

# **CRUISE REPORT SS 03/96**

May 13 - May 27, 1996  
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**DIVISION OF FISHERIES**

## ITINERARY

DEPART: EDEN 1200 HOURS MONDAY, 13 MAY 1996

RETURN: HOBART 1630 HOURS MONDAY, 27 MAY 1996

## CRUISE OBJECTIVES

1. Map the physical oceanography of the area east of Eden in which the tuna longline fishery operates.
2. Quantify zooplankton and micronekton biomass in these waters in relation to the main water masses and to the shelf and shelf break.
3. Quantify phytoplankton biomass in the region, and to characterise the insitu optical properties, including spectral absorption and upwelling and down-welling spectral irradiance in different water masses east of Tasmania and compare these with phytoplankton pigments.
4. Characterise the diel variation in fluorescence response of the Wetstar fluorometer.
5. Continue investigations of the distribution of ichthyoplankton in relation to the main water masses off south eastern Australia.

## COMPLEMENTARY OBJECTIVES

1. Deploy acoustic tags on live-caught tuna to track their movements in the area.
2. Liaise with longliners to collect tuna stomachs for later comparison of gut contents with net captures.
3. Deploy an array of archival tags on a longline to examine the effect of currents and set time on hook depth.

## SECONDARY OBJECTIVES

1. Quantify the biomass, and obtain estimates of the length-frequency distribution, of salps (especially *Thetys* spp.) and pyrosomas caught in midoc and bongo trawls, and preserve some individuals to determine which phytoplankters are being eaten.
2. Collect multi-frequency acoustic data with the Simrad EK500 at 12, 38 and 120 kHz for species identification and biomass studies.
3. Test a Simrad sd750 multi-beam sonar for studies of pelagic fish distribution and school behaviour.

## AREA OF OPERATION

Oceanic and shelf waters off south eastern New South Wales in the area of the local yellowfin tuna longline fishery and the east coast of Tasmania (Fig. 1).

## RESULTS

1. Three hydrographic transects were completed off south eastern New South Wales: one east of Bermagui, one east of Green Cape, and a north to south transect offshore (Figs. 1 and 2)(Appendix 1). Along each transect, CTD casts to

1000 m, followed by three replicate drop nets and one surface net were completed at each station. Spacing of stations ranged from 5 to 30 n.miles depending on the immediate oceanography, bottom topography and, on one occasion, the weather.

Two radiometer casts to 100 m were completed daily around midday, independent of position. Filters for pigment and spectral absorbance analysis were collected at 6 depths from each of these casts. Nutrients were collected underway between stations. From these data we will develop a physical and biological description of the main water masses affecting the study area.

2. A total of 41 separate sites in the 6 main bodies of water visited were sampled for microzooplankton (Table 1). Thirteen of these sites were also sampled for zooplankton with replicated bongo tows. Each zooplankton tow was accompanied by a surface net. On board, samples were photographed by a silhouette technique for later comparisons of size structure and relative biomass. At most of the bongo sites, replicate (depth-stratified) tows were made with the midwater trawl at night. Up to four surface nets were completed with each trawl. The net samples will be grouped by area and used to compare the biomass of the main faunal size classes between areas.

3. Multi-frequency echo soundings at 12, 38 and 120 kHz were collected throughout the cruise to increase our understanding of the biomass and composition of plankton and nekton communities in relation to oceanographic features. In total, 5 GBytes of data were collected; they were analysed for data quality during the cruise.

When conditions were suitable, acoustic multi-beam sonar investigations were conducted to observe the spatial structure of fish schools and fish behaviour. At one time we observed large schools of jack mackerel on the shelf, including some dramatic avoidance and schooling behaviour in response to the *Southern Surveyor*. Using the sonar, we also observed many surface schools that were not detected on our standard scientific echo sounders. Off the shelf, the sonar did not appear to pick up any schooling fish during our trials. The ability of video to capture the sonar images and process them at high speed will greatly enhance our scientific use of the instrument.

4. Approximately 75 stomachs of yellowfin tuna and one northern bluefin tuna were collected from the longline fishers in the study area. Jessica Farley spent two days on the longliner *Tonka* deploying longline hook monitors.

5. Larval fish samples were collected on all transects throughout the cruise. Morwong larvae (Cheilodactylidae) were common in offshore waters east of Bermagui and Green Cape. Most of these were *Cheilodactylus* spp. Jackass morwong (*Nemadactylus macropterus*) larvae were collected on the north-south transect both within and south of the East Australia Current filament east of Victoria and Tasmania. There were fewer jackass morwong larvae south of the filament than in previous years.

Rock lobster larvae (phyllosoma) were collected in reasonable numbers from MIDOC trawls during the cruise. Capture details will be incorporated in an FRDC-funded synthesis of the distribution of rock lobster larvae in southern Australia.

6. Benthic sled trawls were completed for the Shelf Ecosystem project.

Not all objectives were met. We did not track a southern bluefin tuna from *Southern Surveyor*. Also, we were unable to take the samples and measurements of salps and pyrosomes as there were none, or very few, in the samples we collected.

