NOT TO BE CITED WITHOUT AUTHOR'S PERMISSION

CAFSAC Res. Doc. 80/10

Noncatch fishing mortality at West Greenland and in home water fisheries

by

D. G. Reddin
Research and Resource Services
Northwest Atlantic Fisheries Center
Department of Fisheries and Oceans
P. O. Box 5667
St. John's, Newfoundland
A1C 5X1

Abstract

Information on noncatch fishing mortality losses is examined from research conducted at West Greenland and in the homewater fisheries in 1979. Noncatch fishing losses (terminology of Ricker 1976) are shown to be higher at West Greenland than in home waters. The best estimates of losses in the fishery at West Greenland in terms of reported catch are: fallout loss, 2-4%; dropout loss, 2-4%; discard loss, 13%, and local sales, 14-37%. The best estimates of noncatch fishing losses in the home water Canadian fisheries in terms of reported catch are: fallout loss, 1-2%; dropout loss, 1-2%; discard loss, 0-1%; and local sales, 0%. Thus noncatch fishing mortality rates in terms of total fishing mortalities for West Greenland salmon fishery are 0.22 to 0.42 and for Canadian fisheres are 0.07 to 0.13.

Introduction

In 1979, the ICES Working Group on North Atlantic Salmon met to assess the effects of the West Greenland fisheries on home waters stocks and fisheries. New information presented at this time indicated that the previous assessments of the losses to home water stocks and fisheries were underestimates. One of the parameters that led to this underestimation was noncatch fishery mortality (Anon 1979).

Noncatch fishing mortality as defined by Ricker (1976) and modified by Ritter et al. (1979) includes those fish that die as a result of fishing but that are not reported as catch. Ricker (1976) represented noncatch fishing mortality in terms of total fishing mortality including both the reported catch (those fish actually landed) and the noncatch mortality losses. Thus if noncatch fishing mortality rate was 50%, then 1 fish would be killed and lost for every 1 landed. There are several categories of noncatch fishing mortality: (1) predation loss: those fish removed or eaten by seals, otters, gulls or other predators while caught in nets; (2) drop out losses: those fish that are caught and killed by the gear but are lost prior to hauling back; (3) fallout loss: those fish that are caught and killed by the gear but are lost during the process of hauling back; (4) unreported discards: all fish that are not marketable because they are too small, damaged by predators, or have rotted in nets; (5) escapement mortality: those fish which encounter and are caught temporarily by the gear but escape from it and subsequently die from injuries (e.g. scale loss) or from stress suffered during the capture and escapement process, or from increased predation due to their greater vulnerability; (6) other unreported catch: this can be of two types including "local sales" when those fish used by the fishermen or sold directly to the consumer are not reported in catch statistics and "by-catch" when those fish caught in non-salmon gear (directed or non-directed) are not recorded in catch statistics (Ricker 1976 and Ritter et al. 1979).

Ritter et al. (1979) state that noncatch fishing mortalities occur in all commercial fisheries for North Atlantic salmon and using information derived from Pacific salmon (Ricker 1976) projected a value of 40% for these losses in the West Greenland salmon fishery; while the loss rate in home water coastal fisheries could be 25% and in estuarine fisheries 12.5%. These values have a considerable effect on any assessment of the effects of the West Greenland fishery on home waters fisheries and stocks; and so it was felt that more information is required. The results of the present paper, while only preliminary, does provide more information on these losses and were derived from experimental research vessel fishing at West Greenland as well as general observations of both this and the home waters fisheries.

Methods

Catches of Atlantic salmon were examined at fish plants in West Greenland at Frederikshaab, Godthaab, Holsteinsborg, Egesdesminde, and in Burgeo, Goose Cove, Nain and Packs Harbour, Newfoundland. The number of salmon damaged and type of damage was recorded.

The experimental work in West Greenland was done from the research vessel M.V. Zagreb which operated along the coast from August 11 to September 7, 1979. The research vessel samples were collected from up to 2000 fathoms of drift (monofilament gillnets) nets fished in basic units of 3 nets as follows: 1 monofilament, 126 mm; 1 monofilament, 142 mm and 1 monofilament, 154 mm. The mesh sizes are length of mesh opening. The nets were set over the stern of the research vessel and hauled aboard using a power block and stored in a net compound on deck. Stations and catches are in Fig. 1. The following experiments were performed.

