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CRUISE RESULTS

NOAA R/V MILLER FREEMAN

Cruise No. 77-1, Leg III

Pelagic Fish Survey and Midwater Trawl Tests

March 12-26, 1977

CRUISE AREA AND ITINERARY

The Miller Freeman returned to Kodiak on March 26, 1977 after completing a brief echo sounder/midwater trawl survey for pelagic fish in the eastern Bering Sea. Just prior to departing for the Bering Sea, midwater trawling gear was tested in Chiniak Bay, Kodiak Island. A summary of the cruise itinerary is as follows:

March 12	Midwater trawl tests in Chiniak Bay
March 12-16	Transit from Kodiak to Unimak Pass; 40 hours at anchor due to weather
March 16-23	Echo sounder/trawl survey (area and track-line shown in Figure 1); three days lost to weather
March 23-26	Transit to Kodiak

OBJECTIVES

Despite its limited duration, this cruise provided a valuable opportunity to obtain certain experience and data useful to the planning of future eastern Bering Sea pelagic fish surveys, and to begin accumulating information on the Miller Freeman's capability to fish large midwater trawls.

The principal objectives of the cruise were (1) to obtain information on the handling and performance characteristics of the Freeman's midwater trawling system (large Herman Engel midwater trawl and ELAC direct link

netsounder), and (2) to obtain data, mainly from the Pribilof Island area, on the detectability, relative abundance, diel behavior, and composition of midwater fish aggregations. The frequency of occurrence, echo sign characteristics, and biological composition of pollock and herring schools were of particular interest.

Other objectives were to obtain samples of various fish and squid for biochemical genetic and other taxonomic studies, and to examine pollock stomach contents. If circumstances permitted, it was also planned to occasionally sample ichthyoplankton with bongo nets, and obtain preliminar information on the feasibility of tagging pollock by holding tagged and untagged fish in a live tank.

GEAR AND INSTRUMENTATION

The Herman Engel trawl had a 269 ft. (81.9 m) footrope and a 237 ft. (72.3 m) headrope. The breastlines were 232 ft. (70.9 m). Mesh size (stretched measure) tapered from 22-inch (560 mm) in the forward section to 1.6 inche (40 mm) in the codend, with intermediate sections of 15.8 inches (400 mm), 7.9 inches (200 mm), 6.3 inches (160 mm), 4.7 inches (120 mm), 3.1 inches (80 mm), and 1.8 inches (45 mm) web. The trawl was fished with 14 x 6.5 ft. (4.2 x 1.97 m) Suberkrub doors. Each door weighed 3,218 lbs. (1,460 kg). The dandylines (two per side) were 82 fm (150 m) in length.

In order to increase its vertical mouth opening, the Engel trawl is frequently fished with accessory weights hung to the bottom dandylines, near the footrope. During the cruise, the effect of adding weights was evaluated. One 750 lb. (340 kg) tom weight, which was a rectangular block of lead equipped with a pad eye on each end, was hung to each bottom dandylir During January, 1977 in Puget Sound, a very limited test of the trawl was conducted without using weights, and the vertical mouth opening was only 5 to 8 fms (9.2-14.6 m), which was roughly half the opening expected.

A Mark I Universal Trawl was used during the cruise after the Engel trawl was damaged. This trawl which is designed for both midwater and bottom fishing had a headrope and footrope each 121 ft. (37 m) in length. It wa constructed entirely of 2.5 inch (64 mm) mesh (stretched measure) and had a 1.25 inch (32 mm) codend liner. It was fished with 7 x 10 ft. (2.1 x 3.0 m) steel V doors and triple 30 fm (55 m) dandylines. Its vertical mouth opening was approximately 4 fm (7.3 m).

The echo sounder survey utilized the vessel's 30 kHz ELAC system. This included eight-inch dry paper echo recorder (LAZ 17) with an accessory scale expansion unit. The latter provides for magnification of any sectic of the water column, and has a bottom-locked display capability. The LAZ 17 was also used as a recorder for the netsounder (the overall system design is such that the recorder and transceiver operate with either the vessel's hull-mounted transducer or the netsounder transducers). During the cruise, the netsounder system, which includes a constant tension cabl

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winch, was used with either an up/down or an up/down/forward-looking trawl headrope transducer unit. The latter has two forward-looking transducers which operate at 37.5 kHz. A cathode ray tube display (LAZ 45) was also used with the system. This display, which has a maximum range of only 32 fm (59 m) (except when it is set to operate with the forward-looking headrope transducers) is intended to be used primarily with the netsounder system. The LAZ 45 is the only display unit for the forward-looking transducers. Their outputs cannot be displayed on the paper recorder. Except to check that they were operational, the forward-looking transdueers were not used during the cruise.

