Northwest Atlantic Fisheries Organization

Serial No. N1385 NAFO SCR Doc. 87/82

SCIENTIFIC COUNCIL MEETING - SEPTEMBER 1987

Tagging and Recaptures of Atlantic Halibut (Hippoglossus hippoglossus L.) on the Continental Shelves off Eastern Canada and off Western and Eastern Greenland

by

Olav Rune Godø

Directorate of Fisheries, Institute of Marine Research
P. O. Box 1870, N-5011 Bergen-Nordnes, Norway

and

Tore Haug

Department of Marine Biology, Tromsø Museum, University of Tromsø
P. O. Box 2550, N-9001 Tromsø, Norway

ABSTRACT

Earlier investigations on Atlantic halibut, Hippoglossus hippoglossus, have shown that it is a migratory species with potential of mixing between stocks. Most of the published data are, however, from the east Atlantic. This paper present data from Norwegian tagging experiments on the species carried out in the New Foundland/Labrador region and off the west and east coasts of Greenland in 1955-1969, where respectively 111, 230 and 796 fish were tagged. The recapture frequencies were 3.6%, 12.0% and 15.0%, respectively. Most of the recaptures were in the area of release. Considerable movements within each of the two main Greenland areas were observed, however, with no dominant migration direction. This is in accordance with observations from other areas. Some exchange of fish between the three regions was recorded, and two fish tagged off Greenland were recaptured in Icelandic waters.

INTRODUCTION

The Atlantic halibut, Hippoglossus hippoglossus, is common throughout the North Atlantic on both the North American and Eropean coasts. It has been confirmed through several tagging studies that the species is, at least in certain parts of its life cycle, highly migratory and has a considerable potential for mixing between stocks (Godø & Haug in press).

There is very little published information concerning halibut biology from the Northwest Atlantic (Bowering 1986). Thus, most published halibut tagging data are from the Northeast Atlantic (including Iceland). However, some tagging experiments were

performed in the Gulf of St.Lawrence and the Nova Scotian shelf in the mid 1940's (Martin & McCraken 1950, McCracken & Martin 1955, McCracken 1958, Jensen & Wise 1961, Kohler 1964). Further north, along the Canadian coast north of the Grand Banks of Newfoundland, and the west and east coasts of Greenland, no migration data have been published. In 1955-1969 the Directorate of Fisheries, Bergen, Norway, had annual research cruises to these areas, and halibut were tagged.

Preliminary results of some of the recaptures made from the west Greenland 1958, 1959 and 1961 taggings were presented by Kvavig (1972a, b). This paper analyzes all the recapture results from the Norwegian taggings off the eastern coast of Canada in 1955, 1957 and 1958, off west Greenland in 1955-1969 and off east Greenland in 1959 and 1961-1965.

MATERIAL AND METHODS

All fish tagged were caught during research fisheries using longlines. Total fish lengths were measured in most cases, while sexing of the fish was impossible due to the morphological similarities of males and females. Yellow plastic tags were attached to the eye side operculum of each fish considered capable to survive.

Fish were tagged in Canadian shelf areas at five different sites (Table 1, Fig.1).

On the west coast of Greenland fish were tagged on banks of the shallow and relatively narrow continental shelf, which runs in a south-north direction along the coast line (Table 2, Fig.2). Fish tagged and recaptured within the same geographic boundaries given in Table 2 are defined as recaptured in the tagging area. All others are classified as long distance migrants.

On the east coast of Greenland fish were tagged at 13 sites (Table 3, Fig.3). There are no distinct banks on the continental shelf on this side of Greenland is not separated in distinct banks as on the west side of the island, and the fish are therefore classified as long distance migrants when recaptured outside the east coast of Greenland, or north or south of the tagging area along the Greenland shelf. When classifying the latter group, each recapture was allocated to the nearest tagging site.

Detailed information of all recaptures is given in the Appendix tables.

RESULTS

Length distribution

The fish caught on the Canadian shelf area ranged in size between 60-145 cm (Fig.4). In western and eastern Greenland waters the tagged fish were generally smaller (range 50-125 cm), most being less than 100 cm.

Tagging/recaptures off Canada

Of 111 halibut released at the 5 tagging sites off the east coast of Canada in 1955, 1957 and 1958, 4 (3.6%) were recaptured, one of them in the year of tagging (Table 4). Three were recaptured in the tagging area, while one long distance migrant had moved from Saglek Bank and northwestwards to the west coast of Greenland (Fig.1).

Tagging /recaptures off western Greenland

In the 11 tagging sites to the west of Greenland 796 halibut were tagged in 1955-1969 (Table 5). Of these, 96 (12%) were recaptured, from a< few days and up to 5 years after release.

Of the recaptures, 40 (41.8%) were made in the tagging areas (Table 6), while 52 longdistance migrants were recaptured either at other sites on the western Greenland shelf area (47) or outside this shelf (6). The remaining 4 were insufficiently documented to determine distance moved. Of the 6 caught outside the west Greenland shelf, 5 were recaptured in Newfoundland bank areas and one at the Greenland-Iceland ridge west of Iceland (Fig.2). On the west Greenland shelf, 29 long distance migrants had moved northwards, 6 had moved southwards, while 10 of the fish tagged west of the Tovqussaq Bank had moved eastwards up on the bank (Table 6, Fig.2.).

Tagging/recaptures off eastern Greenland

Of the 230 halibut tagged at 13 sites off the east coast of Greenland in 1959 and 1961-1965, 36 (15%) were recaptured, from a few days and up to 8 years after tagging (Table 7).

Thirteen (36.1%) were recaught in the tagging areas. Of the other recaptures on the east Greenland shelf, 9 had moved southwards and 10 northwards (Table 7, Fig.3). Those leaving the east Greenland areas included one which had moved eastwards to the coastal waters of Iceland while two were recaptured on the continental shelf on the west side of Greenland.

DISCUSSION

A comparison of the size of the fish in the present material with

other data from the western and eastern north Atlantic (McCracken 1958, Bowering 1986, Mathisen & Olsen 1968, Haug & Tjemsland 1986, Jakupsstovu & Haug 1987) shows that the present material is a mixture of many medium sized immature fish, and a few larger mature specimens. The absence of small immature fish and the low number of large adult fish suggest that the continental shelf areas off eastern Canada and around Greenland are general feeding areas rather than typical nursery or spawning areas.

Tagging experiments on halibut in Norwegian waters, using also Danish seines and gill nets to catch the fish, clearly revealed the existence of both nursery areas, where young immature fish are stationary during their first 4-6 years, and spawning areas, where almost exclusively adult fish gather once a year during the spawning season (Godø & Haug in press). In the western Atlantic north of the Grand Banks of Newfoundland, the only documented halibut nursery area is, to our knowledge, the shallow shelf areas (Faxa Bay) on the west side of Iceland (Sigurðsson & Friðriksson 1952, Sigurðsson 1956). Icelandic tagging experiments revealed migrations from the Faxa Bay nursery areas to eastern and western Greenland shelf areas as well as to the banks of Newfoundland (Jonsson 1978). No definite spawning grounds have been documented in the western Atlantic, although it has been inferred, from the occurrence of pelagic eggs and larvae, that the species breeds in deep waters on the slope of the continental shelf off western Greenland (Jensen 1926) and southwest of Iceland (McIntyre 1958).