Drop-out loss: the nets were patrolled on an hourly basis tying reflective tape to the head rope (different colour for each patrol) above each salmon in the net and then knotting the tape at each subsequent patrol if the salmon was still present.

Fall-out loss: the number of fish that fall off the nets while they are being hauled back were counted.

General observations: fishermen were questioned on their opinions of the magnitude of these losses.

The experiments on noncatch fishing losses in home water fisheries were carried out during tagging operations at Goose Cove, Newfoundland from June 14-July 15, 1979 using 115 mm and 127 mm monofilament nylon nets and 127 mm multifilament nylon nets.

The calculations were done by the following formulae:

$$m' = \frac{N_L}{N_T}$$

where, m' refers to West Greenland and m" to Canada,

m' - noncatch fishing mortality rate (Ricker definition) at West Greenland.

N_L - total number of noncatch fishing losses.

N_C - reported catch

N_T - total fishing mortalities = noncatch losses + reported catch

if m' must be expressed in terms of reported catch:

$$\text{then } c = \frac{m'}{N_C/N_T} = \frac{m'}{1-m'}$$

where,

c - noncatch fishing mortality in terms of reported catch. It should be pointed out that noncatch rates in this paper are not always additive when expressed in terms of reported catch.

Results

A) Research observations

1) West Greenland: In total, 17 sets were made along the west coast of Greenland; if practical the noncatch fishery mortality experiments were repeated for each set. The landed catch was 349 and total catch 381.

In total, there was a drop out loss of two, representing 1% of the total catch. They occurred during set number 5 and were 3% of the total catch on that day (Table 1).

There were 32 fallout losses from 15 sets representing 8% of the total catch. These losses ranged from 0% to 40% of the total catch for each set (Table 1).

There were 45 salmon landed in a damaged condition, or 12% of the total catch. These losses ranged from 0% to 28% of the catch for any one set. Examination of these damaged salmon indicated that they had been partially eaten by amphipods, gulls, or seals and in some instances the flesh had been torn open from the abrasive acton of the nets. Although, these damaged fish were further subdivided into the type of damage; it was found that distingushing those fish damaged by predators from those damaged by the mechanical action of the net was impossible in some cases and so they were grouped together. There were 15 salmon damaged in this manner or 4% of the total catch. There were 22 salmon partially eaten by amphipods or 6% of the total catch. There were 18 salmon damaged by amphipods durng set 7 and four salmon, i.e. 10% of the catch in set 8. There were 5 salmon partially eaten by sea birds or 1% of the total catch (range 0-8%) and 3 salmon or 1% of the total catch damaged by mammalian predators (range 0-8%).

2) Canada: In total, 338 salmon were caught in research nets at Goose Cove, Newfoundland. No fallout losses occurred during these experiments. None were landed with any predator damage; however, 2 salmon or 1% of the catch were landed that had been damaged by the mechanical action of the net.

B) General observations

1) West Greenland. During our sampling of salmon in fish plants, it was noticed that virtually none of the fish examined were physically damaged in any way. This could not be explained in light of the number of damaged salmon landed by the research vessel until we observed the crew of a Greenlandic vessel, fishing off Holsteinsborg, that were throwing salmon overboard. When questioned they explained that these salmon had been partially eaten by amphipods. (1) Fishermen apparently must discard damaged salmon rather than selling them to the fish plants. This is not too surprising as the fish plants market all of their product in round, fresh frozen state (Manager, KGH (Royal Greenland Trade Department) fish plant, Godthaab, pers. comm.) and any marked fish would be unmarketable. Fishermen were also observed selling salmon locally rather than to fish plants and feeding salmon in large quantities to their sled dogs.

2) Canada: Fishermen report that some salmon are removed from their nets by predators i.e. otters and seals. The total predator losses probably are low because of the small numbers of seals around the Newfoundland coast in the summer and the fact that fishermen are able to discourage predators by the frequent patrolling of their nets and use of loud noises to scare them away.