#### CRUISE NARRATIVE

We arrived in Eden by plane on the Sunday afternoon and prepared the ship for departure the following morning. The cruise was delayed for 3 h in Eden waiting for supplies, but was underway at 1200 h on 13 May 1996. We left Eden and spent some time testing the new sonar equipment before heading north to Bermagui to begin the first transect. Discussions with one of the longliners indicated that this latitude bisected the main area of fishing activity. There had been good catches over the slope and shelf in this area over the preceding days.

We began the Bermagui transect (Fig. 2) at the 50 m isobath and had made good progress by the next morning. By the afternoon we were ready for our first set of bongos in East Australian Current water. We then steamed further eastward to complete the transect. That night we began midwater trawling. Once the eastward extent of the transect had been completed (defined by the outermost position of the longliners) we slowly worked back along the transect completing replicate sets of net tows. Bongos were used by day and the midoc net by night.

We had frequent communications with the longliners. Two were working offshore near us; the rest were working further inshore or over the shelf. During this period I boarded a longliner (Dee Jay -- skipper Dominic Puglisi) and received some stomach samples from some freshly caught yellowfin. The fish in the area were mainly eating amphipods, crab larvae, jack mackerel and garfish.

By Friday 17 May we had worked our way back to the slope. However, after concern from the longliners that we were drifting onto their lines (there was a strong westerly current pushing the lines up onto the shelf) we moved further west onto the shelf to the original station 1 off Bermagui, where we continued plankton and water sampling. The weather remained calm and sunny.

Once this transect was completed, we headed south to begin the next transect off Green Cape (37° 15' S). Most of the longliners had by then moved south and were setting their lines along the shelf break through to Gabo Island. On the way we were able to trial the new sonar system.

We started the Green Cape transect on 18 May. This transect followed the same work pattern we developed on the first transect: CTDs on the outward leg and netting on the shoreward leg. Sea-surface temperatures were higher than off Bermagui (21°C +) and with a T250 of ~ 15°C we realised we were inside a large

warm-core eddy. Strong westerly surface currents indicated we were close to the northeastern edge of the eddy (warm-core eddies flow anticlockwise in the southern hemisphere). We did not get to the eastern edge of the eddy on that transect as I felt we were getting too far away from the actual fishery. Fortunately, on the final north-south transect we were able to close up the eastern side of the eddy. While we were working the outer edge of the transect, longliners were reporting good catches over the shelf break. As luck would have it, when we were ready to work in the same area, the longliners had to return to shore to prepare their catch for an important holiday in Japan.

Our sampling over the shelf and shelf break revealed a species mix very similar to that off eastern Tasmania, dominated mainly by krill (*Nyctiphanes australis*), jack mackerel (*Trachurus declivis*) and lanternfish (*Lampanyctodes hectoris*). Also of note was the presence of numerous morwong larvae in the samples.

By the afternoon of 21 May we had completed the second transect. We then used the beam trawl in an attempt to collect handfish for the Temperate and Deepwater Program. We collected only one, but it was useful to sort out the beam trawl as we had agreed to finish some work for the Temperate and Deepwater program off Maria Island. At 1700 h we began an acoustic transect from Eden to Bermagui where we were to transfer Jessica Farley to the longliner *Tonka* to complete the hook monitoring objective. Jessica was transferred to the *Tonka* the following morning.

After some discussion with the longliners in Bermagui I decided that the most useful starting point for the last transect was 36°40'S 152°00'E. This position tallied with the top edge of the main eddy and was of great interest to the larger longliners. This transect was aimed to skirt the eddy, and therefore was effectively in "frontal" waters separating the eddy from the Tasman Sea. As we would not be coming back, both the hydrographic and trawl sampling were completed at each station before we continued south. On this transect we were able to add one further station to the Green Cape transect, which effectively closed the eddy we had previously only partly described.

As we headed south, the weather increased, with winds gusting to 35 kts. However, we were still able to continue the sampling, although CTD work was abandoned for a time. By the morning of 25 May it was too rough to work, although we were able to complete surface tows during lulls in the weather. When the weather finally abated, we completed a set of bongos at the southern edge of the north-south transect.

With the tuna work completed, we began the larval fish transect to Maria Island, which continued through to 26 May. There was a surprising lack of phyto- and zooplankton along this transect. Very few morwong larvae were collected. Once the larval transect was completed, we deployed the beam trawl over Darcy's Patch for the Shelf ecosystem project. We then completed the Maria Island hydrographic station requested by Ron Plaschke. We had aimed to do two beam trawls for handfish and then resume the search for larval fish. However, we caught two very large nets of screw shells (*Maoriculpus roseus*), possibly 5

tonnes, but no handfish. At 2230 h we began an acoustic transect from the 80 m isobath eastward through Darcy's patch.

By midnight we were ready to continue the search for morwong larvae. Small numbers were captured and we finished sampling at midday on 27 May. With all work completed we returned to Hobart, arriving at 1630 h.

### **SUMMARY**

The results from this cruise will be analysed, along with feeding data that were collected concurrently, to assist our understanding of what factors affect the distribution of yellowfin tuna off south eastern New South Wales.

