

Northwest Atlantic



Fisheries Organization

Serial No. N2383

NAFO SCR Doc. 94/18

SCIENTIFIC COUNCIL MEETING - JUNE 1994

Migrations of Greenland Halibut in the Northwest Atlantic Based  
on Tagging Experiments in Greenland Waters, 1986-1992

by

Jesper Boje

Greenland Fisheries Research Institute, Tagensvej 135  
DK-2200 Copenhagen N, Denmark

**Abstract.**

Migrations of Greenland halibut in the Northwest Atlantic are evaluated by tagging experiments off Greenland during 1986-1992. Of 3981 Greenland halibut tagged using longlines, 6.7% have been recovered until the first quarter of 1994. 6 long-distance migrants from Godthaab Fjord (Div. 1A) and 3 migrants from a fjord at Ammassalik in East Greenland to Icelandic waters (Div. XIVb and Va), indicate a connection between Greenland halibut in the southern fjords of West and East Greenland and the stock component west of Iceland. Greenland halibut tagged in northern fjords at West Greenland were all recaptures at the tagging site or within a distance of 50 nautical miles from the tagging site, thus adult Greenland halibut from the northern fjords at West Greenland seem very stationary.

**Introduction.**

Greenland halibut (*Reinhardtius hippoglossoides* Walbaum) is widely distributed in the Northwest Atlantic. Spawning grounds are known to be located south west of Iceland (Sigurdsson 1979) and in the deeper parts of the Davis Strait (Atkinson *et al.* 1982, Smidt 1969). The mature stock components exploited to commercial fishery at the east coast of Canada, in the Davis Strait, in the fjords of West Greenland, in the Denmark Strait and inshore at Iceland are supposed to be recruited from these spawning grounds (Sigurdsson 1979, Templeman 1973). Several investigations have been carried out to describe the stock relationship for Greenland halibut the Northwest Atlantic including meristic characters (Templeman 1970, Misra & Bowering 1984, Riget *et al.* 1992), genetic differentiation (Fairbairn 1981, Riget *et al.* 1992), parasites (Boje *et al.* 1990, Khan *et al.* 1982) and tagging experiments (Boje 1990, Bowering 1984, Riget & Boje 1989, Smidt 1969). A summarize of investigations of stock discrimination of Greenland halibut in the Greenland-Canada region has been given by Boje and Jørgensen (1991). So far, the studies indicate that the population of Greenland halibut exposed to fishery in NAFO Subarea 0,1,2 and Div. 3KL originate from the same spawning stock in the Davis Strait. In the same way it seems that the populations exposed to fishery at Iceland originate from a spawning stock at the continental slopes west of Iceland. Certain populations seem to maintain a degree of isolation as they do not migrate to the spawning areas mentioned above when reaching sexual maturity. This applies to the Greenland halibut population in Gulf of St. Lawrence (NAFO Divisions 4RST)(Khan *et al.* 1982), and for the populations in the West Greenland fjords

(Riget & Boje 1989). Spawning has been observed in Gulf of St. Lawrence (Bowering 1980), while only few ripe females has been observed in West Greenland fjords (Riget and Boje 1989).

However, in view of earlier tagging experiments at West Greenland (Boje 1990, Riget & Boje 1989, Smidt 1969), it seems likely that stocks in the southernmost fjords of West Greenland can be recruited from the Icelandic spawning grounds. Smidt (1969) reported a recapture of Greenland halibut in 1959 west of Iceland tagged in southwest Greenland in Lichtenau Fjord in 1954 and Riget and Boje (1989) reported a recapture in 1980 west of Iceland tagged in Godthaab Fjord in 1964.

This paper evaluates recapture records of tagging experiments of Greenland halibut off Greenland in the years 1986-1992 in relation to stock relationship in the Northwest Atlantic.

#### Materials and methods.

Greenland halibut at eight areas off Greenland were tagged during 1986-92; in Disko Bay (NAFO Div.1A) in August 1986 and 1987, in Godthaab Fjord (NAFO Div.1D) in January 1987, in Cape Farewell area (NAFO Div.1F) in January 1988, at Upernavik (NAFO Div.1A) in August 1989 and 1990, in Ammassalik in East Greenland (ICES Div. XIV) in September 1991, and in the Davis Strait (Divs. 1CD) in August 1991 and May 1992. The vessels R/V 'Misiliisoq' and R/V 'Adolf Jensen' both equipped with longlines were used for all the inshore tagging experiments. The Faroese longliner 'Varsol' and the Norwegian longliner 'Skarheim' were used in the offshore taggings in the Davis Strait. Fishing depths were generally between 400 and 900 meters. All linesettings had a duration of about 6 hours.

To avoid damage on the fish by the hook, a landing net was placed under each fish from the time of escapement from the water to the fish reached the deck. The hook was removed carefully and only fish hooked in the mouth region were selected. The condition of fish was judged visually mainly by examination of the color of the gills to ensure that the hook had not resulted in any interior damages. Length of the fish was measured to the nearest centimeter below (total length) and only fish with lengths above 35 cm were chosen. The lengths interval of all tagged fish was 35-110 cm with the bulk in the range 50-70 cm. The fish was tagged with a yellow T-bar tag into the musculature just below the dorsal fin ray near the head. Immediately after tagging the fish was released.

In order to enhance the level of information in connection with recaptures, informative posters on the purposes of the tagging experiments were hang at public places and a reward of DKK 100 (approx. US\$17) are offered for each tag returned with additional information on catch position, gear used and date.

Distances given in this paper are nautical miles (1nm = 1.852km).

#### Results.

Of a total of 3981 tagged Greenland halibut from the experiments 1986-92, 266 recaptures (6.7%) had been reported until the first quarter of 1994. The majority of records were done within the first 2 years after the year of tagging. The precise position of the recaptures are often missing and only the name of the locality has been provided. In the figures of the recapture

sites, more than one recapture can therefore be comprised in each point on the maps. Fig. 1 gives an overview of the tagging sites and NAFO/ICES Subareas and Divisions. Table 1 gives a summary of the tagging experiments and recaptures.

