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Great Barrier Reef Marine Park Authority

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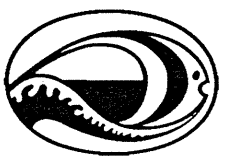

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Abstract

Nutrients and related water quality characteristics were measured at six sites along a transect from the Barron River estuary to Green Island over a twenty-month period.

The water column was generally well mixed and so depth was not a significant source of variation. Overall, slightly higher nutrient concentrations tended to be found at the two most inshore sites. Furthermore, some elevated nutrient levels were recorded right across the transect after periods of heavy rain and/or rough weather. This elevation was most noticeable at the two inshore sites, suggesting input from the Barron River discharge. At Green Island there was no significant increase over background levels in the mean levels of nutrients in the vicinity of the sewage outfall, however relatively high chlorophyll *a* levels were recorded near to the sewage discharge. These high chlorophyll *a* levels could indeed result from the discharge of sewage effluent but further studies will need to be carried out in order to confirm this.

INTRODUCTION

This study was undertaken to assess the water quality between the Barron River / Trinity Inlet and Green Island. This transect was chosen for a combination of reasons. Green Island has a long history of anthropogenic influence through tourism and has been subjected to two outbreaks of the crown of thorns starfish, *Acanthaster planci* within the last thirty years (Baxter, 1990). Therefore it has been a centre of attention for research efforts in a number of fields for a considerable time now.

More recently, interest has also developed in terrestrial inputs to the Great Barrier Reef Lagoon via river run-off which has the potential to carry with it residues of agricultural fertilizers containing nitrogen and phosphorus. As corals are sensitive to nutrient levels (Kinsey and Davies, 1979; Smith *et al.*,1981), the aim of this investigation was to obtain baseline water quality data for nutrients along the transect as well as monitoring any periodic impacts from the river discharge and point source impacts from the sewage outfall at Green Island.

Sampling

Duration

Sampling was conducted over a twenty-month period from September 1988 to April 1990 during which thirteen sampling trips were undertaken on the following dates: 16/9/88, 26/11/88, 4/3/89, 1/6/89, 4/6/89, 10/7/89, 10/8/89, 15/9/89, 30/10/89, 20/11/89, 16/12/89, 12/2/90, 6/4/90.

Sampling was initially carried out with the aid of Queensland National Parks and Wildlife Service aboard one of their boats. However, problems developed regarding the time required for the sampling and accommodating this within scheduled QNPWS field operations. From July 1989, sampling was conducted aboard a privately chartered vessel, the "M.V. Tropic Seas". This led to a change in the sampling site for the Barron River estuary as detailed below.

Procedures

Water samples were collected using a 2 dm^3 Van Dorn water sampler. For the nutrient analyses, sampled water was dispensed directly from the sampler into sterile plastic "Whirl-pak" bags which were immediately stored on dry ice in an esky. These samples were generally frozen within thirty minutes of collection. They remained stored in this manner during transportation back to Townsville, where upon arrival they were placed in a freezer at -20°C until analyzed.

Samples for Chlorophyll *a* and Suspended Solids analyses were collected in 500 cm^3 screw-top plastic bottles and filtered upon returning to land. The filters were frozen until analyzed. Samples for Total Organic Carbon analyses (conducted at the Australian Institute of Marine Science) were transferred to teflon lined screw-cap glass storage tubes containing 100 l of A.R. concentrated HCl. These were kept refrigerated until analyzed. Samples for Mercury (Hg) analyses were stored in 50 cm^3 screw-top plastic bottles containing 2.5 cm^3 of A.R. concentrated nitric acid and 0.5 cm^3 of 5% w/v A.R. potassium dichromate solution as preservatives.

Sites

Six sites were chosen along the transect as detailed below (Figure 1.).

Site .1. Green Island (Figure 2.).

Site .2. On the 30 m depth contour.

Site .3. On the 20 m depth contour.

Site .4. On the 14 m depth contour.

Site .5. Trinity Inlet (End pylon at the seaward end of the entrance channel).

Site .6. *Barron River Estuary.

*For the first five sampling trips, this sample was collected at about 2 km from the mouth of the Barron River (Figure 1.). From July 1989, it was collected from the Captain Cook Highway bridge across the Barron River just North of Cairns, as the charter boat was unable to penetrate into such shallow waters.

The depths sampled at each site are indicated below in Table 1.:

Table 1.

	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Depth m	s* 0.1	0.1	0.1	0.1	0.1	0.1
	m 4.0	15.0	10.0	7.0		1.0
	b 8.0	30.0	20.0	14.0	10.0	3.0

* s surface; m mid-depth; b bottom.

