

CRUISE RESULTS AND OBSERVATIONS  
DURING THE 1977 COOPERATION USA -  
JAPANESE SUMMER SQUID SURVEY

by

EDGAR W. BOWMAN  
and  
RALPH MAYO

National Marine Fisheries Service  
Northeast Fisheries Center  
Woods Hole, Massachusetts  
Laboratory Reference No. 77-25  
13 October 1977

## TABLE OF CONTENTS

	PAGE
INTRODUCTION.....	1
CRUISE PERIOD AND AREA.....	2
PART I.....	2
PART II.....	2
RESEARCH OBJECTIVES.....	2
OPERATIONS AND PROCEEDURES.....	2
RESEARCH RESULTS.....	3
BOTTOM TRAWL SURVEY.....	3
MIDWATER TRAWLING.....	5
OBSERVATIONS.....	7

### TABLES

1.	Catch results from 112, 30-minute bottom tows in water depths 100 meters and greater, conducted within the USA CMZ in the mid and Northeast Atlantic areas.....	4
2.	Catch results from 52 midwater tows in water depths from 120 to 320 meters in the Mid-Northwest Atlantic.....	6

### APPENDIX FIGURES

1.	Position of 120 proposed randomly preselected survey stations.....	8
2.	Japanese bottom trawl used during PART I of squid survey.....	9
3.	Japanese bottom trawl doors.....	10
4.	Bottom trawl and door hookup.....	11
5.	Japanese midwater trawl used during PART II of joint research.....	12
6.	Midwater trawl doors.....	13
7.	Midwater trawl and door hookup .....	14
8.	Schematic of midwater trawling arrangement.....	15
9.	Schematic of bottom trawl fished off bottom utilizing midwater doors and hanging chains.....	16

CRUISE RESULTS AND OBSERVATIONS DURING  
THE 1977 COOPERATIVE USA - JAPANESE SUMMER  
SQUID SURVEY

by

Edgar W. Bowman  
and  
Ralph Mayo

National Marine Fisheries Service  
Woods Hole, Massachusetts

INTRODUCTION

Both the longfin (*Loligo*) and shortfin (*Illex*) squid have been traditionally harvested by the Japanese throughout the New England and Middle Atlantic areas of the Northwest Atlantic Ocean. Under the Fishery Conservation and Management Act of 1976 (P.L. 94-265), the Japanese as well as other foreign countries have been limited in their fishing activities by quotas with time and place (windows) limitations. In talks during the Spring of 1977, representatives of the Japanese fishing industry expressed their desire to have the opportunity to demonstrate their ability to harvest squid with only a minimum bycatch of other species using midwater gear. Similarly, officials of the National Marine Fisheries Service (NMFS) emphasized the need to collect real time stock assessment data for the purpose of formulating fisheries management plans. It was then agreed that the Japanese fishing company, Nippon Suisan Kaisha, Limited, would provide the vessel SUZUKA MARU, a 2,529 GRT stern trawler, a 45 man crew, and a scientist to participate in a cooperative summer squid survey. The NMFS agreed to develop a survey plan and provide four scientists from the Northeast Fisheries Center to participate in the two part cruise. In addition, the NMFS arranged to have one fishing industry representative aboard the vessel during each part of the cruise to observe and evaluate overall operations. This document summarizes both Part I (squid survey) and Part II (midwater trawling) of the cruise and presents the preliminary results obtained.

## CRUISE PERIOD AND AREA

Survey activities were conducted from the southeastern part of Georges Bank to waters east of Ocean City, Maryland during the period July 19 to August 8, 1977.

### Part I

R/V SUZUKA MARU arrived in Woods Hole on 19 July, boarded NEFC scientists, an industry observer, and equipment, and departed prior to noon the same day. Bottom trawl survey operations were initiated on the southeastern part of Georges Bank and terminated in the area east of Hudson Canyon on 27 July.

### Part II

The vessel returned to Woods Hole on 28 July to exchange NEFC scientists and observers and departed the same day to continue survey operations. The final randomly preselected bottom survey station, completed on 31 July, was located approximately 85 mi east of Ocean City, Maryland. The remainder of the cruise was devoted to midwater trawling activities in waters off the Middle-Atlantic States. The SUZUKA MARU returned to Woods Hole of 8 August to terminate cruise activities.

## RESEARCH OBJECTIVES

The objectives of this cruise were to: (1) investigate the abundance of longfin (Loligo) and shortfin (Illex) squid on offshore fishing grounds; (2) determine the by-catch associated with catches of squid; (3) investigate the feeding habits of shortfin squid at the time of the survey; and (4) acquaint NEFC scientists and observers with the Japanese midwater squid fishing operation.

## OPERATIONS AND PROCEDURES

At 112 of the original 120 proposed randomly preselected stations (Figure 1) a 30-min trawl tow was made using a Japanese bottom trawl, doors and hookup (Appendix figures 2, 3, and 4 ) at a vessel speed of 3.5 knots. Catches from each station were processed according to standard bottom trawl survey techniques. Data on each species, including total weight and length frequencies, were recorded on groundfish survey logs. Length measurements were made to the nearest whole centimeter and weights were recorded in kilograms. Unusual or unidentified specimens were preserved and retained for future reference.

At the conclusion of the bottom trawl survey activities, 51, 60-min tows (and one, 100-min tow) were completed using Japanese midwater gear (Appendix figures 5-8) in water depths of 100-320 m (55-175 fathoms) off the Middle-Atlantic States. All catches were processed in the same manner as previously described.

## RESEARCH RESULTS

### Bottom Trawl Survey

Due to the heavy concentration of "set" lobster gear throughout the survey area, only 112 of the 120 proposed stations could be occupied with any degree of confidence that fixed gear would not be encountered. Of those stations completed, the position of many had to be altered somewhat to avoid gear conflicts while the remaining eight stations had to be abandoned entirely. On several occasions tows were terminated early due to the presence of fixed gear not previously detected.

