

**FRV SOUTHERN SURVEYOR**

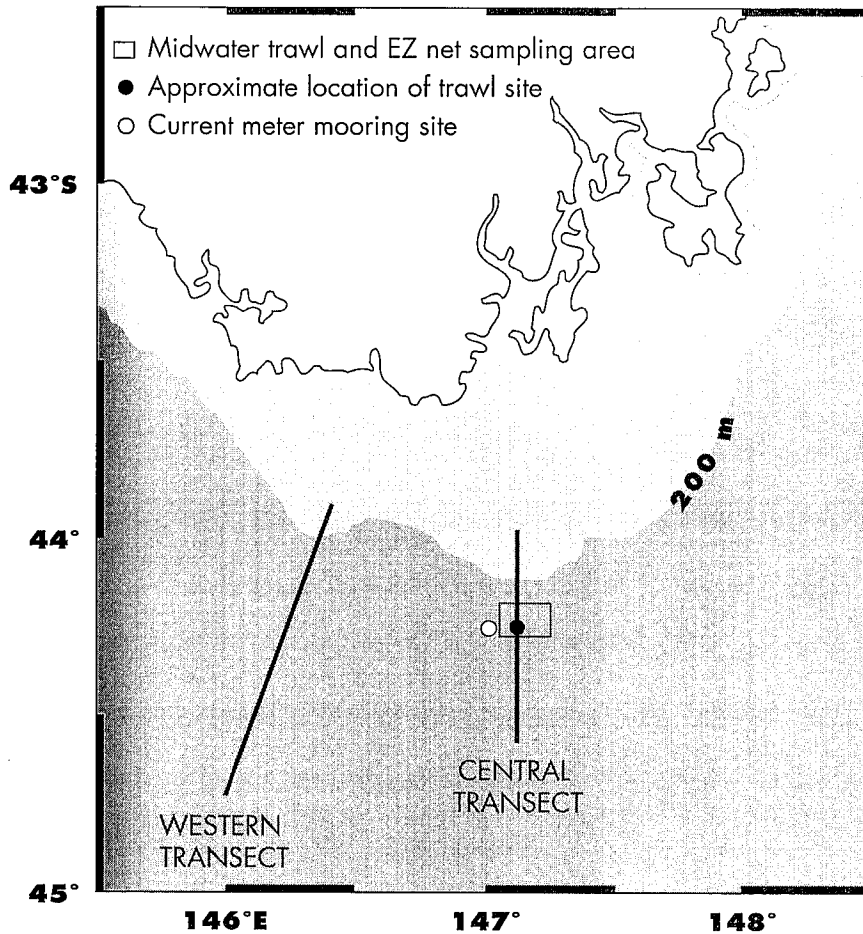
April 7 – April 22 1993



DIVISION OF FISHERIES

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CRUISE REPORT SS 3 / 93



**FIGURE 1.** Area of operations for SS 3/93 showing the location of CTD transects, demersal trawl site and a box enclosing the area where the midwater (MIDOC) and EZ net trawls were made. CTD stations were made along the lines at six and three nautical miles inshore of the shelf break; at the shelf break; and 3, 6, 10, 15, 20, 25 and 30 nautical miles offshore of the shelf break. On the western transect, additional stations at 37 and 45 nautical miles offshore of the shelf break were sampled.

## **ITINERARY**

Departure: Hobart 18:30 h on Friday April 7, 1993.

Return: Hobart 12:45 h on Thursday April 22, 1993.

## **AREA OF OPERATION**

Biological sampling was carried out at 44°10'S, 147°11'E near an orange roughly fishing ground close to Pedra Branca Rock. Oceanographic sampling was carried out near Pedra Branca and on transects from the central and western continental shelf south of Tasmania in waters between 100 m and over 3000 m deep (see Figure 1).