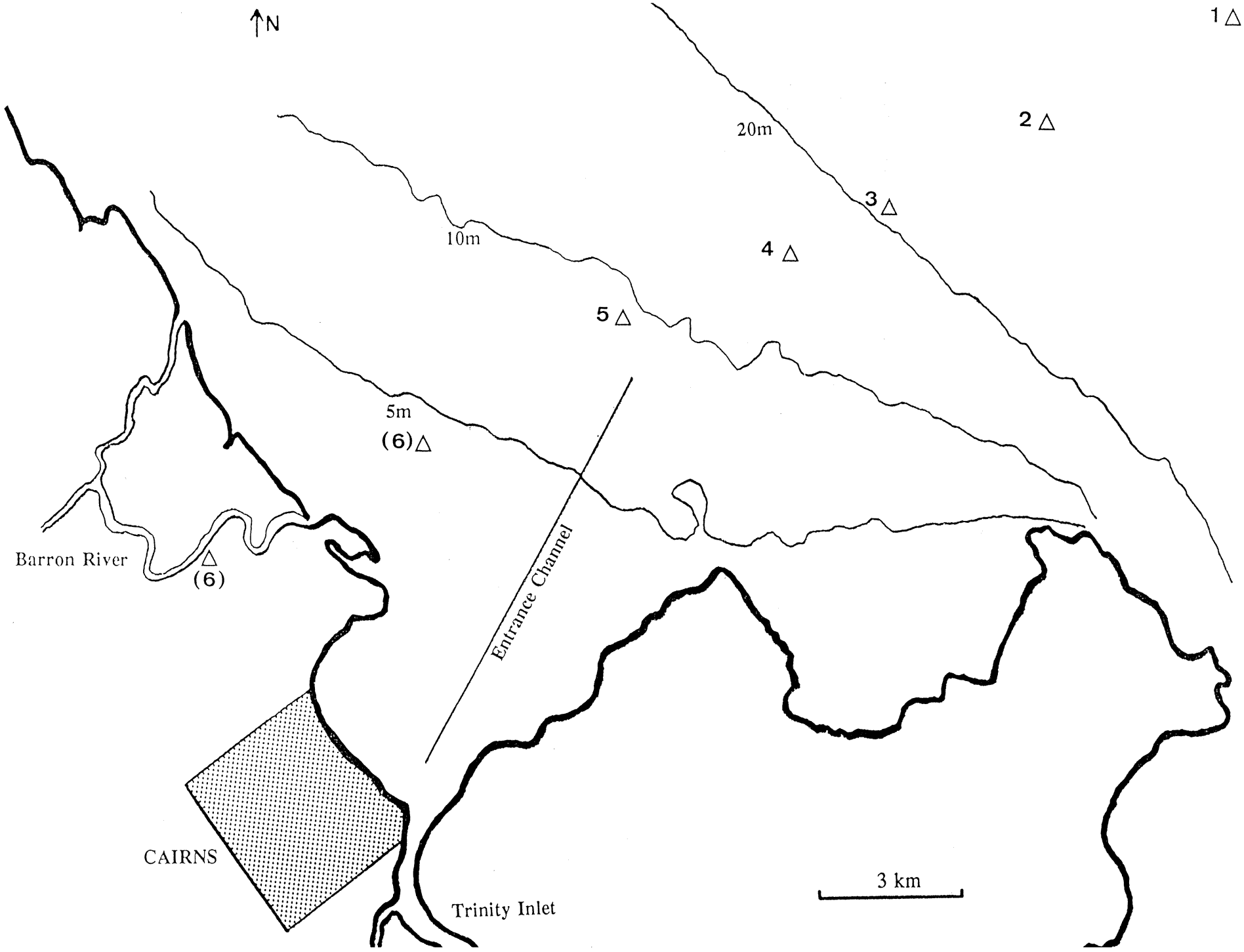

Figure 1: Map showing sampling sites (△).

Figure 2: Sampling Site .1. at Green Island.

Variables Measured

Nutrients:

- Nitrate (NO_3)
- Nitrite (NO_2)
- Ammonium (NH_4)
- Phosphate (PO_4)
- Total Phosphorus (TP)
- Total Organic Carbon (TOC)

Biological Parameters:

- Chlorophyll *a* (Chl *a*)

Physico-Chemical Parameters:

- Salinity
- Temperature
- Dissolved Oxygen (DO)
- Secchi Disc Visibility
- Suspended Solids (SS)

Metals:

- Mercury (Hg)

Analytical Methods

In the field, Secchi Disc visibility readings were taken, and from September 1989 dissolved oxygen and temperature measurements were recorded using a TPS oxygen meter. Salinity was determined via conductance measurements made with a Metrohm Conductometer in the laboratory. For Suspended Solids, 1 dm^3 of sample was filtered through a pre-weighed Whatman GF/C filter paper. These were later dried and then re-weighed.

With the exception of TOC, all the nutrient analyses were conducted manually using standard wet chemical methods (Grasshoff, 1983).

Nitrite

The nitrite concentrations were determined by a spectrophotometric method involving the reaction of nitrite with two aromatic amines to form an azo dye (Grasshoff, 1983). To 50 cm^3 of the thawed sample, 1 cm^3 of sulphanilamide reagent was added followed by 1 cm^3 of N-(1-naphthyl)-ethylenediamine dihydrochloride reagent. The reaction flasks were shaken and the azo dye allowed to develop for at least 15 minutes. The absorbances were measured at 540 nm in 4 cm cuvettes using triply distilled water as a reference. The concentration of nitrite was then determined from a calibration curve obtained from known nitrite standards.

Nitrate

The determination of nitrate involved reducing nitrate to nitrite and then proceeding as described above. The reduction was achieved through a series of copper-coated cadmium reduction columns (Grasshoff, 1983). The columns were prepared by washing coarse cadmium granules in a dilute hydrochloric acid solution and then immersing them in a copper sulphate solution. The copperized cadmium granules were then washed in distilled water and packed into the columns. After checking the efficiency of the columns using suitable standards, the samples were then passed through and analyzed using the nitrite method.

Ammonium

The reaction of ammonia, cyanurate and phenol catalyzed by sodium nitroprusside produced an intensely blue compound, indophenol, which can be detected colorimetrically (Dal Pont *et al.*, 1974; Grasshoff and Johanssen, 1972). To 50 cm^3 of sample, 5 cm^3 of trisodium citrate reagent, 2 cm^3 of phenol-nitroprusside reagent, and 2 cm^3 of sodium dichloro-cyanurate reagent were added. The reaction flasks were then immersed in a water bath for 30 minutes at 70°C. After cooling to room temperature, the absorbances were measured at 630 nm and the concentrations determined from a calibration curve.

Phosphate

The analysis of phosphate was based on the reaction of phosphate ions with an acidified molybdate reagent. This produced a phosphomolybdate complex, which was then reduced to a blue compound that was detected spectrophotometrically (Koroleff, 1983). To 50 cm^3 of sample, 1 cm^3 of ascorbic acid reagent was added, followed by 1 cm^3 of the molybdate/antimony reagent. After a reaction time of 10 minutes, the absorbances were measured at 880 nm and the concentrations determined from a calibration curve.

Total Phosphorus

The determination of total phosphorus involved conversion of organically bound phosphorus to inorganic phosphate and then proceeding as described above. The

conversion was achieved by adding 1.6 cm^3 of potassium persulphate reagent to 20 cm^3 of sample. The samples were then autoclaved for 30 minutes (Koroleff, 1983). After cooling to room temperature, the analyses proceeded as for phosphate (with scaled-down reagent volumes).

Total Organic Carbon

The Total Organic Carbon analyses were conducted by staff at the Australian Institute of Marine Science (AIMS) using a Beckman TOC Analyzer.

Chlorophyll *a*

1 dm^3 of sample was filtered through a Whatman GF/C filter paper. The filter and residue were then transferred to a grinding tube with 2 cm^3 of chilled 90% acetone and ground for 1.5 minutes. The contents were then rinsed into a centrifuge tube and the volume made up to 8 cm^3. The pigments were extracted in a refrigerator for 24 hours and then centrifuged for 5 minutes at 3500 rpm. A portion of the supernatant liquid was transferred to a cuvette and the absorbance read at 750 and 665 nm. (American Public Health Association, 1971; Strickland and Parsons, 1968).

Mercury

The determination of Mercury was based on cold vapour atomic absorption spectrophotometry. Inorganic Hg was reduced to its elemental state and then

transferred to the gas phase. The Hg vapour was then injected into an absorption tube and theabsorbance measured at 253.7 nm (Brodie, 1978).