The collective catch for the 112 stations occupied was 69,134.2 kg and was represented by 38 species of finfish and invertebrates (Table 1). Of the total weight of all species, Illex (shortfin squid) contributed 67,404.5 kg or 97.50 percent of the total; four other species (spiny dogfish, silver hake, butterfish and goosefish) accounted for 1.72 percent; and the remaining 33 species only made up 0.78 percent of the total. In addition to the 38 species which were weighed, 10 hammerhead sharks, 14 swordfish, and 1 blue shark were taken but not weighed. These species were removed from the cod end of the trawl "topside" before discharging the remaining portion of the catch to the processing area below. Every attempt was made to return these animals to the sea unharmed in the shortest time possible. With the exception of one swordfish that weighed about 4 kg, other swordfish taken in the bottom trawl were estimated to range between 40 and 50 kg each.

Butterfish were present in 27 of the 112 tows; the largest catches were 80 and 69 kg with the majority of the remaining tows each producing catches of less than 10 kg. In addition to Illex, silver hake and spiny dogfish were taken in about 50 percent of the tows completed, but contributed only 1.08 percent to the weight of the cumulative total catch.

Table 1. Catch results from 112, 30-minute bottom tows in water depths 100 meters and greater, conducted within the USA CMZ in the Mid- and Northwest Atlantic areas.

Species	Total Catch (kg)	No. of tows in which species occurred
<u>Illex</u>	67,404.5	110
Spiny dogfish	446.2	51
Silver hake	300.7	59
Butterfish	276.1	27
Goosefish	169.1	23
American lobster	91.7	35
Offshore hake	85.8	5
Red crab	73.5	22
Redfish	52.7	33
White hake	46.0	16
Fourspot flounder	42.6	39
Red hake	37.4	17
Jonah crab	28.0	36
Spotted hake	23.8	20
Big skate	11.0	7
Blackbelly rosefish	10.0	9
Little skate	4.9	4
Witch flounder	3.8	9
Armored searobin	3.6	9
Tilefish	3.2	4
Marlin-spike	2.9	7
Cusk eel	2.9	18
Longfin hake	1.9	6
Leopard skate	1.8	5
Lady crab	1.6	7
Chain dogfish	1.3	3
Conger eel	1.3	4
Pollock	1.3	1
Sea raven	1.2	2
Thorny skate	1.1	3
Gulf Stream flounder	0.7	5
Pilotfish	0.6	3
Rock crab	0.6	2
Beardfish	0.3	2
Ocean pout	0.1	1
Unidentified batfish	<0.1	3
Unidentified lanternfish	<0.1	1
Unidentified toadfish	<0.1	2
Total <sup>a</sup>	69,134.2	

<sup>a</sup>In addition to the above species, 10 hammerhead sharks, 14 swordfish, and 1 blue shark were also taken during the course of the survey. While individual overall lengths were recorded, weights were not for fear of inflicting physical damage to the animals. All but one swordfish were successfully returned to the sea unharmed.

As previously mentioned, Illex accounted for 97.5 percent of the total catch (by weight). Three distinct size groups were noted, namely 15-16 cm, 18-19 cm, and 20-21 cm; infrequently were there more than a single size group found in an individual tow; few Illex less than 14 cm were taken during the survey. With few exceptions, the best catches (>1 metric ton) of Illex were made between 0630 and 2200 hours with considerably smaller catches taken at other times. A total of 377 Illex stomachs were taken during the cruise and an additional 250 whole specimens were frozen and returned to Woods Hole for future food habit studies.

The Japanese processed the squid according to size. Galvanized metal trays each weighing 2.5 kg and measuring about 10 cm in depth were packed with the smaller Illex (<17 cm) so that the net weight of the squid equaled 12.5 kg; larger squid (>17 cm) were packed so that the net weight equaled 10.5 kg.

### Midwater Trawling

Locations of the 52 midwater stations (the trawl was rigged to fish 1-2 m off the bottom) were selected by the vessel captain based on fishing fleet observations and echo traces at depths ranging from 120 to 320 m (66 to 175 fathoms). The area of operations was between Hudson and Wilmington Canyons with the heaviest concentration of stations centered around 38°43'N latitude and 73°05'W longitude. Out of a total catch of 90,668 kg, approximately 89,185 kg (98.4 percent) were Illex and 1,483 kg (1.6 percent) consisted of 35 other species, predominantly large pelagic fishes such as swordfish, hammerhead sharks, and ocean sunfish. The lengths of these individuals were measured on deck and the fish were immediately discarded in an attempt to return them to the sea in a viable condition. Consequently, all weights for these species are estimates. Benthic organisms (American lobster, jonah crab, rock crab, and red crab) equaled 28.4 kg. The remaining 28 species amounted to only 19.6 kg combined (Table 2). By-catch species which occurred in the greatest number of tows included blackbelly rosefish, American lobster, offshore hake, and swordfish.

Of the 52 completed off-bottom tows, 13 were set in water less than 183 m (100 fathoms), while 39 were in the commercial fishery restricted zone at depths greater than 183 m. Illex catches were 0-6,789 kg/hr at stations in the shallow zone, and 0-23,814 kg/tow in the deeper zone. The average catch was 16.5 kg/hr at the shallower stations (<183 m) and 2,281 kg/hr at the deeper stations within the restricted zone. The overall catch per tow of Illex at all midwater stations was 1,715 g.

Mantle length measurements of Illex ranged from 16 to 30 cm with the dominant modal length at 22 cm and a second less dominant mode around 25 cm. Approximately 300 specimens of Illex were frozen and returned to NEFC, Woods Hole, for analysis of stomach contents, sex ratio, and maturity stages.

Table 2. Catch results from 52 midwater tows in water depths from 120 to 320 meters in the Mid-Northwest Atlantic.