## **RESEARCH BACKGROUND**

This cruise examined the productivity of the mid-slope region near Pedra Branca, off southern Tasmania, and the processes supporting the rich commercial fisheries of this area. In particular, the cruise examined near-surface primary productivity, the flux of material from the near-surface to deep water, the vertical migrations of organisms through the water column, advection of material into the area, and the trophic pathways leading from primary producers to commercial fishes. This autumn cruise was the last in a series of trophodynamics cruises: the first three cruises were completed in winter 1991 (SS 2/91), summer 1992 (SS 1/92), and spring (SS 4/92).

The cruise was divided between:

1. Biological sampling for demersal fish (using demersal trawls), micronekton (using midwater trawls) and zooplankton (using the EZ net) to determine the vertical distribution and diurnal movements of these three groups, and to obtain samples for trophic analyses.
2. Oceanographic sampling to determine the vertical and horizontal distribution of physical, chemical, and biological properties of the water column (using the CTD and rosette system).

## **CRUISE OBJECTIVES**

1. Determine the day/night vertical distribution of zooplankton, midwater nekton and demersal fish at a site off Pedra Branca, southern Tasmania, using replicated, day/night demersal, midwater and plankton tows.
2. Examine the diet of the main fish and zooplankton species at the site through stomach content and stable isotope analyses, as the basis for determining the general trophic structure at mid-slope depths, the vertical distribution of feeding, and the resulting vertical flux of material.
3. Determine water mass structure in the sampling area by making three cross-slope CTD transects.
4. Measure zooplankton biomass, primary productivity and the concentration of chlorophyll-*a* at the trawl site and on the cross-slope transects.

5. Continue the study of currents at the Pedra Branca site (begun during SS2/91), by retrieving a current meter mooring placed in November 1992 and refurbishing and redeploying it during the current cruise.
6. Investigate the flux of detritus through the water column by deploying moored and free-floating sediment traps.
7. Test and calibrate the lightweight towed body containing acoustic equipment for biomass estimation.
8. Estimate the vertical biomass distribution and its daily vertical flux through the water column, using acoustic techniques in conjunction with net sampling.

## RESULTS

Of the 14 allocated days, 4.5 days were lost due to rough weather. As a result, the EZ net trawl series and one CTD transect were not completed. The stations are listed in Appendix 1; the area of operations is in waters south of Tasmania as shown in Figure 1.

The cruises have been funded by the Marine Environmental Research Program, and the Temperate and Deepwater Fisheries Resources Programs in the CSIRO Division of Fisheries, and grants from the Fisheries Research and Development Corporation (FRDC) and the Australian Research Council (ARC) grant. The principal investigators were: Dr A. J. Koslow (FRDC grant 90/25: 'Development and use of acoustic techniques for the assessment of deepwater commercial fish stocks'), Dr J. S. Parslow (FRDC grant 91/17: 'Trophodynamics of south-east trawl deepwater stocks') and Dr G. Fenton (University of Tasmania; ARC grant: 'Food chain structure on the mid-slope region off south-east Australia').

### Objectives 1 and 2

**Demersal Fishes:** Seven tows were completed with an Engels High-lift demersal trawl in a 27 h period. Catches ranged between 9 kg and 137 kg, with a total catch weight of 535 kg. All fish were identified, weighed and counted. The species selected for further investigation were sampled for stomach contents, length, weight and sex. Tissue samples were taken for enzyme, heavy metal and genetic analyses, and  $^{13}\text{C}:^{12}\text{C}$  isotope ratios. Whole specimens of oreo dories were kept for taxonomic and morphological studies. Whole specimens of *Diastobranchus capensis* and *Coryphaenoides subserrulatus* were kept for heavy metal analyses, which are being done for the Pasminco-EZ research project led by Dr V. Lyne (CSIRO Division of Fisheries).

**Midwater nekton:** The day/night vertical distribution and abundance of midwater nekton was determined over a 48 h period using a modified IYGPT trawl with the MIDOC opening-closing cod end system. The trawl sampled 100 m depth strata between the near-surface and 400 m, and 125 m depth strata between 400 and 900 m. Four strata were sampled in each tow. The modified net worked well, and some information about the mouth geometry of the net was obtained. Catches were generally larger than on the three previous cruises, and all fish, squid, and large crustaceans were preserved for study by Dr A. Williams (CSIRO Division of Fisheries). Specimens of about 15 species of midwater and

demersal fish and crustaceans (not yet identified) were kept for Dr G. Fenton of the University of Tasmania, who will measure  $^{13}\text{C}:^{12}\text{C}$  isotope ratios in each specimen.