RESULTS AND DISCUSSION

The data recorded for all the variables measured are shown in the tables in the Appendix. It should be noted that the values given for the nutrient species are the average of duplicate determinations.

Physico-Chemical Parameters

The physico-chemical parameters indicate that the water column was generally well mixed throughout the year with no evidence of stratification. Whilst these parameters varied temporally from trip to trip, they were quite consistent for any particular trip, both across the transect for the marine sites (Sites 1-5) and with respect to depth. Temperature ranged from 26.5°C (30/10/89) to 31.2°C (12/2/90) over the shortened period that it was recorded. Dissolved Oxygen ranged from 6.8 mg/l (12/2/90) to 8.3 mg/l (30/10/89) over the same period.

For Sites 1-4, salinities generally fell between 35.2-35.7‰ with occasionally lower values recorded at the surface during or after periods of heavy rain. Salinities measured at Site 5 varied over a wider range (31.9-35.9‰) suggesting this site may be somewhat influenced by the Barron River discharge at times. Overall depth-averaged mean Suspended Solids data for the transect are shown in Table 2. Suspended Solids were generally very low for Sites 1-4 with overall means of

approximately 2 mg/l. A slightly higher mean of 3 mg/l was recorded at Site 5 before the much higher values found in the Barron River. These values are comparable to other studies on the Great Barrier Reef. Steven *et al.*(1989) reported a mean Suspended Solids level of 1.98 mg/l at Green Island whilst Jones *et al.*(1989) recorded a mean of 2.64 mg/l at John Brewer Reef.

Seasonal variations in Suspended Solids are shown in Figure 3. The plots show depth-averaged means across the transect for each sampling trip. Error bars are one standard deviation. Elevated Suspended Solids levels were observed over the transect for Trips 6, 11, and 13. These trips took place during or after periods of heavy rain and/or in rough weather conditions. These higher values can therefore be attributed to sediment resuspension as well as increased river run-off particularly for the inshore sites (Sites 5,6). It should also be noted that Site 5 was in the vicinity (within a few km) of both current and disused spoil grounds (see Figure 1.). These are the dump sites used when the Trinity Inlet entrance channel is dredged. They may have had some influence on Site 5.

Secchi Disc readings varied considerably. Visibility at Green Island usually extended to the bottom, whilst at Site 5 it was usually less than 5 m. Secchi Disc Visibility did not always correspond with Suspended Solids data. Whilst visibility was low on Trips 6 and 11, it was quite good on Trip 13. Such discrepancies may arise from variables such as the degree of cloud cover (i.e. overcast/sunny), and the possible contributions of phytoplankton and dissolved organic matter to light attenuation.

Table 2.: Summary table of water quality parameters showing overall depth-averaged means for each site over the study period.

Parameter	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary *	Site.6. Barron Estuary **
Nitrate (M)							
Mean S.D.	0.29 0.09	0.24 0.10	0.24 0.10	0.27 0.14	0.58 0.44	1.29 1.44	4.3 3.7
Range	0.09-0.45	0.11-0.51	0.12-0.47	0.13-0.88	0.29-2.4	0.64-5.1	0.81-11
N	37	37	37	37	24	9	8
Ammonium (M)							
Mean S.D.	0.30 0.16	0.19 0.08	0.25 0.16	0.27 0.18	0.41 0.23	0.53 0.43	0.94 0.29
Range	0.07-0.71	0.06-0.44	0.05-0.68	0.04-0.96	0.10-0.86	0.14-1.3	0.65-1.4
N	36	37	37	36	25	9	7
Phosphate (M)							
Mean S.D.	0.17 0.05	0.18 0.06	0.19 0.06	0.21 0.08	0.25 0.07	0.28 0.11	0.48 0.22
Range	0.07-0.28	0.09-0.28	0.09-0.29	0.09-0.52	0.10-0.42	0.15-0.52	0.26-0.93
N	37	37	37	37	25	9	8
Total P (M)							
Mean S.D.	0.55 0.06	0.58 0.07	0.59 0.06	0.60 0.07	0.69 0.13	0.71 0.12	1.5 0.97
Range	0.39-0.66	0.40-0.73	0.48-0.72	0.48-0.75	0.50-1.1	0.57-0.85	0.87-3.8
N	34	34	34	34	23	7	8
Chl *a* (g/l)							
Mean S.D.	1.56 0.74	0.78 0.18	0.81 0.20	0.81 0.23	1.10 0.28	1.69 0.50	
Range	0.82-3.34	0.48-1.07	0.59-1.23	0.43-1.33	0.77-1.72	1.27-2.24	
N	23	23	21	24	14	3	
Susp. Solids(mg/l)							
Mean S.D.	2.0 0.9	2.0 0.8	2.0 0.8	2.2 1.1	3.0 1.5	3.0 1.0	34 20
Range	1.0-4.6	1.0-4.1	1.1-4.4	1.2-6.6	1.1-6.2	2.1-4.9	17-69
N	34	34	32	32	23	7	6

* Site.6. sample collected approximately 2 km from the mouth of the Barron River.
** Site.6. sample collected from the Captain Cook Highway bridge.

Nutrients

Due to the well mixed nature of the water column, vertical differences in nutrient concentrations were usually small and random. Overall depth-averaged means for the nutrient species are shown in Table 2. Seasonal variations for nutrients and chlorophyll *a* are shown in Figures 4-8. As in Figure 3, the plots show depth-averaged means across the transect for each sampling trip and error bars are one standard deviation.

For the nitrogen species, nitrite (NO_2) concentrations were characteristically low, often at or below detectable limits. Hence they are not included in Table 2 as means were non-quantifiable. The only sites for which consistently detectable levels were found were Sites 5 and 6, and even here, levels were still very low. For Site 5, values ranged between <0.01 and 0.07 M with an overall mean of 0.03 0.02 M (23). For Site 6 samples collected near the mouth of the Barron River, values ranged from 0.02 to 0.10 M with a mean of 0.06 0.03 M (7), whilst samples collected from the bridge ranged from 0.05 to 0.15 M with a mean of 0.10 0.04 M (8). Other studies (Furnas *et al.*,1988; Jones *et al.*,1989) have found similar low levels for nitrite.

In contrast, nitrate and ammonium were both present at measurable levels right throughout the study. For nitrate (NO_3), overall means for Sites 1-4 fell between 0.24 and 0.29 M, rising to 0.58 M at Site 5, and then increasing further at Site 6 (see Table 2.). It should be noted that for the Site 6 samples collected from the bridge,

values recorded for all parameters varied greatly, and this is particularly evident in the case of nitrate.