Species	Total Catch (kg)	No. of tows in which species occurred
<u>Illex</u>	89,184.9	43
Swordfish <sup>a</sup>	635.0	7
Hammerhead shark <sup>a</sup>	500.0	5
Ocean sunfish <sup>a</sup>	300.0	2
American lobster	22.4	8
Torpedo ray	4.5	1
Jonah crab	3.2	7
Red hake	3.0	2
Offshore hake	2.8	7
Spotted hake	2.4	5
Red crab	1.5	2
Rock crab	1.3	4
Goosefish	1.3	2
Cusk eel	1.0	4
Blackbelly rosefish	0.9	9
Gulf Stream flounder	0.4	4
Armored searobin	0.3	3
Atlantic hagfish	0.2	2
Unidentified greeneye	0.2	6
Pilotfish	0.2	1
Conger eel	0.1	1
Portunid crab	0.1	2
Remora	<0.1	1
Longspine snipefish	<0.1	1
Atlantic argentine	<0.1	1
Unidentified lanternfish	<0.1	2
Unidentified hatchetfish	<0.1	3
Unidentified viperfish	<0.1	2
Planehead filefish	<0.1	2
Yellow jack	<0.1	1
Beardfish	<0.1	1
Unidentified squid #1 <sup>b</sup>	<0.1	1
Unidentified squid #2 <sup>b</sup>	<0.1	1
Unidentified fish #1 <sup>b</sup>	<0.1	1
Unidentified fish #2 <sup>b</sup>	<0.1	1
Unidentified fish #3 <sup>b</sup>	<0.1	1
Total	90,668.0	

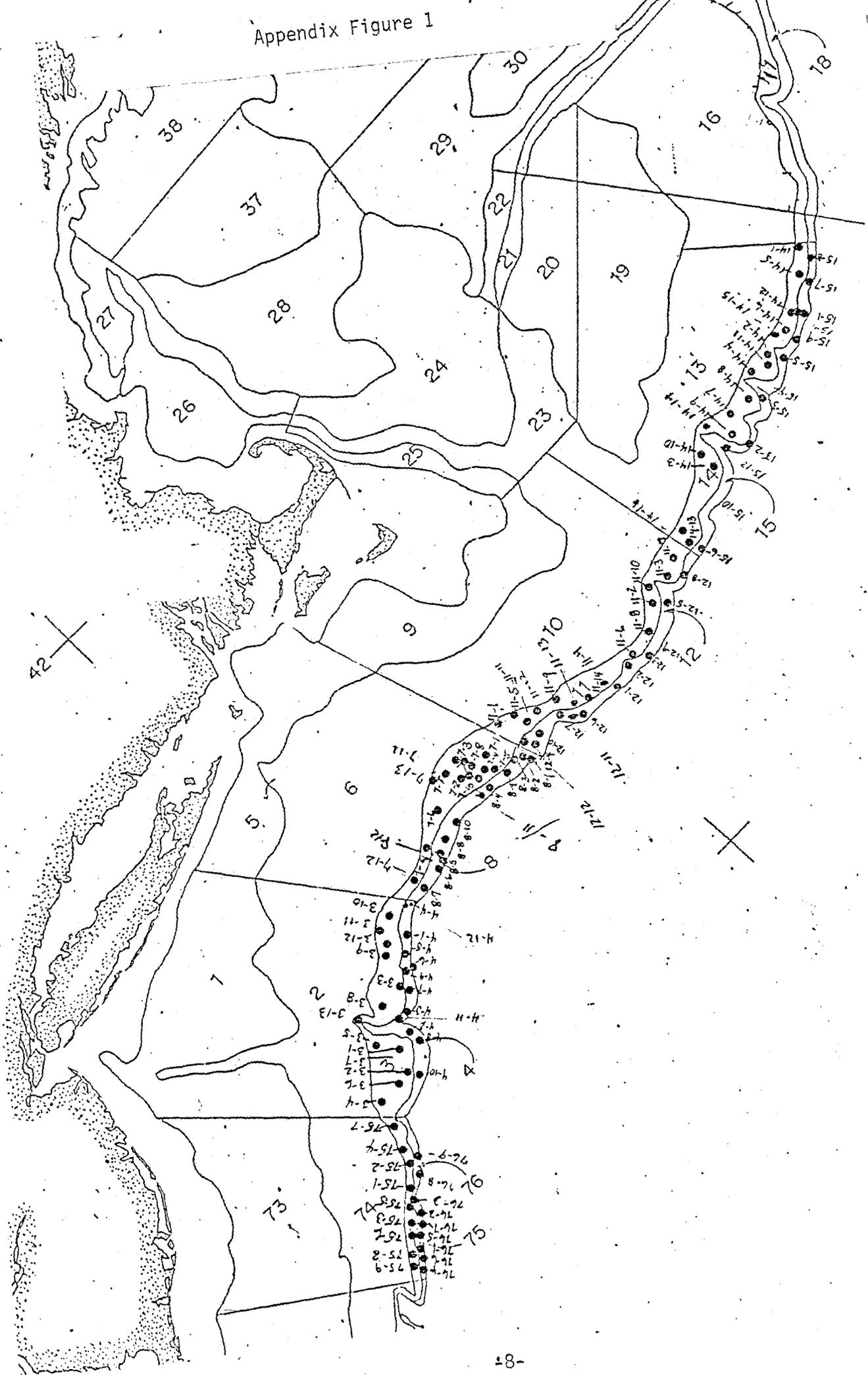
<sup>a</sup>Weights of these species are estimates only.

<sup>b</sup>Preserved and returned to NEFC, Woods Hole, for identification.