Only three of the planned eight EZ net hauls (one day, two night) to determine the vertical distribution of the zooplankton, small midwater crustaceans and fishes were made because of the rough weather. The samples are being examined by Mr A. Terauds (University of Tasmania) and Dr A. J. Koslow (CSIRO Division of Fisheries).

### **Objectives 3 and 4**

Nine of the planned ten CTD stations on the central transect, and all CTD stations on the western transect were completed. This is sufficient to determine the water mass structure both on the transects and the trawl site, and to relate the chemical and biological oceanographic parameters to the structure and to the distribution of zooplankton, micronekton and fish. The eastern transect was not sampled due to time lost because of rough weather.

Samples were taken for salinity, oxygen, nutrients, chlorophyll-*a*, particle size and primary production estimates at depths of 0, 25, 40, 75 and 100 m, with additional samples for salinity, oxygen, nutrients and particle size at 200 m, 500 m, 750 m, 1000 m, 1250 m, 1500 m and 2000 m depths. Primary production measurements were made at every second station. Drop net samples (100  $\mu\text{m}$  mesh; surface to 100 m depth) were taken to obtain estimates of microzooplankton biomass. Fluorescence and underwater light measurements were made at each station with the SeaTech fluorometer/SDL package. A prototype spectroradiometer being developed by the CSIRO Division of Fisheries was deployed at selected stations during daylight to measure profiles of upwelling and downwelling irradiance in support of ocean-colour algorithm development. The oceanographic results are being analysed by Dr J. Parslow, Dr V. Lyne, Ms L. Clementson and Mr B. Griffiths of the CSIRO Division of Fisheries.

### **Objective 5**

The current meter and sediment trap mooring deployed during cruise SS 4/92 was successfully recovered. There is good data on temperature and current speed and direction from depths of 170 m and 1000 m. The deep Honjo sediment trap (at 984 m) returned a full set of 21 samples, each of which represents about 6.75 days of sedimenting detritus. The shallow sediment trap (at 190 m) returned one 6.75 day sample, and then failed. A faulty computer chip was replaced, new batteries were installed in the sediment traps, and replacement current meters were attached to the mooring which was then redeployed on April 10, 1993 at 44°12.29'S, 147°06.14'E. It will be recovered in February 1994. Sediment trap data is being analysed by Mr B. Griffiths and Ms L. Clementson of the CSIRO Division of Fisheries.

### **Objective 6**

The detrital flux in the water column was measured by deploying and following the free-drifting sediment trap for 20 h. The trap drifted about seven nautical miles ENE during the station. CTD samples were taken every 6 h to follow short term variations in the within-site fluorescence, chlorophyll,

nutrients, particle size, microzooplankton biomass, and primary production.

### **Objectives 7 and 8**

The in situ target-strength distribution of midwater fauna between the surface and 900 m was measured acoustically over the 0–900 m depth range on four occasions, using the new, lightweight acoustics towed body. The hull-mounted 38 kHz transducer was used ten times during the midwater trawls to collect backscatter measurements for comparing acoustic and trawl biomass estimates. Mr R. Kloser (CSIRO Division of Fisheries) is analysing these data.

In addition, 23 surface plankton net tows were made to sample for larvae of the jackass morwong, *Nemadactylus macropterus*, for Ms C. Sutton and Mr B. Bruce of the CSIRO Division of Fisheries. Plankton samples were taken at the site, and at the inner four stations on the central and western CTD transects (Appendix 1).

