

R.V. FRANKLIN

NATIONAL FACILITY OCEANOGRAPHIC RESEARCH VESSEL

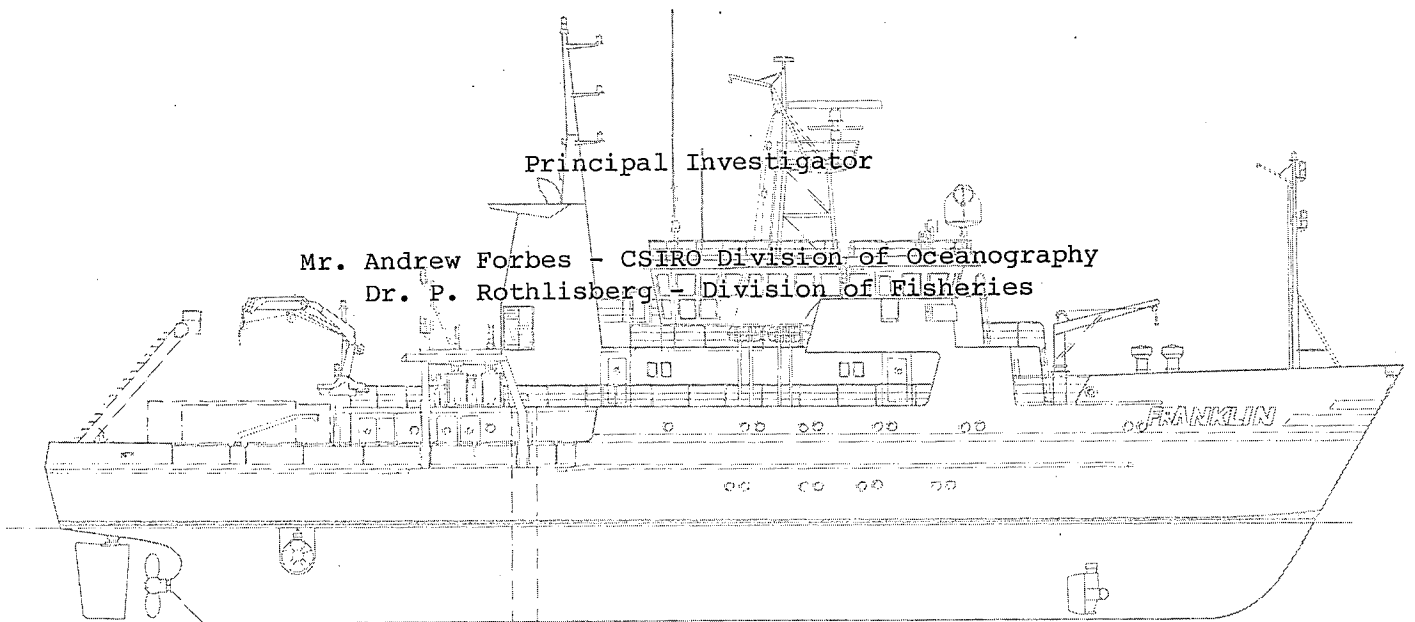
RESEARCH CRUISE SUMMARY

R.V. FRANKLIN

CRUISE 2/88

19 February 1988 - 7 March 1988

CAIRNS - DARWIN



For further information contact

ORV Operations Manager
c/- CSIRO Division of Oceanography
GPO Box 1538, Hobart, Tas. 7001
Telephone (002) 20 6222
Telex AA 57182



R.V. FRANKLIN IS OWNED AND OPERATED BY CSIRO

OBJECTIVES

The cruise investigated the roles that tidal and wind mixing of water masses, and the presence of extensive seagrass beds, may play in determining nutrient distribution and cycling in the Gulf of Carpentaria. Mixing processes are intimately connected with primary and bacterial productivity, therefore data and samples were also collected to determine the stratification and distributions of nutrients and other key chemical parameters (e.g. lipids, pigments and dissolved organic carbon), planktonic algae, animal and bacterial biomasses within the Gulf. The program additionally included daily measurements of primary and bacterial productivity, about which little is presently known for the Gulf.