**Torsukattak 1986 (Fig. 2).** From 272 Greenland halibut tagged in 1986 a total of 17 recaptures (6.3%) were recorded during 1986-1991. Apart from 2 recaptures, all were recorded in the same fjord where they were tagged. One Greenland halibut was recaptured in the icefjord at Ilulissat in 1987, a migration distance of about 50 nm and one was recaptured in 1991 just outside (4 nm) the mouth of the fjord where it was tagged.

**Ilulissat 1986 (Fig. 2).** From 43 Greenland halibut tagged in 1986 there were 3 recaptures (7%) during 1987-1990. All recaptures were recorded at the tagging site.

**Uummannaq 1987 (Fig. 3).** From 241 Greenland halibut tagged in 1987 there were 26 recaptures (10.8%) during 1987-1992. All records were in the same fjord complex as they were tagged, although two recaptures were taken in an offshore direction at a distance of about 16 nm from the tagging site.

**Torsukattak 1987 (Fig. 3).** From 368 Greenland halibut tagged in 1987 there were 50 recaptures (13.6%) during 1987-1991. A total of 7 recaptures were recorded in the southern tagging area in Disko Bay at Ilulissat, 2 records in 1987, 3 records in 1988, one in 1989 and one in 1990. The migration distance is about 40 nm. The remaining were caught in the fjord where they were tagged.

**Ilulissat 1987 (Fig. 3).** From 173 Greenland halibut tagged in 1987 there were 14 recaptures (8.1%) during 1987-1992. One recapture from 1987 was in the northern fjord Torsukattak, which represents a migration distance of about 50 nm in less than one year. Further 2 migrants were recaptured in Torsukattak in 1989 and 1990, respectively. The remaining recaptures were from the icefjord where they were tagged.

**Godthaab Fjord 1987 (Fig. 4).** From 839 Greenland halibut tagged in 1987 there were 45 recaptures (5.4%) during 1987-1992. 3 recaptures in 1989 were from the Denmark Strait at Vikurall (position 65°45'N, 25°30'W, ICES Subarea Va), which represent a migration distance of about 1000 nm. In 1989 another long distance migrant were recaptured off Newfoundland (position 48°16'N, 46°39'W, NAFO Div. 3L). The migration distance for this Greenland halibut was about 1300 nm. In 1990 another long distance migrant was recorded in the Denmark Strait at Vikurall (ICES Va), and also in 1992 one Greenland halibut was recaptured in this area at position 66°23'N, 28°05'W. A total of 6 long distance migrants were thus recorded from this tagging experiment. The remaining 39 recaptures were from the tagging areas or nearby in Godthaab Fjord.

**Cape Farewell 1988 (Fig. 5).** From 120 Greenland halibut tagged in 1988 there were 8 recaptures (6.7%) during 1988-1991. A long distance migrant was recaptured in 1990 by an Icelandic trawler in the Denmark Strait at the position 65°43'N, 27°52'W (ICES Subarea XIVb), a migration distance of about 800 nm. The remaining 7 recaptures were recorded within the same fjords where they were tagged.

**Upernavik 1989 (Fig. 6).** From 634 Greenland halibut tagged in 1989 there were 68 recaptures (10.8%) during 1989-1994. All recaptures were recorded within the tagging area or nearby in the fjord complex of the tagging site.

Upernavik 1990. From 41 Greenland halibut tagged in 1990 no recaptures were recorded so far.

Ammassalik 1990 (Fig. 7). From 183 Greenland halibut tagged in 1990, there was 13 recaptures during 1990-1994. Two recaptures were recorded in 1992 in ICES division XIVb within the icelandic 200 mile fishery zone. Further one recapture was recorded in 1993 in ICES Division Va (within the Icelandic 200 mile fishery zone). The remaining 10 recaptures were all recorded at or near the tagging site.

Davis Strait 1991 (Fig. 8). From 682 Greenland halibut tagged in 1991 in Divisions 1CD, there were 7 recaptures during 1991-1993. Three recaptures were recorded in division 0B in 1991 and one recapture was recorded in 1993 in division 3L in Flemish Pass caught by a spanish trawler. The remaining three recaptures were recorded in the tagging area or in the immediate vicinity of the tagging area.

Davis Strait 1992 (Fig. 8). From 385 Greenland halibut tagged in 1992 in divisions 1CD, there were 5 recaptures during 1992-1993. One recapture was recorded in division 0B in 1993 (unknown position), while the remaining were recorded in the tagging area or in the immediate vicinity of the tagging area.

#### Discussion.

Since the tagging sites in the present study is coinciding with the areas where the commercial fishery for Greenland halibut takes place in the inshore areas, recaptures in inshore waters outside the tagging areas described here are therefore not very likely to occur. However, a fishery takes place for Greenland halibut in the offshore areas of West Greenland, a fishery which has expanded from less than 1,000 tons in 1987 to about 15,000 tons annually in present years. The opportunity to recapture Greenland halibut tagged inshore at West Greenland in the Davis Strait, have therefore been possible in case of migrations. The recaptures of 11 Greenland halibut in the Davis Strait from releases in the same area shows that the possibility for being caught is present. The main fishery for Greenland halibut in the Northwest Atlantic occurs west of Iceland as a trawl fishery with annually catches of about 40,000 tons and off the coasts of Labrador and Newfoundland at about 30,000 tons annually, which is a mixed fishery comprised of a trawl fishery, gillnet fishery and a longline fishery. The West Greenland inshore fishery for Greenland halibut is about 10,000 tons annually. No other directed bottom fishery takes place at depths below 600-800 meter in the Northwest Atlantic.