The fishermen also report some dropout losses but they have no idea of the magnitude.

Fishermen tell us that fallout losses are kept to a minimum by "bagging" the net by hauling it from the footrope. Even so they say that occasionally they will lose a salmon although some say they do not lose any at all.

Discard losses from predator damage are small in comparison to the total catch because the fish are still marketed as local sales or sold to the fish plants if not too badly damaged. Rarely are they discarded. As well, mechanical net damage does occur during storms, but is restricted to areas where nets are set on exposed coastlines. The overall discard losses must be low because the incidence of damaged fish in the landed catch is less than 1% (B. Moores, pers. comm.).

Discussion

Fallout losses

Fallout losses during experimental fishing at West Greenland in 1979 were much higher than those reported in the literature. For instance, French and Dunn (1973) report 1.4% for U.S. research vessels during 1965-70, and in experimental drift netting off Norway, fallout was recorded as being less than 1% of the total number of salmon landed (Jensen 1979). The methods used for bringing the gear back aboard the research vessel at West Greenland was undoubtedly partially to account for these differences and makes comparison of fallout losses between research and commercial vessels at West Greenland extremely difficult. The research vessel was 55 metres in length while the fishing vessels are much smaller than this generally in the 10-12 metre range. When hauling back nets from the research vessel the nets are pulled to the vessel thus dragging as many as 60 m of net through the water at one time. The commercial fishing vessels are much smaller and lighter and so do not drag a large mass of nets through the water during hauling operations but remain much closer to the nets. For these reasons, fallout losses would be less in commercial fishing operations at West Greenland than was the case with the research vessel. However, there is no doubt that fallout losses do occur in commercial fishing operations at West Greenland. It must also be pointed out that most of the research fishing was conducted during calm sea conditions and low wind velocity thus tending to lessen the likelihood of losses.

No fallout losses occurred during research gillnetting for tagging purposes in June and July, 1979, at Goose Cove, Newfoundland. Fishermen report that during commercial fishing operations they frequently will not lose any fish over a fishing season; while others report at the most 1 or 2 losses per year. Fallout losses are minimized because fishermen haul the foot rope first thus creating a "bag" that will catch any salmon that fall out. The number of fallout losses in Canadian homewater fisheries are estimated to be from 1 to 2% of the landed catch.

In comparison, fallout losses at West Greenland must be higher than in Canadian home water fisheries because of the rougher wind and sea conditions in which fishermen can operate with their larger vessels. Also, they do not "bag" the net as a set gillnet fishermen does since the headrope and footrope are hauled aboard at the same time. It would be reasonable to assume fallout losses to be twice that of homewaters, or 2-4% of the present catch.

Dropout losses

At West Greenland, only 1% dropout losses were recorded from research vessel fishing. This would be a minimum estimate of losses in the commercial fishery as the research fishing was performed in calmer wind and sea conditions than commercial vessels can normally be expected to operate in.

There is no quantitative information on dropout losses in Canadian home waters fisheries. But information from fishermen indicates that it does occasionally occur.

Reliable estimates of dropout loss are lacking in the literature. But Ricker (1976) states that dropout losses in coastal set net fisheries would be lower than in drift net fisheries because of calmer seas, shorter length of nets and more frequent patrolling and removal of catch. As well, weather conditions influence losses, more fish dropping off as weather worsens (French and Dunn 1973). Also losses were higher for immature than for mature fish. Gear selectivity also plays a role, losses varying with mesh size and are higher in the less efficient mesh size (Ishida et al. 1969). Jensen (1979) reported dropout losses of 5.5% in experimental fishing off Norway.

Thus, dropout losses in the commercial salmon fishery at West Greenland are estimated to be from 2-4% because the salmon are exploited in an immature state, and the fishery is prosecuted offshore using drift nets. The dropout losses in the Canadian homewater salmon fishery are estimated to be from 1 to 2% of the landed catch because the fish are exploited in a mature state, and the fishery is prosecuted from smaller vessels using shorefast gillnets.

