A Hydroacoustic Survey of Pacific Hake on the Continental Shelf off British Columbia from the Canada/U.S. Boundary to Queen Charlotte Sound: August 15-31, 1994

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A HYDROACOUSTIC SURVEY OF PACIFIC HAKE ON THE CONTINENTAL SHELF OFF BRITISH COLUMBIA FROM THE CANADA/U.S. BOUNDARY TO QUEEN CHARLOTTE SOUND: AUGUST 15 - 31, 1994

by

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ABSTRACT

Cooke, K., M. W. Saunders, W. T. Andrews, and R. Kieser. 1996. A hydroacoustic survey of Pacific hake on the continental shelf off british columbia from the Canada/U.S. boundary to Queen Charlotte Sound: August 15 - 31, 1994. Can. Manuscr. Rep. Fish. Aquat. Sci. 2363: 51p.

A hydroacoustic survey for Pacific hake (*Merluccius productus*) was conducted off Vancouver Island and into Queen Charlotte Sound from August 15 to 31, 1994 to determine the distribution and abundance of hake in the study area. Acoustic biomass for all species and for hake are given. Summary information of associated midwater trawl catches is included. Trawling operations were conducted to verify acoustic targets and to examine the hake size distribution and age composition as a function of latitude. Young-of-the-year hake were observed for the first time off Vancouver Island and extended as far north as Quatsino Sound. Distribution of hake stocks in relation to oceanographic conditions is discussed.

Key words: Hydroacoustic survey, Pacific hake, echo integration, biomass, distribution, abundance, oceanographic conditions

RÉSUMÉ

Cooke, K., M. W. Saunders, W. T. Andrews, and R. Kieser. 1996. A hydroacoustic survey of Pacific hake on the continental shelf off british columbia from the Canada/U.S. boundary to Queen Charlotte Sound: August 15 - 31, 1994. Can. Manuscr. Rep. Fish. Aquat. Sci. 2363: 51p.

Entre le 15 et le 31 août 1994, les auteurs ont effectué un relevé hydroacoustique au large de l'île de Vancouver, jusqu'au détroit de la Reine-Charlotte, afin de déterminer la répartition et l'abondance du merlu du Pacifique (*Merluccius productus*) dans la zone d'étude. Les biomasses estimées par détection acoustique de toutes les espèces de poissons et du merlu sont présentées, ainsi que des informations sommaires sur les prises réalisées au chalut pélagique. Le chalutage a permis de vérifier les résultats obtenus par détection acoustique et d'étudier la répartition selon la taille et la composition par âge des merlus en fonction d'un gradient latitudinal. Des jeunes merlus de l'année ont été observés pour la première fois au large de l'île de Vancouver et plus au nord jusqu'à la baie Quatsino. La distribution des stocks de merlus en fonction des conditions océanographiques est analysée.

Mots clés: Relevé hydroacoustique, merlu du Pacifique, échointégration, biomasse, distribution, abondance, conditions océanographiques.

INTRODUCTION

Pacific hake *(Merluccius productus)* is a migratory species that spawns annually in U.S. waters off California and feeds during the summer months from northern California to Queen Charlotte Sound. Hake in Canadian waters tend to be larger than in southern waters and predominantly female.

Pacific hake is a valuable resource harvested annually in U.S. and Canadian fisheries. Pacific hake were under utilized up to the mid-eighties, however in recent years quotas have been fully subscribed. Hydroacoustic estimates of abundance are used in assessments and in studies of the factors influencing distribution.

The first Canadian quantitative hydroacoustic survey to determine distribution and abundance of Pacific hake off southern Vancouver Island was conducted in 1983 (Barner et al. 1984). From 1987 through 1989, qualitative surveys to examine the distribution and biology of hake from the Canada/U.S. border to Queen Charlotte Sound were carried out (M. Saunders, unpublished data). Results of these surveys indicated substantial hake concentrations from the Canada/U.S. border to Goose Island Gully in Queen Charlotte Sound. The presence of signatory strong year-classes, not found in local populations, indicated that these hake were part of the migratory offshore stock. Annual quantitative surveys of this area have been conducted since 1990 (Saunders et al. 1992; Cooke et al. 1992; Andrews et al. 1994; Saunders et al. in prep). This report describes the 1994 survey. The primary objective of this survey was to determine the distribution and abundance of hake in the study area. Mid-water trawls were conducted to verify acoustic targets and to examine the hake size distribution and age composition as a function of latitude.

This report includes a description of the study areas, survey design, acoustic data acquisition system, analysis procedures, and fishing results. Acoustic biomass estimates and distribution maps for all fish species and for Pacific hake are presented. Trawl catch composition and biological information for Pacific hake and other species are provided.

MATERIALS AND METHODS

The survey was conducted August 15 to 31, 1994 from the *CSS W.E. RICKER*, a 58 m, 2500 h.p. research stern trawler. The survey design and instrumentation were similar to those used in earlier surveys (Barner et al. 1984; Kieser 1983; Saunders et al. 1992; Cooke et al. 1992; Andrews et al. 1994; Saunders et al. in prep).

SURVEY AREA

The overall survey area included the traditional Canadian hake fishing grounds between 48° 15' and 49°. Additionally, waters north to Cape St. James and Queen Charlotte Sound were surveyed. Transects ran westward from about 50 m depth as far as the 1000 m contour or until concentrations of hake diminished.

The survey area was divided into three major transect groups (Table 1; Figures 1a-c). The A and B series transects covered the continental shelf area off southwest Vancouver Island from the Canada/U.S. border to 49°. A grid of east/west parallel transects was used with a distance between transects for the A series of 4.6 km (2.5 nmi) and 9.25 km (5.0 nmi) for the B series. The C series transects extended the coverage from 49°, just north of Barkley Sound, to Cape St. James, Queen Charlotte Sound and the entrance to Queen Charlotte Strait. Previous sounding surveys indicated that in areas north of the La Perouse region (48.5°), hake were generally found in an intermittent band near the shelf break (Saunders et al. 1992; Cooke et al. 1992; Andrews et al. 1994; Saunders et al. in prep). The C series incorporated a 9.25 km (5 nmi) parallel grid and connecting zig-zag transects to survey this region. The survey was conducted during daylight hours, from about 0600 to 2100 PDT.

DATA ACQUISITION and ANALYSIS

The calibrated echo integration system installed on the *CSS W.E. RICKER* consisted of a BioSonics 38 kHz echo sounder, a BioSonics chart recorder, a BioSonics digital echo integrator, a PCM/VCR tape recording system and auxiliary equipment. The "wet end" included a towed body with a Simrad ceramic transducer and armoured tow cable. The echo integrator was programmed to analyze the return echoes for a series of strata (range slices) starting just below the transducer and continuing to bottom. Standard data acquisition procedures were used (Burczynski 1982; Clay and Medwin 1977; Forbes and Nakken 1972; Kieser et al. 1987).

Figures 2a and 2b shows portions of an echogram that was recorded at the shelf break. Horizontal range, vertical sequence and short minute marks are indicated by the solid lines. Bottom tracking is monitored by a line following the bottom. Although not visible in either portion of this echogram, a surface echo occasionally appears between 5 and 10 m range. This signal is used to estimate the depth of the towed body and transducer. It is excluded from the subsequent analysis. The range of the surface echo is added to the target range shown on the echogram to estimate target depth. Bottom tracking was obtained with a 5 m bottom buffer. An echo integration sequence was completed every 30 pings (1 minute) with a ping interval of 2 seconds (.5 Hz) and the measured echo intensities were stored on a personal computer. The echo integrator and chart recorder thresholds were set to 0.2 V. Thus, all integrated echoes were displayed on the echogram. At this low threshold level some noise pulses caused by the increasing time-varied gain were visible on the deeper portions of the echogram. Significant noise levels were excluded during the analysis. These included flow and vessel noise, plankton and some juvenile fishes layers, and porpoises in the vicinity of the towed body. Surface densities for adult hake and all species other than hake were calculated using target strengths of -35 dB/kg, and -32 dB/kg, respectively (Cooke et al. 1992; Kieser 1992); juvenile hake abundance was estimated based on a TS of -26.4 dB/kg (Nakken and Venema 1983) in order to plot distributions but was not included in the total biomass estimates (Table 2; Figures 4a-b, 5a-b and 6a-b).

The processed integrated output was incorporated into the raster-based CompuGrid geo-spatial analysis system (GIS; Langford 1991) to obtain geographically referenced displays of transects and surface density distributions (Figures 1a-c, 3a-c, 4a-b, 5a-b and 6a-b). Abundance estimates were derived using PROXIMAL analysis (Kieser and Langford, 1991; Langford 1992; Cooke et al. 1992; Andrews et al. 1994; Saunders et al. in prep). All echoes from adult fish-like targets were included in the analysis to obtain total (all species) biomass estimates; a subset of these data, identified as hake, were used to estimate hake abundance.

Using the GIS, a geographically referenced surface density matrix with a spacing of 300 m between elements was generated for each area. The study area was defined using all measurements taken by constructing a mask to delineate the survey area (Figures 3a-b). The measurement locations were first assigned unique codes specific to their location and transect. Using the BUFFER program (Langford 1992), we then expanded each code from the point of origin an appropriate number of elements to fill the area between measurements. Given a buffer distance larger or equal to half the distance between transects, a dividing line equidistant between lines will result. Coastline and bathymetric data were then overlaid to outline depths greater than 50 m. With the drawing tools provided by the GIS, we filled in missed areas or cropped unwanted portions. For example, at the seaward extension of the B transects, end-points of the longest transects were connected to include the maximum extent of target distributions observed and thus fill in areas between transects that were not surveyed because of time constraints. Near shore, end-points of the A series were joined approximately along the 50 m depth contour which limited the area of extrapolation to depths greater than 50 m. An outline of the resulting mask is shown in Figures 3a-b with the transects enhanced for ease of reference. The fish surface densities for the matrix were obtained by averaging over 3 minutes (~900 m) all the one minute measurements that were made along each transect. The resulting values were scaled over the available integer range, 0 to 32000, to obtain maximum density resolution.

Using the mask, surface density matrix, and proximal analysis, each unknown point (element) within the mask was assigned the value of the nearest measured surface density. The POLYGON STATISTICS option (Langford 1992) calculated a biomass estimate by summing the appropriate mask elements and multiplying by the cell area of 300 x 300 m^2 (Table 2).

SPECIES IDENTIFICATION

We used the echogram and trawl catch data to identify targets by species. Targets observed on the echogram are classified according to several criteria (Figures 2a-b). Day time rockfish schools are typically seen at depths of 100 m to bottom (~160 m) near the shelf break. They often appear as column-like schools just beyond the shelf break or near steep slopes or pinnacles (Figure 2a). Herring are often characterized by dense 'haystack-type' schools near the bottom or 'needle shaped' schools in mid-water (Figure 2a). In Figure 2b, hake appear between 160 and 300 m in a dense band that continues outward from the shelf break; plankton are indicated by a diffuse scattering layer starting at the shelf break and underlying the hake distribution. In the day, hake schools often form cone-like clusters which produce a zigzag pattern across the echogram. Aggregations of young-of-the-year hake generate similar echograms (Figure 2b). Discrimination between juvenile and adult hake was based on test fishing and on incidental observations of albacore tuna on the echogram, seen in association with juvenile hake schools (Figure 2b). The tuna sign was confirmed by incidental catches of tuna on troll lines and by the proximity of the commercial tuna fleet in the survey area when such targets were noted. At dusk, dawn, and at night, Pacific hake disperse to form layers of single fish, over a considerable depth range. Other potentially confusing species include pollock, herring, rockfish and dogfish. Pollock are mixed with the hake and cannot be separately identified, however, test fishing showed that pollock contributed very little to hake schools. The target strength of dogfish is so low that they generally appear as a haze on the echogram and contribute relatively little to the measured echo intensity. Trawl catch information was used for verification of echogram data and to obtain biological data.

FISHING SURVEY

Test sets were carried out with a Canadian Diamond-7 midwater trawl, a pair of 5 m^2 Superkrub midwater trawl doors, 80 m sweep wires with 300 kg chain weights, and a SIMRAD FS3300 third wire headrope transducer. The vertical net opening was 13.5 m and the cod end mesh was 3.8 cm. Fishing positions were selected to sample major fish concentrations encountered during the acoustic survey with generally less than 2 hours elapsing from the time targets were observed to when they were fished.

Trawl catches were spilled from the codend into a below deck hopper and sorted by species off a conveyor belt into tubs. All tubs of fish were weighed on a platform scale to the nearest kilogram. Representative subsamples of hake were selected by retaining at least 3 tubs of fish from the start, middle and end of the hopper load for routine biological sampling. For small hauls the entire catch was sampled.

Measurements of fork length to the nearest mm, sex and maturity (Weir et al. 1978) were recorded for all hake sampled. Otoliths were collected and stored in a 1/1 glycerine/freshwater solution with thymol at 0.3% for subsequent age determination. The stomach contents of hake from 1 or 2 tubs were examined with prey items being identified to the lowest possible taxon. The volume of each prey item was estimated visually to the nearest 1 cc. The state of digestion was recorded for each prey item and any identifiable herring remains were counted and measured.

OCEANOGRAPHIC DATA

Conductivity and temperature were sampled at one meter depth intervals at pre-selected stations using a GUILDLINE CTD (8770 series) oceanographic probe. Sea surface temperatures were collected at 10 minute intervals using the CSAIL software/hardware system (Revlis Electronics Ltd. Vernon, B.C., and Simmie Software Solutions, Regina, Sask.; Saunders et al., 1992). The seawater intake is approximately 4 m below the surface. Plankton samples were collected at pre-selected stations for use by the COPRA (Cooperative Plankton Research) program. The sampling gear consisted of a bongo net frame with two 0.5 m diameter 230 micron mesh nets attached. Oblique tows were conducted to within 20 m of the bottom or to a maximum depth of 500 m. Wire was paid out at a rate of 1 m/sec and retrieved at a rate of 0.3 m/sec. The samples were preserved in labelled jars with 10% formalin.

