Canadian West Coast Flying Squid Experimental Fishery

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ABSTRACT

Bernard, F. 1981. Canadian west coast flying squid experimental fishery. Can. Ind. Re. Fish. Aquat. Sci. 122: 23 p.

This report covers the experimental drift net fishery for the flying squid Ommastrephes bartramii (Lesuer) on the high seas off the west coast of Vancouver Island in the summer of 1980. Catches were commercial, but development of a fishery is not imminent because of a lack of suitable large vessels and shore-based processing facilities. Further constraints are the large amount of manpower required to run gear and process catch and the volatile prices and deman for squid.

Key words: Squid, fishery, drift net, west coast.

RÉSUMÉ

Bernard, F.R. 1981. Canadian west coast flying squid experimental fishery. Can. Ind. Rep. Fish. Aquat. Sci. 122: 23 p.

Le présent rapport traite de la pêche expérimentale au filet dérivant du calmar Ommastrephes bartramii (Lesuer) en haute mer, au large de la côte ouest de l'Île Vancouver à l'été 1980. Le calmar a été capturé par des pêcheurs commerciaux, mais l'essor de cette pêche n'est pas imminent par suite de l'absence de bateaux suffisamment grands et d'installations de traitement à terre. Au nombre des autres limites figurent la main-d'oeuvre considérable nécessaire pour manier les engins et traiter les prises et les fluctuations extrêmes des prix du calmar et de la demande.

Mots clés: Calmar, pêche, filet dérivant, côte ouest.

Catches of flying squid (Ommastrephes bartramii Lesuer) taken during a trial net fishery off the west coast of Vancouver Island in the summer of 1980 show that commercial aggregations of this species occur within the 200-mile Canadian Extended Jurisdiction Zone. However, absence on the Pacific coast of suitable large vessels, together with current high squid inventories and consequent low prices, make it unlikely that a fishery can develop in the near future. Squid are available in most of the world oceans and may be fished by nations with lower fishing costs than Canada. The average price for squid has more than doubled in recent years, but aggressive development of new fishing grounds, especially on the east coast of Canada, together with a recent high harvest near Japan, has depressed demand.

In 1979, two Japanese squid vessels in collaboration with the west coast fishing industry and the Department, undertook some preliminary exploratory squid fishing off the west coast of Vancouver Island. Small catches only were obtained due to the lateness of the season (October), but indications were excellent that earlier in the year good catches might be obtained.[3] In 1980 the operation was repeated using the TENYU MARU NO. 37 and the TOMI MARU NO. 88 of the Japanese Longliners Association under an agreement between the governments of Japan and Canada. During July and August, good catches were obtained despite the poor influx of warm waters into the 200-mile Extended Jurisdiction Zone.

The flying squid is widely distributed in the warm and temperate seas of the world and is present throughout the Central and North Pacific (Fig. 1) and is extensively fished in the northeastern Pacific.[16] It reproduces in tropical latitudes[11] and moves into cooler boreal waters while feeding along thermal fronts.[13] Rapid growth occurs during this migration and sexual maturity is attained in eighteen months or less. Flying squid are active swimmers, frequenting surface waters at night, but plunging to 400 m or more during daylight. At the surface they occur in schools of a few dozen to several hundred individuals. On occasion they leap out of the water and may land on the deck of the ship, giving rise to the name "flying squid."

Flying squid are voracious feeders to maintain their extremely rapid growth rate. Analysis of stomach contents made in 1980 of 200 specimens taken off Vanvouver Island revealed that fish is the chief prey and there is evidence of cannibalism, though this may be the result of fishing activities. The most abundant remains found was mycophids (lanternfish), followed by Cololabris saura (saury), less frequent were small epipelagic squid belonging to the genus Abraliopsis and remains of euphausiids were rarely present. The squid are in turn taken by large fish such as tuna, and by sea mammals such as sperm whales.[4]

The squid are captured by drift nets which essentially are monofilament gill nets. The net is made up of individual 50 m panels (Fig. 4) strung together to make one long run. Due to the relative sparsity of squid in the open ocean, extremely long nets must be used. The Japanese consider 15 kilometers a minimum commercial set and frequently set 35-45 kilometers.