PRINCIPAL INVESTIGATORS

A. M. Forbes
CSIRO Div. of Oceanography
GPO Box 1538
Hobart, Tas. 7001

P. C. Rothlisberg
CSIRO Div. of Fisheries Research
PO Box 120
Cleveland, Qld. 4163

CRUISE PARTICIPENTS

Peter Nichols	CSIRO Div. Oceanog.	Chief Scientist
David Vaudrey	"	Cruise Manager
Pat Deprez	"	
Fred Boland	"	
Erik Madsen	"	
Ken Suber	"	
Bruce Barker	"	
Jeff Dunn	"	
Peter Rothlisberg	CSIRO Div. Fisheries Res.	
David Moriarty	"	
Peter Pollard	"	
Chris Jackson	"	

SHIFTS: A. (1300-0100) Vaudrey (leader), Madsen, Dunn, Nichols, Pollard, Jackson
B. (0100-1300) Barker (leader), Boland, Suber, Deprez, Rothlisberg, Moriarty

ITINERARY

Departed Cairns 1000 hr Friday 19 February.
Arrived Darwin 1700 hr Sunday 6 March.

CRUISE OUTLINE

Day 1, Friday, February 19, 1988

Departed NQEA slipway wharf, Cairns at 1000 bound for the Gulf of Carpentaria via Torres Strait. Lifeboat muster 1100. Meeting of scientific crew with master 1245, followed by general meeting of all scientific personnel to familiarize everyone with cruise plan and objectives. Watches and preparation of equipment for use during cruise commenced. DELP up and running in part, and pH meter and Turner fluorometer calibrated and acquiring data.

Day 2, Saturday, February 20, 1988

Continuation of equipment preparation for use during cruise. Commenced downloading of surface water pH, fluorescence and other data from VAX to IBM compatible computer. Attempts to interface LSC via VAX to Div. of Fisheries Res. Apple MacIntosh Plus PC together with hardcopy printout from Brother terminal unsuccessful. Modification of Doppler parameters for shallow water profiling to be used in Albatross Bay. Electrical engineer worked on large white chest freezer in scientific hold.

Day 3, Sunday, February 21, 1988

Passed through Torres Strait during the early hours. Water characterized by large changes in pH and fluorescence as well as temperature and salinity. Continuation of calm seas and clear to slightly cloudy skies during day. Niskins cleaned with non-ionic detergent, followed by dilute acid.

Arrived at Albatross Bay 24 hr station at 1345. Trial chemistry/biology station (CTD#1) undertaken to familiarize all personnel with CTD and sampling procedures. Similarly, other equipment to be routinely used at chemistry/biology stations, drop nets (2x) and sediment grab, were also deployed. Albatross Bay Doppler survey commenced at ~1630.

Day 4, Monday, February 22, 1988

Fine weather continues. Completed Doppler survey 0200 and returned to Albatross Bay productivity station. Placed drogue (set at 7m) in water at 0430 with sediment trap and Seastar attached (approx 6m), and commenced 24 hr productivity station at 0500. Cleveland members attached light meter to CTD for productivity water sampling. Drogue was made up with equipment already on board as failed to find gear shipped from Hobart.

Spent rest of day following drogue in Albatross Bay and sampling water from adjacent to drogue at regular intervals. Performed one CTD (#2) cast whilst at 24 hr station. Rigged a 5 l Niskin bottle up on a manually hauled piece of hydro-wire for obtaining many of the water samples. Surface Turner reading around 500 DELP units (~1.3 Turner units). Water very silty and high Turbidity readings obtained with CTD.

Day 5, Tuesday, February 23, 1988

Completed Albatross Bay 24 hr. station and recovered drogue with sediment trap and seastar pump intact. Commenced 12 30' S east-west transect with CTD #3 at 141 00' E. Realised two stations later that we had missed the stations at 12 30' S, 141 30' E, thus causing the chemistry/biology station to not match with the cruise plan. Back on cruise plan at CTD #7, after performing two chemistry/biology stations in succession.

Turner (DELP) reading was still high after leaving Albatross Bay. Had expected Turner value to decrease to ~20-40 DELP units at times in surface waters, as observed on FR10/87 Gulf leg and also prior to entering Albatross Bay. Cleaned and checked calibration at 1700 (local), and found value dropped from 270 to 37 DELP units. Turner will be cleaned on a more frequent basis, particularly when leaving coastal areas. Completed CTD #8 at 2300 (12 30 S, 139 00 E).

Day 6, Wednesday, February 24, 1988

Excellent weather continues. Calm seas and clear skies again. Both shifts settling into station routine;

A. Chemical/biological station:

1. CTD dip with samples taken for routine hydrology (3 depths) and other chemical samples.
2. 2 drop nets (from rear A-frame).
3. Grab sample (sediment depth in Gulf between 20-65 m).