The present tagging experiments clearly showed that most fish remained in the main shelf areas where they were tagged, but that extensive migrations in several directions, in many cases over considerable distances, along the coastlines within each area also took place. Such multidirectional migrations of medium sized immature halibut were also observed in Norwegian waters by Godø & Haug (in subm.). The more extreme long distance migrations of some specimens, e.g., from west Greenland to Newfoundland which include potential crossings of deepwater areas, emphasizes the large migration potential possessed by the species. Similar and even longer migrations were observed in Norwegian (Devold 1943, Godø & Haug in press), Faroese (Vedel-Tåning 1938, 1947), Icelandic (Jonsson 1978, Bowering 1986), and North American waters south of Newfoundland (McCracken & Martin 1955, Jensen & Wise 1961).

The patterns of apparent random directional and often very long migrations of the medium sized immature halibut led Godø & Haug (in press) to doubt that these fish could have navigated according to current stimuli. Several other possible orientation mechanisms are generally observed in fish, for example inertial migrations (Harden Jones 1984) or geomagnetic and geoelectric orientation (Quinn 1984, Walker 1984). The present material gives no opportunity, however, to elucidate possible migration mechanisms for halibut.

Because of the complete lack of tagging data from halibut spawning areas in the western north Atlantic it is unknown whether these fish are able to return to the same spawning area for repeated spawning as has been observed for east Atlantic halibut (Godø & Haug in press)

ACKNOWLEDGEMENTS

Sincere thanks are due to scientists and field assistants from the Directorate of Fisheries, Bergen, Norway, who tagged halibut during research cruises with R/V "G.O. Sars" in the western North Atlantic in 1955-1969. Furthermore we wish to express out gratitude to M.S. Nilsen, G.W. Pettersen and Aa. Svendsen for technical assistance, and to R.T. Barrett for criticizm of the manuscript and correction of the English text. Financial support was received from the Norwegian Council of Fisheries Research (NFFR), project no. I 405.003.

REFERENCES

Bowering, W.R. 1986. The distribution, age and growth and sexual maturity of Atlantic halibut (Hippoglossus hippoglossus) in the Newfoundland and Labrador area of the Northwest Atlantic. Can.Tech.Rep.Fish.Aquat.Sci. 1432: IV+34 p.

Devold, F. 1943. Notes on halibut (Hippoglossus vulgaris Fleming). Annls biol., Copenh. 1: 35-40.

Godø, O.R. & Haug, T. In press. Tagging and recapture of Atlantic halibut, Hippoglossus hippoglossus, in Norwegian waters. J.Cons.int.Explor.Mer.

Harden Jones, F.R. 1984. Could fish use inertial clues when on migration? In Mechanisms of migration in fishes, pp. 67-78. Eds J.D. McCleave, G.P. Arnold, J.J. Dodson & W.H. Neill. Nato Conference Series, Series IV: Marine Science, Vol. 14. Plenum Press, New York and London, 574 pp.

Haug, T. & Tjemsland, J. 1986. Changes in size- and age distributions and age at sexual maturity in Atlantic halibut, Hippoglossus hippoglossus, caught in North Norwegian waters. Fish. Res. 4: 145-155.

Jakupsstovu, S.H.i & Haug, T. 1987. Growth, sexual maturation, and spawning season of Atlantic halibut, Hippoglossus hippoglossus, in Faroese waters. Fish. Res. 5: In press.

Jensen, A.C. & Wise, J. 1961. Movements of tagged halibut off New England - II. Trans.Am.Fish.Soc. 90: 489-490.

Jensen, A.S. 1926. Investigations of the "Dana" in west Greenland waters, 1925. Rapp. P.-v. Reun. Cons. perm. int. Explor. Mer 39: 85-102.

Jonsson, G. 1978. Merkingar á luðu. Sjávarfréttir 6: 26-28.

Kohler, A.C. 1964. Movements of halibut on the Nova Scotian and Grand banks. J.Fish.Res.Bd.Can. 21: 837-840.

Kvavig, P. 1972a. Kveitemerking i Davidsstredet i 1958. Fiskets Gang 58: 56-57.

Kvavig, P. 1972b. Kveitemerking i Davisstredet i 1959 og 1961. Fiskets Gang 58: 332-333.

Martin, W.T. & McCracken, F.D. 1950. Movements of halibut on the Canadian Atlantic coast. Fish.Res.Bd.Can., Atlantic Prog.Rep. 50: 3-8.

Mathisen, O.A. & Olsen, S. 1968. Yield isopleths of the halibut, Hippoglossus hippoglossus, in Northern Norway. FiskDir. Skr. Ser. HavUnders. 14: 129-159.

McCracken, F.D. 1958. On the biology and fishery of the Canadian Atlantic halibut, Hippoglossus hippoglossus L. J.Fish.Res.Bd.Can. 15: 1269-1311.

McCracken, F.D. & Martin, W.R. 1955. Recent recoveries of tagged halibut. Fish.Res.Bd.Can., Atlantic Prog.Rep. 61: 4.

McIntyre, A.D. 1958. Scottish halibut investigations. Ann. biol., Copenh. 14: 31-33.

Quinn, T.P. 1984. An experimental approach to fish compass and map orientation. In Mechanisms of migration in fishes, pp. 113-124. Eds J.D. McCleave, G.P. Arnold, J.J. Dodson & W.H. Neill. Nato Conference Series, Series IV: Marine Sciences, Vol. 14. Plenum Press, New York and London, 574 pp.

Sigurðsson, A. 1956. Contribution to the life history of the halibut at the west of Iceland in recent years (1936-1950). Meddr Danm. Fisk.-Havunders., N.S. 1(16): 1-24.

Sigurðsson, A. & Friðriksson, A. 1952. On the Icelandic fishery in the Denmark Strait in 1950. Annls biol., Copenh. 8: 45-46.

Vedel-Tåning, Å. 1938. Migrations of small halibut marked in Faroese waters. J. Cons. int. Explor. Mer 13: 370-375.

Vedel-Tåning, Å. 1947. Marking experiments on 3-5-year-old halibut in Faroese waters. Annls biol., Copenh. 2: 24.

Walker, M.M. 1984. Magnetic sensitivity and its possible physical basis in the yellowfin tuna, Thunnus albacares. In Mechanisms of migration in fishes, pp. 125-142. Eds J.D. McCleave, G.P. Arnold, J.J. Dodson & W.H. Neill. Nato Conference Series, Series IV: Marine Sciences, Vol. 14. Plenum Press, New York and London, 574 pp.

Table 1. Positions of tagging areas on the banks off Newfoundland and along the shelf on the east coast of Labrador, Canada (A-E, see Fig. 1).

	TAGGING AREA	GEOGRAPHIC POSITION
A	Flemish Cape, New Foundland	$45^0$25'W-$45^0$45'W; $46^0$25'N-$46^0$40'N
B	West of Newfoundland	$50^0$40'W-$50^0$45'W; $49^0$00'N-$49^0$05'N
C	Okak/Nain Bank, Labrador	$57^0$30'N-$58^0$25'N
D	Saglek Bank, Labrador	$58^0$25'N-$60^0$30,N
E	East of Baffin Island, Labrador	$63^0$10'N-$63^0$15'N

Table 2. Position of tagging areas along the continental shelf on the west coast of Greenland (A-L, see Fig.2).

	TAGGING AREA	GEOGRAPHIC POSITION	
A	Julianehaabbugt		S of 61^0N
B	Navnløse Bank		$61^0$00'N-$61^0$57'N
C	Fredrikshaab Bank		$61^0$57'N-$62^0$27'N
D	Danas Bank		$62^0$27'N-$63^0$00'N
E	Fiskenæs Bank		$63^0$00'N-$63^0$30'N
F	Fyllas Bank		$63^0$30'N-$64^0$15'N
G	Tovqussaq Bank	E of $54^0$40'W;	$64^0$15'N-$64^0$40'N
H	West of Tovqussaq Bank	W of $54^0$40'W;	$64^0$10'N-$65^0$00'N
I	Sukkertop Bank	E of $54^0$40'W;	$64^0$50'N-$65^0$20'N
K	North of Lille Hellefisk Bank		$66^0$00'N-$66^0$30'N
L	North of Store Hellefisk Bank		$68^0$00'N-$68^0$30'N

Table 3. Position of tagging areas along the coast of eastern Greenland (A-N, see Fig. 3).