### **PERSONNEL**

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

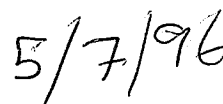
Mr Jock Young	(Cruise leader)
Mr Barry Bruce	(Assistant cruise leader)
Mr Tim Lamb	
Mr Russell Bradford	
Ms Jessica Farley	
Ms Suzanne Long	
Ms Alison Phillips	
Mr Don McKenzie	
Mr Matt Sherlock	
Mr Rudy Kloser	
Mr Ron Plaschke	Division of Oceanography
Mr Bob Griffiths	

**ACKNOWLEDGMENTS**

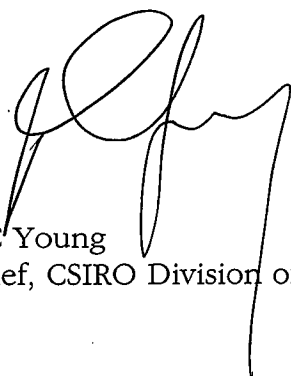
I would like to thank the longliners involved in this study, particularly Mr Jim Uttley more. Thanks to skipper David Murphy, fishing master Roger Pepper, second mate John Boyes and crew of FRV *Southern Surveyor* for their effort and enthusiasm during the cruise. Finally, I would like to thank the CSIRO personnel on this cruise, not only for their efforts but also for their enthusiasm and good humour.



Mr Jock Young  
Cruise Leader



Date



P C Young  
Chief, CSIRO Division of Fisheries



Date

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**This report may not be cited without reference to the author.**



## FIGURES 1 AND 2. AREA OF OPERATION

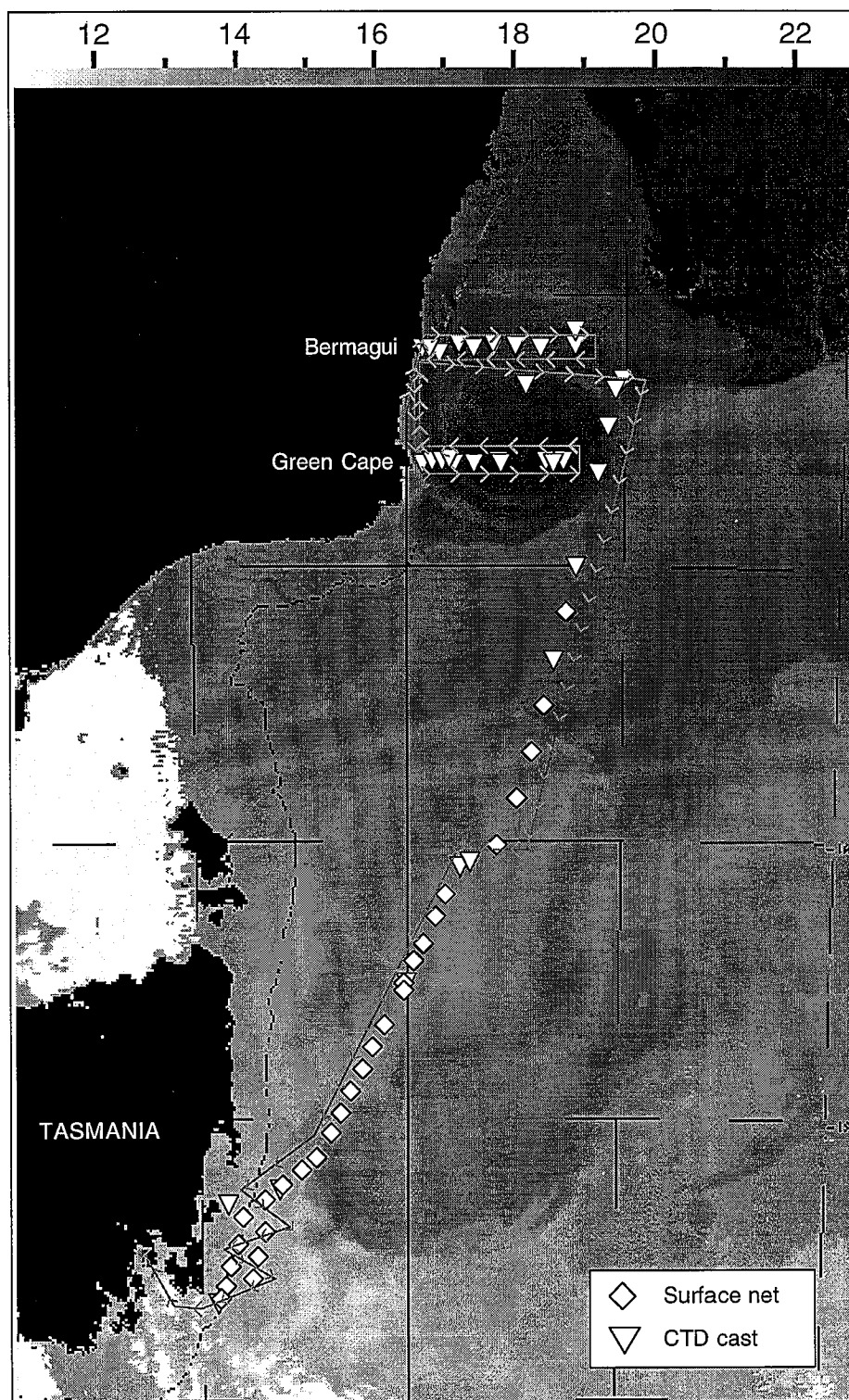


Figure 1. Station positions and cruise track overlain on sea-surface temperature image from composite of NOAA12 orbits 25908–25909, 10 May 1996.

