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Effects of Simulated Sediment Resuspension Events on the Abundance of Water Column Bacteria of Tomales Bay, California

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EFFECTS OF SIMULATED SEDIMENT RESUSPENSION EVENTS ON THE ABUNDANCE OF WATER COLUMN BACTERIA OF TOMALES BAY, CALIFORNIA

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Christopher J.Collumb

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APPROVAL SHEET

This thesis is submitted in partial fulfillment of
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ABSTRACT

Past studies have shown large increases in free living bacterial numbers following a sediment resuspension event. This study simulated, through a series of experiments, the effects of resuspension events on the abundance of water column bacteria with a purpose of determining the controls on the bacterial population during a resuspension event. Postulated causes for these increases include, nutrient release, bacterial release, and simple movement of the sediment, which stimulates attached bacterial growth. In this study, various resuspension effects were simulated in microcosms. Treatment 1 contained an undisturbed sediment core, treatment 2 was resuspended sediment, treatment 3 was an addition of whole pore water, treatment 4 was an addition of 0.22 μm filtered pore water, and treatment 5 was the untreated control. Bacterial counts were the highest in those treatments enriched with whole pore water. A significant ($R^2 > .975$) linear increase in concentrations of NO_2^-, NO_3^-, NH_4^+, PO_4^{-3}, and Si occurred as an increasing volume of pore water was added to stock bay water. This nutrient increase alone can not account for the higher bacterial abundance. Bay water with a 0.22 μm filtered pore water addition, while producing a greater abundance than untreated water, did not have bacterial counts as high as the whole pore water treatments. Thus, the release of bacteria from the sediment enhanced the effect of the nutrient release on the numbers of bacteria in the water column after a resuspension event.

EFFECTS OF SIMULATED SEDIMENT RESUSPENSION EVENTS ON THE ABUNDANCE OF WATER COLUMN BACTERIA OF TOMALES BAY, CALIFORNIA

INTRODUCTION

The importance of oceanic free living bacteria has become known only recently. Previously, methodological limitations led to under-estimation of bacterial densities and consequently their potential importance. This perception was changed with the widespread use of epifluorescence microscopy for direct counting in the 1970's. Previous estimates of the oceanic bacteria by cultural methods were found to be low by two orders of magnitude (Williams 1984; Capriulo 1990). Bacteria originally thought to be unimportant due to their relatively low numbers, were now realized to be the most numerous of the oceanic organisms, their numbers ranging from 0.5 to tens of millions per milliliter, and their biomass a significant portion of the total oceanic biomass (Gray et al. 1984; Sherr et al. 1986; Capriulo 1990).

Once their numbers were known, it was not long before their important roles in the trophodynamics of oceanic food webs were discovered. Bacteria are a significant food source for protists. This discovery of bacterivory by microplankton established an important link in the microbial food web (Pomeroy 1974; Azam et al. 1983; Sherr et al. 1986). The photosynthetic coccoid cyanobacteria are responsible for 5 - 30% of the oceans primary productivity (Van - Es & Meyer - Reil 1982; Williams 1984). Heterotrophic bacteria consume 10 - 60% of the dissolved organic matter released by other organisms (Fuhrman & Azam 1982; Linely et al., 1983; Williams 1984; Fuhrman et al. 1985; Sherr et al. 1986). Thus DOM, that was thought lost to higher trophic levels, is returned to the higher organisms through a complex food web involving the bacteria (Pomeroy 1974; Azam et al. 1983; Sherr et al. 1986) to the extent that it isn't respired by this link.

Factors controlling bacterial populations have been the subject of many recent papers. Since bacteria can replicate over short time intervals, (i.e., doubling times of hours to a few days), mechanisms of regulating the productivity and biomass of the bacterial community must exist. The availability of resources (bottom-up control) and grazing by predators (top-down control) have been considered the main controls on bacterial abundance and community structure (McQueen 1986; Pace & Cole 1994). The limiting resources for bacteria typically are labile carbon, inorganic and organic nitrogen and phosphorus. Bacteria can obtain these resources from primary producers, allocthonous loading, nutrient recycling, and from feeding, excretion and egestion by consumers (Pace & Cole 1994). Top-down control can be in the form of direct grazing by predators or by the way in which a higher trophic level organism structures the ecosystem (Carpenter et al. 1985). More recently other factors have been considered as important in controlling bacterial populations. Viral produced lysis and temperature have been shown to affect the bacterial community (Fuhrman & Suttle 1993; Pace & Cole 1994; Shiah & Ducklow 1994 & 1995).

Bacteria, however, do not reside only in the water column. Oceanic and estuarine sediments make up an extensive habitat with a higher microbial concentration than the water column above (Fenchel 1987). Microbial densities in surface sediments are 2 or 3 orders of magnitude higher than typical water column populations (Dale 1974; Meyer - Reil 1981; Fanning et al. 1982; Wainright 1987).

The boundary layer between the water column and the benthos serves to concentrate not only microorganisms, but carbon and other nutrients settling from the euphotic zone (Williams 1984; Kemp 1988; Capriulo 1990). Thus, the sediment may act as a sink for particulate matter from the water column. The settling of detritus, fecal pellets, plankton, etc. all contribute to the nutrient content of sediments. While some of

this organic matter is buried and lost from the overlying water column, a large portion of the nutrients in the sedimentary material is remineralized and released back into the water column (Hartwig 1976 a&b; Roman 1978; Roman and Tenore 1978). Diffusion, biological activity, and resuspension all play a role in releasing the nutrients to the overlying water (Hartwig 1976 a&b; Walker 1981). These releases have typically been studied in shallow water systems. Sampling is easier in such areas, and it is only in shallow, well mixed areas that such releases can effect the entire water column.

Diffusion is a continual process of nutrient flux along a gradient. In almost every area studied, the diffusive gradient would force dissolved nutrients out of the sediment. However this flux is not always significant. In certain areas, other biological and physical factors can override the diffusive flux out of the sediment, and may cause a net influx of certain dissolved nutrients into the sediment. Ullman and Aller (1989) observed in Saginaw Bay, Lake Huron, that phosphate has at times a net flux into the sediment. In other areas the net flux of dissolved nutrients out of the sediment is an insignificant source of nutrients into the water column (Pomeroy et al. 1965). In some areas of nutrient rich sediments, the diffusive rate can significantly enrich the overlying water column (McCaffery et al. 1980). The importance of diffusion in nutrient enrichment of the water column is dependent on the area being studied and can often be overwhelmed by other factors.

Bioturbation acts to mix sediments and may increase sediment resuspension, thereby playing a role in creating nutrient fluxes which can be orders of magnitude larger than those caused by diffusion alone. Sediment resuspension by feeding, movement of animals, and bioirrigation can inject significant quantities of sediment into the water column, releasing nutrient enriched interstitial water and particulate matter (Pomeroy et al. 1965; McCaffery et al. 1980; Fanning et al. 1982; Aller, 1984; Davies 1984; Havens

1991). Although these resuspension events are small scale (cm's to meters), sufficient numbers of them occur at regular intervals to act as a significant source of nutrients to the water column in shallow waters (McCaffery et al. 1980; Aller, 1988; Havens 1991).

Biological processes, however, are not the only source of resuspension events. Storms and tides can cause large scale sediment disturbances. A storm event can keep sediment suspended for several days and inject an enormous amount of nutrients into the water column (Bothner et al. 1981). While tidal resuspension events are shorter and typically resuspend a smaller amount of sediment, they occur much more regularly than storm events. Thus tides are considered the major resuspension factor in certain shallow water areas (Allen et al. 1980). However, since tidal resuspension occurs so often, the continually resuspended sediments can become depleted of nutrients. Only a minimal nutrient release might occur each tidal cycle (Hellstrom 1991). This is not always the case, in certain areas tidal resuspensions cause a significant nutrient release with every tidal cycle (Tenore 1977; Roman 1978).

There has been much work done dealing with the flux of nutrients in and out of sediments. In some cases the nutrient release from sediment is insignificant compared to the nutrient content of the surrounding water. In Bowling Green Bay, Australia, for example, resuspension of 1 cm of sediment increased phosphate levels by only 3.5 - 5 % and silica by only 0.3 - 0.5 % (Ullman & Sandstrom 1987). And in the Santa Barbara Basin, California only 0.4 % of the nitrogen present is supplied by sediment release (Hartwig 1976 b). In other cases the nutrient release from the sediment is the major source of nutrients for the water column. In Narragansett Bay, Rhode Island, ammonium levels in the pore water are 10 times higher than in the overlying water. Sediment phosphate levels are 20 - 70 times higher and silica is 35 times higher than the overlying water column levels. This nutrient rich interstitial water can supply up to 80 % of the

nutrients entering the bay (McCaffery et al. 1980). In 10 cm of Doboy Sound, Georgia, sediment there is enough phosphate to replace that in the overlying water 25 times (Pomeroy et al. 1965).

Although the importance of the sediment as a source of nutrients has been known for many years, very few studies have been done to analyze the effects of the nutrient fluxes on the biological populations in the water column (Wainright 1990). The amount of nutrients released by some resuspension events are several times more than the bacteria and phytoplankton populations in the water column require for maximal growth (Pomeroy et al. 1965; Hartwig 1976 a&b; Fanning et al. 1982). The sudden "flood" of nutrients associated with a resuspension event would undoubtedly have some effect on the microbial populations. Nutrient limited bacteria and other plankton can react quickly to this brief period of plenty. Thus, measurable blooms of these microorganisms can often be found after a resuspension event (Wainright 1987). Even small resuspensions such as those caused by fish can cause an increase in plankton populations in the water column (Havens 1991). Storms and other large scale events can cause even larger blooms (Roman & Tenore 1978; Fanning et al. 1982).

Since bacterial populations in the surface sediments are themselves two or three orders of magnitude more concentrated than typical water column populations (Dale 1974; Meyer - Reil 1981; Fanning et al. 1982; Wainright 1987), this larger population, if released through some disturbance to the water column, could cause an increase in the microbial population. Thus, bacterial as well as nutrient release are theorized to be major factors in the bacterial bloom that follows many resuspension events (Fanning et al. 1982, Wainright 1987, 1990).

The purpose of my study was to determine the effects certain factors of a resuspension event would have on water column bacterial populations. Several causes

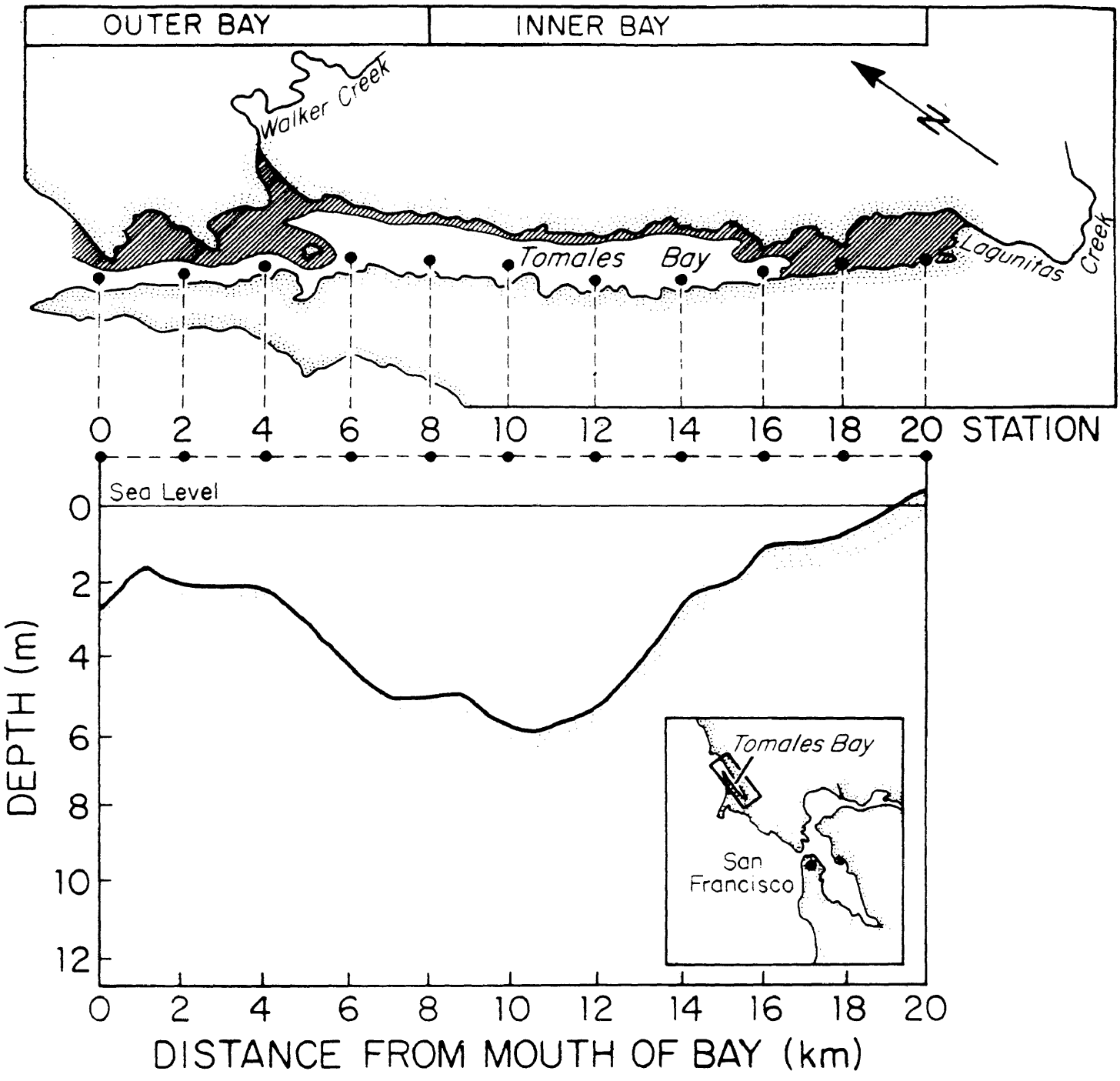
for the increase in bacterial numbers following the resuspension of sediment have been put forward including, nutrient release, bacteria release, and simple movement of the sediment which stimulates attached bacterial growth (Fanning et al. 1982, Findlay et al. 1985, Wainright 1987, 1990). No study has yet tried to determine the relative contribution each of the various resuspension elements have on bacterial numbers. In this study the relative importance of selected elements was measured by progressive exclusion of these elements during simulated resuspension events in microcosms containing Tomales Bay water. Replicate microcosms received the following treatments: Treatment 1 contained an undisturbed sediment core which would isolate a host of benthic effects, such as diffusion, biological pumping, and physical trapping; treatment 2 contained only resuspended sediment to simulate four proposed causes of the post-resuspension event, i. e. increase in bacterial numbers, nutrient release, bacterial release, and sediment movement, isolated from the other benthic effects; treatment 3 was the addition of whole pore water containing nutrients and bacteria without any associated physical sediment effects; treatment 4 was the addition of 0.22 μm filtered pore water to increase nutrient levels without adding bacteria or sediment; treatment 5 was the untreated control.

METHODS AND MATERIALS

SITE DESCRIPTION:

All of the experiments were run at the Land Margin Ecosystem Research: Biogeochemical Research in Estuaries (LMER: BRIE) lab in Marshall, California on Tomales Bay. Tomales Bay is an embayment 20 km long and 1.4 km wide, formed at the intersection of the rift valley of the San Andreas fault and the Pacific Ocean (Fig. 1). The average depth of the bay is 3.1 m, with a maximum depth of 19 m. The watershed of Tomales Bay is 561 km^2. The population in this area is only 11,000 people. Thus, development of the watershed area has not been extensive. The bay has only two major inflows of fresh water (Lagunitas and Walker Creeks) and is a well mixed-estuary year round. Tomales Bay is net heterotrophic. Unlike most estuarine areas, Tomales Bay has a net import of nitrogen and is thought to receive N from tidal inputs from the ocean (Smith & Hollibaugh 1990). Bacterial growth has been measured at the various stations using the thymidine incorporation technique (Fuhrman and Azam, 1982). While the rates varied throughout the year, doubling time was on the order of hours (5 to 60) (Hollibaugh personal communication) and ranged from 14 to 50 hours for the stations I sampled. These doubling times would allow quick, measurable responses to the changing conditions in the various experimental treatments used in this thesis.

Figure 1. Tomales Bay in Northern California. Station designations correspond to distance in km from the mouth of the bay.


OUTER BAY
INNER BAY
Walker Creek
Tomales Bay
Lagunitas Creek
0 2 4 6 8 10 12 14 16 18 20 STATION
Sea Level
DEPTH (m)
0 2 4 6 8 10 12
Tomales Bay
San Francisco
0 2 4 6 8 10 12 14 16 18 20
DISTANCE FROM MOUTH OF BAY (km)

SEDIMENT RESUSPENSION EXPERIMENT

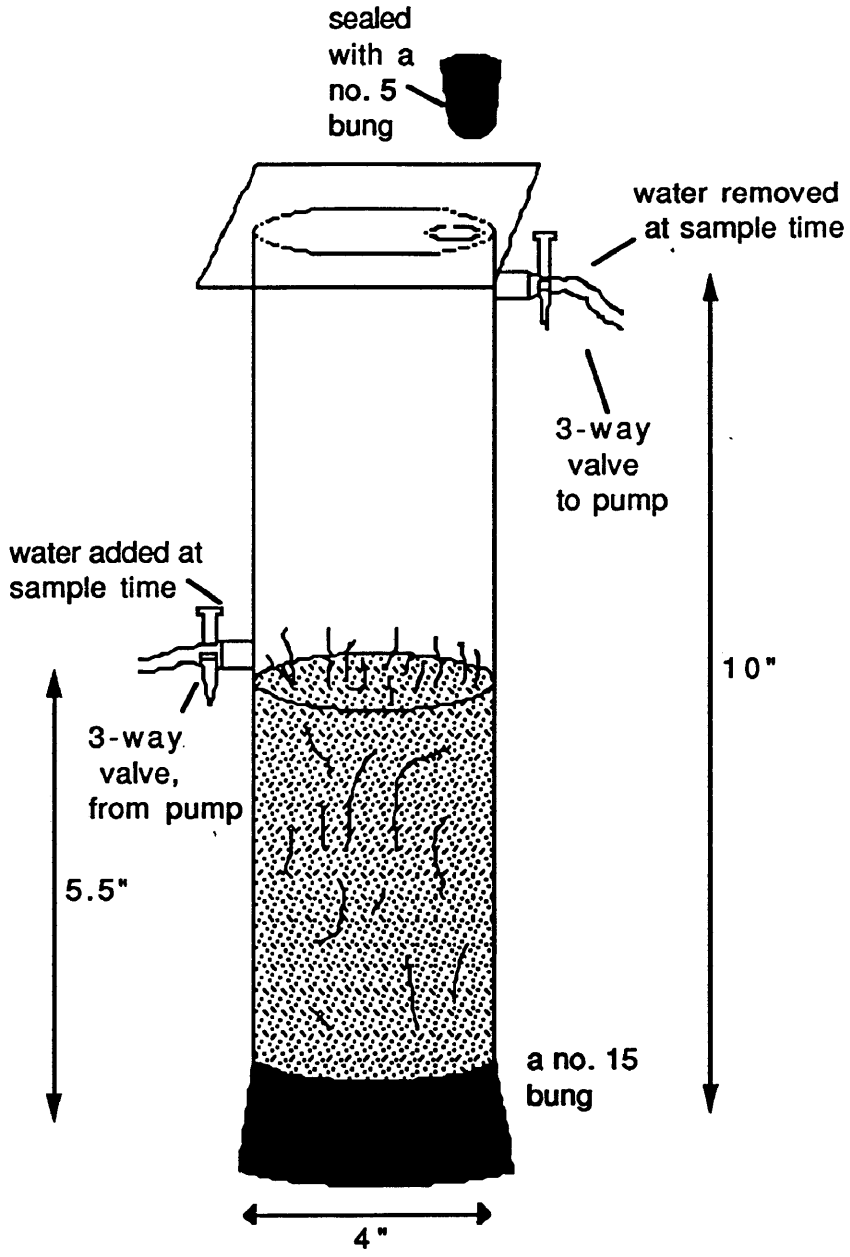
The first experiment was started September 9, 1993 and consisted of 5 incubation chambers. These chambers were made by Jim Fourqurean (See Fig. 2 for exact specifications). Each chamber system held a total volume of 955 ml. A separate treatment was run in each microcosm (Fig. 3). Stock water was obtained from the Tomales Oyster Company boat ramp, located 10 km from the mouth of the bay, by filling a five gallon carboy. This stock water was used in all of the treatments to standardize the starting bacterial population. The first treatment (T-1) consisted of an undisturbed sediment core about 14 cm thick overlaid by approximately 380 ml of bay water. The core was obtained by divers using the chamber itself as the core tube. The cores were taken 8 km from the mouth of the bay at Cypress Grove (station 08). At the LMER: BRIE lab, the in situ water was drained off and stock water was slowly added to fill the chamber. The water was added at a slow rate to minimize the sediment disturbance.

The second treatment (T-2) consisted of stock bay water to which the top 1 cm of a sediment core was added. The core was obtained by divers at station 08 using core tubes the same diameter as the incubation chambers. At the laboratory the top centimeter of the core was removed and placed in an incubation chamber. The chamber was filled with 900 ml of stock bay water and shaken until the sediment appeared uniformly suspended. After the first sample time the water was drained into a new incubation chamber to isolate it from the settled sediment.

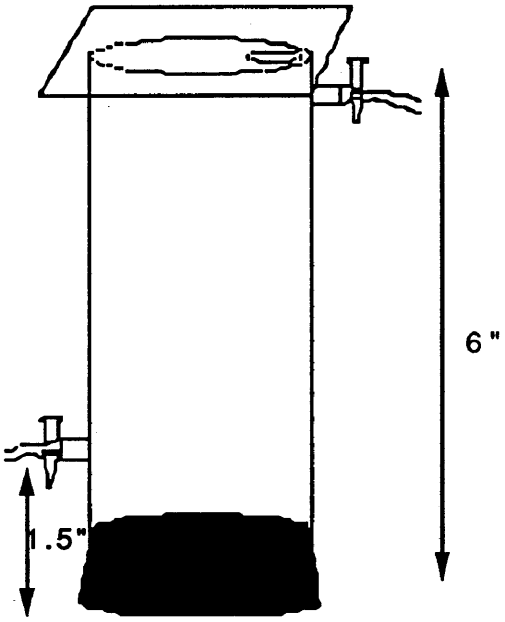
The third treatment (T-3) consisted of 910 ml of stock bay water to which 45 ml of pore water was added (45 ml is the estimated amount of pore water contained in the top centimeter of the core from the second treatment). Pore water was obtained from cores taken from station 08. Sediment from the top 1 cm of the cores was placed

Figure 2. Incubation chamber diagram. Jim Fourqurean's chambers were used for all the treatments in experiments 1 and 2. The core chamber held the undisturbed core T-1 for experiments 3 through 6. The water chamber held T-2 through T-5 for experiments 3 through 6 and all the treatments for experiment 7.

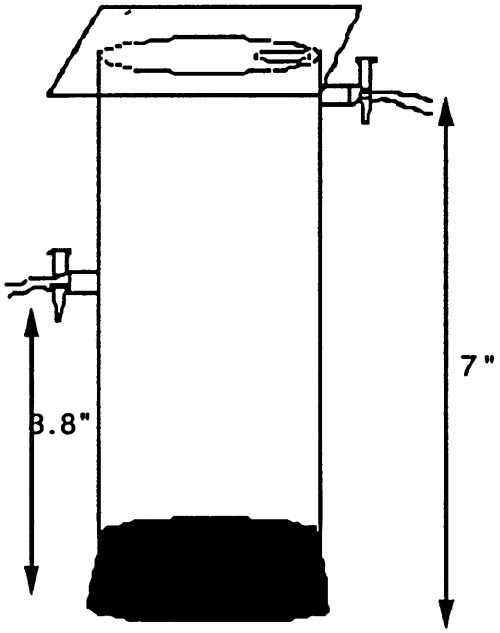
Incubation Chamber Diagram



Core Chamber
Exp. 3, 4, 5 & 6



Water Chamber
Exp 3, 4,
5, 6 &7

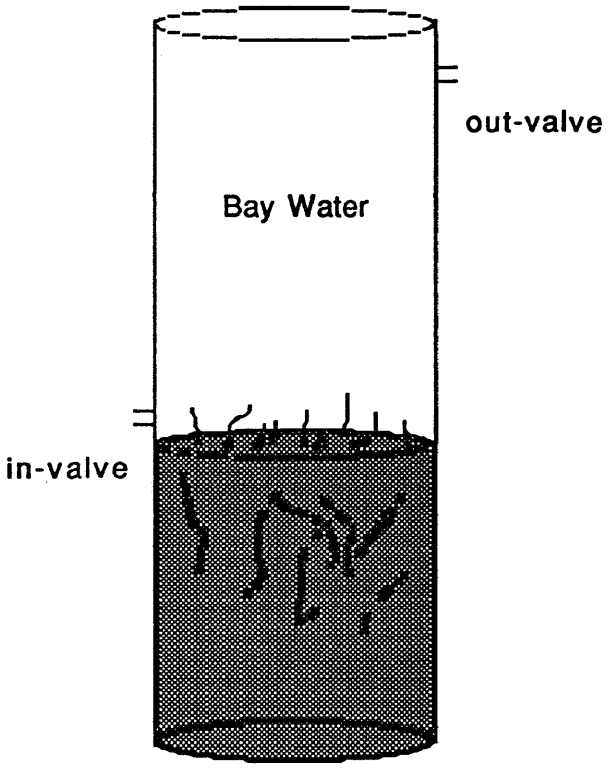


Jim Fourqurean
Chamber
Exp1 &2

Figure 3. Diagram of the five treatments used in experiments 1 through 4. For experiment 1 and 2, only one replicate was run. For experiments 3 and 4, two replicates were run.