METHODS

Midwater Trawling Tests

Three test hauls were made with the Herman Engel trawl in Chiniak Bay. One haul was unsatisfactory because of crossed cables. During the other two hauls, one of which was made with the tom weights, data were obtained on the trawl's depth and vertical mouth opening and the vessel's speed (pit log record) while the vessel was run at a constant propellor RPM (125), and the amount of main cable let out was varied from 26 to 110 fm (48 to 201 m).

A final test haul, which was approximately 7 hours in duration, was made during the first day of operation in the Bering Sea. The haul site was at depths exceeding 400 fm (731 m) in an area where there was essentially no midwater echo sign. An attempt was made to obtain information on the trawl's depth and vertical mouth opening and its response to changes in vessel speed, while being towed with 450, 250, and 150 fm (822, 457, and 274 m) of cable.

Echosounder/trawl survey

The original plan was to conduct most of the survey along a predetermined trackline in the area around the Pribilof Islands, with emphasis on the region north of St. Paul Island bounded by 57°20' - 58°00'N and 168°00' - 172°00'W. However, it was considered necessary to significantly alter this plan, primarily because of the almost complete lack of echo sign in the vicinity of the islands and the short time available for the survey. Also, no fishing vessels were sighted in the area, few marine birds and mammals were observed, and sea conditions were generally very poor.

The survey trackline was shifted in order to follow the edge of the ice pack, since it was believed concentrations of fish, particularly herring, might be found near it. The ice was eventually located about 130 miles north of St. Paul and subsequently the survey progressed southwest adjacent to it as far as the upper continental slope northwest of the Pribilofs. The survey then continued to the southeast along the upper slope/outer shelf region, between approximately the 80- and 150-fm (146 and 274 m) isobaths, until it was necessary to terminate operations about 100 miles northwest of Unimak Pass (Figure 1).

The collection of echo sounder data began when the vessel entered the Beri Sea at Unimak Pass. It continued around-the-clock except when the vessel was weather-bound. Because of weather/time limitations and the initial lack of success in locating fish sign, plans to conduct the basic survey only during daylight hours and to study diel changes in the vertical distribution, density and availability of herring and pollock aggregations were abandoned.

The echo sounder's receiver gain, pulse length and other control settings were standardized, and changed only occasionally. Although the sounder could not be calibrated prior to the survey, there was no indication that its parameters were significantly different from the nominal values specified by the manufacturer. Its performance appeared to be entirely satisfactory for the schooled fish detection requirements of the survey.

Midwater trawl hauls were made to identify selected aggregations of echo sign and one bottom haul was made in an attempt to determine the target species of a fleet of Japanese stern trawlers fishing in leads in the ice pack. The weight by species was determined for each catch. Length composition was determined for most fish species in each catch using either the total number of specimens or a random sample. Pollock were sampled for sex, length, and maturity data, and for otoliths and stomach contents. XBT drops were made at most trawl stations.

RESULTS

Tests with Herman Engel Trawl

The results of the two test hauls made with the Herman Engel trawl in Chiniak Bay indicated that the tom weights hung to the lower dandylines generally caused a significant increase in the vertical mouth opening of the trawl. The following data were recorded:

Haul 1 (without tom weights)

Cable Out (fm)	Cable Out (m)	Ship's speed (knots) (pit log)	Headrope Depth (fm)	Headrope Depth (m)	Vertical Mouth Opening Indicated by Netsounder (fm)	Vertical Mouth Opening Indicated by Netsounder (m)
30	55	3.3	12	22	10	18
60	110	3.2	23	42	10	18
90	165	3.0	42	77	10	18

Haul 2 (with tom weights)

26	48	3.4	15	27	5	9
50	91	3.2	27	49	15	27
75	137	3.2	36	66	16	29
90	165	-	39	71	13	24
100	183	3.1	49	90	13	24
110	201	3.0	52	95	13	24

After both hauls some webbing was found torn along the footrope where the trawl has cross-mesh tapers. This same type of damage occurred during the initial hauls made with the trawl in Puget Sound. The exact reason for this problem has not yet been determined.

