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Results of a Greenland Halibut (*Reinhardtius hippoglossoides*) Tagging Project in Cumberland Sound, NAFO Division 0B, 1997-2000.

by

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Abstract

Cumberland Sound supports a small inshore fishery for Greenland halibut. It has been hypothesized that fish that settle within Cumberland Sound do not migrate back to offshore waters. Extensive tagging experiments in Greenland throughout the late 1980's and 1990's have shown that Greenland halibut that settle in the fiords of Northwest Greenland do not migrate back to spawning areas in the southern Davis Strait and therefore do not contribute to the overall reproduction of the population. During an exploratory fishery in 1994, 407 Greenland halibut were tagged near the mouth of Cumberland Sound. Since then three fish have been recaptured, two in the offshore Division 0B and one on the winter fishing ground in Cumberland Sound. In 1997 an attempt to tag Greenland halibut in the winter was successful and a four-year winter tagging project was initiated in Cumberland Sound. A total of 1,674 fish were tagged during this period and 13 have been recaptured, none in the offshore area.

There is some evidence to suggest that there is a portion of Cumberland Sound near the mouth where there are migratory forms present and from which they move either out to Davis Strait or deeper within Cumberland Sound. There is also evidence to suggest that there are non-migratory forms in the vicinity of the winter fishing grounds within Cumberland Sound.

Introduction

A tagging program in Greenland demonstrated that the majority of Greenland Halibut (*Reinhardtius hippoglossoides*) that enter Greenlandic Fiords as juveniles do not migrate back into Davis Strait to spawn (Boje, 1994, 1999). Cumberland Sound, located within Canadian waters within Northwest Atlantic Fisheries Organization (NAFO) Div. 0B has some characteristics similar to the fiords on the north-west coast of Greenland, shallow shelf waters at the mouth (approx. 200 m) with deeper waters (500 to 1 000 m) further back in the sound.

Cumberland Sound also supports a small inshore fishery for Greenland halibut. Catches have ranged between 34 and 430 tons. The fishery is conducted using baited hooks set on long-lines through holes cut in the land-fast sea ice. Two attempts to locate commercially exploitable aggregations of Greenland halibut during the summer open water season have been unsuccessful; a third attempt is planned for 2003. The winter fishery catches both male and female fish in the size range 30 cm to 100 cm. While some females with mature eggs have been noted, very few of the fish sampled have been sexually mature.

It is hypothesized that the Greenland halibut within Cumberland Sound may behave in a manner similar to the fish in the Greenland fiords. Once they migrate in from the shallow shelf waters they may not return to offshore spawning areas in southern Davis Strait and therefore do not contribute to the overall reproduction of the population.

An initial attempt was made to tag Greenland halibut on the ice in Cumberland Sound in 1993. The fish were not able to survive the tagging process and no fish were released.

In the summer of 1994, 407 Greenland halibut were tagged near the entrance to Cumberland Sound during an exploratory fishery that was conducted in Davis Strait and Cumberland Sound (Northlands Consulting 1994) (Fig. 1). These fish were captured using otter trawl gear. Three fish were subsequently re-captured, two from Davis Strait and one from the winter fishing ground near the base of Cumberland Sound.

In 1995 the NAFO Scientific Council recommended that a tagging project be carried out in Cumberland Sound. However, an attempt to do so during that summer was not successful, few were caught and no tags were applied.

In 1997 a second attempt was made to tag Greenland halibut during the winter fishery. With modifications to the 1993 methods and some good weather this feasibility study proved to be successful (Stephensen *et al*., 1997). It was also demonstrated using mesh cages to hold fish at depth, that Greenland halibut could survive at least 2 days following capture and tagging (Stephensen *et al*., 1997 and Simonsen and Treble, in press). Results of the tagging conducted during 1997-2000, along with the three recaptures from the Northlands Consulting tagging project conducted in 1994 are presented in this paper.

Materials and Methods

Tagging was conducted over a 10 day period during mid April to early May in each year, 1997 to 2000. Greenland halibut were captured using longline gear and local winter fishing techniques. The fish were transported a short distance in an insulated holding tank to a tagging tent, where they were tagged with numbered Floy tags and released. For a detailed description of the methods and details on tagging mortality see Simonsen and Treble (in press).

Many of the tagged fish caught during 1998-2000 were also injected with oxytetracycline (OTC) an anti-biotic that is known to mark fish otoliths and bone and has been useful in age validation.

A reward of $40 is offered for the return of tagged fish in whole (round) condition. In order to improve the success of collecting information on recaptured fish an advertising campaign was conducted in the community of Pangnirtung where fishermen of the region reside and most Greenland halibut are landed. Observer companies and licensing sections were also contacted and information was provided to the NAFO Secretariat who documents tagging programs conducted throughout the region.