These means for Sites 1-4 are similar to nitrate values reported by Steven *et al.*(1989) at Green Island (0.32 M), Brodie *et al.*(1989) at Magnetic Island (0.28 M) and Jones *et al.*(1989) at John Brewer Reef (0.27 M).

Seasonal variations in nitrate levels are shown in Figure 4. Again, Trips 6, 11 and 13 were seen to have elevated levels right across the transect, corresponding with the trips for which higher Suspended Solids were observed. The trend of increasing nitrate values at Sites 5 and 6 was seen on all trips and was even more marked on these three trips.

Ammonium (NH_4) concentrations for Sites 1-4 were of similar magnitude to those of nitrate, but much more variable. Overall means for these sites ranged from 0.19 to 0.30 M. Higher means were again obtained at Sites 5 and 6 although they were not as elevated as in the case of nitrate (see Table 2.). Whilst for the marine sites (Sites 1-5) there was no clear trend as to whether nitrate or ammonium was the dominant nitrogen species, it appears that for Site 6 nitrate was the more abundant. In comparison, Steven *et al.*(1989) found a mean ammonium level of 0.82 M at Green Island, whilst Furnas *et al.*(1988) reported a mean of 0.22 M from the Whitsunday Islands and Jones *et al.*(1989) a mean of 0.19 M at John Brewer Reef.

Seasonal variations in ammonium levels are shown in Figure 5. It can be seen that on most trips, levels varied across the transect with higher values recorded at Sites

5 and 6. Some elevated levels were observed on Trips 6, 13 and 3, and to a lesser extent Trip 11. But it was on these trips that the variability of levels was more noticeable.

Overall mean phosphate (PO_4) concentrations for Sites 1-4 fell between 0.17 and 0.21 M. Site 5 recorded a marginally higher mean of 0.25 M with Site 6 values slightly higher again (see Table 2.). These values compare with those found by Steven *et al.*(1989) (0.17 M), Furnas *et al.*(1988) (0.16 M), and Jones *et al.*(1989) (0.22 M). Phosphate levels were fairly consistent over the study period and this is reflected in Figure 6 showing seasonal variations. Not only were phosphate levels relatively uniform across the transect for Sites 1-4 on any one trip, there was also only modest variability between trips. Slightly higher levels were observed on Trips 6 and 13, and to a lesser extent Trip 11. But only Site 6 displayed a marked increase.

Total Phosphorus levels were generally two to three times that of phosphate. Overall means for Sites 1-4 ranged from 0.55 to 0.60 M. Again, higher means were recorded at Sites 5 and 6 (see Table 2.). In comparison, Steven *et al.*(1989) reported TP levels that were approximately twice that of phosphate with a mean of 0.38 M, whilst Furnas *et al.*(1988) found a mean TP level of 0.84 M on shelf stations throughout the Whitsunday Islands. Figure 7 shows the seasonal variations in TP levels. As for phosphate, values were fairly uniform across the transect for Sites 1-4 on any one trip, and variability between trips was relatively small. Once more, higher levels were observed on Trips 6 and 13, and to a lesser extent Trip 11, with Site 6 values showing the greatest increase.

At the time of writing, Total Organic Carbon analyses were still being completed at the Australian Institute of Marine Science. When complete, they will be forwarded on to GBRMPA as an addendum to this report.

Biological Parameters

Chlorophyll *a* was the only parameter for which Green Island values differed significantly from Sites 2-4. Values at Green Island varied greatly over a wide range with a mean of 1.56 g/l being obtained. In comparison, overall means for Sites 2-4 fell between 0.78 and 0.81 g/l before rising to 1.10 g/l at Site 5 and 1.69 g/l at Site 6 (see Table 2.). Seasonal variations are shown in Figure 8. It can be seen that particularly high levels of Chlorophyll *a* were recorded at Green Island on Trips 4, 5, 6 and 13. Other sites across the transect also had elevated levels on Trips 6 and 13.

In other studies, Furnas *et al.*(1988) reported a mean of 0.68 g/l on shelf stations in the Whitsundays and Jones *et al.*(1989) a mean of 0.52 g/l at John Brewer Reef. However, Steven *et al.*(1989) found an overall mean of 3.48 g/l at Green Island, but also reported that values varied widely.

This Chlorophyll *a* value at Green Island appears a rather odd result considering none of the nutrient species showed any substantial elevation there. It may arise from the discharge of sewage effluent but the great variation in results here suggests caution is required in interpretation. More intensive sampling is needed to verify this figure.

Metals

Without exception, all inorganic Mercury (Hg) levels were found to be below the detectable limit of 0.05 g/l for the entire transect over the study period.

GENERAL CONCLUSIONS

Throughout the study, the water column was generally well mixed and so depth was not a significant source of variation. Overall mean nutrient concentrations indicated a trend of increasing nutrient levels at the inshore sites (Sites 5 and 6). Levels at these sites tended to be not only slightly higher but also more variable than the rest of the transect, reflecting the influence of the Barron River.

Seasonal variations revealed that the trips for which higher nutrient levels were observed right across the transect tended to coincide with the trips for which higher Suspended Solids were also observed. On these trips the trend of increasing values at Sites 5 and 6 was accentuated. These trips took place during or after periods of heavy rain and/or in rough weather conditions. Thus these higher nutrient levels can be attributed in part to increased sediment resuspension with accompanying release of nutrients. This has been noted in other studies (Walker and O'Donnell, 1981; Blake and Johnson, 1988).

The Barron River discharge may also have been contributing to these higher nutrient levels, particularly in the more marked elevations observed in Trinity Inlet and the Barron River estuary. However, how far out its influence extends remains

unclear. Factors such as the local hydrodynamics and the Coriolis effect need to be considered in addressing this question.

Finally, the observed nutrient concentrations revealed no significant impact from the sewage outfall at Green Island. Levels obtained here were of similar magnitude to those found at Sites 2-4. The exception was Chlorophyll *a* for which higher and greatly variable results were obtained. However, it should be remembered that the sampling involved just one site at Green Island that was sampled intermittently. Trying to assess the relative local impact from a point source would require much more intensive sampling.

