

10. Microbial abundance and dynamics

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Aim: To compare abundance and organic nutrient uptake by dominant microbial groups in planktonic communities around the Crozet Islands.

Objectives

- 1) To determine the vertical distribution, abundance and flow cytometrically resolved community structure of nano- (2 – 20 μm) and pico- (0.2 – 2 μm) plankton in the top 200 m using flow cytometry;
- 2) To estimate the microbial turnover rates of common dissolved organic nutrients, to assess microbial competition and to relate the latter with community composition.
- 3) To collect samples for analyses of bacterioplankton community composition using molecular approach including fluorescence in situ hybridisation.
- 4) Underway sampling from the uncontaminated seawater supply: a) To assess microbial spatial variability at ten km scale; b) To test the capability of the CytoSense flow cytometer for automated underway analysis and to determine the distribution, abundance and community structure of phytoplankton (approx. 3 – 200 μm) in surface waters;



Phytoplankton concentration in the studied area varied between 2 to 10×10^3 cells ml^{-1} in surface waters, and bacterioplankton concentration varied about 20 fold, from $<100 \times 10^3$ cells ml^{-1} at 200m depth to 2×10^9 cells ml^{-1} in the surface waters (see Appendix at the end for examples of vertical distribution). Also a wide range of rates of microbial activity was observed. Flow sorting and scintillation counting were done on board the ship but the detailed analysis of the data will be done back in the UK. The molecular analysis will be also done after the cruise. When completed the data set will allow estimation of the rates of microbial nutrient uptake as well as linkage between microbial function, composition and hydrological structure of the water column.

Methods

Seawater samples were collected and analysed for determination of microbial concentration, biomass and composition. Fresh seawater samples were collected in acid washed 50 mL polypropylene tubes from a CTD system containing 24 x 20 L Niskin bottles. Samples were stored in a refrigerator and microorganisms were preserved with paraformaldehyde (1% final concentration) within 1-2 hours of collection. Phytoplankton samples were analysed unstained and bacterioplankton samples were stained with SYBR Green I nucleic acid dye. The bacterial samples were then left in the dark at 35°C for at least 1 hour before enumeration of bacterioplankton by a flow cytometer (FACSort BD). Table 10.1 summarises the CTD casts sampled and analysed during cruise D285. Samples

were also collected for later molecular identification of microorganisms. To correlate with high-resolution underway analyses samples were collected from the Ti-CTD casts at 5 m depth to determine microbial nutrient uptake and turnover rates by incubating samples with isotopically labelled precursor molecules: ^3H -leucine, ^{35}S -methionine, ^3H -glucose (Table 10.2).

Underway samples (Table 10.3) for analysis by FACSort were drawn and preserved with 1% paraformaldehyde automatically from the ships underway supply system by a Tecan Miniprep 60 robot. Samples for analysis by Cytosense flow cytometer were taken automatically by the instrument from the ships underway supply system.

10.1 CTD Sampling

A list of CTD's sampled is provided below for cruises D285 and D286 in tabular form, along with total numbers of bacterioplankton and phytoplankton cells recorded. Data for total numbers of individuals within different populations have also been recorded. After station 15496, it was decided that samples should not be taken from depths greater than 200m, owing to low phytoplankton and bacterioplankton abundance at greater depths. Alterations in bottle firing sequence however denoted that some stations had to be sampled to a depth of 250m, in order to obtain data for depths greater than 175m. No data were recorded for Bacterioplankton at station 15496 due to an error in the preservation / SYBR Green staining procedure. Samples were not analysed from Niskin bottles 17 and 18 (150 and 125 m) at station 15513 as the bottles misfired. Niskin bottles 17 at station 15553, 20 at station 15584 and 20 at station 15587 were not sampled, as they were observed to be leaking.

