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Cruise results of the winter 1999 Bering Sea pollock survey (*Kaiyo Maru*)

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1. Cruise description and objectives

The Hokkaido National Fisheries Research Institute (HNF) and the National Research Institute of Fisheries Engineering (NRIFE) conducted an echo integration mid-water trawl (EIMWT) survey of walleye pollock (*Theragra chalcogramma*) in the southeastern Bering Sea aboard the R/V *Kaiyo Maru* of the Fisheries Agency of Japan. In this area, the Alaska Fisheries Science Center (AFSC: MACE) has conducted annual surveys since 1988 with the NOAA ship *Miller Freeman*. In 1999, however, AFSC was not conducting this survey because the *Miller Freeman* was being repaired. Therefore, the 1999 *Kaiyo Maru* survey was an international cooperative work joined by AFSC and the Pacific Research Institute of Fisheries and Oceanography (TINRO-centre).

The primary objectives of the survey were:

1) To determine the geographical distributions of walleye pollock in the southeastern Aleutian Basin.

2) To collect echo integration data to determine the biomass of walleye pollock in the area.

3) To collect biological information on walleye pollock in the basin and shelf area.

4) To collect information on the oceanographic and biological environments during the winter in the area.

2. Survey area and cruise itinerary

We conducted the survey in the Specific Area (Bogoslof Island area) that is defined by the Annex of the Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea (CBS). The survey area (Fig. 1) encompassed the southeastern part of the Aleutian Basin around Bogoslof Island, Umnak Island (UI), and the Islands of Four Mountains (IFM). This area has been surveyed by the *Miller Freeman* since 1988 and is wholly enclosed within the U.S. Exclusive Economic Zone (EEZ).

The survey ran from late January to mid-March in 1999. To assess the area accurately, the *Kaiyo Maru* was allowed to survey within 3 miles of the U.S. coast. The survey was divided into two legs, both of which covered almost the same area. Acoustic system calibration and pollock sampling by hook and line were carried out in Captains Bay, Unalaska Island.

3. Research vessel

Ship name: *Kaiyo Maru* (Fisheries Agency of Japan, Tokyo)

Type: Stern trawler Tonnage: 2,630 tons

Length: 93.01 meters Radio call sign: JNZL

4. Crew and researchers on board

1) Crew: Captain Masaru Tanabe and 45 crew

2) Japanese Researchers

Researchers

Akira Nishimura, HNF (Chief scientist; biology)

Takashi Yanagimoto, HNF (Acoustic and oceanography)

Yoshimi Takao, NRIFE (Acoustic)

Assistant researchers

Seiji Katakura, Hokkaido Tokai University (Biology and acoustic)

Kyoko Mori, Tokyo University of Fisheries (Oceanography and acoustic)

Fuma Tanaka, Kagoshima University (Biology and Oceanography)

Kengo Nakanishi, Tokyo University of Fisheries (Acoustic)

3) Foreign researchers

Taina Honkalehto, Alaska Fisheries Science Center (U.S.A.)

Neal Williamson, Alaska Fisheries Science Center (U.S.A.)

Alexander Nikolaev, TINRO (Russia)

5. Vessel itinerary

Preliminary survey (in the adjacent waters of Tokyo)

Dec. 15, 1998	leave Tokyo
Dec. 16-21	Acoustic system calibration and noise measurements
Dec. 21	arrive Tokyo

Main survey (in the Bering Sea)

Jan. 21, 1999	leave Tokyo
Jan. 30-31 (U. S. date)	System calibration in Captains Bay, Unalaska Is.
Feb. 1-9	Leg 1 survey
Feb. 12	arrive Kodiak
Feb. 16	leave Kodiak
Feb. 19-20	System calibration in Captains Bay, Unalaska Is.
Feb. 21-Mar. 4	Leg 2 survey
Mar. 12 (Japanese date)	arrive Kushiro
Mar. 16	leave Kushiro
Mar. 19	arrive Tokyo; end of cruise

6. Methods

A standard sphere calibration of the acoustic systems was conducted at Manazuru

Bay, Japan in the preliminary survey and at Captains Bay in the beginning of each leg.

The EIMWT survey was conducted 24 hours per day in each leg. Acoustic data were collected continuously along a transect with a KJ2000 echo integration system (*Kaijo*). The *Kaijo* 38-kHz transducer was mounted on the hull. Ship speed and integration distance were usually kept between 8-10 knots and 1 nmi, respectively, through the survey. However, under noisy conditions (e.g., during bad weather), the ship speed was decreased to 4-6 knots. Transect spacing was designed to be 10 nmi, and in leg 2 it was reduced to 5 nmi where fish aggregations were observed (Table 1, Fig. 1). Southern transect endpoints were at approximately 100-m bottom depth. The northern extent of the 10 nmi-spaced transects was between approximately 54° 30' and 54° 40' N east of 168° W and between 53° 45' and 54° 30' N west of 168° W.

Biological sampling was conducted using a mid-water trawl net to identify the echo sign and to obtain biological data of the organisms. When significant echo sign appeared, the vessel returned to the area at typical signs, and a mid-water trawl was conducted. Hauling duration was kept to a minimum for obtaining adequate biological samples. Catch from the trawl was weighed and counted after sorting by species. A subsample of up to 300-500 pollock was selected randomly for length frequency analysis. An additional sample of 60 males and 60 females was collected, and length, maturity, and gonad weight were recorded. Maturity stages were classified according to U.S. manual. At the same time, parasites were observed, otoliths were dissected out, and a tissue sample was collected for genetic analysis.

Pollock abundance estimates were derived from the results of both acoustic and trawl data. Echo integration data were grouped into two areas for leg 1 data and three areas for leg 2 data as distinguished by echo sign characteristics, geographic location, length composition in the hauls, and transect spacing.

One CTD cast per day was carried out to collect oceanographic data. At the CTD station, a water sample was collected from selected depths. At the same time, plankton sampling was conducted by using a NORPAC net. At selected stations, an XBT/XCTD cast collected water temperature profiles.

7. Results

1) Sphere calibration

Sphere calibrations were conducted before this survey in Manazuru Bay on December 15-22. A tungsten carbide sphere (38.1 mm) was used for the 38-kHz calibration. In the Bering Sea, sphere calibrations were conducted twice in Captains Bay at the beginning of each leg. Sphere integration results are shown in Table 2. Only a slight change of TR factor (transmitting and receiving coefficient) was observed between each leg in the Bering Sea.