In the present tagging experiment nearly all inshore releases were recaptured within about 10 nm from the tagging site until 5 years after the release. A few Greenland halibut have been recaptured in neighbor fjords to the tagging site and 7 were caught more than 800 nm from the tagging site. 6 of the long distance migrants were tagged in the Godthaab Fjord and one migrant in a more southerly fjord at Cape Farewell. In numbers of tagged Greenland halibut these tagging sites only makes up about one third of the total numbers tagged in West Greenland. This means that Greenland halibut from Godthaab Fjord and from more southern fjords at West Greenland in some way are connected to the Greenland halibut stock component at Iceland. Results of earlier tagging experiments have also confirmed this connection. Recaptures were reported at Iceland in 1959 from a tagging experiment in Lichtenau Fjord in southern West Greenland in 1955 and in 1980 from tagging in Godthaab Fjord in 1964. The long

distance migrants in present study included fish which were in the length range 62-77 cm at the time of tagging. Assuming an annual growth of about 5 cm, the length range of the recaptures is 62-89 cm. According to Smidt (1969) the smallest Greenland halibut reach maturity at lengths of 55-70 cm depending on sex. The long distance migrants may therefore indicate a spawning migration from West Greenland fjords to the spawning grounds west of Iceland. This lends support to the hypothesis made by Riget and Boje (1988), that young Greenland halibut in the southernmost coast areas at West Greenland do not originate from the same spawning grounds as those in the northern part of West Greenland. This suggest that Greenland halibut eggs and larvae are transported by the East Greenland Current from Denmark Strait to the southernmost areas of West Greenland as earlier has been shown for cod eggs and larvae (Tåning 1937). But as mean length at time of tagging of the recaptures in the fjords does not differ from the mean length at time of tagging of the recaptures at Iceland, a supposed spawning migration may therefore not involve all mature fish. In Fig. 9 is shown length distributions of tagged fish in the two most comprehensive tagging experiments together with the length distribution in the successive years of recapture at the tagging site (length of fish at the time of tagging). In both experiments many of the large fish and probably mature fish were recaptured in the tagging area 4 years after being tagged. This fact has also been verified by Riget and Boje (1989) from earlier tagging experiments in Godthaab Fjord as the recapture rate at the tagging site was constant within all length groups.

The recaptures of Greenland halibut from releases in the northern fjords in Ilulissat, Torsukattak, Uummannaq and Upernavik indicates that these stock components are very stationary as no migration distances more than 50 nm have been observed. The short-distance migrations observed in these areas can be due to annual feeding migrations between the mouth of the fjords in wintertime and the bottom of the fjords in summertime. However, the inshore fishery actually follows this pattern so the location of the recaptures also are a reflection of this fact. The supposed stationarity is in accordance with earlier tagging experiments in these areas (Riget and Boje 1989).

The recapture records from the recently tagging experiments in the Davis Strait are expected to continue in the next years, so the few recaptures recorded yet should be interpreted with care. So far Greenland halibut in the Davis Strait seem to mix across the boundaries of Subareas 1 and 0. The observed migration of the recapture recorded at Flemish Pass in 1993 is not explainable in regard to Canadian tagging experiments in Labrador and Newfoundland, where most fish seem to migrate in a northern direction (Bowering 1984).

#### References.

- Atkinson, D.B., W.R. Bowering, D.G. Parsons, Sv. Aa. Horsted and J.P. Minet. (1982). A review of the biology and fisheries for roundnose grenadier, Greenland halibut and northern shrimp in Davis Strait. NAFO Sci. Coun. Studies, 3:7-27.
- Boje, J. (1990). On recaptures of Greenland halibut in Icelandic waters from tagging experiments in West Greenland fjords. NAFO SCR Doc. 90/37, Ser. No. N1754.
- Boje, J. and O.A. Jørgensen. (1990). On the relevance of a combined assessment of Greenland halibut in NAFO Subareas 0,1,2 and Divisions 3KL. NAFO SCR Doc. 90/35, Ser.No. N1735.

- Boje, J., F. Riget and M. Kjøie (1993). Parasites in Greenland halibut (Reinhardtius hippoglossoides (Walbaum)), in the Northwest Atlantic. (in prep. for Can. J. Fish. Aquat. Sci.).
- Bowering, W.R. (1980). Fecundity of Greenland halibut, Reinhardtius hippoglossoides (Walbaum), from southern Labrador and southeastern Gulf of St. Lawrence. J. Northw. Atl. Fish. Sci., 1:39-43.
- (1984). Migrations of Greenland halibut, Reinhardtius hippoglossoides, in the Northwest Atlantic from tagging in the Labrador-Newfoundland region. J. Northw. Atl. Fish. Sci. Vol. 5:85-91.
- Fairbairn, D.J. (1981). Biochemical genetic analysis of population differentiation in Greenland halibut (Reinhardtius hippoglossoides) from the Northwest Atlantic, Gulf of St. Lawrence, and Bering Strait. Can. J. Fish. Aquat. Sci., 38:669-677.
- Khan, R.A., M. Dawe, R. Bowering, and R.K. Misra (1982). Blood protozoa as an aid for separating stocks of Greenland halibut (Reinhardtius hippoglossoides) in the Northwest Atlantic. Can. J. Fish. Aquat. Sci., 39:1317-1322.
- Misra, R.K. and W.R. Bowering (1984). Stock delineation of Greenland halibut in the Northwest Atlantic using a recently developed multivariate statistical analysis based on meristic characters. North Amer. J. Fish. Manag., 4:390-398.
- Riget, F. and J. Boje (1988). Distribution and abundance of young Greenland halibut (Reinhardtius hippoglossoides) in West Greenland waters.
- (1989). Fishery and some biological aspects of Greenland halibut (Reinhardtius hippoglossoides) in West Greenland waters. NAFO Sci. Coun. Studies, 13:41-52.
- Riget, F., J. Boje and V. Simonsen (1992). Analysis of meristic characters and genetic differentiation in Greenland halibut (Reinhardtius hippoglossoides) in the Northwest Atlantic. J. Northw. Atl. Fish. Sci., Vol. 12:7-14.
- Sigurdsson, A. (1979). The Greenland halibut (Reinhardtius hippoglossoides (Walbaum)), at Iceland. Hafrannsóknir, 16, 31p.
- Smidt, E.L.B. (1969). The Greenland halibut, Reinhardtius hippoglossoides (Walb.), biology and exploitation in Greenland waters. Medd. Danm. Fisk.- Havunders. 6(4):79-148.
- Templeman, W. (1970). Vertebral and other meristic characters of Greenland halibut, Reinhardtius hippoglossoides, from the Northwest Atlantic. J. Fish. Res. Bd. Can., 27:1549-1562.
- Templeman, W. (1973). Distribution and abundance of Greenland halibut (Reinhardtius hippoglossoides (Walbaum)), in the Northwest Atlantic. ICNAF Res. Bull., 10:83-98.
- Tåning, A.V. (1937). Some features in the migration of cod. J. Cons. Perm. Int. Explor. Mer., 12:1-35.