10.2 Underway sampling

Underway Sampling on D285

FACSort underway sampling began before Station J, at 14:30 on day 314 (09/11/04). Continuous Cytosense sampling began at Station J, at 11:15 on day 316 (11/11/04). Underway samples were drawn continuously throughout the survey and the results of sampling were related to ships navigational data in order to compare large-scale variation in community structure whilst steaming, to small-scale variation whilst on station. Variations in sampling frequency, with reasons for alteration are outlined below.

As Cytosense sampling is automated and not labour intensive, regular sampling is possible. Cytosense sampling frequency was altered from 15 minutes to 10 minutes at 18:00 on day 321. The decision was made in order to increase the resolution of the survey to coincide with the SeaSoar survey. Such frequent sampling had not been undertaken previously owing to concerns about the stability of the laser under conditions of such regular use. As the instrument suffered no ill effects during increased sampling, at the end of the first Sea Soar survey it was decided not to revert to the original 15 minute sampling interval.

The FACSort autoloader equipment was not used during D285 or D286 in order to allow a greater volume of water to be analysed per phytoplankton sample, facilitated by an external syringe pump. As the manual analysis of FACSort samples is more labour intensive than Cytosense, an initial half hourly sampling frequency was selected for this instrument. A change in frequency to hourly sampling at 05:00 on day 317 occurred in

order to accommodate time for shipboard data analysis. Sampling was again increased to half hourly intervals, at the expense of data analysis time throughout the period of the first Sea Soar survey, commencing at 18:30 on day 320, and returning to hourly sampling at 18:00 on day 325. The final half hourly sampling period (19:30, day 335 until 19:00 day 336,) was undertaken during a sea soar survey, and was possible owing to a decrease in CTD sampling.

Underway Sampling on D286

Hourly sampling for FACSORT analysis (Table 10.4) began before Station J, at 09:00 on day 349 (2004) and was continued throughout the cruise. Sampling was discontinued after leaving the area of study on day 016 (2005) due to a recurrent sampling error caused by stormy seas.

Cytosense sampling at 10 minute intervals began at 07:30 on day 349 (2004), and continued until 07:30 on day 018 (2005).

Table 10.4 Underway sampling (D285)

	FACSORT	Cytosense
JULIAN DAY	Sampling Interval	Sampling Interval
314	30 minutes	
315	—	
316	—	15 minutes
317	60 minutes	—
318	—	—
319	—	—
320	30 minutes	—
321	—	10 minutes
322	—	—
323	—	—
324	—	—
325	60 minutes	—
326	—	—
327	—	—
328	—	—
329	—	—
330	—	—
331	—	—
332	—	—
333	—	—
334	—	—
335	30 minutes	—
336	60 minutes	—
337	—	—
338	—	—
339	—	—
340		

Table 10.1 CTD casts sampled for determination of microbial concentrations (D285)

Station number	Sample number	Location	Depth, m	Bacterioplankton, cells ml ⁻¹	Phytoplankton, cells ml ⁻¹
15496	49610	M3	175	-	1263.5
15496	49611	M3	150	-	1253.9
15496	49612	M3	100	-	3585.4
15496	49613	M3	63	-	3101.5
15496	49615	M3	42	-	3889.3
15496	49617	M3	27	-	3996.2
15496	49619	M3	15	-	3080.1
15496	49621	M3	10	-	3859.0
15500	50015		200	322421.9	817.2
15500	50016		150	390015.8	1349.0
15500	50017		100	650081.1	8301.5
15500	50018		80	711117.5	8973.4
15500	50019		60	707967.9	9337.8
15500	50020		40	701561.7	9869.6
15500	50021		20	725162.7	9866.6
15500	50022		10	685432.7	9418.2
15500	50023		5	664125.0	9797.3
15504	50415	M2	250	174159.6	151.2
15504	50417	M2	150	269463.2	338.5
15504	50418	M2	125	309019.4	585.6
15504	50419	M2	100	524356.2	4287.6
15504	50420	M2	80	586166.5	6538.6
15504	50421	M2	60	548153.6	7551.3
15504	50423	M2	10	485080.3	7108.8
15504	50424	M2	5	471555.9	6110.8
15506	50615		250	206309.7	76.0
15506	50616		175	290862.5	442.5
15506	50617		150	381075.0	1016.4
15506	50618		125	504856.2	2611.0
15506	50619		100	567639.6	4463.8
15506	50620		80	604824.8	6400.7
15506	50621		60	593926.7	10243.5
15506	50622		40	573268.5	10209.6
15506	50623		10	515849.9	7996.1
15507	50715	M6	250	338130.6	3212.9
15507	50716	M6	175	266545.5	630.6
15507	50717	M6	150	332052.9	1200.8
15507	50718	M6	125	423793.4	3770.5
15507	50719	M6	100	460979.5	6037.1
15507	50720	M6	80	448410.1	6979.7
15507	50721	M6	60	454198.1	7824.2
15507	50722	M6	40	444712.7	7723.9
15507	50723	M6	10	453311.3	7836.8
15507	50724	M6	5	429412.2	8069.9
15513	51315		250	202217.1	31.7

