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1984年第５福進丸によるベーリング海域における日米共同底魚調査予備報告

Preliminary report on the Japan-U.S. cooperative groundfish survey in the Bering Sea by Fukushin maru No.5 in 1984

山　口　閎　常

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１９８４年　８月

August　１９８４

水　　産　　庁

Fisheries Agency of Japan

1984年第5福進丸によるベーリング海域における日米共同底魚調査予備報告

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1984年の水産庁による北洋底魚生物調査は，ベーリング海とアラスカ湾の2水域に分けて実施され，それぞれ別の調査船が担当した。

ベーリング海域の調査は，バイオマス推定の精度向上を図るため，CPUEの昼夜別水域別日周変化や，計器による袖網間隔の実測，及び主要魚種の摂餌生態解明のための胃標本採集などを目的として，北転型スターン・トローラー第5福進丸（349.90トン）を用船し，5月～6月に実施した。

以下に調査の概要を報告する。

調　査　日　程

調査船第5福進丸は，1984年5月21日石巻港を出港し，5月28日にプリビロフ諸島北西側の大陸

本報告の引用は下記に従うこと：
山口閎常　1984．1984年第5福進丸によるベーリング海域における日米共同底魚調査予備報告（北太平洋漁業国際委員会提出文書）．19頁．水産庁，東京．

This paper may be cited in the following manner:
Hirotsune Yamaguchi 1984. Preliminary report on the Japan-U.S. cooperative groundfish survey in the Bering Sea by Fukushin maru No. 5 in 1984. (Document submitted to the International North Pacific Fisheries Commission.) 19p. Fisheries Agency of Japan, Tokyo 100 Japan.

斜面域から調査活動を開始した（第1図参照）。

5月28日（日本標準時，以下同じ）：漁場探索及び漁具調整のためのテスト曳網（3回）

5月29日〜31日：カラスガレイ・アブラガレイを対象とした連続曳網観測（20回）

6月 1日：袖網間隔の計測予備実験（3回）

6月 2日：袖網間隔の計測及びコガネガレイの標識放流（5回）

6月 3日：ブリストル湾口域における，コガネガレイ調査のための漁場探索，及び漁具調整のためのテスト曳網（2回）

6月 4日〜7日：コガネガレイ・シュムシュガレイを対象とした連続曳網観測（17回）

6月 8日：漁具効率推定のための，同一地点におけるくり返し曳網実験（10回）

ここまで調査を進めてきた時点で，船内事故により漁撈長がダッチ・ハーバーで下船したため，調査活動の継続が不可能となった。したがって，予定していたスケトウダラ・マダラを対象とする連続曳網観測及び100 *m*以深域における袖網間隔の計測は実施することなく帰途に着き，6月17日石巻港に入港した。

5月28日〜6月8日の12日間に，事故網や失敗網も含めて60回の曳網調査を実施した。

調査船及び漁具

本調査に従事した第5福進丸（福島県いわき市所属）は，総トン数349.90トンの北転型スターン・トローラーで，1979年以降のベーリング海及びアリューシャン水域での日米共同底魚調査に従事した船とほぼ同型のものである。その要目は第1表に示した。

また，本調査で使用した漁具の仕様を第2表に示したが，従来の調査網の網口高さが平均して5 *m*以上であったのに対し，今回のものは2.5〜3.0 *m*とかなり低い値を示したのが特徴であった。

調査結果の概要

以下で述べる各調査ごと（但し，標識放流分は除く）の主要魚種別の名目漁獲量は第3表に示した。これによれば，漁獲の第1位はコガネガレイでギンダラがこれに次ぎ，カラスガレイ，シュムシュガレイ，アブラガレイ，スケトウダラ，マダラであった。これら7魚種で全漁獲量の97％を占めていた。

1） カラスガレイ・アブラガレイＣＰＵＥの時刻による変化

水深400〜550 *m*の大陸斜面域において，主対象魚種であるカラスガレイとアブラガレイのＣＰＵＥが，昼夜あるいは時間の経過と共に変化するかどうか，またその間の摂餌状態に変化があるか等を調べた。すなわち，5月29日〜31日の3日間，30分曳網を，曳網水域を日毎に変更しながら合計20回実施した。

カラスガレイ，アブラガレイ及びギンダラの主要3魚種の，時刻（日本標準時）別漁獲量の変化を

第2図に示した。現地では17時少し前に日没となり，23時前には日の出となった。いずれの魚種においても漁場の変化による漁獲変動を示しているようにみられるが，昼夜或いは時間的な漁獲の差については検討を要する。ただし，1隻の調査船が一般商業用の大型の網を用いて2～3時間毎に3日間連続して曳網作業を続けることは非常に困難であり，可能ならば2隻の船がペアとなり交互に網を曳く方法を採った方が得られる資料は格段に多くなろう。

採集した胃標本の大部分は空胃状態と思われたが，摂餌状態については陸上における詳細な検討が必要である。なお，5月28日の試験曳網も含めた斜面域におけるカラスガレイ，アブラガレイ及びギンダラの標本体長組成は第3～第5図に示した。

2) 計器による袖網間隔の実測実験

6月1日～8日の間，100 *m*以浅の陸棚上において，カレイ類を対象とした37回の曳網を行なった。この際，Furuno 製のＦＮＲ－80型ネットゾンデを右側袖網部中央に横向きに装着し，曳網時の袖網口の展開距離の実測を試みた。発射音波はある角度の拡がりを保っているため，反対側の袖網部のみでなく海底の反射も拾う可能性があるため，発信器をかなり上向きにする必要があったが，網部のみの反射が得られる発振器の取り付け角度をみつけるのは非常に困難であった。良好な角度と思われるように調整を行っても，投網時における計器の船体とのはげしい接触等により角度保持ができない例が多かった。袖間隔がうまく計測できたと思われる例は僅かに3回しかなく，反射波を受ける方式による実測は，かなり悲観的であるが，7月から実施されるアラスカ湾での第2次航海以降の実験結果も含めた上で，もう少し詳細に検討する必要があろう。

3) コガネガレイの標識放流

6月2日の5回の曳網では，毎回15分程度の曳網とし，とれたコガネガレイの内元気の良いものに，直径1.1 *cm*の円盤型の標識（白色）を背鰭下部筋肉部の両側に1本のニッケル製針で装着して放流した。標識魚の全長は172～392 *mm*の範囲で，合計1,000個体を放流した（1983年 北洋底魚標識放流記録参照）。

4) コガネガレイ・シュムシュガレイ ＣＰＵＥ の時刻による変化

コガネガレイの主分布域であるブリストル湾口域の，水深60 *m*前後の水域において，コガネガレイ，シュムシュガレイのＣＰＵＥの経時的な変化と，摂餌状態を知るための胃標本採集を目的として，17回の曳網を6月4日～7日に実施した。この内1回は，わずか20分間の曳網でコガネガレイが多量に入網したため揚網できず，漁獲量の推測も不可能のままほとんど海中に放棄した。この水域はコガネガレイが濃密に集群していたらしく，毎回相当の漁獲が見込まれたので，曳網は5分間を目途として実施した。

コガネガレイ，シュムシュガレイ及び混獲の多かったマダラとスケトウダラの主要4魚種について，各曳網時における5分曳網当りの漁獲量の変化を第6図に示した。斜面域のカラスガレイ，アブラガレイと同様，いずれの魚種においても昼夜あるいは時間的経過によるCPUEの傾向的な変化はみられなかった。採集したコガネガレイ，アサバガレイ及びツノガレイの胃標本には，シワロウバイ（Nuculana pernula radiata；Radiated nut clam）と思われる貝がどの個体にも満腹の状態で観察されたが，消化程度等については陸上における詳細な検討が必要である。