2) Catch composition and pollock distribution

Pollock were observed along the Aleutian Islands in the survey area. In the offshore

area, only scattered or few echo signs of pollock were observed. Echo signs of lanternfish were observed throughout the survey area. Most pollock were observed in extremely dense aggregations from Umnak Island to the Islands of Four Mountains. The highest concentrations were observed in the area northeast of the IFM. The vertical distribution of pollock echo sign ranged between 400 m and 600 m below the surface.

In leg 1, 6 trawl hauls were conducted (Fig. 2). Most of these trawl hauls were conducted to collect biological data of pollock from aggregations observed by acoustic instruments. The dominant catches were pollock followed by lanternfish. The pollock catch from T101, T103 and T104 was larger than 3,000 kg, and the biggest catch was obtained from T104 (Table 3). One trawl haul (T105) was conducted to identify the fish species of non-pollock echo sign. Most of the catches from this trawl haul were lanternfish and northern smoothtongue.

In leg 2, 8 trawl hauls were conducted. Two trawl hauls (T201 & T202) were made east of 167W, and the other hauls were made west of 167W along the shelf of UI and IFM. T203 and T204 were located north of UI, and T205-208 were located between UI and the IFM. The dominant catch species was pollock. More than 3,000 kg pollock catches were collected at T205 and T207 (Table 3).

3) Length and weight of pelagic pollock

Pollock from the IFM area showed length ranging 400-620 mm for male, and 430-670 mm in leg 2 (Fig. 3.3). Modal lengths of trawl hauls from IFM in leg 2 were observed 530-550 mm for male fish and 560-580 mm for female fish. No big difference was observed in the size range between leg 1 and leg 2 (Fig. 3.1). Average lengths at each trawl station are listed on Table 4. The female fish are about 30 mm larger than the male fish.

Pollock from the UI area showed length ranging 400-600 mm for male, and 410-660 mm in leg 2 (Fig. 3.2). Modal lengths from leg 2 trawl hauls were observed 530-540 mm for male fish and 550-570 mm for female fish (Fig. 3.2). Pollock from the UI showed almost the same mode length from the IFM, however occurrence frequency of the fish smaller than 500 mm length is a little higher than the IFM area. Sequentially, the mean length in this area became a little smaller (~10 mm) than the IFM area.

Three trawl hauls (T105, T201, and T202) were made from the area east of 167W in this survey. The length distributions from these 3 stations showed quite different patterns from those of the IFM and UI area (Figs. 3.1, 3.2). The major part of the fish was smaller than 500 mm, and those fish appeared to be younger fish. It was suggested that those younger fish were migrating from the adjacent shelf area. The length modes at T202 were 430 and 480 mm for males and 460 mm for females.

The average weight at each station is shown in Table 5. Average weights of pollock from the IFM in leg 2 ranged from 1.17 to 1.37 kg for males and from 1.44 to 1.69 kg for females.

The length-weight relationships were obtained for east and west of 167W. The

following equations were calculated from length-weight data of male and female fish from each leg by Geometric Mean Regression analyses.

East of 167W: $W=2.011\times10^{-7} \times L^{3.574}$ for leg 1

$W=1.097\times10^{-6} \times L^{3.306}$ for leg 2

West of 167W: $W=6.116\times10^{-7} \times L^{3.397}$ for leg 1

$W=4.882\times10^{-7} \times L^{3.432}$ for leg 2.

4) Sex ratio and maturity

Data from 6 trawl hauls in leg 1 showed that female percentages by haul ranged from 37-58% and averaged around 50%. In Leg 2, the female percentage ranged from 37-87%. Female percentages at T205-207 ranged from 72-87% in the IFM area where the major fish aggregations were observed. In this high-density area, we had to collect the fish from the upper layer to help minimize our sample size. This sex percentage might be affected by the difference in the vertical distribution of male and female fish. T208, located at the edge of a high-density aggregation of spawning fish, had a percentage of female fish that was 40%.

Maturity compositions differed between sexes. Maturities for males were 70% pre-spawning1 (stage4), 30% pre-spawning2 (stage5), and only a few percentage of the fish were classified to spawning stage (stage6) in leg 1. As time elapsed, the percentage of pre-spawning2 stage increased from 30% to 80% in leg 2. At the last trawl in this survey, conducted on Mar. 3, 30% of the fish were classified to be spawning stage.

Among the female pollock, 10-20% were in a pre-spawning2 stage, and the remaining 80% were in a pre-spawning1 stage in both leg 1 and 2. Though the maturity stage in leg 2 did not show obvious differences, the number of hydrate eggs significantly increased. Spawning females were not observed in the sample for biological measurements; however, a few spawning females were observed in the length frequency sample at the end of the survey.

5) SA distribution and biomass estimates

Horizontal SA distribution is shown in Fig. 4. Dense fish aggregation was found in the area from UI to the IFM. The survey area was divided into 3 areas: east of 167W (2-1), inshore west of 167W (2-2), and offshore west of 167W (2-3). The transect spacing of each area was 10 nmi, 5 nmi, and 10 nmi, and the estimated biomass of each area was 78,257 t, 380,560 t, and 16,494 t, respectively (Table 6). Most of the pollock echo sign was distributed in the shore side in the west of 167W. Total biomass estimate from the whole survey area in leg 2 was 475,312 tons. Since the CBS specific area is defined as the area between 167W and 170W, area 2-1 and the westernmost two transects in the area 2-2 and 2-3 should be excluded from the biomass estimates. In this case, the total biomass estimates for the CBS specific area was 392,537 t.

6) Other sampling activity

Otoliths were collected from about 1,000 pollock during leg 2 for age determination and shipped to the Alaska Fisheries Science Center. Ages determined by AFSC will be used for future analysis to keep the consistency of ageing results. Additional otoliths were collected for the Japanese Institute.

Information about parasites was obtained and stomach, ovary, and genetic samples were also collected. Oceanographic data were also collected. These samples and data were transferred to HNF and will be used for future study. In addition, fin-clip samples were collected for future genetic analysis at AFSC.

Inter-system calibration between KJ2000 and EK500 was conducted.

Acknowledgements

In order to get accurate biomass estimates in the CBS specific area, the *Kaiyo Maru* was allowed to conduct a trawl survey inside the 3-mile territorial waters of the U.S. We appreciate all the people who worked to make this arrangement possible. U.S. and Russian onboard scientists gave us precious information. We thank them for their good cooperation during the survey. We also thank the captain and crew of the *Kaiyo Maru*.

We thank Drs. Neal Williamson, Taina Honkalehto, and Steve deBlois of AFSC for their comments on the manuscript.