RESULTS

BIOMASS ESTIMATES: MAIN SURVEY AREA

A total of 76 transects were run encompassing a survey area of 24251 km^2 (Tables 1 and 2; Figures 1a-c). The estimates of total biomass for all species (Figures 4a-b) and for hake only (Figures 5a-b), using proximal analysis, are as follows:

SERIES	AREA km^2	AVG. SD kg/m^2	MAX. SD kg/m^2	ALL FISH kt	AVG. SD kg/m^2	MAX. SD kg/m^2	HAKE kt
A	2589	0.06	3.2	113	0.02	0.3	43
BS	98	0.01	0.1	9	0.01	0.1	6
B	8031	0.03	3.2	163	0.01	0.7	78
Sub:	**10718**			**275**			**121**
C	13533	0.03	1.4	246	0.01	0.8	160
Total:	**24251**			**523**			**281**

FISHING RESULTS

A total of 16 hauls were conducted, one bottom trawl and 15 midwater trawls, to obtain species composition and biological samples (Figures 1b-c). Table 4 lists bridge log and catch data for each gear type. Pacific hake were present in 13 sets and accounted for 72% of the total catch by weight for all gear (Table 5). Tables 6 and 7 detail the biological samples for Pacific hake and other species sampled; length frequencies by haul are presented in Tables 8 and 9. Oceanographic station locations for CTDs are listed in Table 10; Table 11 details plankton collecting sites.

DISCUSSION

The 1994 hake survey covered a total area of 24251 km^2 off Vancouver Island and through portions of Queen Charlotte Sound. It extended from the Canada/U.S. boundary (approximately 48° 15') to south of Cape St. James (52°). Transects were run from about the 50 m depth contour, to well seaward of the continental shelf. Lengths of each line varied depending upon offshore target distribution and time constraints. Most transects were run beyond the 1000 m contour, however, south of 49° some lines were ended just beyond the shelf break to allow time for extended coverage further north.

Hake biomass was 281 kt, which represents the lowest abundance observed since 1990, although area surveyed was the most extensive (Saunders et al. 1992; Cooke et al. 1992; Saunders et al. in prep; Andrews et al. 1994). We observed more varied acoustic sign during the 1994 survey and overall distribution patterns were notably different from previous surveys. Less than half of the adult hake biomass was located in the southern half of the survey area where most of the commercial harvest traditionally occurs. Young-of-the-year hake were observed for the first time in the Canadian zone and extended as far north as Quatsino Sound (50°20.5' N latitude; Figures 6a-b). Albacore tuna (*Thunnus alalunga*) were seen in association with the juvenile hake. The tuna were observed directly below or in amongst the targets and were feeding on the juvenile hake. Both juvenile hake and tuna aggregations appear to be associated with warm water masses where surface temperatures often exceeded 16° C. Such temperatures occassionally extended to the seaward end of our longest transects, that is, approximately 100 nmi offshore.

Generally, biomass was distributed along the shelf break with only occassional dispersal well offshore (Figures 4a-b). The offshore component of the biomass was more patchy than that observed in 1992 (Andrews et al. 1994) with targets clustered in small aggregations. The largest concentrations of adult hake were found near the entrance to Juan de Fuca Strait and off La Perouse Bank, in the southern portion of the survey area (Table 2; Figure 5a) and near the shelf break off Nootka Sound and Brooks Peninsula with a more continuous, albeit less dense, band further north and offshore between Cape Scott and Cape St. James at the entrance to Queen Charlotte Sound (Table 2; Figure 5b). Juvenile hake (<10 cm length), were found in very heavy concentrations west of Barkley Sound at the shelf break (Figure 6a). Less dense aggregations were also noted off Nootka Sound, inshore of the shelf break to Brooks Peninsula and again north of Brooks Peninsula to Quatsino Sound (Figure 6b). The overall increase of hake in the northern portion of the survey area has been positively correlated with warm water intrusion (Smith et al. 1990; Saunders et al. in prep). Such conditions are generally thought to occur in conjunction with El Nino events, however, no such event occurred in 1994 and the northward extent of very warm water may be due to the unusual absence of the wind-driven coastal currents that are largely responsible for mixing the cooler upwelled and warmer surface waters (R. Thomson, Institute of Ocean Sciences, Pat Bay, B.C.; pers. communication). Our studies will continue to explore relations between target distribution and abundance with species specific behaviour, bottom slope and topographic features, and other oceanographic and biological parameters.

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Table 1. Transect information including date, start time, and start and end latitude and longitude for the *CSS W.E. RICKER* Pacific hake acoustic survey, Aug. 15 - Sept. 1, 1994.

EVENT #	NAME	DATE	TIME	LATITUDE deg	LATITUDE min	LONGITUDE deg	LONGITUDE min	LATITUDE deg	LATITUDE min	LONGITUDE deg	LONGITUDE min
6.0	A1E	15-AUG-94	06:13	48	55.93	125	46.76	48	55.88	125	37.93
13.0	A2W	15-AUG-94	07:06	48	53.99	125	38.28	48	54.05	125	47.04
15.0	A3E	15-AUG-94	07:54	48	52.53	125	46.83	48	52.70	125	30.85
17.0	A4W	15-AUG-94	09:25	48	50.18	125	26.94	48	50.11	125	42.03
19.0	A5E	15-AUG-94	10:50	48	47.48	125	41.91	48	47.70	125	17.01
28.0	A6W	15-AUG-94	15:46	48	44.97	125	13.16	48	45.07	125	50.01
32.0	A7AE	15-AUG-94	18:39	48	42.48	125	49.87	48	42.55	125	13.97
36.0	A7BE	16-AUG-94	06:07	48	42.61	125	13.87	48	42.48	125	10.92
39.0	A8W	16-AUG-94	06:58	48	40.05	125	4.71	48	40.07	125	42.19
45.0	A9E	16-AUG-94	09:54	48	37.61	125	41.77	48	37.48	124	48.90
48.0	A10W	16-AUG-94	14:01	48	34.90	124	45.30	48	35.09	125	37.96
51.0	A11AE	16-AUG-94	17:55	48	32.71	125	37.91	48	32.46	124	55.10
57.0	A11BE	17-AUG-94	06:04	48	32.56	124	55.67	48	32.34	124	32.79
60.0	A12W	17-AUG-94	08:11	48	30.15	124	32.89	48	30.25	125	36.82
64.0	A13AE	17-AUG-94	13:15	48	27.74	125	36.89	48	27.69	125	24.75
66.0	A13BE	17-AUG-94	15:57	48	27.71	125	24.64	48	27.36	125	5.07
22.0	BS1E	15-AUG-94	12:53	48	50.53	125	15.55	48	57.74	125	6.78
26.0	BS2W	15-AUG-94	14:03	48	58.42	125	8.41	48	52.53	125	15.70
73.0	B0W	18-AUG-94	06:02	48	10.23	125	55.27	48	10.42	126	34.43
79.0	B1AE	18-AUG-94	09:40	48	15.27	126	34.63	48	15.28	125	57.83
82.0	B1BE	18-AUG-94	15:01	48	15.23	125	55.88	48	15.14	125	41.32
86.0	B3AW	18-AUG-94	17:16	48	20.28	125	24.84	48	20.31	126	15.87
89.0	B3BW	19-AUG-94	06:24	48	20.35	126	16.26	48	20.17	127	1.19
70.0	B5AW	17-AUG-94	17:58	48	25.09	125	12.54	48	25.05	125	52.41
93.0	B5BE	19-AUG-94	12:40	48	25.46	126	59.28	48	25.28	126	17.82
95.0	B5CE	19-AUG-94	15:38	48	25.28	126	17.82	48	25.27	126	10.95
99.0	B5DE	19-AUG-94	16:15	48	25.27	126	10.95	48	25.24	125	52.05
103.0	B7AW	19-AUG-94	18:30	48	30.19	125	43.29	48	30.50	126	15.95
107.0	B7BW	20-AUG-94	06:01	48	30.25	126	16.23	48	30.37	126	59.61
110.0	B9AE	20-AUG-94	09:49	48	35.42	126	59.32	48	35.26	126	28.06
113.0	B9BE	20-AUG-94	14:41	48	35.29	126	27.57	48	35.26	126	21.41
114.0	B9CE	20-AUG-94	15:07	48	35.26	126	21.41	48	35.22	126	16.55
115.0	B9DE	20-AUG-94	15:36	48	35.22	126	16.55	48	35.21	125	59.70
119.0	B11AW	20-AUG-94	19:04	48	40.13	126	1.70	48	40.16	126	27.41
122.0	B11BW	21-AUG-94	06:00	48	40.25	126	26.91	48	40.37	126	52.36
125.0	B11CW	21-AUG-94	11:04	48	40.49	126	51.19	48	40.38	126	59.49
127.0	B13AE	21-AUG-94	12:14	48	45.38	126	59.34	48	45.08	126	6.21
131.0	B15AW	21-AUG-94	16:24	48	50.13	126	9.84	48	50.07	127	10.83
135.0	B17AW	22-AUG-94	06:06	48	55.20	126	14.05	48	55.19	126	44.28
138.0	B17BW	22-AUG-94	09:47	48	55.20	126	44.77	48	54.99	127	8.29
141.0	B19AE	22-AUG-94	12:11	48	59.98	127	8.05	49	0.07	126	37.21
146.0	B19W	23-AUG-94	06:33	49	0.17	126	19.17	49	0.30	126	37.20
154.0	C2AW	23-AUG-94	11:46	49	5.18	126	13.59	49	5.24	126	57.65
159.0	C2BW	23-AUG-94	17:24	49	5.20	126	58.11	49	4.97	127	45.97
162.0	C4AE	24-AUG-94	06:33	49	9.91	128	13.20	49	9.84	127	13.43
169.0	C4BE	24-AUG-94	11:55	49	9.84	127	13.40	49	10.20	126	20.60
173.0	C6W	24-AUG-94	16:40	49	15.22	126	28.91	49	14.90	127	25.77
179.0	C8W	25-AUG-94	06:23	49	20.32	126	39.56	49	20.43	126	55.93
183.0	C8BW	25-AUG-94	09:06	49	20.31	126	55.99	49	20.01	127	29.65

Table 1. (cont'd.)

EVENT #	NAME	DATE	TIME	LATITUDE deg	LATITUDE min	LONGITUDE deg	LONGITUDE min	LATITUDE deg	LATITUDE min	LONGITUDE deg	LONGITUDE min
187.0	C10AE	25-AUG-94	12:19	49	24.93	127	29.73	49	24.99	127	12.23
192.0	C10BE	25-AUG-94	15:39	49	25.09	127	12.16	49	25.37	126	57.50
194.0	C12W	25-AUG-94	17:24	49	30.19	127	1.80	49	30.11	127	39.75
200.0	C14E	26-AUG-94	06:14	49	35.06	127	39.28	49	35.27	127	18.92
204.0	C14BE	26-AUG-94	09:21	49	35.18	127	18.47	49	35.20	127	9.80
206.0	C16W	26-AUG-94	10:40	49	40.18	127	16.88	49	40.20	127	45.80
209.0	C18E	26-AUG-94	13:17	49	45.16	127	47.72	49	45.58	127	25.31
211.0	C22W	26-AUG-94	15:47	49	50.18	127	37.73	49	50.29	127	50.72
213.0	C23E	26-AUG-94	16:41	49	50.29	127	50.81	49	55.35	127	42.27
215.0	C26W	26-AUG-94	17:32	49	55.40	127	42.68	49	55.17	128	31.46
222.0	C30W	27-AUG-94	06:31	50	0.31	127	40.27	50	0.24	128	19.18
224.0	C30-34	27-AUG-94	09:06	50	0.49	128	19.03	50	5.08	128	1.50
226.0	C34W	27-AUG-94	10:29	50	5.08	128	1.77	50	5.22	128	20.57
227.0	C34-38	27-AUG-94	11:49	50	5.22	128	20.57	50	9.92	128	4.85
229.0	C38W	27-AUG-94	12:59	50	10.26	128	4.41	50	10.24	128	15.56
231.0	C38-40	27-AUG-94	13:49	50	10.67	128	15.29	50	15.18	128	7.16
233.0	C40W	27-AUG-94	14:30	50	15.39	128	7.31	50	15.37	128	24.92
235.0	C40-42	27-AUG-94	15:45	50	15.55	128	24.59	50	20.34	128	12.26
238.0	C42W	27-AUG-94	16:43	50	20.49	128	12.60	50	20.31	129	17.15
241.0	C44W	28-AUG-94	06:41	50	25.37	128	11.22	50	25.26	128	35.91
247.0	C44BW	28-AUG-94	10:45	50	25.26	128	36.09	50	25.19	128	41.39
249.0	C46E	28-AUG-94	11:40	50	30.31	128	42.24	50	30.50	128	16.53
251.0	C48W	28-AUG-94	13:58	50	35.20	128	23.66	50	35.43	128	38.88
255.0	C48BW	28-AUG-94	16:44	50	35.44	128	40.66	50	35.27	129	6.04
257.0	C49N	28-AUG-94	18:37	50	35.63	129	6.27	50	45.83	129	11.04
258.0	C50W	28-AUG-94	19:49	50	45.83	129	11.04	50	40.91	129	24.69
261.0	C51N	29-AUG-94	06:45	50	40.18	129	25.49	50	48.53	129	19.93
264.0	C52W	29-AUG-94	07:39	50	48.53	129	19.93	50	45.47	129	27.86
265.0	C53AN	29-AUG-94	08:18	50	45.47	129	27.86	50	49.37	129	27.55
269.0	C53BN	29-AUG-94	11:04	50	49.67	129	27.66	50	51.57	129	26.93
271.0	C54W	29-AUG-94	11:19	50	51.76	129	27.22	50	45.30	129	43.47
273.0	C55E	29-AUG-94	12:38	50	45.47	129	43.74	51	8.74	129	36.57
275.0	C56W	29-AUG-94	15:01	51	8.89	129	36.74	51	8.99	129	54.27
278.0	C57W	29-AUG-94	16:14	51	9.21	129	54.79	51	20.44	130	4.19
282.0	C58N	29-AUG-94	19:01	51	20.73	130	4.46	51	30.70	130	5.21
283.0	C59E	29-AUG-94	20:09	51	30.70	130	5.21	51	31.19	130	0.40
284.0	C60E	29-AUG-94	20:32	51	31.19	130	0.40	51	31.98	129	57.88
290.0	C61W	30-AUG-94	06:41	51	34.65	129	46.45	51	43.56	129	51.61
292.0	C62N	30-AUG-94	07:42	51	43.56	129	51.61	51	42.51	130	26.70
294.0	C63N	30-AUG-94	10:15	51	42.51	130	26.70	51	49.74	130	30.98
295.0	C64W	30-AUG-94	11:11	51	49.74	130	30.98	51	44.61	130	54.97
296.0	C65E	30-AUG-94	12:57	51	44.61	130	54.97	51	45.75	130	10.68
299.0	C66	30-AUG-94	16:09	51	45.90	130	10.57	51	52.78	130	5.80
301.0	C67	30-AUG-94	17:16	51	51.82	130	2.84	51	49.68	129	56.84
303.0	C68	30-AUG-94	17:46	51	49.68	129	56.84	51	45.19	129	57.23
304.0	C69	30-AUG-94	18:17	51	45.19	129	57.23	51	45.86	130	13.36
310.0	C70	31-AUG-94	06:27	51	28.50	128	35.15	51	35.33	128	29.76
311.0	C71	31-AUG-94	07:17	51	35.33	128	29.76	51	30.84	128	27.31
313.0	C72	31-AUG-94	09:04	51	32.97	128	28.27	51	12.45	128	27.94
314.0	C73	31-AUG-94	11:07	51	12.45	128	27.94	51	3.92	128	11.13
315.0	C74	31-AUG-94	12:31	51	3.92	128	11.13	51	0.55	127	51.20

Table 2. Total and Hake biomass by transect for the *CSS W.E. RICKER* Pacific hake acoustic survey, August 15 - 31, 1994. Transect length, surface density cell area, mean and maximum surface densities, and biomass by transect are given. BIOMASS: TOTAL includes BIOMASS: HAKE at TS of -35 dB/kg plus all other fish at TS of -32 dB/kg (see text p.5).