	TAGGING AREA	GEOGRAPHIC EXTENSION
A	East of Kap Farvel	59°54'N , 42°33'W
B	East of Kap Walløe	60°39'N , 42°07'W
C	East of Kap Steen Bille	62°04'N , 40°40'W - 41°00'W
D	Southeast of Kap Skold	62°43'N , 40°56'W
E	Northeast of Kap Skold	63°13'N , 40°48'W
F	East of Kap Moltke	63°29'N , 39°18'W
G	East of Kap Møsting	63°30'N - 63°55'N , 37°50'W - 38°30'W
H	Northeast of Kap Møsting	63°58'N , 39°32'W
I	Southeast of Kap Lovenørn	63°58'N - 64°10'N , 35°20'W - 36°20'W
K	East of Kap Lovenørn	64°18'N , 39°55'W
L	Northeast of Kap Lovenørn	64°45'N , 35°14'W
M	Kap Dan Bank	64°50'N - 65°28'N , 34°00'W - 38°00'W
N	Southeast of Kap Nordenskiold	65°35'N - 60°02'N , 31°54'W - 33°30'W

Table 4. The number of Atlantic halibut tagged and recaptured in waters off Labrador and Newfoundland, Canada (A-E, see Fig. 1). N = number of fish tagged.

TAGGING			NO. OF RECAPTURES						
DATE	LOCALITY	N	1955	1956	1957	1958	1959	+1959	TOTAL
1955									
Aug	D Saglek Bank	23	-	1	-	-	-	-	1
Aug	C Okak/Nain Bank	7	-	-	-	-	-	-	0
1957									
Jul-Oct	E W of Cumberland Sound	18			1	-	-	-	1
Aug	D Saglek Bank	6			-	-	-	-	0
Aug-Sep	A Flemish Cape	25			-	-	-	-	0
1958									
Aug-Sep	A Flemish Cape	10				-	1	-	1
Sep	B W of New Foundland	22				-	1	-	1

Table 5. The number of Atlantic halibut tagged and recaptured in coastal waters off western Greenland in 1955-1969. N= number of fish tagged. All recaptures made in 1969 and later are given in the 1969 recapture column. A-L, see Fig. 2.

TAGGING				NO. OF RECAPTURES IN															
DATE		LOCALITY	N	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	Total
1955																			
Jul-Aug	G	Tovqussaq Bank	26	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Jul-Aug	L	N of S Hellefisk Bk	11	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Sep	E	Fiskenæs Bank	26	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Sep	A	Julianehaabbugt	7	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2
1956																			
May-Jun	H	W of Tovqussaq Bank	41		-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
Jun-Oct	A	Julianehaabbugt	83		-	2	-	-	1	-	-	-	-	-	-	-	-	-	4[1]
Aug	C	Fredrikshaabs Bank	7		-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Aug	B	Navnløse Bank	7		-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
1957																			
Jul	A	Julianehaabbugt	16			1	1	1	-	-	-	-	-	-	-	-	-	-	3
Aug	C	Fredrikshaabs Bank	13			-	1	-	-	-	-	-	-	-	-	-	-	-	1
Sep	K	N of L Hellefisk Bk	1			-	-	-	-	-	-	-	-	-	-	-	-	-	0
1958																			
May-Jul	H	W of Tovqussaq Bank	103				3	7	1	-	-	-	-	-	-	-	-	-	12[1]
Jul	A	Julianehaabbugt	24				1	-	-	-	1	-	-	-	-	-	-	-	2
Aug	D	Danas Bank	2				-	-	-	-	-	-	-	-	-	-	-	-	0
1959																			
Apr	B	Navnløse Bank	4					-	-	-	-	-	-	-	-	-	-	-	0
Apr-Jul	C	Fredrikshaabs Bank	15					1	2	2	-	-	-	-	-	1	-	-	6
Apr	G	Tovqussaq Bank	1					-	-	-	-	-	-	-	-	-	-	-	0
Apr	F	Fyllas Bank	3					-	-	-	-	-	-	-	-	-	-	-	0
May-Jun	H	W of Tovqussaq Bank	99					1	4	3	-	-	-	-	-	-	-	-	10[2]
1960																			
Apr	B	Navnløse Bank	21						-	1	1	1	1	-	-	-	-	-	4
Apr	A	Julianehaabbugt	18						-	1	-	1	-	-	-	-	-	-	2
Apr	C	Fredrikshaabs Bank	10						-	-	-	1	-	-	-	-	-	-	1
1961																			
Apr-May	B	Navnløse Bank	15							3	-	-	-	-	-	1	-	-	4
Apr	F	Fyllas Bank	4							1	-	-	-	-	-	-	-	-	1

(Table 5 ctd.)

Apr	G	Tovqussaq Bank	15	1	-	-	-	-	-	-	-	-	1
Apr	I	Sukkertop Bank	12	2	-	-	-	-	-	-	-	-	2
Apr	E	Fiskenæs Bank	9	2	1	-	-	-	-	-	-	-	3
1962													
Apr	K	N of L Hellefisk Bk	6		-	-	-	-	-	-	-	-	0
Apr	G	Tovqussaq Bank	2		-	1	-	-	-	-	-	-	1
May	D	Danas Bank	8		-	1	2	-	-	-	-	-	3
May	C	Fredrikshaabs Bank	3		-	-	-	-	-	-	-	-	0
May	B	Navnløse Bank	13		1	1	1	-	-	-	-	-	3
1963													
Apr	G	Tovqussaq Bank	11			1	-	-	-	-	-	-	1
May	B	Navnløse Bank	2			-	-	-	-	-	-	-	0
May	A	Julianehaabbugt	13			-	-	-	-	-	-	-	0
1964													
Apr	B	Navnløse Bank	23				1	-	1	-	-	-	2
Apr	F	Fyllas Bank	10				2	1	-	-	1	-	4
1965													
Apr	D	Danas Bank	14					-	2	-	-	-	2
Apr	I	Sukkertop Bank	3					-	-	-	-	-	0
May	G	Tovqussaq Bank	18					-	1	-	-	-	1
1966													
Mar	A	Julianehaabbugt	6						-	1	-	-	1
Apr	G	Tovqussaq Bank	22						1	-	-	-	1
Apr	I	Sukkertop Bank	3						-	-	-	-	0
Apr	F	Fyllas Bank	11						-	1	-	2	3
Apr	C	Fredrikshaabs Bank	4						1	-	-	-	1
Apr	B	Navnløse Bank	3						-	-	-	-	0
1967													
Apr	A	Julianehaabbugt	10							-	-	-	0
Apr	C	Fredrikshaabs Bank	1							1	-	-	0
Apr	B	Navnløse Bank	5							-	-	-	0
1968													
May	G	Tovqussaq Bank	1								1	-	1
1969													
Apr-May	G	Tovqussaq Bank	13									1	1

[1] One recapture without recapture year data. [2] Two recaptures without recapture year data.

Table 6.Distribution of recaptures of Atlantic halibut tagged along the continental shelf west of southern Greenland in the years 1955-1969. A-L, see Fig. 2.