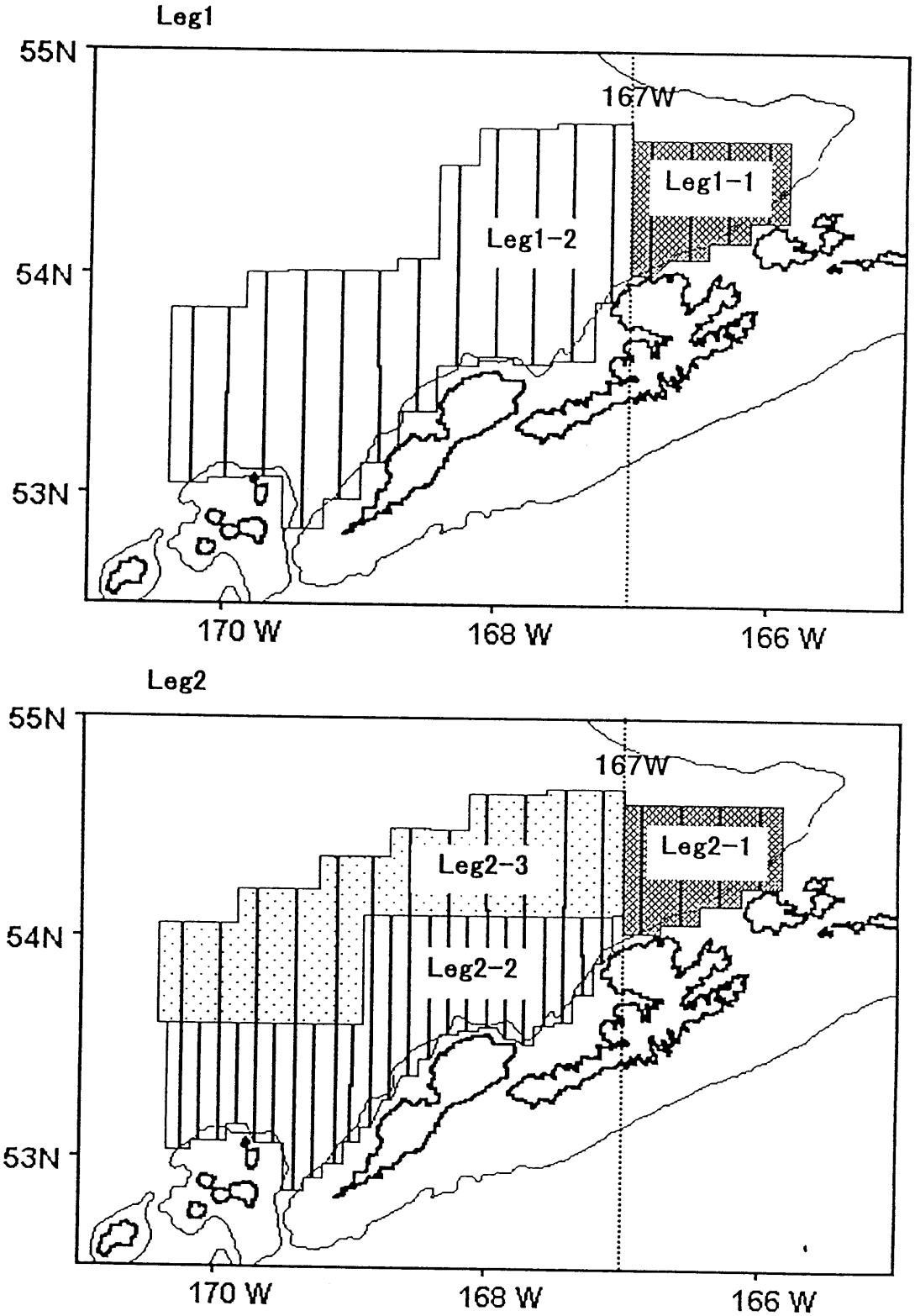


Fig. 1. Transect lines of the winter 1999 *Kaiyo Maru* survey. Eastern and western areas were divided at 167° W longitude. Biomass estimations were conducted by each area.