5）同一曳網領域の繰り返し曳網実験

トロール網の漁獲効率の推定あるいはその可能性をチェックする目的で，前記繰り返し曳網実験水域のやや西側65 *m*深前後の水域において，可能な限り同一地点と考えられる所で，10回の曳網を実施した。同一地点の確認に使用する船位プロッターが故障したため，デジタルで表示されているロランーCの数値を頼りにして曳網を実施した。したがって10回全てがまったくの同一地点での曳網という保障はない。

コガネガレイ，シュムシュガレイ，マダラ及びスケトウダラの4魚種の，30分曳網当りの漁獲を曳網時間ごとにプロットすると第7図となる。05～06時及び10～13時の間は，乗組員の食事や休憩に当てたためブランクとなった。この結果によると，シュムシュガレイ及びスケトウダラでは，短時間の内に同一地点を繰り返し曳網することにより漁獲が低下する傾向を示している。コガネガレイでは逆に漁獲が増加する傾向がみられた。本来3日間の実験を実施する予定であったのが1日間のみの資料しか得られなかったので確信はないが，同一地点を繰り返し曳網することによって，いくつかの魚種では漁獲効率が推定可能のように思われる。但し，まったくの同一領域を1隻の船で短時間の内に繰り返し曳網するのは相当な困難さがあるので，2隻の同一船型の船を使うことにより，能率良く良質の資料を得られるものと考えられる。

なお，ブリストル湾口域での時刻別曳網実験及び繰り返し曳網実験において漁獲されたコガネガレイ，シュムシュガレイ及びツノガレイの標本体長組成を第8～第10図に示した。

6）混獲オヒョウ

今回の調査で混獲されたオヒョウの出現位置と尾数を第11図に，その体長組成を斜面域と陸棚上（実際にはブリストル湾口域のみに出現）の2水域に分けて第4表と第12図に示した。斜面域では23回の曳網の内，8回の曳網で69尾のオヒョウが混獲され，平均尾叉長は79.6 *cm*，平均体重は6.0 kgであった。ブリストル湾口域では，26回の曳網で118尾のオヒョウの混獲が観られ，平均尾叉長は57.3 *cm*，平均体重は2.6 kgと斜面域のものよりも明らかに小型であった。

Table 1. Specifications of the research vessel Fukushin maru No. 5 conducting the Japan-U.S. cooperative survey in the Bering Sea in 1984.

Overall length (m)	56.60
Gross tonnage (tons)	349.90
Horsepower (PS)	2,700
Propeller	Controlable pitch propeller
Trawl winch	17 tos/80 m/min.
Number of crew	22
Scientists	2

Table 2. Specifications of the trawl gears used for the 1984 surveys

Headrope length (m)	54.0
Footrope length (m)	64.5
Net and codend length (m)	65.4+20.0=85.4
Mesh-size of net (mm)	120 - 240
Mesh-size of codend (mm)	100
Diameter of steel bobbins (mm)	350(shelf), 440(slope)
Handrope length (m)	134[a]
Size of otterdoor (m)	3.50 x 2.25
weight of the otterdoor in water (kg)	4,272

a Handrope (60 m) + net pendant (60 m) + otter pendant (14 m)

Table 3. Norminal catch by species caught by bottom trawl during the Japan-U.S. cooperative survey in the Bering Sea in May and June of 1984.

RESEARCH	Net and Gear test	Hauling with the lapse of time: Greenland turbot & Arrowtooth flounder	Hauling with the lapse of time: Yellowfin sole & Rock sole	Repetition haul in same area	TOTAL
Hauling number	3	20	16	10	49
Hauling time total(min.)	295	590	103	300	1,288
Haul distance total(n.m)	16.1	32.7	7.7	17.2	73.8
CATCK(kg)					
Yellowfin sole	-	-	141,764.3	3,330.3	145,094.6
Rock sole	-	-	1,628.4	8,169.5	9,797.9
Flathead sole	0.3	5.9	64.7	202.0	272.9
Alaska plaice	-	-	411.4	72.7	484.1
Greenland turbot	2,258.0	7,860.5	-	-	10,118.5
Arrowtooth flounder	1,811.3	7,352.1	-	-	9,163.4
Halibut	14.0	406.3	84.3	211.8	716.4
Rex sole	0.1	31.8	-	-	31.9
Other flounder	-	-	70.8	17.2	88.0
(Sub-total)	(4,083.7)	(15,656.6)	(144,023.9)	(12,003.5)	(175,767.7)
Pacific cod	-	258.1	5,781.0	423.4	6,462.5
Pollock	0.5	90.5	7,018.5	1,578.5	8,688.0
(Sub-total)	(0.5)	(348.6)	(12,799.5)	(2,001.9)	(15,150.5)
Sablefish	2,183.7	10,214.9	-	-	12,398.6
Pacific ocean perch	0.2	0.3	-	-	0.5
Shortraker rockfish	-	74.5	-	-	74.5
Rougheye rockfish	-	6.3	-	-	6.3
Other rockfishes	-	0.8	-	-	0.8
Shortspine thornyhead	13.5	4.2	-	-	17.7
Herring	-	-	-	3.3	3.3
Capelin	-	0.1	-	0.1	0.2
Eulachon	-	-	0.5	-	0.5
Sculpins	2.3	120.9	145.9	33.5	302.6
Poachers	0.1	1.6	0.5	3.6	5.8
Eelpouts	83.9	124.8	-	-	208.7
Snailfishes	2.3	31.0	-	-	33.3
Rattails	578.1	1,178.3	-	-	1,756.4
Skates	14.7	222.6	34.0	32.2	303.5
Other fishes	2.1	14.7	-	-	16.8
(Sub-total)	(2,880.9)	(11,995.0)	(180.9)	(72.7)	(15,129.5)
Fishes Total	6,965.1	28,000.2	157,004.3	14,078.1	206,047.7
Octopus	2.0	20.9	-	-	22.9
Squids	111.7	1,963.1	-	-	2,074.8
Pink shrimp	-	0.1	-	-	0.1
Sidestripe shrimp	6.9	78.5	-	-	85.4
(Sub-total)	(120.6)	(2,062.6)	(-)	(-)	(2,183.2)
TOTAL CATCH	7,085.7	30,062.8	157,004.3	14,078.1	208,230.9
Halibut (Number)	1	68	24	94	187

Table 4. Size composition of halibut caught during the Japan-U.S. cooperative survey in the Bering Sea in May and June of 1984.

Fork length(cm)	Slope region	Shelf region	Total
21 - 25		1	1
30		1	1
35		2	2
40		1	1
45		3	3
50		14	14
55		27	27
60	2	36	38
65	6	15	21
70	11	9	20
75	11	2	13
80	11	1	12
85	10	5	15
90	8		8
95	4	1	5
100	3		3
105	1		1
110			
115			
120			
125			
130			
135			
140	2		2
TOTAL	69	118	187