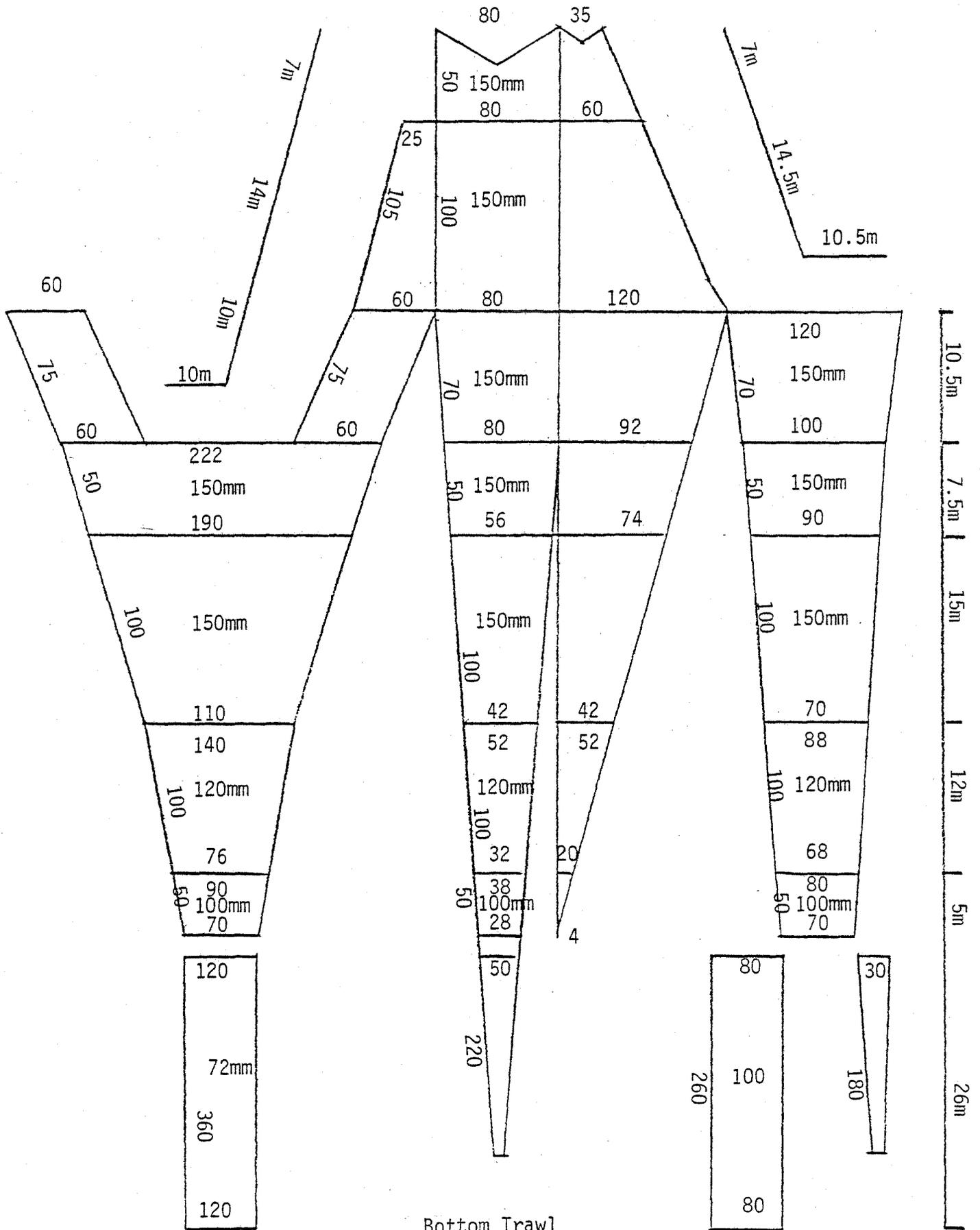
## OBSERVATIONS

1. Heavy concentrations of "set" lobster gear were noted throughout the entire bottom trawl survey area in water depths ranging from 100 to 300 m (55-165 fathoms).
2. Based on up-to-date reports by the U.S. Coast Guard on the positions of fixed gear, and on the amount of gear actually observed, it would be optimistic to assume that more than 30 to 40 percent of the "set" gear had been reported.
3. For the most part, fixed gear observed on the eastern end of the survey area was adequately marked with buoys and staff-pennant-radar reflector combinations. However, as the cruise progressed westward much of the "set" gear observed was inadequately marked in several ways: (1) a buoy only at one end of the trawl; (2) a short staff ( $\pm$  5 ft) with a small pennant and radar reflector or without a radar reflector altogether; and (3) simply the use of 1-gal plastic chlorox bottles. It was noted that in only a mild breeze, much of this makeshift gear was difficult to spot visually during daylight hours not to mention the problems experienced during hours of darkness.
4. During the bottom trawl survey for squid, the by-catch of other species was minimal.
5. In the future, the use of a wide sling and the ship's boom to lower large fish (e.g., swordfish) back to the sea may increase chances of survival rather than merely sliding them down the stern ramp.
6. The Japanese were very cooperative, energetic, and enthusiastic about the survey and often expressed the hope that such cooperative squid research would continue.
7. Catch rates at the midwater stations within the restricted fishing zone were considerably higher than those in the nonrestricted zone (<183 m or 100 fathoms).