TRANSECT			BIOMASS: TOTAL			BIOMASS: HAKE		
EVE #	NAME	Area km^2	Surf D kg/m^2	Max SD kg/m^2	ALL FISH t	Surf D kg/m^2	Max SD kg/m^2	HAKE t
6	A1E	36	0.03	0.05	936	0.02	0.04	751
13	A2W	35	0.01	0.06	458	0.01	0.05	409
15	A3E	71	0.00	0.02	177	0.00	0.01	63
17	A4W	94	0.01	0.14	657	0.00	0.00	33
19	A5E	148	0.01	0.15	1195	0.00	0.04	609
28	A6W	211	0.04	0.46	6280	0.02	0.13	3340
32	A7AE	202	0.02	0.16	2475	0.01	0.15	1020
36	A7BE	22	0.02	0.05	407	0.02	0.05	407
39	A8W	217	0.03	0.18	4740	0.01	0.18	2790
45	A9E	298	0.05	0.66	8570	0.01	0.04	1640
48	A10W	303	0.09	1.84	15735	0.01	0.18	3470
51	A11AE	236	0.15	3.20	18520	0.01	0.09	2540
57	A11BE	119	0.28	3.20	20475	0.06	0.28	7250
60	A12W	398	0.09	1.30	23050	0.02	0.22	10100
64	A13AE	73	0.04	0.25	2985	0.04	0.25	2960
66	A13BE	125	0.05	0.21	5970	0.05	0.20	5880
22	BS1E	63	0.01	0.06	419	0.01	0.02	253
26	BS2W	36	0.01	0.12	445	0.01	0.12	364
73	B0W	462	0	0	0	0	0	0
79	B1AE	454	0	0	0	0	0	0
82	B1BE	201	0.12	1.2	16035	0.04	0.18	8370
86	B3AW	600	0.03	0.17	16850	0.02	0.13	13300
89	B3BW	514	0.01	0.04	4315	0.00	0.02	1570
70	B5AW	362	0.04	0.18	15250	0.04	0.18	15100
93	B5BE	484	0.01	0.02	1785	0	0	0
95	B5CE	82	0.02	0.04	735	0	0	0
99	B5DE	215	0.07	0.66	7995	0.01	0.07	1390
103	B7AW	361	0.02	0.10	4600	0.01	0.10	2260
107	B7BW	496	0.00	0.02	555	0	0	0
110	B9AE	366	0.00	0.02	428	0.00	0.00	178
113	B9BE	71	0.01	0.01	354	0.01	0.01	352
114	B9CE	57	0.00	0.01	155	0.00	0.01	142
115	B9DE	197	0.04	0.64	5515	0.01	0.09	2390
119	B11AW	287	0.04	0.13	7145	0.01	0.06	2990
122	B11BW	274	0.03	0.06	5580	0.01	0.03	2140
125	B11CW	99	0.02	0.04	980	0	0	0
127	B13AE	612	0.02	0.27	10770	0.01	0.12	7040
131	B15AW	680	0.02	0.27	9540	0.01	0.25	6380
135	B17AW	352	0.14	3.20	27700	0.02	0.17	5300
138	B17BW	273	0.01	0.03	1159	0.00	0.03	508
141	B19AE	336	0.07	0.93	15900	0.02	0.69	8200
146	B19W	196	0.10	3.20	9950	0	0	0
154	C2AW	579	0.02	0.31	8890	0.01	0.31	7080
159	C2BW	621	0.00	0.04	1960	0.00	0.02	1670
162	C4AE	672	0.00	0.03	327	0.00	0.03	327
169	C4BE	602	0.08	1.44	28045	0.01	0.16	5790
173	C6W	701	0.02	0.25	8690	0.01	0.24	3280

Table 2. (cont'd.)

TRANSECT			BIOMASS: TOTAL			BIOMASS: HAKE		
EVE #	NAME	Area km^2	Surf D kg/m^2	Max SD kg/m^2	ALL FISH t	Surf D kg/m^2	Max SD kg/m^2	HAKE t
179	C8W	203	0.12	0.82	24400	0.12	0.82	24400
183	C8BW	387	0.01	0.08	1780	0	0	0
187	C10AE	217	0.02	0.17	3295	0.01	0.17	2380
192	C10BE	176	0.01	0.04	481	0	0	0
194	C12W	436	0.01	0.35	1826	0.00	0.03	251
200	C14E	247	0.03	0.24	8060	0.03	0.24	7860
204	C14BE	100	0.01	0.03	339	0	0	0
206	C16W	336	0.02	0.13	4325	0.01	0.13	3260
209	C18E	256	0.04	0.72	8785	0.03	0.18	6570
211	C22W	125	0.04	0.33	4045	0.03	0.33	3310
213	C23E	101	0.02	0.12	1235	0.01	0.11	1070
215	C26W	500	0.01	0.22	4630	0.01	0.22	4510
222	C30W	369	0.02	0.21	6110	0.01	0.19	5000
224	C30-34	116	0.00	0.05	206	0.00	0.05	140
226	C34W	107	0.00	0.06	344	0.00	0.06	344
227	C34-38	90	0	0	0	0	0	0
229	C38W	62	0.01	0.08	148	0	0	0
231	C38-40	75	0.04	0.17	2275	0.02	0.15	1630
233	C40W	135	0.02	0.09	1100	0	0	0
235	C40-42	104	0.06	0.19	3755	0.02	0.08	1710
238	C42W	643	0.01	0.08	3415	0	0	0
241	C44W	275	0.01	0.08	2325	0.01	0.08	1680
247	C44BW	82	0	0	0	0	0	0
249	C46E	311	0.01	0.07	3070	0.01	0.04	1600
251	C48W	160	0.02	0.09	2875	0.01	0.06	2090
255	C48BW	418	0.02	0.13	6460	0.02	0.13	6460
257	C49N	248	0.03	0.42	3245	0	0	0
258	C50W	153	0.02	0.13	1465	0	0	0
261	C51N	79	0.05	0.51	1930	0	0	0
264	C52W	47	0.03	0.31	700	0	0	0
265	C53AN	50	0.05	0.27	2290	0.04	0.26	2100
269	C53BN	17	0.08	0.55	650	0	0	0
271	C54W	216	0.02	0.10	1978	0.00	0.04	655
273	C55E	449	0.04	0.25	11195	0.01	0.09	4290
275	C56W	132	0.02	0.11	1597	0.01	0.03	794
278	C57W	217	0.08	0.21	16900	0.08	0.21	16800
282	C58N	133	0.05	0.21	6150	0.05	0.21	6030
283	C59E	34	0.03	0.05	863	0.02	0.04	819
284	60E	28	0.03	0.04	781	0.02	0.04	692
290	C61W	156	0.05	0.14	8005	0.05	0.13	7670
292	C62N	258	0.06	0.22	11985	0.04	0.12	9270
294	C63N	148	0.01	0.03	711	0.00	0.00	62
295	C64W	200	0.03	0.10	3330	0.05	0.05	1310
296	C65E	492	0.02	0.08	5265	0.05	0.07	2290
299	C66	153	0.02	0.05	2640	0.01	0.04	2120
301	C67	86	0.03	0.09	1995	0.01	0.09	1050
303	C68	82	0.09	0.28	4490	0.02	0.11	1620
304	C69	98	0.03	0.08	2665	0.02	0.07	2390
310	C70	151	0.02	0.07	2760	0.02	0.07	2670
311	C71	98	0.03	0.21	2990	0.03	0.21	2950
313	C72	269	0.01	0.05	1483	0.00	0.03	866
314	C73	150	0.03	0.72	2901	0.00	0.01	632
315	C74	184	0.02	0.12	1925	0.00	0.02	550

Table 3. List of common and scientific names of fishes captured during *CSS W.E. RICKER* Pacific hake acoustic survey, August 15 - 31, 1994.

Common name	Scientific names
Roundfish	
Eelpouts	
Eulachon	Thaleichthys pacificus
King-of-the-salmon	Trachipterus alivelis
Lanternfish	Stenobrachius leucopsarus
Pacific hake	Merluccius productus
Sablefish/Blackcod	Anoplopoma fimbria
Shad	Alosa sapidissima
Rockfish	
Chilipepper	Sebastes goodei
Pacific ocean perch	S. alutus
Redband rockfish	S. babcocki
Redstripe	S. proriger
Silvergray rockfish	S. brevispinis
Widow rockfish	S. entomelas
Yellowmouth rockfish	S. reedi
Yellowtail rockfish	S. flavidus
Flatfish	
Dover sole	Microstonomus pacificus
Flathead sole	Hippoglossoides elassodon
Rex sole	Glyptocephalus zarchirus
Slender sole	Lyopsetta exilis
Turbot/Arrowtooth flounder	Atheresthes stomias
Selachii	
Dogfish	Squalus acanthias
Long nose skate	Raja rhina
Ratfish	Hydrolagus colliei

TABLE 4. Bridge log and species composition, by haul, for the *CSS W.E. RICKER* Pacific hake acoustic survey August 15 - 31, 1994.

SET NO.	1	2	3	4	5	6
DATE	AUG. 17	AUG. 18	AUG. 19	AUG. 20	AUG. 21	AUG. 22
AREA(MAJ. MIN. LOC.)	3-23-06	3-23-13	3-24-00	3-24-00	3-24-00	3-24-07
TIME START (PDT)	1436	1244	1032	1248	0852	0849
DURATION(HR.MIN)	0.30	0.26	0.54	0.40	0.44	0.10
START N. LAT. (DEG)	48	48	48	48	48	48
(MIN)	27.4	14.9	20.0	35.0	39.9	54.9
W. LONG. (DEG)	125	125	127	126	126	126
(MIN)	26.5	58.0	0.0	33.0	43.0	43.4
FINISH N. LAT. (DEG)	48	48	48	48	48	48
(MIN)	27.3	14.9	20.0	35.0	39.8	54.9
W.LONG. (DEG)	125	126	126	126	126	126
(MIN)	28.4	0.0	56.3	36.9	39.6	42.2
TARGET DEPTH (MODAL)	150	55	400	195	350	100
(m) (MIN)	152	50	350	190	300	110
(MAX)	150	60	425	200	375	90
CAPTURE DEPTH(MODAL)	152	50	370	192	350	109
(m) (MIN)	0	50	340	190	320	110
(MAX)	0	50	400	195	375	100
TYPE OF GEAR	[BOTTOM TRAWL]	[-------CANADIAN DIAMOND #7 MIDWATER-----]				
MOUTH OPENING (m)	14	15	12	13	12	12
REMARKS	USABLE	USABLE	USABLE	USABLE	USABLE	USABLE
ROUNDFISH (kg)						
PACIFIC HAKE	20	47	13	10	34	535
SABLEFISH	78	..	..	..	..	..
LANTERNFISH	..	..	3	..	3	..
KING-OF-SALMON	..	..	6	..	..	..
EULACHON	1	..	..	..	..	..
EELPOUTS	TRACE	..	..	..	..	..
SHAD	TRACE	..	..	..	..	..
ROCKFISH *(Sebastes)(kg)*						
S. PRORIGER	..	..	..	..	..	..
S. REEDI	..	..	..	..	..	..
S. ALUTUS	..	..	..	..	..	..
S. FLAVIDUS	..	..	..	..	..	..
S. ENTOMELAS	..	..	..	..	..	..
S. BREVISPINIS	..	..	..	..	..	..
S. GOODEI	5	..	..	..	..	..
S. BABCOCKI	..	..	..	..	..	..
FLATFISH (kg)						
TURBOT	40	..	..	..	..	..
DOVER SOLE	36	..	..	..	..	..
REX SOLE	13	..	..	..	..	..
FLATHEAD SOLE	6	..	..	..	..	..
SLENDER SOLE	TRACE	..	..	..	..	..
SELACHII (kg)						
DOGFISH	45	..	..	..	..	..
LONG NOSE SKATE	25	..	..	..	..	..
RATFISH	TRACE	..	..	..	..	..
INVERTEBRATES (kg)						
SHRIMP	7	..	..	..	..	..
JELLYFISH	..	..	..	3	..	..
TOTAL CATCH (kg)	276	47	22	13	37	535

TABLE 4 - (Con't)