B. CTD station:

Samples for routine hydrology (as for 1. above).

The 0900 productivity sampling coincided with chemical/biological stations for the first two days (February 23 at CTD #3,4; February 24 at CTD #11,12). The light meter was attached to the CTD at these stations. Surface plots of T, S, pH and fluorescence showed surface front at 0400 between CTD #9 and #10 (12 30 S, 138 07.68 E). T and S contours plotted for 12 30 S transect. Bottom front further west than surface front. May plan more detailed CTD survey at a similar longitude along future transects if time permits.

Grab needed lubrication at CTD #12, as it was not triggering. Completed first transect at 1300. Work in wet lab performed with door to scientific hold closed and air conditioning ducts open-considerably more comfortable.

Chlorophyll analyses (including size fractionation) and number crunching commenced. Chlorophyll measurements show that for the Albatross Bay station, a large portion of the phytoplankton (and 14-C uptake) is in the >10 um fraction.

Cyclone Charlie now 500 nm east of Cooktown. Will follow progress closely, as may need to change cruise track and retrieve

Wombat earlier than planned. Completed CTD #17 at 2300 (13 30 S, 137 00 E). Moving east along 13 30 S transect.

Day 7, Thursday, February 25, 1988

Good weather continues. Cyclone appears as if it will not intensify, nor move towards the Gulf. Cleveland members plan to change the second 24 hr station from along the third transect across the Gulf, to the end of the cruise.

The B shift has greased the trigger mechanism on the Smith-MacIntyre grab the past two mornings as it has not been triggering. The sediments have been of similar texture and color so far. They are comprised of mainly silt material, with varying amounts of sand present. Shell fragments are also present in many samples. Worm tubes have also been observed in all grab samples, indicating bioturbation is occurring in the sediments. No H₂S odour can be detected. Sediment from CTD #23 showed a slightly greyer layer under the surface layer. Cleveland members continue to subsample late evening grab sample for measurement of bacteria growth rates using tritiated thymidine.

Surface water fluorescence is consistently low (<40 DELP) through the centre of the Gulf, after showing a number of large peaks along the southerly transect from 12 30 S to 13 30 S. Recalibrated Turner fluorometer between 1905 to 1940 whilst on station at CTD #24. Turner DELP units rose from 14 to 47 (correction of ~0.05-0.1 ug/l chlorophyll a). Instrument reading was quite variable whilst trying to set blank value. Turner fluorescence started increasing again near eastern end of 13 30 S transect. Completed CTD #25 (13 30 S, 140 30 E) at 2300.

Day 8, Friday, February 26, 1988

Excellent weather again. Transect along 13 30 S completed at 0200. Each station was slightly east of points shown on cruise plan since CTD #16 needed to be further offshore due to depth constraints. Stations were then spaced at 30 nm intervals, with CTD #26 at the eastern end of the transect (13 30 S, 141 12 E). With these changes, 10 stations were completed along the 13 30 S transect, rather than the 11 scheduled.

Commenced 14 30 S transect at 0700 (CTD #27). Additional station performed at 0900 for productivity experiments (CTD #29). Confirmed that 24 hr station scheduled for this transect will not be performed until the end of the east-west transects. Cleveland members need more time to perform 24 hr experiment, and thus will wait until survey work is complete.

Variosens III has been particularly useful for observing the position of and targeting in on the chlorophyll maximum at each station. The major chlorophyll maximum at each station is in the mixed bottom layer and generally occurs between 5-15 m above the bottom. Other fluorescence peaks are also usually observed. Size-fractionation samples collected on polycarbonate filters for on-board chlorophyll measurement were found to need correction for filter contribution to A664. The small volume filtered (0.5-

1.0 l) for the size-fractionation samples was also found to be at the limits of sensitivity for determination of chlorophyll. Samples will now be collected using GFF filters, with no fractionation performed.

Cleveland productivity measurements to date show that algal productivity is greatest in surface to mid-depth water samples, rather than in the chlorophyll max. Bacteria also seem to account for a significant portion of the C-14 uptake in the deeper samples. The productivity data differs from that found by Japanese workers who found that productivity increased with depth in the Gulf. The light conditions used by the Japanese may have resulted in higher than in situ light levels for the deeper samples, which therefore resulted in a measurement of potential rather than true productivity. The productivity experiments are all being performed at similar light intensity to that corresponding to sample depth. (A limited number of experiments on FR10/87 had produced similar results to the Japanese).