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APPENDIX

Nitrate µM	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 1 16/9/88	s* 0.34	0.24	0.23	0.22	♯14	5.1
	m 0.09	0.22	0.12	0.28		
	b 0.18	0.23	0.18	0.88	2.4	1.1
Trip 2 26/11/88	s 0.36	0.22	0.15	0.13	0.45	0.72
	m 0.34	0.16	0.17	0.22		
	b 0.45	0.18	0.18	0.36	0.55	0.85
Trip 3 4/3/89	s 0.27	0.35	0.30	0.33	0.74	0.89
	m 0.29	0.30	0.26	0.34		
	b 0.31	0.33	0.35	0.29	0.82	1.0
Trip 4 1/6/89	s 0.31	0.23	0.16	0.15	0.36	0.64
	m 0.30	0.24	0.18	0.18		
	b 0.32	0.19	0.22	0.24	0.38	0.68
Trip 5 4/6/89	s** 0.29	0.17	0.20	0.16	0.34	0.66
	m					
	b					
Trip 6 10/7/89	s 0.42	0.48	0.47	0.39	0.61	***
	m 0.40	0.45	0.42	0.44		4.9
	b 0.42	0.51	0.45	0.43	0.64	
Trip 7 10/8/89	s 0.28	0.16	0.17	0.15	0.35	
	m 0.28	0.20	0.23	0.18		1.2
	b 0.31	0.22	0.19	0.26	0.38	
Trip 8 15/9/89	s 0.19	0.17	0.18	0.19	0.33	
	m 0.21	0.14	0.19	0.16		0.81
	b 0.21	0.16	0.23	0.20	0.35	
Trip 9 30/10/89	s 0.25	0.13	0.14	0.15	0.37	
	m 0.24	0.13	0.12	0.17		2.6
	b 0.26	0.15	0.16	0.24	0.41	

Nitrate µM	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 10 20/11/89	s 0.17	0.11	0.12	0.16	0.29	
	m 0.19	0.13	0.18	0.19		3.0
	b 0.20	0.12	0.23	0.22	0.31	
Trip 11 16/12/89	s 0.38	0.32	0.32	0.28	0.68	
	m 0.38	0.32	0.34	0.35		8.7
	b 0.36	0.33	0.35	0.37	0.70	
Trip 12 12/2/90	s 0.20	0.20	0.18	0.23	0.32	
	m 0.19	0.21	0.22	0.21		2.1
	b 0.20	0.20	0.21	0.24	0.35	
Trip 13 6/4/90	s 0.40	0.36	0.34	0.35	0.86	
	m 0.39	0.36	0.35	0.38		11
	b 0.40	0.38	0.38	0.42	0.94	

* s surface; m mid-depth; b bottom.
** Only surface samples collected.
*** Change of sampling site.
♯ Anomalous value.

Ammonia µM	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 1 16/9/88	s* 0.12	0.08	0.06	0.04	0.15	0.14
	m 0.09	0.08	0.05	0.08		
	b 0.11	0.08	0.11	0.10	0.10	0.18
Trip 2 26/11/88	s 0.19	0.44	0.51	0.10	0.27	0.33
	m 0.25	0.19	0.20	0.29		
	b 0.32	0.28	0.33	0.34	0.42	0.26
Trip 3 4/3/89	s 0.22	0.30	0.21	0.20	0.86	1.2
	m 0.07	0.11	0.29	0.65		
	b 0.35	0.16	0.42	0.96	0.72	1.3
Trip 4 1/6/89	s 0.39	0.14	0.19	0.12	0.32	0.39
	m 0.56	0.31	0.13	0.18		
	b 0.71	0.09	0.20	0.26	0.20	0.57
Trip 5 4/6/89	s** 0.69	0.21	0.25	0.07	0.29	0.38
	m					
	b					
Trip 6 10/7/89	s 0.42	0.15	0.32	0.36	0.51	***
	m 0.27	0.22	0.41	0.28		1.1
	b 0.33	0.35	0.57	0.49	0.78	
Trip 7 10/8/89	s 0.17	0.06	0.18	0.09	0.18	
	m 0.36	0.11	0.10	0.14		0.68
	b 0.22	0.21	0.14	0.19	0.29	
Trip 8 15/9/89	s 0.24	0.17	0.10	0.15	0.21	
	m 0.30	0.13	0.29	0.23		0.74
	b 0.19	0.19	0.21	0.25	0.40	
Trip 9 30/10/89	s 0.27	0.28	0.08	0.34	0.33	
	m 0.35	0.19	0.14	0.43		0.65
	b 0.32	0.24	0.16	0.37	0.45	

Ammonia µM	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 10 20/11/89	s 0.27	0.13	0.08	0.35	0.19	
	m 0.11	0.22	0.18	0.20		0.80
	b 0.19	0.24	0.15	0.20	0.30	
Trip 11 16/12/89	s 0.22	0.19	0.31		0.47	
	m 0.28	0.26	0.18	0.36		1.2
	b 0.38	0.23	0.25	0.28	0.59	
Trip 12 12/2/90	s 0.11	0.21	0.17	0.18	0.22	
	m 0.23	0.09	0.24	0.10		
	b	0.13	0.15	0.20	0.31	
Trip 13 6/4/90	s 0.50	0.14	0.68	0.40	0.81	
	m 0.61	0.22	0.58	0.38		1.4
	b 0.43	0.24	0.63	0.48	0.86	

* s surface; m mid-depth; b bottom.
** Only surface samples collected.
*** Change of sampling site.

Nitrite µM	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 1 16/9/88	s*					
	m					
	b					
Trip 2 26/11/88	s 0.05	0.02	0.03	0.01	0.02	0.08
	m 0.02	0.01	<0.01	0.02		
	b 0.01	0.02	0.01	<0.01	0.02	0.06
Trip 3 4/3/89	s 0.01	<0.01	0.02	<0.01	0.05	0.10
	m 0.02	0.01	<0.01	0.01		
	b <0.01	0.02	<0.01	0.04	0.07	0.09
Trip 4 1/6/89	s 0.02	0.01	<0.01	0.02	0.03	0.04
	m <0.01	0.01	0.01	<0.01		
	b <0.01	<0.01	<0.01	0.01	0.01	0.02
Trip 5 4/6/89	s** <0.01	<0.01	<0.01	<0.01	0.01	0.02
	m					
	b					
Trip 6 10/7/89	s 0.02	<0.01	<0.01	0.02	0.05	***
	m <0.01	0.01	0.02	0.01		0.15
	b <0.01	<0.01	0.02	<0.01	0.06	
Trip 7 10/8/89	s 0.03	0.02	0.02	<0.01	0.06	
	m 0.01	<0.01	0.01	<0.01		0.10
	b 0.01	0.01	<0.01	<0.01	0.04	
Trip 8 15/9/89	s 0.04	0.01	0.01	0.02	0.04	
	m 0.03	0.02	<0.01	0.01		0.12
	b 0.02	<0.01	<0.01	0.01	0.05	
Trip 9 30/10/89	s 0.01	<0.01	0.02	<0.01	0.01	
	m 0.01	<0.01	<0.01	<0.01		0.06
	b <0.01	<0.01	0.01	<0.01	0.02	