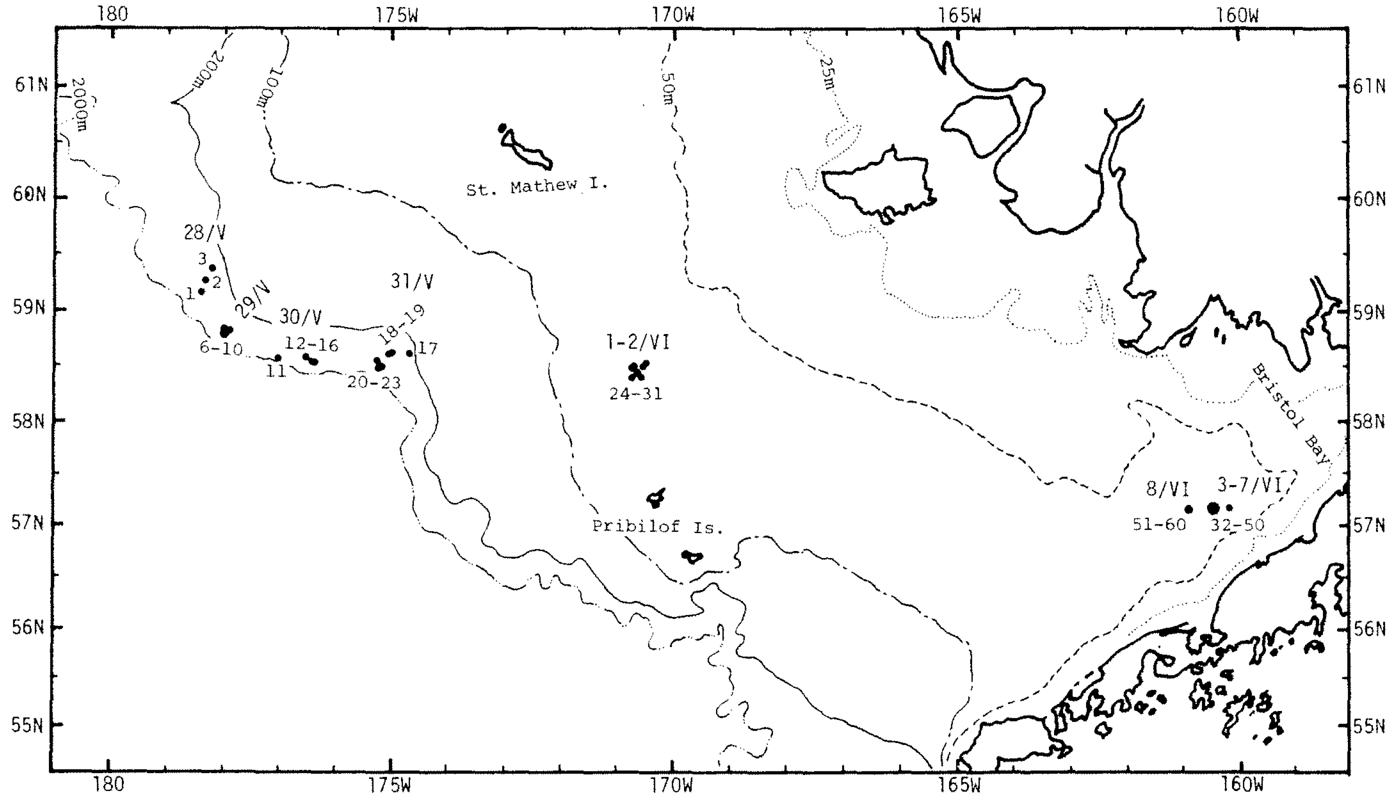

Fig. 1. Survey area of Japan-U.S. cooperative survey by <u>Fukushin maru</u> No. 5 in the Bering Sea in May and June of 1984.

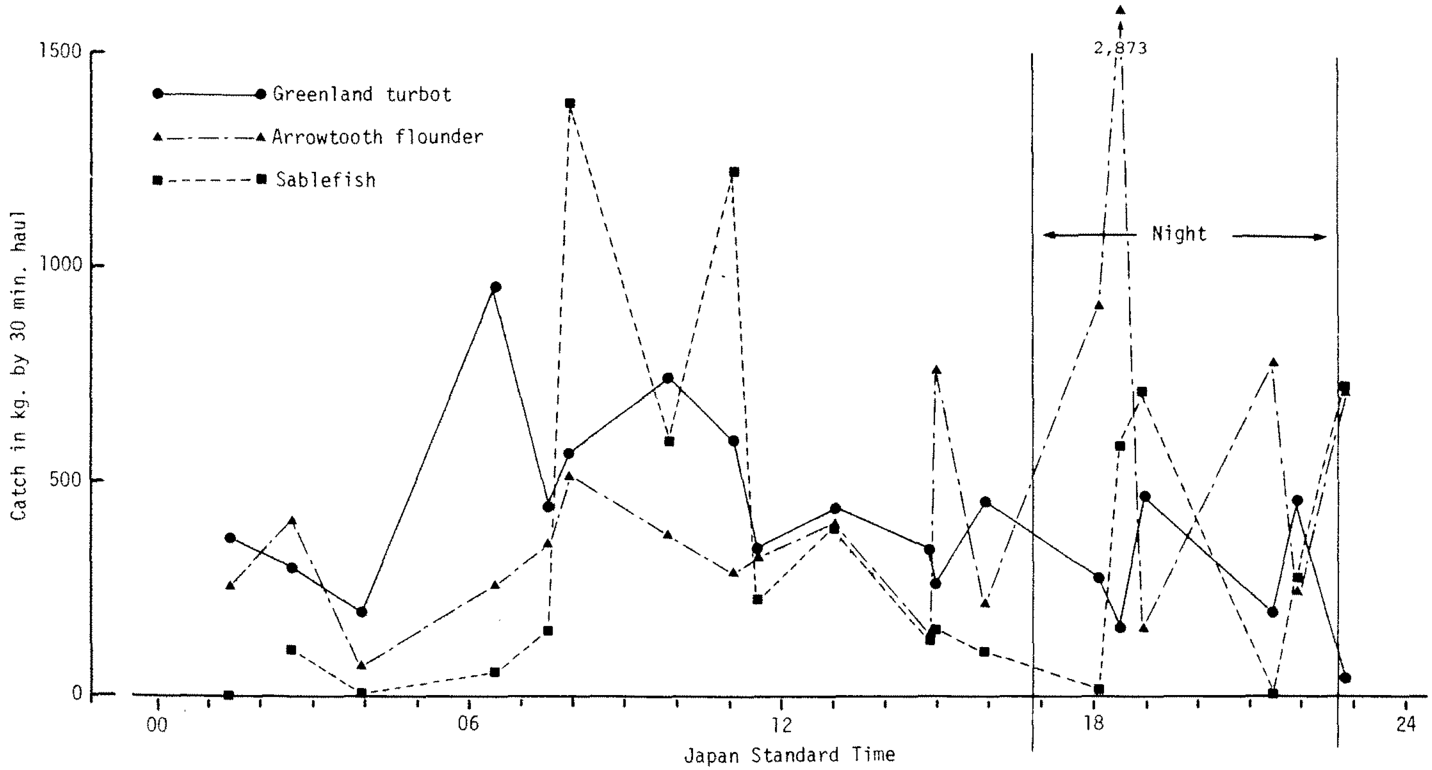

Fig. 2. Changes of catch by time for Greenland turbot, arrowtooth flounder and sablefish with the lapse of time in 3 days on the slope region of the Bering Sea, May of 1984.