Weather update at 1905. Cyclone Charlie regenerating-position at 1600, 17.7 S, 152.3 E and moving WSW at 6 knots.

Sediment from mid-Gulf station at CTD #32 was extremely silty. Sand and shell fragments were absent. Completed CTD #33 (14 30 S, 138 45 E) at ~2400.

Day 9, Saturday, February 27, 1988

Continued good weather. Productivity station at ~0900 performed at chemistry/biology station (CTD #36). Plots of surface T, S and pH along 14 30 S transect show a steady increase in these parameters across the Gulf. CTD data indicates salinity of bottom mixed layer along 14 30 S has also increased west of 139 00 E. Surface fluorescence has stayed fairly constant across the transect, apart from a few small peaks along the middle of the transect.

Flood in GP laboratory at 1530. Caused by overflow of drainage tank for the lab. Inflow to Turner fluorometer and pH meter switched off for 10 minutes, whilst engineer drained tank. Lab. mopped up and continuous pH meter and Turner restarted.

Passed south of Groote Eylandt and reached western extremity of 14 30 S transect at ~1600. Performed chemistry/biology station (CTD #39). Surface mixed layer observed to bottom (20 m). Sediment quite coarse with plenty of sand and shell material present. On completing station headed east for about one hour before heading south-east at 1800 for the Sir Edward Pellow Group. First station on 15 30 S transect will be north of Vanderlin Is. at 15 30 S, 137 06 E. Planned station at 136 30 E not possible due to shallow water and unsurveyed nature of the region. Nine stations will be surveyed along 15 30 S. Surface water temperature reached over 32 C between CTD #39 and 40.

Cleaned Turner fluorometer at 1935. Turner reading returned to similar values as before cleaning.

Unusual meteorological event at 2100 whilst heading SE to CTD

#40. Southerly winds gusting to 35 knots lasted for one hour. Winds were accompanied by electrical storm with spectacular lightening display over land to west. Arrived at first station of 15 30 S section at 137 06 E (CTD #40) at 2400.

Day 10, Saturday, February 28, 1988

Weather still good, hot and humid. Small swell running with wind from the north west. Steaming east along 15 30 S section. Productivity station at 0900 coincided with a routine CTD (#43) station (15 30 S, 138 50 E). Sediment collected along the section at CTD #40, 42, 44 & 46 has been mainly sand. The grab sample at station CTD #44 (15 30 S, 139 20 E) contained many small crustaceans. Surface mixed layer has reached all the way to the bottom along this section. Cooler bottom mixed layer water, seen during previous sections, not present. Stations along the 15 30 S section have also been characterised by a smaller bottom fluorescence maximum. Up to 10 fluorescence peaks have been observed in the water column at these stations.

UPS power failure at 0955. Back up after about an hour. Further hardware repairs needed to get DELP back on line. Fixed and on line at ~1245.

Time estimate undertaken in the evening for rest of cruise, still slightly behind schedule. Changed order of stations at southern end of the Gulf. The stations in the SE corner of the Gulf will be performed immediately following first station of 16 10 S section. The new cruise track will see these stations undertaken in an anticlockwise loop, before rejoining the 16 10 S section NE of Mornington Island. Will then head west and complete the 16 10 S section before heading off to the Wombat from the western end of this section. Neil (Master) checked the revised cruise track and determined we would save ~10 hours. The new track will have us at the mid-Gulf 24 hr station at around 0300-0400 on Wednesday, 2nd March.

Position at 2400 was 15 30 S, 141 05 E.

Day 11, Monday, February 29, 1988

Wind has been slowly increasing in strength, now up to 18-20 knots. Arrived at last station (CTD #48, 15 30 S, 141 06 E) of 15 30 S section at 0012. Surface fluorescence very high (800 DELP units). Station in 24 m water, with no stratification. Very high and constant Variosens fluorescence signal all the way to the bottom. Sediment had slightly more silt than previous samples along section, but still mainly sand. Little evidence of bioturbation, and H₂S odour evident when sifting through it. Station completed at 0100, and headed SSW to commence next section.

Minor cruise track change made at ~0500. Cleveland members wanted productivity station to be as far to the SE as possible. Station due west of CTD #49 was therefore deleted. Productivity station coincided with chemistry/biology station (CTD #50 and 51; 16 40 S, 140 50 E). All stations continue to show well mixed

ater column from the surface to the bottom. No Variosens fluorescence data at CTD #49 due to water leaking into instrument. The problem was fixed before the next cast. Unmarked shoals (12-15 m depth) encountered between CTD #50 and 51 and 52. The Master slowed the ship down and made a few changes in course during this time. Continued on revised cruise track. Water in SE region of Gulf has been well mixed, shows a high surface fluorescence (Turner fluorometer), and also has large fluorescence peaks as evidenced by Variosens III traces. Sediment continues to be mainly sand.