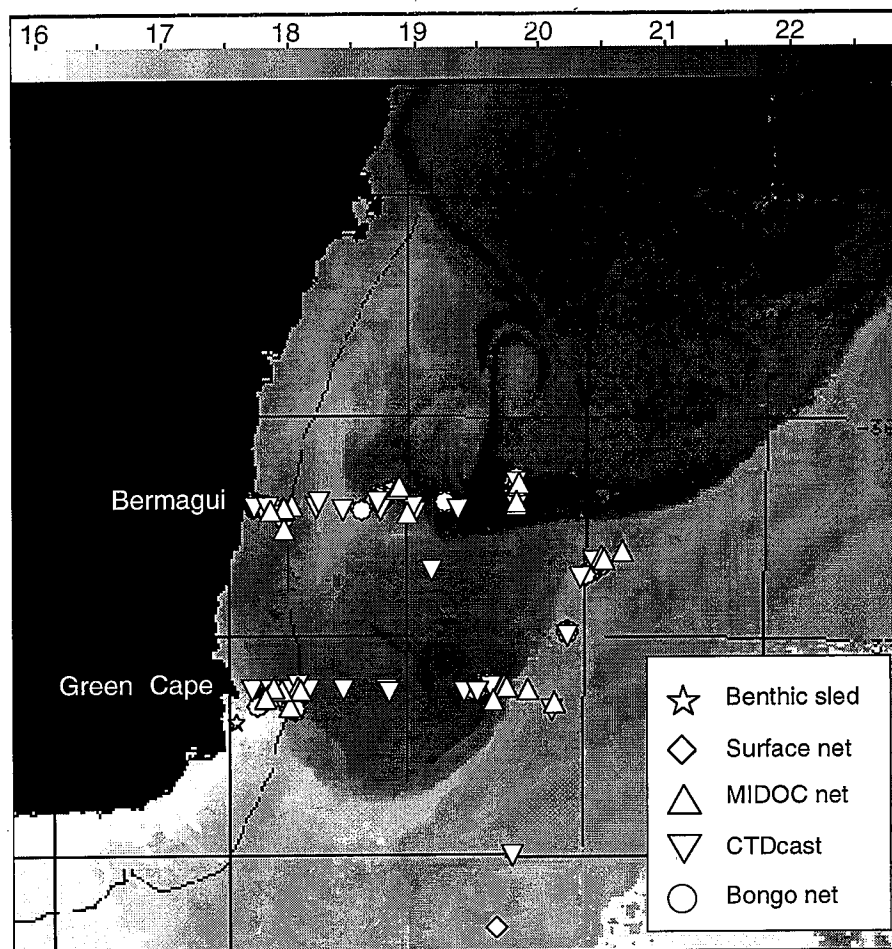


Figure 2. Detail of Bermagui and Green Cape transects showing fine structure of EAC and eddy from composite of NOAA14 orbits 7176-26080 22 May 96.

TABLE 1:

Summary of the number of samples collected by area. † Replicate bongo net and MIDOC trawls were completed at a number of sites (EAC = East Australian Current; EAC/front = boundary region between EAC and the EAC filament in the region east of Merimbula; EAC/filament = cooler filament of EAC extending towards Tasmania).

Activity	Area	† No. Sites per Area	Replicates/ Site	Total No. Samples
Drop (100 µm)	EAC/filament	6	3	18
	EAC/front	4	3	12
	EAC	8	3	24
	Eddy	7	3	21
	shelf	9	3	27
	slope	7	3	21
<b>Subtotal</b>				<b>123</b>
Bongo (500 µm)	EAC/filament	2	3	6
	EAC/front	1	8	8
	EAC	3	4-12	27
	Eddy	1	10	10
	shelf	3	1-12	24
	slope	3	1-8	11
<b>Subtotal</b>				<b>86</b>
Surface (1000 µm)	EAC/filament	31	1-3	35
	EAC/front	11	1-2	16
	EAC	35	1-4	56
	Eddy	17	1-2	20
	shelf	35	1-2	42
	slope	28	1-4	46
<b>Subtotal</b>				<b>215</b>
MIDOC Trawl	EAC/front	3	1-3	5
	EAC	2	3-4	7
	Eddy	1	3	3
	shelf	2	1-5	6
	slope	2	3-4	7
<b>Subtotal</b>				<b>28</b>
<b>TOTAL</b>				<b>452</b>

## APPENDIX 1

Station positions and activities completed during cruise SS 3/96 (13–27 May 1996). One surface net was completed with each CTD, bongo and MIDOC tow unless otherwise indicated (sn [# replicates]). Three drop nets were completed at each CTD station († = thermosalinograph temperature; slope\* = slope stations within a region of cooler Tasman Sea water; EAC = East Australian Current; EAC/front = boundary region between EAC and the EAC filament in the region east of Merimbula; EAC/filament = cooler filament of EAC extending towards Tasmania).