During the one long test haul made in the Bering Sea (Haul No. 155, Table 1), the trawl was towed at speeds as high as approximately 6.5 knots, and was extensively damaged. Between the wings and the codend the webbing was almost completely torn off the riblines and the two lower riblines (2 cm nylon rope) had parted. As indicated above, this damange was not due to contact with the bottom and, since sign was not significant on the net-sounder or echo sounder records, it is improbable that it could have been caused by an unusually large catch of fish or other organisms. The trawl was towed at speeds greater than 5.0 knots during the last hour of the haul. This may have put excessive strain on the webbing, particularly if there were any errors in the hanging of the trawl. However, it seems unlikely that the higher speed towing by itself would have caused the riblines to break. Isolating the reason(s) for the trawl damage is expected to be difficult. However, it will be possible to make a detailed examination of both the damaged trawl and an unused duplicate of it.

Since the time at which the damage occurred is unknown, all data on the trawl's performance during the haul are questionable. However, it is worth noting that at the start of the haul, with 450 fm (823 m) of cable out, the trawl was towed at depths ranging from 225 to 135 fm (411 to 247 m) at speeds ranging from approximately 3.0 to 3.5 knots, and the vertical mouth opening of the trawl varied from 11 to 14 fms (20-26 m).

The tests with the Engel trawl were especially important in demonstrating that, except when towing at very slow speeds, the vessel is not capable of retrieving the trawl without having it sink below the target depth. This capability is absolutely essential, particularly when making near-bottom midwater hauls. Smaller trawls will have to be utilized until adequate trawl winches and auxiliary power are available, and the tendency of the vessel's main engine to overheat at trawling speeds above approximately 4.0 knots can be corrected. The latter problem might be significantly reduced by replacing the present speed-type propellor with a towing type.

The method used to handle and attach the tom weights when the trawl was being set, which required using the vessel's cranes and manual shifting of the weights, was cumbersome and potentially hazardous. Alternative methods of handling the weights, and the possible use of other types of weights are now being considered. It was apparent, because of the problem with the weights, and other factors, that the time required to set the gear was excessively long. The interval from the start of a set until the doors were in the water was typically 25-30 minutes. On this particular cruise, the slowness of the setting procedure was further aggravated by the fact that one of the main trawl winches had a defective clutch and it was necessary to let the cable out under power. Another problem encountered with the winches was the formation of ice in the lines of

the air control system during a haul when the air temperature was near 0°F. Retrieval of the trawl was delayed for a long period while steam lines and an acetylene torch were used to thaw the ice. Modifications to the air control system will be necessary if trawling is to be conducted during severe winter weather.

The netsounder system operated satisfactorily and furnished an excellent record in both the up and down-looking modes. The latter was usually used except when the gear was being set and retrieved. During some hauls the cable broke, or became disconnected from the headrope unit. However, this usually occurred during the latter part of the retrieval process and did not significantly hinder trawling operations. Also, the cable breaks were quite readily repaired.

It was apparent that a netsounder recorder should be installed in the trawl house. When the officer-in-charge of the trawl house is controlling the vessel during fishing operations he should not have to communicate with the bridge to determine the position of the net relative to the bottom and the target echo sign. Direct observations of the netsounder recorder by whoever is controlling the vessel is particularly important when fishing near bottom and on small aggregations of fish.

Echosounder/trawl survey

The echo sounder survey trackline which, as indicated above, was significantly different than that originally planned, was approximately 880 nautical miles long (Figure 1). Trawl catch and biological sampling data are summarized in Tables 1 and 2. Only three hauls (Nos. 156, 158 and 159) were made to identify echo sign.

Except for the infrequent occurrence of small, low-density echo traces, which it was impractical to sample, essentially no echo sign was observed on the section of trackline between Unimak Pass and the edge of the ice pack. Even though the survey coverage was not intensive, the absence of midwater fish sign was surprising, especially since between Unimak Pass and the Pribilof Islands the trackline followed and crossed the 80-200 fm (146-366 m) depth zone where winter concentrations of adult pollock were expected to occur.

The low abundance of echo sign persisted while running southwest along the drift ice to the edge of the shelf northwest of the Pribilofs. However, some scattered traces of sign were observed at night within 20 fms (37 m) of the surface and a trawl haul (No. 156) in this sign caught minor quantities of capelin, juvenile pollock, juvenile Greenland turbot, jellyfish and amphipods. It was expected that herring would be encountered along the ice, but there were no indications that they, or other schooling pelagic fishes were present. A special effort was made to observe the activities of a fleet of at least eight Japanese stern trawlers fishing in leads in the drift ice at 58°33'N, 173°27'W. No fish echo sign was detected in the vicinity of the vessel. Close-up observation of several of the vessels showed they were not using netsounders and were apparently fishing only on bottom. One bottom haul

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No. 157) made in the fishing area was unsuccessful in indicating the fishery's target species.