TAGGING AREAS (No. of fish tagged in parentheses)	POSITION OF RECAPTURES												
	Juli-anehaab-bugt	Navn-løse Bank	Fred-riks-haab Bank	Danas Bank	Fiske-næs Bank	Fyllas Bank	Tov-qussaq Bank	W of Tov-qussaq Bank	Sukker-top Bank	N of Lille Helle-fisk Bank	N of Store Helle-fisk Bank	Total W. Green-land shelf	Out-side W. Green-land shelf
	A	B	C	D	E	F	G	H	I	K	L		
A Julianehaabbugt (177)	12					1						13	
B Navnløse Bank (93)	1	6	3			1			2			13	1
C Fredrikshaab Bank (53)			6	1		1	1				1	10	1
D Danas Bank (24)				2		2					1	5	
E Fiskenæs Bank (35)				1	3	1						5	
F Fyllas Bank (28)		1				4	1				1	7	1
G Tovqussaq Bank (109)						2	1				2	5	2
H W of Tovqussaq Bank (243)		1				1	10	3	1	3	2	21	1
I Sukkertop Bank (16)									2			2	
K N of L Hellefisk Bk (7)													
L N of S Hellefisk Bk (11)						1					1	2	

Table 7. The number of Atlantic halibut tagged and recaptured in the continental shelf area to the east of Greenland in the years 1959 and 1961-1965 (A-N, see Fig. 3). N = number of fish tagged.

TAGGING				NO. OF RECAPTURES										
TIME		LOCALITY	N	1959	1960	1961	1962	1963	1964	1965	1966	1967	+1967	Total
1959														
Jul	F	E of Kap Moltke	3	-	2	1	-	-	-	-	-	-	-	3
Jul	G	E of Kap Møsting	18	-	-	-	-	-	-	-	-	-	-	0
Jul	I	SE of Kap Lovenørn	2	-	-	-	-	-	-	-	-	-	-	0
Jul	N	SE of Kap Nordenskiold	5	-	-	-	-	1	-	-	-	-	-	1
Jul	K	E of Kap Lovenørn	10	-	-	2	-	-	-	-	-	-	-	2
Jul	H	NE of Kap Møsting	2	-	1	1	-	-	-	-	-	-	-	2
Aug	E	E of Kap Steen Bille	1	-	-	-	-	-	-	-	-	-	-	0
Aug	C	NE of Kap Skold	51	-	3	2	4	-	-		-	1	-	10
Aug	M	Kap Dan Bank	7	-	-	-	-	-	-	-	-	-	-	0
1961														
Aug	C	E of Kap Steen Bille	10			-	1	2	-	-	-	-	-	3
Sep	M	Kap Dan Bank	20			-	1	2	1	1	-	-	-	5
Sep	L	NE of Kap Lovenørn	5			-	-	-	1	-	-	-	-	1
1962														
Aug	B	E of Kap Walløe	3				-	-	-	-	-	-	-	0
Aug	A	E of Kap Farvel	9				-	-	-	-	-	-	-	0
Aug-Sep	M	Kap Dan Bank	14				-	-	-	-	1	-	-	1
Sep	G	E of Kap Møsting	3				-	-	-	-	-	-	-	0
1963														
Aug	I	SE of Kap Lovenørn	5					-	-	-	-	-	-	0
Sep	D	SE of Kap Skold	7					-	2	-	-	-	-	2
1964														
Aug	D	SE of Kap Skold	7						-	-	-	-	1	1
Aug	E	NE of Kap Skold	5						-	-	-	-	1	1
Aug-Sep		Kap Dan Bank	21						-	1	-	-	1	2
1965														
Aug	C	E of Kap Steen Bille	12							-	-	-	1	1
	M	Kap Dan Bank	9							-	-	1	-	1
Aug	I	SE of Kap Lovenørn	1							-	-	-	-	0

Table 8. Distribution of recaptures of Atlantic halibut tagged along the continental shelf off the east coast of southern Greenland during the years 1959-1965. A-N, see Fig. 3.

TAGGING AREAS (No. of fish tagged in parentheses)	NO. OF RECAPTURES															
	E of Kap Farvel A	E of Kap Walløe B	E of Kap Steen Bille C	SE of Kap Skold D	NE of Kap Skold E	E of Kap Moltke F	E of Kap Møsting G	NE of Kap Møsting H	SE of Kap Lovenørn I	E of Kap Lovenørn K	NE of Kap Lovenørn L	Kap Dan Bank M	Se of Kap Nordenskiold N	Total, East Greenland	Outside East Greenland
E of K. Farvel (9)															
E of K. Walløe (3)															
E of K. Steen Bille (23)		2	4	4	3									13	2
SE of K. Skold (14)			1	2										3	
NE of K. Skold (56)						1								1	
E of K. Moltke (3)						2							1	3	
E of K. Møsting (21)															
NE of K. Møsting (2)			1		1									2	
SE of K. Lovenørn (8)															
E of K. Lovenørn (10)					1	1								2	
NE of K. Lovenørn (5)											1			1	
Kap Dan Bank (71)									2		2	3	1	8	1
SE of K. Nordenskiold (5)													1	1	