15513	51316		175	250051.8	147.5
15513	51319		100	514558.9	1290.8
15513	51320		80	703077.9	6728.2
15513	51321		60	734112.0	9736.8
15513	51322		40	693734.5	10438.2
15513	51323		10	679751.6	10341.6
15513	51324		5	689808.6	10034.8
15518	51814	M3	175	415742.9	841.6
15518	51815	M3	150	465082.6	1034.1
15518	51816	M3	125	609469.7	1579.9
15518	51817	M3	100	806595.3	3134.7
15518	51818	M3	80	783775.3	3676.8
15518	51819	M3	60	869325.9	7706.2
15518	51820	M3	40	958844.0	13072.1
15518	51822	M3	20	861064.9	12937.2
15518	51823	M3	10	905178.4	13550.8
15518	51824	M3	5	862545.5	13053.7
15520	52014		200	133859.5	-
15520	52015		150	274151.5	392.4
15520	52016		100	311132.6	183.7
15520	52017		80	513702.6	455.8
15520	52018		60	939997.3	5981.0
15520	52019		40	1069343.6	10877.8
15520	52021		20	1043742.5	11057.1
15520	52022		10	1067890.0	10245.7
15520	52023		5	1084795.7	8167.2
15525	52513		200	229002.7	132.8
15525	52514		175	223623.6	126.1
15525	52515		150	221577.1	159.3
15525	52516		125	282176.8	165.2
15525	52517		100	306762.6	242.7
15525	52518		80	390308.2	465.4
15525	52519		60	886959.8	1058.4
15525	52520		40	984991.9	4367.2
15525	52522		20	1003248.5	3530.1
15525	52523		10	1017862.0	3949.7
15525	52524		5	1010067.2	4165.9
15527	52713		200	238569.5	218.3
15527	52714		175	239174.0	255.2
15527	52715		150	276214.2	216.1
15527	52716		125	300107.4	238.2
15527	52717		100	403577.9	579.7
15527	52718		80	703867.9	1504.7
15527	52719		60	757836.9	2730.5
15527	52720		40	838048.8	9126.1
15527	52722		20	833545.9	10306.9
15527	52723		10	805022.3	9479.4
15527	52724		5	907870.2	9385.7
15528	528013		200	194140.9	103.3