The results of the four trophodynamics cruises will be presented to FRDC and in scientific papers when data processing and analyses are complete. The acoustic biomass estimates have been presented by Dr A. J. Koslow and Mr R. Kloser (CSIRO Division of Fisheries) to the Government and Industry Technical Liaison Committee, South-East Fisheries Workshops and other industry and resource meetings. The data and specimens are stored at the CSIRO Division of Fisheries, Hobart.

The cruise results will be assimilated into a model of the food web supporting mid-slope fisheries, which is being developed by Drs J. S. Parslow and A. J. Koslow.

### **Cruise Narrative**

April 7:

FRV *Southern Surveyor* sailed from Hobart at 18:35 h with a gale warning and 4 m seas forecast for the south coast. The vessel turned around near the Cape Bruny light, because of gale force winds and a heavy swell.

April 8:

The ship left shelter at 23:00 h and the light towed body was deployed for towing and stability tests in D'Entrecasteaux Channel.

April 9:

At the trawl site it was too rough to recover the current meter/sediment trap mooring, so demersal fishing began. The first shot with the Engel net was on the bottom about 11:00 h. The trawl at 20:00 h was hung up, fishing for only 25 min. The tears in the top panel were fixed in about 1.5 h. Demersal trawling continued for the rest of the day and night.

April 10:

The demersal trawling series finished at 10:00 h. The sediment trap/current meter mooring release was triggered about 11:45 h at 44°12.25'S, 147°06.14'E and the mooring array came to the surface

about 200 m behind ship. The refurbished traps and the replacement current meters were redeployed at 44°12.39'S, 147°05.35'E in 1190 m depth for recovery in February 1994.

April 11:

The first of the eight scheduled midwater trawls with the modified net ('MIDOC trawls') did not recover any samples because of a twist in the net ahead of the frame. Two short tows were made to (a) measure the net mouth opening by mounting the Scanmar door-spread transducers on the wings of the net, and (b) test the timer of the MIDOC system.

Both tows were successful, so the first trawl of the 48 h series went down to start fishing at 07:40 h. Dawn and dusk non-fishing periods were observed because the midwater fauna rapidly change their depth distributions at these times in response to changing light intensity. The acoustic towed body was deployed at 11:40 h for estimates of the water column biomass. After the towed body was recovered, one day and one night trawl were successfully completed in the next watch. Very large catches of fishes, crustaceans, salps and pyrosomas were made.

April 12:

The midnight watch made one night haul and one day haul. In the night shot, the surface net had 5 kg salps and 35 kg pyrosomas, and the other nets had very large catches of midwater fish. The towed body was deployed at 02:35 h, but was recovered because of communication problems. The trawl warp was reterminated, but the rubber moulding required eight hours to cure. After the deep daytime trawl was recovered at 15:00 h, the light towed body was deployed for testing. Midwater trawling continued after the dusk exclusion period.

April 13:

Midwater trawling continued until dawn when this series was completed. The first EZ net tow went into the water at 08:00 h, but the net bar drops did not register, so all depths were not sampled. This may have been caused by the net velocity through the water exceeding five knots, as we were towing with the wind, which increased from 5 to 35 kt while the net was being deployed. The wind blew at 20–35 kt for the rest of the day. After midday, the towed body was deployed to complete one deep day haul and one shallow night haul.

April 14:

The EZ net was redeployed after midnight but the last few net times were shortened to 10 min intervals because the weather was deteriorating rapidly. The net was brought on board about 04:00 h in very rough conditions. The vessel sailed to Dover to change over some of the scientific party, and remained overnight in the harbour as 45 kt westerly winds were forecast.

April 15:

The ship moved to Great Taylors Bay about 09:00 h, leaving at 18:00 h to begin the CTD transects.

April 16:

The very large swell and confused seas made CTD work too dangerous until the morning. The central CTD transect was started at 14:00 h.

April 17:

The CTD work continued in worsening weather, but was abandoned about 02:00 h at the end of the second last station. A large sea came through wet lab, over the door sills and into the corridors, triggering the fire alarms. As conditions were very dangerous in 40–50 knot NW winds the vessel was forced to shelter in Great Taylors Bay once again.