SET NO.	7	8	9	10	11	12
DATE	AUG. 23	AUG. 25	AUG. 25	AUG. 26	AUG. 28	AUG. 28
AREA(MAJ. MIN. LOC.)	4-25-01	4-25-02	4-25-02	4-25-04	4-27-00	5-11-06
TIME START (PST)	1535	0822	1407	0830	0845	1540
DURATION(HR.MIN)	0.41	0.03	0.35	0.15	0.57	0.22
START N. LAT. (DEG)	49	49	49	49	50	50
(MIN)	4.9	19.8	24.8	34.9	25.1	34.8
W. LONG. (DEG)	126	126	127	127	128	128
(MIN)	57.0	52.7	13.5	22.9	34.3	34.9
FINISH N. LAT. (DEG)	49	49	49	49	50	50
(MIN)	3.7	19.8	25.0	34.9	24.9	34.0
W.LONG. (DEG)	126	126	127	127	128	128
(MIN)	54.2	53.0	16.5	21.6	30.2	36.6
TARGET DEPTH (MODAL)	265	120	190	175	220	190
(m) (MIN)	260	110	0	160	240	180
(MAX)	270	130	0	190	200	200
CAPTURE DEPTH(MODAL)	300	119	220	160	230	175
(m) (MIN)	290	119	196	160	250	170
(MAX)	310	119	244	160	210	180
TYPE OF GEAR	[--------CANADIAN DIAMOND #7 MIDWATER TRAWL---------]					
MOUTH OPENING (m)	12	12	12	12	12	12
REMARKS	USABLE	USABLE	USABLE	USABLE	USABLE	USABLE
ROUNDFISH (kg)						
PACIFIC HAKE	216	424	..	265	91	..
SABLEFISH	..	..	..	..	..	..
LANTERNFISH	..	..	..	..	2	..
KING-OF-SALMON	..	..	..	..	..	..
EULACHON	..	..	..	..	..	..
EELPOUTS	..	..	..	..	..	..
SHAD	..	..	..	..	..	..
ROCKFISH *(Sebastes)* (kg)						
S. PRORIGER	..	..	..	..	..	336
S. REEDI	..	..	..	..	..	27
S. ALUTUS	..	..	119	..	..	..
S. FLAVIDUS	..	..	..	14	..	..
S. ENTOMELAS	..	..	..	..	..	..
S. BREVISPINIS	..	..	..	..	..	5
S. GOODEI	..	..	..	..	..	..
S. BABCOCKI	..	..	..	..	..	..
FLATFISH (kg)						
TURBOT	..	..	2	..	..	2
DOVER SOLE	..	..	..	..	..	..
REX SOLE	..	..	..	..	..	..
FLATHEAD SOLE	..	..	..	..	..	..
SLENDER SOLE	..	..	..	..	..	..
SELACHII (kg)						
DOGFISH	..	..	..	..	..	..
LONG NOSE SKATE	..	..	..	..	..	..
RATFISH	..	..	..	..	..	..
INVERTEBRATES (kg)						
SHRIMP	..	..	..	..	..	..
JELLYFISH	..	..	..	..	..	..
TOTAL CATCH (kg)	216	424	121	279	93	370

TABLE 4 - (Con't)

SET NO.	13	14	15	16
DATE	AUG. 29	AUG. 29	AUG. 30	AUG. 31
AREA(MAJ. MIN. LOC.)	5-11-10	6-08-10	6-08-11	6-08-01
TIME START (PST)	0914	1807	1946	0815
DURATION(HR.MIN)	0.49	0.09	1.04	0.17
START N. LAT. (DEG)	50	51	51	51
(MIN)	47.8	19.6	46.4	32.1
W. LONG. (DEG)	129	130	130	128
(MIN)	27.7	4.0	13.1	28.0
FINISH N. LAT. (DEG)	50	51	51	51
(MIN)	45.5	19.2	47.2	32.8
W.LONG. (DEG)	129	130	130	128
(MIN)	26.7	3.6	14.3	28.4
TARGET DEPTH (MODAL)	300	225	160	120
(m) (MIN)	290	216	140	100
(MAX)	320	240	180	140
CAPTURE DEPTH(MODAL)	290	225	160	140
(m) (MIN)	234	216	150	150
(MAX)	340	240	170	138
TYPE OF GEAR	[-----CANADIAN DIAMOND #7 MIDWATER------]			
MOUTH OPENING (m)	12	12	12	12
REMARKS	USABLE	USABLE	USABLE	USABLE
ROUNDFISH (kg)				
PACIFIC HAKE	228	276	..	479
SABLEFISH	..	..	..	..
LANTERNFISH	..	..	..	..
KING-OF-SALMON	..	..	..	..
EULACHON	..	..	..	..
EELPOUTS	..	..	..	..
SHAD	..	..	..	..
ROCKFISH *(Sebastes)*(kg)				
S. PRORIGER	4	..	..	..
S. REEDI	158	12	..	..
S. ALUTUS	..	4	..	39
S. FLAVIDUS	..	..	..	16
S. ENTOMELAS	11	1	..	..
S. BREVISPINIS	..	3	..	..
S. GOODEI	..	..	..	..
S. BABCOCKI	..	1	..	..
FLATFISH (kg)				
TURBOT	..	..	..	..
DOVER SOLE	..	..	..	..
REX SOLE	..	..	..	..
FLATHEAD SOLE	..	..	..	..
SLENDER SOLE	..	..	..	..
SELACHII (kg)				
DOGFISH	..	..	..	..
LONG NOSE SKATE	..	..	..	..
RATFISH	..	..	..	..
INVERTEBRATES (kg)				
SHRIMP	..	..	..	..
JELLYFISH	..	..	..	..
TOTAL CATCH (KG)	401	297	0	534

Table 5. Summary of total catch by species for the *CSS W.E. RICKER* Pacific hake acoustic survey, August 15 - 31, 1994.

CODE	SPECIES	kg	PERCENT
225	PACIFIC HAKE	2638	71.98
455	SABLEFISH	78	2.13
185	LANTERNFISH	8	0.22
271	KING-OF-SALMON	6	0.16
148	EULACHON	1	0.03
231	EELPOUTS	Tr	0.00
095	SHAD	Tr	0.00
439	S. proriger	340	9.28
440	S. reedi	197	5.38
396	S. alutus	162	4.42
418	S. flavidus	30	0.82
417	S. entomelas	12	0.33
405	S. brevispinis	8	0.22
420	S. goodei	5	0.14
401	S. babcocki	1	0.03
602	TURBOT	44	1.20
626	DOVER SOLE	36	0.98
610	REX SOLE	13	0.35
612	FLATHEAD SOLE	6	0.16
625	SLENDER SOLE	Tr	0.00
044	DOGFISH	45	1.23
059	LONG NOSE SKATE	25	0.68
066	RATFISH	Tr	0.00
SAB	SHRIMP	7	0.19
3G0	JELLYFISH	3	0.08
TOTAL		3665	100

Table 6. Summary of Pacific hake biological samples collected, by set, during the *CSS W.E. RICKER* Pacific hake acoustic survey, August 15 - 31, 1994.

Set no	Location	Length M	Length F	Length T	Maturity	Stomach contents	Paired otoliths	Fish no	Remarks[a]
1	Finger Bank 032306	4	13	17	17	17	-	-	total catch
2	Barkley Canyon 032313	-	-	200	-	50	-	-	Juvenile hake ~ 100 preserved ~ 200 frozen
3	Barkley Deep 032400	10	8	18	18	18	18	65239-65256	Total catch
4	Barkley Canyon 032400	-	-	200	-	50	-	-	Juvenile hake ~ 150 preserved ~ 200 frozen
5	Clayoquot 032400	23	24	47	47	47	47	65257-65303	Total catch
6	Clayoquot 032407	-	-	200	-	50	-	-	Juvenile hake ~ 150 preserved ~ 200 frozen
7	Nootka 042501	114	129	243	120	40	120	65304-65423	2 tubs l/s/m/o/st 2 tubs l/s 50 fish parasite sample
8	Nootka 042502	99	161	260	100	40	100	65424-65523	2 tubs l/s/m/o 3 tubs l/s/m 50 fish parasite sample
10	Esperanza 042504	-	-	200	-	50	-	-	Juvenile hake ~ 150 preserved ~ 200 frozen
11	Quatsino 042700	54	61	115	80	40	80	65524-65603	2 tubs l/s/m/o 2/3 tub l/s 50 fish parasite sample
13	Triangle 051110	113	153	166	100	40	100	65604-65703	1 + 2/3 tubs l/s/m/o 3 tubs l/s 50 fish parasite sample
14	Q.C. Sound 060810	119	108	227	40	40	-	-	1 tub l/s/m 3 tubs l/s
15	Q.C. Sound 060811		no fish						
16	Q.C. Sound 060801	107	138	245	80	40	80	65704-65783	1 + 1/2 tubs l/s/m/o 3 tubs l/s 50 fish parasite sample
Totals		643	795	2138	602	522	545	65239-65783	

[a] l=fork length o=paired otoliths s=sex st=stomach contents m=maturity

Table 7. Summary of other biological samples collected, by set, during the *CSS W.E. RICKER* Pacific hake acoustic survey, August 15 - 31, 1994.

Species	Set #	Location	Length M	Length F	Length T	Remarks[a]
Dogfish	1	Finger Bank 032306	24	-	24	Total Catch l/s
Sablefish	1	Finger Bank 032306	13	19	32	Total Catch l/s
Pacific Ocean Perch	9	Nootka 042502	16	66	82	2 tubs l/s
Redstripe	12	Quatsino 051111	66	69	135	2 tubs l/s
Reedi	13	Triangle 051110	27	28	55	2 tubs l/s
Pacific Ocean Perch	16	Q.C. Sound 060801	17	19	36	Total Catch l/s

[a] l=length s=sex

Table 8. Length frequency of Pacific hake, by haul, collected during the *CSS W.E. RICKER* Pacific hake acoustic survey, August 15 - 31, 1994.

SET NO.	1			2			3			4			5			6			7		
FORK LENGTH (CM)	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
7	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	11	-	-	-	-	-	51	-	-	-	-	-	6	-	-	-
9	-	-	-	-	-	67	-	-	-	-	-	99	-	-	-	-	-	74	-	-	-
10	-	-	-	-	-	64	-	-	-	-	-	46	-	-	-	-	-	106	-	-	-
11	-	-	-	-	-	44	-	-	-	-	-	3	-	-	-	-	-	14	-	-	-
12	-	-	-	-	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
////																					
39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3
43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	2	7
44	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	13	8	21
45	-	-	-	-	-	-	1	-	1	-	-	-	5	3	8	-	-	-	16	19	35
46	-	-	-	-	-	-	1	1	2	-	-	-	3	4	7	-	-	-	30	23	53
47	1	-	1	-	-	-	2	2	4	-	-	-	7	7	14	-	-	-	21	27	48
48	1	-	1	-	-	-	3	2	5	-	-	-	4	3	7	-	-	-	18	18	36
49	2	2	4	-	-	-	2	1	3	-	-	-	3	2	5	-	-	-	6	13	19
50	-	1	1	-	-	-	-	1	1	-	-	-	1	3	4	-	-	-	2	8	10
51	-	0	0	-	-	-	-	0	0	-	-	-	-	1	1	-	-	-	1	5	6
52	-	0	0	-	-	-	-	1	1	-	-	-	-	1	1	-	-	-	2	1	3
53	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
54	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
55	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
56	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
57	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
58	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
59	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
61	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
62	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
63	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
64	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
65	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
66	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
67	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	4	13	17	0	0	200	10	8	18	0	0	200	23	24	47	0	0	200	114	129	243

Table 8 - (Con't)

SET NO.	8			10			11			13			14			16			TOTAL		
FORK LENGTH (CM)	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	68
9	-	-	-	-	-	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	273
10	-	-	-	-	-	130	-	-	-	-	-	-	-	-	-	-	-	-	-	-	346
11	-	-	-	-	-	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	96
12	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	1	-	1
41	1	-	1	-	-	-	-	-	-	3	-	3	-	1	1	-	-	-	4	1	5
42	0	-	0	-	-	-	-	1	1	0	3	3	2	4	6	-	1	1	2	12	14
43	2	1	3	-	-	-	-	1	1	8	10	18	7	2	9	4	5	9	26	21	47
44	4	5	9	-	-	-	1	2	3	13	11	24	9	3	12	5	4	9	46	33	79
45	16	6	22	-	-	-	10	0	10	19	16	35	19	5	24	10	13	23	96	62	158
46	20	22	42	-	-	-	11	7	18	19	17	36	19	16	35	19	19	38	122	109	231
47	18	28	46	-	-	-	16	10	26	23	20	43	22	19	41	26	18	44	136	131	267
48	14	23	37	-	-	-	9	10	19	11	25	36	23	28	51	22	23	45	105	132	237
49	11	21	32	-	-	-	4	17	21	7	20	27	12	13	25	11	24	35	58	113	171
50	6	20	26	-	-	-	2	3	5	6	9	15	4	8	12	6	11	17	27	64	91
51	4	14	18	-	-	-	1	0	1	1	8	9	1	6	7	0	10	10	8	44	52
52	3	6	9	-	-	-	-	4	4	1	4	5	0	0	0	1	4	6	7	21	29
53	-	7	7	-	-	-	-	1	1	0	4	4	0	2	2	2	2	4	2	17	19
54	-	4	4	-	-	-	-	3	3	1	4	5	1	0	1	1	1	2	3	14	17
55	-	1	1	-	-	-	-	0	0	-	1	1	-	0	0	-	1	1	-	3	3
56	-	1	1	-	-	-	-	1	1	-	0	0	-	0	0	-	0	0	-	2	2
57	-	1	1	-	-	-	-	0	0	-	1	1	-	1	1	-	1	1	-	4	4
58	-	0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	0	0	-	3	3
59	-	0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	0	0	-	2	2
60	-	0	0	-	-	-	-	1	1	-	-	-	-	-	-	-	0	0	-	1	1
61	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	-	2	2
62	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	-	2	2
63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	-	0	0
64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	-	0	0
65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	-	0	0
66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	1	1
67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
TOTAL	99	161	260	0	0	200	54	61	115	113	153	266	119	108	227	107	138	246	643	795	2239

Table 9. Length frequency for other species, by set, during the *CSS W.E. RICKER* Pacific hake acoustic survey, August 15 - 31, 1994.