Predation losses

There is no new quantitative information on predation losses in the West Greenland salmon fisheries. However, there were salmon caught in research vessel nets that were damaged by both mammalian and avian predators and it is assumed that similarly damaged fish would be found in commercial nets. Most of the research fishing was located further offshore than the commercial fishery and one would expect the abundance of seals and thus predation losses to increase inshore relative to the offshore. Only one seal was observed around research nets during fishing activities at West Greenland. However, harp seals, (Pagophilus groenlandicus) are quite abundant in the Disko Bay to Umanak area and migrate through the region of the commercial fishery. Tags have been returned from harp seals caught in commercial salmon gear (pers. comm. D. Sergeant). Hooded seals (Cystophora cristata), bearded seals (Erignatus barbatus) and the ringed seals (Phoca hispida) are also present and may prey on salmon caught in gillnets or salmon escaping from nets in a weakened or damaged condition (escapement mortality). Avian scavengers such as the fulmar (Fulmarus glacialis) and shearwater (Puffinus gravis) were seen in great numbers around research nets and were seen to be scavenging on salmon in the nets. Lear (pers. comm.) reported that during tagging for salmon at West Greenland in 1972 that salmon were landed that had been damaged mainly by birds and in a few instances by seals.

In the Canadian home water fisheries, the harbour seal (Phoca vitulina) and otter (Lontra canadensis) are known to remove salmon from gillnets although the incidence as evidence of damaged fish in the catch indicates would be quite low (less than 1%). As seals are not as abundant as at West Greenland, the incidence of predation losses in home waters would have to be less. Avian scavengers occur in abundance around Newfoundland and Labrador, although losses from this source, and losses of removals by seals and otters are kept to a minimum by the frequent removal of the catch by the fishermen.

Escapement mortality losses.

Doubleday and Reddin (1979) estimated escapement mortality losses to be 5% to 15% of the reported catch of the West Greenland fishery. Estimates of

5% to 10% are assumed for the homewater Canadian fisheries (Ricker 1976 and Ritter et al. 1979). The overall escapement mortality rate would be higher for the West Greenland fishery because fish near home waters approaching maturity are physiologically hardier. In addition the number of 'escapees' would be less because a portion of Canadian catch is from trapnets.

Discards

Noncatch losses from unreported discards were assumed to be small in most salmon fisheries (Ritter et al. 1979). However, general observations in 1979 indicated that at West Greenland discards could be as high as 13% of the landed catch. As stated previously, it was surprising that no fish sampled at the fish plants were marked or damaged. This discrepancy could only be explained when fishermen were observed throwing salmon overboard that had been damaged by amphipods. The reasons for these discards are that fish landed in fish plants in West Greenland are generally marketed gutted with the head on, so that any marks or blemishes render them unsaleable. The numbers of salmon damaged during research fishing by mechanical action of the nets was undoubtedly higher than in the commercial fishery because of the way the research nets are fished. However, mechanical net action would increase with rougher weather conditions. The values presented for damage done by amphipods and avian scavengers should be comparable to commercial operations. The amphipod damage occurred in only 2 sets during research operations, but as both sets were in ICNAF Div. 1B, which is an area of fishing concentration, and as local fishermen stated that it was a problem, losses of this type may be higher in commericial fishing operations. Damage by seals is expected to be higher in the fishery closer to shore than the research vessel sampling.

In the home water Canadian fisheries damage done by birds and mammals is kept to a minimum by frequent inspections and removal of the catch from the nets. As well, fishermen report in most cases damaged salmon are not discarded but sold to the fish plants as #2 salmon. Salmon that were damaged but could not be sold to the fish plants are marketed as "local sales". In Canada local sales data are collected by fishery officers and reported in the catch figures. The number of salmon actually discarded according to the fishermen is less than 1% of the landed catch.