With a 50 m vessel and 30 man crew, the Japanese consider the break-even catch to be about 5 tonnes. As various lengths of net are used, depending on local conditions and state of repair of the panels, it is convenient to compare catches using an efficiency index obtained by dividing catch (kg) by net length (km). Using the five tonnes commercial catch and 15 km net, the break-even point is equivalent to 333 kg/km net. It will be noticed that the fishing tests made across the North Pacific during transit from Japan to Canada (Fig. 2) resulted in a majority of commercial hauls (Table 5) and a small standard deviation between catches. The results in the Canadian Extended Jurisdiction Zone are much more variable (TENU MARU $\bar{X}$ 326, SD 125; TOMI MARU $\bar{X}$ 166, SD 73), but include some high concentrations (532) equal to the best encountered in the traditional western Pacific fishing grounds (Tables 3, 4). This indicates that populations are more clustered closer to shore, probably reflecting the more complex thermal regimes.

The drift nets may be set on the surface using the intrinsic float line, or additional weights may be attached to the leadlines and the entire net sunk up to 10 m below the surface while buoyed by plastic floats attached to the float line on long tethers. This system may be used to avoid capture of near-surface fish or to avoid dense surface schools of jelly fish which could foul the net. The swimming squid encounter the net with their tentacles and become entwined while attempting to force a passage through the net. The squid then attempt to perform their normal backwards jetting escape response which results in forcing the heart-shaped fins through the net mesh and trapping the animal.

By-catch is low in properly placed nets (Tables 1,2). The most common by-catch is the pomfret (*Brama japonica*), followed by the blue shark (*Prionace glauca*). The latter, together with the salmon shark (*Lamna ditropis*) are trapped while feeding on the squid and greatly increase in number during daylight, so the nets are pulled as soon as possible after dawn to minimise loss to sharks. Over 81% of the catch consisted of squid (Table 2), but it is possible that in certain years yellowfin tuna could be caught in larger numbers. Of particular interest in 1980 were several additional specimens of the yellowtail (*Seriola dorsalis*) and the first record off the west coast of the shark *Isurus glaucus* (Müller and Heule) represented by a 2.2 m specimen. By-catch is principally influenced by water temperature and nets are set by running surface temperature profiles during the day prior to setting the net. In water above 15°C increasing tuna will be caught and there is a high risk of encountering large schools of jellyfish which will foul the net and actively discourage the presence of squid. Below 13°, salmon will be caught as the genus actively avoids warm water.[9,10] The ideal temperature is 14.5°C and the net is set across a thermal discontinuity, preferably in the lower isotherm. An acceptable operation may probably be maintained and unacceptable incidental catches, particularly of salmon, avoided, by adhering to the following restrictions:

(1) Nets to be set more than 100 kilometers offshore.
(2) Nets to be set in water warmer than 13°C.
(3) Nets set at surface or submerged.
(4) Maximum 600 panels (30 kilometers).

(5) By-catch limits (by weight)

(a) Salmon (all species) less than 1%.
(b) Tuna less than 5%.
(c) Shark--no restriction.
(d) Pomfret--no restriction

A minimum 50 m vessel is required to accommodate the large quantity of net and allow working space on deck, as well as adequate frozen storage holds. After surface temperature profiles have been analysed and a fishing site selected, the net is shot at 5 knots over the stern so that it is fully deployed at about dusk. The vessel then stands off but patrols the net to prevent its overrunning by large vessels. At dawn, one end is recovered using the attached radio beacons and the net is hauled over a drum roller situated outboard over the prow of the ship. Ten or fifteen hands are required to shake out the net, which is then carried to the stern through a large diameter pipe while being drawn by two opposing soft rubber rollers. Five hands are required to flake the net on the stern deck in preparation for the next set. Damaged panels are unlaced and set aside to be mended later in the day. The catch is sorted and conveyed to the hold where it is soon eviscerated, washed and graded by size. Bodies (tubes) are arranged in aluminum trays and plate-frozen to yield 13 kg blocks which are water-glazed and stored bare at -40°C. Heads and attached tentacles are similarly treated and fetch a lower price than the mantles.

Flying squid are almost entirely used as the basis for further manufacture, either dried (Surumé) or partially dried and seasoned (Duruma) or as the basis for many specialty products. It is unlikely that Canada can compete for raw markets in Japan or elsewhere, but it is possible that, if acceptable processing can be developed in Canada, markets, particularly in Asia, may develop. The preferred treatment is immediate rapid freezing and storage in blocks at -30° to -40°C to meet export quality standards. Under these conditions, squid may be held for one year and can then be thawed for further processing and refrozen with a shelf life of a further 6-12 months.[8] Alternatively, if fishing be done by smaller vessels using a mother ship, squid may be held for a short time using non-contact icing with a little sea water[5], allowing storage for up to 2 days without drastic colour loss. External colour is the primary method of quality evaluation and is much affected by various processes. At room temperature, squid become totally unacceptable in less than 10 hours.[6]

Development of processing capability will involve adaptation of automatic skinning and perhaps eviscerating machines designed for east coast squid.[1,2] Domestic squid consumption will doubtless remain low, limited to small ethnic markets, but suitable processed commodities should find a market in North America. Canned minced squid may be an acceptable substitute for increasingly expensive clams, and breaded cubes of squid mantle could be a substitute for scallops.