April 18:

FRV *Southern Surveyor* left Great Taylors Bay about 06:00 h to start the 24-hour station at the trawl site. There were light winds, with big seas running. The free-floating sediment trap was deployed about 13:15 h at 44°09.0'S, 147°11.2'E in 25 kt WNW winds with a 3–4 m swell. The 24-hour productivity series was begun with CTD 10 (Stn 36), the first of the 24-hour stations. Particulate organic carbon samples for stable isotope analysis were collected at CTD 11 (Stn 37). The ship followed the sediment trap for the rest of the day and night, with CTD stations being done every six hours.

April 19:

The free-floating sediment traps were recovered about four hours early because the wind had increased to 35–40 kt. The recovery went very smoothly, due in large part to the mooring system designed by Don McKenzie (CSIRO Division of Fisheries). It was too rough to deploy the EZ net or continue with CTD work. The vessel sheltered behind Maatsuyker Island at the inshore end of the western transect.

April 20:

The western CTD transect was begun about 07:00 h. On the third station the signal from the CTD was lost. This was fixed by reterminating the cable and changing the deck unit for the CTD. The wind shifted to the SW, for the first time in days. Later in the watch the CTD wire again jammed in the lead block on the winch; reterminating the wire delayed work for about three hours.

April 21:

The western CTD transect continued in moderate weather, with some large swells causing heavy rolling at times. The transect was finished at about 22:00 h, and course was set for Hobart. The trip up D'Entrecasteaux Channel in glassy calm weather made a great change from the rocking and rolling we had just endured. The vessel docked at the CSIRO wharf in Hobart at 12:45 h on April 22, 1993.

## **ACKNOWLEDGEMENTS**

The success in getting most of the planned work completed on the series of four trophodynamics cruises in this rough and unpredictable region is due in no small measure to the patience, perseverance and good humour of the officers and crew of the FRV *Southern Surveyor*, and the participating scientists.



P. C. Young  
Chief, CSIRO Division of Fisheries

Date: 5/8/93



**PERSONNEL**

(Note: unless indicated otherwise, all personnel are staff of the CSIRO Division of Fisheries)

Brian Griffiths (Cruise Leader and Day Watch leader)	M. Sherlock
M. Lewis	D. McKenzie
S. Garland	C. Bulman (Midnight Watch leader)
C. Rathbone	Q. Nguyen
A. Williams*	R. Kloser*
C. Sutton*	L. MacDonald**
R. Plaschke** (CSIRO Division of Oceanography)	Bob Griffiths**
A. Terauds (University of Tasmania)	

\* until April 14 \*\* from April 14

**Ship's Company**

I. Taylor, Master	R. Pepper, First Mate
J. Boyes, Second Mate	P. Gibbons, Chief Engineer
M. Phillips, Second Engineer	J. Hinchliffe, Electrical Engineer
M. Berrell, Bosun	A. Brownlie, AB
L. Darling, AB	A. Hearn, AB
M. McDougall, AB	M. Blanchard, AB
H. Thomas, AB	L. Jacomos, AB
P. Hyde, Chief Steward	A. Smith, Chief Cook
D. Collins, Second Cook	