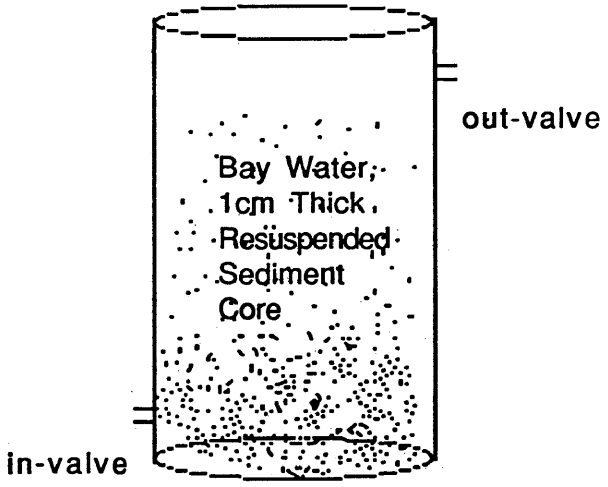
Sediment Resuspension Experiment

For experiments 1&2, one experimental set.
For experiment 3&4, two experimental sets.



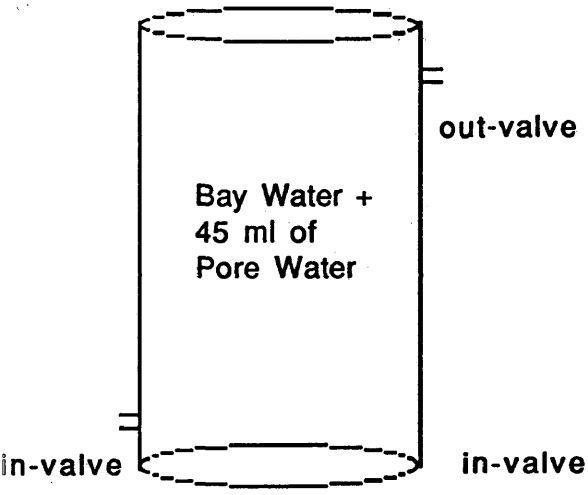
Sediment Core

T-1



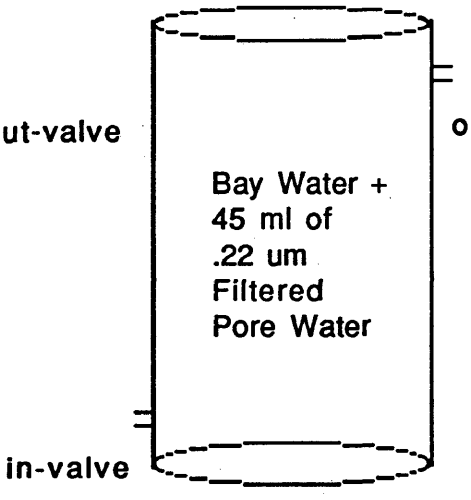
Resuspended Sediment

T-2



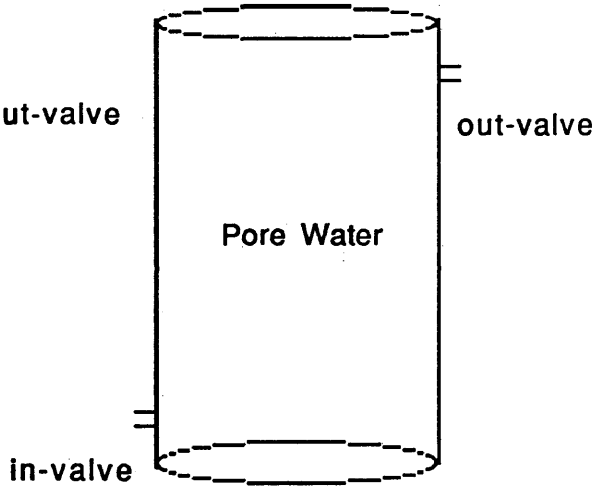
Pore Water

T-3



Filtered Pore Water

T-4



Control

T-5

into 50 ml centrifuge tubes and spun at 2,500 rpm for 10 minutes. The overlying pore water was decanted into a clean centrifuge tube until sufficient pore water was obtained,

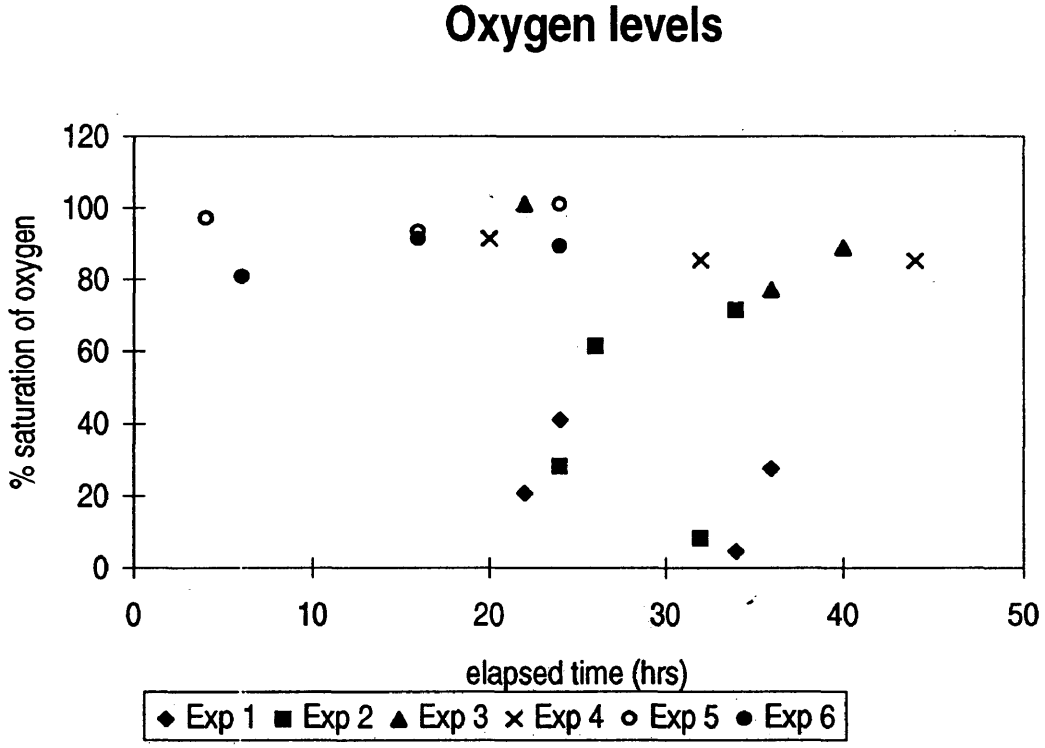
The fourth treatment (T-4) consisted of stock bay water to which 45 ml of 0.22 µm filtered pore water was added. The pore water was obtained as in the third treatment, but before being added to the chamber it was filtered through a 0.22 µm polycarbonate membrane filter. The chamber was then filled with stock bay water to a final volume of 955 ml.

The fifth treatment (T-5) consisted of a chamber filled with 955 ml of stock bay water, to which nothing was added. This fifth treatment set was the control.

Treatments were not replicated in this first experiment due to a lack of microcosms. Once prepared the chambers were placed in a shade box to more closely simulate light conditions of the benthos. Water was kept circulated with a peristaltic pump (flow ca. 20-30 ml/min.). Oxygen levels were monitored periodically throughout the experimental run using a polarographic oxygen probe and meter (YSI Models 5730 and 58, respectively). If oxygen in a chamber dropped below 50% saturation, air was bubbled through that chamber until the oxygen level was higher than 75% saturation. Only in T-1 did oxygen levels drop below 85% saturation and need to be aerated (see Fig. 4 for the various T-1 oxygen levels).

A four ml sample was removed from each chamber every 2 hrs. for thirty-six hours. The samples were removed with syringes from three way valves to allow the chambers to remain sealed. Stock water was simultaneously injected to replace the 4 ml of sample water removed. The samples were immediately preserved with 150 µl of 6% filtered glutaraldehyde and kept refrigerated, until slides were made back at VIMS. Because of high sediment concentrations, the water samples taken from T-2 for the first

Figure 4. Oxygen levels (in percent saturation) of the undisturbed core treatments (T-1) at various times for experiments 1 through 6.


Oxygen levels
% saturation of oxygen
120
100
80
60
40
20
0
0
10
20
30
40
50
elapsed time (hrs)
Exp 1
Exp 2
Exp 3
Exp 4
Exp 5
Exp 6

10 sample times were centrifuged at low speed. This eliminated interfering sediment particles and allowed easier counting without significantly affecting bacterial counts (see Table 1).

The second experiment, started September 12, 1993, followed the same basic experimental design previously described. In this case the stock water was obtained from station 08, the same area from which the cores were taken. The experimental run lasted for 44 hours rather than 36. It was necessary during slide preparation to centrifuge T-2 samples for the first 15 sample times.

The third experiment was started on November 5, 1993 and ran for 48 hrs. Some modification was made to the experimental design. I made my own incubation chambers (see Fig. 2 for specifications). The chamber holding the undisturbed core was designed to contain the same volume of water as the other chambers. Ten of these chambers were made so a replicate could be run of each treatment during the experiment. The treatments were the same as those in the first two experiments. In this experimental run, the sediment was from station 14 (Tomasini Point, located 14 km from the mouth of the bay). For both T-3 and T-4, 40 ml instead of 45 ml of pore water were added. Pore water was obtained from slurry cores taken from the top 1 cm of the bay sediment as well as from the top cm of undisturbed cores. The stock bay water came from the Tomales Oyster Company boat ramp. T-2 samples were centrifuged prior to filtration for the first 11 sample times to allow bacterial counts to be made.

The fourth experiment was started on November 8, 1993 and ran for 48 hrs. It had the same experimental design as the third run except the sediment and stock bay water were from station 08. T-2 samples were spun through the twelfth sample.

Table 1. T-test of bacterial counts from a spun and not spun sample from the same pool. The counts are not significantly different form each other.

Spun vs. Not Spun Bacterial Counts

Spun	Not Spun		Mean	St Dev	T-test	Prob.
33	29	Spun	31.6	3.69	0.25	.81 n.s.
36	26	Not Spun	31.1	5.28		
30	26					
34	39					
35	27					
29	31					
27	29					
30	34					
36	41					
26	29					

SEDIMENT CORE / PORE WATER / CONTROL EXPERIMENT

Experiments 5 & 6

The sediment resuspension experimental design was altered for these experiments. Only T-1, T-3 and T-5 were run, allowing three replicates of each treatment (Fig. 5).

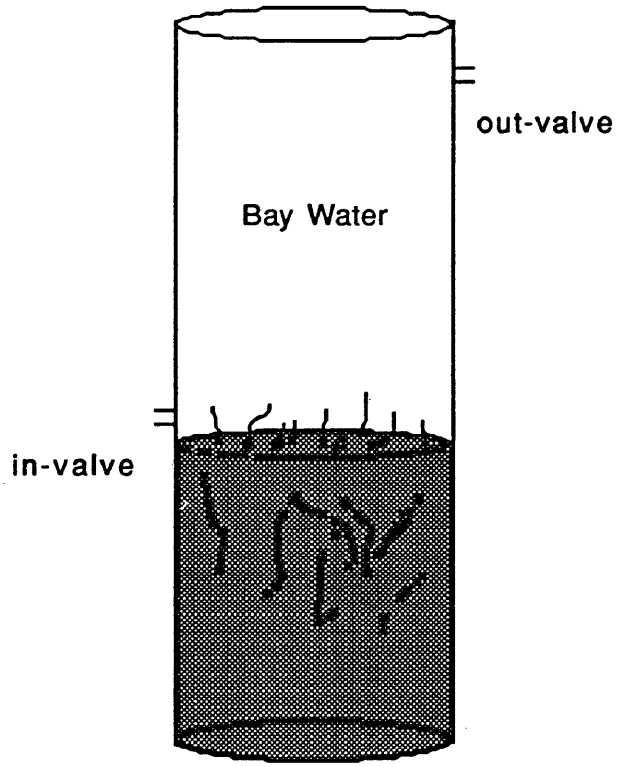
The first run of this experimental design started on March 2, 1994 and ran for 24 hrs. The preparation of T-1, T-3, and T-5 was the same as those in the resuspension experiment. The sediment and stock bay water was obtained from station 08. Forty-five ml of pore water was added to T-3. Once all the treatments were prepared, a 130 ml sample was taken from each of the chambers and from the stock bay water for nutrient analysis. The chambers were then refilled with additional stock bay water. Direct count samples and oxygen readings were taken and analyzed as in the sediment resuspension experiment. At the end of the 24 hour run, another nutrient sample was taken from each of the chambers. Nutrient samples were filtered through GF/C filters at the time of removal. The samples were frozen and shipped on dry ice to the Hawaii Institute of Marine Biology, Analytical Services for analysis. Concentrations of the dissolved inorganic nutrients nitrate + nitrite (N+N), ammonium (NH_4^+), phosphate (PO_4^{-3}), and silica (Si) were obtained following the standard autoanalyzer procedures for the Technicon AA II.

The second run of this experiment started on March 6, 1994 and ran for 24 hours. It had the same experimental design as the first run was used except the sediment and stock bay water were from station 14.

Figure 5. Diagram of the three treatments used in experiments 5 and 6. Three replicates were run for each experiment.

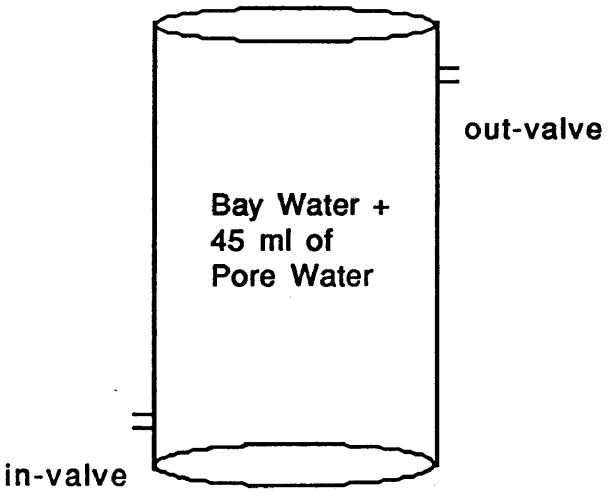
Core / Pore / Control Experiment

Three Experimental Sets Run



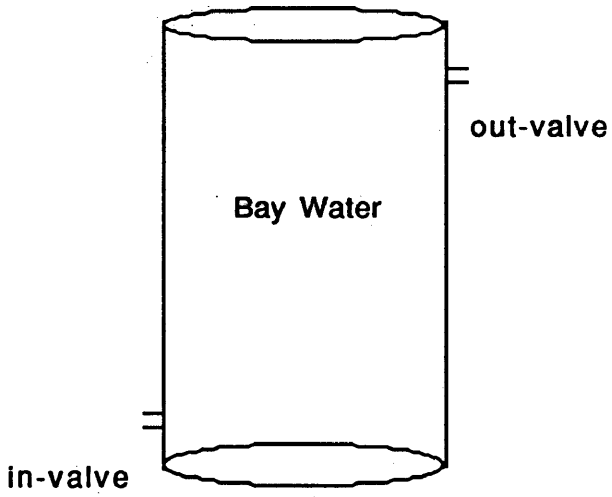
Sediment Core

T-1



Pore Water

T-3



Control

T-5

DOSE / RESPONSE EXPERIMENT

(Experiment 7)

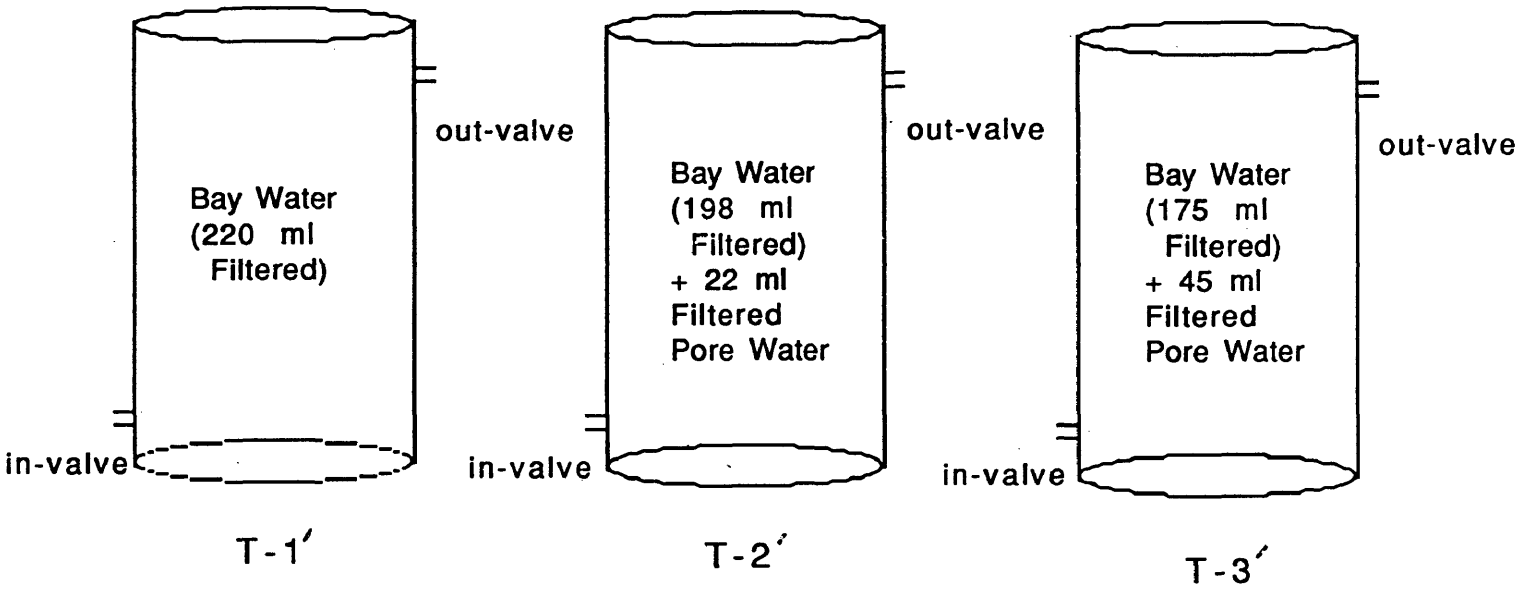
A nutrient dose / response experiment was started on March 4th 1994. It consisted of 2 sets of 5 incubation chambers (Fig. 6). The first treatment (T-1') was the control. It consisted of a 955 ml chamber filled with stock bay water, 220 ml of which were 0.22 µm filtered. The second treatment (T-2') consisted of 22 ml of 0.22 µm filtered pore water added to stock bay water (of this stock 198 ml were 0.22 µm filtered). The third treatment (T-3') consisted of 45 ml of 0.22 µm filtered pore water added to stock bay water (of this stock 175 ml were filtered). The fourth treatment (T-4') consisted of 90 ml of 0.22 µm filtered pore water added to stock bay water (of this stock 130 ml were 0.22 µm filtered). The fifth treatment (T-5') consisted of 220 ml of 0.22 µm filtered pore water added to stock bay water (none of this treatment's stock was filtered). The reason for filtering a portion of the stock bay water was so that in all of the treatments 220 ml of water was 0.22 µm filtered. This was necessary so that each treatment had the bacteria removed by filtration from 220 ml of water. The pore water was obtained from surface sediment slurry cores from station 08 and processed as in the other experiments. The stock bay water was obtained from station 08 as well.

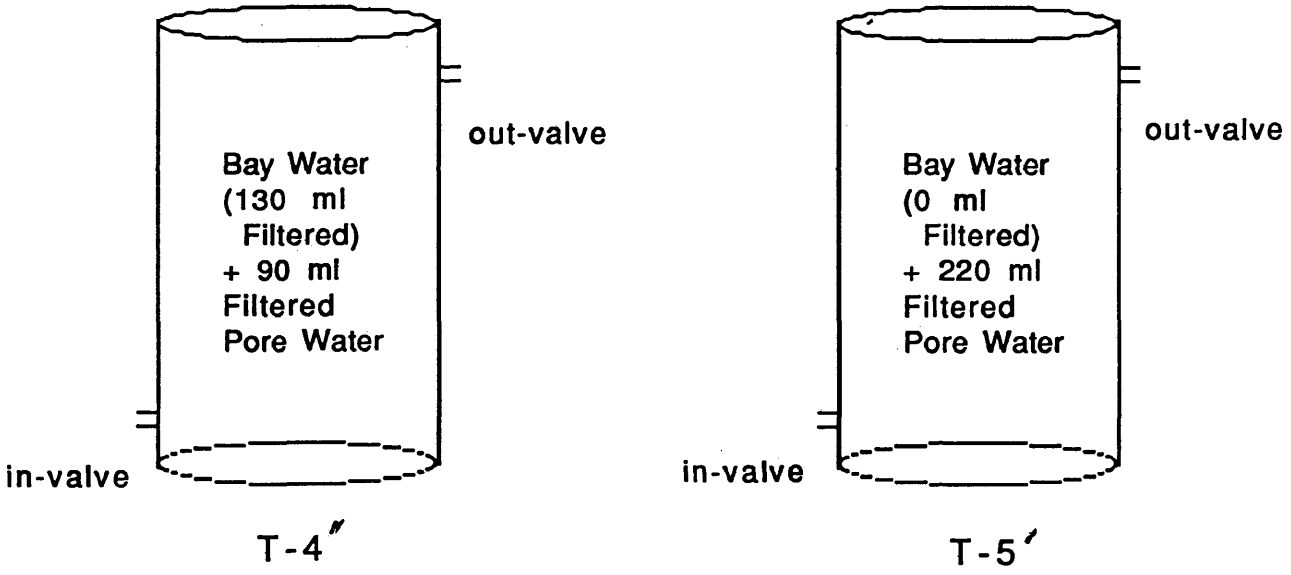
Once the treatments were prepared, a 130 ml nutrient sample was taken from each of the chambers. The chambers were brought up to volume with unfiltered stock bay water and the experimental run was started. The chambers were kept in the dark for the entire run (except during sampling). The chambers were kept well mixed with a peristaltic pump. A 4 ml sample for direct counting was removed from each chamber

Figure 6. Diagram of the five treatments used in experiment 7. Two replicates of experiment 7 were run. Total incubation voulme was 955 ml.

Dose Response Experiment

Two Experimental Sets Run





SLIDE PREPARATION AND COUNTING

Slides were prepared by staining a 2 ml sub-sample with 40 µl of proflavin at 0.033% concentration and 100 µl of DAPI at 0.04% concentration. This stained sample was vacuum filtered prepared by staining a 2 ml sub-sample with 40 µl of proflavin at 0.033% concentration and 100 µl of DAPI at 0.04% concentration. This stained sample was vacuum filtered through a 0.22 µm irgalan black membrane filter. The filter was placed on a slide coated with immersion oil, and covered with a drop of oil and a coverslip. Direct bacterial counts were made with a Zeiss Universal epifluorescence microscope with a 75 W xenon lamp and a UV (G 36, FT 395, LP 420) filter set at 787.5 X magnification. During the third experiment direct counts were made at VIMS using a Zeiss Universal epifluorescence microscope at 630X magnification. From each slide 10 grid counts were made. By averaging and converting these counts the bacterial concentration per milliliter in each sample was determined.

STATISTICAL ANALYSIS

Centrifuged and non-centrifuged bacterial counts were compared, at a 95% confidence interval, using a paired t-test on Excel v5.0 (Microsoft Corp). The multiple bacterial counts of the experimental treatments were compared, at a 95% confidence interval, over time by using a multivariate repeated measures analysis of co-variance on Statistix v4.0 (Analytical Software). Linear regression analysis was run on the time series, and F-tests, with a confidence interval of 95%, were performed on the slope of the linear regression on Statview II (Analytical Software).

RESULTS

The results of the resuspension experiments (Exp. 1-6) show a higher bacterial abundance in the treatments to which a resuspension element was added (T2, T3, and T4) (Table 2). In two experiments (Exp. 3&5) the bacterial counts decreased over time (Table 2). The abundance of bacteria in the undisturbed core (T-1) and control (T-5) treatments were in every case statistically lower than in the resuspension additions (Table 2). The pore water dose/response experiment (Exp. 7) shows a linear increase in nutrient concentration as the volume of 0.22 μm filtered pore water added was increased (Fig. 14). The addition of pore water significantly increases the bacterial numbers over the control, but this increase is not statistically different over the various volumes in the addition regime (Fig. 15, Table 4).