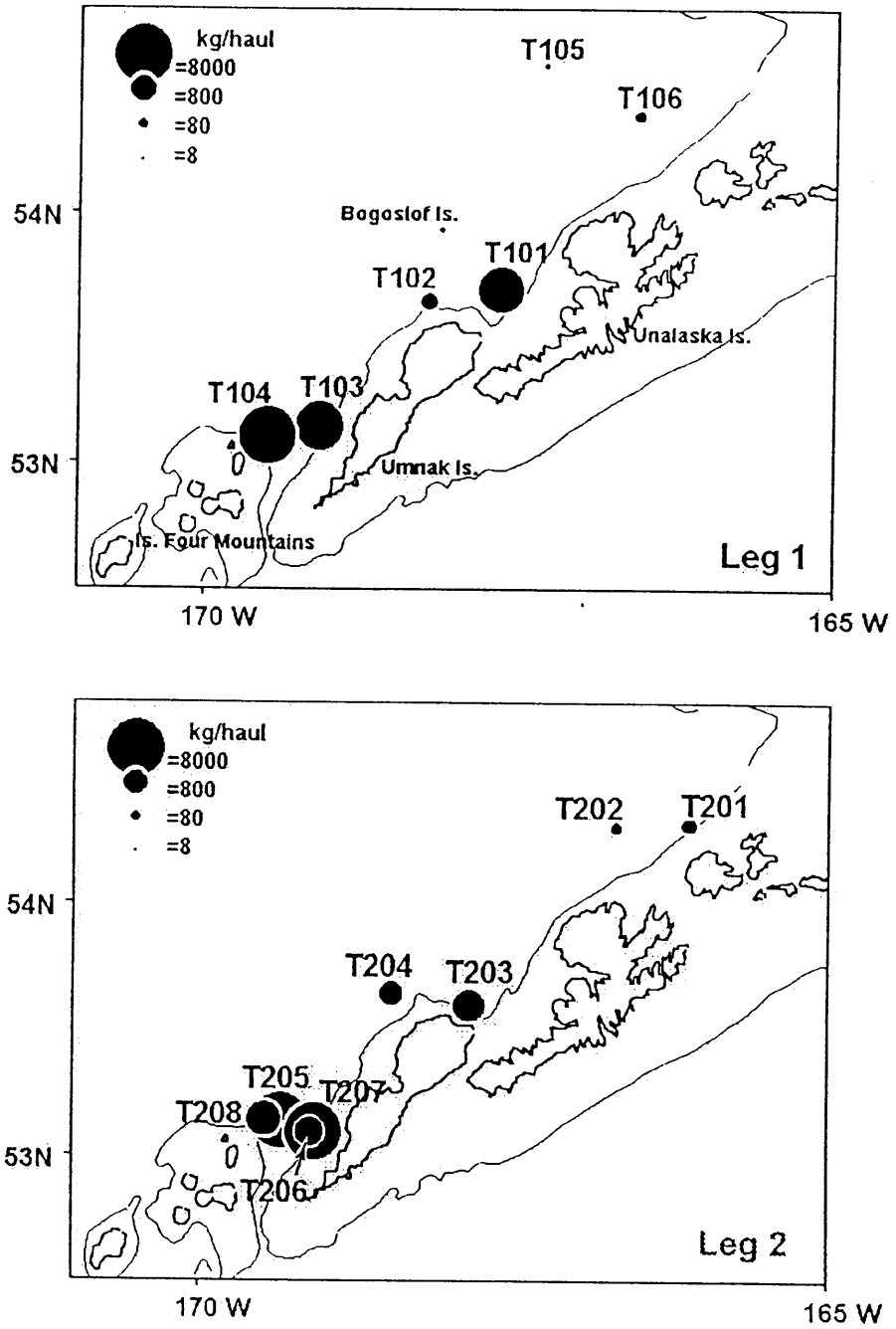


Fig. 2. Catch(kg/haul) of adult walleye pollock by mid-water trawl net in the *Kaiyo Maru* 1999 survey.

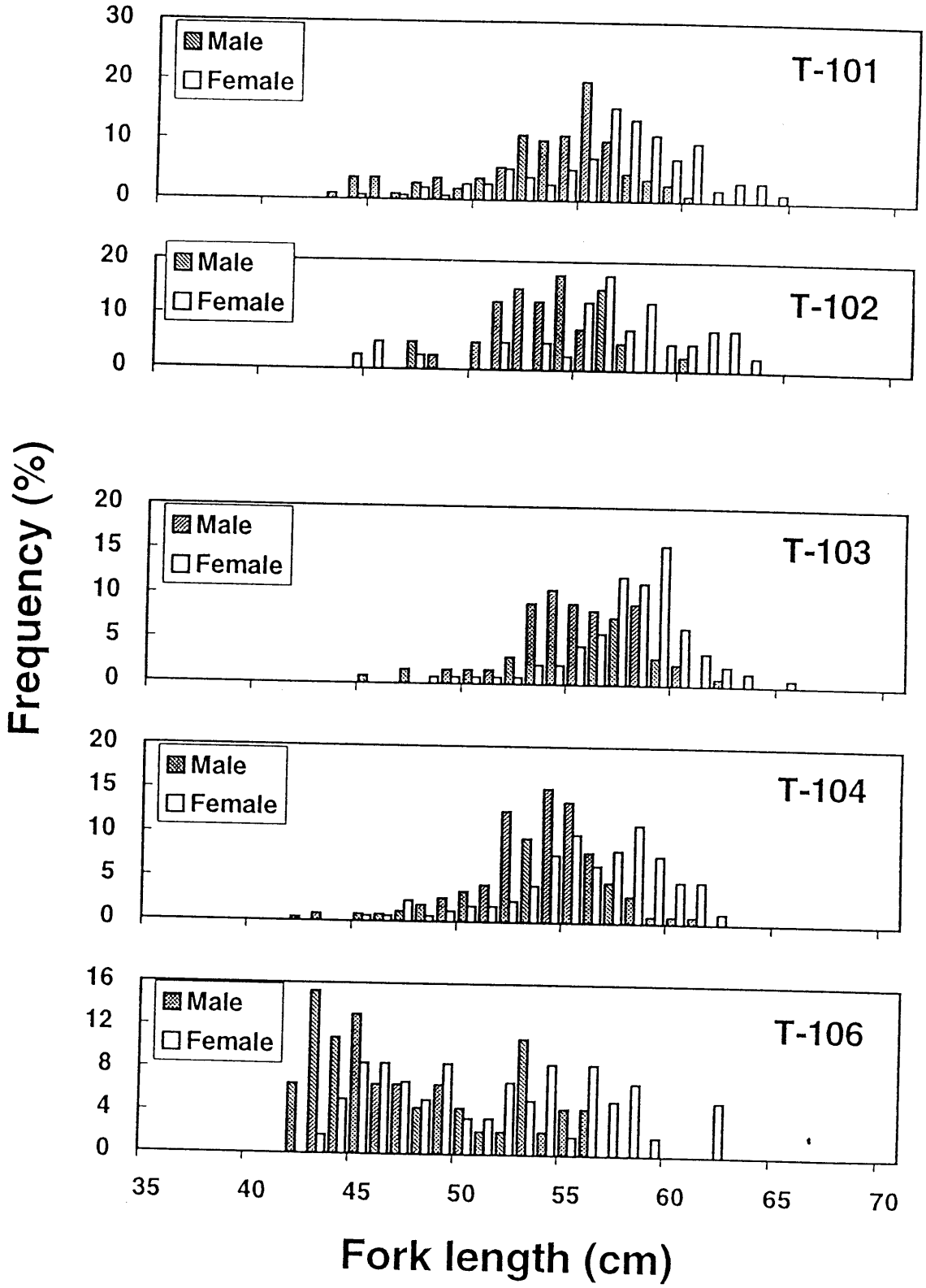


Fig. 3.1 Length frequency distribution of walleye pollock collected in leg1, 1999 Kaiyo Maru survey.