Meeting held to plan mid-Gulf 24 hr station and drogue and mooring operations scheduled for 2nd March. Weather stayed fine and wind has dropped back to 5-10 knots. Heard that cyclone Charlie is causing a bit of trouble around Townsville and is off Cape Bowling Green this evening. Steaming west along 16 10 W north of Mornington Island at 2400.

Day 12, Tuesday, March 1, 1988

Good weather continues still. Productivity station (CTD #59) performed west of Mornington Island at 0900. It did not coincide with either type of routine station.

Turner cleaned at 1100. Signal dropped slightly from before it was cleaned.

Held second meeting at 1400 re plans for 24 hr station tomorrow. Last cross-Gulf transect, along 16 10 S, completed with CTD #61. Commenced steaming to the Wombat mooring site after CTD #61. Encountered uncharted shoals at around 1630. Depth rose sharply to 11 m. Surface fluorescence decreasing as we steamed north.

Position at 2400, 16 08.71 S, 139 54.24 E.

Day 13, Wednesday, March 2, 1988

Arrived at mid-Gulf Wombat mooring station at ~0430. Deployed drogue at 0500 and then did a CTD dip for water for 24 hr productivity experiments. Will be sampling water from near the drogue during the next 24 hr. A line of bottles on a weighted piece of hydro wire was attached to the Wombat at 0700. This experiment will compare in situ incubation versus on deck simulated incubation conditions. No sign of sediment trap mooring from FR10/87.

Current meter and tide gauge mooring recovered at 1100.

Grappled for FR10/87 sediment trap mooring off rear A-frame between 1600 and 1700. No success.

Retrieved line of bottles hanging off Wombat at ~1800. Light bottles had all detached from the line, leaving only the dark bottles.

Spent rest of the evening sitting at the drogue collecting water

and taking plankton samples at regular intervals.

Air conditioning problems during the afternoon. Computer room reached 34 C, lower GP lab reached 30 C. Major VAX problem encountered during the evening.

Recalibrated pH 1800-1900 whilst stationary at Wombat. pH dropped 0.1 pH units after the calibration. Position at 2400: 14 01.61 S, 149 02.69 E.

Day 14, Thursday, March 3, 1988

Recovered drogue at Wombat site at ~0500. Seastar and sediment experiments attached to the drogue were both successful. Line attached to Wombat for recovery and equipment detached from the mooring. Commenced mooring recovery at 0830. Everything on deck by 1030. Survey of Gulf completed. Of the 63 dips, 31 were chemical/biological stations (A), 22 were for routine CTD stations (B), 7 were for productivity water samples at the same station as either A or B, 2 were for productivity stations which did not coincide with routine stations, the first station was a trial station, and one CTD cast (#13) was aborted. A summary of station locations and samples collected is appended. Picked up buoy that had come loose from Wombat attachment line, then headed north to recover other current meters in Arafura Sea.

Heading NNW at 2400 to Arafura Sea.

Day 15, Friday, March 4, 1988

Recovered current meter mooring at 9 49.27 S, 137 07.65 E between 1030 and 1115 and then steamed south to the next mooring.

Continued telex communications with Hobart re the VAX. At 1200 the system was still down. DEC people will be required in Darwin. The VAX failure prevented entry of all hydrology and nutrient data obtained for the cruise. Turner fluorometer cleaned at 1130, DELP reading 143 before cleaning and 137 after.

Watches finished at 1200, and packing and cleaning operations started. Recovered final current meter mooring at 10 30.45 S, 136 56.54E between 1435 and 1520, then commenced steaming for Darwin. ETA 1600 6/3/88. Neil (Master) confirmed arrangements for early arrival.

Day 16, Saturday, March 5, 1988

Clear skies and calm seas again. Continued steaming towards Darwin and packing cleaning up work. Scientific hold was rearranged in order to accommodate Hobart Chemistry and Cleveland gear for storage until the vessel returns to Cairns.

Turned pH meter and Turner off at 0800 and readied both units for storage. Had stopped logging both signals on the VAX yesterday.