Experiment 1:

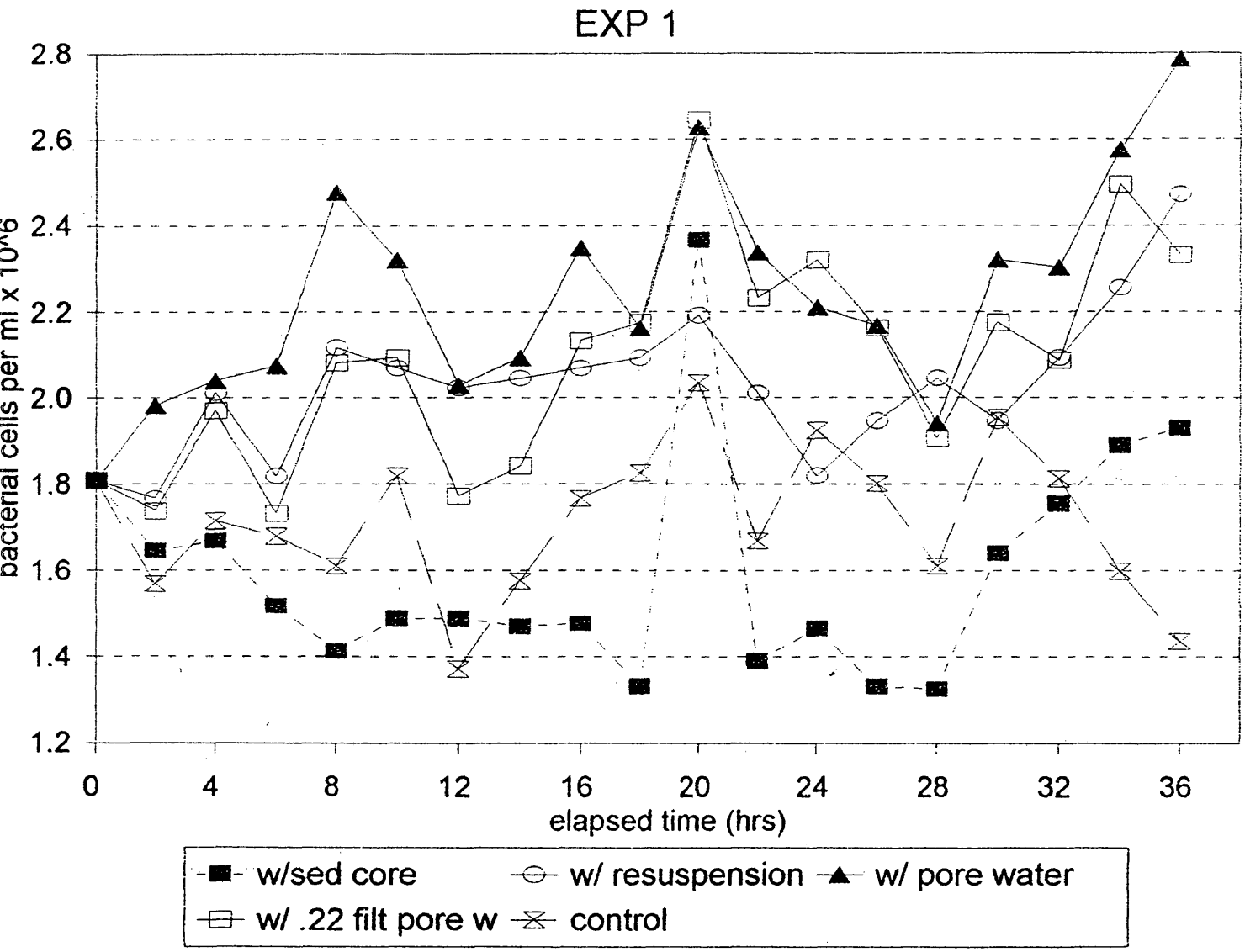
The means of the bacterial numbers and their confidence intervals, over the 36 hr incubation period, are given in Table 2. A multivariate repeated measures ANOVA, comparing treatment over time for the cell counts, showed that the abundance of bacteria for T-1 was statistically lower than the other 4 treatments. A regression analysis of the undisturbed core data (T-1) showed that the bacterial abundance does not increase or decrease in a simple linear fashion over time. The slope of the regression line did not differ significantly from 0 (C.I. 95%) (Fig. 7, Table 2).

Bacterial numbers for treatment 2 (1 cm of resuspended sediment) were significantly higher than the undisturbed core (T-1) and the control (T-5) and significantly lower than pore water (T-3). There was no significant difference in

Table 2. Statistical analysis of experiment 1 through 6. The means (in millions / ml) of the bacterial numbers, the 95% confidence interval (in millions / ml), which of the treatment groups (at the 95% level) are significantly different, and the linear regression formula with its F-test value are shown. (A * after the F-value signifies that the regression is significant at the 95% level.)

	Treatment	Treatment Mean	95% CI	Homogeneous Treatment Groups	Linear Regression Formula	F-Test	
Exp 1	T-3 Pore Water	2.243	0.048	I	.026x + 2.008	34.177	*
Sept 1993	T-4 Filtered Pore Water	2.090	0.047	. I	.029x + 1.829	44.399	*
Station 08	T-2 Suspended Core	2.033	0.039	. I	.017x + 1.878	23.173	*
One replicate	T-5 Control	1.716	0.043	. . I	.002x + 1.695	0.329	
	T-1 Undisturbed Core	1.601	0.052	. . . I	.007x + 1.538	2.166	
Exp 2	T-3 Pore Water	3.074	0.059	I	.031x + 2.728	49.108	*
Sept 1993	T-4 Filtered Pore Water	2.929	0.061	. I	.021x + 2.695	20.906	*
Station 08	T-2 Suspended Core	2.776	0.057	. . I	.020x + 2.555	21.023	*
One replicate	T-5 Control	2.400	0.051	. . . I	.004x + 2.354	1.152	
	T-1 Undisturbed Core	2.343	0.051	. . . I	.037x + 1.940	90.683	*
Exp 3	T-3 Pore Water	1.903	0.032	I	-.014x + 2.060	40.606	*
Nov 1993	T-2 Suspended Core	1.742	0.031	. I	-.016x + 1.929	56.115	*
Station 14	T-4 Filtered Pore Water	1.685	0.032	. I	-.010x + 1.799	19.129	*
Two replicates	T-5 Control	1.600	0.033	. . I	-.017x + 1.798	59.337	*
	T-1 Undisturbed Core	1.104	0.032	. . . I	-.035x + 1.504	248.649	*
Exp 4	T-3 Pore Water	2.014	0.032	I	.008x + 1.915	13.215	*
Nov 1993	T-4 Filtered Pore Water	1.740	0.028	. I	.007x + 1.652	13.703	*
Station 08	T-2 Suspended Core	1.716	0.030	. I	.009x + 1.615	16.575	*
Two replicates	T-5 Control	1.552	0.027	. . I	.004x + 2.354	0.429	
	T-1 Undisturbed Core	1.418	0.029	. . . I	.002x + 1.398	0.645	
Exp 5	T-3 Pore Water	2.697	0.040	I	-.020x + 2.933	52.877	*
March 1994	T-1 Undisturbed Core	2.219	0.038	. I	-.012x + 2.367	22.314	*
Station 08	T-5 Control	2.158	0.034	. I	-.019x + 2.380	64.581	*
Three replicates							
Exp 6	T-3 Pore Water	2.435	0.046	I	.043x + 2.171	46.658	*
March 1994	T-1 Undisturbed Core	1.924	0.038	. I	.025x + 1.777	23.949	*
Station 14	T-5 Control	1.853	0.033	. . I	.004x + 1.827	0.921	
Three replicates							

Figure 7. Average bacterial numbers for the five treatments of experiment 1. Experiment started at 13:45 September 9, 1993. T-2 samples were centrifuged prior to counting through time 20.


EXP 1
bacterial cells per ml x 10^6
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
0
4
8
12
16
20
24
28
32
36
elapsed time (hrs)
w/sed core
w/ resuspension
w/ pore water
w/ .22 filt pore w
control

abundance between T-2 and the filtered pore water (T-4) over the incubation period. Total abundance of bacteria showed a significant increase with time. The slope of the regression line for T-2 was statistically larger than 0 (Fig. 7, Table 2).

Bacterial numbers for treatment 3 (whole pore water) were significantly higher than all the other treatments. The regression analysis showed that the abundance of bacteria increased over the length of the experiment (slope > 0) (Fig. 7, Table 2).

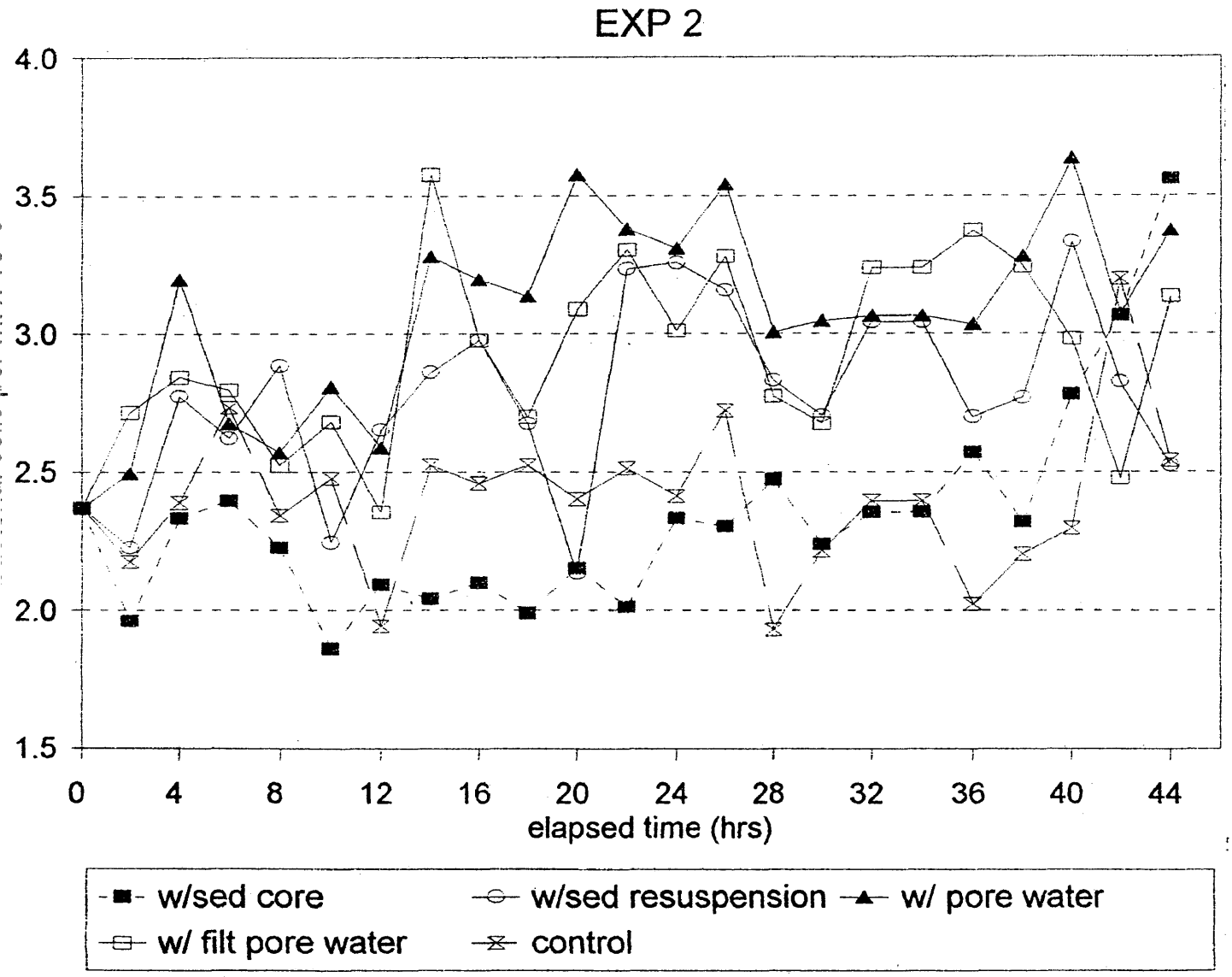
Bacterial numbers for the filtered pore water (T-4) were significantly higher than the undisturbed core (T-1) and the control (T-5), lower than pore water (T-3), and not significantly different than the resuspended sediment (T-2) over the length of the experimental. Regression analysis showed a significant increase in bacterial counts over time (slope > 0) (Fig 7, Table 2).

ANOVA analysis for the control (T-5) showed that the control's abundance was significantly higher than the undisturbed core treatment (T-1) but significantly lower than the other 3 treatments over the incubation period. The slope of the regression line was not statistically different from 0 (Fig. 7, Table 2).

Experiment 2:

The means for treatment 1 through 5 are reported in Table 2. The multivariate repeated measure ANOVA showed that the bacterial abundance of the pore water treatment (T-3) was significantly greater than the other treatments. The abundance in the filtered pore water treatment (T-4) was greater than all but T-3. Counts for T-2 were greater than for T-5 and T-1, but less than those of T-3 and T-4. Bacterial numbers for T-5 and T-1 were not significantly different from each other, but were significantly less than the other treatments. Treatments 1 through 4 showed a significant linear increase in bacterial numbers over time. The control (T-5) showed no significant increase or decrease over time (Fig. 8, Table 2).

Figure 8. Average bacterial numbers for the five treatments of experiment 2. Experiment started at 12:10 September 12, 1993. T-2 samples were centrifuged prior to counting through time 30.


EXP 2
4.0
3.5
3.0
2.5
2.0
1.5
0
4
8
12
16
20
24
28
32
36
40
44
elapsed time (hrs)
w/sed core
w/sed resuspension
w/ pore water
w/ filt pore water
control

Experiment 3:

The means for treatment 1 through 5 are reported in Table 2. The multivariate repeated measure ANOVA showed that the bacterial abundance of the pore water treatment (T-3) was significantly greater than the other treatments. The numbers for the resuspended sediment treatment (T-2) and pore water treatment (T-4) were not significantly different from each other, but were greater than all the remaining treatments except T-3. Bacterial numbers for the control (T-5) were significantly less than T-2, T-3, and T-4, but greater than undisturbed core treatment(T-1). T-1 numbers were significantly less than all the other treatments. The bacterial numbers in all the treatments showed a significant linear decrease with time (Fig. 9, Table 2).

Experiment 4:

The means for the 5 treatments are reported in Table 2. The multivariate repeated measure ANOVA showed that the bacterial abundance of the pore water treatment (T-3) was significantly greater than the other treatments. The numbers for T-2 and T-4 were not significantly different from each other, but were greater than all the remaining treatments, except T-3. Bacterial numbers for T-5 were significantly less than T-2, T-3, and T-4, but greater than T-1. T-1 numbers were significantly less than all the other treatments. Treatment 3, 4, and 2 showed a significant increase in bacteria with time. Treatments 5 and 1 showed no significant increase or decrease in bacterial numbers over the incubation period (Fig. 10, Table 2).

Experiment 5:

The means for the five treatments are given in Table 2. The ANOVA analysis showed that the bacterial counts for T-3 were significantly greater than the other treatments. Numbers for T-1 and T-5 were not significantly different from each other, but were

Figure 9. Average bacterial numbers for the five treatments of experiment 3. Experiment started at 15:00 November 5, 1993. T-2 samples were centrifuged prior to counting through time 22.

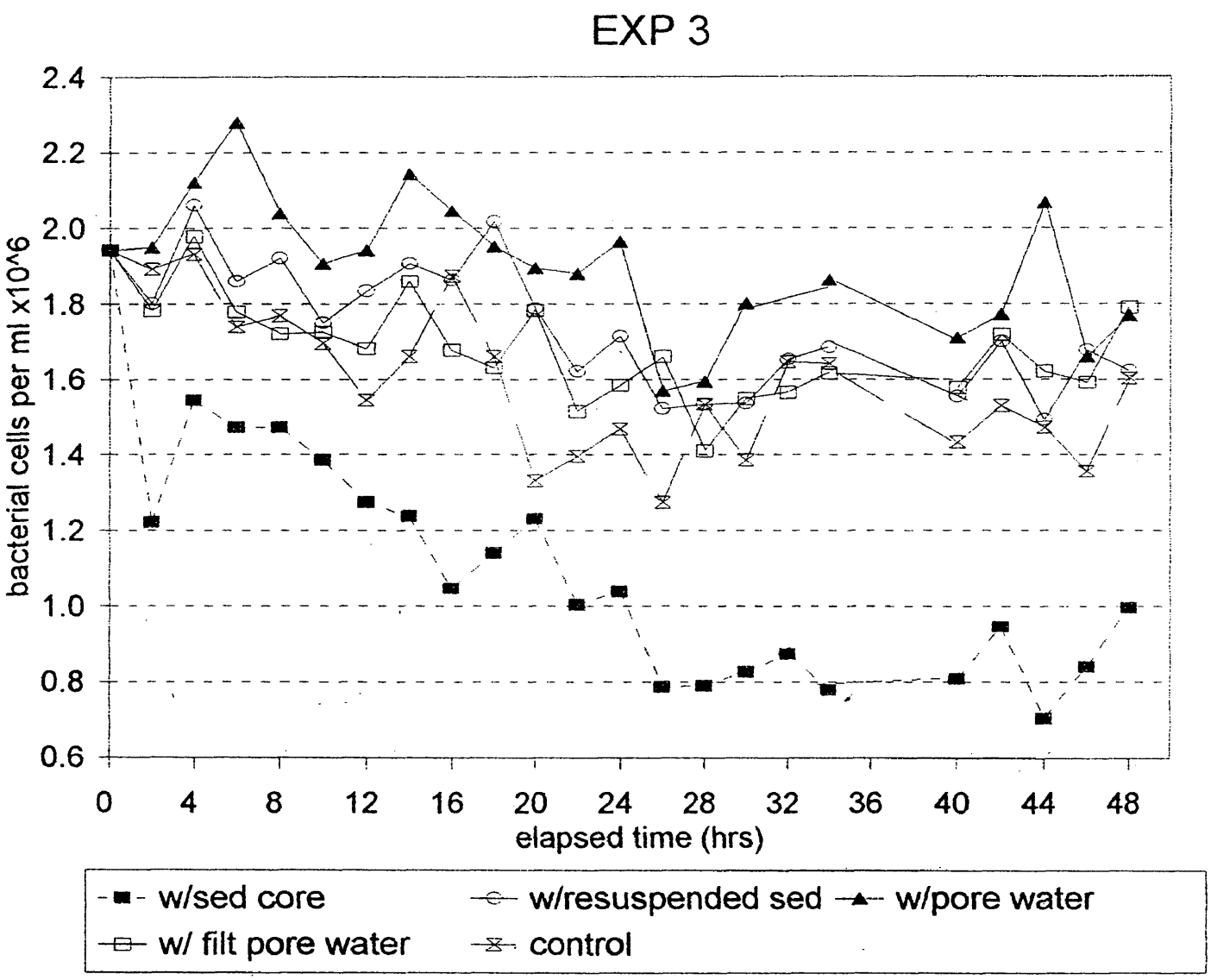
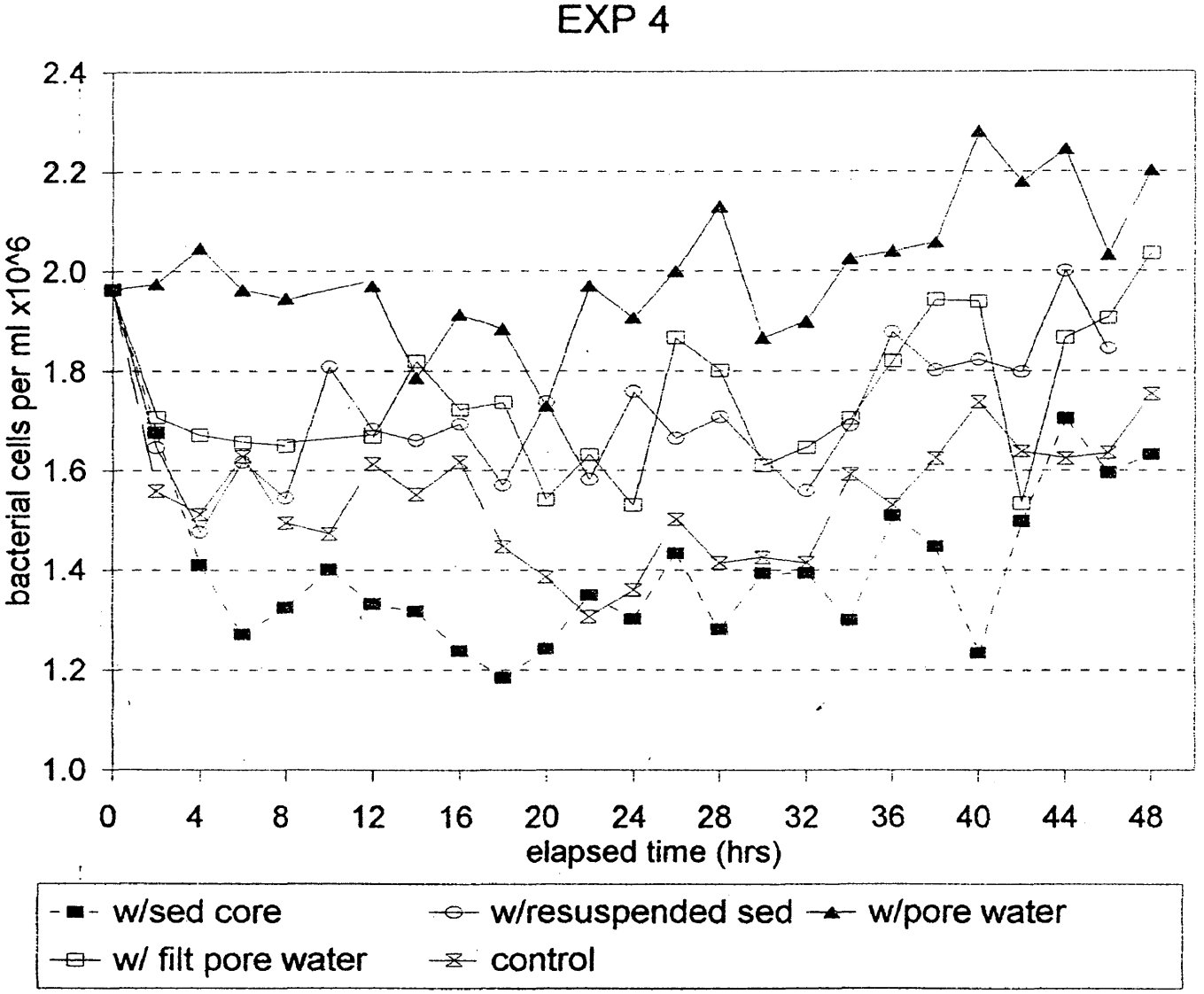

EXP 3
bacterial cells per ml x10^6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0
4
8
12
16
20
24
28
32
36
40
44
48
elapsed time (hrs)
w/sed core
w/resuspended sed
w/pore water
w/ filt pore water
control

Figure 10. Average bacterial numbers for the five treatments of experiment 4. Experiment started at 14:40 November 8, 1993. T-2 samples were centrifuged prior to counting through time 24.


EXP 4
bacterial cells per ml x10^6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0
4
8
12
16
20
24
28
32
36
40
44
48
elapsed time (hrs)
w/sed core
w/resuspended sed
w/pore water
w/ filt pore water
control

lower than T-3. All the treatments showed a significant decrease in bacteria with time (Fig. 11, Table 2).

Nutrient concentrations for the stock water, before any additions occurred, after the additions and at the end of the experiment are reported in Table 3. Nitrite+nitrate concentrations increased in the three treatments indicating the occurrence of nitrification. Ammonium concentrations varied with treatment and phosphate concentrations increased consistent with mineralization exceeding utilization in the three treatments. (Fig. 13)

Experiment 6:

The bacterial counts for the three treatments (T-1, T-3, and T-5 were significantly different from one another. The pore water and undisturbed core (T-3 and T-1) showed an increase in bacterial counts over time, while the control (T-5) showed no significant increase or decrease (Fig. 12, Table 2).

Nutrient levels are reported in Table 3 and are not inconsistent with the observations for experiment 6 (Fig 13).

Experiment 7: Pore water dose / response

The means of the bacterial counts for each pore water addition are shown in Table 4. Originally, treatment 1' (no addition) had significantly lower bacterial numbers than the treatments which had pore water additions (T-2' through T-5') but, as the experiment progressed, no significant differences were found. No significant difference in bacterial numbers were found either between treatments which had pore water additions (Fig. 14, Table 4).