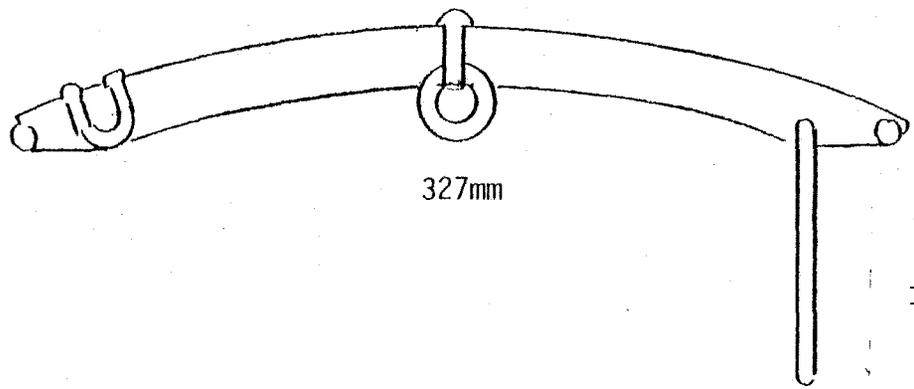
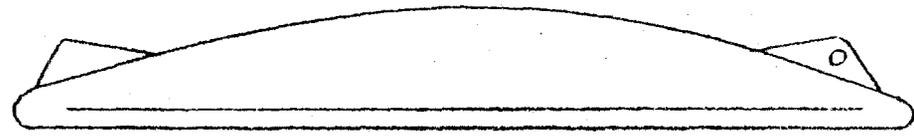
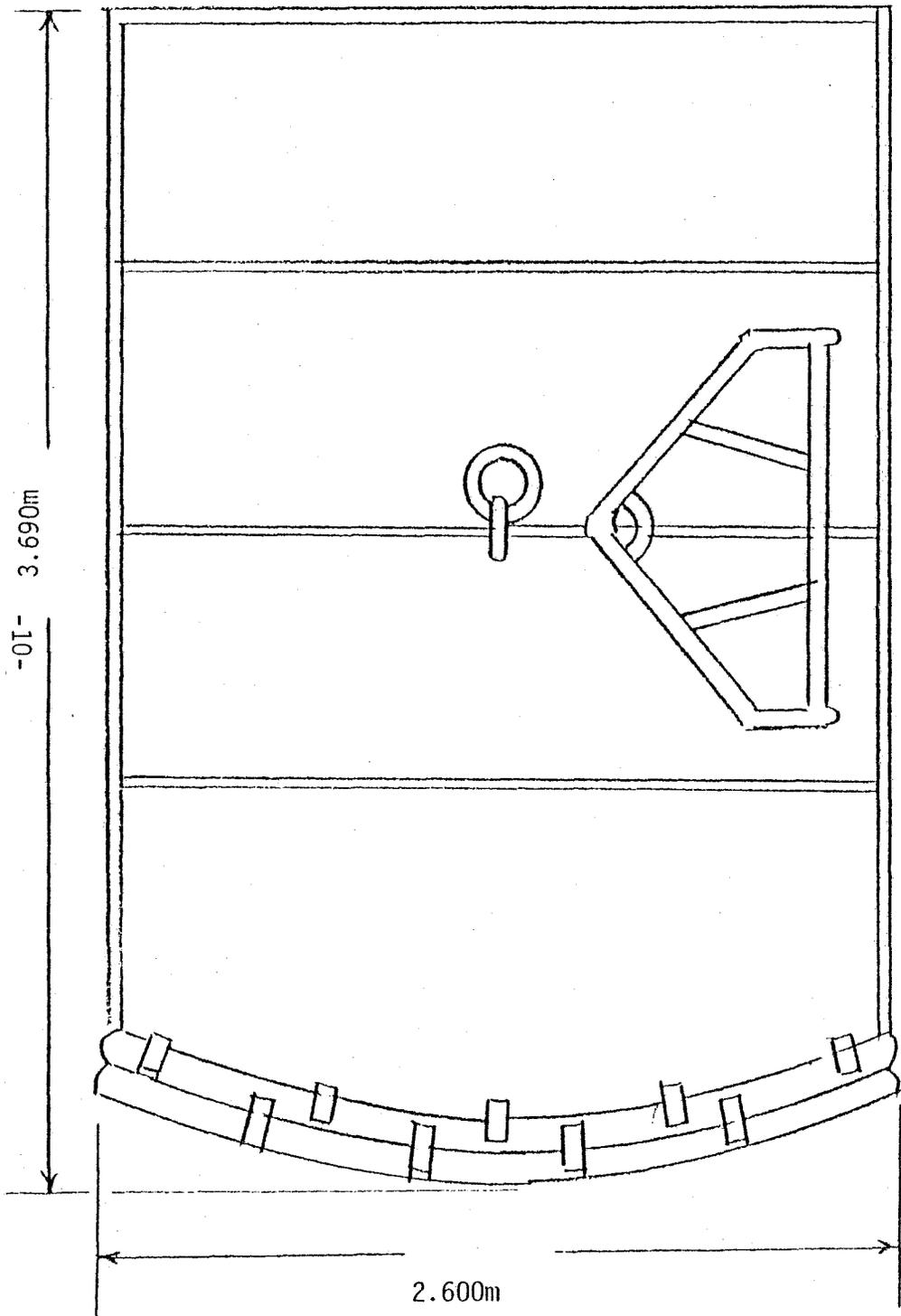
Appendix Figure 1



Appendix Figure 2. Japanese Bottom Trawl used during Part I of Squid Survey.

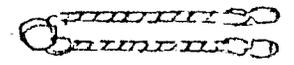
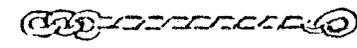


Note cod end same as on bottom trawl.