A meeting was held before lunch to prepare a listing of samples

taken at the chemistry/biology stations and to discuss the Gulf productivity data. Preliminary primary productivity estimates of 100 mgC/m².day for the mid-Gulf and 280 mgC/m².day for Albatross Bay were obtained. Depth data (mgC/m³.day) indicated that previous productivity experiments performed in Gulf waters by Japanese workers and during FR10/87 may have used inappropriate light conditions during incubation, thereby causing overestimates of productivity in deeper samples (>40 m, ie around the chlorophyll maxima).

Held a brief final meeting of scientific personnel at 1300 and followed up with a team photo on fore-castle deck.

Day 17, Sunday, March 5, 1988

Picked up Darwin pilot at 1600 and docked at Darwin wharf at 1700.

EQUIPMENT REPORT

Biological container

A number of problems were encountered with the biological container: A number of the interior cupboard fittings were in poor condition. The drip tray for the air conditioner leaked water continuously. The air conditioner did not provide adequate cooling for intensive work in the tropics.

Scientific hold chest freezer

The large white freezer in the scientific hold failed twice during the cruise and should be monitored carefully. Samples were transferred to the food freezer at the end of the cruise.

Variosens

See attached electronics report.

VAX

See electronics report.

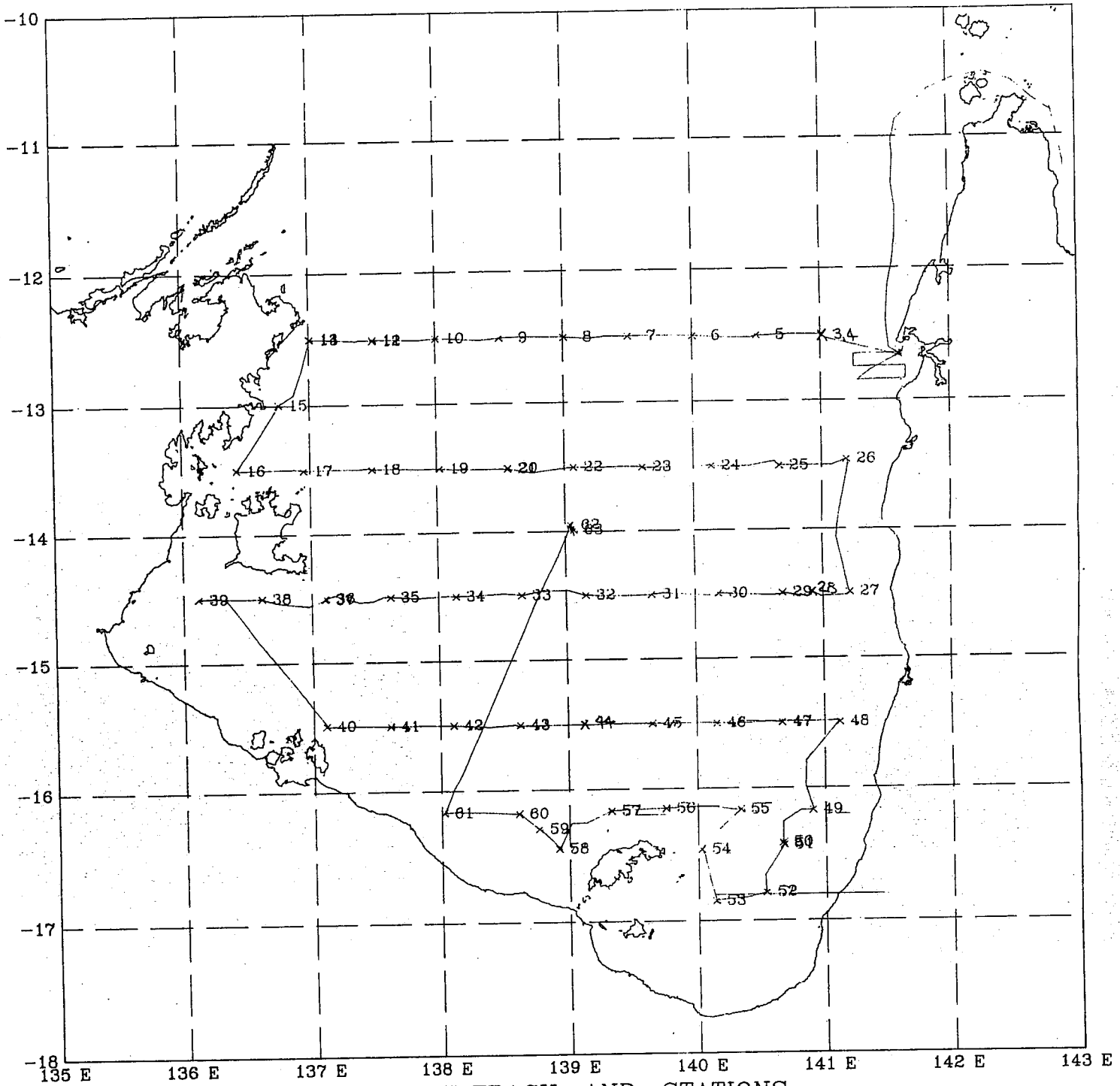
Light meter

A light meter was attached to the CTD for productivity work during the cruise. Data was logged to a separate data logger. It is recommended that a light sensor be interfaced to one of the analogue channels on the CTD and that the software be set up to show light readings in micro Einsteins and percent of surface light.



Peter Nichols
(Chief Scientist)

GULF OF CARPENTARIA EXPERIMENT



CRUISE TRACK AND STATIONS

FR2/88 GULF OF CARPENTARIA EXPERIMENT: SUMMARY OF STATION LOCATIONS AND SAMPLES COLLECTED

CTD#	Lat (S)	Long (E)	Depth	Samples										SED 1°PROD	3H-THY	3H-SED	PHY-NET	ZOO-NET	PHY PRES	
				NUT	OXY	SAL	DOC	CHL A	HPLC	LIPIDS	CHN	δ13C								
			14 ALBATROSS BAY TRIAL STATION																	