Nitrite µM	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 10 20/11/89	s <0.01	<0.01	<0.01	<0.01	<0.01	
	m <0.01	<0.01	<0.01	0.01		0.05
	b 0.01	0.02	<0.01	<0.01	0.03	
Trip 11 16/12/89	s <0.01	0.01	<0.01	0.01	0.02	
	m <0.01	0.01	0.02	<0.01		0.09
	b <0.01	<0.01	0.01	<0.01	0.03	
Trip 12 12/2/90	s <0.01	<0.01	0.01	<0.01	0.01	
	m 0.01	<0.01	<0.01	<0.01		0.08
	b <0.01	<0.01	0.01	0.02	0.04	
Trip 13 6/4/90	s 0.01	<0.01	0.01	0.02	0.05	
	m <0.01	<0.01	<0.01	0.01		0.14
	b <0.01	0.01	<0.01	<0.01	0.07	

* s surface; m mid-depth; b bottom.
** Only surface samples collected.
*** Change of sampling site.

Phosphate µM	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 1 16/9/88	s* 0.11	0.09	0.09	0.09	0.29	0.25
	m 0.13	0.10	0.18	0.10		
	b 0.13	0.11	0.12	0.52	0.21	0.27
Trip 2 26/11/88	s 0.19	0.16	0.13	0.13	0.10	0.15
	m 0.23	0.19	0.12	0.10		
	b 0.16	0.09	0.17	0.18	0.28	0.19
Trip 3 4/3/89	s 0.21	0.22	0.20	0.16	0.27	0.36
	m 0.25	0.28	0.20	0.29		
	b 0.19	0.20	0.22	0.29	0.34	0.52
Trip 4 1/6/89	s 0.15	0.21	0.24	0.20	0.23	0.26
	m 0.08	0.27	0.24	0.24		
	b 0.13	0.21	0.25	0.25	0.24	0.28
Trip 5 4/6/89	s** 0.20	0.15	0.23	0.27	0.21	0.26
	m					
	b					
Trip 6 10/7/89	s 0.24	0.25	0.28	0.25	0.26	***
	m 0.23	0.19	0.24	0.25		0.51
	b 0.22	0.27	0.27	0.22	0.29	
Trip 7 10/8/89	s 0.15	0.21	0.16	0.19	0.25	
	m 0.14	0.18	0.17	0.21		0.39
	b 0.16	0.18	0.20	0.23	0.28	
Trip 8 15/9/89	s 0.07	0.14	0.10	0.10	0.14	
	m 0.14	0.12	0.14	0.13		0.35
	b 0.11	0.20	0.18	0.24	0.23	
Trip 9 30/10/89	s 0.13	0.15	0.26	0.11	0.22	
	m 0.18	0.17	0.15	0.32		0.29
	b 0.23	0.17	0.25	0.26	0.26	

Phosphate µM	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 10 20/11/89	s 0.12	0.16	0.09	0.10	0.17	
	m 0.10	0.09	0.12	0.09		0.26
	b 0.12	0.11	0.10	0.16	0.12	
Trip 11 16/12/89	s 0.21	0.19	0.18	0.22	0.27	
	m 0.15	0.25	0.25	0.19		0.65
	b 0.19	0.21	0.18	0.24	0.26	
Trip 12 12/2/90	s 0.16	0.15	0.16	0.18	0.22	
	m 0.15	0.14	0.14	0.15		0.46
	b 0.15	0.15	0.22	0.15	0.21	
Trip 13 6/4/90	s 0.26	0.26	0.25	0.26	0.42	
	m 0.28	0.26	0.23	0.28		0.93
	b 0.28	0.24	0.29	0.24	0.38	

* s surface; m mid-depth; b bottom.
** Only surface samples collected.
*** Change of sampling site.

Total P µM	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 1 16/9/88	s*					
	m					
	b					
Trip 2 26/11/88	s 0.61	0.71	0.63	0.63	0.68	0.74
	m 0.64	0.73	0.72	0.75		
	b 0.65	0.67	0.72	0.66	0.71	0.83
Trip 3 4/3/89	s 0.63	0.63	0.66	0.62	0.68	0.77
	m 0.65	0.67	0.68	0.67		
	b 0.66	0.71	0.65	0.74	0.70	0.85
Trip 4 1/6/89	s 0.43	0.52	0.51	0.48	0.50	0.58
	m 0.45	0.51	0.52	0.50		
	b 0.50	0.54	0.53	0.51	0.52	0.62
Trip 5 4/6/89	s** 0.39	0.40	0.48	0.50	0.53	0.57
	m					
	b					
Trip 6 10/7/89	s 0.60	0.58	0.62	0.65	0.72	***
	m 0.61	0.63	0.66	0.62		1.5
	b 0.59	0.66	0.61	0.63	0.72	
Trip 7 10/8/89	s 0.54	0.55	0.57	0.59	0.66	
	m 0.51	0.56	0.55	0.59		1.1
	b 0.52	0.57	0.58	0.61	0.67	
Trip 8 15/9/89	s 0.52	0.53	0.50	0.53	0.60	
	m 0.54	0.53	0.53	0.56		0.98
	b 0.53	0.55	0.56	0.54	0.63	
Trip 9 30/10/89	s 0.53	0.52	0.56	0.57	0.70	
	m 0.55	0.53	0.59	0.59		0.92
	b 0.56	0.55	0.61	0.62	0.69	

Total P µM	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 10 20/11/89	s 0.51	0.54	0.53	0.56	0.64	
	m 0.51	0.52	0.55	0.54		0.87
	b 0.52	0.54	0.55	0.55	0.65	
Trip 11 16/12/89	s 0.56	0.57	0.58	0.61	0.71	
	m 0.57	0.58	0.58	0.58		1.4
	b 0.57	0.57	0.60	0.59	0.78	
Trip 12 12/2/90	s 0.52	0.53	0.54	0.56	0.70	
	m 0.53	0.55	0.54	0.55		1.1
	b 0.51	0.54	0.55	0.56	0.71	
Trip 13 6/4/90	s 0.61	0.63	0.67	0.69	1.1	
	m 0.62	0.68	0.66	0.68		3.8
	b 0.62	0.66	0.65	0.73	0.95	

* s surface; m mid-depth; b bottom.
** Only surface samples collected.
*** Change of sampling site.