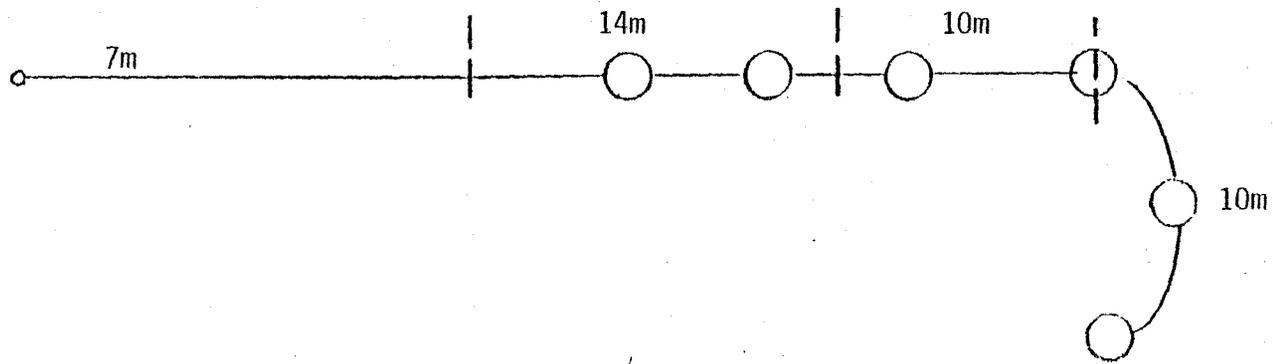
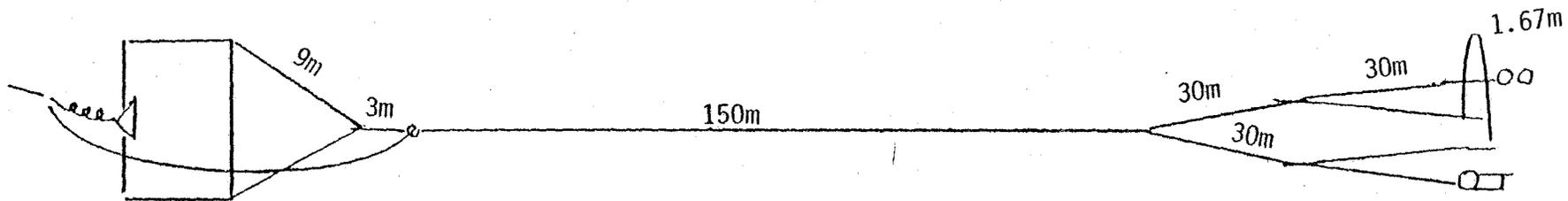