Nutrient levels increased linearly in response to the pore water additions. PO_4^{-3}, NO_3^-&NO_2^-, NH_4^+ and Si levels all increased with increasing levels of pore water. In

Figure 11. Average bacterial numbers for the three treatments of experiment 5. Experiment started at 12:50 March 2, 1994.

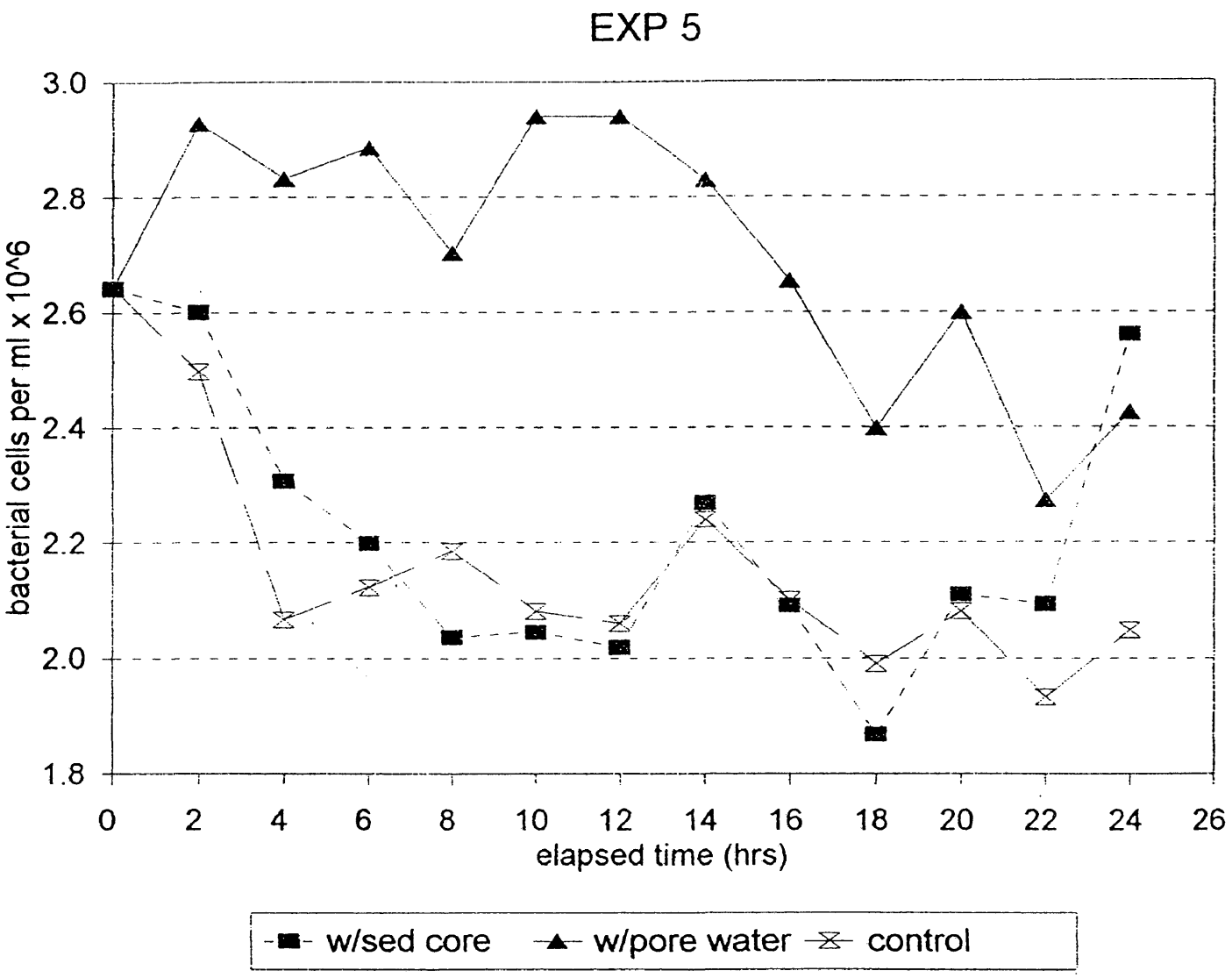

EXP 5
bacterial cells per ml x 10^6
3.0
2.8
2.6
2.4
2.2
2.0
1.8
0
2
4
6
8
10
12
14
16
18
20
22
24
26
elapsed time (hrs)
w/sed core
w/pore water
control

Figure 12. Average bacterial numbers for the three treatments of experiment 6. Experiment started at 14:40 March 6, 1994.

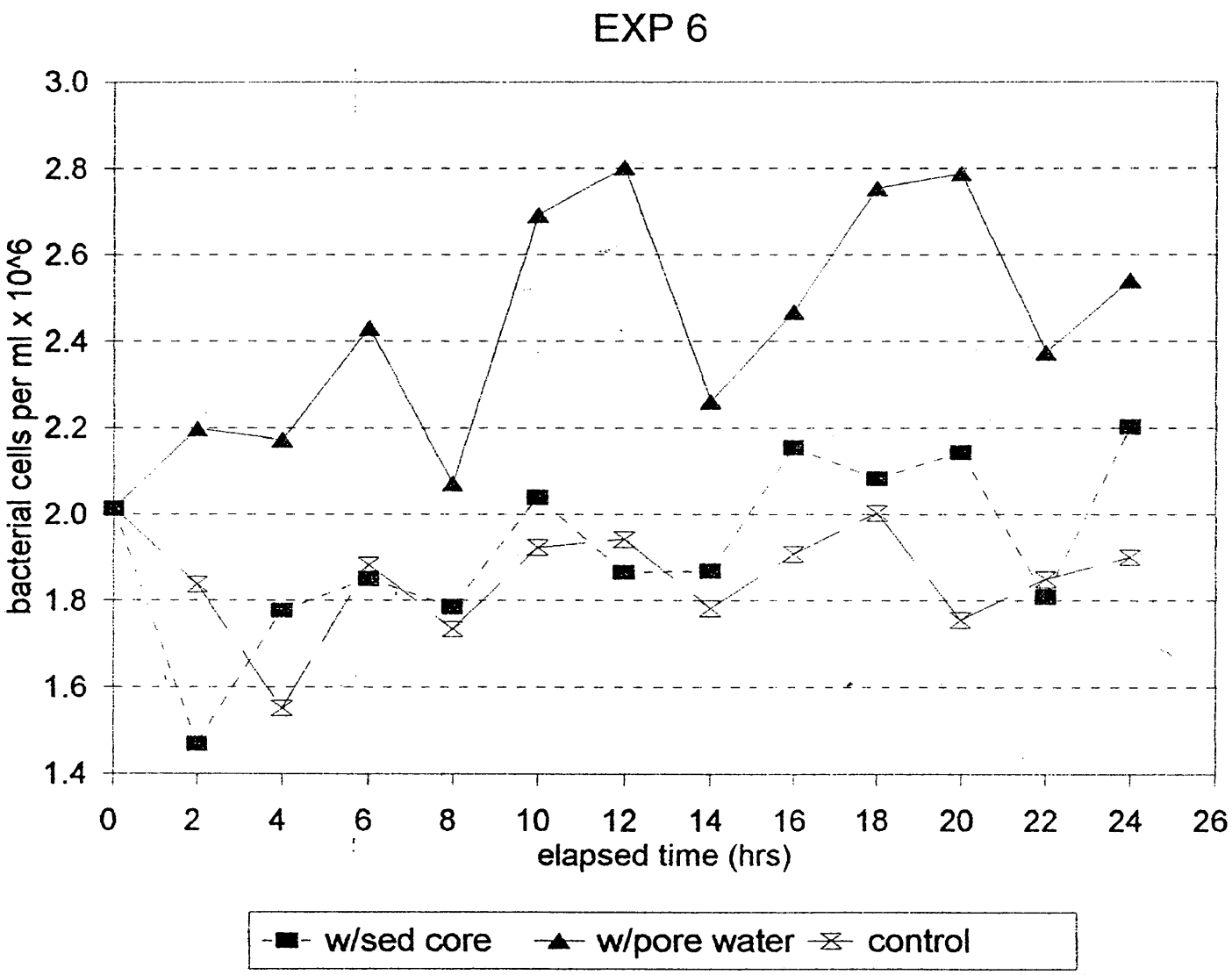
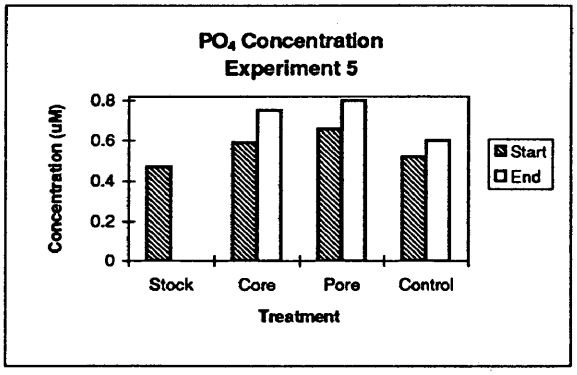
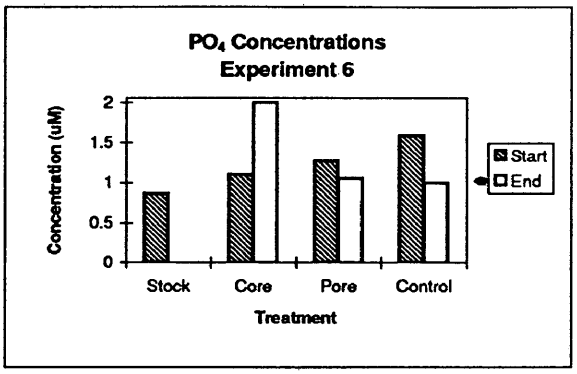
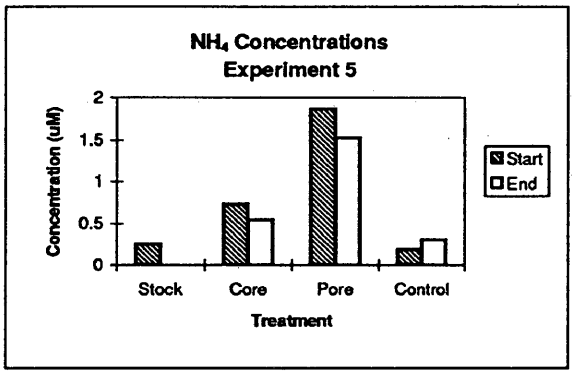
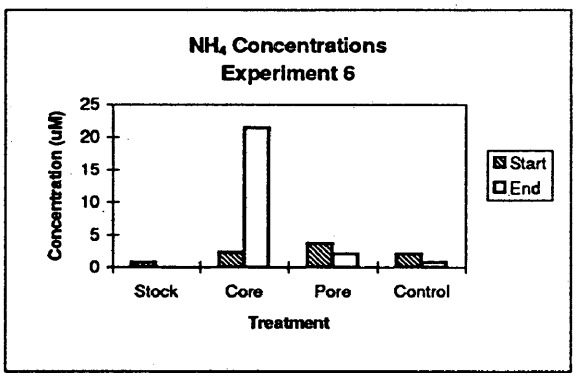

EXP 6
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
bacterial cells per ml x 10^6
0
2
4
6
8
10
12
14
16
18
20
22
24
26
elapsed time (hrs)
w/sed core
w/pore water
control

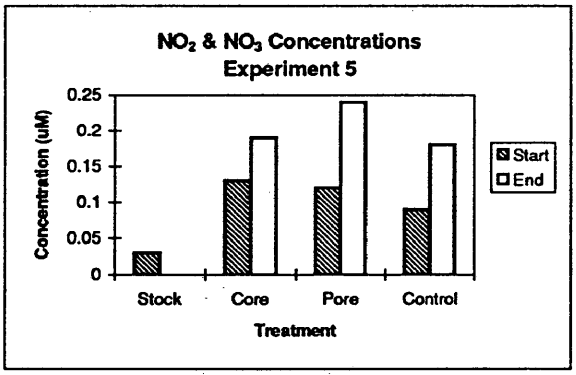
Figure 13. Comparison of the nutrient levels of the whole stock water, T-1 (Core), T-3 (Pore), and T-5 (Control) for experiment 5 (Cypress Grove) and experiment 6 (Tomasini Point) at the start and end of the experimental runs.

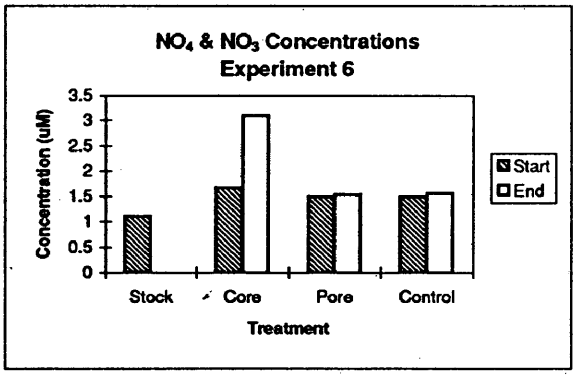

PO4 Concentration
Experiment 5
Concentration (uM)
0.8
0.6
0.4
0.2
0
Stock
Core
Pore
Control
Treatment
Start
End

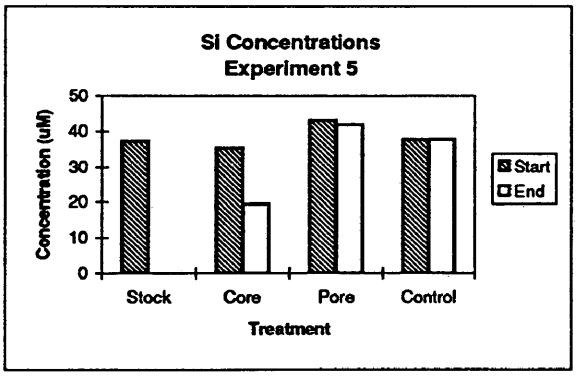

PO4 Concentrations
Experiment 6
Concentration (uM)
2
1.5
1
0.5
0
Stock
Core
Pore
Control
Treatment
Start
End


NH4 Concentrations
Experiment 5
Concentration (uM)
2
1.5
1
0.5
0
Stock
Core
Pore
Control
Treatment
Start
End


NH4 Concentrations
Experiment 6
Concentration (uM)
25
20
15
10
5
0
Stock
Core
Pore
Control
Treatment
Start
End


NO2 & NO3 Concentrations
Experiment 5
Concentration (uM)
0.25
0.2
0.15
0.1
0.05
0
Stock
Core
Pore
Control
Treatment
Start
End


NO4 & NO3 Concentrations
Experiment 6
Concentration (uM)
3.5
3
2.5
2
1.5
1
0.5
0
Stock
Core
Pore
Control
Treatment
Start
End


Si Concentrations
Experiment 5
Concentration (uM)
50
40
30
20
10
0
Stock
Core
Pore
Control
Treatment
Start
End

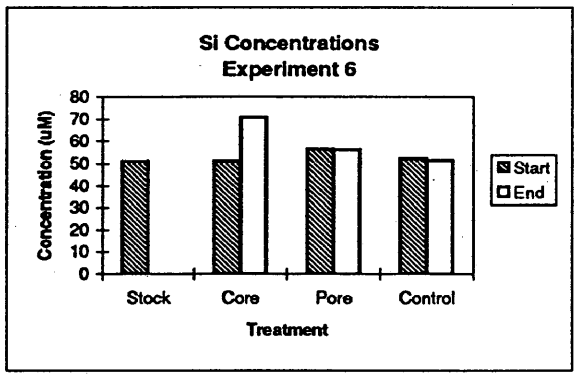

Si Concentrations
Experiment 6
Concentration (uM)
80
70
60
50
40
30
20
10
0
Stock
Core
Pore
Control
Treatment
Start
End

Figure 14. Average bacterial numbers for the five treatments of experiment 7. Experiment started at 22:00 March 4, 1994.

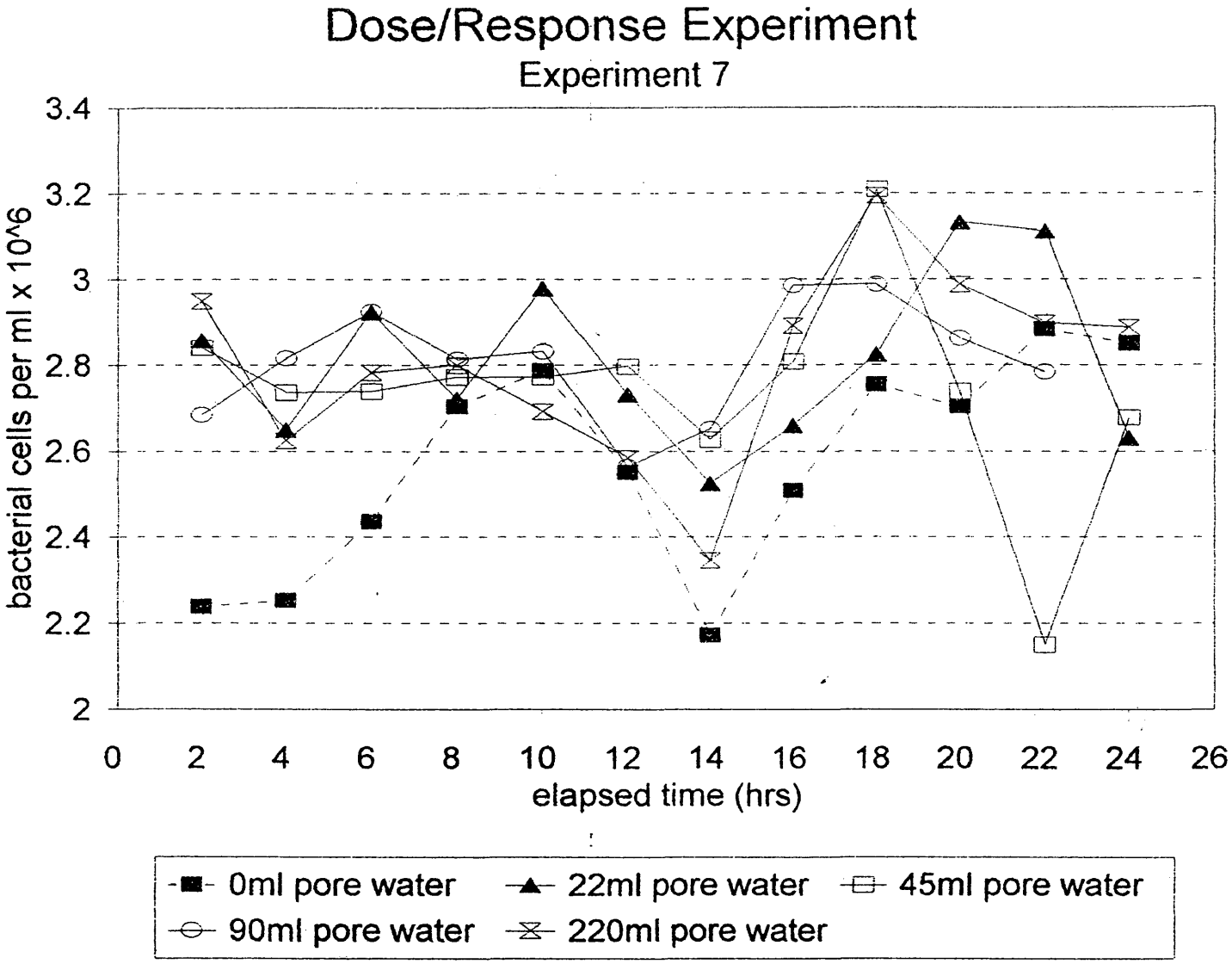

Dose/Response Experiment
Experiment 7
bacterial cells per ml x 10^6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
0
2
4
6
8
10
12
14
16
18
20
22
24
26
elapsed time (hrs)
0ml pore water
22ml pore water
45ml pore water
90ml pore water
220ml pore water

Table 3: Nutrient analysis of experiment 5 and 6 at start and end of experimental run. Sediment and water collected from station 08 (Cypress Grove) for experiment 5. Sediment and water collected from station 14 (Tomasini Point) for experiment 6. Stock water was not analyzed at the end of the experiment. Concentrations are μm.

Start of experiment 5				
	Stock	Core	Pore	Control
PO4	0.47	0.59	0.66	0.52
N+N	0.03	0.13	0.12	0.09
NH4	0.25	0.73	1.87	0.19
Si	37.17	35.33	43.11	37.71
End of experiment 5				
PO4		0.75	0.80	0.60
N+N		0.19	0.24	0.18
NH4		0.54	1.53	0.31
Si		19.57	41.85	37.78

Start of experiment 6				
	Stock	Core	Pore	Control
PO4	0.87	1.11	1.27	1.59
N+N	1.10	1.67	1.50	1.49
NH4	0.80	2.31	3.75	2.10
Si	51.18	51.26	56.43	52.24
End of experiment 6				
PO4		2.00	1.06	1.00
N+N		3.10	1.53	1.56
NH4		21.50	2.09	0.76
Si		70.68	56.08	51.36

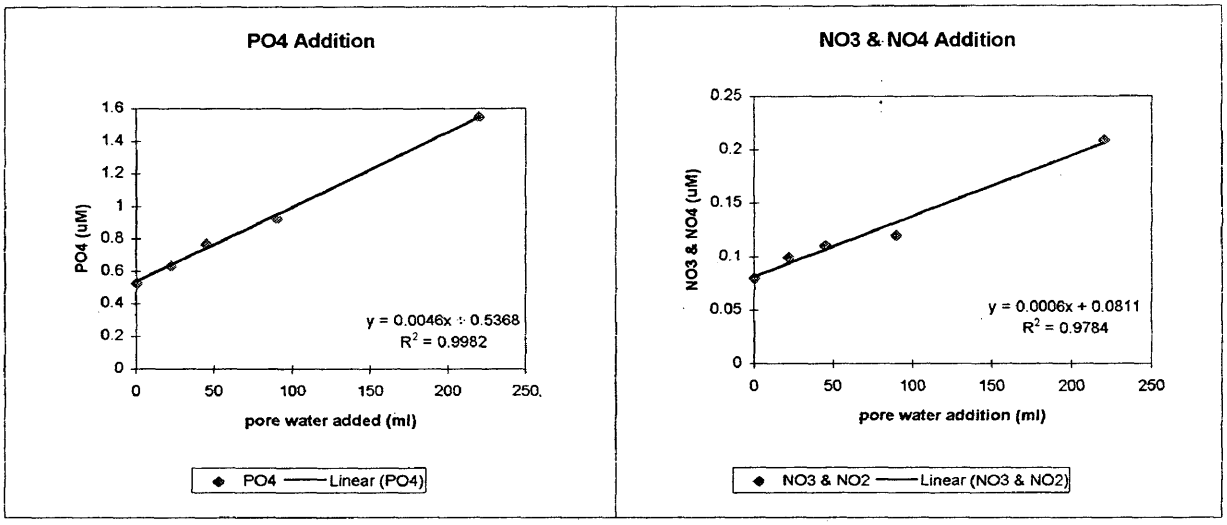
Table 4. Statistical analysis of experiment 7. The means (in millions / ml) of the bacterial numbers, the 95% confidence interval (in millions / ml), which of the treatment groups (at the 95% level) are significantly different, and the linear regression formula with its F-test value are shown. (A * after the F-value signifies that the regression is significant at the 95% level.)

Treatment	Treatment Mean	95% CI	Treatment Groups	Regression Formula	F-test
22 ml Addition	2.814	0.055	I	.004x + 2.757	1.176
90 ml Addition	2.812	0.053	I	.003x + 2.772	0.609
220 ml Addition	2.804	0.056	I	.010x + 2.677	5.539
45 ml Addition	2.788	0.055	I	.001x + 2.781	0.016
0 ml Addition	2.571	0.055	I	.023x + 2.267	33.046 *

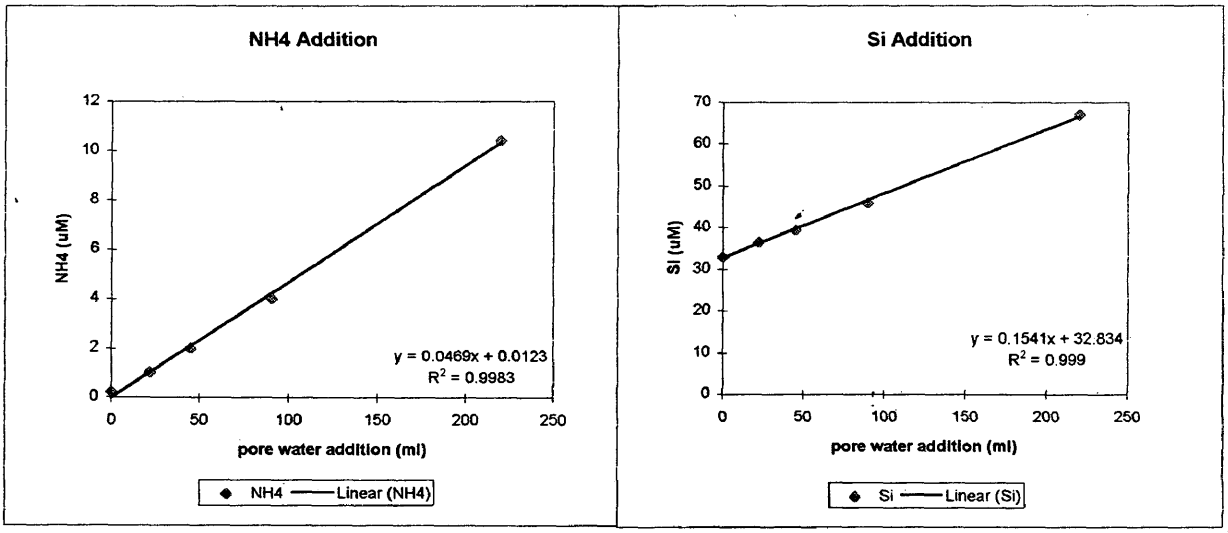
every case, the fit of the regression line to the nutrient data was extremely good (R^2 > .95) (Fig. 15).