1	12 40	141 36	14	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	12 39	141 36	14	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	12 30	141 00	60	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	12 30	141 00	60											X	X					X
5	12 30	140 30	65	X	X	X														
6	12 30	140 00	66	X	X	X	X	X	X	X	X	X	X					X	X	
7	12 30	139 30	63	X	X	X	X	X	X	X	X	X	X					X	X	
8	12 30	139 00	60	X	X	X														
9	12 30	138 30	57	X	X	X	X	X	X	X	X	X	X				X	X	X	
10	12 30	138 00	53	X	X	X														
11	12 30	137 30	52	X	X	X	X	X	X	X	X	X	X					X	X	
12	12 30	137 30	52					X						X	X					X
			53 CAST ABORTED, BOTTLES INCORRECTLY MOUNTED																	
13	12 30	137 00	53	X	X	X														
14	12 30	137 00	53	X	X	X														
15	13 00	136 46	35	X	X	X	X	X	X	X	X	X	X					X	X	
16	13 30	136 25	22	X	X	X	X	X	X	X	X	X	X				X	X	X	
17	13 30	136 57	44	X	X	X														
18	13 30	137 29	54	X	X	X	X	X	X	X	X	X	X					X	X	
19	13 30	138 01	57	X	X	X														
20	13 30	138 34	59	X	X	X	X	X	X	X	X	X	X					X	X	
21	13 30	138 34	59					X						X	X					X
22	13 30	139 04	63	X	X	X														
23	13 30	139 36	65	X	X	X	X	X	X	X	X	X	X					X	X	
24	13 30	140 08	67	X	X	X														
25	13 30	140 40	59	X	X	X	X	X	X	X	X	X	X				X	X	X	
26	13 30	141 12	27	X	X	X														
27	14 30	141 12	29	X	X	X	X	X	X	X	X	X	X				X	X	X	
28	14 30	140 54	45					X						X	X					X
29	14 30	140 42	51	X	X	X														
30	14 30	140 11	64	X	X	X	X	X	X	X	X	X	X					X	X	
31	14 30	139 40	64	X	X	X														
32	14 30	139 09	62	X	X	X	X	X	X	X	X	X	X				X	X	X	
33	14 30	138 39	59	X	X	X														
34	14 30	138 08	57	X	X	X	X	X	X	X	X	X	X				X	X	X	
35	14 30	137 37	53	X	X	X														
36	14 30	137 06	44	X	X	X	X	X	X	X	X	X	X					X	X	
37	14 30	137 06	44					X						X	X					X
38	14 30	136 37	32	X	X	X														
39	14 30	136 07	21	X	X	X	X	X	X	X	X	X	X				X	X	X	
40	15 30	137 06	26	X	X	X	X	X	X	X	X	X	X				X	X	X	
41	15 30	137 36	36	X	X	X														
42	15 30	138 06	48	X	X	X	X	X	X	X	X	X	X				X	X	X	
43	15 30	138 37	52	X	X	X		X						X	X					X
44	15 30	139 08	51	X	X	X	X	X	X	X	X	X	X				X	X	X	
45	15 30	139 39	50	X	X	X														
46	15 30	140 10	46	X	X	X	X	X	X	X	X	X	X				X	X	X	
47	15 30	140 40	37	X	X	X														
48	15 30	141 07	23	X	X	X	X	X	X	X	X	X	X				X	X	X	
49	16 10	140 54	20	X	X	X	X	X	X	X	X	X	X				X	X	X	
50	16 25	140 40	19	X	X	X	X	X	X	X	X	X	X					X	X	
51	16 25	140 40	19					X						X	X					X