SET NO.	1			1			9			12			13			16		
SPECIES	Dogfish			Sablefish			Pacific Ocean Perch			Redstrip Rockfish			Reedi Rockfish			Pacific Ocean Perch		
FORK LENGTH (CM)	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
28	-	-	-	-	-	-	-	-	-	3	-	3	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	3	-	3	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	20	-	20	-	-	-	-	-	-
31	-	-	-	-	-	-	-	-	-	15	2	17	-	-	-	-	-	-
32	-	-	-	-	-	-	-	-	-	11	6	17	-	-	-	-	-	-
33	-	-	-	-	-	-	-	-	-	6	9	15	-	-	-	-	-	-
34	-	-	-	-	-	-	4	1	5	4	5	9	-	-	-	-	-	-
35	-	-	-	-	-	-	1	4	5	1	14	15	-	-	-	-	-	-
36	-	-	-	-	-	-	2	4	6	2	9	11	-	-	-	-	-	-
37	-	-	-	-	-	-	1	4	5	1	11	12	1	1	2	1	-	1
38	-	-	-	-	-	-	2	3	5	-	6	6	3	2	5	0	-	0
39	-	-	-	-	-	-	5	8	13	-	4	4	10	2	12	0	1	1
40	-	-	-	-	-	-	0	8	8	-	2	2	2	4	6	4	2	6
41	-	-	-	-	-	-	1	9	10	-	0	0	2	4	6	5	0	5
42	-	-	-	-	-	-	-	10	10	-	1	1	2	0	2	6	4	10
43	-	-	-	-	-	-	-	4	4	-	-	-	1	2	3	1	3	4
44	-	-	-	-	-	-	-	4	4	-	-	-	1	1	2	-	2	2
45	-	-	-	-	-	-	-	4	4	-	-	-	0	4	4	-	4	4
46	-	-	-	-	-	-	-	1	1	-	-	-	0	1	1	-	3	3
47	-	-	-	-	-	-	-	2	2	-	-	-	2	5	7	-	-	-
48	-	-	-	-	-	-	-	-	-	-	-	-	2	1	3	-	-	-
49	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-
50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
52	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-
53	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
54	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
55	-	-	-	1	2	3	-	-	-	-	-	-	-	-	-	-	-	-
56	-	-	-	1	3	4	-	-	-	-	-	-	-	-	-	-	-	-
57	-	-	-	4	2	6	-	-	-	-	-	-	-	-	-	-	-	-
58	-	-	-	1	0	1	-	-	-	-	-	-	-	-	-	-	-	-
59	-	-	-	0	1	1	-	-	-	-	-	-	-	-	-	-	-	-
60	-	-	-	0	1	1	-	-	-	-	-	-	-	-	-	-	-	-
61	-	-	-	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-
62	-	-	-	0	1	1	-	-	-	-	-	-	-	-	-	-	-	-
63	-	-	-	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-
64	-	-	-	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-
65	-	-	-	2	0	2	-	-	-	-	-	-	-	-	-	-	-	-
66	-	-	-	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-
67	-	-	-	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-
68	-	-	-	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-
69	-	-	-	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-
70	1	-	-	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-
71	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
72	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
73	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
74	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
76	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
77	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
78	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
79	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
81	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
82	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
83	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
84	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
85	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
86	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
87	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
88	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
89	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
90	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	24	0	24	13	19	32	16	66	82	66	69	135	26	28	54	17	19	36

Table 10. CTD stations occupied during the CSS W.E. RICKER Pacfic hake acoustic survey, August 15 - 31 1994.

Stn No.	Cast No.	Date (yymmdd)	Time (PDT)	Cast Location Latitude	Cast Location Longitude	Station Location Latitude	Station Location Longitude	Bottom Depth (m)	Cast Depth (m)
LB02	8	940815	22:55	48 39.0N	125 02.6W	48 39.0N	125 02.4W	52	32
LB03	9	940815	23:23	48 37.3N	125 05.7W	48 37.3N	125 05.6W	92	74
LB04	10	940815	23:49	48 35.6N	125 08.8W	48 35.7N	125 08.8W	110	91
LB05	11	940816	01:16	48 33.9N	125 12.1W	48 34.0N	125 12.0W	99	71
LB06	12	940816	00:46	48 32.1N	125 15.5W	48 32.2N	125 15.5W	112	81
LB07	13	940816	01:31	48 28.5N	125 22.2W	48 28.7N	125 22.1W	153	124
LB08	14	940816	02:21	48 25.4N	125 28.5W	48 25.3N	125 28.7W	137	108
LB09	15	940817	22:37	48 22.0N	125 34.7W	48 22.0N	125 34.8W	148	119
LB10	16	940817	23:26	48 18.5N	125 41.3W	48 18.6N	125 41.4W	151	126
LB11	17	940818	00:14	48 15.3N	125 47.7W	48 15.2N	125 47.8W	202	174
LB12	18	940818	00:48	48 13.0N	125 51.9W	48 12.9N	125 51.9W	510	481
LB13	20	940818	02:01	48 10.7N	125 56.3W	48 10.6N	125 56.1W	900	501
LB14	21	940818	02:39	48 08.6N	126 00.1W	48 08.5N	126 00.0W	1180	500
LB15	22	940818	03:42	48 04.5N	126 08.6W	48 04.4N	126 08.5W	1400	500
LC11	23	940818	22:02	48 19.0N	126 26.8W	48 19.0N	126 26.7W	1300	500
LC10	24	940818	22:57	48 22.3N	126 20.2W	48 22.4N	126 20.2W	1200	500
PLA3	25	940818	23:46	48 24.8N	126 15.9W	48 24.7N	126 15.8W	1000	500
LC08	26	940819	01:59	48 29.4N	126 07.0W	48 29.5N	126 07.1W	197	168
LC07	27	940819	02:45	48 32.9N	126 00.4W	48 32.9N	126 00.5W	122	94
PLA2	28	940819	04:04	48 22.6N	126 03.6W	48 22.7N	126 03.8W	374	346
LC04	29	940821	00:24	48 43.4N	125 41.0W	48 43.4N	125 40.8W	165	138
LC05	30	940821	01:09	48 39.9N	125 47.4W	48 39.9N	125 47.4W	61	34
LC06	31	940821	01:51	48 36.5N	125 54.0W	48 36.5N	125 54.0W	91	62
LC02	32	940822	22:03	48 48.7N	125 31.1W	48 48.7N	125 30.9W	105	76
LC03	33	940822	22:35	48 46.9N	125 34.3W	48 46.9N	125 34.2W	130	103
LD02	34	940822	00:22	48 58.3N	125 47.3W	48 58.4N	125 47.1W	40	25
LD03	35	940823	00:48	48 56.7N	125 50.4W	48 56.6N	125 50.4W	44	27
C401	36	940824	06:05	49 10.0N	128 14.3W	-	-	2500	500
C601	37	940824	21:29	49 14.8N	127 24.9W	-	-	1270	500
C602	38	940824	23:07	49 14.9N	127 06.4W	-	-	460	432
C603	39	940825	00:11	49 14.9N	126 57.5W	-	-	170	141
C801	40	940825	06:04	49 19.7N	126 38.4W	-	-	87	71
C261	41	940826	21:14	49 55.2N	128 32.1W	-	-	2060	500
C262	42	940826	23:25	49 54.9N	126 03.9W	-	-	1000	500
C263	43	940826	00:36	49 55.1N	127 50.8W	-	-	700	500
C264	44	940827	01:18	49 55.1N	127 44.7W	-	-	158	129
C421	45	940827	21:20	50 20.5N	129 17.3W	-	-	1100	500
C422	46	940828	00:37	50 20.0N	128 33.9W	-	-	1180	500
C423	47	940828	01:53	50 20.1N	128 20.1W	-	-	750	500
C424	48	940828	02:36	50 20.1N	128 14.4W	-	-	184	155
C441	49	940828	06:21	50 25.4N	128 11.2W	-	-	107	95
LQ03	50	940828	22:36	50 39.8N	129 01.9W	50 39.8N	129 01.9W	1200	500
CPE2	51	940829	01:18	50 42.9N	128 39.9W	50 43.0N	128 40.0W	122	93
GI07	53	940830	00:07	51 09.2N	130 21.6W	51 09.2N	130 21.8W	1950	500
GI06	54	940830	01:27	51 15.1N	130 09.2W	51 15.2N	130 09.1W	900	500
GI04	55	940830	02:45	51 21.3N	129 56.3W	51 21.3N	129 56.5W	247	218
GI03	56	940830	03:25	51 24.1N	129 50.3W	51 24.3N	129 50.2W	221	92
GI02	57	940830	04:35	51 30.4N	129 37.5W	51 30.3N	129 37.5W	142	114
CPE1	58	940831	14:05	51 00.0N	127 50.1W	51 00.0N	127 50.0W	147	118

Table 11. Summary of plankton[1] stations occupied during the CSS W.E. RICKER Pacfic hake acoustic survey, August 15 - 31, 1994.

Stn no.	Date (yymmdd)	Time (PDT)	Cast Location Latitude	Longitude	Bottom Depth (m)	Cast Depth (m)	Bongo Depth (m)	Ctd cast no.
PLA3	940818	00:05	48 24.8	126 15.2	1000	500	500	25
PLA2	940819	04:36	48 22.5	126 03.6	336	300	300	28
LQ03	940828	22:55	50 39.8	129 01.9	1200	500	463	50
CPE2	940829	01:26	50 42.9	128 39.9	123	93	90	51
GI02	940831	00:25	49 39.9	127 34.3	143	114	110	57
CPE1	940831	14:12	51 00.9	127 51.5	145	118	110	58

1 Plankton Research Program consisting of one CTD probe and one oblique bongo net plankton tow at each station.

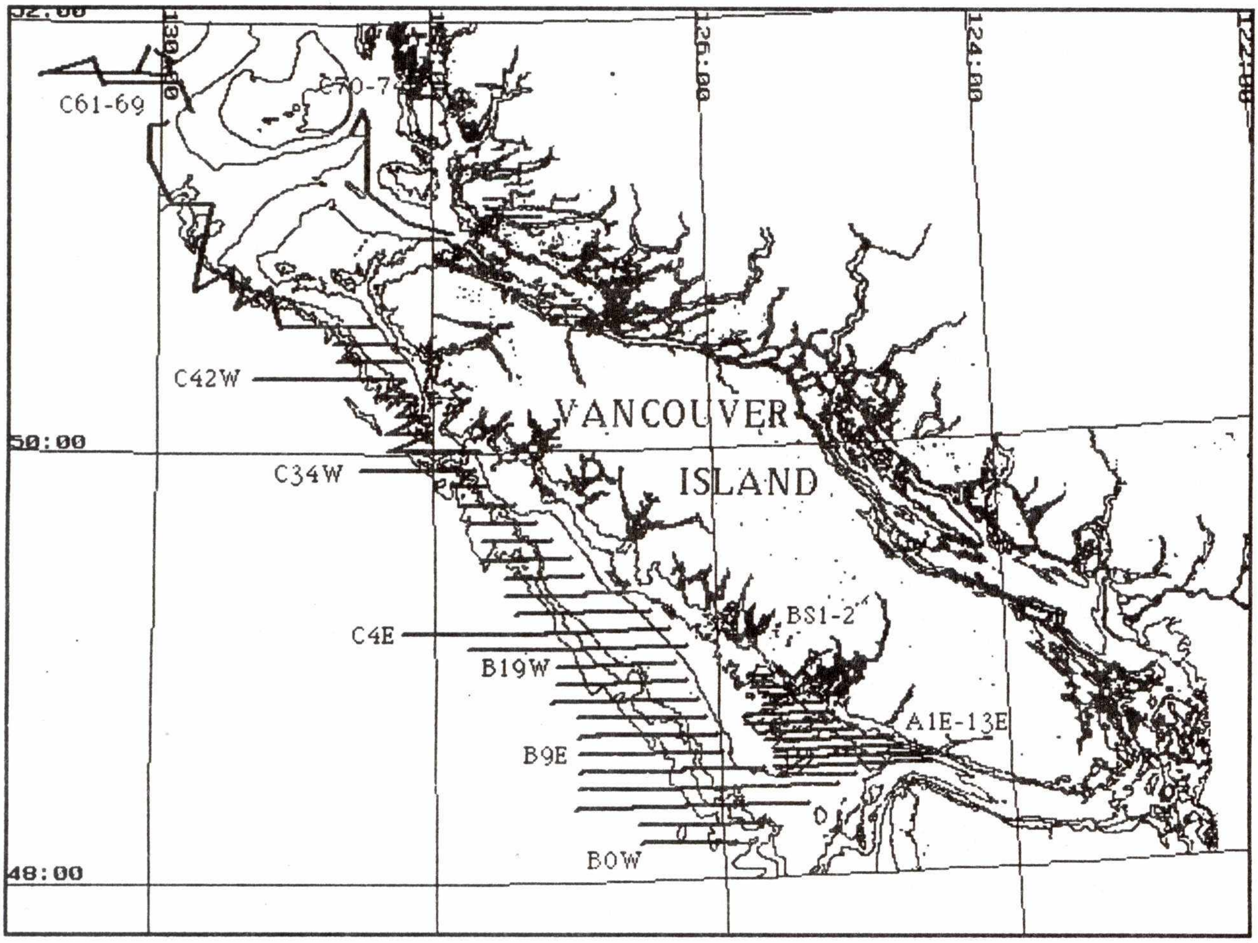


Figure 1a. Transects occupied during the Pacific hake acoustic stock assessment survey August 15 - 31, 1994, on the *C.S.S. W.E. RICKER*.

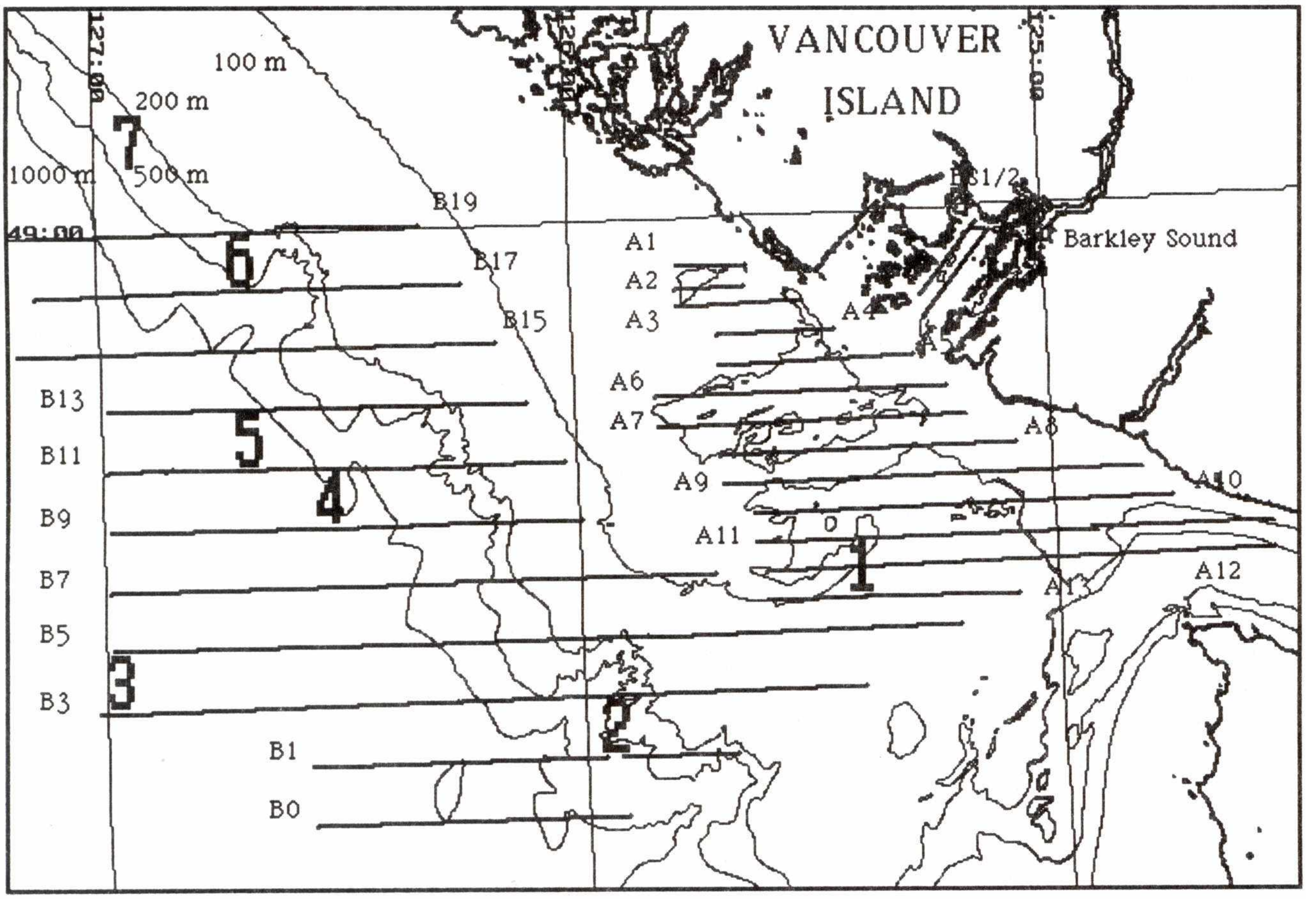


Figure 1b. A and B transects occupied during the Pacific hake acoustic stock assessment survey August 15-31, 1994, on the C.S.S. W. E. RICKER. Large bold numbers indicate trawl set locations with actual position of set at lower left corner of number.