The results of the resuspension experiments (Exp. 1-6) show that the three treatments to which a resuspension element was added (T2, T3, and T4) had a higher bacterial abundance than T-1 and T-5 (Table 2). However, no clear "bloom", as described in other studies (Fanning et al. 1982; Wainright 1987, 1990), occurred (Figs. 7 -12). In two cases the bacterial counts decreased over the length of the experiment. The abundance of bacteria in the undisturbed core (T-1) and control (T-5) treatments were in every case statistically lower than in the resuspension additions (Table 2). The dose / response experiment (Exp. 7) had a linear increase in nutrient concentration as the volume of 0.22 μm filtered pore water added was increased (Fig. 15). The addition of pore water significantly increased the bacterial numbers over time from the control, but this increase in not statistically different over the various volumes in the addition regime (Fig. 14, Table 4).

Figure 15. Regression lines of each nutrient measured in experiment 7. The regression formula and fit is given in the right corner of each graph.


PO4 Addition
PO4 (uM)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
50
100
150
200
250
pore water added (ml)
y = 0.0046x + 0.5368
R2 = 0.9982
PO4
Linear (PO4)

NO3 & NO4 Addition
NO3 & NO4 (uM)
0.25
0.2
0.15
0.1
0.05
0
0
50
100
150
200
250
pore water addition (ml)
y = 0.0006x + 0.0811
R2 = 0.9784
NO3 & NO2
Linear (NO3 & NO2)


NH4 Addition
NH4 (uM)
12
10
8
6
4
2
0
0
50
100
150
200
250
pore water addition (ml)
y = 0.0469x + 0.0123
R2 = 0.9983
NH4
Linear (NH4)

Si Addition
Si (uM)
70
60
50
40
30
20
10
0
0
50
100
150
200
250
pore water addition (ml)
y = 0.1541x + 32.834
R2 = 0.999
Si
Linear (Si)

DISCUSSION

This study simulated, through a series of laboratory experiments, the effects of resuspension events on water column bacterial abundance. Specific elements of a resuspension event were isolated in an attempt to determine factors that cause the free water bacterial abundance to increase as observed in past studies (Fanning et al. 1982; Findlay et al. 1985; Wainright 1987, 1990; Ritzrau & Graf 1992).

Treatment 1:

By using an undisturbed core, the effects of benthic processes on bacterial numbers in the overlying water, without a resuspension event, were evaluated. Diffusional fluxes, small scale biological transports and resuspensions will continue to affect the overlying water column, in the absences of a large scale resuspension event. Nutrient analysis from the pore / core/ control experiments suggested that the cores did release a small amount of nutrients. All nutrients measured, except Si, increased in treatment T-1 compared to the control treatment (Fig. 13). Yet, despite this nutrient release, treatment T-1 was in the lowest statistical grouping of the bacterial numbers over time, alone or with the control treatment (T-5), in five of the six experimental runs, and lower than all the addition treatments (T-2, T-3, and T-4) in all six runs. In experiment 6, T-1 had significantly higher bacterial counts than the control, but lower than the three addition treatments (Table 2).

This pattern of bacterial abundance, as compared to the addition treatments, could have been caused by many factors. The benthos could remove a portion of the bacteria from the water column through both physical and biological means. Bacteria could attach to sediment particles, be drawn in by biological pumping / irrigation, or fed upon

by the benthic organisms. While no quantitative work was done on the benthic community present in the sediment cores, in every case, polychaete worms of the genera *Polydora, Capitella* and / or *Boccardia* dominated the macrofauna (Samantha B. Joye, personal communication). These worms and the microfauna present in the sediment could have had an effect on the water column bacteria. The larger the benthic community, the greater potential impact it could have on the water column bacterial population. Not only could grazing on the water column bacteria increase, but consumption of the oxygen in the water could be greatly affected by the heterotrophic community present in the sediment core. Respiration and decomposition occurring in the sediment could consume a large proportion of the oxygen present in the microcosm. It appears that in four of the 6 experiments this occurred. Oxygen levels became severely depleted during the first and second experimental runs (< 10% of saturation). Depletion occurred to a lesser extent in experiments 3 and 4 (< 80% for Exp. 3, < 85% for Exp. 4) (Fig. 4). While air was bubbled into the microcosms to minimize this effect, the fact that periods of time were spent in an oxygen poor environment could have affected the bacteria present in these treatment groups. Yet, even in the treatments in which oxygen never became depleted the bacterial counts were significantly lower than those for the addition treatments (Table 2). This suggests that oxygen depletion was not solely responsible for the lower bacterial numbers present through out the experimental run in the treatment 1 microcosms.

Treatment 2:

By resuspending 1 cm of surface sediment, the effects of a significant resuspension event can be simulated. The release of nutrients and bacteria, as well as the effects of sediment movement, which typically occur during a storm-induced scale

resuspension event were replicated as closely as possible in the microcosm. By transferring the water at time 1, after the majority of the sediment had settled, the potential effects of contact with the benthos on the water population of bacteria were reduced. This treatment was placed in a statistical grouping of higher bacterial numbers than the control in all four experiments run. Thus, this simulated resuspension event appeared to maintain higher bacterial numbers in the water column. However, treatment T-2 did not maintain the highest bacterial numbers. Among the addition treatments (T-2, T-3, and T-4) T-2 was always placed in the lowest abundance group (either alone or with T-4) (Table 2).

Two factors could have played a role in the lower bacterial counts observed in the "complete" resuspension event, compared with the whole pore water addition (T-3). First, the resettling of the sediment after the resuspension event could strip some of the bacteria from the water column. Novitsky (1990) described the "colonization" of suspended sediment particles by water column bacteria. Colonizing bacteria could attach to a passing sediment particle and then sink out of the water column as that particle settles to the bottom. Removal of bacteria by the sediment could have acted to limit the numbers of bacteria present after the resuspension event, lessening the effects of the nutrient and bacterial release on the abundance of the bacterial population in the overlying water. Second, in order to obtain the direct bacterial counts for this treatment group, it was necessary to centrifuge the earlier samples to remove the excess of sediment. This centrifugation could have reduced the counts for the first part of the experimental run. However, evidence suggests that this was not the case. I found no statistical difference between bacterial counts made from centrifuged and non-centrifuged samples taken from the same source (Table 1). If centrifugation removed bacteria from the sample, one might expect to see a sharp increase in the bacterial count

at the first sample time for which centrifugation was not used. This abundance increase between the last spun sample time and first non-spun sample time is not observed, in 2 cases the bacterial counts increased and in 2 cases they decreased (Figs. 7 -12).

Treatment 3:

By using whole nonfiltered pore water, the presumed release of bacteria and nutrients which occurred during a resuspension event was simulated in the microcosm, without any sediment effects. The 40 - 45 ml pore water additions were estimated to contain the approximate volume of pore water released from the top 1 cm sediment core in treatment 2. Bacterial counts from this addition, were statistically higher than those of all other treatments.

From the observation that treatment T-3 had the highest bacterial abundance in the water column (Table 2), one could conclude that the release of both nutrients and bacteria were necessary for the peak bacterial abundance to occur. Nutrient levels in the microcosm would certainly be increased due to the interstitial water addition. Pore water nutrient levels are typically many times higher than those of the overlying water column (Pomeroy et al. 1965; McCaffery, et al. 1980; Fanning et al. 1982) My pore / core / control experiments revealed an increase, compared to the control, in all the measured nutrients (Fig. 13, Table 3). This increase was larger than the one observed for T-1. Most importantly, NH_4^+ concentrations were nearly tripled for Cypress Grove and doubled for Tomasini Point compared with those of the control. Analysis of the stock water and control treatments, suggested that nitrogen was the limiting nutrient in the system. The nutrient ratio for Si:N:P in the stock water was ca.: 79.1 : 0.6 : 1.0, for Cypress Grove (Exp. 5) 58.9 : 2.3 : 1.0 and for Tomasini Point (Exp. 6). The ratios for the control treatments were ca.: 72.5 : 0.5 : 1.0, for Cypress Grove (Exp. 5) and 32.9 : 2.3 : 1.0 for

Tomasini Point (Exp. 6). Compared to the Redfield ratio of: 20 : 16 : 1, for Si:N:P, the waters of Cypress Grove and Tomasini Point appear to be limited by nitrogen. Also, the dose / response experiment showed a strong ($R^2 > .975$) linear increase in nutrient concentrations as the volume of pore water added was increased (Fig. 15). Weaker evidence suggested that the whole pore water addition added bacteria to the water column population. Wainright (1987) and Fanning, et al. (1982) contend that the bacteria in the sediment and interstitial waters would be released to the overlying water in a resuspension event. My own results tend to support this assumption. In every case the bacterial numbers were higher at the sample time following the pore water addition, even in those whose general trend was a decrease in population (Figs. 7 - 12). However, this increase was not always significant. An experiment to measure the bacterial release should have been run. Simply resuspending sediment and adding pore water to 0.22 μm filtered bay water would have effectively measured this release. Unfortunately lack of foresight and time constraints prevented such an experiment from being run.

Another possible explanation for the highest abundance in the whole pore water addition, was that the 40 - 45 ml estimate of pore water content in the 1 cm core was too high, and thus too high a nutrient level was added. However, as my dose / response results show, a larger addition should not lead to a significant increase in the numbers of bacteria in the water column population. Over a large range of pore water additions bacterial populations did not vary significantly from one another (Table 4).

Treatment 4:

The addition of 0.22 μm filtered pore water simulated the addition of a whole suite of nutrients, which would occur in a sediment resuspension event, without the addition of sediment and benthic bacteria. The 0.22 μm filtration would remove any

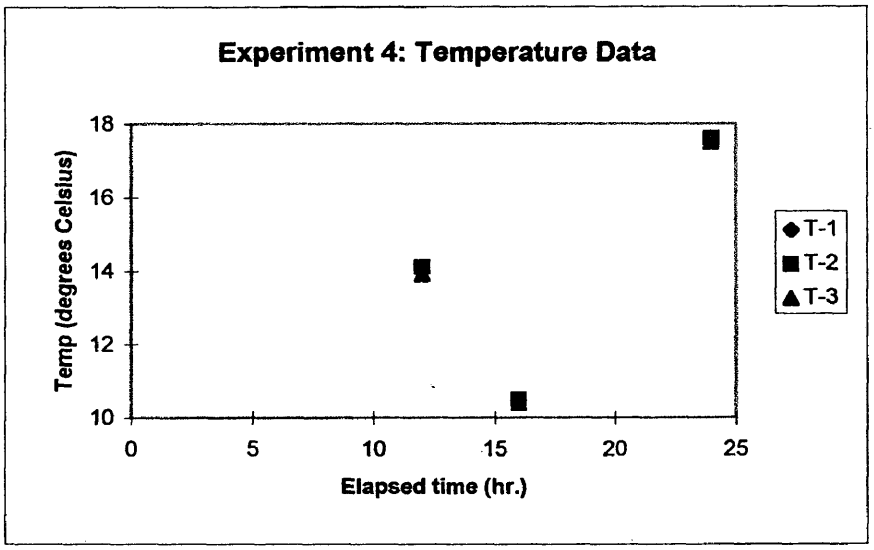
bacteria or other particulates from the interstitial water. Thus the effects of only nutrient addition would be measured. Bacterial counts for treatment 4 showed that the addition of filtered pore water maintained a higher bacterial abundance than the control and undisturbed cores. Yet, treatment T-4 did not increase bacterial counts to the extent of whole pore water (T-3) addition. Bacterial counts for T-4 were not significantly different from treatment 2 for three (Exp. 1, 3, and 4) of the four experimental runs. In experiment 2, bacterial numbers in T-4 were significantly higher than in T-2 (Table 2).

The fact that the addition of filtered pore water did not have as large an effect on the bacterial abundance as whole pore water suggested that bacteria in the unfiltered pore water help maintain the higher abundance. This initial increase of bacteria does not have to be large to increase abundance over time. Since bacteria grow exponentially, a small increase in the starting population numbers can lead to large differences in abundance over time.

Treatment 5:

This treatment was the control. It was used as a standard against which to compare the treatments. Physical and chemical factors affecting microbial populations are greatly changed through manipulations of sampling, removal from the environment and microcosm manipulations. The control was used to identify changes caused by these "bottle" effects. Light levels, temperature, oxygen content, water circulation and other factors can all be altered in a microcosm. However, except for oxygen levels which have already been discussed earlier for T-1, the changes to these variables were fairly uniform across all of the treatments (Figs. 4, 16 & 17). Temperature changed by several degrees in the experimental chambers throughout the experimental runs (Fig. 16). While these changes in temperature took place in all of the chambers, they are much more extreme

Figure 16. Recorded temperatures in the different treatment microcosms for experiment 5 and 7.


Experiment 4: Temperature Data
Temp (degrees Celsius)
18
16
14
12
10
0
5
10
15
20
25
Elapsed time (hr.)
T-1
T-2
T-3

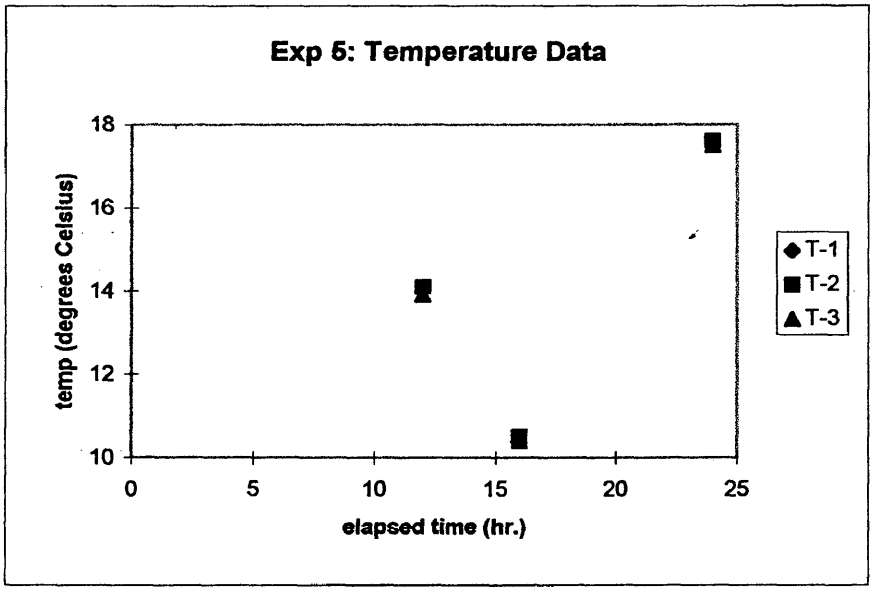
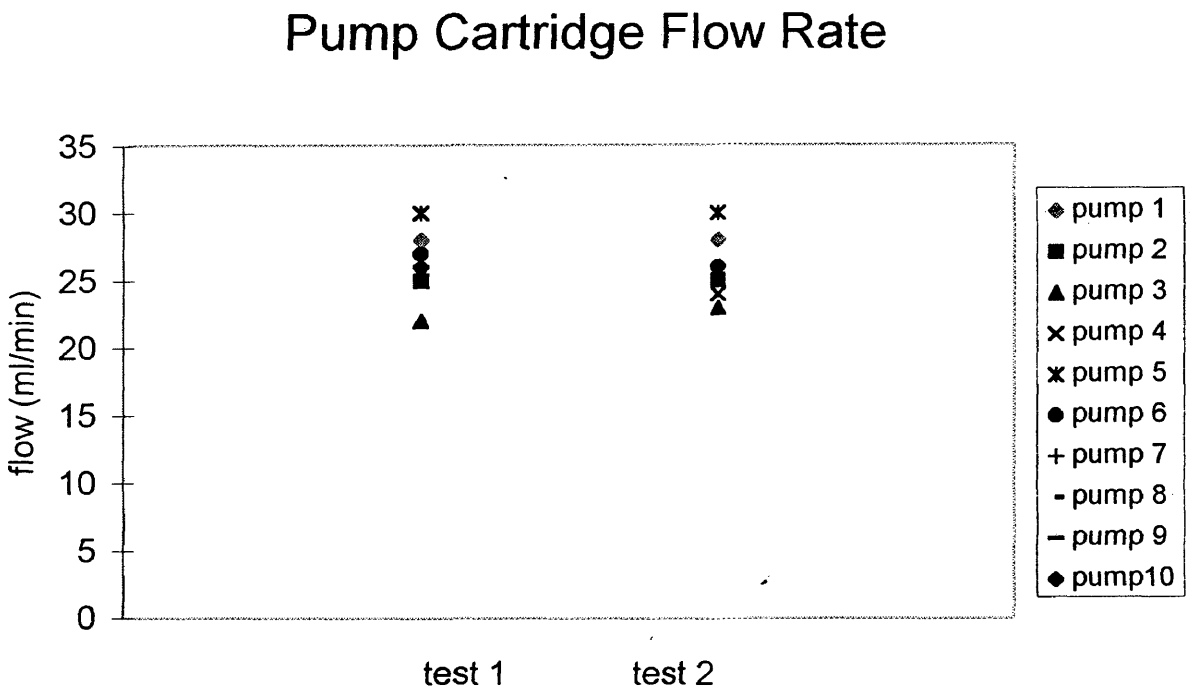

Exp 5: Temperature Data
temp (degrees Celsius)
18
16
14
12
10
0
5
10
15
20
25
elapsed time (hr.)
T-1
T-2
T-3

Figure 17. Recorded flow speeds of the 10 pump cartridges on the peristaltic pump sampled on two occasions.


Pump Cartridge Flow Rate
flow (ml/min)
35
30
25
20
15
10
5
0
test 1
test 2
pump 1
pump 2
pump 3
pump 4
pump 5
pump 6
pump 7
pump 8
pump 9
pump10

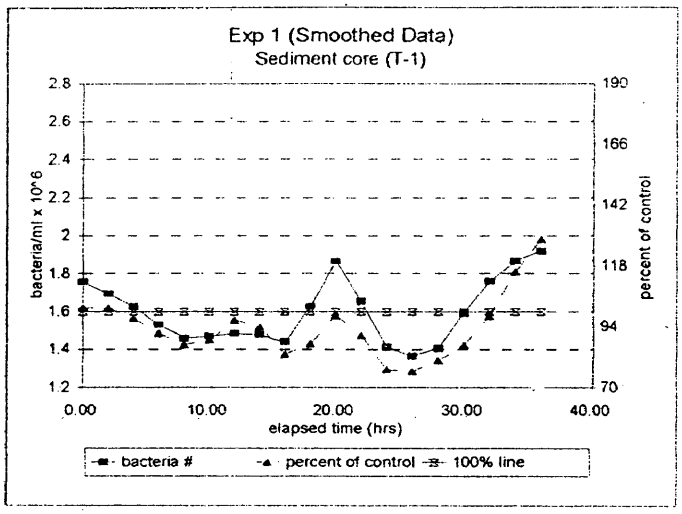
than the changes which would take place in the bay. Such rapid temperature changes can have a large effect on the growth rate of the bacteria (Shiah & Ducklow 1994, 1995). Light levels and circulation did not exactly mimic the natural conditions, and could effect growth and mortality of the bacteria as well. The control acted as the reference to which the various treatments were compared. Since the control was under the same conditions, differences from the control over the experimental period, not the starting point, showed the effects of the various treatments (Figs. 18 - 23, Table 2). In all six experiments the addition treatments (T-2, T-3, and T-4) showed a general increase in abundance compared to the control. Even when the numbers of bacteria decreased, and went below the starting abundance, the addition treatments numbers remained above the control numbers (experiments 3 and 5, Fig. 21 & 23, Table 2.).

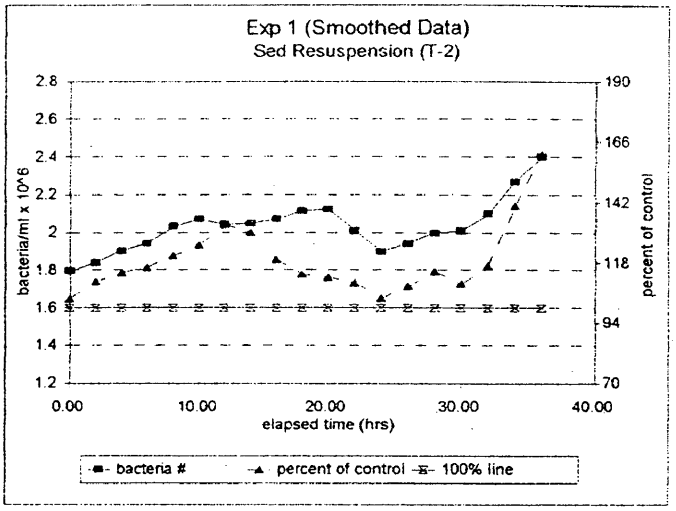
DOSE RESPONSE EXPERIMENT

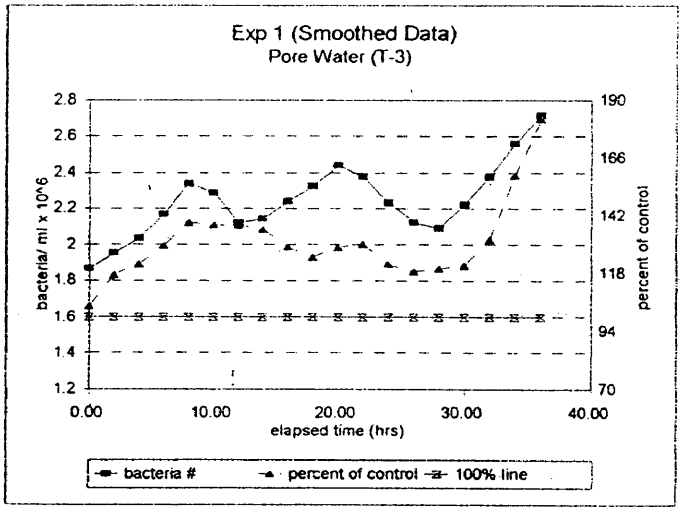
Bacterial counts:

Over the length of the experimental run, the control (0 ml pore water added) had a significantly lower bacterial abundance than all the treatments to which filtered pore water was added (Fig 14 Table 4). However, this difference was attributed to the low initial abundance of the control. The large difference at hour 2 was disturbing since all of the treatments started from the same stock water and 220 ml of 0.22μm filtered water (stock and / or pore water). Thus, the bacterial counts at the start of the experiment should have been quite similar. However, since no time-0 counts were made, it is unknown whether these differences reflected a real change, or an artifact of different starting points.