L = 1.472m

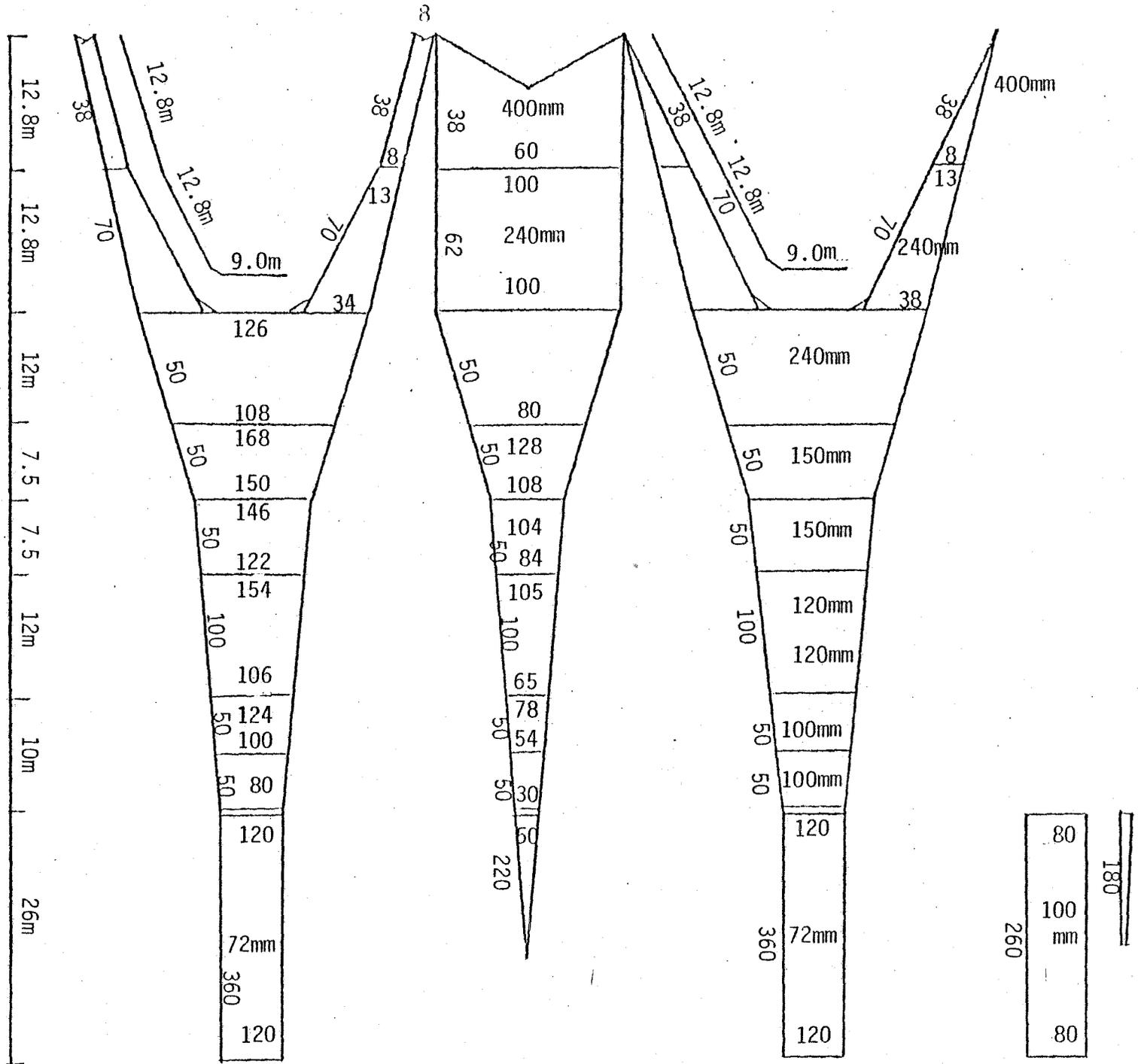
L = 1.900m



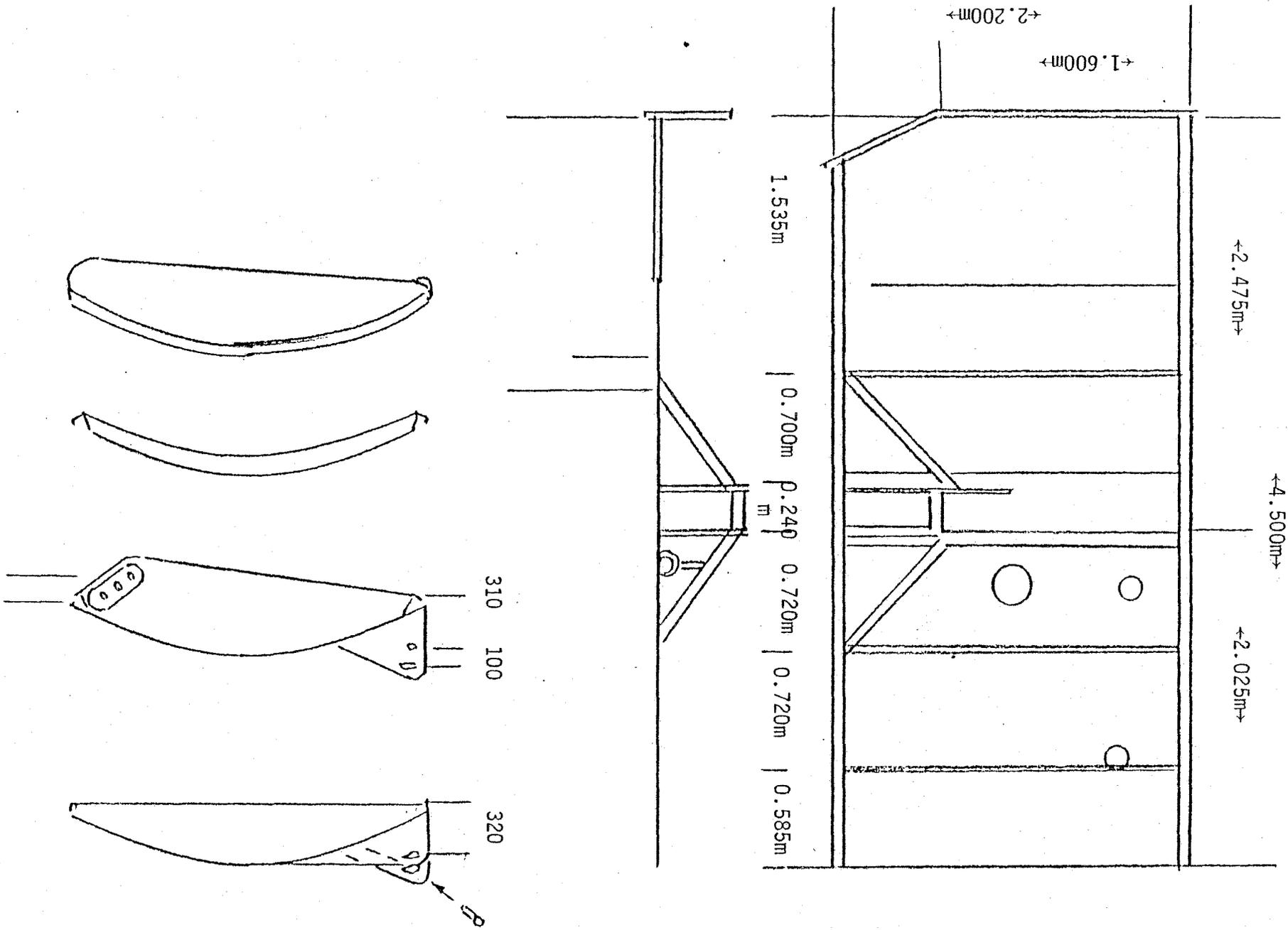
Bottom trawl door



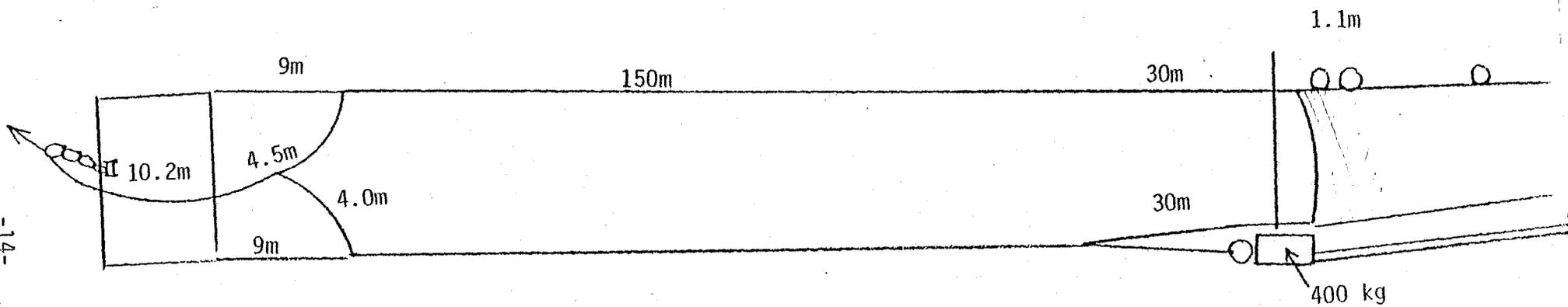
52.7.20 Bottom trawl--door hookup



Midwater trawl

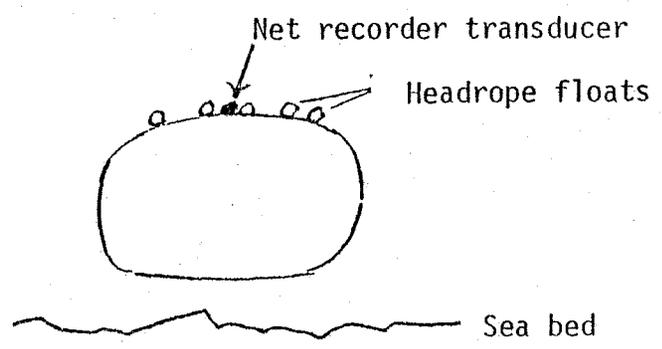