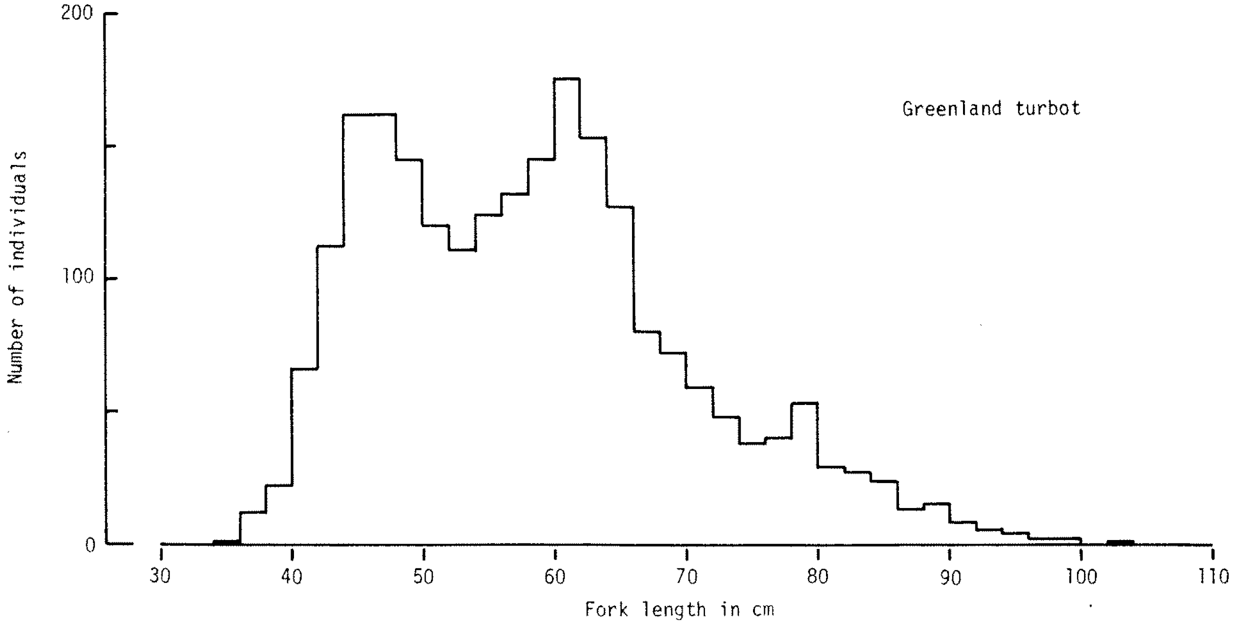

Fig. 3. Size composition of Greenland turbot caught during the Japan-U.S. cooperative survey on the slope region of the Bering Sea, May of 1984.

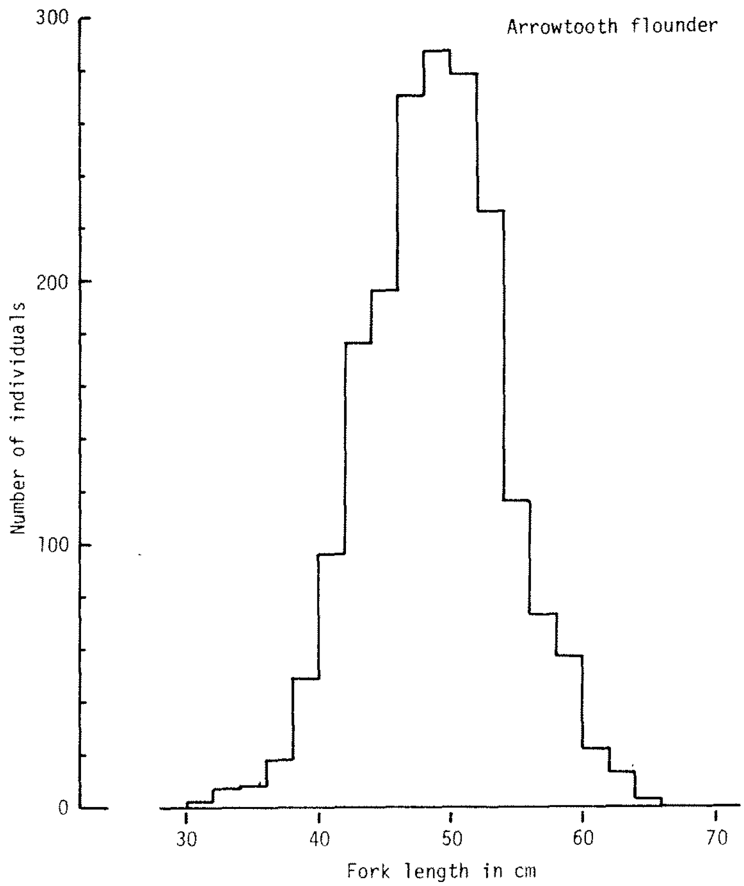

Fig. 4. Size composition of arrowtooth flounder caught during the Japan-U.S. cooperative survey on the slope region of the Bering Sea, May of 1984.

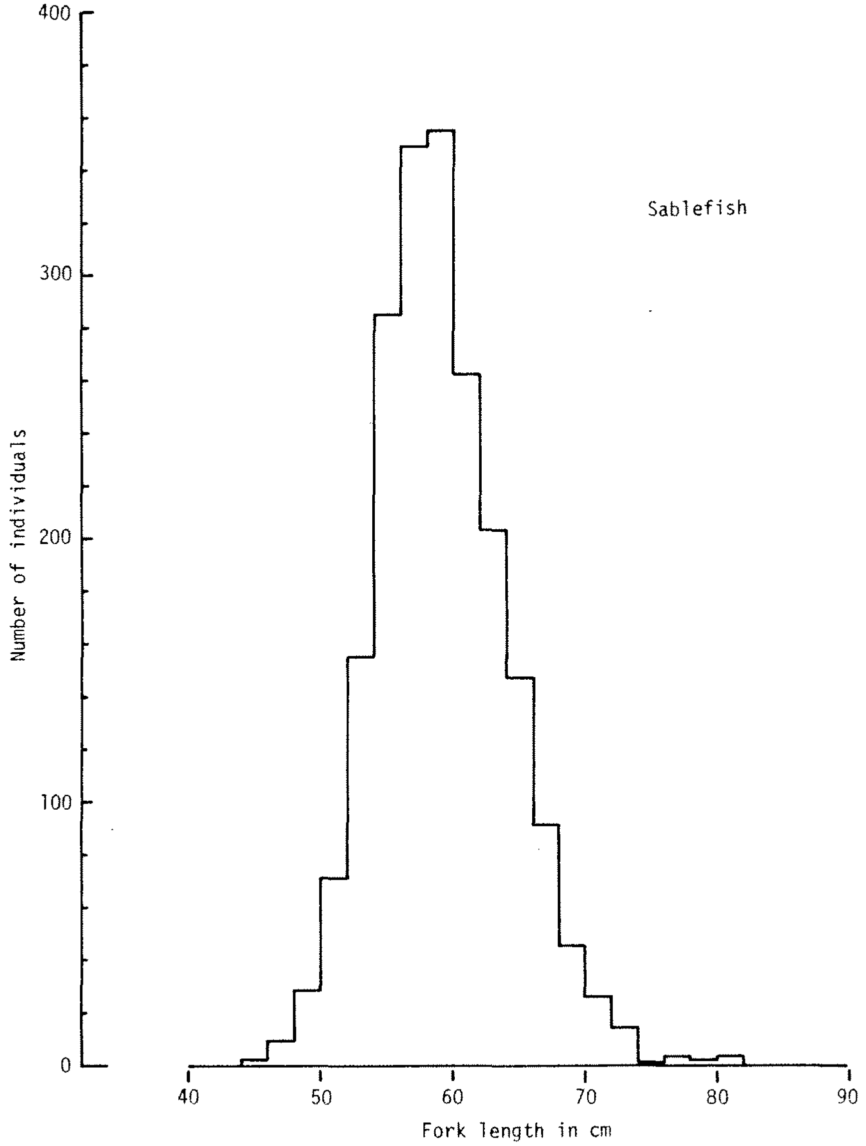

Fig. 5. Size composition of sablefish caught during the Japan-U.S. cooperative survey on the slope region of the Bering Sea, May of 1984.