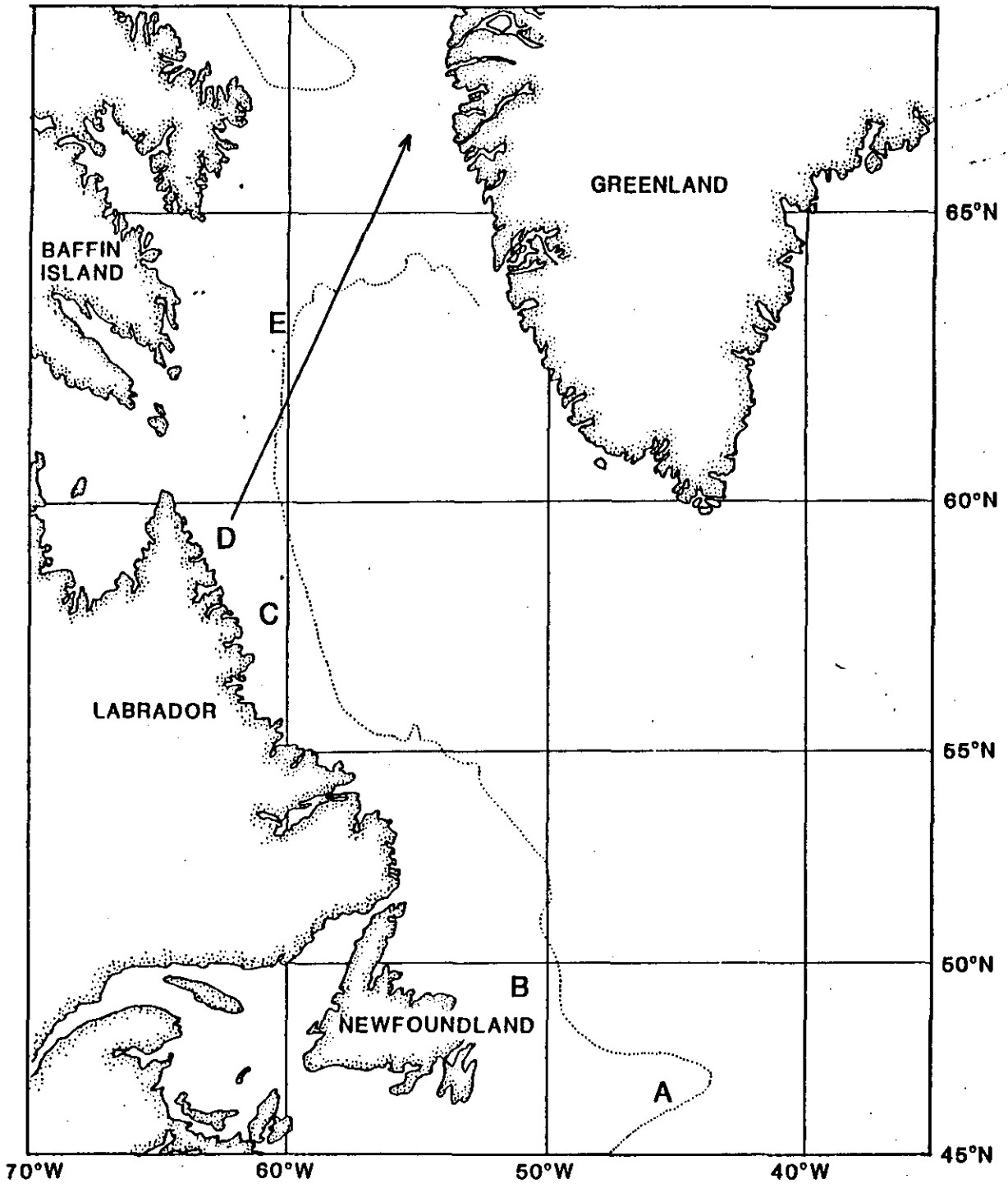

Fig. 1. Tagging sites (capital letters, see Table 1) and recapture (indicated by arrow) sites of Atlantic halibut caught off eastern Canada.

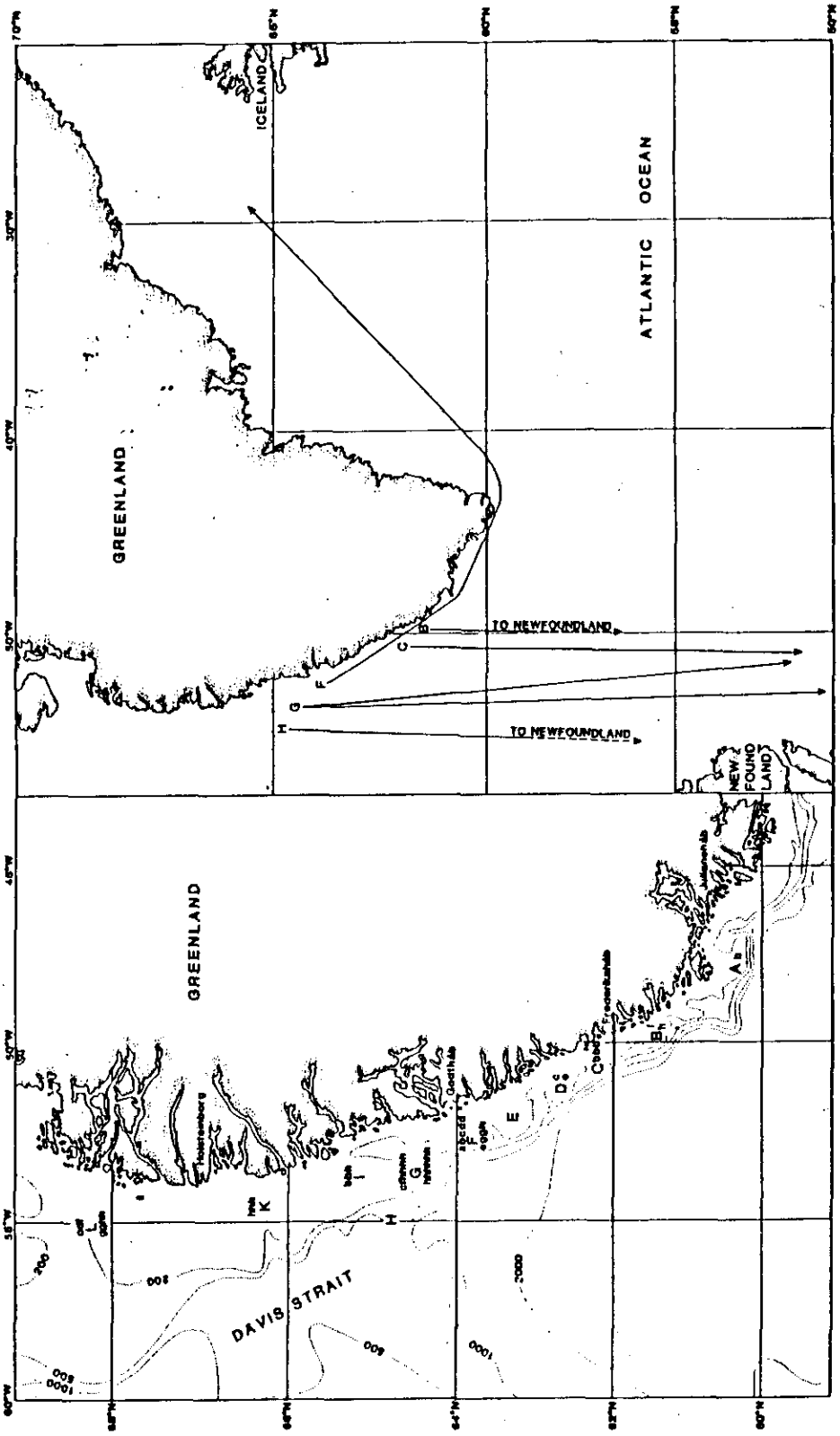

Fig. 2. Detailed map (left) of tagging sites of Atlantic halibut on the west coast of Greenland (capital letters, see Table 2) and recapture sites (small letters; recapture a was tagged in site A, recapture b was tagged in site B, etc.) in western Greenland shelf areas. The right map shows the movement of long distance migrants (arrows) who left the western Greenland shelf area.