The development of a flying squid fishery off the west coast of Canada is unlikely due to its abundance throughout the North Pacific. The large vessel and manpower requirements, together with the current low prices for squid, are unattractive. Further constraints are the erratic and fluctuating abundance of flying squid in Canadian waters, the shortness of the season (probably six weeks) and its conflict with the peak of the salmon season. Development may probably only proceed in tandem with a shore-based processing industry, utilizing a multi-purpose fleet exploiting other high-season resources such as tuna.[7]

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Table 1. List of species.

Brama japonica Hilgendor	Pomfret
Icosteus aenigmaticus Lockington	Ragfish
Isurus glaucus (Mülle and Heule)	Shark
Lamna ditropis Hubbs and Follett	Salmon shark
Mola mola (Linné)	Sunfish
Ommastrephes bartramii (Lesueur)	Flying squid
Oncorhynchus gorbuscha (Walbaum)	Pink salmon
Oncorhynchus keta (Walbaum)	Chum salmon
Oncorhynchus kisutch (Walbaum)	Coho salmon
Oncorhynchus nerka (Walbaum)	Sockeye salmon
Prionace glauca (Linné)	Blue shark
Salmo gairdneri Richardson	Steelhead trout
Scomber japonicus Houttuyn	Mackerel
Seriola dorsalis (Gill)	Yellowtail
Squalus acanthias Linné	Dogfish
Thunnus alalunga (Bonnaterre)	Albacore tuna
Trachurus symmetricas (Ayres)	Mackerel

Table 2. Squid exploration 1980 catch summary.

Species	(kg)	Percentage
Ommastrephes	130045	81.14
Prionace	10968	6.84
Brama	8745	5.46
Lamna	5243	3.27
Thunnus	3554 (502) [a]	2.22
Scomber	1260	0.78
Squalus	30	0.02
O. keta	110 (40)	0.07
O. nerka	29 (7)	0.02
O. kisutch	27 (10)	0.02
O. gorbuscha	25 (9)	0.02
Salmo	36 (17)	0.02

[a] Pieces in brackets.

Table 3. Tenyu Maru No. 37 squid exploration stations July-August 1980.

Station	T (°C)	Day	Location Lat. N.	Location Long. W	Time (hr)	Net length (km)	Catch (kg)	
1	14.0	30	47°47.8'	130°31.7'	7	15.0	Ommastrephes	2120
							Brama	890
							Lanna	510
							Prionace	160
							Scomber	120
							Thunnus	60
2	14.3	31	46°53.8'	129°39.9'		15.0	Ommastrephes	1070
							Lamna	340
							Prionace	335
							Brama	220
							Trachurus	160
							Thunnus	40
							O. gorbuscha	4
3	14.0	1	47°44.0'	130°06.2'	10	15.0	Ommastrephes	3420
							Brama	1230
							Lamna	470
							Prionace	270
							Thunnas	85
							Scomber	20
							O. gorbuscha	2
4	14.2	2	47°49.2	130°06.3'	9	18.5	Ommastrephes	7840
							Lamna	600
							Brama	380
							Scomber	320
							Prionace	230
							Thunnus	45
							Salmo	6
							O. gorbuscha	3
							O. nerka	4

Table 3 (cont'd)

Station	T (°C)	Day	Location: Lat. N.	Location: Long. W	Time (hr)	Net length (km)	Catch (kg)	
5	14.4	3	47°55.3'	129°42.0'	10	18.5	Ommastrephes	6610
							Lamna	570
							Scomber	440
							Prionace	420
							Brama	360
							Thunnus	100
							O. kisutch	8
6	14.5	4	47°58.2'	129°25.0'	11	18.4	Ommastrephes	8560
							Prionace	600
							Lamna	340
							Brama	140
							Thunnus	120
							O. gorbuscha	10
7	14.3	5	48°02.1'	129°25.4'	11	18.5	Ommastrephes	7670
							Prionace	500
							Lamna	180
							Brama	145
							Thunnus	85
							O. kisutch	12
8	14.3	6	48°09.5	129°34.6'	12	20.0	Ommastrephes	5780
							Prionace	520
							Brama	270
							Thunnus	150
							Lamna	40
							Squalus	30