Ship's Station	Activity	Date (local)	Time (local)	Latitude (S)	Longitude (E)	†Surface Temp °C	Water Mass	Comments
1	CTD #1	13/5/96	18:40	36° 25.30'	150° 07.10'	20.34	shelf	
2	CTD #2	13/5/96	20:07	36° 25.90'	150° 13.20'	19.71	shelf	
3	CTD #3	13/5/96	21:45	36° 27.30'	150° 18.30'	19.63	slope	
4	CTD #4	14/5/96	00:05	36° 25.60'	150° 29.20'	20.59	slope*	
5	CTD #5	14/5/96	01:14	36° 23.70'	150° 29.40'	20.56	slope*	
6	CTD #6	14/5/96	03:21	36° 25.90'	150° 38.10'	20.79	slope*	
7	CTD #7	14/5/96	05:40	36° 25.50'	150° 50.20'	20.59	EAC	
8	CTD #8	14/5/96	08:28	36° 26.10'	151° 02.40'	19.45	EAC	sn (0)
9	CTD #9	14/5/96	10:20	36° 24.90'	151° 01.60'	19.63	EAC	sn (0)
10	CTD #10	14/5/96	12:53	36° 25.70'	151° 16.20'	19.08	EAC	sn (0)
11	Bongo	14/5/96	14:57	36° 23.90'	151° 12.80'	19.40	EAC	
12	Bongo	14/5/96	15:22	36° 23.00'	151° 12.00'	19.41	EAC	
13	Bongo	14/5/96	15:49	36° 23.90'	151° 12.40'	19.47	EAC	
14	Bongo	14/5/96	16:15	36° 22.60'	151° 12.10'	19.58	EAC	
15	Bongo	14/5/96	16:39	36° 23.20'	151° 11.90'	19.58	EAC	
16	CTD #11/12	14/5/96	19:02	36° 24.90'	151° 36.60'	18.48	EAC	sn (0)
17	MIDOC	14/5/96	21:44	36° 24.00'	151° 35.90'	18.43	EAC	sn (4)
18	MIDOC	15/5/96	01:37	36° 18.10'	151° 37.00'	19.95	EAC	sn (4)
19	MIDOC	15/5/96	04:18	36° 23.30'	151° 36.30'	18.06	EAC	sn (4)
20	Bongo	15/5/96	07:52	36° 21.40'	151° 36.20'	17.78	EAC	
21	Bongo	15/5/96	08:26	36° 22.00'	151° 35.90'	17.71	EAC	
22	Bongo	15/5/96	09:03	36° 20.00'	151° 35.70'	—	EAC	
23	Bongo	15/5/96	09:35	36° 18.50'	151° 35.90'	18.26	EAC	
24	Bongo	15/5/96	10:13	36° 17.00'	151° 36.20'	19.25	EAC	
25	CTD #13	15/5/96	10:45	36° 18.00'	151° 36.00'	18.46	EAC	sn (0)
26	Bongo	15/5/96	12:49	36° 18.10'	151° 35.70'	19.32	EAC	
27	Bongo	15/5/96	13:20	36° 19.10'	151° 35.90'	19.09	EAC	
28	Bongo	15/5/96	13:45	36° 19.80'	151° 35.90'	19.15	EAC	
29	Bongo	15/5/96	14:18	36° 20.90'	151° 36.10'	19.08	EAC	
30	Bongo	15/5/96	14:54	36° 22.10'	151° 36.30'	18.25	EAC	
31	Bongo	15/5/96	15:32	36° 23.20'	151° 36.40'	18.21	EAC	
32	Bongo	15/5/96	16:01	36° 22.10'	151° 36.60'	18.49	EAC	
33	MIDOC	15/5/96	19:35	—	—	—	EAC	sn (4)
34	MIDOC	15/5/96	22:35	36° 20.30'	150° 55.90'	19.71	EAC	sn (4)
35	MIDOC	16/5/96	01:35	36° 26.70'	150° 59.30'	18.86	EAC	sn (4)
36	MIDOC	16/5/96	04:14	36° 19.30'	150° 57.10'	19.15	EAC	sn (4)
37	Bongo	16/5/96	08:34	36° 20.10'	150° 55.10'	19.03	EAC	