Local Sales

At West Greenland, the author observed fishermen selling salmon at local markets and feeding salmon to sled dogs that otherwise may have been discarded. Shearer and Balmain (1967) also reported that some salmon were consumed locally. Salmon consumed or sold locally are termed local sales and are unreported in official landings. The official catch records include only those fish bought from fishermen by the local fish plants (usually the Royal Greenlandic Trade Department (KGH)) (pers. comm., J. Møller Jensen, Greenland Fisheries Investigations, Denmark) and do not include those fish that fishermen eat themselves or sell to local consumers. Local sales in other fisheries occur at West Greenland since in 1978 at least 20% of seal skins were marketed locally (Kapel and Geisler 1979).

In Newfoundland and Labrador local sales statistics are included in the catch statistics and represent 25 to 37% of the catch reported through fish plants (20 to 27% of the total catch) for 1976-78. Minimum estimates of local sales for Hopedale, Nain and Makkovik in Labrador for 1978 show an amount equivalent to 14% of the reported catch (12% of total catch) are consumed locally (pers. comm. A. Pittman, District Protection Officer, Labrador). As the residents of these towns are indiginous native people (Innuit) these values should be comparable to the West Greenland situation. Thus, applying the range of 14% to 37% to the quota of 1191 tonnes between 167 and 441 metric tonnes of salmon would be consumed locally and not reported in the offical catch records. Information on by-catch of salmon from other fisheries at Greenland are not available; but as the salmon fishery is the main coastal gillnet fishery the by-catch landings in other fisheries could not be very large.

Local sales are included in the catch statistics for home water Canadian fisheries, as are the landings of salmon caught in non-salmon gear (Reddin 1978).

Noncatch fishing mortality rates based on total fishing mortality (reported catch and noncatch fishing losses) are 0.22 to 0.42 for the West Greenland salmon fishery and 0.07 to 0.13 for the Canadian salmon fishery (Table 2). The higher rates for the West Greenland fishery than the home water fisheries are supported by Rickers statement that "losses of immature fish can scarcely be less than 50%, while for fish in the final year it averages about 25%". Noncatch losses in the home water fisheries are further reduced because the gear predominately fished is either set gillnets or trapnets as opposed to drift gillnets at West Greenland. These figures have been derived from general observations and additional future experimental work is required to define the estimates. The noncatch fishing mortality rates for Canada would be closer to those of Wst Greenland if local sales were not included in Canadian landings.

Conclusions

1. More studies are required to provide accurate information on noncatch fishing mortality rates in both West Greenland and home water salmon fisheries.

2. Unreported losses of salmon by predators occurs in both the West Greenland and Canadian salmon fisheries. No quantitative information is available.

3. Losses from salmon dropping out of salmon gear occurs in both the West Greenland and Canadian salmon fisheries. It is estimated that losses at West Greenland range from 2-4%. No information of a quantitative nature is available for Canadian fisheries but literature information supports the hypothesis that it would be less than at West Greenland, i.e. 1-2%.

4. Losses from salmon "fallouts" occur in both the West Greenland and Canadian fisheries. In the research investigations at West Greenland 8% of the salmon catch were fall outs but this is thought to be an overestimate of the losses in the fishery, 2-4% being a more reasonable estimate. Fallout losses in Canadian home water fisheries are about 1-2% of the landed catch.

5. Unreported discards occur in both the West Greenland and home water commercial fisheries. If only unmarked fish are sold to fish plants and included in the reported landings then 12% of the research vessel catch would have been discarded. In Canadian home water fisheries less than 1% are discarded and not reported.

6. Unreported catches marketed as local sales could be between 14 and 37% of the reported catch at West Greenland based on reported local sales in the Newfoundland fisheries. Local sales are reported in the total landings for Canadian fisheries.

7. Noncatch fishing mortality rates for the West Greenland salmon fishery are 0.22 to 0.42 and for the Canadian fisheries are 0.07 to 0.13.

References

Anonymous. 1979. Report of the Working Group on North Atlantic Salmon Cons. Int. Explor. Mer. C.M. 1979/M:10.

Doubleday, W. G. and D. G. Reddin. 1980. Gear selectivity and escapement mortality of Atlantic salmon in drift nets at West Greenland. CAFSAC Res. Doc. 80/11, 10 p.