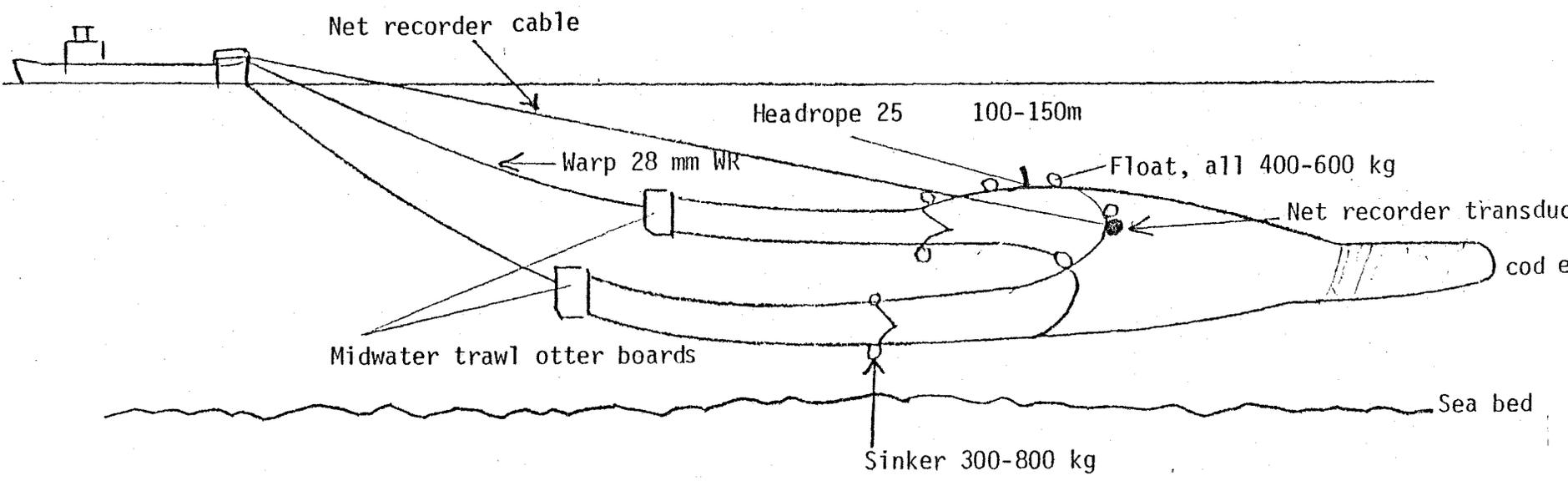


Midwater trawl door

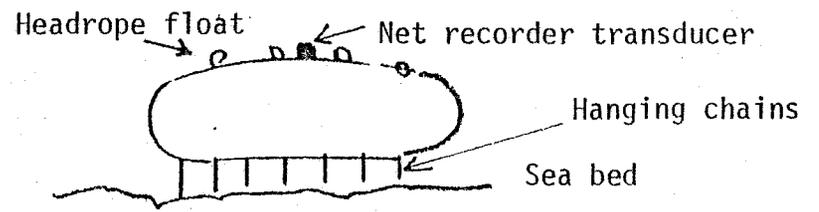
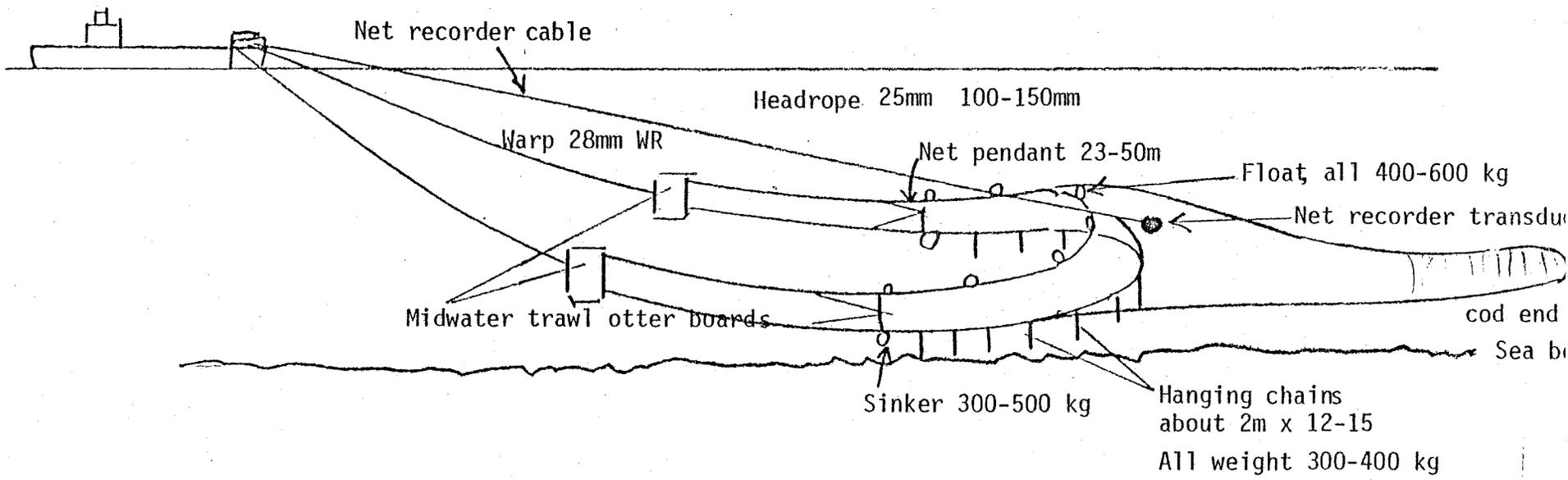


Appendix Figure 7.

Midwater trawl--door hookup



Midwater trawl



Bottom trawl fished off-bottom