Table 1. Summary of information of recaptures of Greenland halibut tagged at West Greenland 1986-1992.

Tagging experiment				Information of recaptures			
Location	Time of tagging	Length range (cm)	Nos.	Year of recapture	Nos.	% of tagged	cumul ative %
Torsukattak (1A)	Aug. 1986	35-85	272	1986	1	0.4	0.4
				1987	6	2.2	2.6
				1988	5	1.8	4.4
				1990	3	1.1	5.5
				1991	2	0.7	6.2
Ilulissat (1A)	Aug. 1986	35-95	43	1987	1	2.3	2.3
				1988	1	2.3	4.6
				1990	1	2.3	7.0
Uummannaq (1A)	Aug. 1987	35-98	241	1987	2	0.8	0.8
				1988	7	2.9	3.7
				1989	3	1.2	4.9
				1990	8	3.3	8.2
				1991	3	1.2	9.4
				1992	3	1.2	10.6
Torsukattak (1A)	Aug. 1987	38-100	368	1987	10	2.7	2.7
				1988	21	5.7	8.4
				1989	8	2.2	10.6
				1990	9	2.5	13.1
				1991	2	0.5	13.6
Ilulissat (1A)	Aug. 1987	35-90	173	1987	2	1.1	1.1
				1988	2	1.1	2.2
				1989	4	2.3	4.5
				1990	6	3.5	7.0
				1991	2	1.1	8.1
Godthaab Fjord (1D)	Jan. 1987	35-110	839	1987	14	1.7	1.7
				1988	20	2.4	4.1
				1989	9	1.1	5.2
				1990	1	0.1	5.3
				1992	1	0.1	5.4
Cape Farewell (1P)	Jan. 1988	35-91	120	1988	4	3.3	3.3
				1989	1	0.8	4.1
				1990	2	1.7	5.8
				1991	1	0.8	6.7
Upernavik (1A)	Aug. 1989	35-107	634	1989	2	0.3	0.3
				1990	26	4.1	4.4
				1991	15	2.4	6.8
				1992	13	2.1	8.9
				1993	9	1.4	10.3
Upernavik (1A)	Aug. 1990	39-106	41	1990	0	0	0
				1994	3	0.5	10.8
Ammassalik (XIV)	Sept. 1990	40-74	183	1990	0	0	0
				1991	6	3.2	3.2
				1992	3	1.6	4.8
				1993	3	1.6	6.4
				1994	1	0.6	7.0
Davis Strait (1CD)	August 1991	42-109	682	1991	5	0.7	0.7
				1992	1	0.2	0.9
				1993	1	0.2	1.0
Davis Strait (1CD)	May 1992	36-101	385	1992	4	1.0	1.0
				1993	1	0.3	1.3

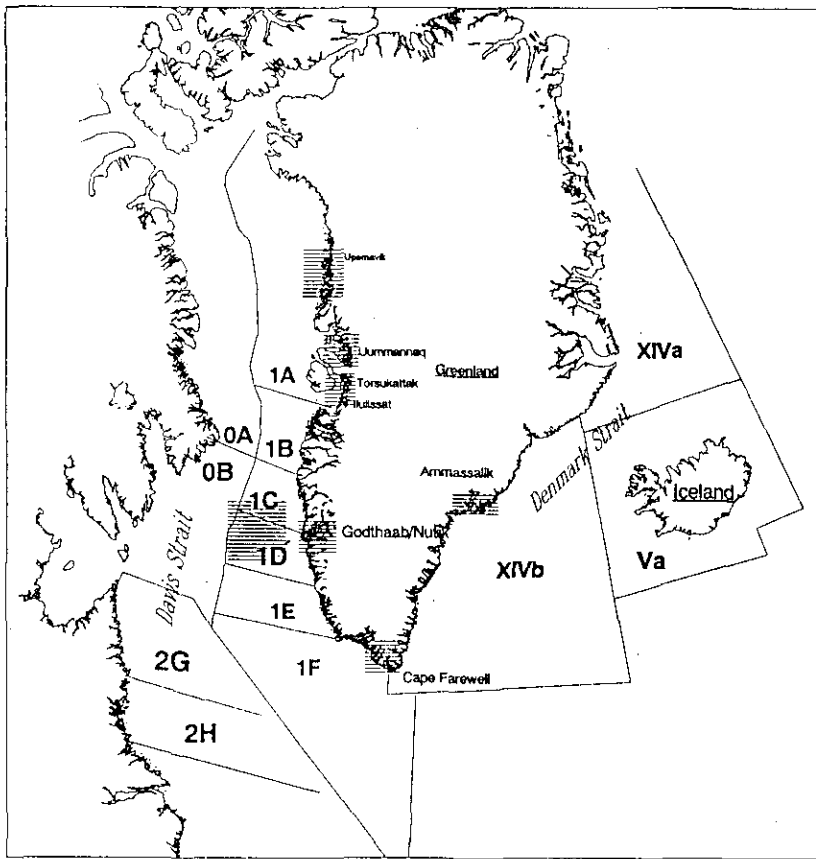


Fig. 1. Overview of the tagging sites at Greenland of the experiments in 1986-92 (hatched areas) and NAFO/ICES Subareas/Divisions.

