air temperatures were -5 to 5°C during the period of tagging.

#### Tag recaptures

The mixing of herring from widely different areas of capture in the storage tanks at reduction plants and the time delay between the initial processing phase and the recovery of the tags in the dry meal line meant that it was not always possible to assign area of capture for each recovered tag except in those cases when the entire fleet was fishing in the same general locality or when the individual landings were widely separated in time. In various plants in the southern Gulf of St. Lawrence catches sometimes arrived at the plants simultaneously from various parts of the Gaspé coast, Chaleur Bay, American Bank or Bradelle Bank. Consequently assignation of areas of capture could not be made for several recoveries in the southern Gulf and these are listed as doubtful in Table 2.

Within a week after the first herring were tagged, tag recoveries were being reported at the reduction plant at Isle aux Morts (Fig. 1), and by the end of the fishery along southwest Newfoundland in mid-April a total of 391 tags was recovered from landings of herring taken by purse seiners between Lapoile Bay and Cape Anguille. The majority of these tags were recovered at the Isle aux Morts plant (243) but tags were also recovered from reduction plants at Burgeo, Nfld. (13), and East Pubnico, N.S. (135) where substantial quantities of herring caught in Newfoundland waters were shipped for reduction.

Following the disappearance of herring from southwest Newfoundland the seiner fleet began fishing between St. Paul Island, off Cape Breton, and the Magdalen Islands and 51 tags were recovered during the last half of April

from landings of seiners fishing in that area (40 at Isle aux Morts, 7 at Caraquet, N.B., 3 at Burgeo, and 1 at Pubnico, N.S.). During May 1-15 fishing was mainly centred around the Bird Rocks area and 13 tags were recovered during this period (12 at Isle aux Morts and 1 at Lameque, N.B.). A single tag was recovered on June 25, 1970 at Shippegan, N.B. from landings of seiners fishing on American Bank, and during early July to mid-August the fishing area was restricted to American Bank and the Gaspé coast from Fox River to Chaleur Bay. A total of 38 tags was recovered during this period mainly from reduction plants at Shippegan and Caraquet. Also, 2 tags were recovered in the plant at Souris, P.E.I. from landings of seiners fishing in the East Point-Fisherman's Bank area in late August. In September most of the tag recoveries were from catches made on American Bank. Fishing areas were expanded in October to include Orphan and Bradelle banks, and with landings from several different areas being processed at the same time it was not possible in most cases to assign areas of capture with any degree of confidence. Returns from the southern Gulf of St. Lawrence from mid-April to October 1970 totalled 164 tags.

The usual fall fishery near the Bird Rocks failed to materialize in November 1970 and the Newfoundland fishery was about 2 weeks later in starting. Consequently the next tag returns were reported in early December from seiners fishing near Burgeo, Nfld. The La Hune Bay-Burgeo area (Fig. 1) yielded most of the tags from December to early January. Fishing effort was mainly centred west of Burgeo, particularly in Lapoile Bay from January 1971 onwards, and the majority of the tag recaptures were reported from that area. A total of 95 tags was recovered from the 1970-71 winter fishery along southwest Newfoundland. Total recoveries from all areas to March 31, 1971 were 653 tags, a recovery percentage of 2.6%.

#### Significance of tag recoveries

The tag returns have indicated that in early April there is a rapid migration of herring from their overwintering area in southwest Newfoundland westward across Cabot Strait to an area 30 miles northwest of St. Paul Island and thence toward the Magdalen Islands. Also some herring seem to move westward by way of the Bird Rocks area. The herring fishery in those areas at this time is mainly based on spring-spawning fish. By late June some of the herring have reached American Bank, which is a major feeding ground for herring (Iles and Tibbo, MS, 1970), and by July are dispersed around the Gaspé coast-Chaleur Bay region, where spawning occurs in late summer and early fall. Some of the herring also move southward to the eastern part of Prince Edward Island in late summer. There is a migration of herring out of the southern Gulf area in October and these herring move across Cabot Strait to the southwest Newfoundland coast in late November.

The significant feature of the above migratory pattern is that the herring stocks, which support the fall-winter fishery in the area between Cape Ray and Hermitage Bay on the south coast of Newfoundland, are not native to that area but rather represent the overwintering phase of a stock complex of herring derived from spring and fall spawnings in the southern Gulf of St. Lawrence. This had been indirectly indicated by a comparison of certain biological characteristics of herring from these areas (Hodder and Parsons, MS, 1970).