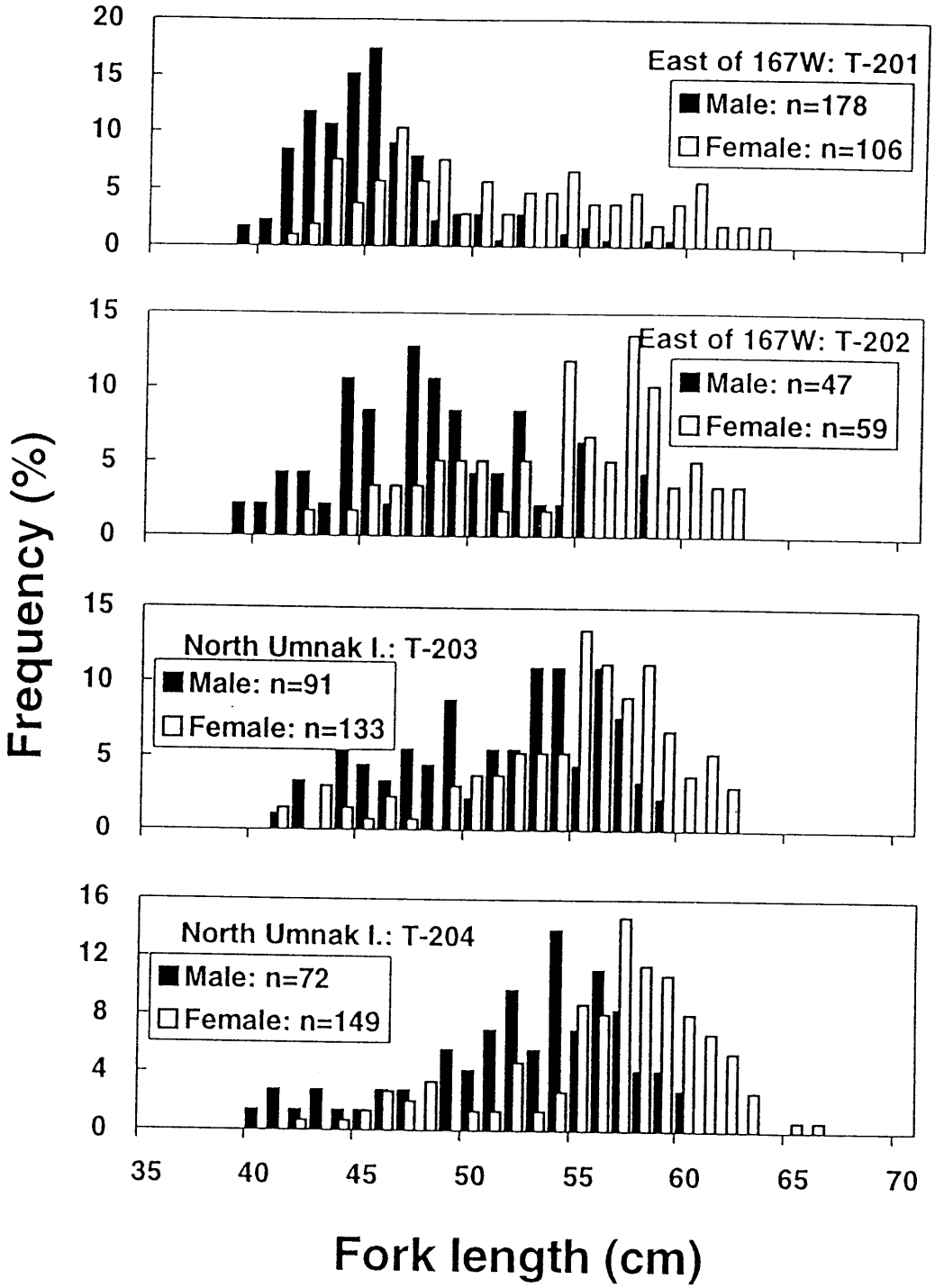


Fig. 3.2 Length frequency distribution of walleye pollock collected in leg2, 1999 Kaiyo Maru survey (West of 167W, and North of Umnak Island).

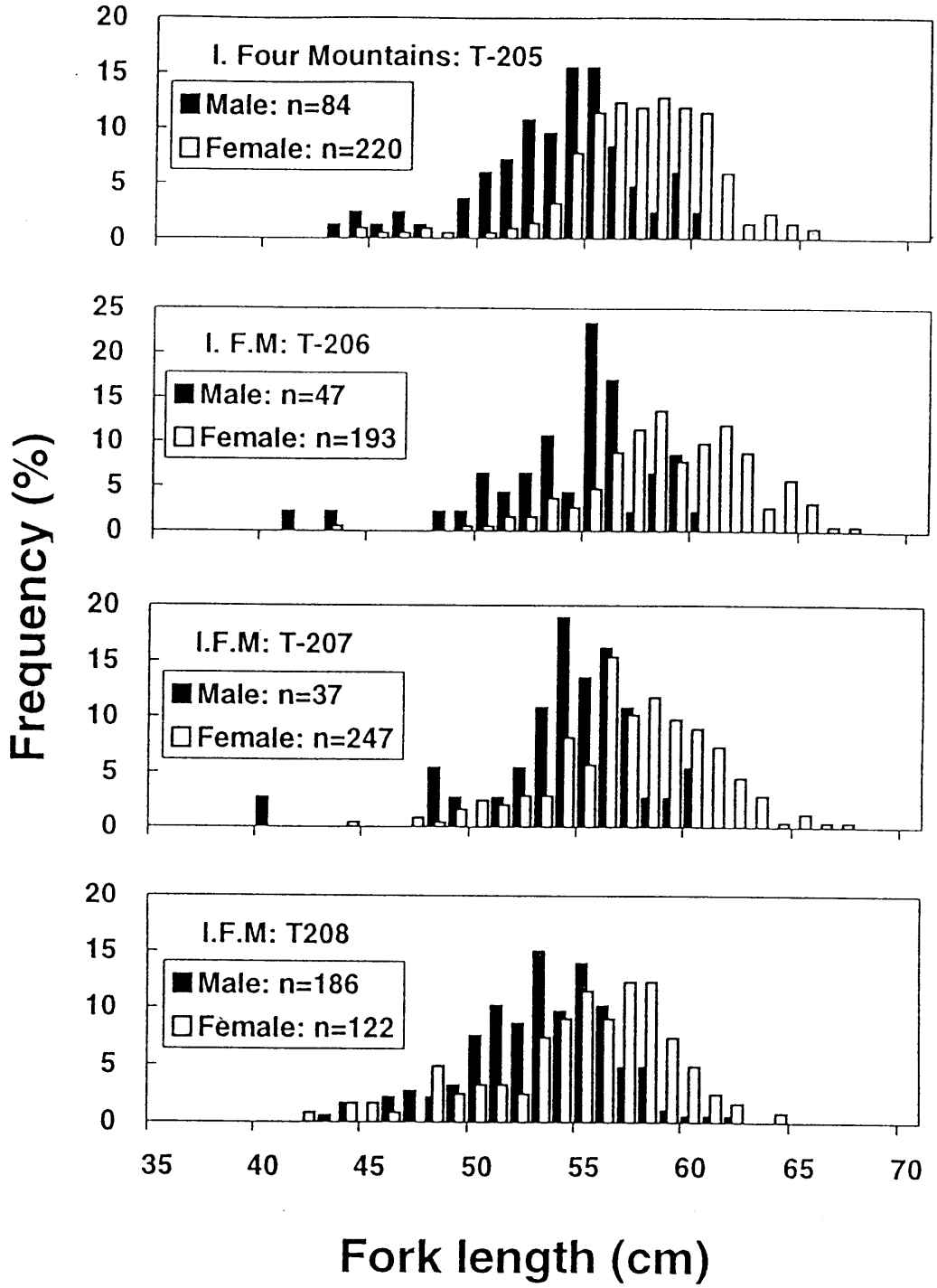


Fig. 3.3. Length frequency distribution of walleye pollock collected in leg2, 1999 Kaiyo Maru survey (Islands of Four Mountains area).