Table 3 (cont'd)

Station	T (°C)	Day	Location Lat. N.	Location Long. W	Time (hr)	Net length (km)	Catch (kg)	
9	14.2	7	48°11.1'	129°53.6'	10	20.0	Ommastrephes	7520
							Brama	340
							Lamna	210
							Prionace	200
							Thunnus	105
							O. keta	3
							O. kisutch	7
10	14.3	8	48°00.1'	129°39.8'	11	20.0	Ommastrephes	4790
							Prionace	330
							Brama	178
							Lamna	170
							Thunnus	45
11	14.3	9	47°49.1'	129°21.0'	10	18.8	Ommastrephes	7560
							Prionace	300
							Brama	170
							Lamna	90
							Thunnus	20
							O. nerka	14
							Salmo	8
12	14.6	10	47°42.8'	129°17.5'	10	18.8	Ommastrephes	3880
							Prionace	430
							Brama	170
							Scomber	160
							Lamna	100
							Thunnus	90
							O. nerka	11
							Salmo	5

Table 3 (cont'd)

Station	T (°C)	Day	Location Lat. N.	Location Long. W	Time (hr)	Net length (km)	Catch (kg)	
13	14.4	11	47°52.5'	129°15.4'	11	18.8	Ommastrephes	10000
							Prionace	450
							Brama	190
							Lamna	140
							Thunnus	250
							Scomber	20
							Salmo	3
14	14.4	12	47°52.9'	129°11.1'	11	18.8	Ommastrephes	7790
							Prionace	900
							Thunnus	195
							Brama	120
							Scomber	100
							Lamna	80
							Salmo	6
15	14.3	13	48°06.4'	129°17.9'	10	15.0	Ommastrephes	4180
							Prionace	1070
							Brama	170
							Lamna	50
							Scomber	40
							Thunnus	52
16	14.0	14	48°20.0'	129°46.1'	10	10.0	Ommastrephes	3840
							Prionace	710
							Brama	120
							Lamna	70
							Thunnus	65

Table 4. Tomi Maru No. 88 squid exploration stations August 1980.

Station	T (°C)	Day	Location Lat. N.	Location Long. W.	Time (hr)	Net length (hr)	Catch (kg)	
1	15.0	15	48°25.4'	128°38.0'	9	18.2	Ommastrephes	4860
							Prionace	600
							Brama	275
							Thunnus	167
							Seriola	(1)
							Mola	(2)
							Icosteus	(1)
2	16.0	16	48°25.2'	128°54.2'	11	19.1	Ommastrephes	4833
							Prionace	470
							Brama	500
							Thunnus	53
							Lamna	516
3	15.2	17	48°37.2'	129°56.8'	10	19.0	Ommastrephes	2645
							Prionace	501
							Brama	82
							Thunnus	68
							Lamna	20
							Scomber	19
							O. keta	8
							Salmo	4
4	15.1	18	48°12.3	129°36.8'	11	19.0	Ommastrephes	3896
							Prionace	413
							Lamna	295
							Brama	92
							Thunnus	60

Table 4 (cont'd)

Station	T (°C)	Day	Location Lat. N.	Location Long. W.	Time (hr)	Net length (hr)	Catch (kg)	
5	15.2	20	48°11.1'	129°16.6'	10	19.1	Ommastrephes	747
							Prionace	316
							Thunnus	129
							Brama	122
							Lamna	32
							O. keta	3
6	15.0	21	49°05.6'	130°49.9'	10	19.0	Ommastrephes	3670
							Thunnus	676
							Brama	276
							Prionace	192
							Lamna	65
							Scomber	21
							O. keta	30
							Salmo	2
7	14.6	23	49°38.7'	132°52.0'	11	19.0	Ommastrephes	2455
							Brama	482
							Prionace	196
							Thunnus	121
							Lamna	32
							Seriola	24
							O. keta	22
8	15.0	24	49°24.5'	132°43.4'	10	19.1	Ommastrephes	2374
							Brama	851
							Thunnus	61
							Prionace	118
							Lamna	63
							O. keta	15
							Seriola	9

Table 4 (cont'd)

Station	T (°C)	Day	Location Lat. N.	Long. W.	Time (hr)	Net length (hr)	Catch (kg)	
9	14.5	25	49°11.2'	131°56.7'	10	18.8	Ommastrephes	2372
							Brama	368
							Prionace	128
							Lamna	98
							Thunnus	76
							O. keta	9
10	15.3	26	49°05.8'	130°54.7'	10	18.7	Ommastrephes	1505
							Thunnus	402
							Prionace	360
							Brama	252
							Lamna	49
							O. keta	12
							O. gorbuscha	3
							Isurus	(1)
11	15.4	27	48°50.5'	130°16.3'	11	18.2	Ommastrephes	3168
							Brama	260
							Thunnus	129
							Prionace	118
							Lamna	32
							O. keta	5
							Salmo	4
12	15.1	29	48°43.9'	129°47.5'	10	18.4	Ommastrephes	4890
							Prionace	131
							Brama	92
							Lamna	81
							Thunnus	105
							O. keta	6

Table 5. Tomi Maru No. 88 North Pacific squid exploration stations 1980.