CTD#	Lat (S)	Long (E)	Depth	Samples															
				NUT	OXY	SAL	DOC	CHL A	HPLC	LIPIDS	CHN	δ13C	SED	1°PROD	3H-THY	3H-SED	PHY-NET	ZOO-NET	PHY PRES
52	16 48	140 32	21	X	X	X													
53	16 51	140 08	24	X	X	X	X	X	X	X	X	X	X			X	X	X	
54	16 28	140 01	30	X	X	X													
55	16 10	140 20	33	X	X	X	X	X	X	X	X	X	X			X	X	X	
56	16 10	139 45	36	X	X	X													
57	16 10	139 19	23	X	X	X	X	X	X	X	X	X	X			X		X	
58	16 27	138 56	22	X	X	X	X	X	X	X	X	X	X			X	X	X	
59	16 18	138 46	27					X						X	X				X
60	16 10	138 37	29	X	X	X													
61	16 10	138 01	22	X	X	X	X	X	X	X	X	X	X			X	X	X	
62	13 57	139 02	63					X						X	X				X
63	14 00	139 04	63	X	X	X	X	X	X	X	X	X	X			X	X	X	

CODE SUMMARY:

NUT: AUTOANALYSER NUTRIENT SAMPLES (NITRATE, SILICATE, PHOSPHATE)

OXY: DISSOLVED OXYGEN

SAL: SALINITY

DOC: DISSOLVED ORGANIC CARBON

CHL A: SPECTROPHOTOMETRIC CHLOROPHYLL A ANALYSES PERFORMED AT SEA

HPLC: SAMPLE COLLECTED AT CHL A MAXIMUM FOR HPLC ANALYSIS OF PIGMENTS

LIPIDS: SAMPLE COLLECTED AT CHLOROPHYLL A MAXIMUM FOR LIPID ANALYSIS

δ13C: SAMPLE COLLECTED AT CHLOROPHYLL A MAXIMUM FOR STABLE CARBON ISOTOPE ANALYSIS

SED: SEDIMENT COLLECTED FOR LIPID AND STABLE CARBON ISOTOPE ANALYSIS

1°PROD: PRIMARY PRODUCTIVITY EXPERIMENTS PERFORMED USING 14-C BICARBONATE, 4-5 DEPTHS, LIGHT METER READINGS FROM CTD, ON DECK INCUBATIONS

3H-H2O: TRITIATED THYMIDINE BACTERIAL PRODUCTIVITY EXPERIMENTS PERFORMED IN PARALLEL TO 1° PRODUCTIVITY EXPERIMENTS

SAMPLES ALSO TAKEN FOR AOC ENUMERATION OF BACTERIAL NUMBERS

3H-SED: TRITIATED THYMIDINE BACTERIAL PRODUCTIVITY EXPERIMENTS PERFORMED FOR SEDIMENT

PHY-NET: PHYTOPLANKTON DROP NET SAMPLE

ZOO-NET: ZOOPLANKTON DROP NET SAMPLE

PHY PRES: WATER SAMPLE PRESERVED FOR PICOPLANKTON MICROSCOPY

NB: TWO 24 HR STATIONS WERE UNDERTAKEN; 1. ALBATROSS BAY (CTD #1,2) AND, 2. AT THE WOMBAT MET BUOY SITE (CTD #62,63). A DROGUE WAS DEPLOYED AT THE TWO SITES AND SAMPLES WERE TAKEN AT 2-3 HR INTERVALS FOR PRODUCTIVITY MEASUREMENTS AND PHYTOPLANKTON AND ZOOPLANKTON (DROP NETS). SEASTAR WATER SAMPLER AND SEDIMENT TRAP WERE ATTACHED TO DROGUE LINE AT BOTH 24 HR STATIONS