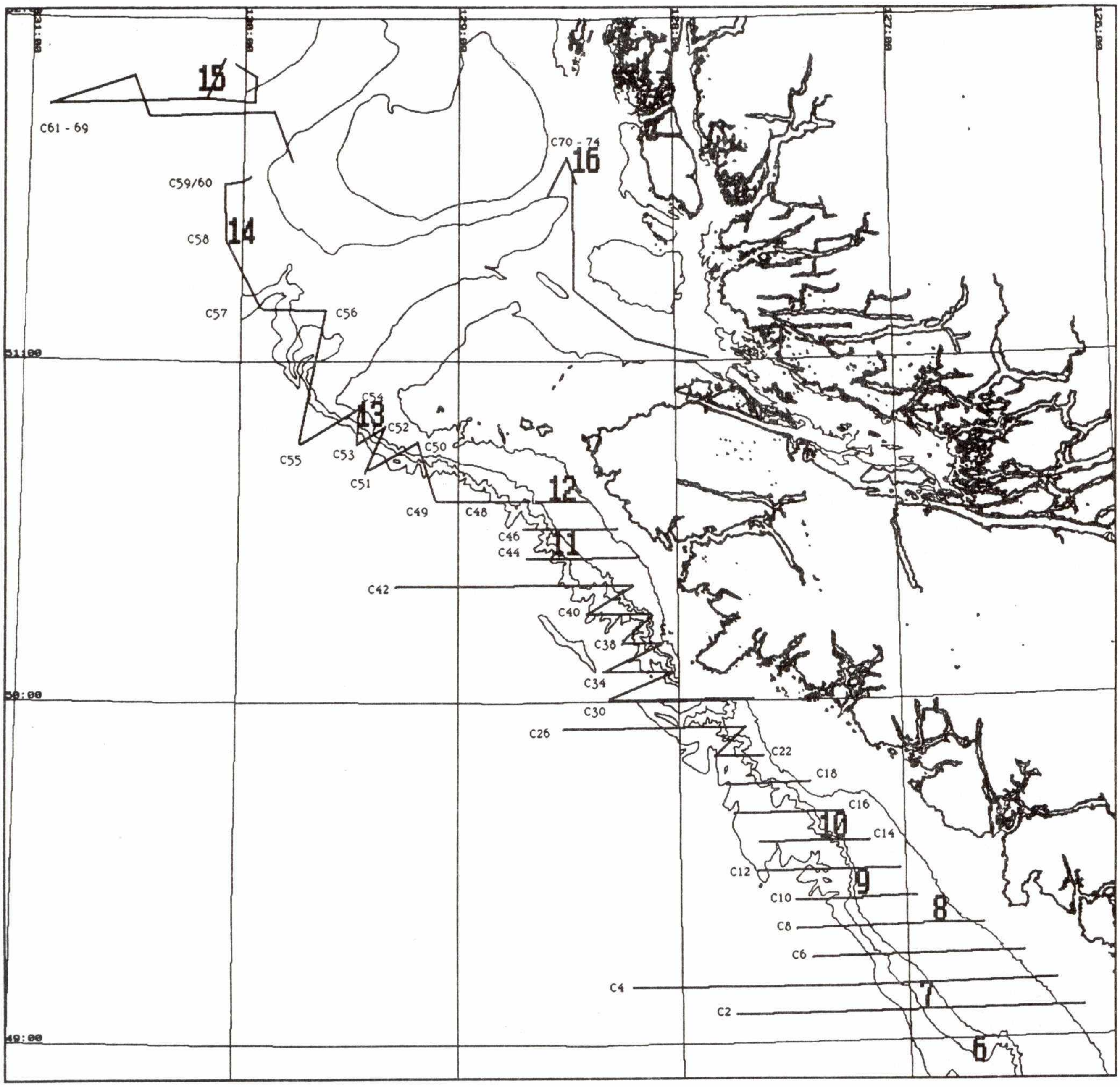


Figure 1c. C transects occupied during the Pacific hake acoustic stock assessment survey August 15 - 31, 1994, on the C.S.S. W. E. RICKER. Large bold numbers indicate trawl set locations with actual position of set at lower left corner of number.

Figure 2a. Portion of an echogram collected August 21, 1994 during the acoustic stock assessment survey of Pacific hake off the westcoast of Vancouver Island, August 15 -31, 1994. Typical rockfish schools are shown at ranges from 100 m to bottom. A characteristic 'needle-shaped' herring aggregation is labelled. Bottom track, range, sequence and event marks are labelled.

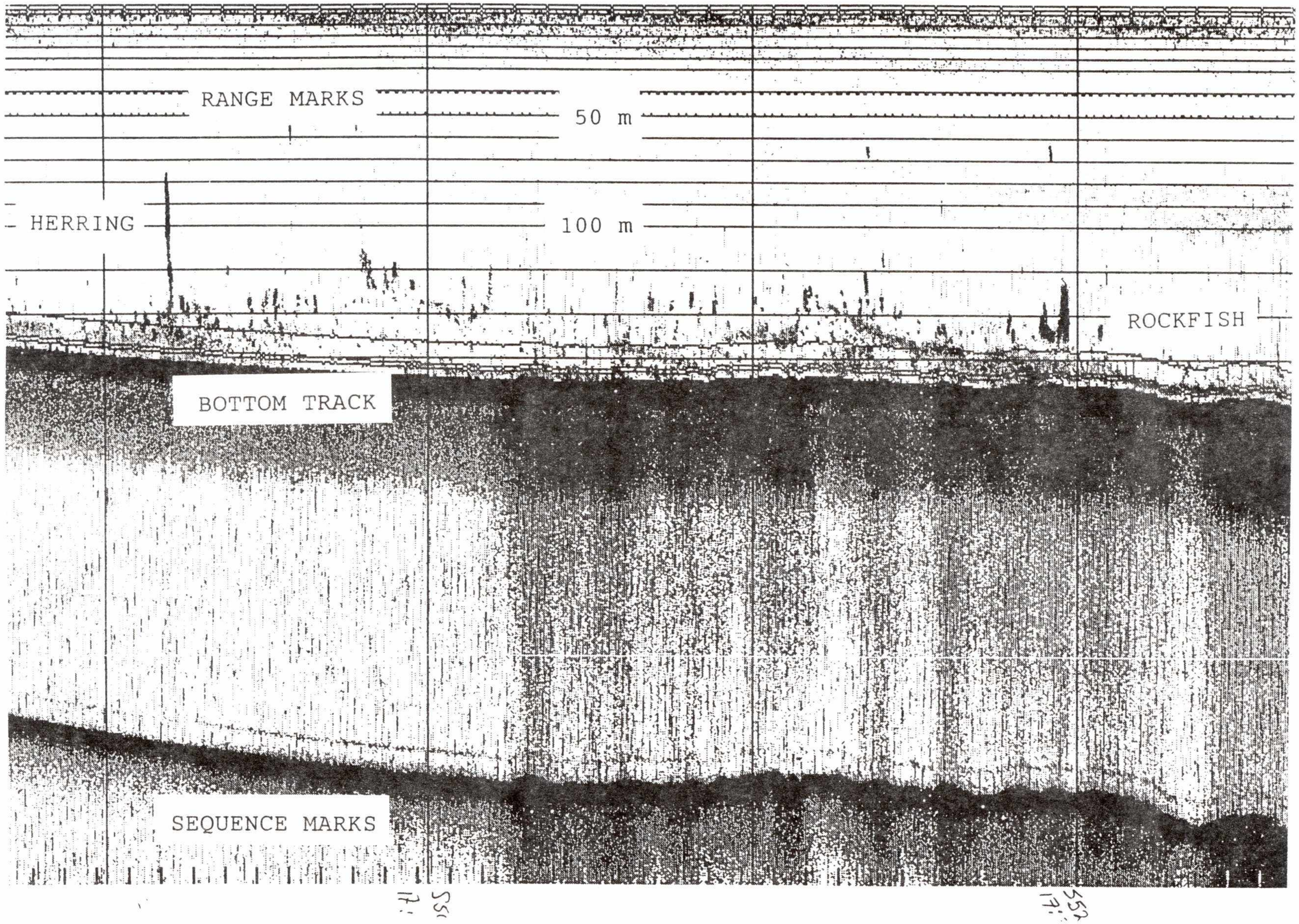
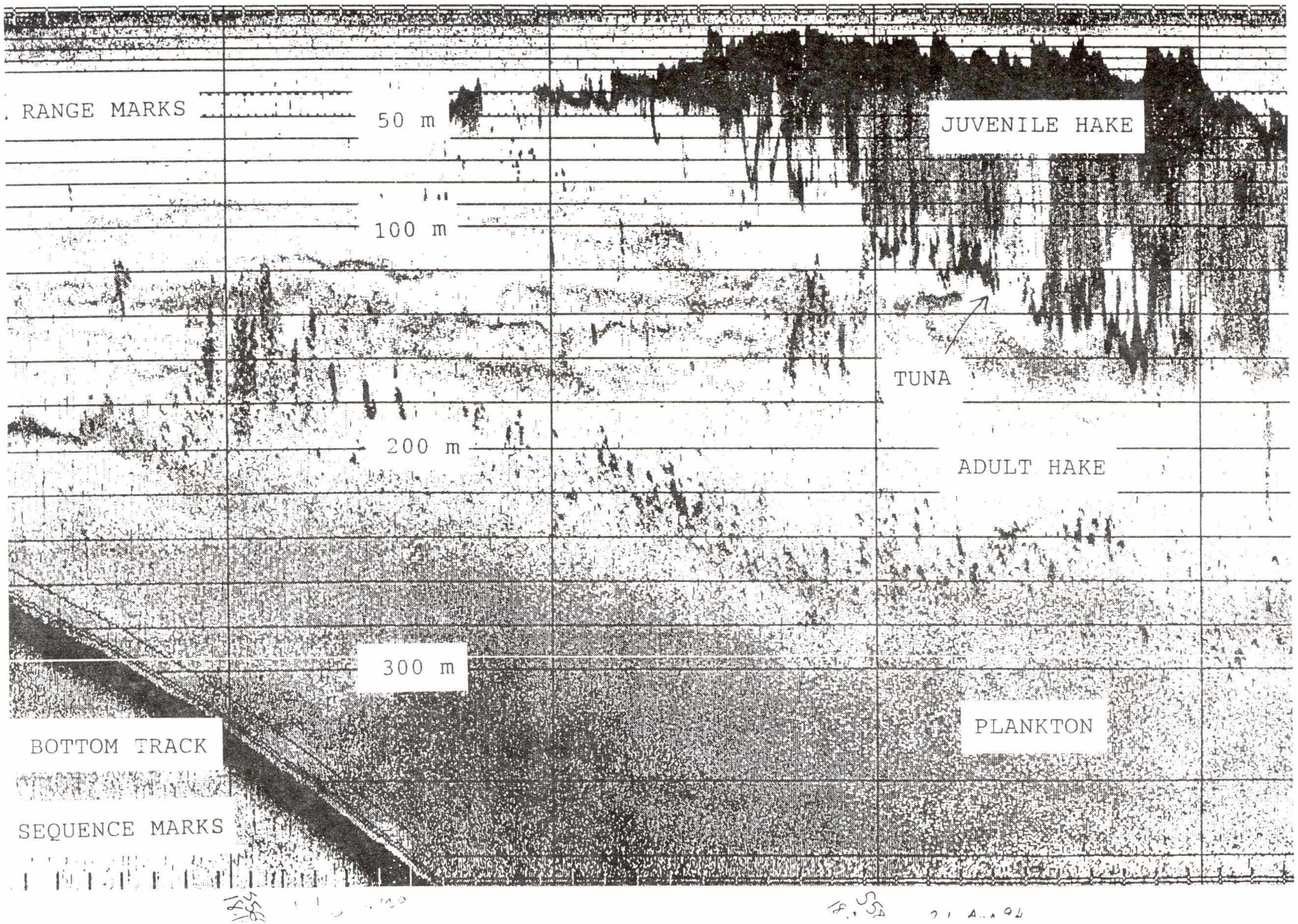


Figure 2b. Portion of an echogram collected August 21, 1994 during the acoustic assessment survey of hake off the westcoast of Vancouver Island, August 15 - 31, 1994. Typical adult hake aggreagations are shown between 160 and 300 m range. Underlying the hake layer is a diffuse scattering of plankton extending from the shelf break offshore to at least 400 m range. Also visible from near surface to 100 m range is a dense shoal of juvenile hake with an underlying school of albacore tuna. Bottom track, range, and sequence marks are labelled.