Figure 18. Comparison of the bacterial numbers of the various treatments to that of the control for experiment 1. The bacterial abundance time series were smoothed to reflect the influence of the previous sample abundance on the next. Data was smoothed with the formula: Smoothed count = (Previous count x 0.25) + Present count x 0.50) + (Next count x .25). For those counts without a previous or next count (i.e. the first and last times in a treatment set.) the formula (Previous /or next count x 0.33) + (Present count x .67)


Exp 1 (Smoothed Data)
Sediment core (T-1)
bacteria/ml x 10^6
percent of control
elapsed time (hrs)
bacteria #
percent of control
100% line


Exp 1 (Smoothed Data)
Sed Resuspension (T-2)
bacteria/ml x 10^6
percent of control
elapsed time (hrs)
bacteria #
percent of control
100% line


Exp 1 (Smoothed Data)
Pore Water (T-3)
bacteria/ ml x 10^6
percent of control
elapsed time (hrs)
bacteria #
percent of control
100% line

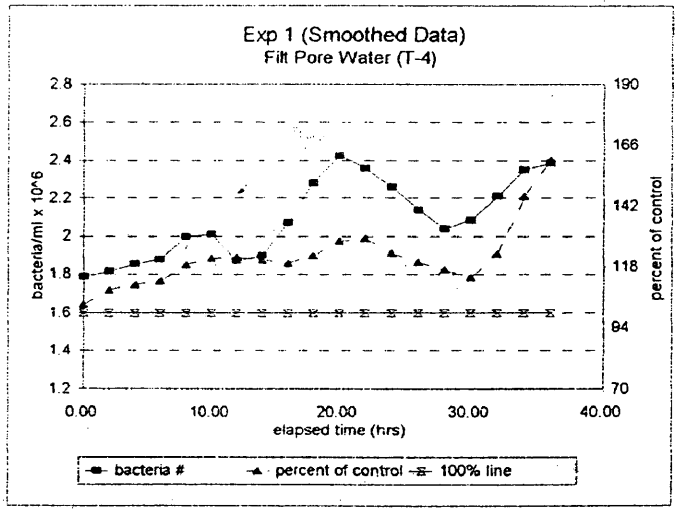
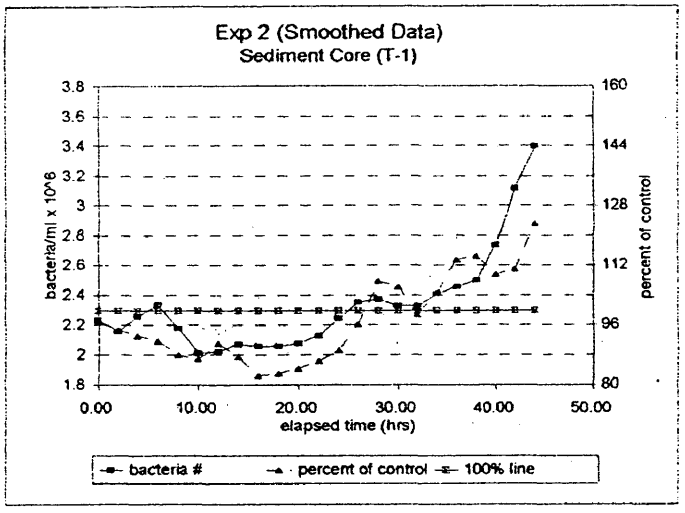
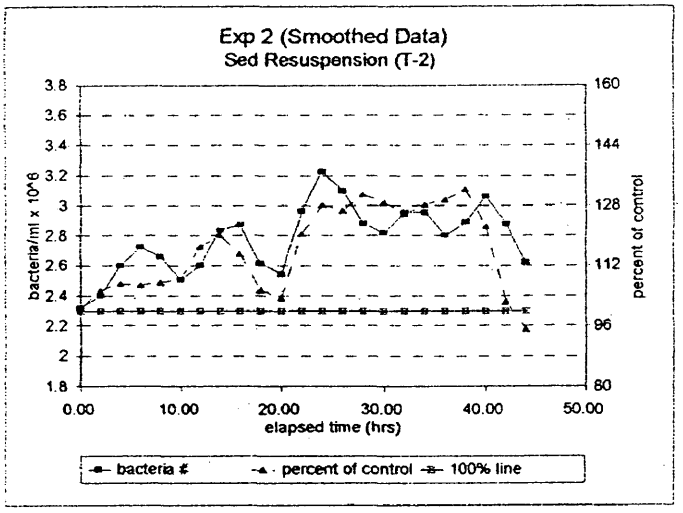
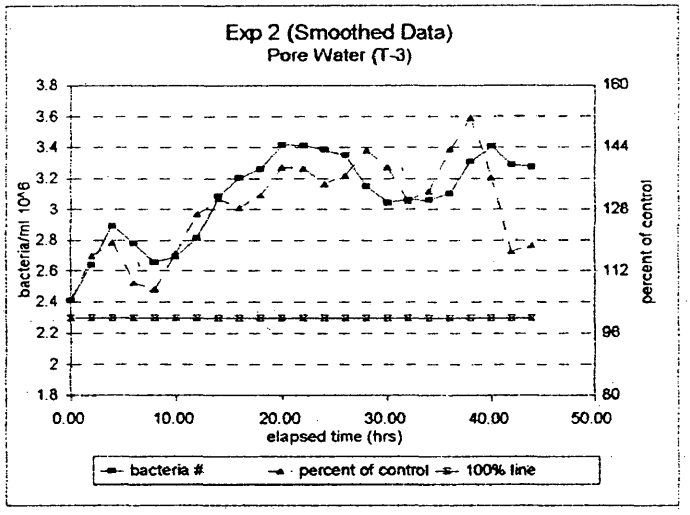

Exp 1 (Smoothed Data)
Filt Pore Water (T-4)
bacteria/ml x 10^6
percent of control
elapsed time (hrs)
bacteria #
percent of control
100% line

Figure 19. Comparison of the bacterial numbers of the various treatments to that of the control for experiment 2. The bacterial abundance time series were smoothed to reflect the influence of the previous sample abundance on the next.


Exp 2 (Smoothed Data)
Sediment Core (T-1)
bacteria/ml x 10^6
percent of control
elapsed time (hrs)
bacteria #
percent of control
100% line


Exp 2 (Smoothed Data)
Sed Resuspension (T-2)
bacteria/ml x 10^6
percent of control
elapsed time (hrs)
bacteria #
percent of control
100% line


Exp 2 (Smoothed Data)
Pore Water (T-3)
bacteria/ml 10^6
percent of control
elapsed time (hrs)
bacteria #
percent of control
100% line

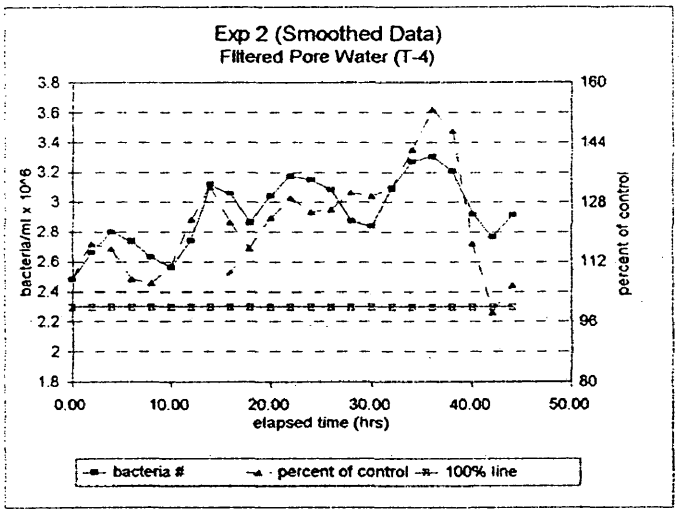
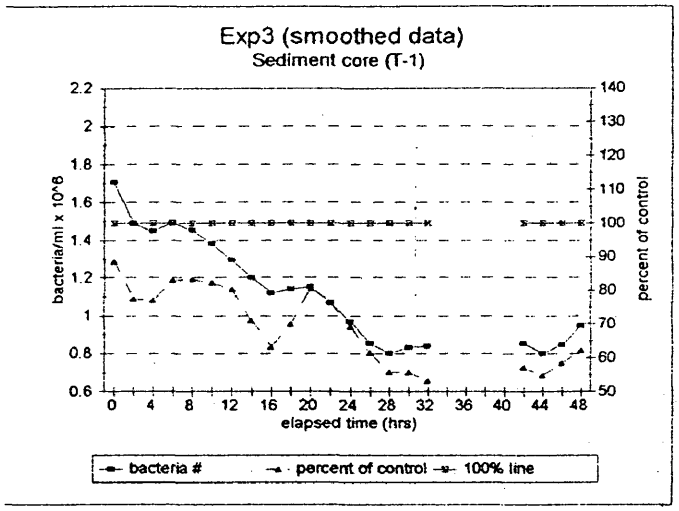
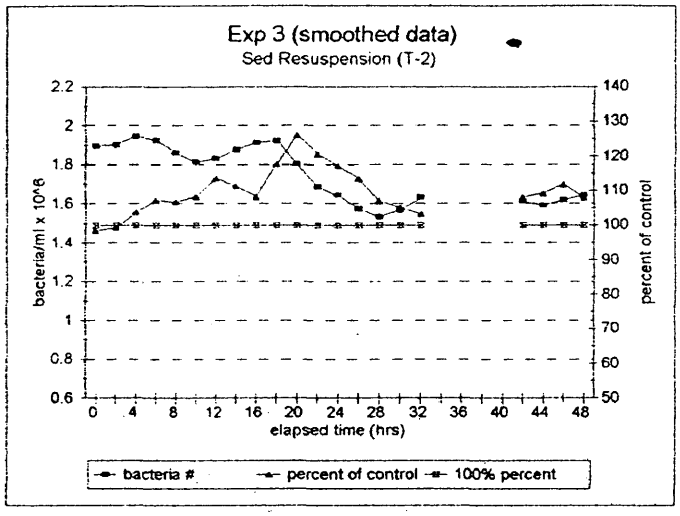
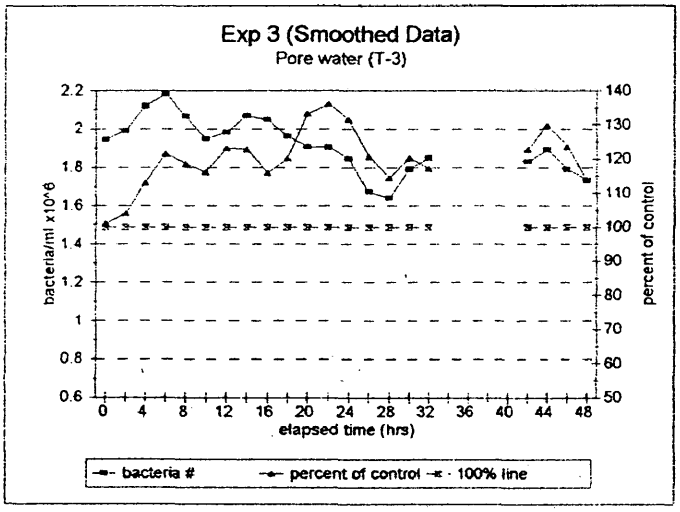

Exp 2 (Smoothed Data)
Filtered Pore Water (T-4)
bacteria/ml x 10^6
percent of control
elapsed time (hrs)
bacteria #
percent of control
100% line

Figure 20. Comparison of the bacterial numbers of the various treatments to that of the control for experiment 3. The bacterial abundance time series were smoothed to reflect the influence of the previous sample abundance on the next.


Exp3 (smoothed data)
Sediment core (T-1)
bacteria/ml x 10^6
percent of control
elapsed time (hrs)
bacteria #
percent of control
100% line


Exp 3 (smoothed data)
Sed Resuspension (T-2)
bacteria/ml x 10^6
percent of control
elapsed time (hrs)
bacteria #
percent of control
100% percent


Exp 3 (Smoothed Data)
Pore water (T-3)
bacteria/ml x10^6
percent of control
elapsed time (hrs)
bacteria #
percent of control
100% line

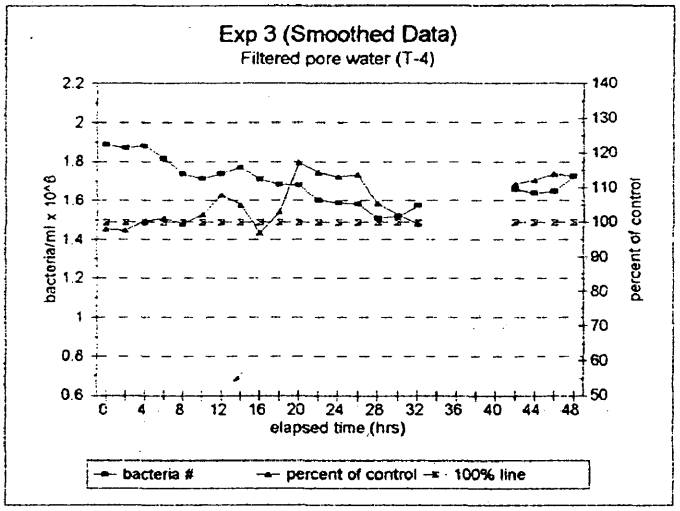
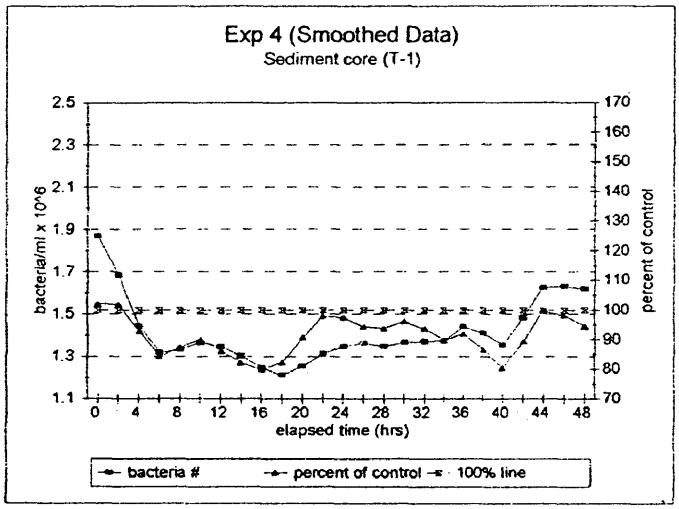
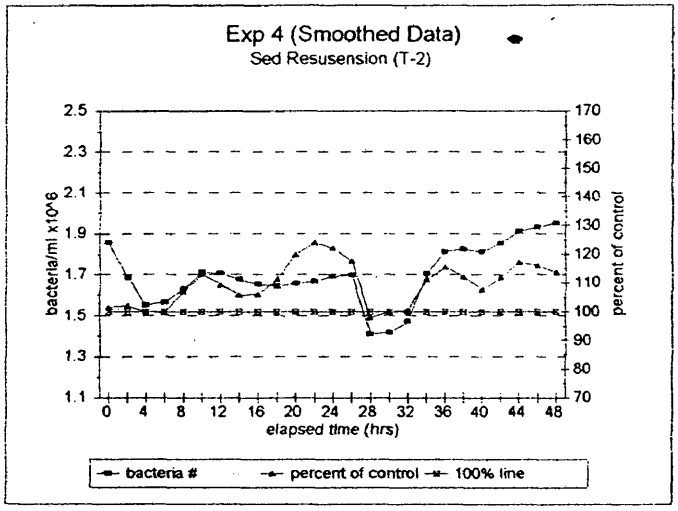
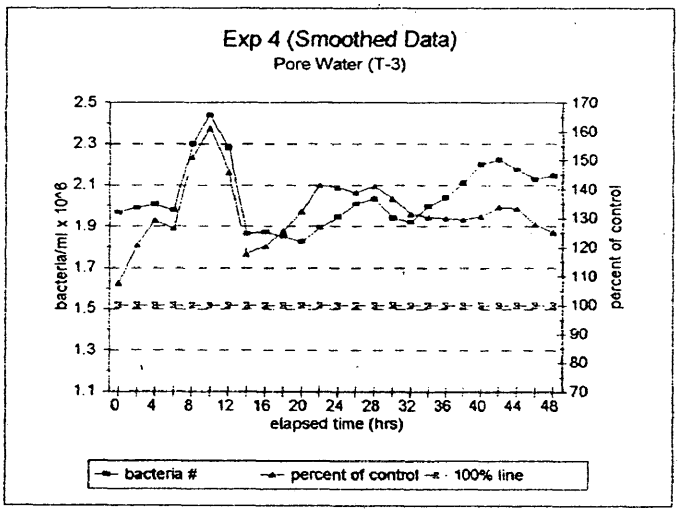

Exp 3 (Smoothed Data)
Filtered pore water (T-4)
bacteria/ml x 10^6
percent of control
elapsed time (hrs)
bacteria #
percent of control
100% line

Figure 21. Comparison of the bacterial numbers of the various treatments to that of the control for experiment 4. The bacterial abundance time series were smoothed to reflect the influence of the previous sample abundance on the next.


Exp 4 (Smoothed Data)
Sediment core (T-1)
bacteria/ml x 10^6
percent of control
elapsed time (hrs)
bacteria #
percent of control
100% line


Exp 4 (Smoothed Data)
Sed Resusension (T-2)
bacteria/ml x10^6
percent of control
elapsed time (hrs)
bacteria #
percent of control
100% line


Exp 4 (Smoothed Data)
Pore Water (T-3)
bacteria/ml x 10^6
percent of control
elapsed time (hrs)
bacteria #
percent of control
100% line

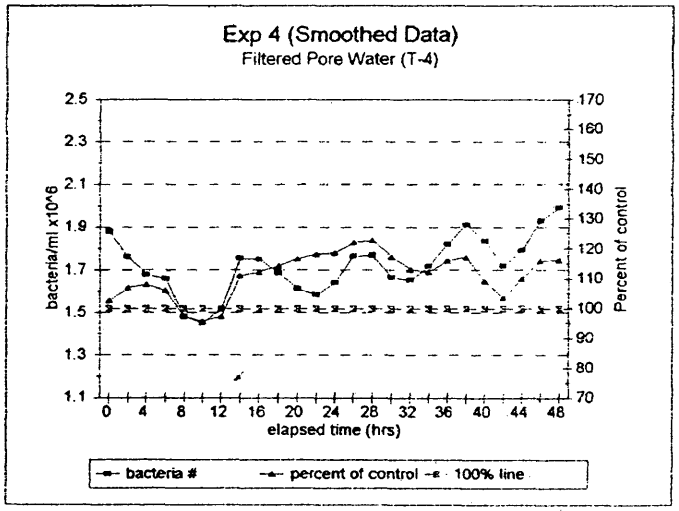
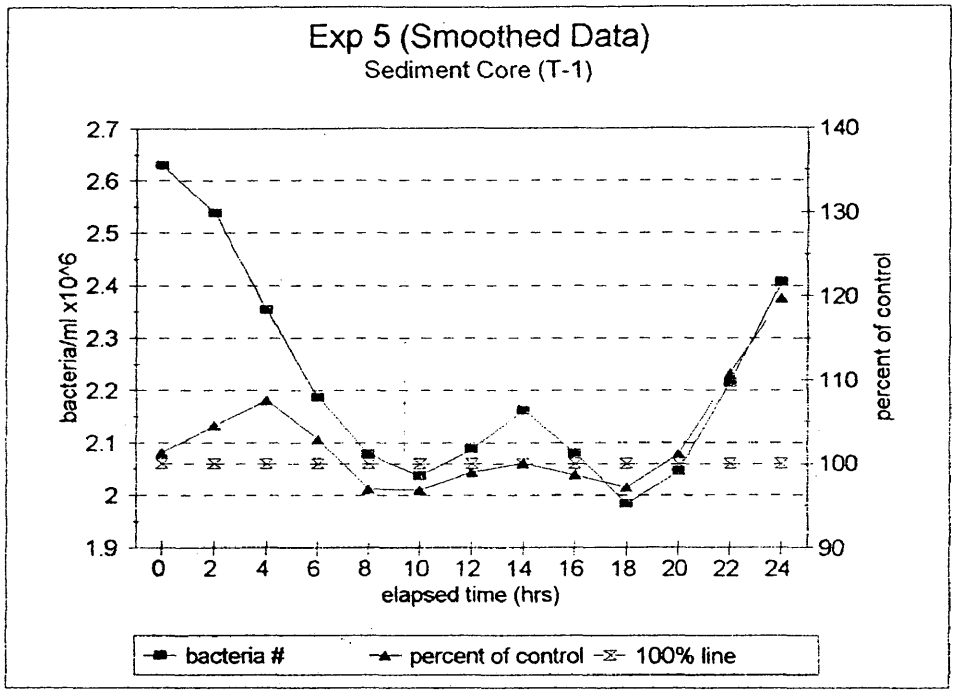

Exp 4 (Smoothed Data)
Filtered Pore Water (T-4)
bacteria/ml x10^6
Percent of control
elapsed time (hrs)
bacteria #
percent of control
100% line

Figure 22. Comparison of the bacterial numbers of the various treatments to that of the control for experiment 5. The bacterial abundance time series were smoothed to reflect the influence of the previous sample abundance on the next.


Exp 5 (Smoothed Data)
Sediment Core (T-1)
bacteria/ml x10^6
percent of control
elapsed time (hrs)
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
140
130
120
110
100
90
0 2 4 6 8 10 12 14 16 18 20 22 24
bacteria #
percent of control
100% line

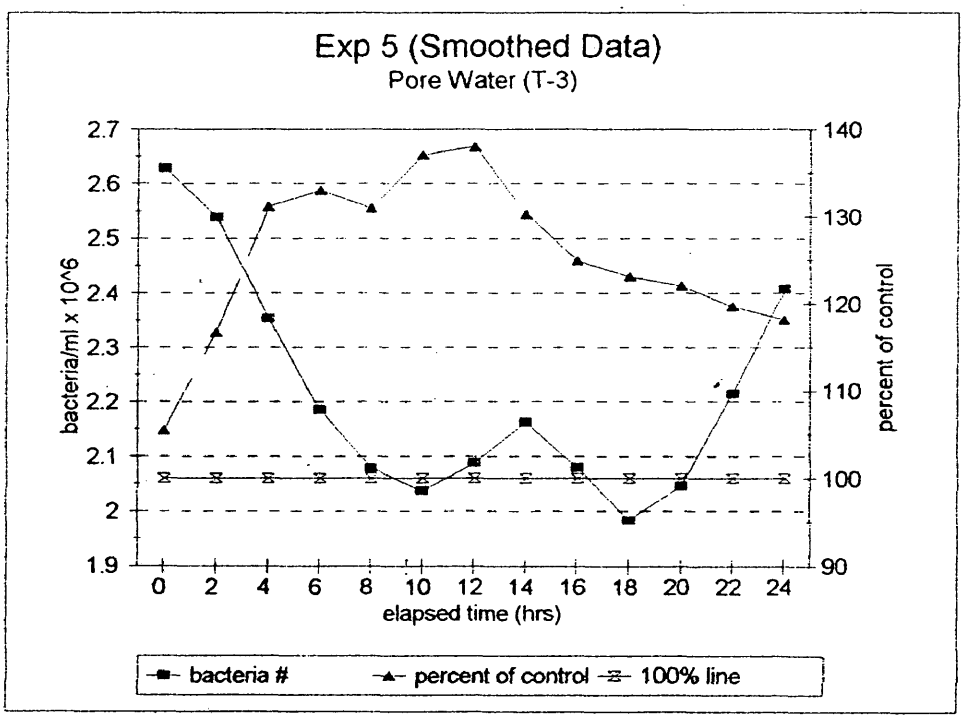
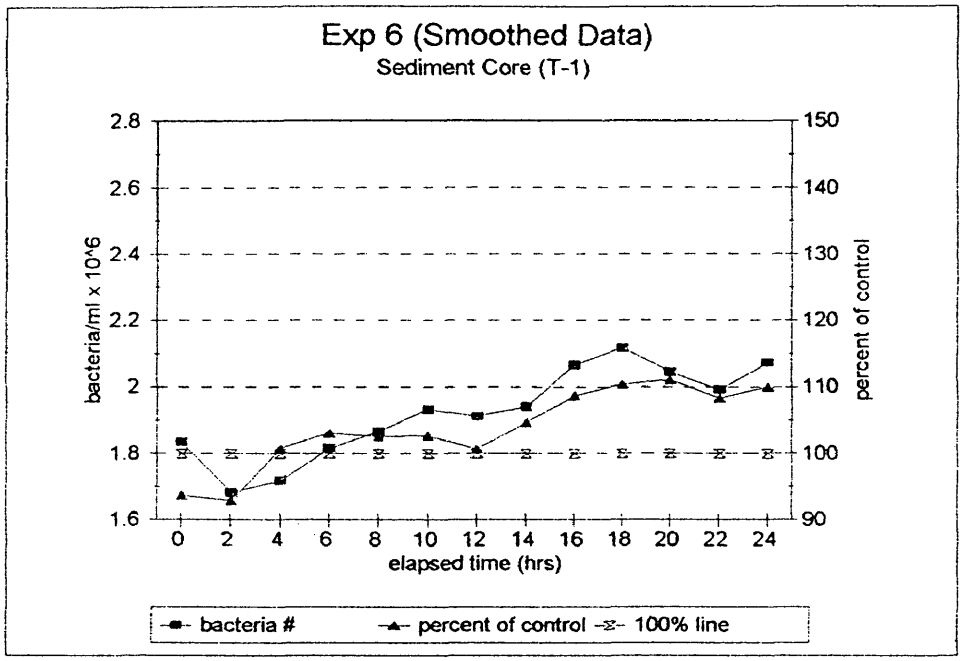
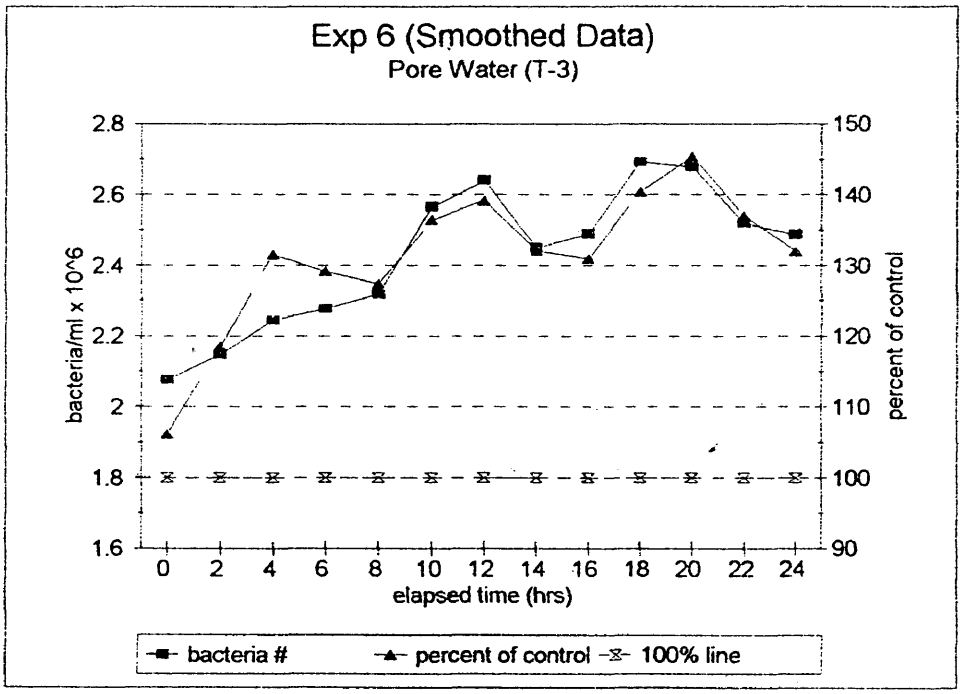

Exp 5 (Smoothed Data)
Pore Water (T-3)
bacteria/ml x 10^6
percent of control
elapsed time (hrs)
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
140
130
120
110
100
90
0 2 4 6 8 10 12 14 16 18 20 22 24
bacteria #
percent of control
100% line

Figure 23. Comparison of the bacterial numbers of the various treatments to that of the control for experiment 6. The bacterial abundance time series were smoothed to reflect the influence of the previous sample abundance on the next.