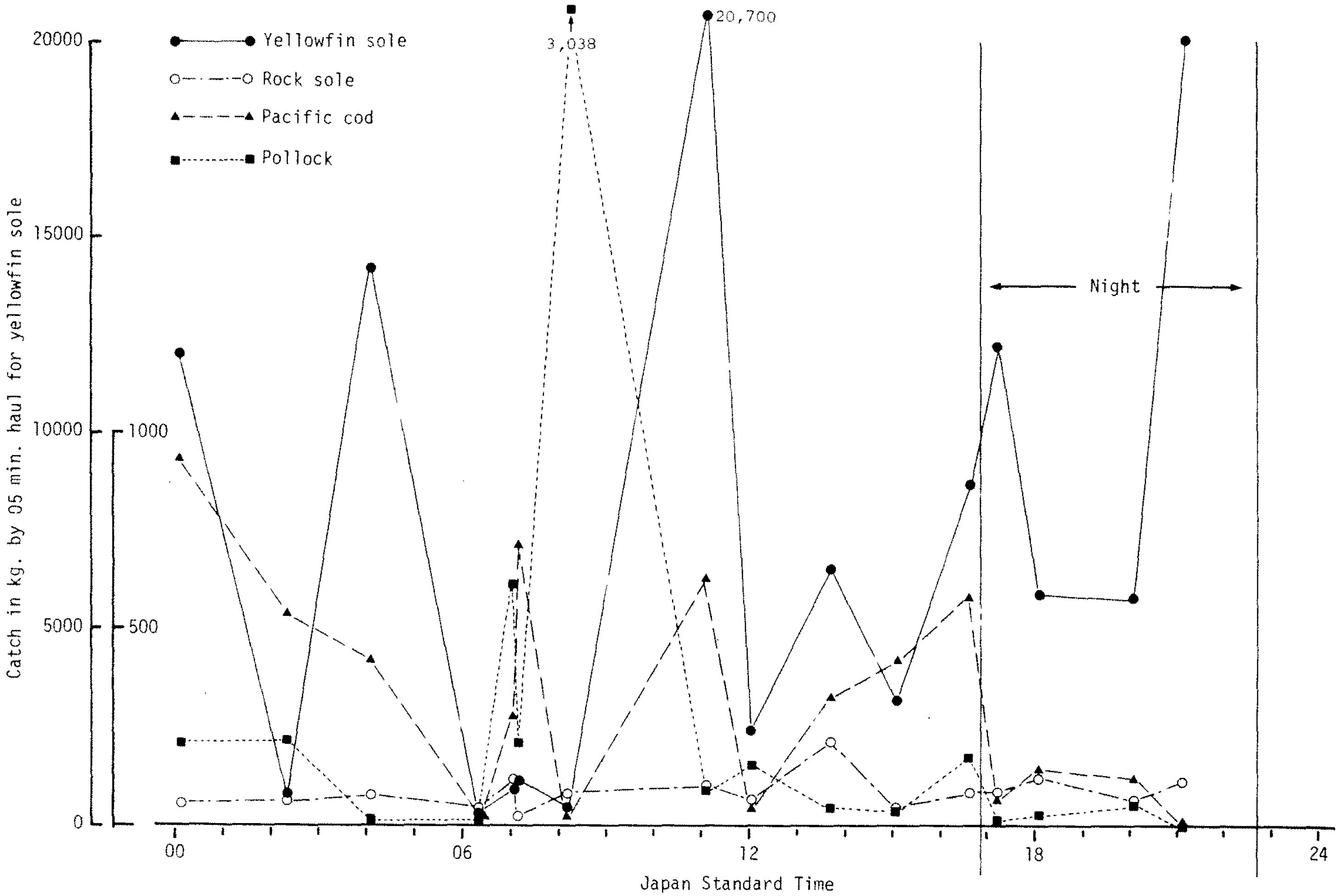

Fig. 6. Changes of catch by time for yellowfin sole, rock sole, Pacific cod and pollock with the lapse of time in 4 days on the shelf region of the Bering Sea, June of 1984.

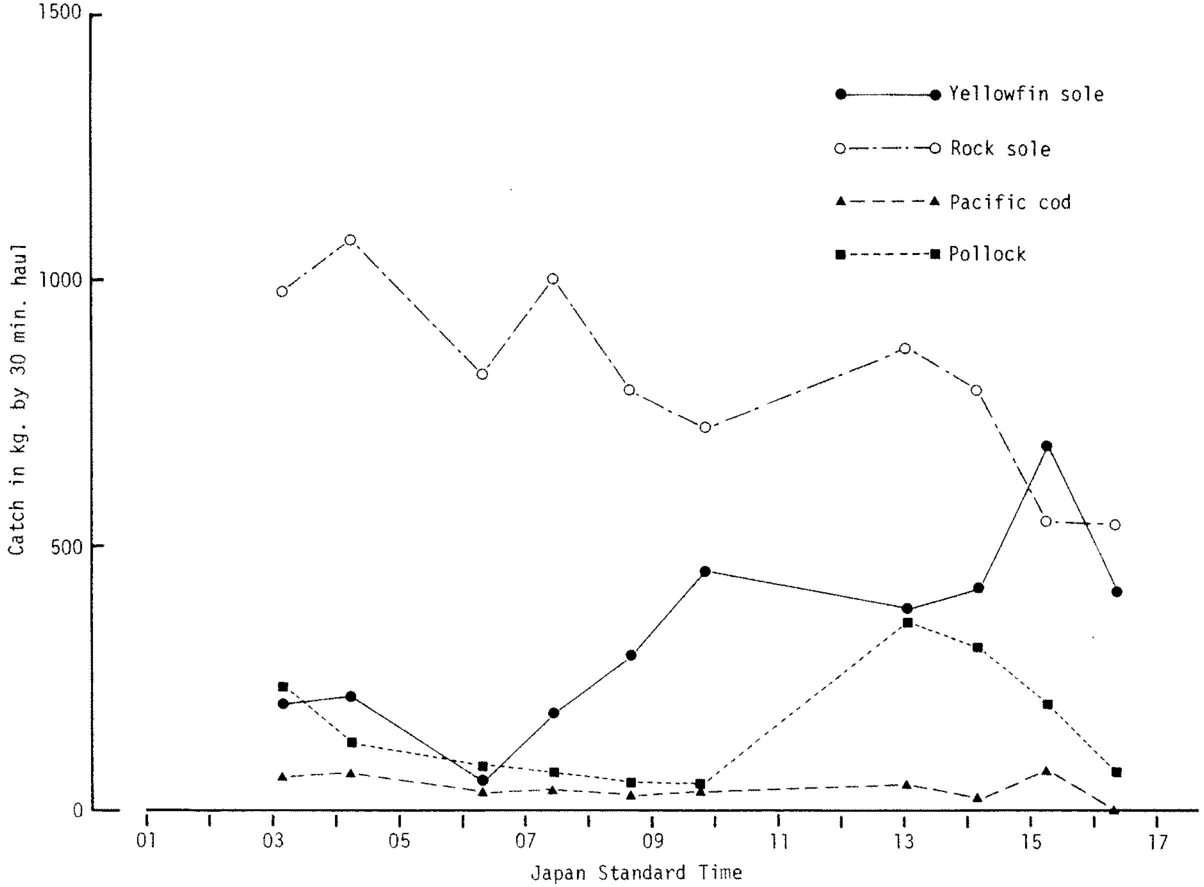

Fig. 7. Changes of catch by time for Rock sole, yellowfin sole, Pacific cod and pollock with repetition haul in same area on the shelf region of the Bering Sea, June of 1984.