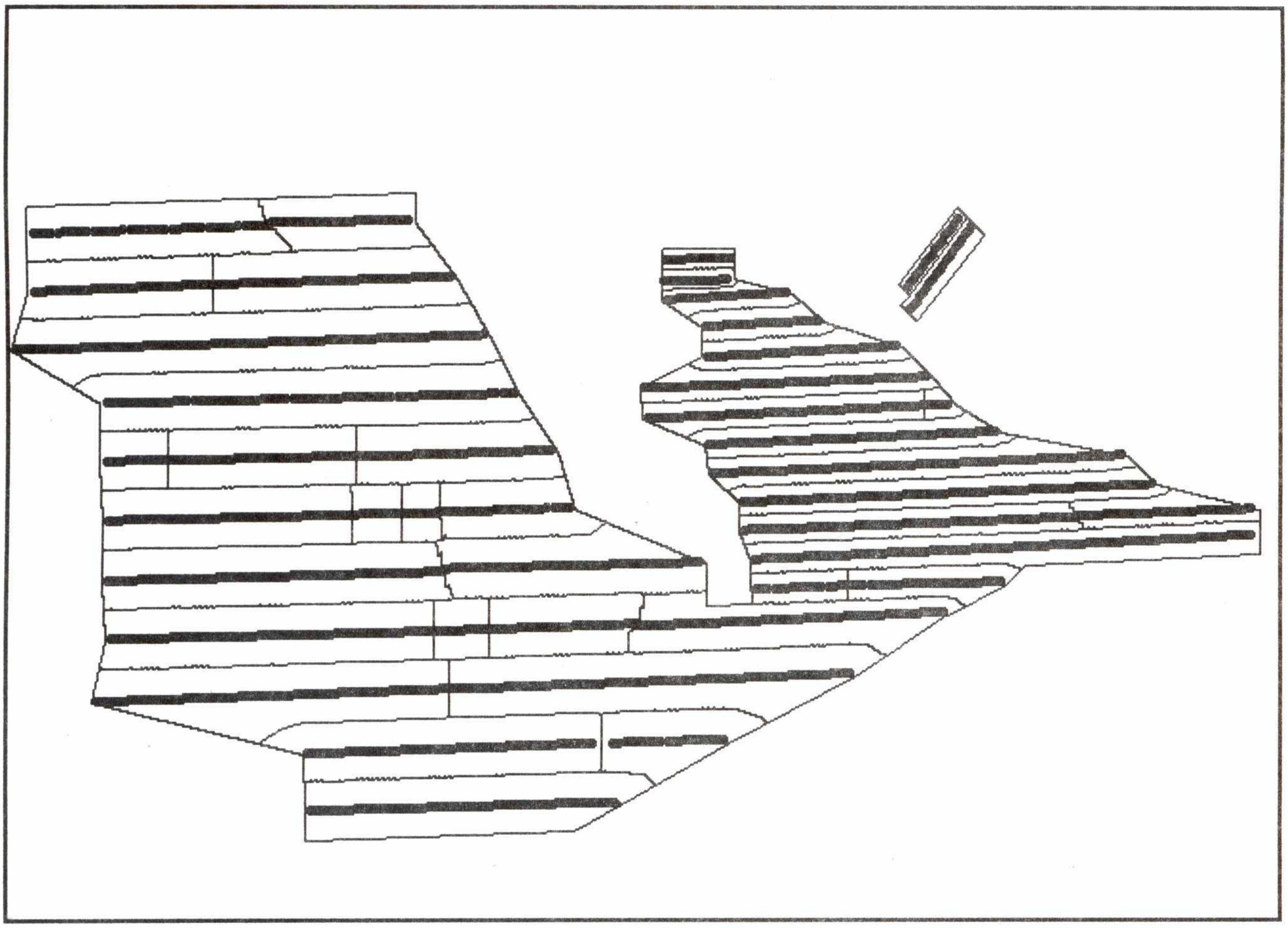


Figure 3a. Transect boundaries defining the A and B series for biomass estimation based on surface densities collected from the Pacific hake acoustic stock assessment survey August 15 - 31, 1994, on the C.S.S. W. E. RICKER. East and west boundaries of mask are hand drawn connecting end points of transects. North, south and interior boundaries are determined by 'buffering' the sample locations.

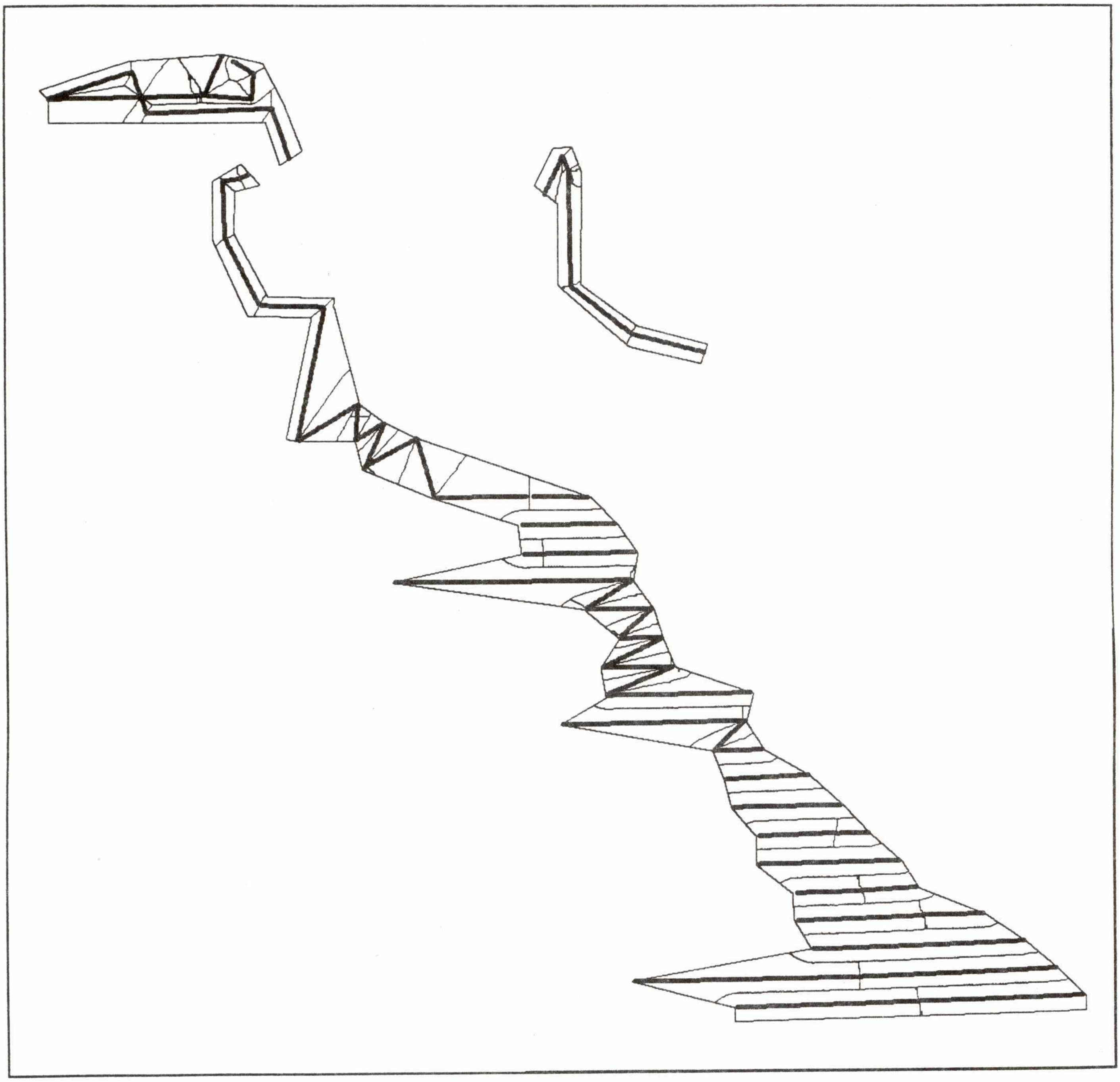


Figure 3b. Transect boundaries defining the C series for biomass estimation based on surface densities collected from the Pacific hake acoustic stock assessment survey August 15-31, 1994, on the C.S.S. W. E. RICKER. East and west boundaries of mask are hand drawn connecting end points of transects. North, south and interior boundaries are determined by 'buffering' the sample locations.

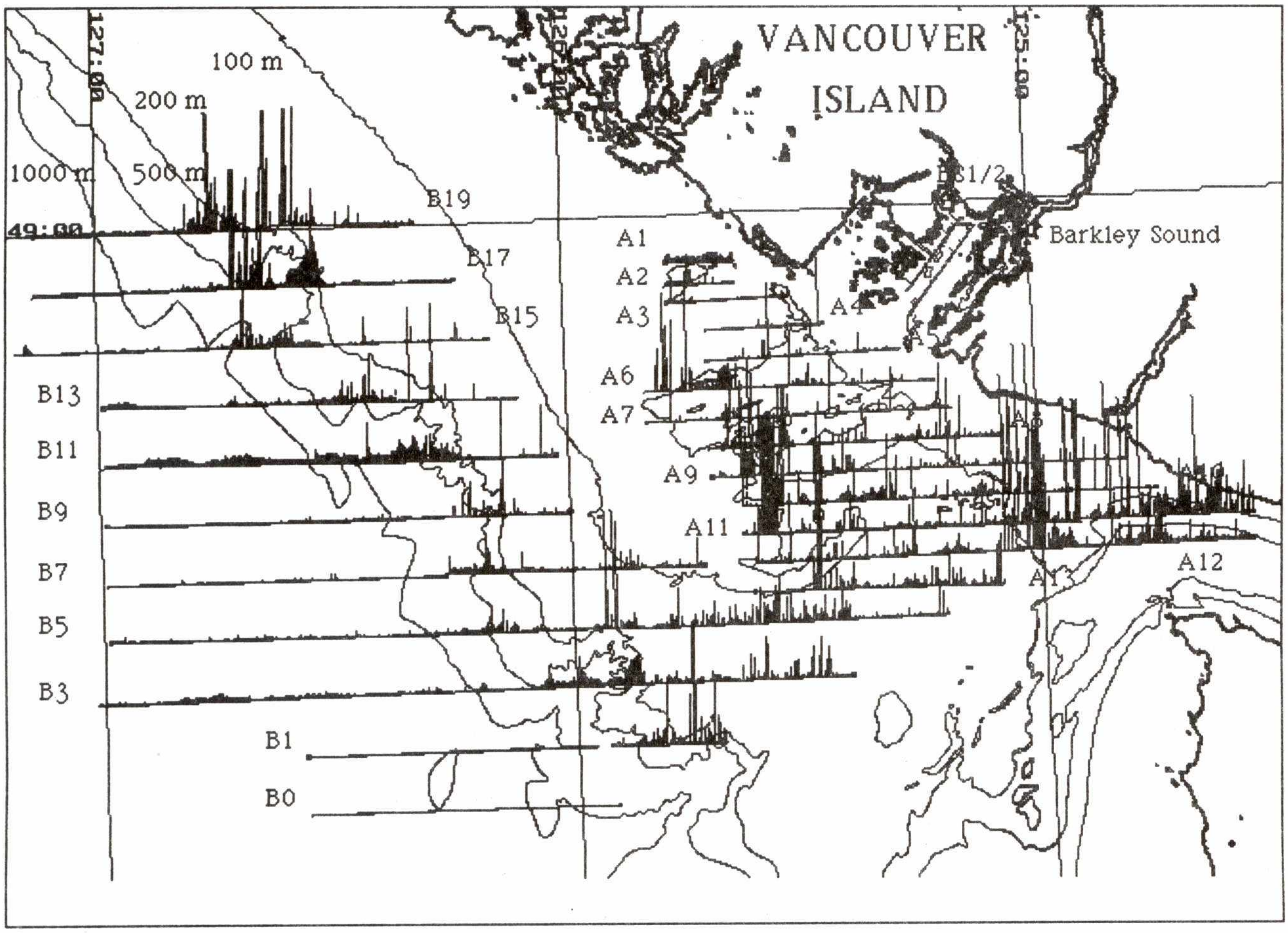


Figure 4a. Surface densities for TOTAL BIOMASS (Table 2) for the A and B transects from the Pacific hake acoustic stock assessment survey August 15 - 31, 1994, on the C.S.S. W. E. RICKER. Densities are shown as vertical bars on a linear scale from 0.0 to 0.5 kg/m^2.

Figure 4b. Surface densities for TOTAL BIOMASS (Table 2) for the C transects from the Pacific hake acoustic stock assessment survey August 15 - 31, 1994, on the C.S.S. W. E. RICKER. Densities are shown as vertical bars on a linear scale from 0.0 to 0.5 kg/m^2.