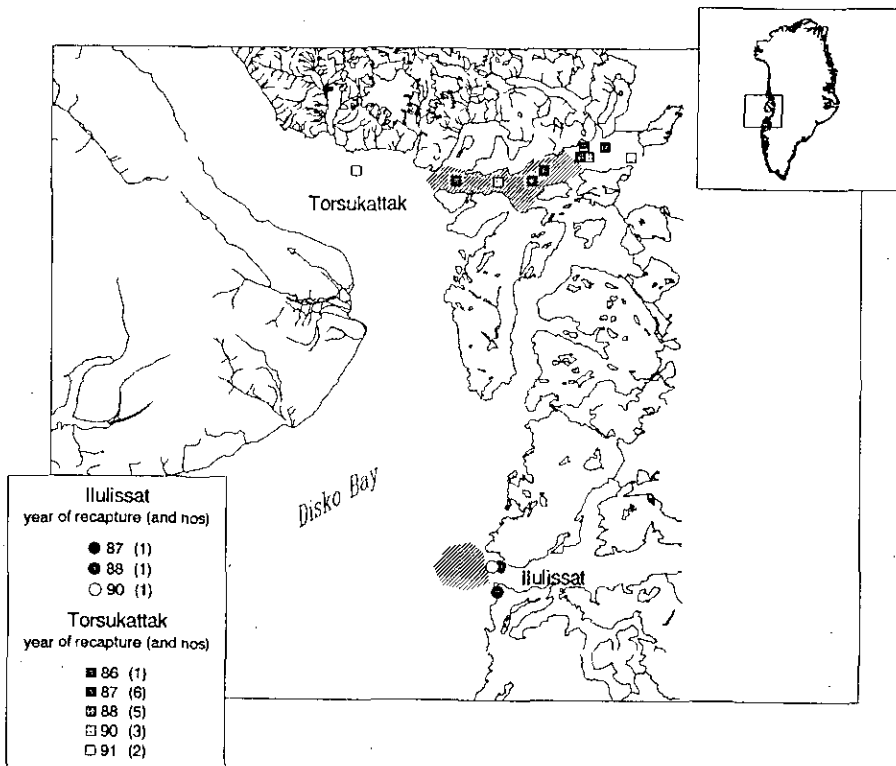


Fig. 2. Map of tagging areas and recapture sites from releases in Torsukattak and Ilulissat in 1986.



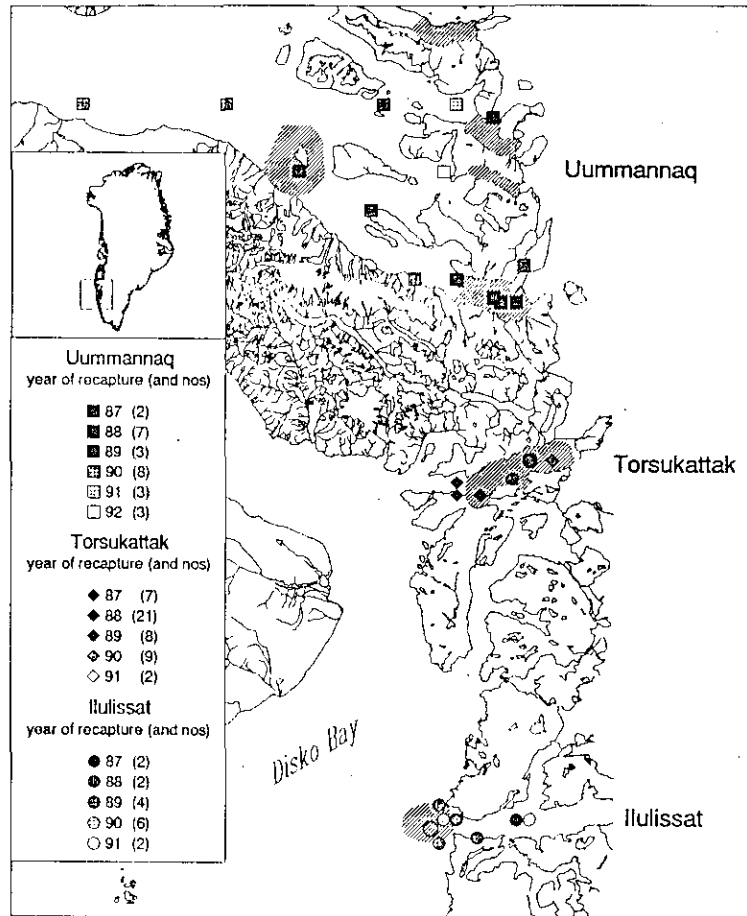


Fig.3. Map of tagging areas and recapture sites from releases in Uummannaq, Torsukattak and Ilulissat in 1987.

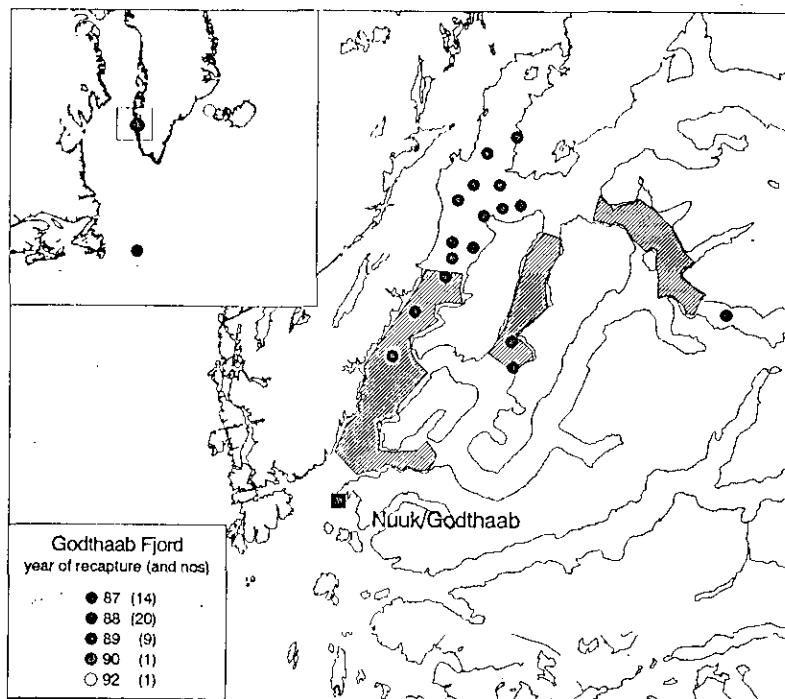


Fig. 4 Map of tagging areas and recapture sites from releases in Godthaab Fjord in 1987.