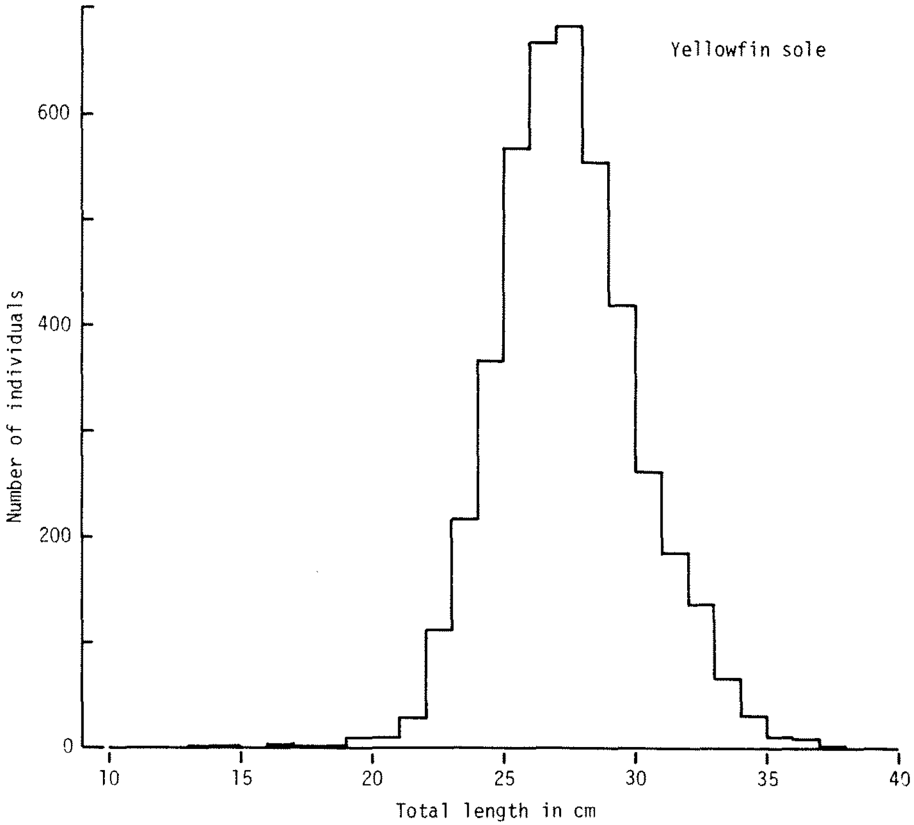

Fig. 8. Size composition of yellowfin sole caught during the Japan-U.S. cooperative survey on the Shelf region of the Bering Sea, June of 1984.

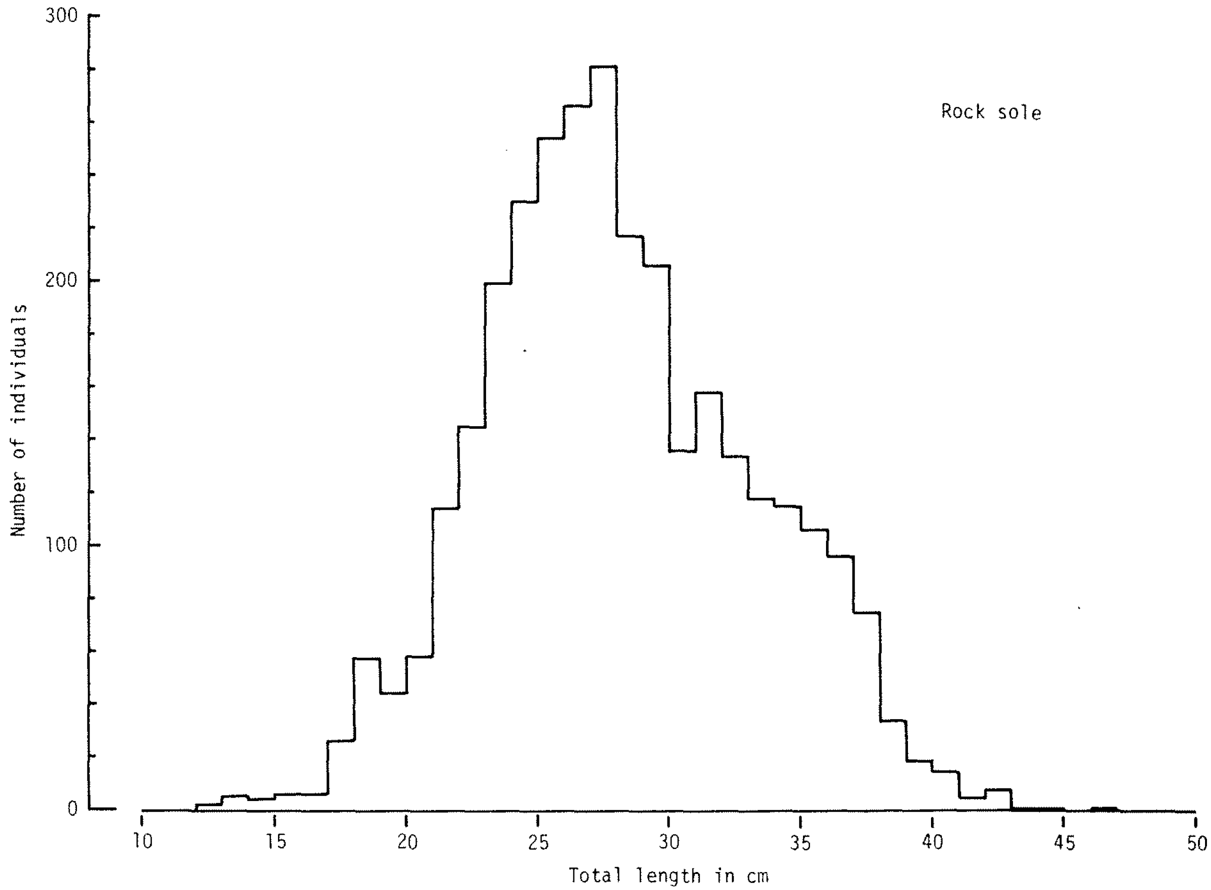

Fig. 9. Size composition of rock sole caught during the Japan-U.S. cooperative survey on the shelf region of the Bering Sea, June of 1984.

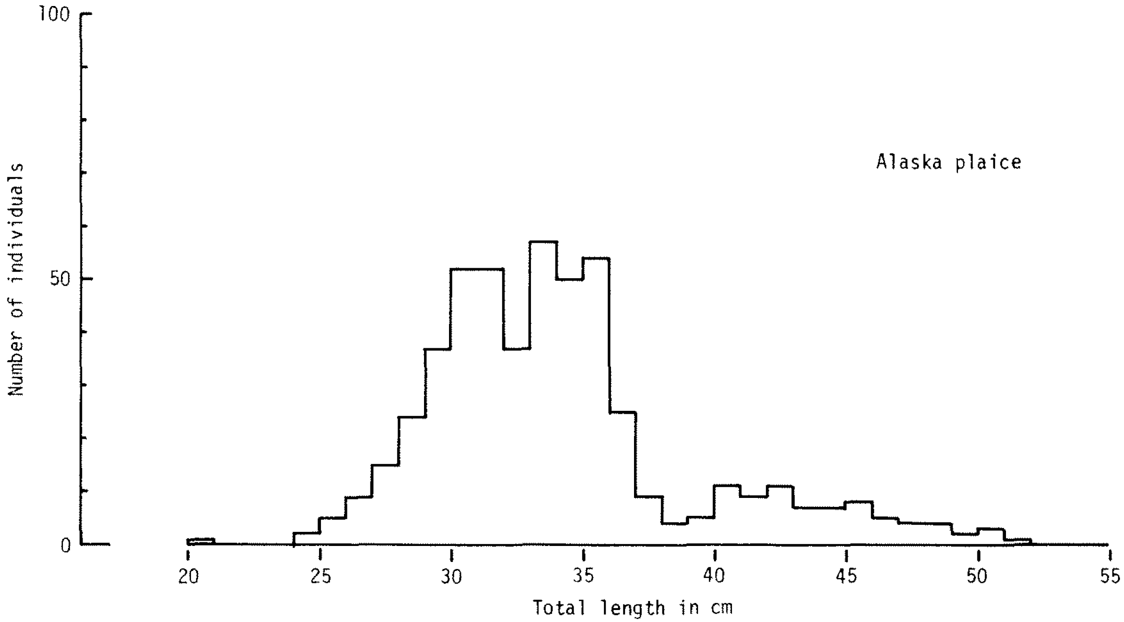

Fig. 10. Size composition of Alaska plaice caught during the Japan-U.S. cooperative survey on the shelf region of the Bering Sea, June of 1984.