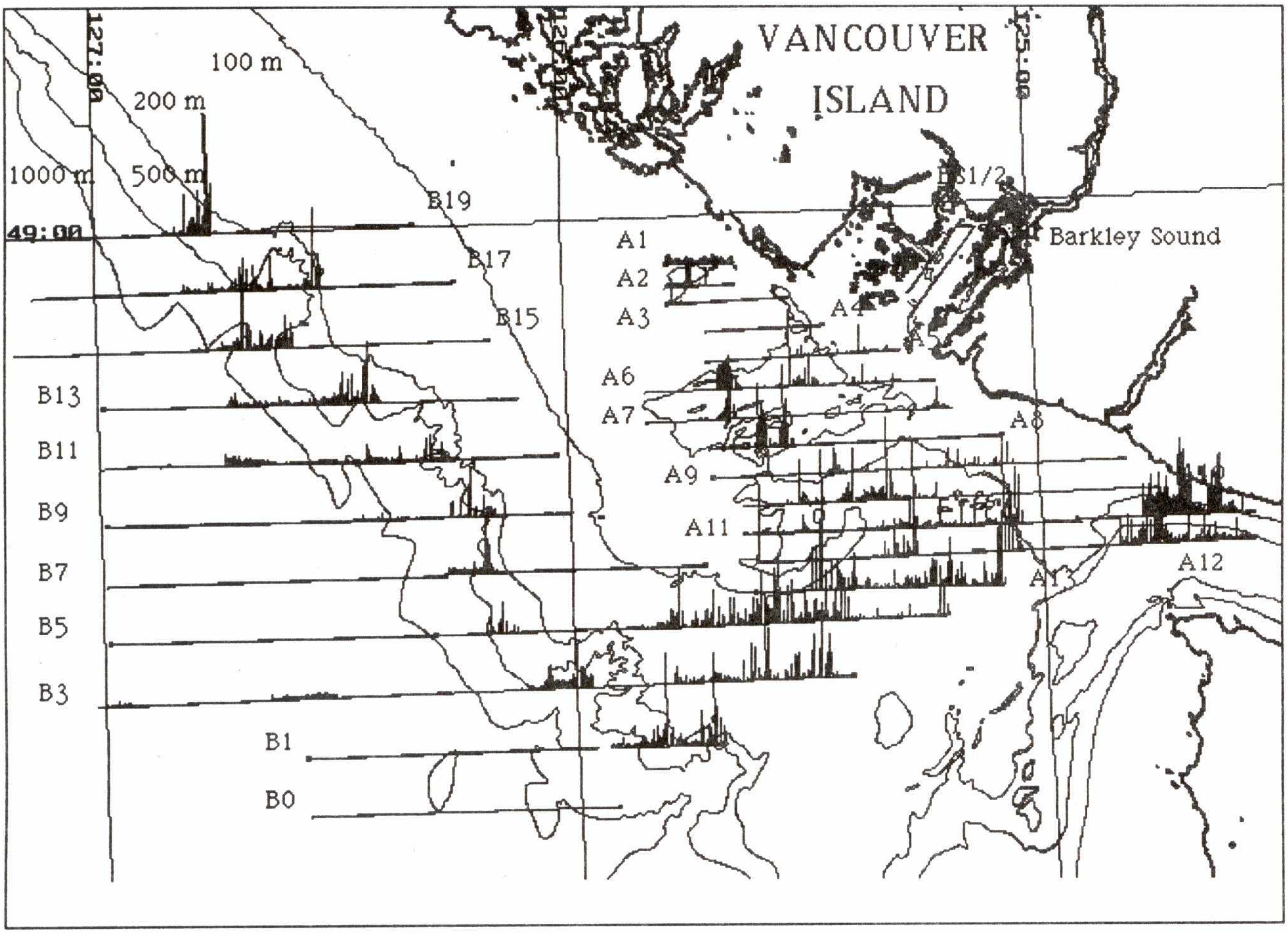


Figure 5a. Surface densities for HAKE BIOMASS (adult only; Table 2) for the A and B transects from the Pacific hake acoustic stock assessment survey August 15 - 31, 1994, on the C.S.S. W. E. RICKER. Densities are shown as vertical bars on a linear scale from 0.0 to 0.5 kg/m^2.

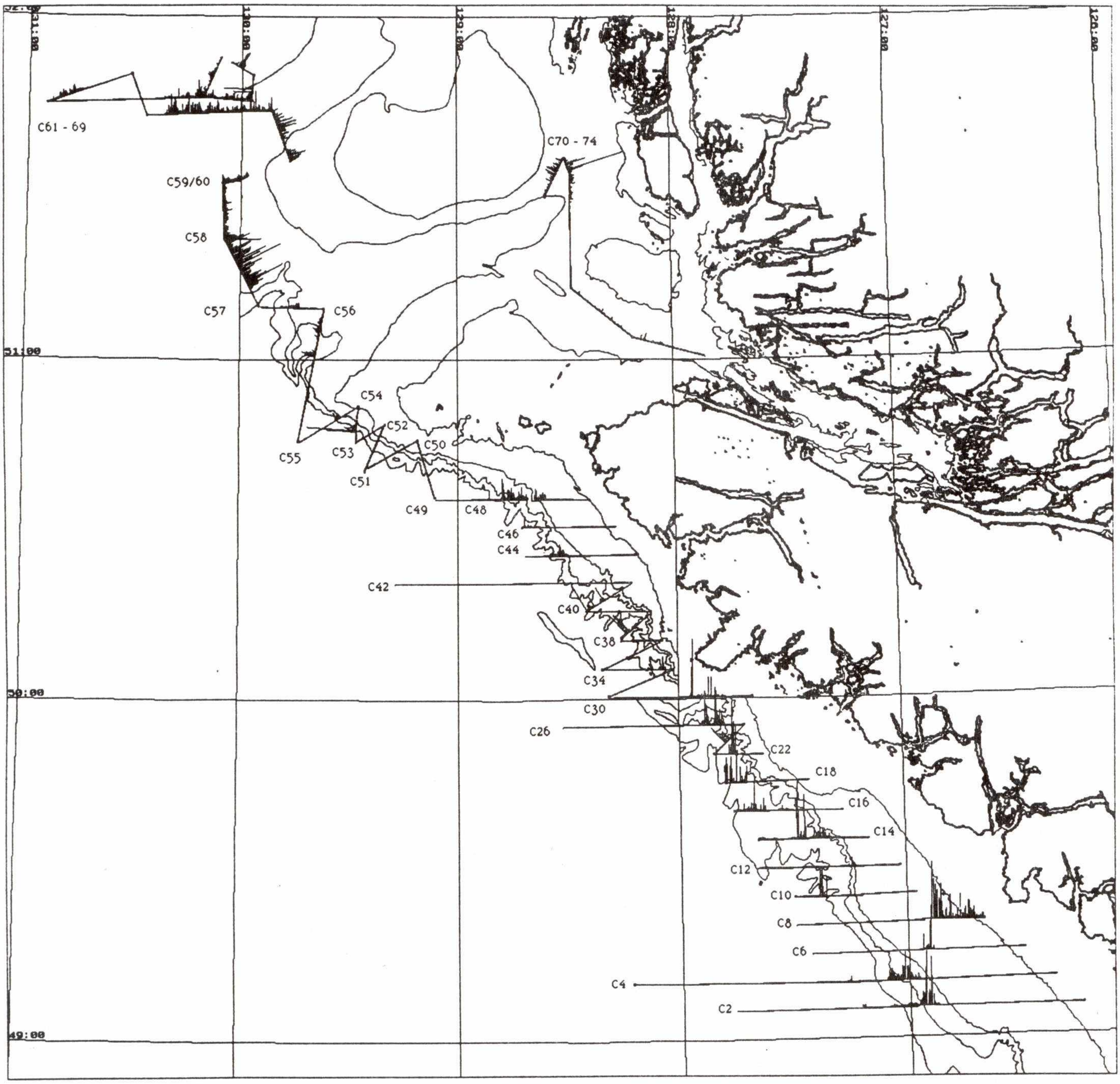


Figure 5b. Surface densities for HAKE BIOMASS (adult only; Table 2) for the C transects from the Pacific hake acoustic stock assessment survey August 15 - 31, 1994, on the C.S.S. W. E. RICKER. Densities are shown as vertical bars on a linear scale from 0.0 to 0.5 kg/m^2.

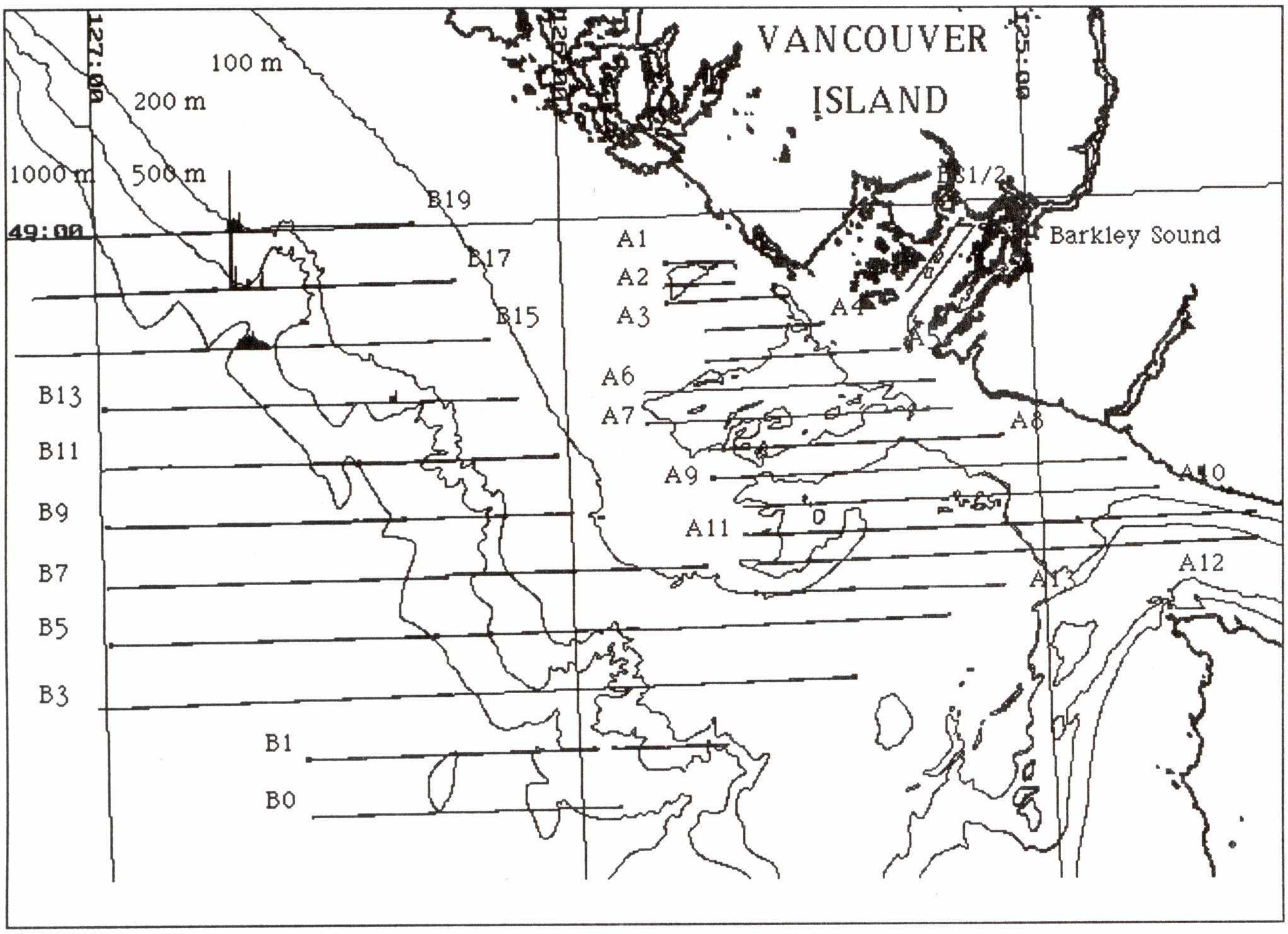


Figure 6a. Surface densities for young-of-the-year hake (<10 cm) for the A and B transects from the Pacific hake acoustic stock assessment survey August 15 - 31, 1994, on the C.S.S. W. E. RICKER. Densities are shown as vertical bars on a linear scale from 0.0 to 0.5 kg/m^2.

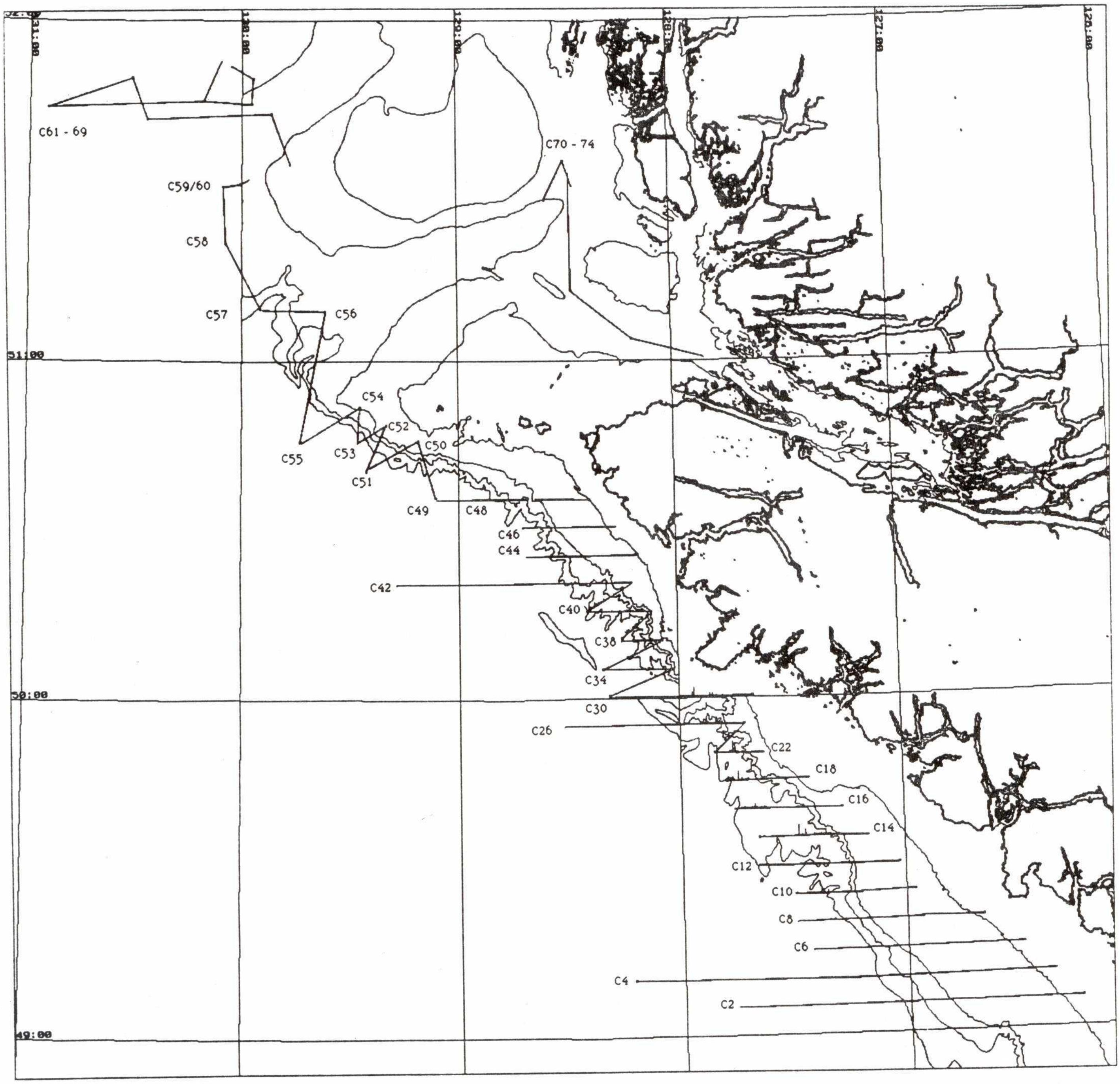


Figure 6b. Surface densities for young-of-the-year hake (<10 cm) for the C transects from the Pacific hake acoustic stock assessment survey August 15 - 31, 1994, on the C.S.S. W. E. RICKER. Densities are shown as vertical bars on a linear scale from 0.0 to 0.5 kg/m^2.