French, R. R., and J. R. Dunn. 1973. Loss of salmon from high-seas gillnetting with reference to the Japanese salmon mothership fishery. U.S. Nat. Mar. Fish. Serv. Fish. Bull. 71: 845-875.

Ishida, M., N. Sano, S. Michima, and S. Saito. 1969. On measuring the dropping rate of salmon gillnets by means of underwater television techniques. Bull. Jpn. Soc. Sci. Fish. 35: 1157-1166.

Jensen, K. W. 1979. Experimental drift-netting for salmon in Norway 1978. ICES, C.M. 1979/M:9.

Kapel, F. O., and A. Geisler. 1979. Progress Report on Research on Harp and hooded seals in Greenland, 1978-79. NAFO/SCR Doc. 79/XI/0.

Reddin, D. 1978. Report of the salmon by-catch in miscellaneous marine fishing gear, 1976, Newfoundland and Labrador. Fish. Mar. Serv. Man. Rept. No. 1461.

1979. Evidence of an underestimation of the proportion of North American origin Atlantic salmon caught in the commercal fisheries at West Greenland. ICES, C.M. 1979/M:17, 7 p.

Ricker, W. E. 1976. Review of the rate of growth and mortality of pacific salmon in salt water and noncatch mortality caused by fishing. J. Fish. Res. Board Can. 33(7): 1483-1524.

Ritter, J. A. T. L. Marshall and D. G. Reddin. 1979. A review of noncatch fishing mortality as it related to Atlantic samon (*Salmo salar* L.). Cons. Int. Explor. Mer. C.M. 1979/M:10.

Table 1. The noncatch fishing mortalities from research vessel nets in 1979.

			Fallouts		Dropouts		Salmon caught in a damaged condition		Amphipods		Salmon damaged by: Seabirds		Salmon damaged by: Mammals		Net action or or unrecognized as predator damage			
Set Number	Landed catch	Total catch	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Sea condition	Wind factor
1	4	6	2	33	0(6)	0	0	0	0	0	0	0	0	0	0	0	2	4
2	18	20	2	10	0(20)	0	0	0	0	0	0	0	0	0	0	0	1	1
3	9	15	6	40	0(15)	0	0	0	0	0	0	0	0	0	0	0	1	1
4	67	74	7	9	0(30)	0	6	8	0	0	1	1	1	1	4	5	1	1
5	62	67	5	7	2(64)	3	4	6	0	0	2	3	1	1	1	1	1	1
6	26	26	0	0	0(18)	0	7	27	0	0	2	8	0	0	5	19	1	2
7	75	76	1	1	0(26)	0	21	28	18	24	0	0	0	0	3	4	2	3
8	33	39	6	15	-	-	5	13	4	10	0	0	0	0	1	3	0	1
9	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
10	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	4
11	13	13	0	0	-	-	1	8	0	0	0	0	1	8	0	0	0	1
12	9	10	1	10	-	-	0	0	0	0	0	0	0	0	0	0	2	3
13	3	4	1	25	-	-	1	25	0	0	0	0	0	0	1	25	4	5
14	25	25	0	0	-	-	0	0	0	0	0	0	0	0	0	0	1	1
16	2	3	1	33	-	-	0	0	0	0	0	0	0	0	0	0	2	2
17	1	1	0	0	-	-	0	0	0	0	0	0	0	0	0	0	1	0
Total	349	381	32	8	2*(179)	1	45	12	22	6	5	1	3	1	15	4		

* ( ) indicates number of marked fish used to calculate drop out rate and does not equal landed catch because some salmon caught after the last patrol but before the nets were hauled.

Table 2. Noncatch fishing mortality rates for West Greenland and Canadian homewater fisheries.

		West Greenland fishery		Homewater fisheries	
		upper	lower	upper	lower
Predation	1	-	-	-	-
Drop out	1	.04	.02	.02	.01
Fall out	1	.04	.02	.02	.01
Escapement mortality	1	.15	.05	.10	.05
Discard	1	.13	.05	.01	0
Local sales	1	.37	.14	0	0
Total	1	.73	.28	.15	.07
	2	.42	.22	0.13	.07

1 - proportion of reported catch
2 - noncatch fishing mortality rates in terms of total fishing mortality.