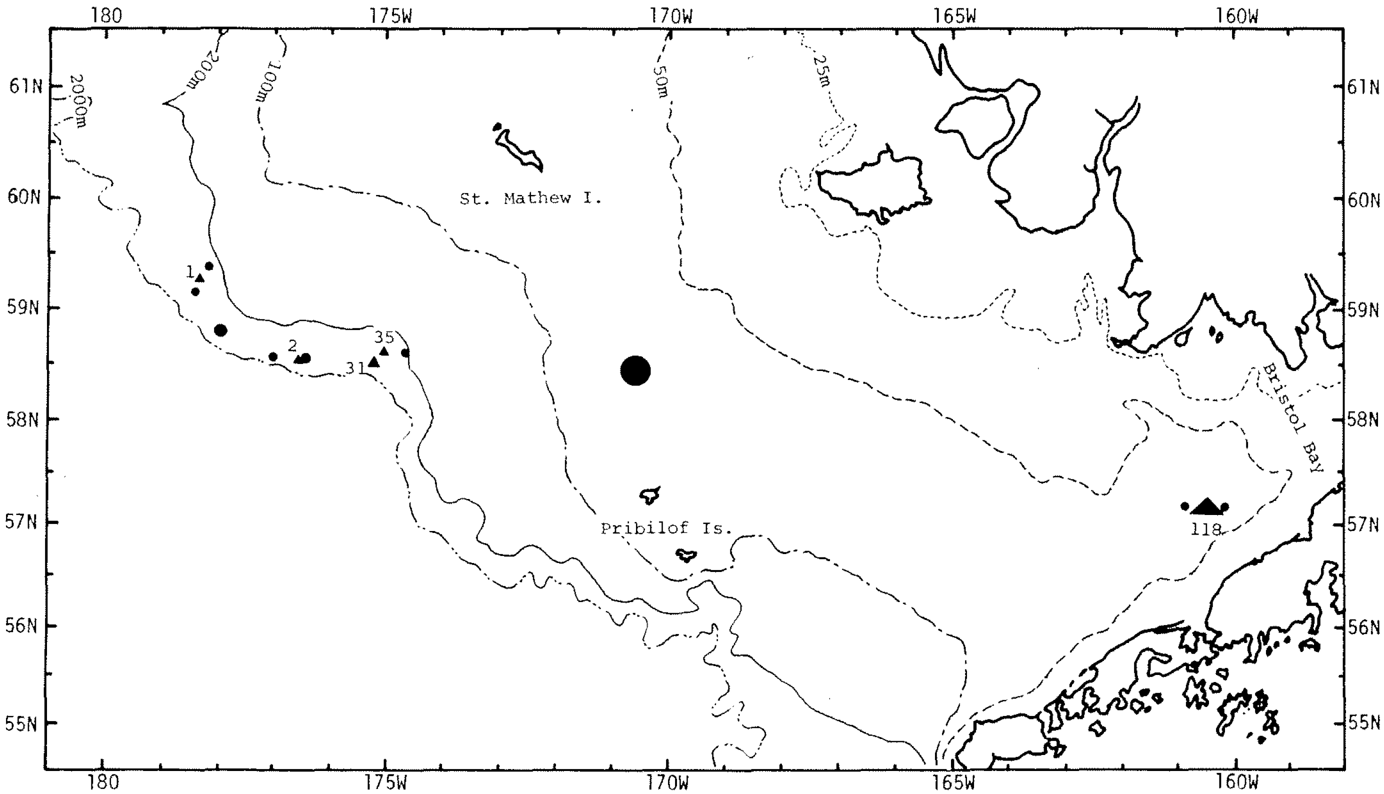

Fig. 11. The number of halibut caught and the stations where halibut were caught during the Japan-U.S. cooperative surveys in the Bering Sea, May and June of 1984.

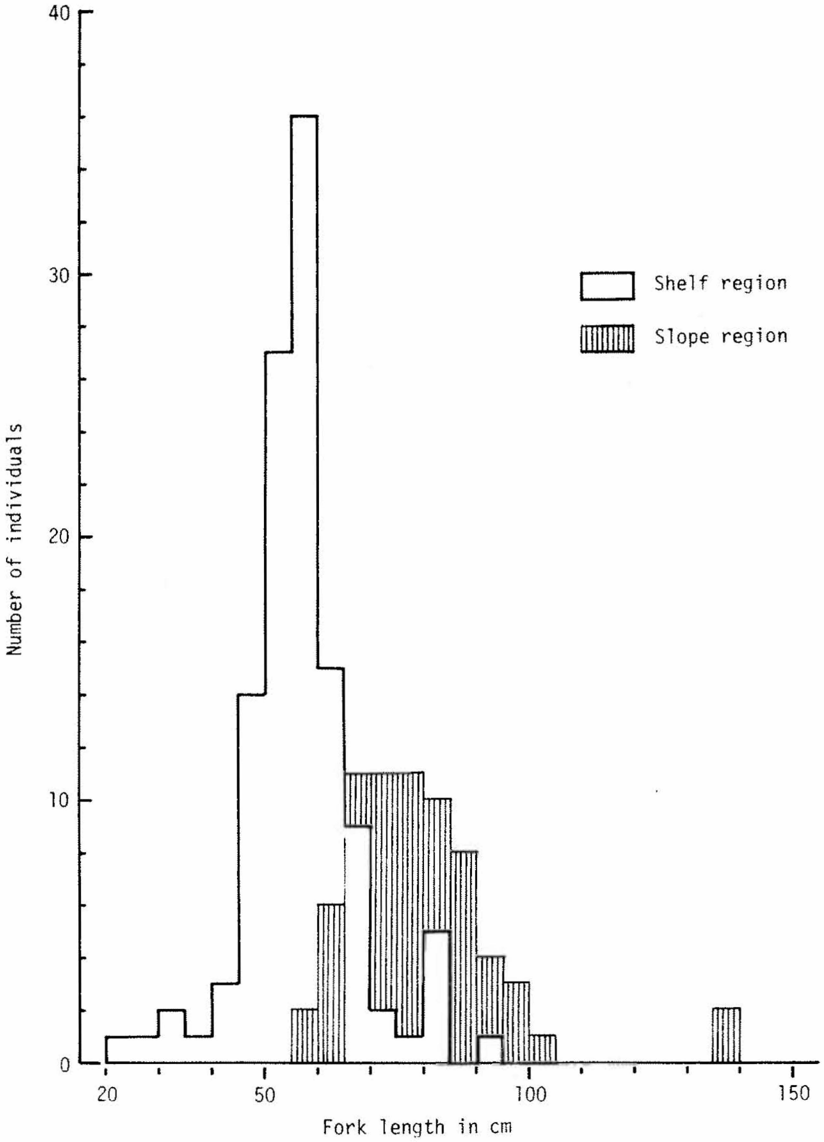

Fig. 12. Size composition of halibut caught during the Japan-U.S. cooperative surveys in the Bering Sea, May and June of 1984.

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PRELIMINARY REPORT ON THE JAPAN-U.S. COOPERATIVE GROUNDFISH SURVEY IN THE BERING SEA BY FUKUSHIN MARU NO. 5 IN 1984

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Groundfish surveys in the Convention area by the Fisheries Agency of Japan were conducted in two areas, i.e. the Bering Sea and the Gulf of Alaska with different vessels for each area. This report summarizes the Bering Sea survey.

In the Bering Sea, a chartered stern trawler (Hokuten-type) Fukushin maru No. 5 (349.90 GT) conducted a survey in May and June with objectives of collecting stomachs in order to study feeding habits of major species, collecting data on diurnal changes of CPUE by area, and measuring distance between trawl net wings by using a mensuration system in order to improve accuracy of biomass estimation.