15528	528014		175	203425.0	125.4
15528	528015		150	199341.5	184.4
15528	528016		125	239333.8	354.8
15528	528017		100	444496.9	1419.1
15528	528018		80	517133.6	3437.9
15528	528019		60	537803.8	7740.9
15528	528020		40	513439.0	9212.4
15528	528022		20	529401.0	9199.1
15528	528023		10	500341.2	9365.8
15528	528024		5	550373.6	9348.1
15532	532013	M8E	200	272612.8	90.7
15532	532014	M8E	175	267731.6	115.8
15532	532015	M8E	150	317977.6	180.7
15532	532016	M8E	125	398742.2	384.3
15532	532017	M8E	100	445880.1	648.3
15532	532018	M8E	80	908040.4	9960.3
15532	532019	M8E	60	1303883.7	13131.9
15532	532020	M8E	40	1091786.3	15135.9
15532	532022	M8E	20	1002901.3	19192.6
15532	532023	M8E	10	935027.9	20588.9
15532	532024	M8E	5	907804.5	20854.3
15539	53903	M8W	200	250263.615	199.1465603
15539	53905	M8W	175	320236.686	196.1962409
15539	53907	M8W	150	380371.429	242.6637717
15539	53910	M8W	125	440864.458	469.8383664
15539	53912	M8W	100	642734.043	598.9148407
15539	53913	M8W	80	656034.173	943.3646321
15539	53915	M8W	60	968269.494	2400.084842
15539	53917	M8W	40	930684.34	2286.497545
15539	53920	M8W	20	798626.374	6144.040176
15539	53922	M8W	10	790073.703	4640.114856
15540	54003	M8W	200	297493.348	387.9670027
15540	54005	M8W	175	306407.388	268.4790665
15540	54007	M8W	150	336406.883	380.5912042
15540	54009	M8W	125	451605.456	678.5734648
15540	54011	M8W	100	532140.575	814.2881578
15540	54013	M8W	80	677824.17	1005.32134
15540	54015	M8W	60	896258.152	2400.084842
15540	54017	M8W	40	787162.442	3554.397312
15540	54020	M8W	20	781771.654	3294.769204
15540	54022	M8W	10	815338.583	4151.836993
15544	54413	M9	200	212699.443	267.7414867
15544	54414	M9	175	479114.286	3578.737447
15544	54415	M9	150	216193.439	469.1007866
15544	54416	M9	125	263454.545	673.4104059
15544	54417	M9	100	330008.451	1862.389129
15544	54418	M9	80	479941.292	2593.330763
15544	54419	M9	60	768498.516	8476.267672
15544	54420	M9	40	560503.125	9379.802992

15544	54422	M9	20	577814.371	6506.191884
15544	54423	M9	10	490977.509	3628.155297
15544	54424	M9	5	542333.966	6938.413678
15546	54616		200	181704	276.5924449
15546	54617		150	202428.872	342.2370518
15546	54618		100	336504.215	1006.796499
15546	54619		80	415206.677	1500.237421
15546	54620		60	443282.881	1817.396758
15546	54621		40	680643.402	6461.937093
15546	54622		20	711309.524	3515.30558
15546	54623		10	570949.926	4835.573517
15546	54624		5	609635.711	5187.399107
15547	54714		200	213548.896	275.1172852
15547	54715		150	257746.154	411.569558
15547	54716		100	454521.531	1545.967372
15547	54717		80	707735.849	3689.374425
15547	54718		60	957418.033	7544.704317
15547	54719		40	1279959.48	14632.84671
15547	54721		20	1286971.9	16175.12618
15547	54722		10	1283424.34	15854.27894
15547	54723		5	1332864.16	15085.72073

Table 10.2 CTD casts sampled for determination of microbial concentrations (D286)

Station number	Sample number	Location	Depth, m	Bacterioplankton cells ml ⁻¹	Phytoplankton cells ml ⁻¹
15553	55314	M9	200	303180.3797	350
15553	55315	M9	175	333712.6246	202
15553	55316	M9	150	409409.7421	300
15553	55318	M9	100	515811.8406	1568
15553	55319	M9	80	604910.1628	5721
15553	55320	M9	60	651024.5902	10804
15553	55321	M9	40	468089.3884	16244
15553	55322	M9	20	634266.6667	12453
15553	55323	M9	10	738499.7196	11329
15553	55324	M9	5	757395.8333	11126
15556	55612		200	219603.9067	359
15556	55613		150	311295.2799	791
15556	55614		100	364903.0234	761
15556	55615		80	496508.8235	6243
15556	55616		60	733258.2322	29453
15556	55617		40	958015.2225	27127
15556	55618		20	1008264.868	29946
15556	55621		10	998963.3081	30080
15556	55623		5	987460.733	30177
15557	55714		200	256447.5874	401
15557	55715		175	307675.0142	349
15557	55716		150	362430.4009	316