Table 1. Start and end positions of each transect line(TR) in 1999 *Kaiyo Maru* survey.

Leg	TR	Start position		End position		AVG.SA	Distance	Data No.
		Latitude	Longitude	Latitude	Longitude	(dB)	(nm)	
Leg1	T1	N54-14.79'	W166-00.87'	N54-35.71'	W166-00.84'	-45.81	20.9	149
	T2	N54-35.28'	W166-18.61'	N54-09.35'	W166-17.76'	-48.09	25.9	224
	T3	N54-35.82'	W166-35.19'	N54-04.86'	W166-35.51'	-51.25	31.0	325
	T4	N54-00.84'	W166-52.35'	N54-35.87'	W166-52.56'	-52.93	35.0	370
	T5	N54-40.01'	W167-09.63'	N53-53.43'	W167-09.49'	-55.54	46.6	544
	T6	N53-37.68'	W167-26.48'	N54-40.22'	W167-26.90'	-55.43	62.5	526
	T7	N53-47.82'	W167-43.81'	N54-38.38'	W167-43.50'	-51.46	50.6	597
	T8	N54-38.44'	W168-00.82'	N53-37.76'	W168-00.65'	-61.99	60.7	496
	T9	N53-32.13'	W168-17.38'	N54-28.71'	W168-17.76'	-52.78	56.6	483
	T10	N53-23.86'	W168-34.88'	N54-03.94'	W168-34.54'	-54.66	40.1	331
	T11	N53-09.68'	W168-51.36'	N54-00.01'	W168-51.67'	-51.49	50.3	458
	T12	N54-00.18'	W169-08.28'	N52-59.30'	W169-08.22'	-47.71	60.9	513
	T13	N52-51.84'	W169-24.87'	N54-00.06'	W169-25.10'	-59.05	68.2	602
	T14	N54-00.03'	W169-42.09'	N53-04.85'	W169-41.86'	-59.36	55.2	485
	T15	N53-05.28'	W169-59.14'	N53-50.17'	W169-58.48'	-58.27	44.9	382
	T16	N53-50.36'	W170-14.89'	N53-02.50'	W170-14.68'	-54.33	47.9	426
Leg2	T1	N54-14.97'	W166-00.57'	N54-35.95'	W166-00.85'	-43.85	21.0	172
	T2	N54-35.83'	W166-18.11'	N54-09.14'	W166-17.94'	-48.29	26.7	221
	T3	N54-04.83'	W166-35.23'	N54-35.71'	W166-35.13'	-50.77	30.9	257
	T4	N54-35.81'	W166-52.36'	N54-01.92'	W166-52.53'	-54.17	33.9	310
	T5	N53-54.50'	W167-09.25'	N54-39.77'	W167-09.47'	-51.38	45.3	371
	T6	N54-40.10'	W167-26.14'	N53-37.91'	W167-26.51'	-52.04	62.2	564
	T7	N53-45.76'	W167-18.17'	N54-04.87'	W167-18.27'	-50.12	19.1	162
	T8	N54-05.12'	W167-35.31'	N53-36.54'	W167-35.20'	-46.42	28.6	223
	T9	N53-32.27'	W167-43.66'	N54-38.35'	W167-43.65'	-49.94	66.1	567
	T10	N54-38.44'	W168-00.84'	N53-36.03'	W168-00.79'	-53.52	62.4	561
	T11	N53-33.44'	W167-52.25'	N54-05.07'	W167-52.27'	-47.63	31.6	252
	T12	N54-04.99'	W168-09.09'	N53-34.61'	W168-09.04'	-51.98	30.4	262
	T13	N53-32.17'	W168-17.36'	N54-28.56'	W168-17.45'	-52.00	56.4	474
	T14	N54-28.80'	W168-34.50'	N53-23.36'	W168-34.56'	-53.73	65.4	591
	T15	N53-27.90'	W168-26.12'	N54-04.99'	W168-25.95'	-52.09	37.1	342
	T16	N54-05.04'	W168-42.98'	N53-16.55'	W168-43.07'	-56.94	48.5	440
	T17	N53-09.76'	W168-51.31'	N54-20.78'	W168-51.47'	-59.86	71.0	638
	T18	N52-59.34'	W169-07.10'	N54-20.65'	W169-07.16'	-44.68	81.3	670
	T19	N53-35.08'	W168-59.76'	N53-04.93'	W168-59.90'	-49.80	30.1	272
	T20	N53-35.12'	W169-16.61'	N52-55.02'	W169-16.67'	-39.68	40.1	359
	T21	N52-52.05'	W169-25.11'	N54-12.06'	W169-25.06'	-48.21	80.0	717
	T22	N53-04.92'	W169-41.93'	N54-12.05'	W169-41.89'	-54.33	67.1	562
	T23	N53-35.06'	W169-33.59'	N53-04.02'	W169-33.49'	-50.04	31.0	264
	T24	N53-35.10'	W169-50.29'	N53-09.62'	W169-50.28'	-56.82	25.5	226
	T25	N53-05.35'	W169-58.63'	N54-02.48'	W169-58.76'	-57.48	57.1	472
	T26	N53-02.51'	W170-15.49'	N54-02.39'	W170-15.47'	-59.48	59.9	500
	T27	N53-35.08'	W170-07.13'	N53-05.13'	W170-07.33'	-55.06	29.9	245

Table 2. Calibration results of KJ-2000 quantitative echo-sounding system

Date	Aug. 28/98		Dec. 17/98		Jan. 28/99		Feb.19/99	
Place	Manazuru Bay		Manazuru Bay		Captain's Bay		Captain's Bay	
Weather Condition	Good		Good		Fair		Fair	
Water temperature(degree)	23.4		18.2		4.4		3.1	
Salinity(ppt)	34		34.4		32.3		32.5	
Sound speed (m/s)	1530		1516		1465		1461	
Type of Standard Sphere	Copper		Tungsten carbide		Tungsten carbide		Tungsten carbide	
	60.0 mm		38.1 mm		38.1 mm		38.1 mm	
TS of Standard Sphere (dB)	-33.6		-42.4		-42.2		-42.2	
Beam Channel	Narrow	Wide	Narrow	Wide	Narrow	Wide	Narrow	Wide
Pulse width (ms)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Effective pulse width (ms)	1.11	1.08	1.11	1.08	1.11	1.08	1.11	1.08
TR factor* (dB)	64.6	65.5	64.6	65.7	62.5	63.4	62.4	63.2

*TR factor = (source level) + (receiving sensitivity) + (gain of pre-amplifier)

Table 3. Summary of catch (kg) by species in mid-water trawls during 1999 winter *Kaiyo Maru* survey in the southeastern Aleutian Basin.