Results and Discussion

Tagging locations for 1994 and 1997-2000 are shown in Fig. 1 and 2. Recapture locations are also shown coded by year tagged. There have been only 2 recaptures in the offshore Davis Strait area, both from the summer 1994 tagging program. This tagging took place at 65°3'N and 64°58'W (Fig. 1). A third fish from this location was recaptured on the winter fishing ground at the base of Cumberland Sound.

The extent of the land-fast sea ice and therefore fishing location varies from year to year. During 1997 and 1999 tagging took place at approximately 65°58'N and 66°40'W and in 1998 and 2000 ice conditions were better and the location was shifted slightly to the SE over deeper water at approximately 65°50'N and 66°21'W (Fig. 2). There were 1 674 tags applied over four years, 1997-2000 (Table 1). Over 80% of the tagged fish in 1998 and 1999 were marked with OTC, with an additional 43% marked in 2000. The otoliths for three of these marked fish have been retrieved, one after 1 yr, 10+ months, one after 2 years, 11+ months and one after 3 years, 10+ months. Analysis of these results is not yet completed.

Of the 1 674 fish tagged from 1997-2000, 13 have been recaptured, all during the Cumberland Sound winter fishery. The time between tagging and recapture has varied from less than one year to four years, 11 months with at least 6 of these recaptures occurring at or very near where they were tagged (Table 2). There have also been two tagged fish that were not recaptured in the fishery. One was found dead in one of the fishing holes 12 days after tagging (#PG03965) and one was found in the stomach of a Greenland shark 3 days after tagging (#PG03875).

The recaptured fish varied in length at tagging from 330 mm to 755 mm with the majority falling above 550 mm (Table 2). Not all fish have been sampled upon recapture and at least one length measurement looks unusual so annual growth rates have not been estimated. There is sex information for seven of the recaptured fish and six were classed as female.

A majority of the recaptured fish (10) came from the 1997 and 1999 tagging location (Fig. 2, Table 1). This is the location where the ice first forms over a deep, >500 m, hole and in two of the five years since tagging the fishermen have not been able to move beyond this location because of poor ice conditions. Therefore, more effort has been expended in this area which may explain the greater number of returns, assuming the fish are not moving around very much. However, fish tagged in 1997 and 1999 have been caught in both fishing locations but fish tagged in 1998 and 2000 have only been caught in the deeper location, suggesting that movement or migrations may be in one direction only, from shallower to deeper waters. The tagging methods and weather conditions were similar across all years but some of the differences observed in numbers of recaptures across years tagged may also be due to tagging mortality.

The analysis of these tagging data is difficult given so few tag returns. There is some evidence that there is a portion of Cumberland Sound extending from the mouth to approximately 65°3'N and 64°58'W where there are migratory forms and from which they move either out to Davis Strait or deeper within Cumberland Sound. This observation is based on the results of the tagging project conducted in 1994. There is also some evidence to suggest that there are non-migratory forms in the vicinity of the winter fishing grounds. This observation is based on the fact none of the fish tagged on the winter fishing ground between 1997 and 2000 have been caught in the offshore despite the fact that offshore effort has increased substantially in recent years (Treble et al. 2003). For five of the six years since tagging began the Cumberland Sound fishery has been at an all time low point in terms of catch and effort. Catches were low varying between 34-77 tons from 1998 to 2001 in 2002 they increased to 106 tons and in 2003 they have increased again to just over 200 tons. Numbers of recaptured fish have increased along with these increases in catch (Table 2). At the same time catches in the offshore Div. 0B fishery (which is comprised of trawl, gillnet and longline fleets) have remained fairly constant ranging from 3 800 tons to 6 000 tons and catches in the new Div. 0A fishery reached 2,626 in 2001 and 3.561 in 2002. Also, several of these recaptured fish have been caught in the same location they were tagged as much as 2 to 4 years later, suggesting they may be non-migratory residents of Cumberland Sound.

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Table 1. Mark and recapture data for the 1994 (source: Northlands Consulting 1994) and 1997-2000 Greenland halibut tagging projects.

Year	Tagging Period	Number of Fish Tagged	Number of Fish Marked with Oxytetracycline	Number of Fish Recaptured
1994	Aug-Sept	407	0	3
1997	May 1-8, 8 days	143	0	4
1998	April 17-27, 10 days	595	523	0 (1 found dead in fishing hole)
1999	April 12-22, 10 days	404	367	6 (1 found in shark stomach)
2000	April 9-17, 9 days	532	229	3
Sub-Total 97-00		*1674*	*1119*	*13*
TOTAL		2081		16

Table 2. Data on recaptured Greenland halibut, tag number, date, location and size at tagging, date, location, size and sex at recapture (if available) and time since tagging.