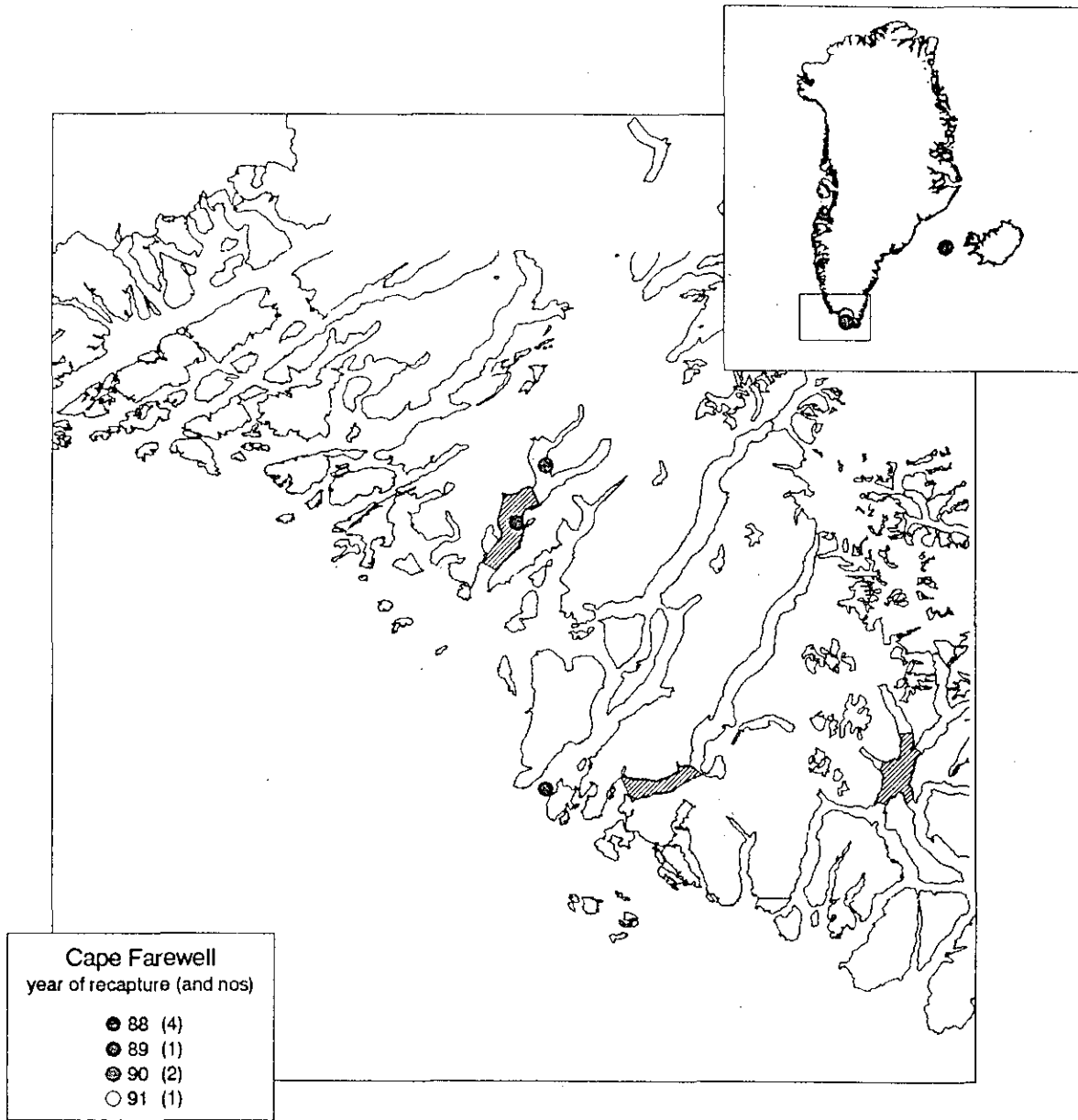


Fig. 5 Map of tagging areas and recapture sites from releases at Cape Farewell in 1988.