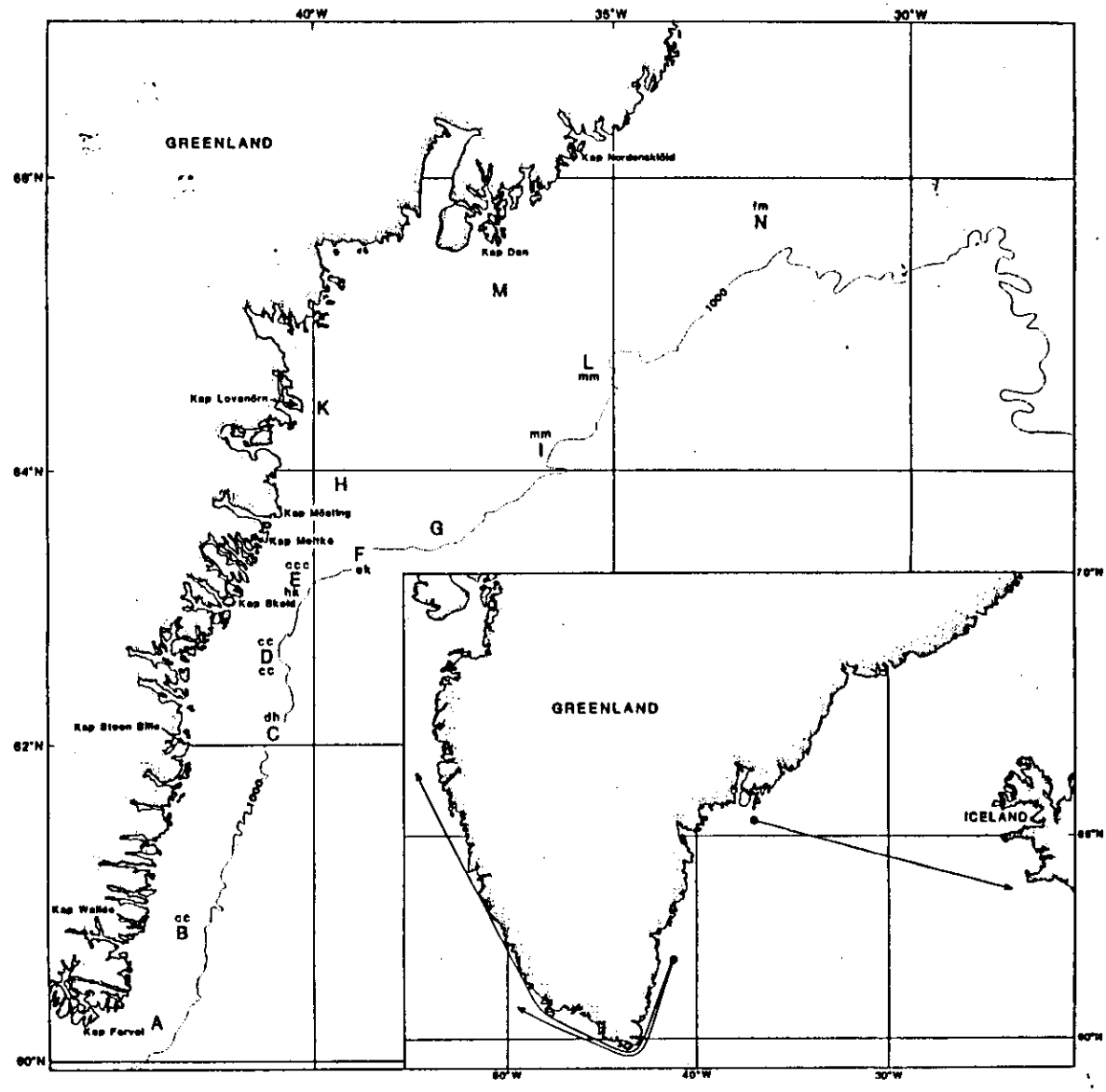

Fig. 3. Large detailed map show tagging sites of Atlantic halibut on the east coast of Greenland (capital letters, see Table 3), and recapture sites (small letters; recapture a was tagged in site A, recapture b was tagged in site B, etc.) in eastern Greenland shelf areas. The inserted map shows the movement of long distance migrants (arrows) who who left the eastern Greenland shelf area.

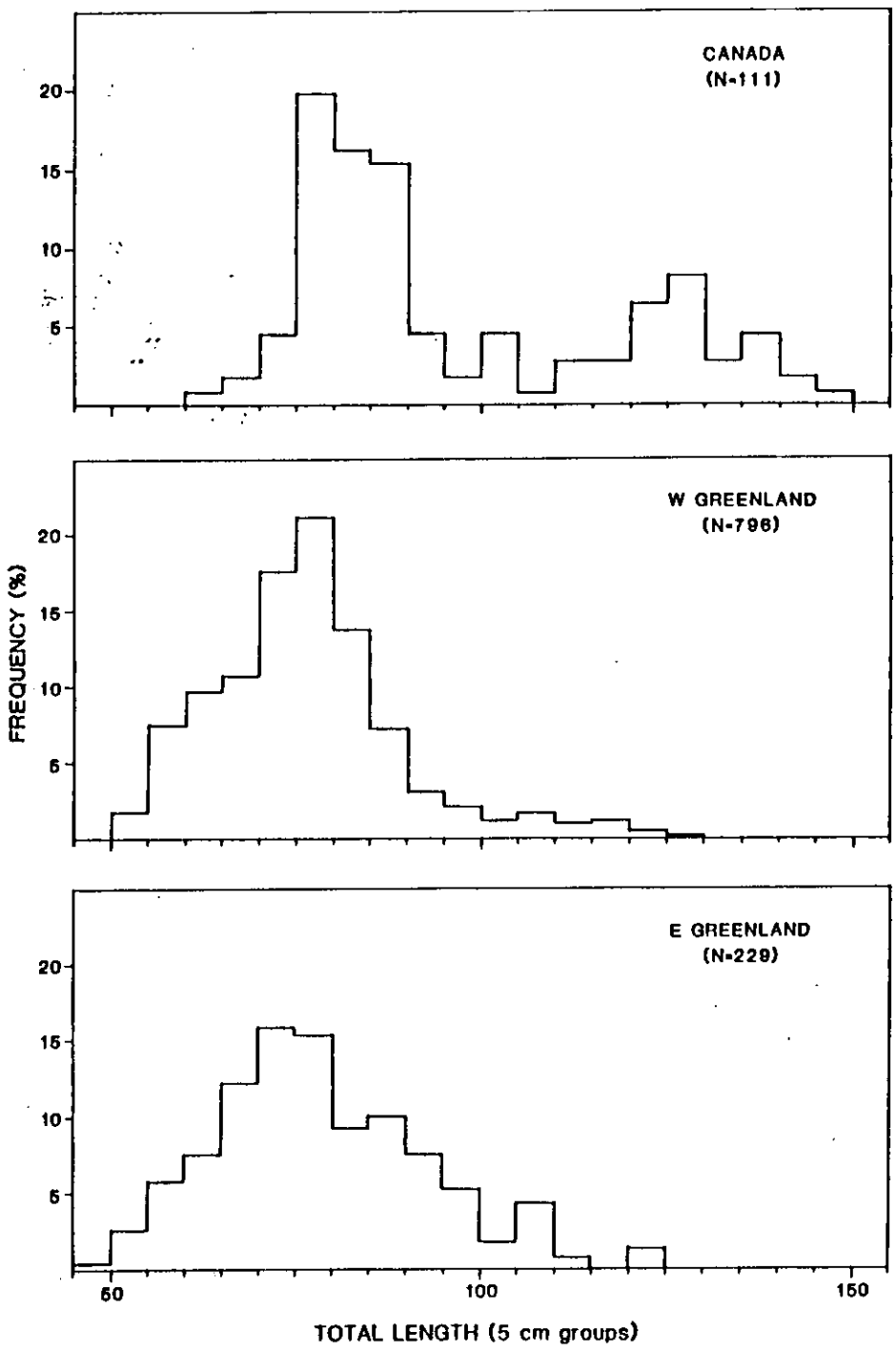

Fig. 4. Length composition of Atlantic halibut caught on long-lines and tagged off eastern Canada and off western and eastern Greenland. N = number of fish.

APPENDIX

Table I. Details of recaptures of Atlantic halibut tagged in waters off Labrador and Newfoundland in 1955-1958.

TAGGING				RECAPTURES			
Date	Position N	Position W	Length (cm)	Date	Position N	Position W	Depth (m)
A. FLEMISH CAPE							
Recaptured in tagging area							
27 Aug 1958	46°36'	45°41'	88	15 Aug 1959	46°28'	45°29'	
B. W OF NEWFOUNDLAND							
Recaptured in tagging area							
25 Sep 1958	49°04'	50°41'	129	14 Aug 1959	49°04'	50°41'	
C. OKAK/NAIN BANK							
None							
D. SAGLEK BANK							
Long distance migrants							
22 Aug 1955	58°50'	60°12'	81	1956	66°33'	55°00'	
E. W OF CUMBERLAND SOUND							
Recaptured in tagging area							
26 Jul 1957	63°13'	60°16'	80	21 Sep 1957	63°10'	60°35'	

Table II. Details of recaptures of Atlantic halibut tagged in waters off western Greenland in 1955-1963.