Chl *a* µg/l	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 1 16/9/88	s*					
	m					
	b					
Trip 2 26/11/88	s					
	m					
	b					
Trip 3 4/3/89	s					
	m					
	b					
Trip 4 1/6/89	s 2.14	0.84		0.68	0.87	1.27
	m	0.71	1.12	0.79		
	b 1.73		0.94	0.52	1.04	1.56
Trip 5 4/6/89	s** 2.35	0.68	0.77	0.43		2.24
	m					
	b					
Trip 6 10/7/89	s	0.98	1.23	1.05	1.35	***
	m 3.22	1.05		0.89		
	b 2.70	0.94	1.10	1.18	1.27	
Trip 7 10/8/89	s 1.38	0.54	0.59	0.80	1.01	
	m 1.07	0.48	0.64	0.85		
	b 1.18		0.75	0.91		
Trip 8 15/9/89	s 1.18	0.80		0.53	0.96	
	m 0.96	1.07	0.69			
	b 1.23	0.80	0.75		1.12	
Trip 9 30/10/89	s	0.71	0.63	0.58	0.83	
	m 1.14		0.71	0.76		
	b 1.10	0.85	0.67	0.63		

Chl *a* µg/l	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 10 20/11/89	s 0.94	0.54	0.66	0.80	0.77	
	m 0.82	0.57		0.63		
	b	0.61	0.74		0.85	
Trip 11 16/12/89	s 1.25		0.70	0.86	0.98	
	m 1.33	0.82		0.77		
	b 1.46	0.77		0.77		
Trip 12 12/2/90	s 1.03	0.63	0.63	0.68		
	m 0.97		0.71	0.74		
	b 1.16	0.68	0.71		1.07	
Trip 13 6/4/90	s 2.26	1.03	1.16	1.33	1.56	
	m 3.34	0.91		1.20		
	b	0.98	1.08	1.16	1.72	

* s surface; m mid-depth; b bottom.
** Only surface samples collected.
*** Change of sampling site.

Inorg Hg µg/l	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 2 26/11/88	s*<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	m <0.05	<0.05		<0.05		
	b <0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Trip 3 4/3/89	s <0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	m <0.05		<0.05	<0.05		
	b <0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Trip 4 1/6/89	s <0.05	<0.05		<0.05	<0.05	<0.05
	m <0.05	<0.05	<0.05	<0.05		
	b <0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Trip 5 4/6/89	s** <0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Trip 6 10/7/89	s <0.05	<0.05	<0.05	<0.05	<0.05	m# <0.05
Trip 7 10/8/89	s <0.05		<0.05	<0.05	<0.05	m<0.05
Trip 8 15/9/89	s <0.05	<0.05	<0.05	<0.05	<0.05	m<0.05
Trip 9 30/10/89	s <0.05	<0.05	<0.05		<0.05	
Trip 10 20/11/89	s <0.05	<0.05	<0.05	<0.05	<0.05	m<0.05
Trip 11 16/12/89	s	<0.05	<0.05	<0.05	<0.05	m<0.05
Trip 12 12/2/90	s <0.05	<0.05	<0.05	<0.05	<0.05	m<0.05
Trip 13 6/4/90	s <0.05	<0.05	<0.05	<0.05	<0.05	m<0.05

* s surface; m mid-depth; b bottom.

** Only surface samples collected.

Change of sampling site; only mid-depth samples collected at Site.6.

Temp. °C	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 9 30/10/89	s* 26.8	27.3	27.6	27.5	27.0	
	m 26.8	27.3	27.6	27.5		
	b 26.5			27.5	27.0	
Trip 10 20/11/89	s 28.9	28.9	28.9	29.0	29.1	
	m 28.8	28.8	28.8	28.9		
	b 28.8			28.9	29.0	
Trip 11 16/12/89	s 29.3	29.5	29.6	29.5	29.5	
	m 29.2	29.2	29.3	29.2		
	b 29.2			29.2	29.3	
Trip 12 12/2/90	s 30.4	31.2	31.0	30.5	30.1	
	m 30.3	30.4	30.3	30.3		
	b 30.3			30.3	30.0	
Trip 13 6/4/90	s 28.8	28.6	28.6	28.7	28.4	
	m 28.6	28.3	28.3	28.3		
	b 28.6			28.3	28.4	

* s surface; m mid-depth; b bottom.

Dissolved Oxygen mg/l	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 9 30/10/89	s* 8.3	8.1	8.2	8.2	8.0	
	m 8.2	8.0	8.1	8.0		
	b 8.2			7.9	7.9	
Trip 10 20/11/89	s 7.8	7.7	7.7	7.8	7.7	
	m 7.7	7.6	7.7	7.7		
	b 7.7			7.6	7.6	
Trip 11 16/12/89	s 7.4	7.5	7.4	7.4	7.3	
	m 7.4	7.3	7.3	7.3		
	b 7.4			7.3	7.2	
Trip 12 12/2/90	s 7.1	7.0	7.0	7.1	7.0	
	m 7.0	6.8	6.9	7.0		
	b 6.9			6.9	6.8	
Trip 13 6/4/90	s 7.6	7.6	7.6	7.7	7.6	
	m 7.6	7.6	7.5	7.5		
	b 7.5			7.5	7.4	

* s surface; m mid-depth; b bottom.

Salinity ‰	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 1 16/9/88	s*					
	m					
	b					
Trip 2 26/11/88	s					
	m					
	b					
Trip 3 4/3/89	s 33.5	33.3	34.6	34.3	31.9	30.8
	m 34.4	35.0	35.0	35.1		
	b 34.8	35.4	35.2	35.2	33.2	31.3
Trip 4 1/6/89	s 35.3	35.5	35.4	35.3	35.2	34.9
	m 35.1	35.6	35.2	35.4		
	b 35.2	35.3	35.3	35.8	35.7	35.2
Trip 5 4/6/89	s** 35.5	35.2	35.4	35.3	35.1	34.7
	m					
	b					
Trip 6 10/7/89	s 34.5	34.4	34.4	34.6	33.4	***
	m 34.9	35.1	35.2	35.4		6.9
	b 35.0	35.3	35.5	35.4	35.0	
Trip 7 10/8/89	s 35.2	35.3	35.2	35.2	35.4	
	m 35.4	35.3	35.7	35.4		8.3
	b 35.4	35.4	35.6	35.5	35.5	
Trip 8 15/9/89	s 35.5	35.4	35.4	35.5	35.3	
	m 35.6	35.6	35.4	35.3		14.2
	b 35.5	35.5	35.5	35.6	35.4	
Trip 9 30/10/89	s 35.6	35.8	35.7	35.7	35.8	
	m 35.5	35.5	35.4	35.5		11.1
	b 35.5	35.6	35.6	35.5	35.8	

Salinity ‰	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 10 20/11/89	s 35.7	35.8	36.0	35.8	35.9	
	m 35.6	35.6	35.7	35.6		9.4
	b 35.5	35.5	35.6	35.6	35.8	
Trip 11 16/12/89	s 35.2	35.5	35.3	35.4	35.4	
	m 35.4	35.5	35.5	35.6		2.7
	b 35.4	35.6	35.6	35.6	35.6	
Trip 12 12/2/90	s 35.1	35.2	35.0	35.2	35.1	
	m 35.3	35.5	35.4	35.4		5.3
	b 35.3	35.5	35.5	35.4	35.4	
Trip 13 6/4/90	s 34.9	34.7	34.4	34.6	34.3	
	m 35.0	35.4	35.3	35.1		3.2
	b 35.1	35.5	35.3	35.2	34.8	

* s surface; m mid-depth; b bottom.
** Only surface samples collected.
*** Change of sampling site.