15557	55718		100	476592.0398	903
15557	55719		80	548361.2233	2000
15557	55720		60	766061.7978	14347
15557	55721		40	943485.0993	31059
15557	55722		20	981378.0207	32070
15557	55723		10	973566.3717	31630
15557	55724		5	917551.0204	30720
15562	56214	M10	200	210498.3389	220
15562	56215	M10	175	250332.9298	258
15562	56216	M10	150	293606.5574	285
15562	56217	M10	125	366017.2911	457
15562	56218	M10	100	436115.6304	936
15562	56219	M10	80	483840.4133	1375
15562	56220	M10	60	560745.0524	8612
15562	56221	M10	40	860150.289	18453
15562	56222	M10	20	909050.2793	15168
15562	56223	M10	10	891000	15218
15562	56224	M10	5	809240.7199	14648
15565	56514		200	206324.2009	124
15565	56515		150	252901.3255	205
15565	56516		125	298903.7571	328
15565	56517		100	353191.0995	494
15565	56518		80	427679.4616	447
15565	56519		60	586793.9481	9193
15565	56520		40	574156.9027	2878
15565	56521		20	730178.8413	23211
15565	56523		10	723863.7532	23331
15565	56524		5	769766.9492	23346
15566	56610		85	28517	3908
15566	56611		75	23367	5762
15570	57008		200	276802.0441	641
15570	57009		150	503558.5831	903
15570	57019		100	493370.0138	3082
15570	57020		80	700203.8627	5445
15570	57021		60	693619.8738	6994
15570	57022		40	632756.0473	6096
15570	57023		20	619927.4611	6206
15570	57024		10	608351.735	5921
15573	57317	M3	250	228840	164
15573	57318	M3	125	470511.9543	414
15573	57319	M3	100	565301.8868	1026
15573	57320	M3	80	696503.3872	2919
15573	57321	M3	60	925895.5614	6770
15573	57322	M3	40	1381483.771	30017
15573	57323	M3	20	1362712.902	30102
15573	57324	M3	10	1301276.488	30918
15576	57616		200	157287.2076	265
15576	57617		150	228840	583
15576	57618		100	470511.9543	561

15576	57619		80	565301.8868	4605
15576	57620		60	696503.3872	21724
15576	57621		40	925895.5614	20008
15576	57622		20	1381483.771	22088
15576	57623		10	1362712.902	22186
15576	57624		5	1301276.488	22258
15582	58216	M5	200	158329.1833	110
15582	58217	M5	150	222732.2134	221
15582	58218	M5	100	411097.0677	3294
15582	58219	M5	80	368183.8454	13500
15582	58220	M5	60	482338.0567	15167
15582	58221	M5	40	467212.8784	17416
15582	58222	M5	20	492835.277	22601
15582	58223	M5	10	498591.8675	22337
15582	58224	M5	5	555494.5055	23018
15584	58415		200	152876.8963	215
15584	58416		150	189695.1626	199
15584	58417		125	280827.8633	474
15584	58418		100	338736.9036	1578
15584	58419		80	500518.5615	9308
15584	58421		40	464627.1641	18870
15584	58422		20	460901.5002	19001
15584	58423		10	452342.9251	19229
15584	58424		5	496074.104	18652
15585	58515		200	156409.0279	19102
15585	58516		150	195581.7139	14830
15585	58517		125	229077.1043	34214
15585	58518		100	384376.4495	361085
15585	58519		80	462463.8408	574301
15585	58520		60	494944.9359	701189
15585	58521		40	481425.1247	596918
15585	58522		20	488347.6155	531042
15585	58523		10	491196.2839	424893
15585	58524		5	502340.7516	434796
15586	58615		200	104343.5157	104
15586	58616		150	114547.2742	136
15586	58617		125	398108.6517	947
15586	58618		100	304112.0008	1643
15586	58619		80	326274.3196	4948
15586	58620		60	309804.3535	7800
15586	58621		40	241988.5865	6601
15586	58622		20	233829.7296	6935
15586	58623		10	207224.9402	6265
15586	58624		5	230615.9699	6282
15587	58715		200	101742.3021	326
15587	58716		150	152986.111	292
15587	58717		125	245097.5692	652
15587	58718		100	256274.7739	1013
15587	58719		80	264686.9471	2519