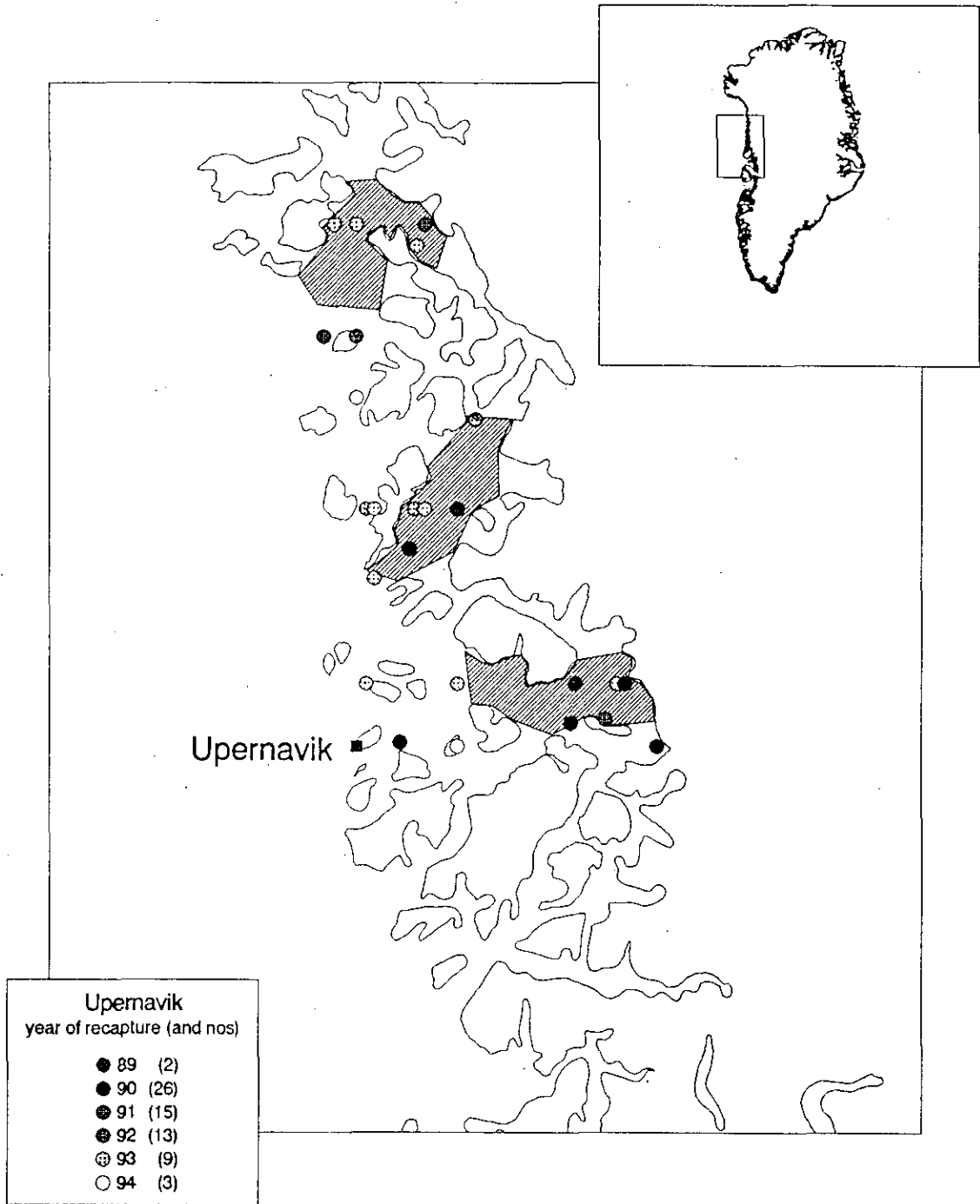


Fig. 6 Map of tagging areas and recapture sites from the tagging in Upernavik in 1989.

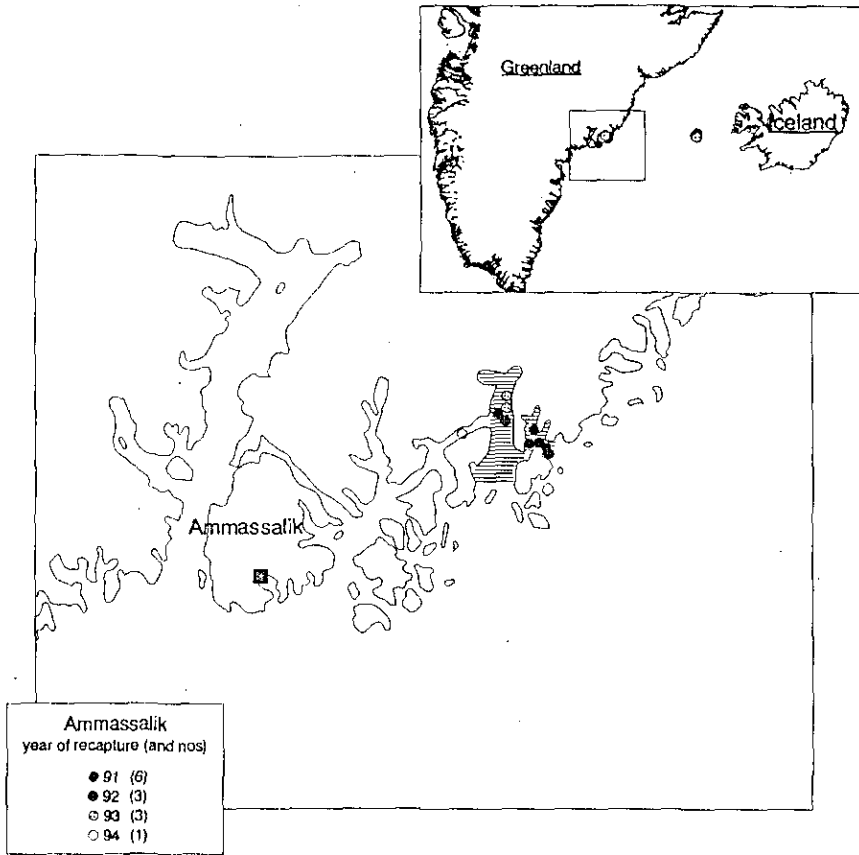


Fig. 7 Map of tagging areas and recapture sites from the tagging in Ammassalik in 1990.