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Ship's Station	Activity	Date (local)	Time (local)	Latitude (S)	Longitude (E)	†Surface Temp °C	Water Mass	Comments
38	Bongo	16/5/96	09:10	36° 20.90'	150° 53.70'	19.37	EAC	
39	Bongo	16/5/96	09:42	36° 21.80'	150° 52.60'	19.41	EAC	
40	Bongo	16/5/96	10:19	36° 22.80'	150° 51.40'	18.62	EAC	
41	CTD #14	16/5/96	11:28	36° 23.40'	150° 49.50'	18.23	EAC	sn (0)
42	Bongo	16/5/96	13:09	36° 21.60'	150° 49.80'	19.19	EAC	
43	Bongo	16/5/96	13:39	36° 22.10'	150° 49.60'	18.74	EAC	
44	Bongo	16/5/96	14:12	36° 22.80'	150° 48.60'	18.36	EAC	
45	Bongo	—	—	—	—	—	EAC	
46	Bongo	—	—	—	—	—	EAC	
47	Bongo	16/5/96	15:47	—	—	—	EAC	
48	Bongo	16/5/96	16:20	36° 25.80'	150° 44.20'	18.98	slope*	
49	MIDOC	16/5/96	19:58	36° 24.60'	150° 20.50'	19.93	slope	sn (4)
50	MIDOC	17/5/96	00:04	36° 25.10'	150° 18.40'	—	slope	sn (4)
51	MIDOC	17/5/96	02:39	36° 31.00'	150° 18.30'	—	slope	sn (4)
52	Bongo	17/5/96	05:11	36° 28.30'	150° 17.70'	19.80	slope	
53	Bongo	17/5/96	05:44	36° 27.10'	150° 18.10'	19.81	slope	
54	Bongo	17/5/96	09:15	36° 25.50'	150° 08.10'	—	shelf	
55	Bongo	17/5/96	09:37	36° 24.50'	150° 08.40'	19.49	shelf	
56	Bongo	17/5/96	10:48	36° 23.70'	150° 08.80'	19.50	shelf	
57	Bongo	17/5/96	11:11	36° 24.40'	150° 08.60'	19.52	shelf	
58	CTD #15	17/5/96	11:44	36° 25.20'	150° 08.50'	19.54	shelf	sn (0)
59	Bongo	17/5/96	13:08	36° 24.90'	150° 08.20'	19.72	shelf	
60	Bongo	17/5/96	13:31	36° 24.80'	150° 09.10'	19.56	shelf	
61	Bongo	17/5/96	13:54	36° 24.70'	150° 10.10'	19.53	shelf	
62	Bongo	17/5/96	14:18	36° 24.50'	150° 11.10'	19.47	shelf	
63	Bongo	17/5/96	14:31	36° 24.50'	150° 11.70'	19.47	shelf	
64	Bongo	17/5/96	14:51	36° 24.80'	150° 12.30'	19.30	shelf	
65	Bongo	17/5/96	15:00	36° 25.00'	150° 12.50'	19.17	shelf	
66	Bongo	17/5/96	15:30	36° 25.00'	150° 12.50'	—	shelf	
67	Bongo	17/5/96	15:55	36° 26.40'	150° 12.60'	20.01	shelf	
68	CTD #16	17/5/96	16:36	36° 25.50'	150° 13.10'	19.94	shelf	sn (0)
69	MIDOC	17/5/96	18:48	36° 26.30'	150° 13.20'	19.68	shelf	sn (3)
70	CTD #17	18/5/96	01:13	37° 15.10'	150° 08.10'	19.55	shelf	
71	CTD #18	18/5/96	02:27	37° 14.90'	150° 14.50'	19.54	shelf	
72	CTD #19	18/5/96	04:04	37° 15.00'	150° 20.40'	19.94	shelf	
73	CTD #20	18/5/96	05:19	37° 15.10'	150° 26.60'	20.98	slope	
74	CTD #21	18/5/96	07:39	37° 15.20'	150° 38.90'	—	eddy	
75	CTD #22	18/5/96	10:28	37° 14.80'	150° 52.90'	21.06	eddy	
76	CTD #23	18/5/96	11:53	37° 15.60'	150° 53.70'	21.06	eddy	sn (0)
77	CTD #24	18/5/96	15:01	37° 15.00'	151° 19.50'	21.63	eddy	
78	CTD #25	18/5/96	17:00	37° 14.00'	151° 28.40'	21.52	eddy	sn (0)
79	MIDOC	18/5/96	19:03	37° 13.20'	151° 32.20'	21.47	eddy	sn (2)
80	MIDOC	18/5/96	21:35	37° 13.90'	151° 40.80'	21.32	EAC/front	sn (2)
81	MIDOC	18/5/96	23:54	37° 13.70'	151° 33.60'	21.52	eddy	sn (2)
82	MIDOC	19/5/96	02:30	37° 17.40'	151° 28.90'	21.53	eddy	sn (2)
83	Bongo	19/5/96	07:44	37° 15.40'	151° 21.90'	21.49	eddy	