Tag no.	Date Tagged	Lat. Tagged (dd)	Long. tagged (dd)	Length (mm)	Weight (g)	Date recap	Lat. Recap. (dd)	Long. Recap. (dd)	Length (mm)	Rd. Weight (g)	Dressed Wt. (g)	Sex	Time Since Tagging
PG04243	Sept. 2, 1994	65.05	-64.98	330	800	Nov. 18, 1995	62.57	-60.22	600	2004			1 yr, 2+ months
PG04196	Sept. 2, 1994	65.05	-64.98	600	2500	Feb/Mar, 1996	65.92	-66.58					1 yr, 5+ months
PG04161	Sept. 2, 1994	65.05	-64.98	610	2500	June 18, 1997	61.98	-60.52	660	2500		F	2 yr, 9+ months
1569	May 2, 1997	65.98	-66.73	600		March 14, 1998	65.83	-66.35					10+ months
PG03965	April 22, 1998	65.84	-66.35	470		May 3-4, 1998	65.84	-66.35					12 days
PG03875	April 19, 1999	65.97	-66.68	550		April 22, 1999	65.97	-66.68					3 days
1562	May 2, 1997	65.98	-66.73	725		May 8, 2000	65.85	-66.35					3 yrs
PG03397	April 20, 1999	65.97	-66.68	550		March 15, 2001	65.97	-66.67	550	1550	1200	M	1yr, 10+ months
PG02769	April 15, 2000	65.85	-66.35	755		April 6, 2001	65.83	-66.42			3856	F	11+ months
1573	April 3, 1997	65.98	-66.73	540		March 10, 2001	65.96	-66.62					3 yrs, 11+ months
PG03250	April 15, 1999	65.97	-66.68	645		March 1, 2002	65.98	-66.75			2270		2 yrs, 10+ months
PG03270	April 15, 1999	65.97	-66.68	635		April 4-7, 2002	65.97	-66.67	640	2340	1790	F	2 yrs, 11+ months
PG03422	April 21, 1999	65.97	-66.68	675		April 7-10, 2002	65.87	-66.58				F	3 yrs
1584	May 4, 1997	65.98	-66.73	620		April 10-13, 2002			690	3150	2270	F	4 yrs, 11+ months
PG02162	April 13, 2000	65.85	-66.35	555		Feb. 20, 2003							2 yrs, 10 months
PG03916	April 20, 1999	65.97	-66.68	600		March 4, 2003	65.83	-66.42	660	2730	2025	F	3 yrs, 10+ months
PG02321	April 16, 2000	65.85	-66.35	605		March 16, 2003	65.83	-66.42			1704		2 yrs, 10+ months
PG03423	April 21, 1999	65.97	-66.68	670		March 16, 2003	65.83	-66.42			4390		3 yrs. 10+ months