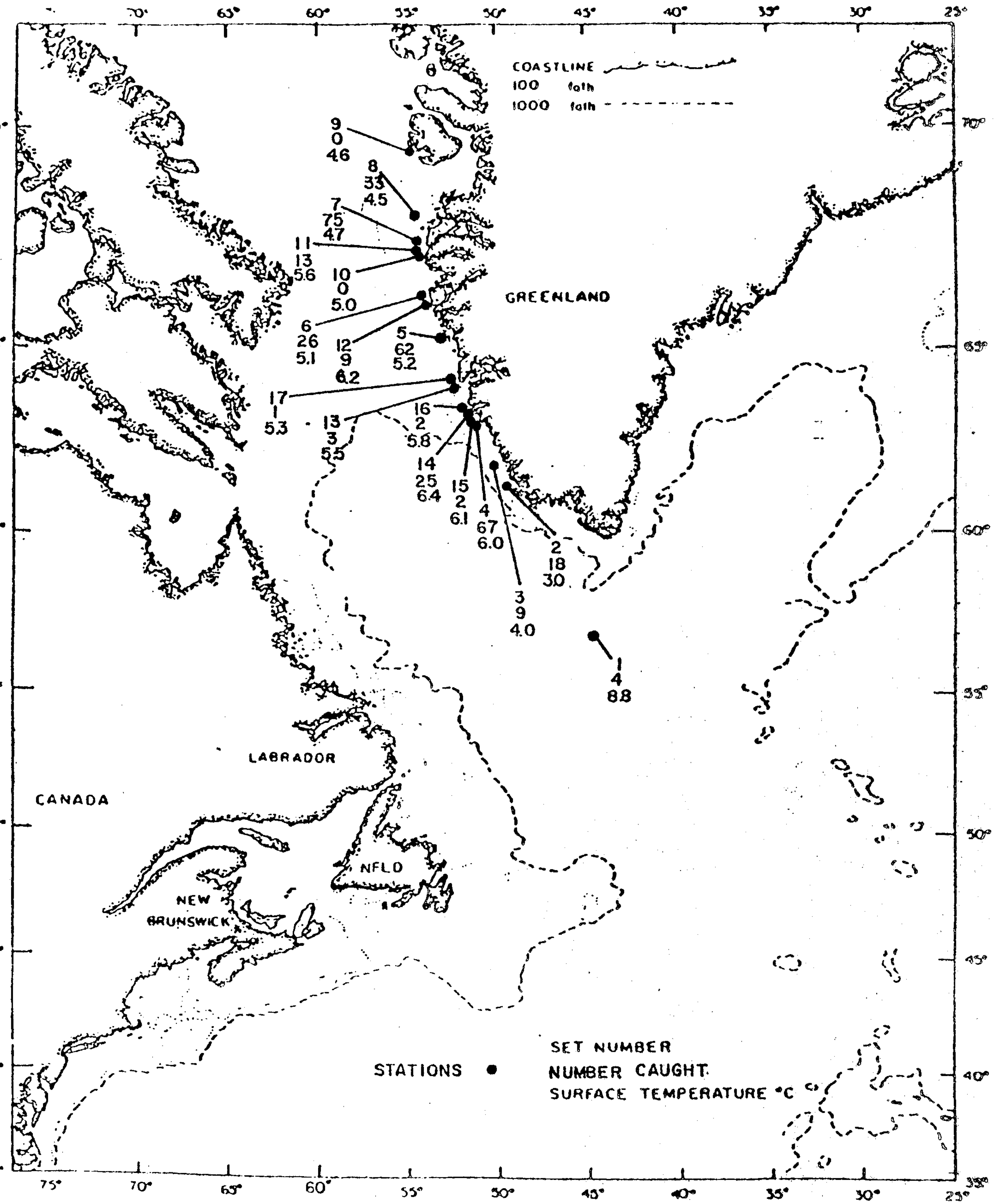

Figure 1. The stations, catch, set number and water temperature of West Greenland experimental work, 1979.