Station	Date	Location Lat. N	Location Long. W	Net length (km)	Flying squid (kg)	Efficiency
1	July 25	43°05.0'	176°38.8'	5.4	1819	336.8
2	26	44°00.0'	176°40.4'	10.3	3502	340.0
3	27	43°49.9'	174°49.5'	2.6	867	333.5
4	28	44°25.9'	172°09.3'	9.2	3128	340.0
5	29	44°52.6'	170°24.6'	20.5	6970	340.0
6	30	45°40.1'	170°29.6'	27.6	9401	340.6
7	31	45°50.1'	170°29.3'	29.2	9945	340.6
8	Aug. 2	45°24.9'	164°58.2'	13.6	4607	338.8
9	3	45°49.6'	164°45.0'	18.6	6307	339.1
10	4	45°55.0'	163°30.5'	15.7	5538	352.7
11	5	45°46.9'	161°38.1'	12.6	4267	338.7
12	6	45°44.9'	160°04.5'	20.8	7072	340.0
13	9	46°38.8'	145°17.2'	35.5	12053	339.5
14	10	46°37.5'	144°49.2'	42.2	5865	139.00
15	11	46°45.1'	143°08.1'	25.5	8687	340.8
16	13	46°58.2	134°50.1'	17.5	5950	340.0
17	14	47°28.0	133°30.1'	4.6	1547	336.3