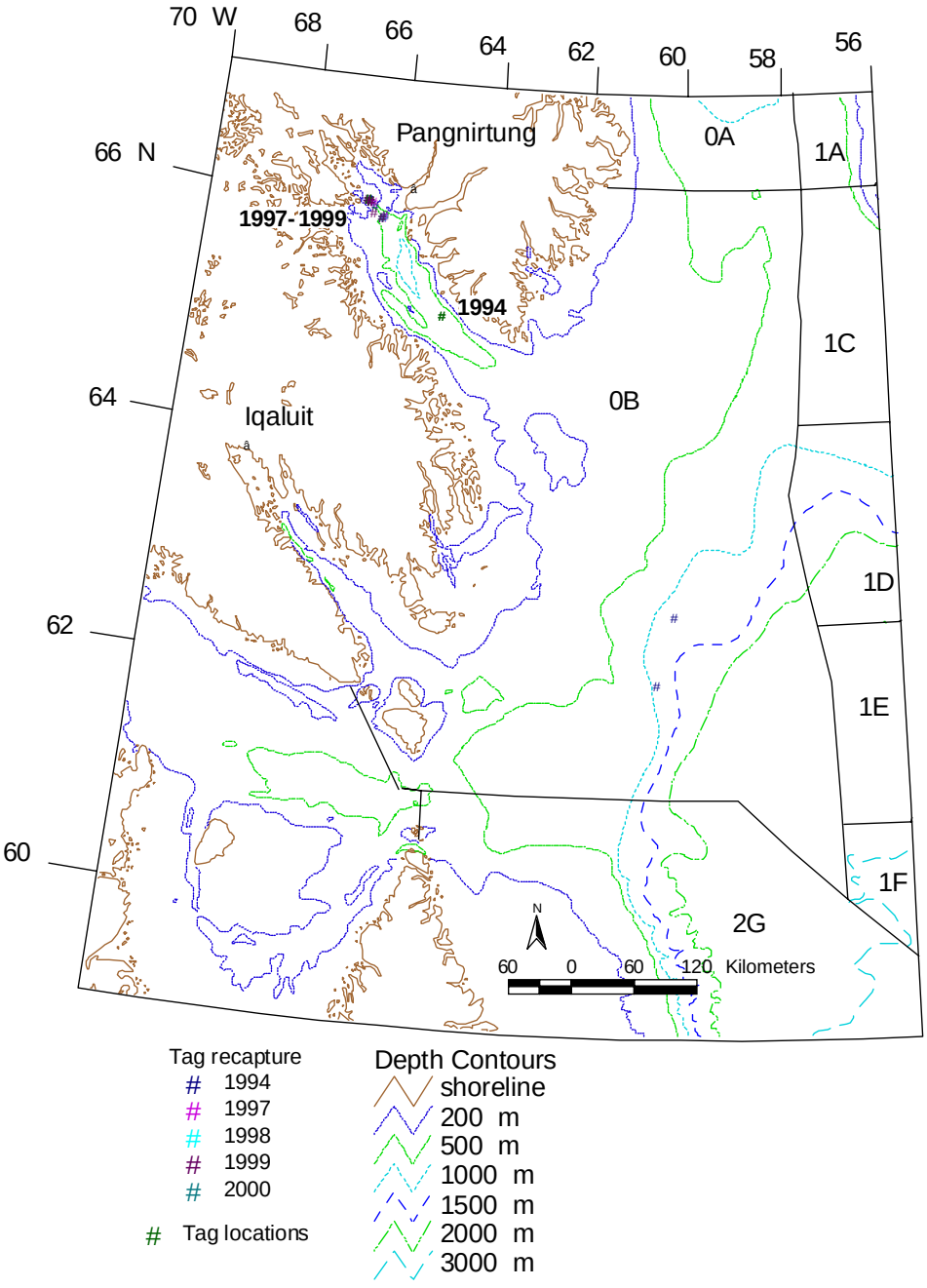

Fig. 1. Tagging and recapture locations for Greenland halibut tagged in Cumberland Sound, 1994 and 1997-2000. Only the 1994 location is visible, the tag recapture points obscure the others. Two of the three fish recaptured from the 1994 tagging project were recaptured in the offshore area of Div. 0B and one was recaptured on the winter fishing grounds in Cumberland Sound.

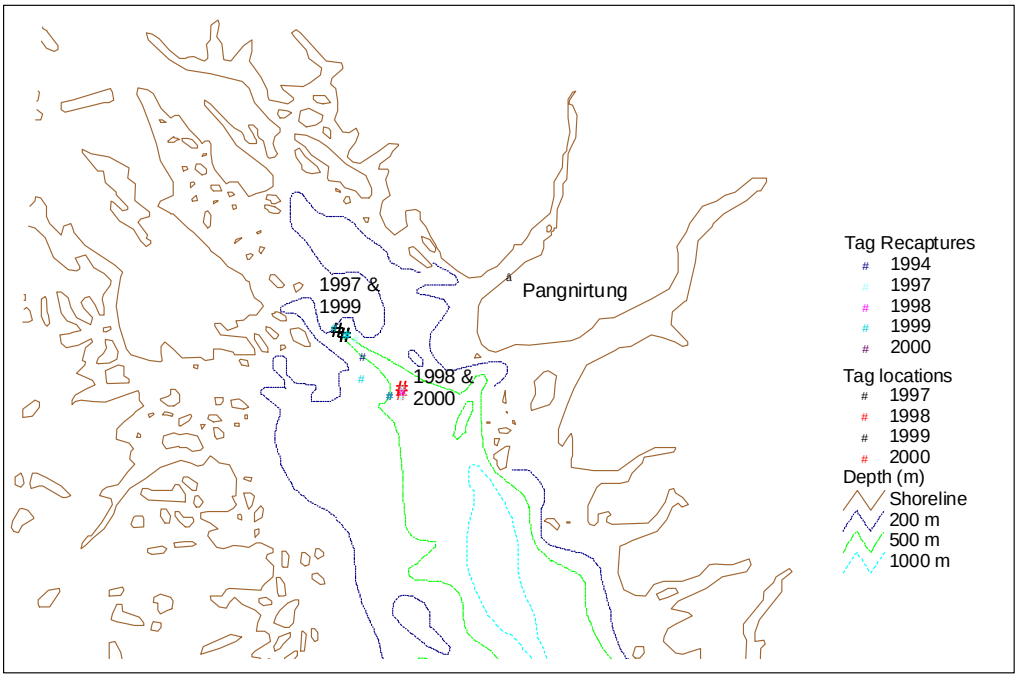

Fig. 2. Recapture locations for Greenland halibut tagged during the 1997-2000 tagging program.