TAGGING				RECAPTURES			
Date	Position N	Position W	Length cm	Date	Position N	Position W	Depth (m)
A. JULIANEHAABBUGT							
Long distance migrants							
05 Apr 1960	60° 41'	50° 40'	57	06 Jan 1961	Fyllas Bank		
Recaptured in tagging area							
09 Sep 1955	60° 12'	47° 08'	77	30 Sep 1955	Julianehaabbugt		
09 Sep 1955	60° 12'	47° 08'	75	21 Jul 1956	60° 10'	47° 00'	
01 Oct 1956	60° 21'	46° 02'	75	(nr. 4521.no.info. given)			
06 Aug 1956	60° 12'	47° 35'	80	03 Oct 1957	60° 10'	45° 28'	
06 Aug 1956	60° 10'	47° 20'	78	30 Sep 1957	60° 12'	47° 15'	
04 Aug 1956	60° 10'	47° 20'	76	09 Jun 1960	60° 15'	47° 10'	280
31 Jul 1957	60° 34'	48° 51'	76	12 May 1959	60° 50'	49° 15'	
31 Jul 1957	60° 34'	48° 51'	75	03 May 1958	60° 50'	48° 55'	
28 Jul 1957	60° 15'	47° 50'	81	02 Aug 1957	60° 08'	47° 02'	
22 Jul 1958	60° 16'	48° 10'	75	02 Apr 1962	60° 10'	46° 50'	360
22 Jul 1958	60° 16'	48° 10'	85	25 Nov 1958	60° 15'	47° 15'	250
05 Apr 1960	60° 41'	50° 40'	61	05 Mar 1963	60° 54'	49° 26'	260
29 Mar 1966	60° 36'	48° 32'	91	02 Apr 1967	60° 19'	48° 05'	200
B. NAVNLØSE BANK							
Long distance migrants							
23 Aug 1956	61° 06'	49° 22'	72	02 May 1958	60° 50'	49° 15'	145
06 Apr 1960	61° 29'	50° 28'	57	18 Jul 1964	Woodfall Bk., Newfoundland		
05 Apr 1960	61° 44'	50° 39'	76	25 Jun 1962	Fredrikshaab Bk.		160
15 Apr 1961	61° 45'	50° 39'	66	1961	W of Sukkertoppen		
15 Apr 1961	61° 45'	50° 39'	65	01 Sep 1961	62° 26'	55° 55'	80
15 Apr 1961	61° 45'	50° 39'	54	25 Jan 1967	63° 32'	52° 28'	
04 May 1962	61° 20'	50° 29'	57	04 Jun 1963	64° 48'	52° 15'	
11 Apr 1964	61° 45'	50° 40'	53	17 Apr 1964	62° 05'	50° 45'	315
Recaptured in tagging area.							
06 Apr 1960	61° 29'	50 28'	74	19 Mar 1963	W of Fredrikshaab		270
05 Apr 1960	61° 44'	50 39'	75	16 aug 1961	Navnløse Bank		160
15 Apr 1961	61° 45'	50 39'	62	21 Apr 1961	Navnløse Bank		
04 May 1962	61° 20'	50 29'	85	10 Mar 1964	SW of Fredrikshaab		1080
04 May 1962	61° 20'	50 29'	79	07 Aug 1962	Navnløse Bank		54
11 Apr 1964	61° 34'	50° 35'	82	08 Jun 1964	Navnløse bank		
C. FREDRIKSHAAB BANK							
Long distance migrants							
28 Jul 1959	62° 09'	50° 45'	60	02 Jun 1960	62° 35'	51° 30'	
28 Jul 1959	62° 09'	50° 45'	61	14 Oct 1967	51° 06'	50° 55'	
07 Apr 1960	62° 13'	50° 49'	59	02 Aug 1963	67° 28'	54° 50'	
15 Apr 1966	62° 18'	50° 57'	58	08 Jun 1966	64° 00'	52° 45'	

18 Apr 1967	62°06'	50°25'	60	Oct 1967	Tovqussaq Bank		

Recaptured in tagging area

20 Aug 1956	62°10'	50°26'	74	06 Jul 1957	Fredrikshaab Bank		
02 Aug 1957	61°57'	50°32'	86	16 Jul 1958	62°05'	50°35'	360
28 Jul 1959	62°09'	50°45'	64	20 Jun 1960	Fredrikshaab Bank		270
28 Jul 1959	62°09'	50°45'	74	13 Oct 1959	62°12'	50°35'	45
28 Jul 1959	62°09'	50°45'	61	28 Jun 1961	Fredrikshaab Bank		170
28 Jul 1959	62°09'	50°45'	76	21 Aug 1961	62°00'	50°34'	160

D. DANAS BANK

Long distance migrants

02 May 1962	62°26'	51°10'	65	Des 1963	Fyllas Bank		
11 Apr 1965	62°59'	51°55'	71	24 Feb 1966	Fyllas Bank		
14 Apr 1965	62°34'	51°18'	65	05 Aug 1966	67°28'	55°10'	

Recaptured in tagging area

02 May 1962	62°26'	51°10'	80	09 Jan 1964	62°23'	50°58'	350
02 May 1962	62°26'	51°10'	57	28 Aug 1964	62°25'	50°53'	70

E. FISKENÆS BANK

Long distance migrants

27 Apr 1961	63°03'	52°25'	56	09 Jul 1962	62°48'	51°09'	
27 Apr 1961	63°03'	52°25	63	08 Oct 1961	Fyllas Bank		45

Recaptured in tagging area

05 Sep 1955	63°15'	52°00'	80	21 Jun 1956	63°22'	51°32'	
05 Sep 1955	63°15'	52°00'	73	22 Jul 1956	63°27'	52°00'	
27 Apr 1961	63°03'	52°25'	58	27 Jul 1961	63°28'	52°15'	

F. FYLLAS BANK

Long distance migrants

17 Apr 1964	63°37'	52°54'	75	20 Jun 1964	65°40'	29°50'	
17 Apr 1964	63°37'	52°54'	58	10 Feb 1968	61°18'	50°10'	
17 Apr 1964	63°37'	52°54'	58	29 Jul 1964	64°30'	53°20'	
08 Apr 1966	64°10'	53°14'	59	20 Aug 1967	67°58'	54°00'	36

Recaptured in tagging area

18 Apr 1961	64°14'	53°00'	83	25 Aug 1961	Fyllas Bank		240
17 Apr 1964	63°37'	52°54'	70	09 Jul 1965	64°10'	51°45'	
08 Apr 1966	64°10'	53°14'	57	?? ??? 1969	Fyllas Bank		
08 Apr 1966	64°10'	53°14'	62	13 Apr 1971	Fyllas Bank		

G. TOVQUSSAQ BANK

Long distance migrants

27 Apr 1961	64°27'	54°17'	67	18 Aug 1961	64°05'	52°55'	60
27 Apr 1962	64°31'	53°56'	60	27 Apr 1963	51°40'	51°40'	
08 May 1965	64°31'	54°39'	55	17 Aug 1966	67°30'	54°50'	
06 Apr 1966	64°18'	54°32'	71	18 Aug 1966	67°35'	55°20'	
03 May 1968	64°44'	53°09'	72	15 Sep 1968	Fyllas Bank		180
25 Apr 1969	64°14'	53°55'	69	29 Apr 1969	50°30'	53°00'	