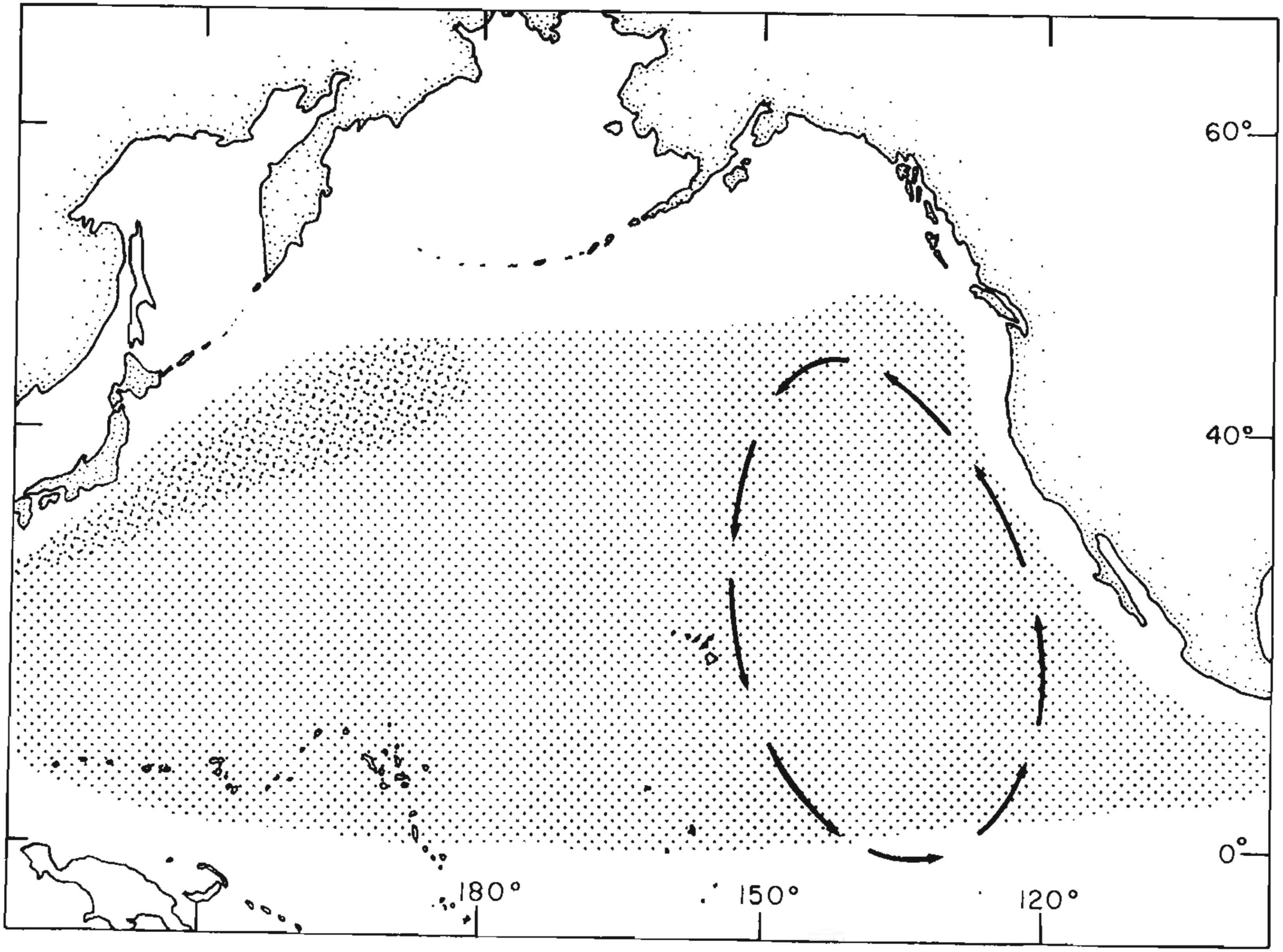

Fig. 1. Distribution of flying squid <u>Ommastrephes</u> <u>bartramii</u> in the North Pacific. Arrows indicate conjectured migration of eastern population. Double hatched area is traditional western Pacific fishing grounds.