Suspended Solids mg/l	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 1 16/9/88	s*					
	m					
	b					
Trip 2 26/11/88	s 2.0	2.1	1.8	2.8	2.4	3.2
	m 2.8	1.5	1.4	2.4		
	b 1.7	1.6			5.0	2.6
Trip 3 4/3/89	s 1.4	2.9	1.4	2.4	3.4	3.7
	m 1.4	2.1	1.9	3.4		
	b 1.9	2.8	1.7	2.0	5.6	4.9
Trip 4 1/6/89	s 1.8	1.9	2.0	1.9	2.2	2.2
	m 2.1	1.9	2.6	2.0		
	b 2.1	1.9	1.9		3.9	2.6
Trip 5 4/6/89	s** 1.7	1.6	1.9	1.9	2.0	2.1
	m					
	b					
Trip 6 10/7/89	s 4.6	3.7	4.0	4.2	4.7	***
	m 4.5	4.1	4.1	4.2		42
	b 3.9	4.1	4.4	6.6	4.4	
Trip 7 10/8/89	s 2.3	2.0	1.7	1.4	2.4	
	m 1.2	1.4	1.4	1.3		
	b 1.9	1.2	1.8	2.1	2.7	
Trip 8 15/9/89	s 1.0	1.2	1.1	1.3	1.6	
	m 1.2	1.2	1.3	1.3		18
	b 1.0	1.1	1.1	1.4	1.3	
Trip 9 30/10/89	s 1.5	1.5	1.5	1.6	2.6	
	m 1.5	1.4	1.4	1.5		27
	b 1.6	1.7	1.8	1.5	3.1	

Suspended Solids mg/l	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 10 20/11/89	s 1.3	1.2	1.4	1.2	1.2	
	m 1.2	1.3	1.3	1.3		
	b 1.2	1.6	1.3	1.4	1.6	
Trip 11 16/12/89	s 2.5	2.4	2.2	2.9	4.8	
	m 2.3	2.6	2.4	3.0		69
	b 2.3	2.3	2.2	2.5	6.2	
Trip 12 12/2/90	s 1.3	1.2	1.1	1.3	1.1	
	m 1.2	1.0		1.2		17
	b 1.5	1.2	1.2	1.3	1.2	
Trip 13 6/4/90	s 2.2	2.3	2.4	2.1	3.0	
	m 2.5	2.3	2.4	2.5		31
	b 2.6	2.6	2.3	2.2	3.4	

* s surface; m mid-depth; b bottom.
** Only surface samples collected.
*** Change of sampling site.

Secchi Disc Visibility m	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
16/9/88	#8	11	9	6		
26/11/88	#8	15	5	6	4.5	2
4/3/89	#6	7	5.5	5	3.5	2
1/6/89	#7	8.5	7.5	4	3.5	2.5
4/6/89						
10/7/89	7.5	4	4.5	5.5	2.5	
10/8/89	#9	9	5	6	4	
15/9/89	#9	9	7	5	4.5	
30/10/89	6.5	9	3.5	3	2.5	
20/11/89	#8	9.5	5.5	4	4	
16/12/89	4.5	5.5	4.5	4	2.5	
12/2/90	#8	14.5	13.5	11	6.5	
6/4/90	6.5	11	11	11	8	

bottom.

TOC mg/l	Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 1 16/9/88	s*					
	m					
	b					
Trip 2 26/11/88	s					
	m					
	b					
Trip 3 4/3/89	s 2.66	2.17	1.75	1.48		2.03
	m 1.41	4.40	1.95			
	b 1.27	1.90	3.70	4.40	5.10	
Trip 4 1/6/89	s 0.99	1.82	1.59	1.88		
	m 1.24	1.59	1.82	1.44		
	b	1.65	1.10		1.59	
Trip 5 4/6/89	s**1.49		1.13	1.28	1.59	1.43
	m					
	b					
Trip 6 10/7/89	s					***
	m					
	b					
Trip 7 10/8/89	s 0.75	3.57	1.81			
	m 1.96	1.39		1.61		3.38
	b	1.64	2.16	1.94	2.06	
Trip 8 15/9/89	s 2.33	2.66		1.34		
	m 1.03	0.92	2.29	2.73		3.35
	b 3.91	1.78	2.88	2.14	4.15	
Trip 9 30/10/89	s 1.00	0.88	1.27	1.56	2.45	
	m 1.38	0.91	1.28	1.00		3.00
	b 1.13	1.18	0.83	1.12	0.98	

TOC mg/l		Site.1. Green Island	Site.2.	Site.3.	Site.4.	Site.5. Trinity Inlet	Site.6. Barron Estuary
Trip 10 20/11/89	s	3.6	2.3		1.1	5.9	
	m	5.5		2.6	0.9		
	b	3.6	2.3	3.3	3.3	2.6	
Trip 11 16/12/89	s	2.2	1.6	3.2	3.6	1.9	
	m	2.9	2.5		1.8		5.7
	b	1.8	2.4		4.8	0.4	
Trip 12 12/2/90	s	6.2	2.2		3.8	5.6	
	m	4.8					4.3
	b	4.9	3.7	2.4	2.8	3.1	
Trip 13 6/4/90	s		1.5	6.2	6.4		
	m	4.0					5.5
	b		4.7		4.4	3.6	

* s surface; m mid-depth; b bottom.
** Only surface samples collected.
*** Change of sampling site.

	Site.1.	Site.2.	Site.3.	Site.4.	Site.5	Site.6.
Mean ± S.D.	2.6±1.6	2.2±1.0	2.3±1.2	2.5±1.5	2.9±1.7	3.6±1.5
Range	0.75-6.2	0.88-4.7	0.83-6.2	0.9-6.4	0.4-5.9	1.43-5.7
N	24	24	19	23	14	8