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**DISTRIBUTION**

Normal distribution  
Cruise participants

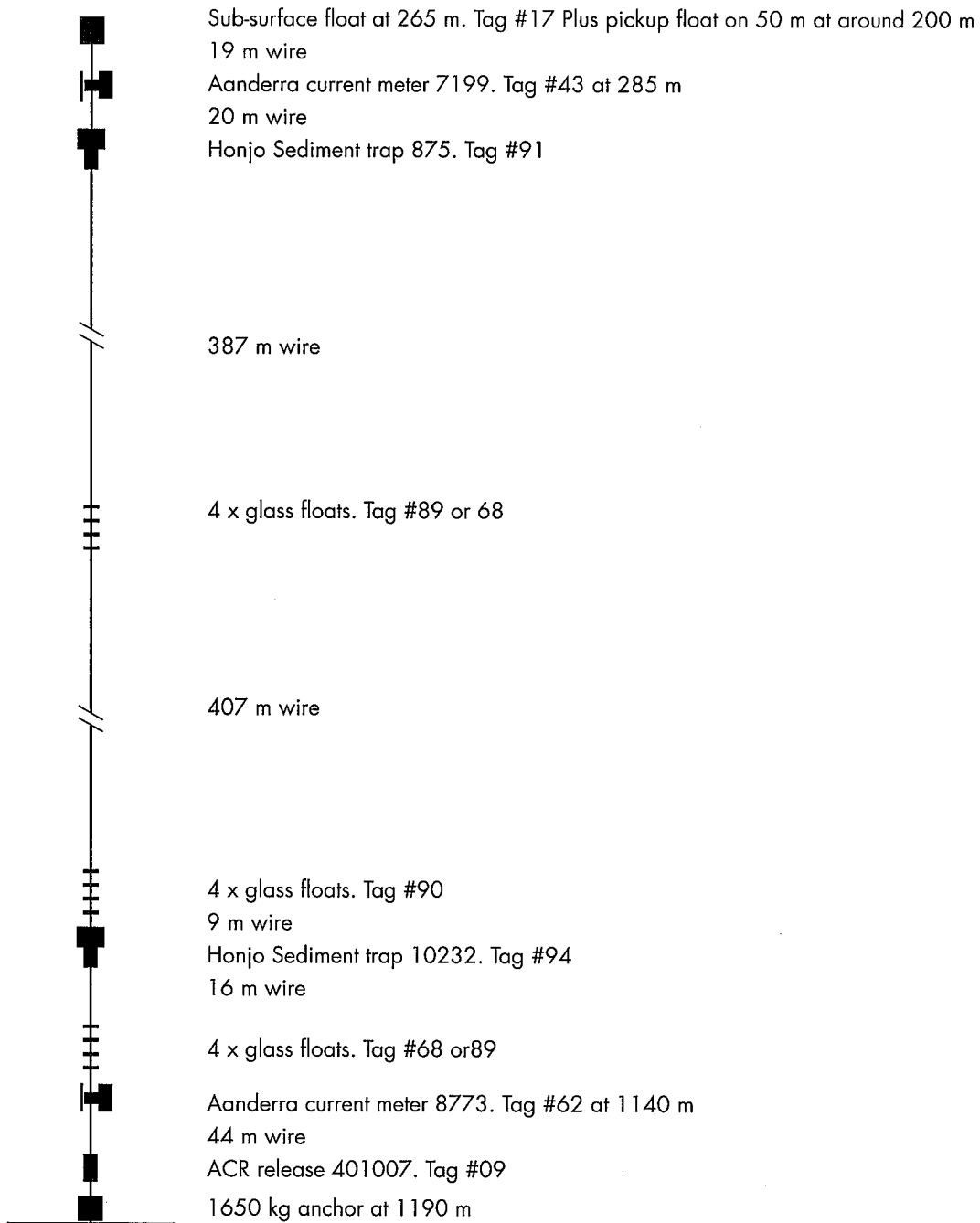
**APPENDIX 1.** Stations occupied by FRV *Southern Surveyor* during SS3/93. The dates and times are Australian Eastern Standard time.