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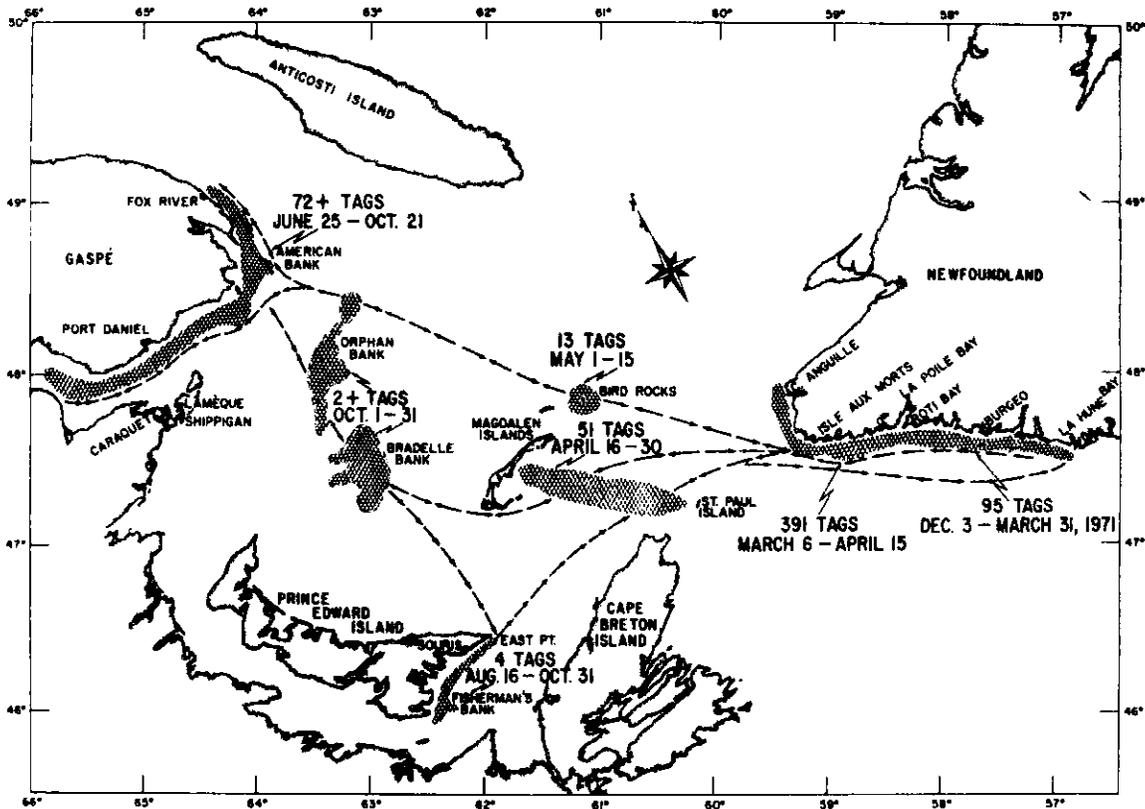


Fig. 1. Areas and dates of recapture of herring tagged along southwest Newfoundland, March 1970. Arrows indicate probable migration routes.

Table 1. Details of tagging operations in southwest Newfoundland waters, March 1970.

Liberation	Date 1970	Locality	No. released
I	March 3	Lapoile Bay	1100
	4	"	4600
	5	"	2700
II	March 7	Lapoile Bay	4500
	8	"	300
III	March 11	Roti Bay	2000
	12	"	7000
	13	"	2800
Total			25000

Table 2. Summary of returns from herring tagged in southwest Newfoundland, March 1970. The plus signs indicate possible areas of capture of tags recovered from mixed landings.

Date of recapture	Nfld. south coast	St. Pauls-Magdalens	Bird Rocks	American Bank	Orphan Bank-Bradelle Bank	Gaspé coast-Chaleur Bay	East Point-Fisherman's Bank	Doubtful (S. Gulf of St. Lawrence)	Total returns
March 1-15/70	21	..	..	..	..	..	..	..	21
16-31	261	..	..	..	..	..	..	..	261
April 1-15	109	..	..	..	..	..	..	..	109
16-30	..	51	..	..	..	..	..	..	51
May 1-15	..	..	13	..	..	..	..	..	13
16-31	..	..	..	..	..	..	..	..	..
June 1-15	..	..	..	1	..	..	..	..	1
16-30	..	..	..	..	..	4	..	..	4
July 1-15	..	..	..	8	..	11	..	..	19
16-31	..	..	..	..	..	14	..	1	15
Aug. 1-15	..	..	..	1	..	9	2	..	12
16-31	..	..	..	16	..	1	..	2	19
Sept. 1-15	..	..	..	7	..	..	..	..	7
16-30	..	..	..	..	..	..	..	..	12
Oct. 1-15	..	..	..	+	..	+	..	..	14
16-31	..	..	..	+	2	..	..	..	..
Nov. 1-15	..	..	..	..	..	..	..	..	..
16-30	..	..	..	..	..	..	..	..	3
Dec. 1-15	3	..	..	..	..	..	..	..	4
16-31	4	..	..	..	..	..	..	..	23
Jan. 1-15/71	23	..	..	..	..	..	..	..	16
16-31	16	..	..	..	..	..	..	..	12
Feb. 1-15	12	..	..	..	..	..	..	..	24
16-28	24	..	..	..	..	..	..	..	10
March 1-15	10	..	..	..	..	..	..	..	3
16-31	3	..	..	..	..	..	..	..	..
Total	486	51	13	33+	2+	39+	4	25	653