Exp 6 (Smoothed Data)
Sediment Core (T-1)
bacteria/ml x 10^6
percent of control
elapsed time (hrs)
bacteria #
percent of control
100% line


Exp 6 (Smoothed Data)
Pore Water (T-3)
bacteria/ml x 10^6
percent of control
elapsed time (hrs)
bacteria #
percent of control
100% line

None of the addition treatments' bacterial counts significantly varied from one another over time. This showed that at the lowest pore water addition level (22 ml), the nutrient addition was large enough to remove the possible nutrient limitation of the bacteria. Increasing the levels of nutrients beyond the 22 ml addition had no significant effect on bacterial populations (Table 4). The observation that bacteria, with the addition of filtered pore water, showed greater abundance than the control in all seven of the experiments, strongly suggested that the bacterial populations are at least partially limited by nutrients. However this "bottom-up" control was eliminated by the addition of a minor amount of nutrients. Greater additions had no significant effect on the bacterial population abundance. Either they were at maximal growth rate, or were controlled by grazing ("top-down" control), mortality via pathogens ("side-in") or temperature.

Nutrient level effects:

All of the nutrients measured show a strong ($R^2 > .975$) linear increase as the amount of 0.22 μm filtered pore water was increased (Fig. 15). This was to be expected if the pore water had a nutrient concentration several times higher than the overlying water, as described by Pomeroy et al. (1965), McCaffery, et al. (1980), and Fanning et al. (1982). Based on initial nutrient measurements it would appear that nitrogen was the limiting nutrient since, in the 0 ml addition, it was present, at lower than the Redfield ratios. Nutrient concentrations in the control treatment (0 ml addition) were in the ratio of : Si - 62.4 : N - 0.6 : P - 1.0. Thus, the abundance of nitrogen in the water used for experiment 7 was considered limiting for plankton growth.

CONCLUSIONS

Although no clear bloom event occurred in these experiments, as did in the similar experiments run by Wainright (1987, 1990), the treatments to which a resuspension element was added did maintain higher bacterial numbers than the other treatments. The fact that the addition of unfiltered pore water (T-3) showed the highest bacterial abundance suggested that both the nutrients and the bacteria present in the interstitial water have an impact on increasing the bacterial abundance in the overlying water. The lower abundance of bacteria in the 0.22 μm filtered pore water treatment (T-4) supported this conclusion.

The nutrient analysis of the dose response experiment (experiment 7) clearly showed a strong ($R^2 > .975$) linear increase in all the nutrients analyzed, as the pore water additions increased. The ratios of individual nutrients of experiments 5, 6 and 7 is consistent with nitrogen being the limiting nutrient. However, the bacterial counts of experiment 7 indicated that only a small nutrient addition was necessary to relieve the nutrient limitation. Nutrient additions beyond this level did not increase bacterial numbers. Thus, it would appear that, the release of bacteria from the sediment during a resuspension event along with the nutrient release would be necessary for the greatest bacterial increase.

Appendix

Bacterial Counts - Experiment 1
September 1993 - Cypress Grove (Station 08)
10 grids of a 2 ml sample were counted

	Elapse	Cells/mL			Actual Counts -->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
all	0	1.81	31.1	5.28	29	26	26	39	27	31	29	34	41	29
T-1	2	1.65	28.3	5.66	33	34	17	36	27	24	27	32	28	25
T-1	4	1.67	28.7	2.98	27	31	33	30	28	27	32	30	25	24
T-1	6	1.52	26.1	4.43	25	28	28	24	21	18	27	29	27	34
T-1	8	1.41	24.3	2.95	27	24	20	28	22	27	22	22	23	28
T-1	10	1.49	25.6	3.27	28	27	29	26	29	18	26	25	25	23
T-1	12	1.49	25.6	3.13	27	29	28	22	25	21	27	22	25	30
T-1	14	1.47	25.3	4.95	27	17	24	26	24	26	19	25	32	33
T-1	16	1.48	25.4	5.60	22	29	15	32	20	25	29	33	23	26
T-1	18	1.33	22.9	3.21	19	25	28	22	24	25	17	22	25	22
T-1	20	2.37	40.7	3.50	43	45	41	41	45	41	37	38	42	34
T-1	22	1.39	23.9	4.41	25	22	17	21	33	22	24	27	27	21
T-1	24	1.47	25.2	3.68	28	32	21	25	22	23	28	28	21	24
T-1	26	1.33	22.9	2.96	30	20	24	24	21	21	24	20	23	22
T-1	28	1.33	22.8	2.62	21	28	20	24	24	21	24	19	24	23
T-1	30	1.64	28.2	4.32	26	28	27	35	24	26	26	37	28	25
T-1	32	1.76	30.2	3.19	26	32	28	27	27	35	33	34	30	30
T-1	34	1.89	32.5	3.44	30	30	31	36	40	32	31	31	35	29
T-1	36	1.93	33.2	10.52	24	18	19	26	35	37	42	43	45	43
T-2	2	1.77	30.4	3.41	32	33	36	29	29	31	34	28	25	27
T-2	4	2.01	34.6	2.91	34	31	34	31	37	38	38	38	33	32
T-2	6	1.82	31.3	3.27	29	34	30	29	36	31	26	34	29	35
T-2	8	2.12	36.4	4.74	40	33	43	40	36	36	37	40	32	27
T-2	10	2.07	35.6	5.04	35	40	37	32	44	33	41	36	29	29
T-2	12	2.02	34.8	4.87	40	30	35	35	40	30	34	27	35	42
T-2	14	2.05	35.2	3.71	35	40	37	35	36	37	32	34	39	27
T-2	16	2.07	35.6	4.20	34	45	36	31	30	38	35	38	35	34
T-2	18	2.09	36.0	3.94	33	30	40	38	34	37	43	32	35	38
T-2	20	2.19	37.7	5.98	35	32	36	38	38	33	50	42	43	30
T-2	22	2.01	34.6	4.77	28	36	34	41	34	43	30	32	31	37
T-2	24	1.82	31.3	2.63	29	33	27	32	33	29	36	30	31	33
T-2	26	1.95	33.5	3.69	31	37	32	32	35	38	30	38	27	35
T-2	28	2.05	35.2	3.71	35	40	37	35	36	37	32	34	39	27
T-2	30	1.95	33.5	2.95	33	32	37	28	36	37	34	33	35	30
T-2	32	2.09	36.0	3.89	34	30	38	39	37	35	39	30	42	36
T-2	34	2.26	38.8	4.18	40	39	40	34	32	43	34	43	39	44
T-2	36	2.47	42.5	5.02	45	37	48	39	40	48	34	41	48	45
T-3	2	1.98	34.1	5.47	35	37	37	37	25	41	33	40	27	29
T-3	4	2.04	35.1	3.90	36	38	39	35	33	30	34	28	39	39
T-3	6	2.08	35.7	6.57	25	41	41	34	37	34	32	48	36	29
T-3	8	2.48	42.6	6.24	31	49	38	52	47	41	42	37	43	46
T-3	10	2.32	39.9	3.81	41	39	42	42	33	45	43	39	34	41
T-3	12	2.03	34.9	4.43	40	30	38	35	43	33	32	33	36	29
T-3	14	2.09	36.0	4.40	33	32	39	40	45	34	38	33	31	35
T-3	16	2.35	40.4	5.78	47	37	31	44	45	31	46	42	41	40

Bacterial Counts - Experiment 1
September 1993 - Cypress Grove (Station 08)
10 grids of a 2 ml sample were counted

	Elapse	Cells/mL			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
T-3	18	2.16	37.2	2.94	36	35	37	38	38	36	35	42	42	33
T-3	20	2.63	45.2	3.49	40	51	48	44	41	46	44	46	49	43
T-3	22	2.34	40.2	7.05	29	47	44	47	36	34	44	50	34	37
T-3	24	2.21	38.0	4.90	40	28	36	42	38	35	39	47	37	38
T-3	26	2.17	37.3	4.42	42	38	45	31	42	34	34	37	35	35
T-3	28	1.94	33.4	4.06	34	29	34	34	35	29	42	28	34	35
T-3	30	2.32	39.9	3.07	38	41	39	36	43	41	40	36	39	46
T-3	32	2.30	39.6	3.13	40	38	39	45	41	39	42	42	35	35
T-3	34	2.58	44.3	3.71	47	46	50	41	39	40	46	46	41	47
T-3	36	2.79	47.9	7.28	56	46	46	56	52	35	47	53	51	37
T-4	2	1.74	29.9	5.30	35	24	22	28	29	27	35	39	28	32
T-4	4	1.97	33.9	4.43	36	28	33	30	37	37	27	36	41	34
T-4	6	1.73	29.8	3.65	29	31	30	33	27	25	26	35	35	27
T-4	8	2.08	35.8	3.91	37	39	41	35	35	40	36	36	29	30
T-4	10	2.09	36.0	4.52	36	29	37	33	39	36	36	46	32	36
T-4	12	1.77	30.5	2.32	33	29	34	27	30	33	31	29	31	28
T-4	14	1.84	31.7	3.68	34	29	33	28	39	28	34	30	28	34
T-4	16	2.13	36.7	5.44	33	34	29	43	45	44	33	37	35	34
T-4	18	2.18	37.4	4.45	38	40	42	39	39	27	36	41	39	33
T-4	20	2.65	45.5	5.99	53	54	40	53	41	43	38	48	43	42
T-4	22	2.23	38.4	3.03	36	38	37	45	36	39	40	40	34	39
T-4	24	2.32	39.9	4.20	35	34	46	35	39	41	43	43	44	39
T-4	26	2.16	37.2	6.80	40	30	29	37	40	36	46	38	48	28
T-4	28	1.91	32.8	2.10	35	30	32	32	34	34	31	30	34	36
T-4	30	2.18	37.4	4.84	33	38	36	47	34	37	35	33	45	36
T-4	32	2.09	35.9	4.01	31	39	32	43	38	31	38	36	38	33
T-4	34	2.49	42.9	6.92	35	42	53	42	54	41	32	44	46	40
T-4	36	2.33	40.1	6.95	41	44	31	36	41	36	36	36	44	56
T-5	2	1.57	27.0	4.22	21	29	28	25	25	23	30	36	28	25
T-5	4	1.72	29.5	5.97	33	26	28	29	26	44	30	26	22	31
T-5	6	1.68	28.9	5.74	32	33	27	30	20	28	23	41	27	28
T-5	8	1.61	27.7	4.55	19	32	31	26	28	23	35	27	27	29
T-5	10	1.82	31.3	3.09	33	32	33	30	31	25	37	32	29	31
T-5	12	1.37	23.6	2.55	25	22	25	26	22	22	22	27	26	19
T-5	14	1.58	27.1	3.67	32	23	29	29	22	28	28	32	25	23
T-5	16	1.77	30.4	3.69	27	35	34	26	36	30	26	31	31	28
T-5	18	1.83	31.4	4.65	38	29	28	39	35	27	32	30	31	25
T-5	20	2.04	35.0	3.23	37	36	32	41	35	35	32	34	30	38
T-5	22	1.67	28.7	4.50	31	30	24	27	26	28	25	24	36	36
T-5	24	1.92	33.1	5.24	38	36	30	32	36	39	39	26	25	30
T-5	26	1.80	31.0	2.49	33	29	32	32	33	31	28	35	27	30
T-5	28	1.61	27.7	5.12	28	37	33	25	20	26	26	33	24	25
T-5	30	1.95	33.6	4.53	39	39	34	26	30	33	39	29	35	32
T-5	32	1.81	31.2	4.42	28	35	26	33	26	29	35	27	36	37
T-5	34	1.60	27.5	2.07	25	27	26	31	26	28	25	28	30	29
T-5	36	1.44	24.7	3.95	26	25	26	22	28	24	19	23	33	21

Bacterial Counts - Experiment 2
September 1993 - Cypress Grove (Station 08)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts -->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
all	0	2.37	40.7	3.92	39	41	41	50	37	35	41	40	42	41
T-1	2	1.96	33.7	3.27	32	29	30	38	34	35	37	38	33	31
T-1	4	2.33	40.1	5.26	40	35	34	42	45	45	45	46	37	32
T-1	6	2.40	41.2	6.07	44	41	34	35	45	40	41	52	47	33
T-1	8	2.23	38.3	5.12	47	36	32	33	41	42	37	40	32	43
T-1	10	1.86	32.0	5.27	27	25	28	39	39	30	36	37	28	31
T-1	12	2.09	36.0	4.00	38	36	35	39	44	35	30	33	38	32
T-1	14	2.04	35.1	5.99	47	37	40	37	30	31	27	36	29	37
T-1	16	2.10	36.1	2.28	36	38	32	38	36	35	34	35	40	37
T-1	18	1.99	34.2	3.22	37	29	35	32	37	33	39	34	36	30
T-1	20	2.15	37.0	4.14	38	30	37	36	30	42	41	40	39	37
T-1	22	2.01	34.6	2.59	36	31	35	35	32	32	35	34	36	40
T-1	24	2.33	40.1	5.00	37	37	37	44	47	41	35	35	49	39
T-1	26	2.30	39.6	6.26	37	41	39	31	31	35	49	45	41	47
T-1	28	2.47	42.5	4.38	43	48	47	43	48	36	40	42	42	36
T-1	30	2.24	38.5	3.66	38	30	38	42	41	36	39	40	38	43
T-1	32	2.36	40.5	5.19	37	43	36	30	47	40	45	40	41	46
T-1	34	2.36	40.5	5.19	37	43	36	30	47	40	45	40	41	46
T-1	36	2.57	44.2	5.45	49	49	43	41	39	41	43	56	42	39
T-1	38	2.32	39.9	4.65	44	32	33	39	42	37	41	45	41	45
T-1	40	2.78	47.8	6.58	47	38	36	44	52	52	52	49	56	52
T-1	42	3.06	52.7	4.76	55	59	56	48	58	46	51	53	46	55
T-1	44	3.56	61.2	4.26	62	59	62	60	58	57	62	70	66	56
T-2	2	2.23	38.3	3.62	37	33	40	44	37	39	37	42	41	33
T-2	4	2.77	47.7	7.20	42	40	46	39	49	46	62	45	54	54
T-2	6	2.62	45.1	5.26	54	50	46	51	43	40	45	42	43	37
T-2	8	2.88	49.6	5.89	44	40	47	49	51	44	54	59	53	55
T-2	10	2.24	38.6	3.41	39	44	39	36	34	37	35	44	40	38
T-2	12	2.65	45.6	5.42	40	35	52	46	45	48	45	49	43	53
T-2	14	2.86	49.2	5.90	49	40	50	48	48	45	45	54	62	51
T-2	16	2.98	51.2	2.94	54	50	49	53	46	55	54	51	52	48
T-2	18	2.68	46.0	4.29	40	41	47	45	43	44	54	50	49	47
T-2	20	2.13	36.7	4.74	38	39	38	35	37	47	35	37	29	32
T-2	22	3.23	55.6	9.08	54	44	51	47	68	64	69	60	52	47
T-2	24	3.26	56.0	8.49	48	67	52	58	55	69	54	58	59	40
T-2	26	3.16	54.3	7.90	55	43	48	59	56	68	48	58	62	46
T-2	28	2.83	48.7	6.60	50	41	60	42	53	46	50	47	41	57
T-2	30	2.70	46.5	8.75	40	37	34	48	62	46	53	53	52	40
T-2	32	3.04	52.3	5.03	44	55	54	46	53	55	53	62	50	51
T-2	34	3.04	52.3	5.03	44	55	54	46	53	55	53	62	50	51
T-2	36	2.70	46.4	5.34	47	39	49	41	48	55	52	46	48	39
T-2	38	2.77	47.6	5.99	53	40	36	48	53	46	46	51	55	48
T-2	40	3.33	57.3	8.21	52	46	65	67	69	63	58	49	53	51
T-2	42	2.83	48.6	3.75	43	50	46	49	48	46	53	51	45	55
T-2	44	2.52	43.4	3.31	46	44	40	49	43	40	42	42	40	48
T-3	2	2.49	42.9	6.52	43	49	46	51	47	42	31	47	34	39
T-3	4	3.20	55.0	8.00	66	56	52	45	50	52	70	46	56	57
T-3	6	2.68	46.0	5.10	54	49	46	38	42	43	50	44	42	52
T-3	8	2.57	44.2	4.96	49	53	47	42	39	46	42	38	39	47

Bacterial Counts - Experiment 2
September 1993 - Cypress Grove (Station 08)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts -->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
T-3	10	2.81	48.3	10.25	40	46	47	57	56	71	45	37	43	41
T-3	12	2.59	44.5	5.50	39	39	38	45	48	51	49	43	40	53
T-3	14	3.28	56.4	5.52	60	59	58	58	65	59	49	50	58	48
T-3	16	3.20	55.0	5.66	50	64	56	54	54	50	63	51	48	60
T-3	18	3.13	53.9	6.26	43	52	59	49	52	54	56	54	53	67
T-3	20	3.58	61.5	5.21	60	52	58	70	60	65	59	63	68	60
T-3	22	3.38	58.1	5.74	68	51	63	59	57	50	56	54	59	64
T-3	24	3.31	56.9	7.42	53	58	57	52	72	66	52	57	46	56
T-3	26	3.54	60.9	8.49	48	55	74	51	60	65	58	69	70	59
T-3	28	3.01	51.7	4.79	49	52	44	57	57	49	59	53	48	49
T-3	30	3.05	52.4	6.57	59	53	39	53	48	51	64	50	53	54
T-3	32	3.06	52.7	7.85	53	45	61	59	45	62	62	45	43	52
T-3	34	3.06	52.7	7.85	53	45	61	59	45	62	62	45	43	52
T-3	36	3.04	52.2	7.76	55	41	55	47	58	45	60	54	64	43
T-3	38	3.28	56.4	4.79	51	56	57	56	64	55	62	60	55	48
T-3	40	3.63	62.5	5.58	66	62	63	65	59	52	59	71	69	59
T-3	42	3.07	52.8	5.88	49	59	59	59	46	49	60	53	48	46
T-3	44	3.37	58.0	5.79	58	71	56	55	65	55	54	59	55	52
T-4	2	2.72	46.7	5.85	48	52	51	49	52	40	40	37	45	53
T-4	4	2.84	48.9	6.72	41	55	50	57	47	60	45	50	41	43
T-4	6	2.80	48.1	4.48	53	43	54	50	52	48	43	48	49	41
T-4	8	2.52	43.4	4.67	46	49	40	36	41	47	39	40	48	48
T-4	10	2.68	46.1	4.56	48	51	43	49	43	41	46	43	55	42
T-4	12	2.36	40.5	4.03	41	33	40	41	48	43	38	38	39	44
T-4	14	3.58	61.5	5.93	65	61	65	59	62	70	67	53	62	51
T-4	16	2.98	51.2	5.55	58	53	55	42	54	45	48	59	48	50
T-4	18	2.70	46.4	5.40	40	43	46	40	55	50	46	41	52	51
T-4	20	3.09	53.1	7.16	61	56	58	59	55	42	46	51	60	43
T-4	22	3.30	56.8	3.91	48	56	57	59	58	60	62	53	57	58
T-4	24	3.01	51.8	7.91	52	69	53	46	46	55	52	46	58	41
T-4	26	3.28	56.4	3.75	54	58	51	59	58	57	59	62	50	56
T-4	28	2.77	47.7	5.58	47	46	37	49	46	57	50	42	50	53
T-4	30	2.68	46.0	3.80	49	46	52	48	45	49	47	40	43	41
T-4	32	3.24	55.7	12.16	74	39	47	41	59	44	65	61	59	68
T-4	34	3.24	55.7	12.16	74	39	47	41	59	44	65	61	59	68
T-4	36	3.37	58.0	8.14	69	70	63	56	57	46	62	54	56	47
T-4	38	3.25	55.8	6.61	64	46	60	51	52	66	59	56	56	48
T-4	40	2.98	51.3	4.11	48	55	49	47	53	52	60	53	48	48
T-4	42	2.48	42.6	5.66	40	39	41	37	47	39	38	51	41	53
T-4	44	3.13	53.9	6.33	51	62	50	53	50	49	67	58	51	48
T-5	2	2.18	37.4	3.89	40	35	34	39	38	36	45	36	40	31
T-5	4	2.39	41.1	7.09	35	45	55	37	33	35	47	37	47	40
T-5	6	2.73	47.0	7.04	48	52	41	35	39	53	48	54	56	44
T-5	8	2.34	40.3	4.83	36	37	45	44	41	43	47	38	31	41
T-5	10	2.48	42.6	4.12	40	42	47	48	41	43	48	42	40	35
T-5	12	1.94	33.4	2.95	34	37	39	30	31	35	31	32	34	31
T-5	14	2.52	43.4	4.65	45	49	35	45	43	44	49	36	44	44
T-5	16	2.46	42.3	4.00	40	39	46	47	40	42	39	49	37	44
T-5	18	2.52	43.4	5.32	52	44	34	44	41	51	39	41	43	45

Bacterial Counts - Experiment 2
September 1993 - Cypress Grove (Station 08)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts —>									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
T-5	20	2.40	41.3	4.81	40	42	33	46	45	49	42	41	40	35
T-5	22	2.51	43.2	5.25	51	42	40	43	47	50	33	43	43	40
T-5	24	2.41	41.5	4.17	39	51	42	41	44	39	43	41	35	40
T-5	26	2.72	46.8	4.26	46	43	43	53	49	48	47	42	54	43
T-5	28	1.93	33.2	3.26	29	37	34	31	33	27	34	36	36	35
T-5	30	2.22	38.1	3.78	37	34	34	41	44	43	36	35	41	36
T-5	32	2.40	41.2	4.29	42	36	39	45	42	50	42	41	40	35
T-5	34	2.40	41.2	4.29	42	36	39	45	42	50	42	41	40	35
T-5	36	2.02	34.8	5.55	46	34	34	40	39	29	35	33	30	28
T-5	38	2.20	37.9	5.15	38	43	39	40	48	36	36	32	37	30
T-5	40	2.30	39.5	5.04	44	32	35	38	39	39	34	48	44	42
T-5	42	3.20	55.0	8.64	60	37	61	45	54	52	67	57	57	60
T-5	44	2.54	43.7	7.78	39	54	30	49	33	52	47	43	46	44