Schedule

The research vessel Fukushin maru No. 5 left Ishinomaki on May 21, 1984 and started research activities on the continental slope northwest of the Pribilof Islands on May 28, Japan Standard Time (Fig. 1).

May 28	Test tows (3) to determine the fishing grounds and coordinate the fishing gear
May 29 to 31	Serial tows for Greenland turbot and arrowtooth flounder (20 tows)
June 1	Preliminary measurement of distance between net wings (3 operations)
June 2	Measurement of net wings and tagging of yellowfin sole (5 tows)
June 3	Search of fishing ground for yellowfin sole at the mouth of Bristol Bay and test tows for coordination of the gear (2 tows)

June 4 to 7	Serial tows for yellowfin sole and rock sole (17 tows)
June 8	Repeated tows at the same station for estimation of the gear efficiency (10 tows)

Because of an accident, the fishing master had to disembark at Dutch Harbor and therefore research activities could not be continued and originally planned survey items, such as serial tows for pollock and Pacific cod and measurement of distance between wings of the net at depths greater than 100 m, were cancelled. The vessel returned to Ishinomaki on June 17. A total of 60 tows (including failed and incomplete) were made during the 12 days from May 28 to June 8.

Research vessel and gears used

The *Fukushin maru No. 5* (registered in Iwaki, Fukushima) used in this survey is a Hokuten-type trawler with gross tonnage of 349.90 tons and is almost the same as vessels used previously as research vessels in the Bering Sea-Aleutian surveys since 1979. The general specifications of the vessel are shown in Table 1 and of the gears used in Table 2.

A characteristic of the net used was that height of the net mouth is as low as 2.5 to 3.0 m while that of the nets previously used was 5 m or greater.

Summary of survey

The nominal catch of major species for each type of research (excluding tagging) is shown in Table 3. Yellowfin sole was predominant in the catch followed by sablefish, Greenland turbot, rock sole, arrowtooth flounder, pollock, and Pacific cod. These seven species constituted 97% of the total catch.

1. Hourly changes in CPUEs of arrowtooth flounder and Greenland turbot

An experiment to determine whether CPUEs for arrowtooth flounder and Greenland turbot change between daytime and nighttime tows or with passage of time and whether there are any changes in stomach contents with changes in time was carried out. A total of twenty 30-minute tows were made during May 29 to 31 in a different area of operation each day.

The changes in catch of the three major species, arrowtooth flounder, Greenland turbot, and sablefish, are shown in Fig. 2 by hour (Japan Standard Time). In the area, the sun set slightly before 1700 hours and rose before 2300 hours (JST). All three species seemed to show differences in catch by area fished but diurnal or hourly changes could not be confirmed. It was extremely difficult for only one research vessel to haul such a large commercial type trawl net every two or three hours for three days and the number of samples and data will considerably increase if two vessels are used and haul the net in turn.

Most stomachs collected seemed to be empty but further detailed examination in the laboratory is required.

The size composition of Greenland turbot, arrowtooth flounder, and sablefish at surveyed areas of the continental slope are shown in Figs. 3 to 5, respectively.

2. Measurement of distance between wings by mensuration system

A total of 37 tows were made for flatfishes in areas shallower than 100 m on the continental shelf from June 1 to 8. The net zonde (FNR-80, Furuno Co. Ltd.) was attached horizontally to the center of the right wing and the distance between the wings of the net while being towed was measured. Sonic waves emitted from the zonde spread at an angle and echoes or reflections, not only from the other wing but also from the bottom, are possibly collected. Therefore, the sonic wave generator should be set with a fairly upward angle but it was extremely difficult to determine an appropriate angle so that reflections only from the other wing could be collected. Even though the zonde was set at an angle which seemed to be appropriate, the angle could not be maintained in many cases because the device struck the body of vessel when the net was thrown into the sea. Measurements which seem to have been successful were obtained only three times.

Although we are pessimistic about the measurements obtained using this device with a reflection receiving system, further detailed examination is to be made after receiving data from experiments in the second cruise in the Gulf of Alaska which starts in July.

3. Tagging of yellowfin sole

Five 15-minute tows were made on June 2. A total of 1,000 active yellowfin sole were selected from the catches, tagged with white disk tags (1.1 cm in diameter), attached on both sides of the musculature below the dorsal fin by using a nickel pin, and released.

The total length of tagged fish ranged from 172 to 392 mm (see "Release data of tagged groundfish in the Bering Sea in 1984", Doc. 2794).

4. Hourly changes in CPUEs of yellowfin sole and rock sole

A total of 17 tows were made during June 4 to 7 in an area about 60 m deep at the mouth of Bristol Bay where there is a main area of distribution of yellowfin sole. The objectives of these tows were to obtain data on hourly changes in CPUEs for yellowfin sole and rock sole and stomach samples for the study of feeding habits. In one of these tows, retrieval became impossible because too many yellowfin sole were caught in only 20 minutes fishing. All of the sole were returned to the sea without measurement or estimation of catch. Yellowfin sole seemed to be quite densely distributed in this area so subsequently only 5-minute tows were made.

Figure 6 shows the hourly changes in catches for four major species, yellowfin sole, rock sole, Pacific cod, and pollock which were caught in the 5-minute tows. For Greenland turbot and arrowtooth flounder, as noted earlier, no clear hourly or diurnal changes in CPUE were observed. All yellowfin sole, rock sole, and Alaska plaice had stomachs full of shellfish which appeared to be radiated nut clam (Nuculana pernula radiata). Subsequent detailed examination is necessary for determining the digested states of these shellfish, etc., in the laboratory.

5. Repeated tows at the same station

A total of 10 tows were made at a station with depth of 65 m somewhat west of the area described in Section 4. The objective of these tows was to estimate or determine the possibility of estimating catching efficiency. The tows were made repeatedly in a location estimated to be the same with the highest possible accuracy. Unfortunately, because the vessel location plotter, which is usually used to confirm that the location is the same as planned, did not work, the operations were made by relying on Loran C which shows location digitally. Therefore, no guarantee can be given that the locations for the 10 tows were exactly the same.

Figure 7 shows the changes by time in catches per 30-minute tow of yellowfin sole, rock sole, Pacific cod, and pollock. Because crew members rested or ate during 0500 to 0600 hours and 1000 to 1300 hours, no data were obtained at these times. The catches of rock sole and pollock showed a tendency to decrease in repeated tows at short intervals in the same location while the yellowfin sole catch showed the reverse.

Although the author is not fully confident because only one day's operation could be accomplished out of the three days originally planned, it seems to be possible to estimate the catching efficiency of the net by repeated operations in the same location for some species of fish. It is, however, quite difficult for one vessel to repeat tows at short intervals in exactly the same area. Data from this type of experiment can be obtained more efficiently and of higher quality if more than one of the same size and type of vessel is used.

Size compositions of the yellowfin sole, rock sole, and Alaska plaice caught in these operations are shown in Figs. 8 to 10.

6. Halibut incidentally caught

The location and numbers of halibut incidentally caught in this cruise are shown in Fig. 11 and their size compositions for continental slope and shelf areas are shown separately in Table 4 and Fig. 12. On the shelf areas, halibut were actually caught only at the mouth of Bristol Bay.

In the slope areas, 69 halibut were caught incidentally in eight tows out of 23 total tows. They were an average of 79.6 cm in fork length and 6.0 kg in body weight. At the mouth of Bristol Bay 118 halibut caught in 26 tows had an average fork length of 57.3 cm and body weight of 2.6 kg which was smaller than those taken in the slope areas.

TABLES 1 TO 4 AND FIGS. 1 TO 12 ARE IN ENGLISH IN THE JAPANESE DOCUMENT