<b>STATION</b>	<b>DATE</b>	<b>TIME</b> h	<b>LATITUDE</b> °S	<b>LONGITUDE</b> °E	<b>ACTIVITY</b>
1	8/4/93	23:21	43°25.06	147°04.18	Towed body
2	9/4/93	10:38	44°10.32	147°10.73	Demersal
3	9/4/93	15:55	44°10.90	147°10.40	Demersal
4	9/4/93	19:00	44°10.80	147°11.10	Demersal
5	9/4/93	23:20	44°10.00	147°11.50	Demersal
6	10/4/93	03:10	44°11.10	147°10.20	Demersal
7	10/4/93	06:00	44°10.29	147°10.85	Demersal
8	10/4/93	08:00	44°10.00	147°11.00	Demersal
9	10/4/93	16:40	44°12.39	147°06.14	Mooring recovery
10	10/4/93	10:51	44°11.78	147°09.50	Pelagic
11	11/4/93	03:48	44°13.09	147°15.05	Pelagic
12	11/4/93	04:41	44°13.17	147°15.36	Pelagic
13	11/4/93	06:40	44°12.64	147°04.40	Pelagic
14	11/4/93	11:50	44°13.33	147°18.25	Towed body
15	11/4/93	13:54	44°12.21	147°03.59	Pelagic
16	11/4/93	17:35	44°12.20	147°04.60	Pelagic
17	11/4/93	22:58	44°12.37	147°06.99	Pelagic
18	12/4/93	02:35	44°12.50	147°20.90	Towed body
19	12/4/93	07:06	44°12.63	147°04.30	Pelagic
20	12/4/93	10:43	44°13.68	147°18.79	Pelagic
21	12/4/93	18:40	44°12.86	147°04.77	Pelagic
22	13/4/93	23:40	44°12.20	147°17.90	Pelagic
23	13/4/93	08:15	44°13.53	147°01.48	EZ net tow
24	13/4/93	14:00	44°12.80	147°19.50	Towed body
25	13/4/93	20:35	44°13.60	147°18.70	EZ net tow
26	14/4/93	01:20	44°13.32	147°14.76	EZ net tow
27	16/4/93	08:45	44°13.99	147°10.12	CTD 1
28	16/4/93	10:10	44°13.79	147°12.54	CTD 2
29	16/4/93	13:37	43°58.74	147°09.35	CTD 3
30	16/4/93	16:13	44°00.97	147°10.27	CTD 4
31	16/4/93	18:37	44°05.49	147°10.43	CTD 5
32	16/4/93	20:34	44°08.94	147°10.58	CTD 6
33	16/4/93	23:16	44°13.28	147°10.89	CTD 7
34	17/4/93	02:09	44°20.02	147°10.09	CTD 8

<b>STATION</b>	<b>DATE</b>	<b>TIME</b> h	<b>LATITUDE</b> °S	<b>LONGITUDE</b> °E	<b>ACTIVITY</b>
35	17/4/93	04:43	44°27.17	147°10.61	CTD 9
36	18/4/93	14:51	44°09.05	147°11.17	CTD 10*
37	18/4/93	17:13	44°08.53	147°12.55	CTD 11
38	18/4/93	20:08	44°08.62	147°14.01	CTD 12
39	20/4/93	02:16	44°08.83	147°15.42	CTD 13
40	20/4/93	08:16	44°08.76	147°17.41	CTD 14
41	20/4/93	09:53	43°53.07	146°21.08	FF trap recovery**
42	20/4/93	10:03	43°53.05	146°21.17	CTD 15
43	20/4/93	12:37	43°55.98	146°18.01	CTD 16
44	20/4/93	15:46	43°59.25	146°15.79	CTD 18
45	20/4/93	17:44	44°05.08	146°15.16	CTD 19
46	20/4/93	19:41	44°09.11	146°15.26	CTD 20
47	21/4/93	01:17	44°14.45	146°09.86	CTD 21
48	21/4/93	03:37	44°18.96	146°07.08	CTD 22
49	21/4/93	06:20	44°24.75	146°03.85	CTD 23
50	21/4/93	09:03	44°31.06	146°01.91	CTD 24
51	21/4/93	11:40	44°37.07	145°59.83	CTD 25
52	21/4/93	14:19	44°43.14	145°58.52	CTD 26
53	21/4/93	16:24	44°43.90	146°00.73	CTD 27
54	21/4/93	18:25	44°44.09	146°03.49	CTD 28

\* Plus free-floating sediment trap deployment

\*\* Free-floating sediment trap recovery



**Figure 2.** Diagram of the sediment trap/current meter mooring deployed during SS 3/93 at 44°12.29'S, 147°06.14'E on April 10, 1993. The top float on the mooring is at a depth of about 265 m below the surface. The complete mooring will be recovered in February 1994.