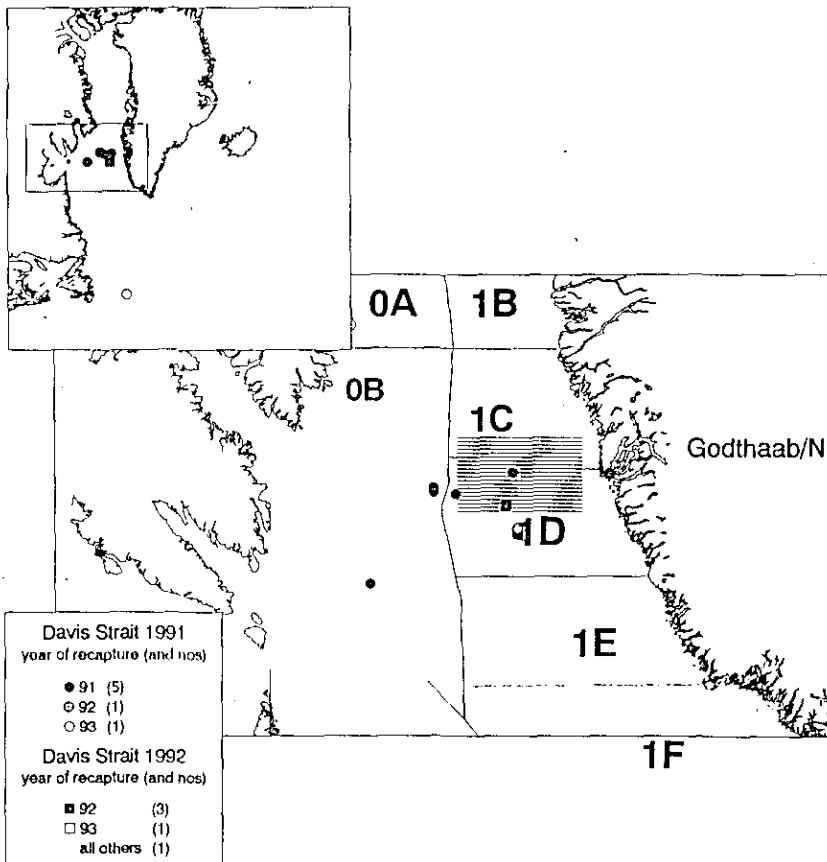


Fig. 8. Map of tagging areas and recapture sites from the tagging in the Davis Strait in 1991-1992.

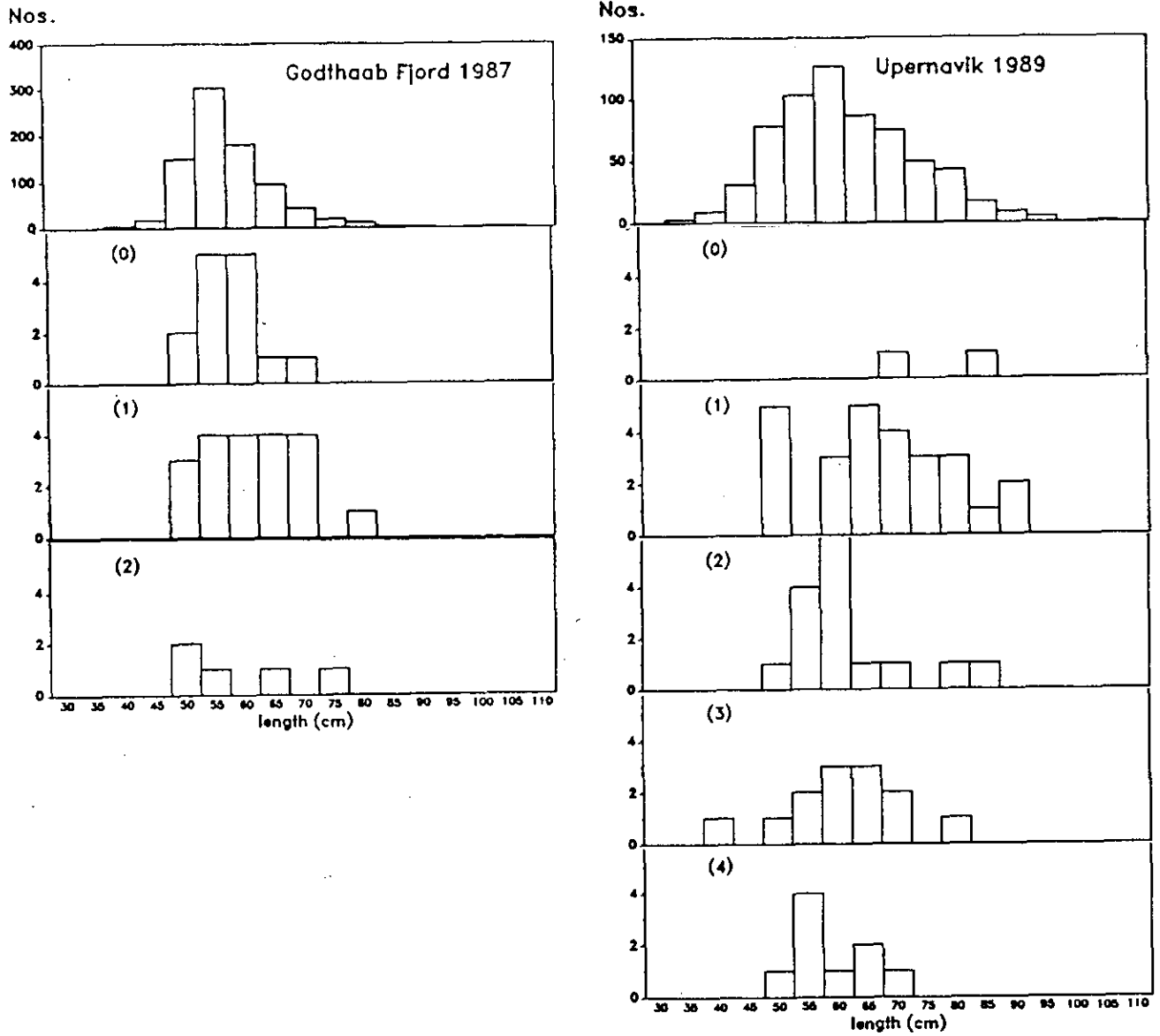


Fig. 9. Length distributions of Greenland halibut in tagging experiments at Godthaab Fjord (1987) and Upernavik (1989) and length distribution of recaptures at the tagging site in subsequent years (year of recapture after tagging is shown in brackets).