Significant fish echo sign was first encountered near the location of haul No. 158 (57°15'N, 173°47'W) after the survey had begun to progress southeast to cover the outer shelf/upper slope region west and southwest of the Pribilofs. Between the location of haul No. 158 and that of haul No. 159 (57°30'N, 168°40'W) dense on and off bottom concentrations of echo sign were intermittently detected. The largest aggregations, which were semi-continuous layers several miles in length, were those fished during haul Nos. 158 and 159. It is likely that most of the echo sign was pollock. Both hauls caught only that species (primarily 2- and 3-year old fish) and the type of sign was quite consistent throughout the area. Also, a large Japanese stern trawler was closely observed while completing a bottom trawl haul in the area at 56°24'N, 172°49'W. Its catch, which was roughly estimated to be between 25 and 40 metric tons, appeared to be almost entirely small pollock. Unfortunately, no time was available to further investigate the areal extent, behavior and composition of the fish sign detected. However, it was apparent the total biomass of fish detected in the area was significant.

The abundance of echo sign encountered on most of the trackline was significantly less than had been anticipated. However, this result should probably not be considered too unusual given the minimal amount of survey effort relative to the size of the area of interest. Possibly the apparent lack of fish in the Pribilof Island area was related to the warmer-than-average water temperatures and the earlier-than-normal retreat of the ice pack.

It was of interest to note that in the area where pollock were caught there was a notable lack of diversity in the type of echo sign detected. This was undoubtedly partially due to the time of year the survey was conducted, but also suggests, as expected, that all but a relatively small fraction of the total biomass of semi-pelagic species of fish is pollock.

The most unexpected result of the survey was the complete absence of any indication of herring aggregations. It was a further indication of the need to conduct a substantial exploratory survey effort during the initial stage of any pelagic fish assessment program in the eastern Bering Sea.

Scientific Personnel

March 12-26	Martin Nelson, Chief Scientist	NWAFC
"	Jimmie Traynor, Fishery Biologist	"
"	Gary Smith, Oceanographer	"
"	James Mason, Fishery Biologist	"
"	Karl Niggol, Fishery Biologist	"
"	Charles Cetak, Fishery Technician	"

For further information, contact Dr. Murray L. Hayes, Division Director, Division of Resource Assessment and Consevation Engineering, Northwest and Alaska Fisheries Center, National Marine Fisheries Service, 2725 Montlake Boulevard East, Seattle, Washington 98112.