Trawl st / Scientific name	Leg 1						Total
	T101	T102	T103	T104	T105	T106	
Theragra chalcogramma	4268	317	5000	8000	1.1	98	17684.5
Myctophidae	44.8	106.0	83.3		41.0	57.5	332.6
Squids	3.6		3.2	2.5	1.1	17.9	28.3
Oncorhynchus tschawytsha	2.9	1.4	6.0	3.3		0.6	14.2
Aptocyclus ventricosus	2.0	2.0	3.3	2.1			9.3
Shrimp	6.9				0.7	1.2	8.8
Sebastes aleutianus	4.2						4.2
Oncorhynchus keta			0.9				0.9
Entosphenus tridentatus		0.7	0.2				0.9
Reinhardtius hippoglossoides			0.7				0.7
Atheresthes stomias				0.7			0.7
Eelpouts			0.6				0.6
Bathylagidae					0.3		0.3
Others	0.7						0.7

Trawl st / Scientific name	Leg 2								Total
	T201	T202	T203	T204	T205	T206	T207	T208	
Theragra chalcogramma	246	113	1590	607	7800	1272	8147	1953	21728.0
Myctophidae	179.7	90.4	25.7	310.5	+	20.6	+		626.9
Squids	35.9	21.5	0.7	16.7	3.6	0.7	3.3	3.2	85.7
Oncorhynchus tschawytsha			4.8	2.5	2.8	1.3			11.4
Shrimp	5.3	2.1	0.2	2.8	+	+	+		10.4
Coryphaenoides pectoralis		2.6		5.3					7.9
Somniosus pacificus		6.8							6.8
Aptocyclus ventricosus			1.4	1.7				2.5	5.6
Oncorhynchus keta		1.6		1.4	1.9				4.9
Entosphenus tridentatus	0.3		0.6	0.6			0.3		1.8
Atheresthes stomias						1.7			1.7
Sebastes borealis								1.4	1.4
Osmerus eperlanus	0.1		0.1						0.2
Paralepididae	0.1	0.1	0.1						0.2
Osmerus eperlanus		0.1				0.0			0.1
unknown sp		0.0				0.1			0.1
Others									0.0

Table4. Average length of walleye pollock collected at each Mid-water trawl

	Male	Female	Combined(1:1)
Leg1			
T101	534	567	550
T102	536	565	550
T103	555	581	568
T104	539	564	552
T105	-	-	-
T106	479	518	498
Leg2			
T201	455	514	484
T202	484	543	513
T203	519	552	536
T204	530	569	550
T205	538	576	557
T206	546	592	569
T207	547	576	561
T208	535	555	545

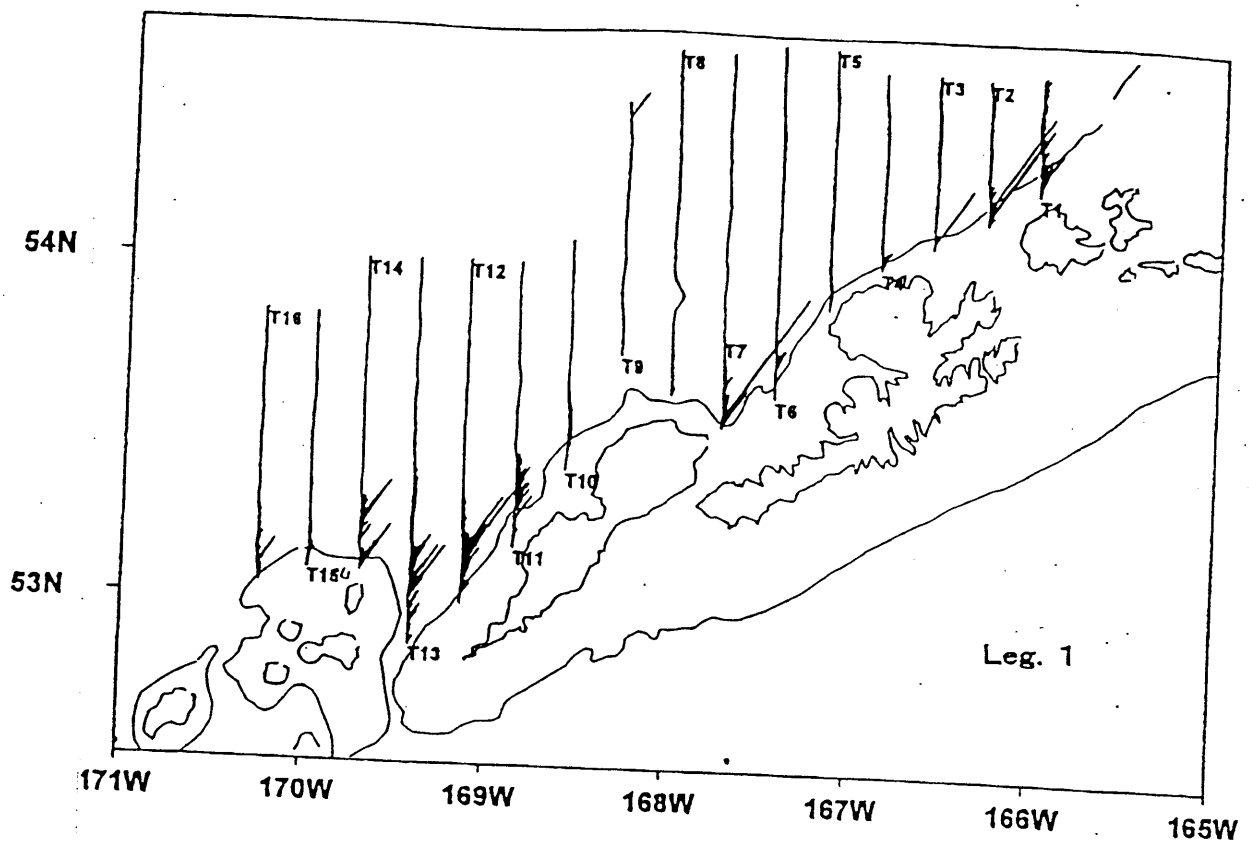
		Male	Female	Combined
Four Mountain Is.	T103	555	581	568
	T104	539	564	552
	T205	538	576	557
	T206	546	592	569
	T207	547	576	561
	T208	535	555	545
	Combined (not weighted by the catchs)	543	574	559
Umnak Is.	T101	534	567	550
	T102	536	565	550
	T203	519	552	536
	T204	530	569	550
	Combined (not weighted by the catchs)	530	563	547
NE area	T106	479	518	498
	T202	484	543	513
	Combined (not weighted by the catchs)	481	530	506
SE area	T201	455	514	484