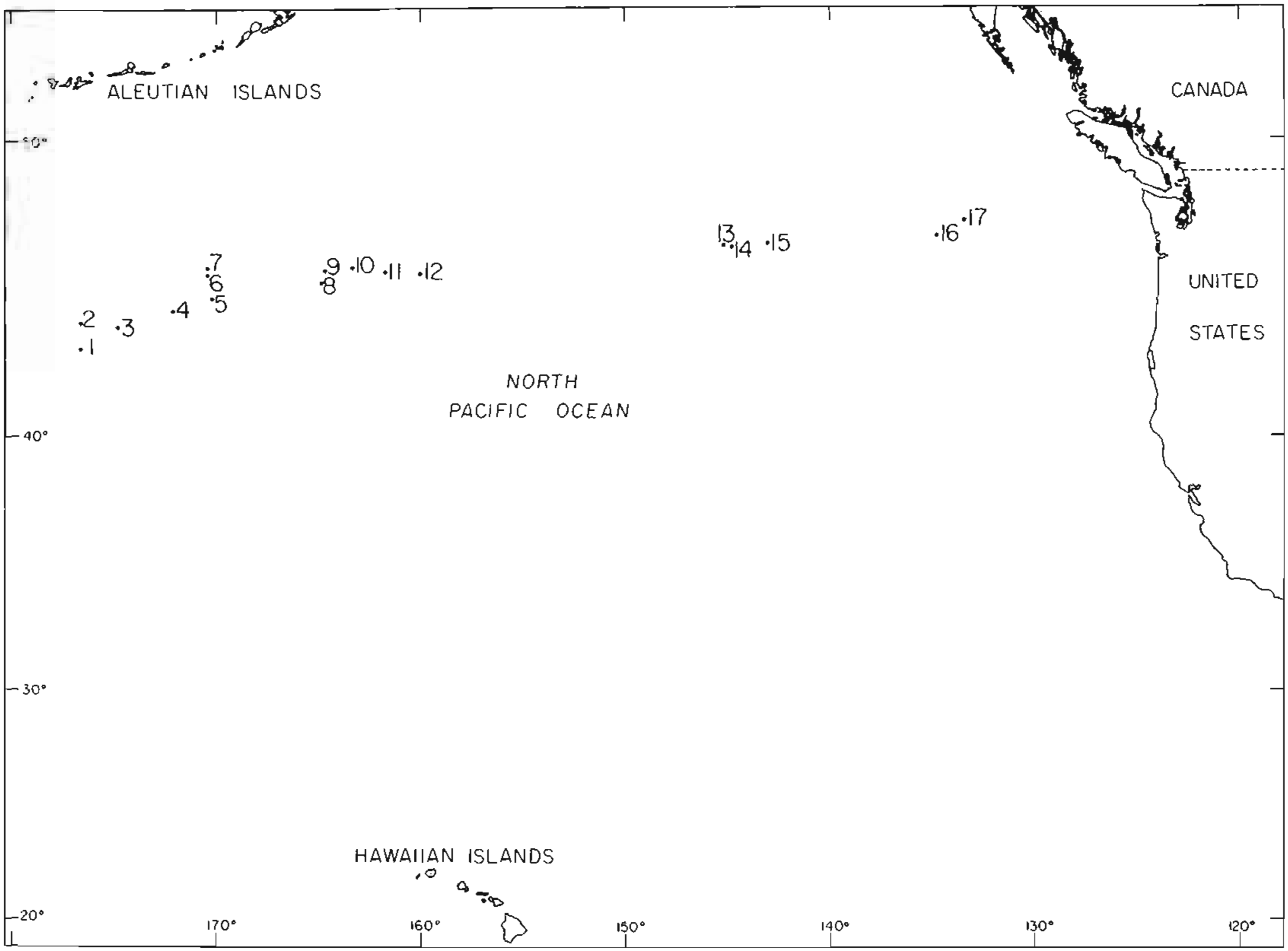

Fig. 2. Trans-Pacific flying squid survey stations taken by TOMI-MARU NO. 88, Summer 1980.

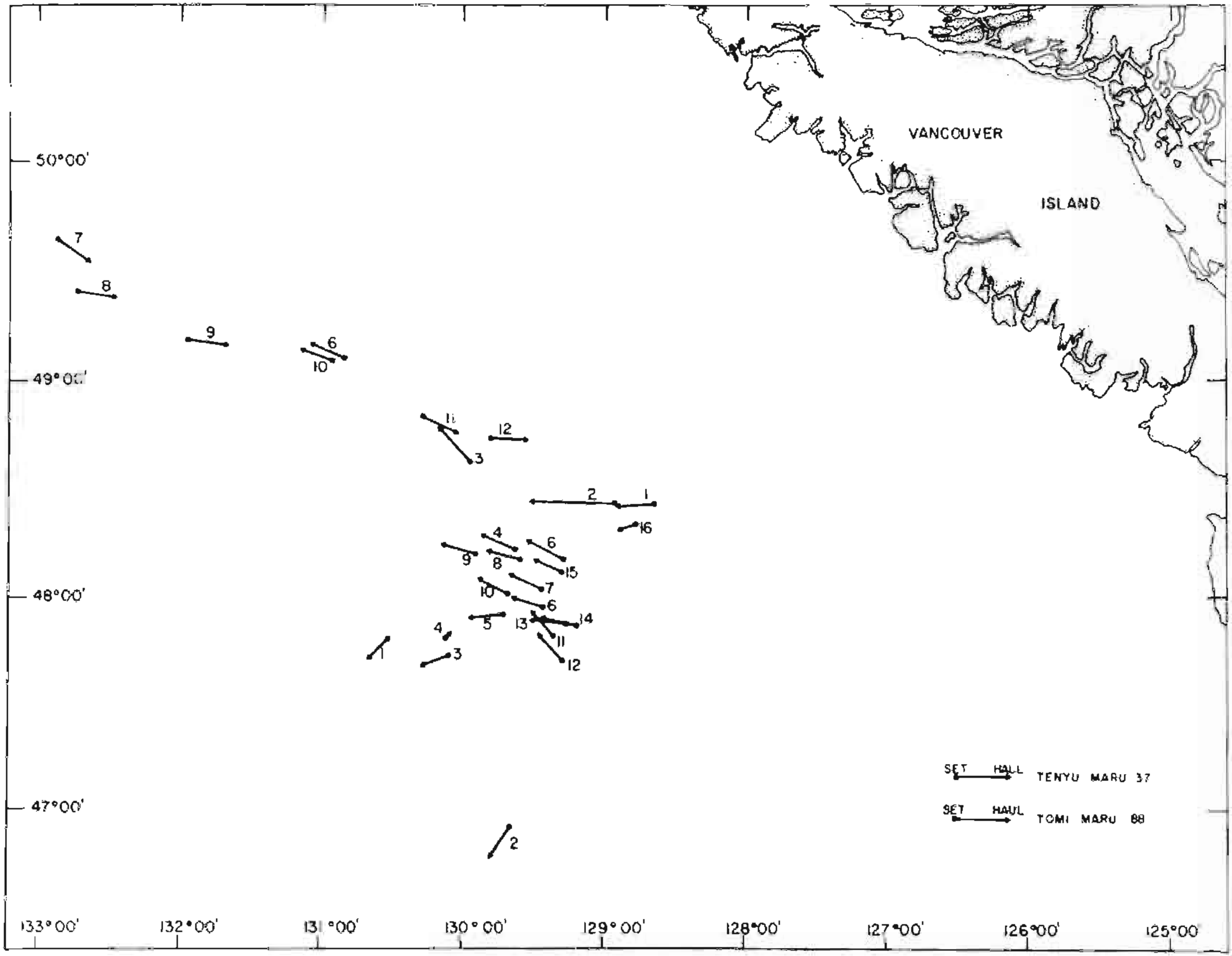

Fig. 3. Squid survey stations taken by TENU MARU NO. 37 and TOMI MARU NO. 88 off the west coast of Vancouver Island, summer 1980.