15587	58721		40	306142.9061	4158
15587	58722		20	316634.8141	4662
15587	58723		10	282215.5552	4157
15587	58724		5	278935.5597	3899
15589	58913	M3	200	149014.1603	442
15589	58914	M3	150	191026.2097	912
15589	58915	M3	125	212282.4095	1483
15589	58916	M3	100	244689.3224	4145
15589	58917	M3	80	281575.4127	5926
15589	58918	M3	60	298014.9503	7433
15589	58920	M3	40	287209.9525	7497
15589	58921	M3	20	268788.3293	7205
15589	58922	M3	10	268429.7621	7141
15589	58924	M3	5	248671.1179	7447
15596	59616	M6	200	309603.253	111
15596	59617	M6	150	189456.7789	162
15596	59618	M6	100	438621.0851	984
15596	59619	M6	80	576502.5673	1827
15596	59620	M6	60	511321.0753	5894
15596	59621	M6	40	526448.4955	5755
15596	59622	M6	20	525612.027	5537
15596	59623	M6	10	529247.7445	6825
15596	59624	M6	5	514644.3124	6061
15600	60001	M6	40	608957.0174	8048
15600	60003	M6	40	580988.9394	8579
15600	60005	M6	40	585454.5818	8845
15600	60007	M6	40	572608.2454	8063
15600	60009	M6	40	589426.0569	8280
15600	60011	M6	40	520998.752	6644
15600	60013	M6	40	586575.008	7906
15600	60015	M6	40	615492.5037	8898
15600	60017	M6	40	618054.8828	7361
15600	60019	M6	40	613641.5933	10047
15600	60021	M6	40	543808.3496	18668
15600	60023	M6	40	580921.2316	8720
15606	60615	M2	200	146204.1152	86
15606	60616	M2	150	203275.2881	327
15606	60617	M2	125	319191.8149	693
15606	60618	M2	100	460344.654	1710
15606	60619	M2	80	582554.7977	3144
15606	60620	M2	60	602837.8819	10259
15606	60621	M2	40	466222.1806	9210
15606	60622	M2	20	490558.9195	9726
15606	60623	M2	10	429511.0905	8951
15606	60624	M2	5	413978.6699	8345
15614	61411		200	138229.5767	284
15614	61412		150	126556.9984	706
15614	61413		125	160024.8337	696
15614	61414		100	184350.0753	1353