Table 5. Pollock catch, sex ratio, and average weight at each mid-water trawl haul.

Trawl st.	Pollock catch		Random length freq. Sample				
	Number	Weight (kg)	Number			Average weight	
			Male	Female	F. rate	Male	Female
Leg1						(kg)	
T101	3061	4268	110	154	58%	1.23	1.51
T102	248	317	47	48	51%	1.14	1.40
T103	3581	5000	92	100	52%	1.26	1.52
T104	6157	8000	223	131	37%	1.22	1.43
T105	1	1	-	-	-	-	-
T106	105	98	46	59	56%	0.77	1.07
Leg2							
T201	284	246	178	106	37%	0.69	1.16
T202	106	113	47	59	56%	0.86	1.23
T203	1271	1590	91	133	59%	1.05	1.39
T204	450	607	72	149	67%	1.12	1.46
T205	5308	7800	84	220	72%	1.19	1.58
T206	782	1272	47	193	80%	1.37	1.69
T207	5334	8147	37	247	87%	1.29	1.56
T208	1529	1953	186	122	40%	1.17	1.44

Table 6. Biomass and numbers of pollock for total and each estimated area from the 1999 *Kaiyo Maru* echo integration-trawl survey.

Leg	Estimate area	Biomass (ton)	Number (thousands)	Transect	Trawl
1	Total	268,178	230,242	1-16	
	Leg1-1	66,540	74,189	1-4	T106
	Leg1-2	201,003	156,052	5-16	T101,3,4
1-CBS	Leg1-2	192,004	149,066	5-15	
2	Total	475,312	415,860	1-27	
	Leg2-1	78,257	98,047	1-4	T201,2
	Leg2-2	380,560	304,610	5-27(Shore)	T203,4,5,6,7,8
	Leg2-3	16,494	13,202	5-26(Offshore)	
2-CBS	Total	392,537	314,197	5-25	
	Leg2-2	376,043	300,995	5-25(Shore)	
	Leg2-3	16,494	13,202	5-25(Offshore)	



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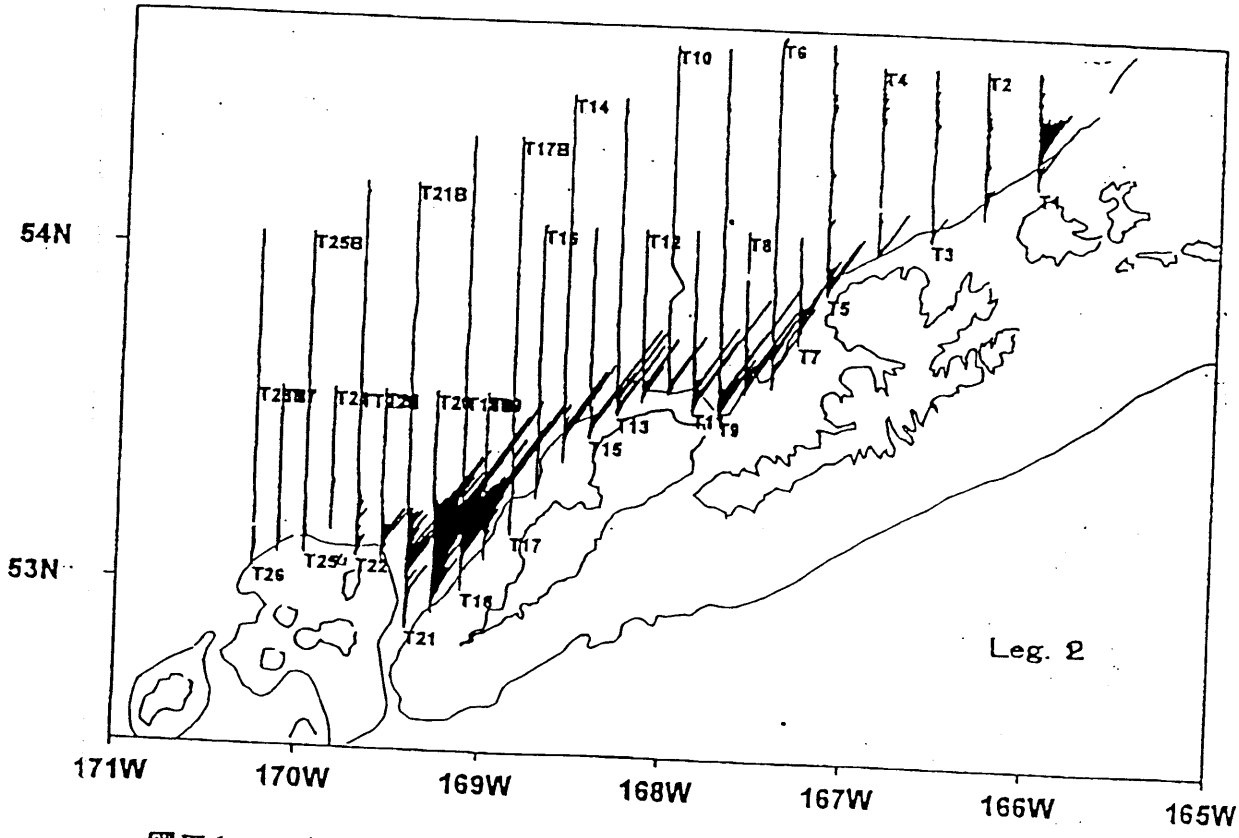

図Ⅲ4－4. 各トランセクトでのスケトウダラのSA分布

Figure 1 Relative acoustic density of walleye pollock along each transect.