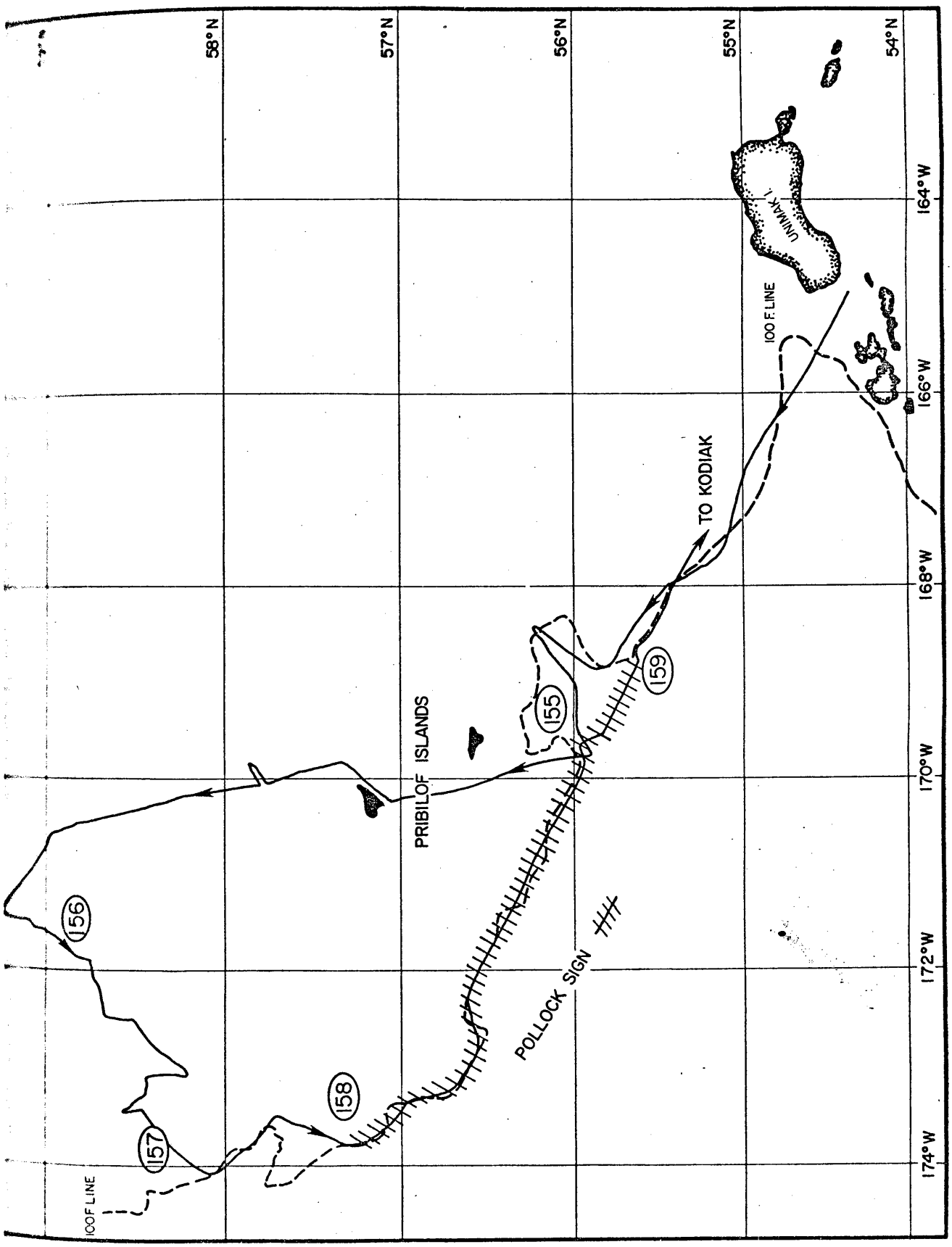

Figure 1. Echo sounder survey trackline and trawl haul locations (circled numbers).

TABLE 1. TRAWL HAUL SUMMARY

Haul No.	Position N. Latitude W. Longitude	Gear Type1/	Haul Type2/	Duration (Hours)	Depth (fms)3/ Bottom	Depth (fms)3/ Gear	Catch Species	Catch Wt. (lbs)	Remarks
155	56°03' 168°52'	H	M	6.7	500+	various	Pollock	26.0	Trawl severely torn dur stepped oblique test haul; towing depth rang from 240 to 30 fm; traw was towed at several speeds with each of 450 250 and 150 fm. cable.
							Sandfish	1.0	
							Lanternfish	0.1	
							Squid	17.1	
156	58°58' 171°36'	U	M	1.7	48	7	Pollock	0.1	Near surface haul made night along edge of dri ice; trawl winches froz and had to be thawed before gear could be retrieved.
							Capelin	1.0	
							Greenland turbot	1.0	
							Snailfish	0.1	
							Amphipods	2.0	
							Jellyfish	180.0	
157	58°33' 173°27'	U	B	0.3	70	70	Pollock	11.9	Haul made in lead in ic among Japanese stern trawlers apparently fishing on bottom.
							Greenland turbot	4.0	
							Snails	19.5	
							Tanner Crab	6.5	
							Hermit Crab	5.4	
							Jellyfish	5.0	
							Misc. fish & Invertebrates	2.6	
158	57°15' 173°47'	U	M	0.6	110	100	Pollock	4100.0	----------
159	55°39' 168°40'	U	M	1.0	115	102	Pollock	584.0	Codend puckering string partially untied; net-sounder record and fish seen spilling from net : dicated bulk of catch

TABLE 2. BIOLOGICAL DATA AND SAMPLE SUMMARY BY TRAWL HAUL (see TABLE 1. for catch data).

Pollock				Greenland turbot	Capelin

	173°47'								
159	55°39' 168°40'	U	M	1.0	115	102	Pollock	584.0	Codend puckering string partially untied; net-sounder record and fish seen spilling from net

TABLE 2. BIOLOGICAL DATA AND SAMPLE SUMMARY BY TRAWL HAUL (see TABLE 1. for catch data

	Pollock						Greenland turbot		Capelin		
Haul No.	Length No. Meas.	Length Range (cm)	Otoliths	Stomachs	Maturity	Whole Fish[1/]	Length No. Meas.	Length Range (cm)	Length No. Meas.	Length Range (cm)	Misc. Whole Specimen Samples[1/]
155	23	44-52	-	-	23	20	60	8-12			Squid
156	5	9-11	5	5	-	-	-	-	67	6-14	Amphipods
157	191	11-23	145	20	-	30	-	-	-	-	Snails, sculpins, poachers, and snailfish
158	167	18-33	160	20	-	20	-	-	-	-	-
159	190	17-43	-	20	190	20	-	-	-	-	-
Total	576		310	65	213	90					

1/ specimens preserved for taxonomic studies