15614	61415		80	249259.3742	2653
15614	61416		70	325011.8506	3108
15614	61417		60	272521.6361	3727
15614	61418		50	300197.1041	5819
15614	61419		40	304985.1509	6400
15614	61420		30	323715.2918	11396
15614	61421		20	420242.8395	28123
15614	61423		10	469962.8015	28651
15614	61424		5	475327.9529	29636
15620	62006		200	212144.511	963
15620	62008		150	244335.2086	665
15620	62011		100	294660.9932	683
15620	62013		80	335390.4966	1245
15620	62015		60	383198.9085	1598
15620	62016		50	423818.3949	2052
15620	62018		40	464690.7676	2856
15620	62021		20	639834.1801	14312
15620	62023		10	776934.2022	14955
15623	62305		200	235415.1783	621
15623	62306		200	248251.0107	594
15623	62307		150	282872.4447	882
15623	62308		125	306083.4859	1644
15623	62309		100	391160.1868	1198
15623	62310		100	398006.1751	1220
15623	62311		80	435399.0748	3125
15623	62312		80	436729.0046	3346
15623	62313		60	452626.9723	9990
15623	62314		60	496505.6876	11247
15623	62315		50	415782.0492	20473
15623	62316		50	421805.2635	20653
15623	62317		40	399762.4001	23631
15623	62318		40	419643.0893	23001
15623	62319		20	399732.2	22538
15623	62320		20	409047.5532	23072
15623	62321		10	376594.7396	24020
15623	62322		10	369754.9893	24028
15623	62323		5	399606.1104	21677
15623	62324		5	392038.1816	23955
15628	62815		200	175113.8502	240
15628	62816		150	232516.3028	319
15628	62817		125	247649.8784	401
15628	62818		100	337004.5212	527
15628	62819		80	318960.5823	786
15628	62820		60	419707.6935	1449
15628	62821		40	589355.3759	6053
15628	62822		20	751350.2507	14867
15628	62823		10	674827.8026	15307
15628	62824		5	697764.8101	16140
15632	63215		200	137348.7825	108

15632	63216		150	155119.6896	163
15632	63217		125	166874.9645	257
15632	63218		100	214516.4907	651
15632	63219		80	201091.58	1079
15632	63220		60	268095.9711	2462
15632	63221		40	418552.2164	5370
15632	63222		20	345175.8866	19199
15632	63223		10	352913.2299	19187
15632	63224		5	447270.0641	20005

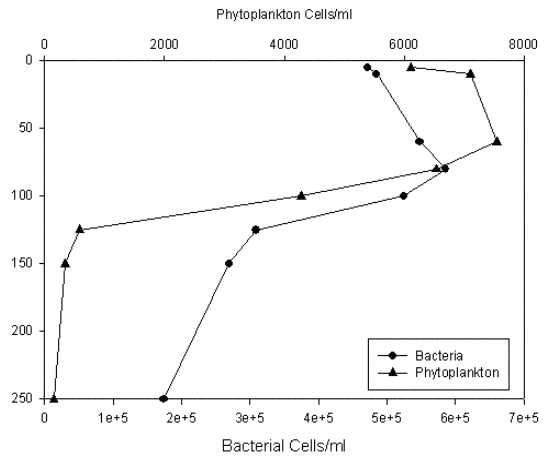
Table 10.3 CTD casts sampled for nutrient dynamic experiments

Date	CTD	Lat, °S	Long, °E
11-Nov	15491	43.92	50.23
13-Nov	15496	46.07	51.79
18-Nov	15499	46.03	51.81
19-Nov	15502	47.80	52.86
23-Nov	15511	49.00	51.50
24-Nov	15516	46.06	51.79
27-Nov	15524	45.49	49.00
30-Nov	15531	44.92	49.90
2-Dec	15537	44.87	49.66
4-Dec	15543	43.12	47.18

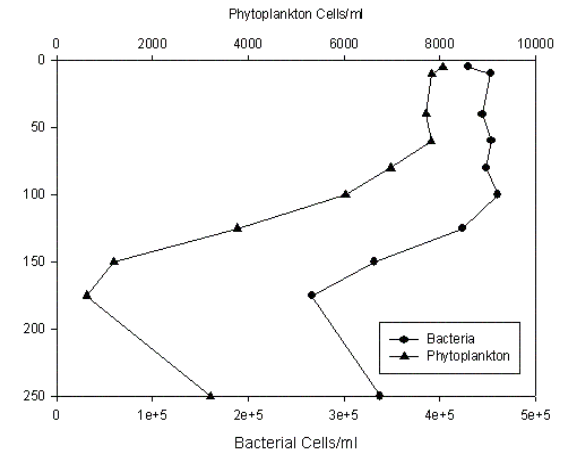
Appendix:

Plots of Raw CTD FC Data for Major Stations Sampled

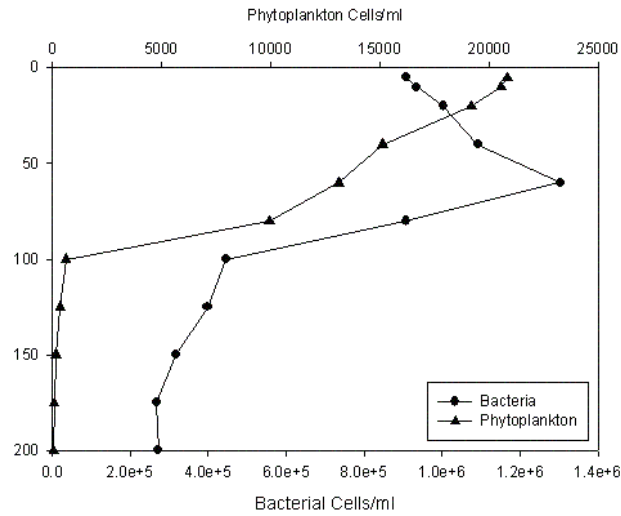
Bacteria and Phytoplankton Cell Counts at Station 15504 (M2)



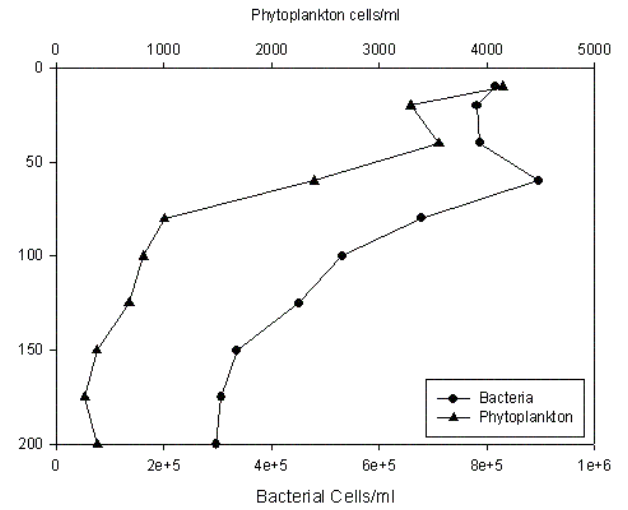
Bacterial and Phytoplankton Cell Counts/ml at Station 15507 (M6)



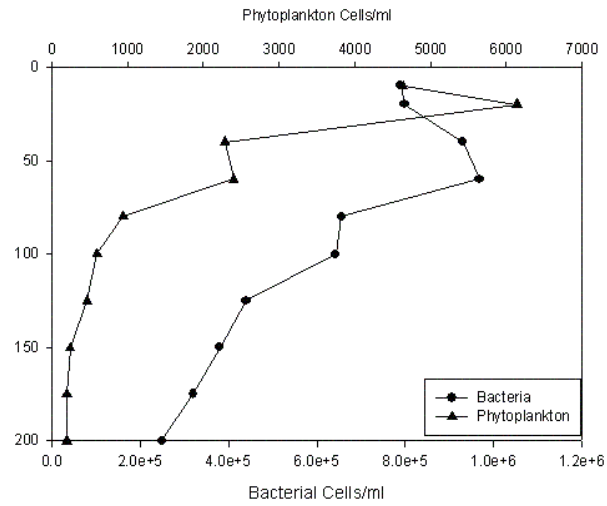
Bacterial and Phytoplankton Cells/ml at Station 15532 (M8 East)



Bacterial and Phytoplankton Cells/ml at Station 15540 (M8 West)



Bacterial and Phytoplankton Cells/ml at Station 15539 (M8 West)



Bacterial and Phytoplankton Cells/ml at Station 15544 (M9)