Recapturted in tagging area

24 Apr 1963	64°15'	53°40'	61	Des 1963	64°30'	54°10'	150

H. W OF TOVQUSSAQ BANK

Long distance migrants

23 Jul 1955	64°56'	55°08'	107	18 Aug 1956	67°14'	55°30'	
28 Jul 1958	64°40'	55°27'	89	01 May 1959	Toyqussaq Bank		400
27 Jul 1958	64°40'	55°27'	84	22 Aug 1958	64°27'	53°16'	
03 Jun 1958	64°26'	55°18'	85	24 Aug 1959	67°13'	54°28'	
03 Jun 1958	64°26'	55°18'	79	17 Apr 1959	64°15'	53°55'	240
01 Jun 1958	64°27'	55°18'	83	03 Jun 1959	Tovqussaq Bank		720
30 May 1958	64°27'	55°18'	87	11 May 1959	Fyllas Bank		
28 May 1958	64°25'	55°17'	67	28 Aug 1958	64°28'	53°34'	
28 May 1958	64°25'	55°17'	77	05 Sep 1958	65°00'	53°40'	
26 May 1958	64°26'	55°18'	72	05 Jul 1959	66°20'	54°09'	
21 May 1958	64°26'	55°18'	77	12 Oct 1960	65°45'	54°55'	145
08 May 1959	64°26'	55°18'	70	01 Sep 1960	Labrador/Newfound-land		
27 May 1959	64°14'	55°00'	76	07 Nov 1961	Toyqussaq Bank		
24 May 1959	64°12'	54°58'	80	14 Oct 1960	64°32'	52°30'	170
21 May 1959	64°18'	55°12'	79	12 May 1960	64°18'	54°30'	380
19 May 1959	64°12'	54°58'	81	11 Jul 1961	Lille Hellefisk Bank		180
19 May 1959	64°12'	54°58'	80	14 Apr 1960	64°30'	54°22'	290
18 May 1959	64°14'	55°00'	72	20 Jan 1961	60°43'	48°20'	
11 May 1959	64°26'	55°18'	73	26 Jun 1959	Tovqussaq Bank		

Recaptured in tagging area

23 Jul 1955	64°56'	55°08'	108	06 Sep 1956	64°48'	55°01'	
22 Jun 1956	64°20'	55°17'	88	23 Jun 1958	64°27'	55°17'	
26 May 1958	64°26'	55°18'	79	(5723, no info.)			
24 May 1958	64°25'	55°17'	84	03 May 1959	64°30'	54°45'	490
22 May 1959	64°12'	54°58'	78	(6290, no info.)			
19 May 1959	64°12'	54°58'	85	(6263, no info.)			

I. SUKKERTOP BANK

Recaptured in tagging area

25 Apr 1961	64°52'	54°34'	64	26 Oct 1961	64°50'	54°45'	230
25 Apr 1961	64°52'	54°34'	79	30 Jun 1961	Sukkertop Bank		

K. N OF LILLE HELLEFISK BANK

None

L. N OF STORE HELLEFISK BANK

Long distance migrants

05 Aug 1955	68°24'	54°58'	92	30 Jun 1956	63°50'	52°50'	

Recaptured in tagging area

02 Aug 1955	68°24'	54°58'	98	1956	68°10'	58°00'	

Table III. Details of recaptures of Atlantic halibut tagged in waters off eastern Greenland in 1959-1963.

TAGGING				RECAPTURES			
Date	Position N	Position W	Length (cm)	Date	Position N	Position W	Depth (m)
A. E OF KAP FARVEL							
None							
B. E OF KAP WALLØE							
None							
C. E OF KAP STEEN BILLE							
Long distence migrants							
20 Aug 1959	62°04'	40°43'	72	09 Jun 1960	62°26'	40°12'	370
20 Aug 1959	62°04'	40°43'	75	15 May 1962	63°14'	40°30'	
20 Aug 1959	62°04'	40°43'	77	20 Apr 1962	61°30'	41°15	340
20 Aug 1959	62°04'	40°43'	63	08 Oct 1961	66°19'	54°02'	55
20 Aug 1959	62°04'	40°43'	75	18 Oct 1960	60°52'	49°12'	210
20 Aug 1959	62°04'	40°43'	68	17 May 1962	62°25'	40°15'	380
20 Aug 1959	62°04'	40°43'	68	20 May 1967	SE of Kap Skold		320
20 Aug 1959	62°04'	40°43'	87	09 Jan 1960	62°26'	40°12'	370
28 Aug 1961	62°04'	40°51'	82	15 May 1962	63°14'	40°30'	
28 Aug 1961	62°04'	40°51'	77	21 May 1963	62°55'	40°17'	375
Recaptured in tagging area							
20 Aug 1959	62°04'	40°43'	76	29 Jun 1961	62°10'	40°25'	270
20 Aug 1959	62°04'	40°43'	87	21 Jun 1961	62°04'	41°00'	360
28 Aug 1961	62°04'	40°51'	85	29 May 1963	E of K Steen Bille		
07 Aug 1965	62 06'	40 55'	66	06 Aug 1968	E of K Steen Bille		190
D. SE OF KAP SKOLD							
Long distance migrants							
01 Sep 1963	62°43'	40°56'	81	02 Jun 1964	62°10'	40°25'	350
Recaptured in tagging area							
01 Sep 1963	62°43'	40°56'	63	16 Jun 1964	62°30'	40°31'	
24 Aug 1964	62°39'	40°50'	73	17 Apr 1968	62°23'	40°37'	
E. NE OF KAP SKOLD							
Long distance migrants							
26 Aug 1964	63°20'	40°20'	96	17 Jun 1969	63°30'	39°30'	
F. E OF KAP MOLTKE							
Long distance migrants							
02 Jul 1959	63°29'	39°18'	86	09 Jun 1961	65°30'	30°00'	400

Recaptured in tagging area

02 Jul 1959	63°29'	39°18'	92	02 Jul 1960	63°25'	39°00'	325
02 Jul 1959	63°29'	39°18'	77	04 Oct 1960	63°20'	39°15'	

G. E OF KAP MØSTING

None

H. NE OF KAP MØSTING

Long distance migrants

23 Jul 1959	63°58'	39°32'	86	28 Apr 1960	61°43'	41°50'
23 Jul 1959	63°58'	39°32'	86	20 May 1961	63°00'	40°20'

I. SE OF KAP LOVENØRN

None

K. E OF KAP LOVENØRN

Long distance migrants

23 Jul 1959	64°18'	39°55'	83	20 May 1961	63°00'	40°20'
23 Jul 1959	64°18'	39°55'	99	09 May 1961	63°22'	39°05'

L. NE OF KAP LOVENØRN

05 Sep 1961	64°45'	35°14'	76	12 Sep 1964	64°25'	35°15'	380

M. KAP DAN BANK

Long distance migrants

04 Sep 1961	65°16'	37°18'	67	17 May 1963	65°16'	35°10'	185
02 Sep 1961	65°27'	37°18'	61	01 May 1963	63°43'	22°56'	
02 Sep 1961	65°27'	37°18'	77	12 May 1965	63°55'	36°40'	400
02 May 1961	65°27'	37°18'	87	23 May 1964	65°25'	31°00'	580
04 Sep 1962	65°20'	38°00'	65	06 Apr 1966	64°38'	35°13'	350
31 Aug 1964	65°26'	37°25'	76	04 Mar 1965	64°10'	36°10'	

Recaptured in tagging area

02 Sep 1961	65°27'	37°18'	99	09 Oct 1962	65°30'	37°00'	180
31 Aug 1964	65°26'	37°23'	60	04 Feb 1969	Kap Dan Bank		370
10 Aug 1965	64°51'	36°10'	67	25 Dec 1967	64°55'	36°00'	

N. SE OF KAP NORDENSKIOLD

Recaptured in tagging area

08 Jul 1959	65°40'	31°54'	84	04 Apr 1963	65°33'	29°28'	430