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Ship's Station	Activity	Date (local)	Time (local)	Latitude (S)	Longitude (E)	†Surface Temp °C	Water Mass	Comments
84	Bongo	19/5/96	08:23	37° 13.70'	151° 23.70'	21.57	eddy	
85	Bongo	19/5/96	08:56	37° 12.40'	151° 25.10'	21.57	eddy	
86	Bongo	19/5/96	09:29	37° 13.10'	151° 25.00'	21.57	eddy	
87	Bongo	19/5/96	10:08	37° 14.10'	151° 24.50'	21.49	eddy	
88	Bongo	19/5/96	10:41	37° 14.90'	151° 24.00'	21.44	eddy	
89	Bongo	19/5/96	11:10	37° 15.30'	151° 23.30'	21.35	eddy	
90	CTD #26	19/5/96	12:30	37° 15.30'	151° 23.30'	21.43	eddy	sn (0)
91	Bongo	19/5/96	14:01	37° 14.20'	151° 24.10'	21.49	eddy	
92	Bongo	19/5/96	14:33	37° 14.10'	151° 23.20'	21.52	eddy	
93	Bongo	19/5/96	15:02	37° 14.10'	151° 22.20'	21.53	eddy	
94	MIDOC	19/5/96	20:21	37° 14.40'	150° 23.40'	21.13	slope	sn (2)
95	MIDOC	19/5/96	23:00	37° 19.50'	150° 21.20'	20.76	slope	sn (2)
96	MIDOC	20/5/96	01:30	37° 15.20'	150° 23.90'	21.12	slope	sn (2)
97	MIDOC	20/5/96	04:19	37° 19.40'	150° 21.00'	20.79	slope	sn (2)
98	Bongo	20/5/96	07:39	37° 20.80'	150° 22.60'	20.31	slope	
99	Bongo	20/5/96	08:46	37° 17.70'	150° 22.30'	20.44	slope	
100	Bongo	20/5/96	09:41	37° 20.30'	150° 21.00'	19.80	slope	
101	Bongo	20/5/96	11:11	37° 16.00'	150° 22.40'	20.81	slope	
102	CTD #27	20/5/96	13:02	37° 13.60'	150° 23.80'	20.83	slope	sn (0)
103	Bongo	20/5/96	13:58	37° 13.70'	150° 24.50'	20.71	slope	
104	Bongo	20/5/96	14:59	37° 16.90'	150° 23.10'	20.87	slope	sn (0)
105	Bongo	20/5/96	15:24	37° 18.30'	150° 22.80'	20.80	slope	
106	Bongo	20/5/96	15:54	37° 19.80'	150° 22.40'	20.65	slope	
107	MIDOC	20/5/96	18:28	37° 16.90'	150° 13.40'	19.27	shelf	
108	MIDOC	20/5/96	20:05	37° 14.90'	150° 17.60'	19.74	shelf	sn (2)
109	MIDOC	20/5/96	22:06	37° 17.40'	150° 12.70'	17.54	shelf	sn (2)
110	MIDOC	21/5/96	01:07	37° 14.30'	150° 15.60'	18.90	shelf	sn (2)
111	MIDOC	21/5/96	04:07	37° 17.10'	150° 12.20'	—	shelf	sn (2)
112	Bongo	21/5/96	07:48	37° 15.20'	150° 14.80'	17.13	shelf	
113	Bongo	21/5/96	08:26	37° 16.10'	150° 14.10'	16.41	shelf	
114	Bongo	21/5/96	09:06	37° 17.00'	150° 13.30'	16.32	shelf	
115	Bongo	21/5/96	09:41	37° 16.70'	150° 12.90'	16.31	shelf	
116	Bongo	21/5/96	10:16	37° 17.50'	150° 12.10'	16.52	shelf	
117	Bongo	21/5/96	10:50	37° 18.30'	150° 11.30'	16.92	shelf	
118	CTD #28	—	—	—	—	—	shelf	sn (0)
119	Bongo	21/5/96	12:56	37° 17.80'	150° 12.00'	17.01	shelf	
120	Bongo	21/5/96	13:17	37° 18.30'	150° 11.40'	17.05	shelf	sn (0)
121	Bongo	21/5/96	13:38	37° 18.70'	150° 10.90'	17.05	shelf	
122	Bongo	21/5/96	14:01	37° 19.30'	150° 10.20'	16.90	shelf	sn (0)
123	Benthic	21/5/96	15:32	37° 23.90'	150° 02.50'	16.02	shelf	sn (0)
124	CTD #29	22/5/96	15:31	36° 41.90'	151° 07.50'	20.69	eddy	
125	CTD #30	22/5/96	21:42	36° 39.40'	152° 02.40'	18.07	EAC/front	sn (0)
126	MIDOC	22/5/96	23:06	36° 38.30'	152° 05.10'	17.96	EAC/front	sn (2)
127	MIDOC	23/5/96	01:43	36° 38.70'	152° 06.60'	18.17	EAC/front	sn (0)
128	MIDOC	23/5/96	03:54	36° 36.10'	152° 12.40'	18.18	EAC/front	sn (2)
129	Bongo	23/5/96	07:54	36° 40.30'	152° 05.80'	17.94	EAC/front	