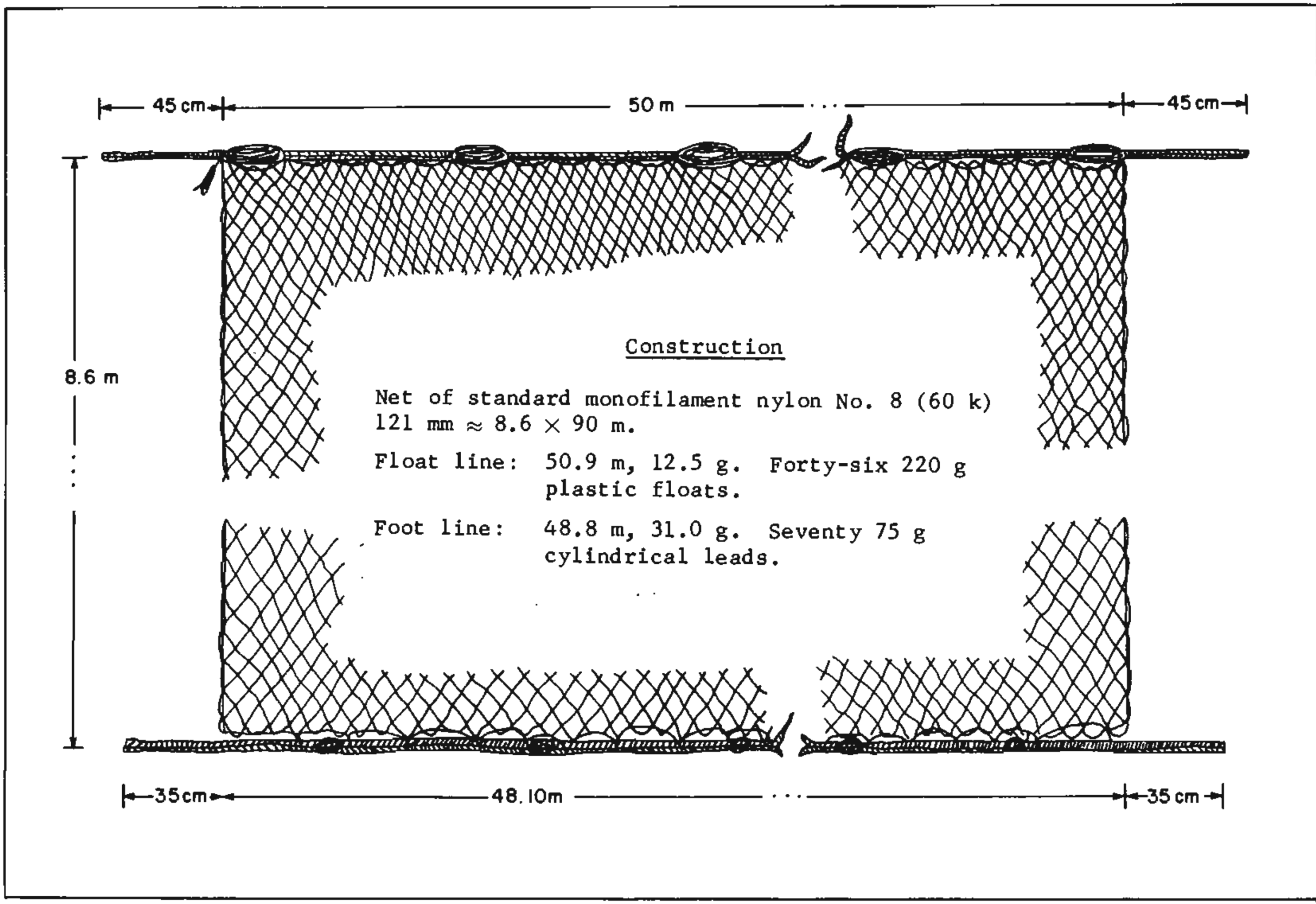

Fig. 4. Details of drift net construction.