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Ship's Station	Activity	Date (local)	Time (local)	Latitude (S)	Longitude (E)	†Surface Temp °C	Water Mass	Comments
130	Bongo	23/5/96	08:40	36° 41.00'	152° 04.20'	17.89	EAC/front	
131	Bongo	23/5/96	09:10	36° 41.50'	152° 03.00'	17.89	EAC/front	
132	Bongo	23/5/96	09:40	36° 42.00'	152° 02.00'	17.85	EAC/front	
133	Bongo	23/5/96	10:12	36° 42.50'	152° 00.90'	17.74	EAC/front	
134	Bongo	23/5/96	10:42	36° 42.90'	151° 59.80'	17.50	EAC/front	
135	CTD #31	23/5/96	11:19	36° 43.70'	151° 58.30'	17.53	EAC/front	sn (0)
136	Bongo	23/5/96	14:32	36° 58.20'	151° 53.90'	17.40	EAC/front	
137	Bongo	23/5/96	15:02	36° 59.00'	151° 53.80'	17.45	EAC/front	
138	CTD #32	23/5/96	15:31	36° 59.80'	151° 53.80'	17.45	EAC/front	sn (0)
139	CTD #33	23/5/96	19:00	37° 19.60'	151° 48.80'	17.66	EAC/front	sn (0)
140	MIDOC	23/5/96	20:23	37° 17.70'	151° 49.70'	17.55	EAC/front	sn (2)
141	CTD #34	24/5/96	02:44	37° 59.80'	151° 35.80'	18.15	EAC/filament	
142	Surface	24/5/96	06:26	38° 19.00'	151° 30.80'	17.93	EAC/filament	sn (2)
143	CTD #35	24/5/96	09:29	38° 40.10'	151° 23.00'	17.43	EAC/filament	sn (2)
144	Surface	24/5/96	13:42	39° 00.20'	151° 17.60'	17.45	EAC/filament	
145	Surface	24/5/96	16:25	39° 19.80'	151° 10.60'	17.75	EAC/filament	
146	Surface	24/5/96	20:06	39° 39.80'	151° 02.40'	17.64	EAC/filament	
147	Surface	25/5/96	03:09	40° 00.30'	150° 50.00'	16.09	EAC/filament	
148	CTD #36	25/5/96	08:09	40° 07.90'	150° 34.70'	16.18	EAC/filament	sn (0)
149	Bongo	25/5/96	09:35	40° 07.10'	150° 35.20'	16.05	EAC/filament	
150	Bongo	25/5/96	10:05	40° 07.70'	150° 33.20'	16.15	EAC/filament	
151	Bongo	25/5/96	10:35	40° 08.40'	150° 31.40'	16.21	EAC/filament	
152	CTD #37	25/5/96	11:15	40° 09.40'	150° 29.00'	16.40	EAC/filament	sn (0)
153	Bongo	25/5/96	12:38	40° 09.30'	150° 29.80'	16.38	EAC/filament	
154	Bongo	25/5/96	13:10	40° 10.20'	150° 28.70'	16.42	EAC/filament	
155	Bongo	25/5/96	13:39	40° 11.20'	150° 27.80'	16.38	EAC/filament	
156	Surface	25/5/96	15:13	40° 21.20'	150° 21.60'	16.56	EAC/filament	
157	Surface	25/5/96	16:31	40° 30.80'	150° 16.00'	16.03	EAC/filament	
158	Surface	25/5/96	18:23	40° 42.30'	150° 08.60'	14.32	EAC/filament	
159	Surface	25/5/96	19:20	40° 49.70'	150° 03.50'	13.85	EAC/filament	
160	Surface	25/5/96	20:41	40° 59.30'	149° 57.80'	13.25	EAC/filament	
161	CTD #38	25/5/96	21:47	41° 00.10'	149° 58.60'	13.14	EAC/filament	sn (0)
162	Surface	25/5/96	23:10	41° 03.30'	149° 57.40'	13.90	EAC/filament	
163	Surface	26/5/96	01:10	41° 17.80'	149° 45.50'	14.53	EAC/filament	
164	Surface	26/5/96	02:23	41° 27.10'	149° 38.80'	14.57	EAC/filament	
165	Surface	26/5/96	03:35	41° 36.60'	149° 32.60'	13.22	EAC/filament	
166	Surface	26/5/96	04:49	41° 46.10'	149° 26.60'	13.61	EAC/filament	
167	Surface	26/5/96	06:05	41° 56.00'	149° 20.60'	—	EAC/filament	
168	Surface	26/5/96	07:06	42° 04.70'	149° 14.90'	13.46	EAC/filament	
169	Surface	26/5/96	08:23	42° 14.80'	149° 07.10'	14.67	EAC/filament	
170	Surface	26/5/96	09:35	42° 20.50'	148° 58.10'	12.87	EAC/filament	
171	Surface	26/5/96	10:54	42° 27.20'	148° 47.10'	13.52	EAC/filament	sn (3)
172	CTD #39	26/5/96	11:41	42° 29.30'	148° 45.70'	14.73	EAC/filament	sn (0)
173	Surface	26/5/96	14:21	42° 33.50'	148° 36.90'	14.95	slope	
174	Benthic	26/5/96	16:48	42° 40.90'	148° 25.10'	13.47	shelf	sn (2)
175	CTD #40	26/5/96	18:58	42° 35.50'	148° 15.40'	13.14	Maria Is. Stat	sn (0)

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Ship's Station	Activity	Date (local)	Time (local)	Latitude (S)	Longitude (E)	†Surface Temp °C	Water Mass	Comments
176	Benthic	26/5/96	20:24	42° 37.20'	148° 10.60'	13.10	shelf	
177	Bongo	26/5/96	22:59	42° 40.40'	148° 15.40'	13.16	shelf	
178	Surface	27/5/96	00:36	42° 40.40'	148° 24.40'	13.39	slope	
179	Surface	27/5/96	02:07	42° 47.60'	148° 37.20'	14.96	EAC/filament	
180	Surface	27/5/96	04:00	42° 52.10'	148° 21.50'	13.45	slope	
181	Surface	27/5/96	05:11	42° 58.20'	148° 32.80'	14.92	EAC/filament	
182	Surface	27/5/96	06:38	43° 02.20'	148° 17.10'	13.18	slope	
183	Surface	27/5/96	07:48	43° 07.60'	148° 29.40'	15.05	EAC/filament	
184	Surface	27/5/96	09:03	43° 10.80'	148° 14.70'	13.43	slope	sn (4)
185	Surface	27/5/96	10:40	43° 15.50'	148° 11.80'	13.45	slope	sn (4)
186	CTD #41	27/5/96	11:25	43° 17.40'	148° 10.50'	–	slope	sn (0)