Bacterial Counts - Experiment 3a
November 1993 - Tomacini Point (Station 14)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
All	0	2.27	31.4	3.84	31	33	29	36	29	29	36	27	37	27
T-1	2	1.66	23.0	3.56	26	26	26	23	20	26	21	15	23	24
T-1	4	1.67	23.1	5.04	14	27	21	19	22	20	25	30	23	30
T-1	6	1.74	24.1	5.20	23	28	20	18	26	17	33	22	30	24
T-1	8	1.78	24.7	5.23	20	19	17	23	31	24	26	29	33	25
T-1	10	1.63	22.6	5.10	19	15	17	22	28	20	30	23	23	29
T-1	12	1.44	20.0	1.94	18	18	21	18	21	21	24	21	19	19
T-1	14	1.48	20.5	5.15	19	15	20	25	21	29	25	15	13	23
T-1	16	1.26	17.4	4.27	27	11	18	18	20	16	14	16	15	19
T-1	18	1.26	17.4	3.03	19	14	13	16	21	19	21	17	20	14
T-1	20	1.23	17.0	2.40	15	19	16	16	19	13	15	20	20	17
T-1	22	1.06	14.7	1.83	15	14	14	18	15	11	16	14	16	14
T-1	24	1.13	15.6	3.86	12	13	18	12	22	17	16	21	14	11
T-1	26	0.93	12.9	2.51	16	11	10	11	15	12	16	16	11	11
T-1	28	0.91	12.6	2.91	11	10	8	13	16	14	11	13	12	18
T-1	30	0.87	12.0	1.89	9	12	11	15	13	11	15	11	12	11
T-1	32	0.93	12.9	2.92	11	13	8	15	12	10	15	12	18	15
T-1	34	0.79	10.9	2.73	10	13	11	7	12	11	10	17	9	9
T-1	36													
T-1	38													
T-1	40	0.82	11.4	2.76	10	10	8	11	18	13	12	12	11	9
T-1	42	1.07	14.8	2.82	15	12	12	21	13	12	16	15	15	17
T-1	44	0.75	10.4	3.24	11	7	12	12	8	8	11	6	17	12
T-1	46	0.97	13.4	2.72	9	11	17	16	11	14	12	13	14	17
T-1	48	1.23	17.0	3.09	23	15	16	14	16	16	21	18	18	13
T-2	2	2.20	30.5	3.21	32	32	33	25	30	28	32	26	32	35
T-2	4	2.18	30.2	6.55	24	33	42	27	37	32	23	25	35	24
T-2	6	2.01	27.9	3.41	34	29	28	26	30	23	27	25	25	32
T-2	8	2.06	28.6	3.13	24	30	27	32	32	33	25	26	28	29
T-2	10	2.09	28.9	4.91	33	24	28	28	28	21	31	34	25	37
T-2	12	1.90	26.3	4.22	23	29	30	24	19	23	26	26	30	33
T-2	14	2.16	29.9	5.65	24	36	23	28	30	32	25	26	39	36
T-2	16	1.99	27.5	4.67	31	25	26	29	31	30	20	35	27	21
T-2	18	2.02	28.0	5.12	34	28	23	33	27	30	22	36	22	25
T-2	20	1.79	24.8	3.33	24	25	26	30	28	28	24	22	19	22
T-2	22	1.78	24.6	4.25	18	25	22	32	24	22	26	24	31	22
T-2	24	1.76	24.4	2.84	19	28	25	25	26	28	23	21	25	24
T-2	26	1.70	23.5	4.43	16	25	24	26	26	26	23	20	18	31
T-2	28	1.62	22.4	3.37	21	20	21	23	21	21	31	19	23	24
T-2	30	1.60	22.1	5.11	12	24	29	27	18	22	22	18	22	27
T-2	32	1.76	24.4	2.50	25	27	21	26	25	29	24	22	22	23
T-2	34	1.81	25.1	2.18	26	27	22	23	24	23	26	28	24	28
T-2	36													
T-2	38													
T-2	40	1.64	22.7	2.83	21	26	23	19	22	26	22	27	22	19
T-2	42	1.79	24.8	3.12	25	23	26	23	20	25	31	22	25	28
T-2	44	1.75	24.2	2.86	23	21	19	25	24	24	26	27	29	24
T-2	46	2.01	27.9	3.60	23	24	31	32	32	30	25	25	31	26
T-2	48	1.81	25.1	2.81	21	26	25	27	23	26	30	25	21	27
T-3	2	2.14	29.6	4.55	32	27	23	33	29	35	29	22	35	31
T-3	4	2.27	31.4	3.13	29	34	36	29	31	34	34	29	32	26
T-3	6	2.35	32.5	2.27	29	31	31	33	32	31	36	34	36	32
T-3	8	2.27	31.5	4.12	32	33	29	24	30	32	32	37	28	38

Bacterial Counts - Experiment 3a
November 1993 - Tomacini Point (Station 14)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
T-3	10	2.15	29.8	3.16	30	34	34	26	26	32	30	27	32	27
T-3	12	1.97	27.3	3.06	24	30	32	28	27	28	23	23	29	29
T-3	14	2.36	32.7	5.25	26	32	29	28	39	29	29	37	40	38
T-3	16	2.35	32.5	6.20	42	33	36	25	32	41	28	23	34	31
T-3	18	1.78	24.7	4.00	20	24	28	17	31	25	27	27	24	24
T-3	20	2.01	27.8	2.86	29	28	26	25	30	22	32	28	30	28
T-3	22	1.73	24.0	3.46	23	30	17	24	23	23	27	27	23	23
T-3	24	1.83	25.4	5.38	28	29	30	18	24	20	34	23	29	19
T-3	26	1.44	19.9	2.73	19	20	26	20	18	23	18	17	20	18
T-3	28	1.45	20.1	4.58	28	15	25	13	19	20	17	20	20	24
T-3	30	1.84	25.5	3.41	25	22	24	22	32	22	30	27	26	25
T-3	32													
T-3	34	1.85	25.6	2.12	27	27	24	29	22	26	26	27	25	23
T-3	36													
T-3	38													
T-3	40	1.68	23.3	3.95	22	27	28	23	18	21	27	28	21	18
T-3	42	1.87	25.9	3.67	20	28	19	27	28	26	27	30	29	25
T-3	44	2.12	29.3	3.53	27	33	33	25	34	24	32	29	28	28
T-3	46	1.76	24.4	3.84	24	24	20	28	30	25	21	20	30	22
T-3	48	1.93	26.7	1.95	28	28	28	23	26	26	26	25	27	30
T-4	2	2.11	29.2	4.64	23	23	29	33	29	26	31	37	27	34
T-4	4	2.32	32.2	4.42	34	32	34	43	30	29	27	29	32	32
T-4	6	1.88	26.0	4.88	20	23	24	26	22	27	34	28	22	34
T-4	8	2.01	27.9	2.60	26	33	23	27	27	30	28	29	28	28
T-4	10	1.88	26.0	3.33	22	26	26	25	24	22	27	25	31	32
T-4	12	1.81	25.1	4.38	23	19	19	28	22	30	31	24	29	26
T-4	14	1.97	27.3	4.19	34	32	26	20	26	29	25	24	31	26
T-4	16	1.81	25.1	3.03	27	21	26	27	21	23	25	31	24	26
T-4	18	2.22	30.8	4.32	26	32	35	28	39	34	28	28	26	32
T-4	20	1.83	25.4	3.63	24	26	20	28	26	28	19	26	26	31
T-4	22	1.58	21.9	2.51	23	18	19	21	24	21	26	20	24	23
T-4	24	1.63	22.6	3.84	17	21	26	23	30	22	22	26	20	19
T-4	26	1.68	23.3	4.14	20	19	28	20	24	28	30	21	24	19
T-4	28	1.47	20.4	3.10	17	19	24	22	22	15	23	24	18	20
T-4	30	1.59	22.0	3.27	21	29	20	21	21	25	23	20	17	23
T-4	32	1.68	23.3	4.95	16	30	22	22	25	25	25	17	20	31
T-4	34	1.48	20.5	2.37	20	25	19	17	20	21	18	23	22	20
T-4	36													
T-4	38													
T-4	40	1.39	19.3	3.68	18	15	25	15	24	17	17	23	18	21
T-4	42	1.64	22.7	3.20	24	21	22	18	19	25	21	29	24	24
T-4	44	1.73	24.0	3.13	25	24	26	21	24	28	28	25	20	19
T-4	46	1.68	23.2	3.99	18	21	19	19	28	24	29	25	27	22
T-4	48	2.01	27.8	4.87	24	28	27	34	30	23	27	37	27	21
T-5	2	2.14	29.7	2.79	25	30	28	29	35	28	29	33	31	29
T-5	4	2.30	31.8	4.44	32	28	36	24	28	31	30	35	36	38
T-5	6	2.01	27.8	4.24	26	23	29	29	35	22	32	23	29	30
T-5	8	2.08	28.8	3.85	28	23	29	37	29	29	26	27	33	27
T-5	10	1.99	27.5	4.43	29	22	22	23	27	30	26	30	36	30
T-5	12	1.68	23.2	4.32	30	18	25	29	23	16	23	21	24	23
T-5	14	1.77	24.5	3.57	24	27	22	30	27	25	17	25	22	26
T-5	16	2.01	27.8	3.77	29	27	27	27	35	31	21	26	25	30
T-5	18	1.75	24.2	3.55	29	21	27	29	22	27	22	22	24	19

Bacterial Counts - Experiment 3a
November 1993 - Tomacini Point (Station 14)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
T-5	20	1.29	17.9	3.57	21	19	21	10	17	16	15	19	19	22
T-5	22	1.50	20.8	4.21	22	25	17	21	24	23	19	12	26	19
T-5	24	1.52	21.1	2.60	22	19	19	21	20	26	24	23	19	18
T-5	26	1.42	19.6	2.99	23	20	22	21	18	21	21	21	15	14
T-5	28	1.68	23.2	2.25	20	21	26	25	25	25	25	21	23	21
T-5	30	1.58	21.9	2.73	24	18	19	23	26	21	25	21	23	19
T-5	32	1.93	26.7	3.06	27	30	31	23	22	27	30	24	27	26
T-5	34	1.67	23.1	3.28	24	21	20	20	21	25	19	28	27	26
T-5	36													
T-5	38													
T-5	40	1.57	21.8	3.08	18	24	20	23	25	21	17	22	27	21
T-5	42	1.63	22.6	4.30	20	14	23	20	21	27	28	21	27	25
T-5	44	1.63	22.6	2.95	18	23	24	22	19	25	21	26	27	21
T-5	46	1.55	21.4	4.06	19	29	18	18	21	22	28	19	18	22
T-5	48	1.80	24.9	3.03	30	20	27	23	24	27	27	21	25	25

Bacterial Counts - Experiment 3b
November 1993 - Tomacini Point (Station 14)
10 grids of a 2ml sample were counted

	Elapse	Cells/ml			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
All	0	1.62	22.4	4.67	22	15	21	16	20	27	27	29	22	25
T-1	2	0.79	10.9	3.60	15	10	9	11	8	17	8	15	10	6
T-1	4	1.42	19.7	3.27	19	21	20	24	24	16	15	17	18	23
T-1	6	1.21	16.7	3.71	20	17	14	13	15	20	22	10	19	17
T-1	8	1.16	16.1	3.14	23	14	19	15	15	16	14	15	18	12
T-1	10	1.14	15.8	2.20	12	15	16	18	13	17	14	18	18	17
T-1	12	1.10	15.3	1.95	17	13	14	15	19	14	17	16	13	15
T-1	14	1.00	13.8	3.88	18	16	7	11	13	20	16	13	10	14
T-1	16	0.84	11.6	4.03	10	8	10	6	11	13	9	20	15	14
T-1	18	1.03	14.2	2.78	16	14	10	10	16	14	14	13	19	16
T-1	20	1.23	17.1	3.84	15	13	17	21	14	16	23	12	22	18
T-1	22	0.95	13.1	2.47	13	13	15	15	13	11	17	14	8	12
T-1	24	0.95	13.2	3.19	12	10	13	12	12	11	16	20	16	10
T-1	26	0.64	8.9	1.91	9	7	11	9	12	11	9	7	7	7
T-1	28	0.67	9.3	3.09	11	14	7	8	7	7	6	15	9	9
T-1	30	0.79	10.9	3.75	6	7	6	17	10	10	14	14	12	13
T-1	32	0.82	11.3	1.89	10	9	10	12	13	13	12	8	13	13
T-1	34	0.77	10.7	2.98	6	14	12	8	8	12	11	14	14	8
T-1	36													
T-1	38													
T-1	40	0.79	11.0	1.76	8	10	11	12	14	12	12	12	9	10
T-1	42	0.82	11.4	3.44	17	12	10	11	8	7	9	13	17	10
T-1	44	0.66	9.1	3.00	11	4	10	12	7	6	12	7	9	13
T-1	46	0.71	9.9	1.37	8	8	10	9	10	11	11	9	12	11
T-1	48	0.77	10.6	2.59	15	9	13	7	10	9	9	9	11	14
T-2	2	1.40	19.4	3.27	16	13	18	20	21	23	24	21	18	20
T-2	4	1.94	26.9	2.85	26	28	20	27	28	30	30	26	28	26
T-2	6	1.70	23.6	3.86	25	28	18	22	27	24	21	29	24	18
T-2	8	1.78	24.6	3.06	31	26	26	24	22	21	21	24	24	27
T-2	10	1.42	19.6	4.99	23	14	19	12	25	16	25	23	15	24
T-2	12	1.77	24.5	3.34	28	28	22	22	19	25	30	23	24	24
T-2	14	1.65	22.9	3.90	20	26	24	26	23	19	17	19	27	28
T-2	16	1.74	24.1	4.56	29	26	18	21	18	22	24	32	27	24
T-2	18	2.01	27.9	3.96	25	29	30	29	27	26	37	26	28	22
T-2	20	1.78	24.7	3.62	25	22	18	24	24	24	30	30	27	23
T-2	22	1.47	20.3	3.02	21	17	24	17	17	21	22	24	17	23
T-2	24	1.67	23.1	4.01	20	31	17	22	19	26	24	23	23	26
T-2	26	1.35	18.7	4.69	13	15	15	23	20	25	24	19	12	21
T-2	28	1.45	20.1	1.97	17	20	19	23	19	21	23	18	21	20
T-2	30	1.48	20.5	2.99	22	23	21	19	19	14	21	25	19	22
T-2	32	1.55	21.4	3.37	17	18	28	21	18	21	21	22	23	25
T-2	34	1.56	21.6	2.67	23	19	26	23	24	23	21	17	20	20
T-2	36													
T-2	38													
T-2	40	1.47	20.4	2.80	24	21	19	20	26	17	18	18	21	20
T-2	42	1.61	22.3	3.43	21	19	18	26	17	23	27	25	23	24
T-2	44	1.24	17.2	2.57	17	19	19	13	13	16	17	20	20	18
T-2	46	1.34	18.6	3.34	18	18	14	17	17	15	22	23	24	18

Bacterial Counts - Experiment 3b
November 1993 - Tomacini Point (Station 14)
10 grids of a 2ml sample were counted

	Elapse	Cells/ml			Actual Counts -->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
T-2	48	1.44	19.9	2.42	20	20	21	20	15	23	18	18	23	21
T-3	2	1.76	24.4	4.25	28	18	26	21	26	25	33	21	22	24
T-3	4	1.98	27.4	3.27	26	27	25	26	32	31	32	26	22	27
T-3	6	2.22	30.7	3.74	33	31	34	24	26	35	31	29	29	35
T-3	8	1.80	25.0	3.74	28	19	26	24	29	24	30	19	26	25
T-3	10	1.66	23.0	3.33	26	28	21	19	19	20	23	27	22	25
T-3	12	1.91	26.5	4.33	27	30	24	26	33	22	18	28	30	27
T-3	14	1.93	26.7	3.62	23	25	30	20	29	31	25	27	31	26
T-3	16	1.75	24.2	3.52	22	28	27	23	26	19	26	26	27	18
T-3	18	2.12	29.4	4.70	34	23	34	33	25	22	32	27	31	33
T-3	20	1.78	24.7	2.54	21	25	29	26	23	23	28	22	25	25
T-3	22	2.03	28.1	3.25	28	30	33	25	33	23	29	26	27	27
T-3	24	2.09	29.0	5.06	24	28	26	33	29	39	22	27	34	28
T-3	26	1.70	23.6	4.20	22	30	27	20	22	24	20	17	25	29
T-3	28	1.74	24.1	3.00	26	21	28	24	23	26	21	26	19	27
T-3	30	1.76	24.4	3.63	26	27	19	24	26	17	27	26	28	24
T-3	32	1.88	26.0	4.88	23	31	29	25	25	27	22	22	36	20
T-3	34	1.88	26.0	5.44	23	21	23	29	22	40	25	26	26	25
T-3	36													
T-3	38													
T-3	40	1.74	24.1	1.45	25	26	22	22	23	24	24	24	26	25
T-3	42	1.68	23.2	3.26	20	19	25	24	18	26	23	23	27	27
T-3	44	2.02	28.0	3.80	23	29	33	27	25	35	29	25	29	25
T-3	46	1.56	21.6	2.99	20	26	16	25	23	23	23	21	20	19
T-3	48	1.61	22.3	2.26	22	20	24	18	23	24	23	25	24	20
T-4	2	1.46	20.2	3.55	15	18	25	25	19	24	18	19	17	22
T-4	4	1.63	22.6	3.69	26	19	23	22	25	17	27	18	27	22
T-4	6	1.68	23.3	2.45	22	21	22	25	20	24	28	22	26	23
T-4	8	1.43	19.8	4.42	23	18	15	13	29	19	21	22	19	19
T-4	10	1.57	21.8	2.53	20	22	20	25	22	24	18	26	21	20
T-4	12	1.55	21.5	3.14	25	24	20	22	22	18	18	21	27	18
T-4	14	1.75	24.2	3.65	29	22	29	25	22	22	22	18	25	28
T-4	16	1.55	21.4	2.76	23	21	23	20	16	21	24	20	26	20
T-4	18	1.04	14.4	3.44	12	14	10	12	18	21	17	11	14	15
T-4	20	1.73	24.0	4.62	22	26	28	23	26	32	15	25	20	23
T-4	22	1.45	20.1	4.75	14	13	23	14	22	24	20	24	21	26
T-4	24	1.54	21.3	3.83	22	15	18	23	24	17	26	26	19	23
T-4	26	1.64	22.7	4.67	17	16	23	28	20	24	29	23	19	28
T-4	28	1.35	18.7	2.95	14	17	19	21	22	20	18	20	22	14
T-4	30	1.51	20.9	4.20	17	17	22	25	19	30	17	19	20	23
T-4	32	1.45	20.1	3.48	18	17	20	19	19	18	19	18	26	27
T-4	34	1.75	24.3	5.72	19	27	26	33	23	15	24	18	31	27
T-4	36													
T-4	38													
T-4	40	1.76	24.4	3.84	24	27	25	19	29	28	28	19	25	20
T-4	42	1.80	24.9	3.78	29	32	24	22	28	24	20	22	26	22
T-4	44	1.51	20.9	2.64	24	18	19	18	25	23	18	22	20	22
T-4	46	1.51	20.9	3.14	18	20	21	20	19	21	18	21	29	22

Bacterial Counts - Experiment 3b
November 1993 - Tomacini Point (Station 14)
10 grids of a 2ml sample were counted

	Elapse	Cells/ml			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
T-4	48	1.57	21.8	3.16	19	28	23	20	22	23	19	17	24	23
T-5	2	1.64	22.7	3.16	23	19	29	25	19	21	20	24	22	25
T-5	4	1.57	21.7	3.37	23	16	20	18	24	20	22	28	23	23
T-5	6	1.47	20.4	4.20	21	24	21	17	20	11	26	20	20	24
T-5	8	1.46	20.2	2.44	22	19	18	18	17	22	18	24	22	22
T-5	10	1.41	19.5	3.24	18	19	24	19	15	17	20	19	18	26
T-5	12	1.42	19.6	2.27	18	16	24	19	18	19	20	22	19	21
T-5	14	1.55	21.5	3.98	15	21	22	18	24	21	28	24	25	17
T-5	16	1.74	24.1	5.82	13	26	22	22	31	25	23	18	31	30
T-5	18	1.57	21.8	2.78	24	24	19	24	17	19	25	24	21	21
T-5	20	1.37	19.0	2.98	19	19	17	17	24	20	19	22	13	20
T-5	22	1.29	17.9	4.36	18	25	25	21	15	16	14	17	15	13
T-5	24	1.42	19.6	4.14	12	21	22	17	24	19	23	14	20	24
T-5	26	1.13	15.7	3.74	22	15	11	14	16	12	16	13	16	22
T-5	28	1.39	19.3	4.27	25	16	22	12	23	18	23	15	22	17
T-5	30	1.19	16.5	3.44	17	18	16	11	17	18	21	18	10	19
T-5	32	1.36	18.9	3.67	19	17	21	20	13	19	16	22	16	26
T-5	34	1.62	22.4	2.27	22	26	20	24	18	21	23	24	23	23
T-5	36													
T-5	38													
T-5	40	1.29	17.9	2.64	21	17	15	19	16	20	19	21	18	13
T-5	42	1.43	19.8	5.47	30	20	12	17	24	18	15	20	16	26
T-5	44	1.31	18.2	3.29	18	18	20	20	21	16	12	14	22	21
T-5	46	1.17	16.2	3.26	19	13	14	11	19	14	19	15	17	21
T-5	48	1.41	19.5	2.01	20	20	18	20	17	20	23	17	18	22

Bacterial Counts - Experiment 4a
November 1993 - Cypress Grove (Station 08)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
All	0	1.96	27.2	5.75	23	35	17	26	24	27	34	28	34	24
T-1	2	1.83	25.3	5.64	25	31	25	23	22	23	39	22	20	23
T-1	4	1.46	20.2	3.88	14	22	19	26	14	22	23	20	23	19
T-1	6	1.32	18.3	4.72	17	14	21	16	25	16	16	25	22	11
T-1	8	1.29	17.9	3.78	20	24	16	24	12	17	17	15	17	17
T-1	10	1.49	20.6	3.27	22	22	25	23	18	24	16	22	17	17
T-1	12	1.38	19.1	3.60	16	22	24	15	23	16	17	15	21	22
T-1	14	1.34	18.5	2.92	19	20	22	16	15	20	18	23	14	18
T-1	16	1.26	17.4	4.60	17	17	23	15	16	25	10	14	15	22
T-1	18	1.13	15.7	5.03	18	12	8	12	12	14	22	24	19	16
T-1	20	1.29	17.8	3.85	20	16	17	23	14	21	10	21	19	17
T-1	22	1.34	18.5	2.76	21	18	12	19	17	18	18	22	20	20
T-1	24	1.31	18.1	3.35	14	18	21	12	15	19	22	20	21	19
T-1	26	1.50	20.8	4.21	14	17	18	21	21	22	25	22	29	19
T-1	28	1.59	22.0	3.59	17	22	25	26	24	18	26	21	24	17
T-1	30	1.44	19.9	2.85	22	23	18	24	18	23	19	19	16	17
T-1	32	1.60	22.1	2.96	19	21	24	20	27	19	21	22	21	27
T-1	34	1.26	17.4	2.95	18	13	17	21	19	14	16	22	15	19
T-1	36	1.57	21.7	5.52	26	18	20	27	11	23	21	21	31	19
T-1	38	1.44	20.0	2.26	20	17	17	19	23	21	20	19	20	24
T-1	40	1.13	15.7	4.14	16	11	15	24	17	21	11	13	14	15
T-1	42	1.58	21.9	3.90	27	21	24	25	18	27	20	23	18	16
T-1	44	1.70	23.6	3.31	22	29	20	21	21	26	21	22	26	28
T-1	46	1.52	21.0	4.14	16	16	19	20	26	25	19	24	27	18
T-1	48	1.96	27.1	3.41	28	34	29	26	27	21	27	24	29	26
T-2	2	1.65	22.8	1.81	25	21	26	21	21	23	23	21	23	24
T-2	4	1.60	22.1	4.01	20	19	22	16	23	24	18	23	27	29
T-2	6	1.78	24.7	5.03	32	19	21	21	29	31	27	27	21	19
T-2	8	1.63	22.6	2.46	18	21	23	23	22	27	22	21	25	24
T-2	10	2.06	28.5	5.32	24	29	32	34	27	32	31	35	20	21
T-2	12	1.75	24.2	4.18	19	22	31	23	31	20	23	24	27	22
T-2	14	1.78	24.7	4.14	19	29	27	26	19	27	20	23	30	27
T-2	16	2.01	27.8	4.69	19	27	25	24	29	31	26	31	36	30
T-2	18	1.63	22.6	3.34	22	28	23	18	18	23	21	26	26	21
T-2	20	1.59	22.0	3.37	24	23	23	24	19	27	19	25	20	16
T-2	22	1.56	21.6	4.81	13	22	27	17	23	26	17	21	28	22
T-2	24	1.88	26.1	2.18	24	27	27	27	24	25	24	25	31	27
T-2	26	1.87	25.9	4.15	22	18	28	28	28	23	24	26	31	31
T-2	28	2.02	28.0	4.69	22	21	32	27	31	28	27	37	29	26
T-2	30													
T-2	32	1.64	22.7	2.45	26	18	22	26	24	22	21	24	23	21
T-2	34	1.84	25.5	4.33	23	18	23	23	30	23	25	31	28	31
T-2	36	1.99	27.6	3.60	28	23	31	29	30	29	27	33	24	22
T-2	38	1.79	24.8	3.19	21	21	21	26	29	28	27	28	24	23
T-2	40	1.99	27.5	4.17	29	27	23	27	31	25	36	28	21	28
T-2	42	1.78	24.6	1.96	24	25	24	21	22	26	27	25	27	25
T-2	44	1.88	26.1	2.56	26	23	26	31	22	28	26	28	26	25
T-2	46	1.93	26.8	2.97	26	28	29	26	27	31	29	27	20	25

Bacterial Counts - Experiment 4a
November 1993 - Cypress Grove (Station 08)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
T-2	48	1.96	27.2	3.49	21	27	29	25	26	25	33	27	27	32
T-3	2	2.16	29.9	4.51	35	23	28	24	32	28	32	37	28	32
T-3	4	2.30	31.9	5.97	24	23	36	41	34	28	39	33	29	32
T-3	6	2.13	29.5	5.54	26	33	25	43	32	27	24	29	29	27
T-3	8	2.19	30.4	5.23	27	27	33	43	27	26	31	27	34	29
T-3	10	2.69	37.3	4.76	45	36	36	39	34	41	38	27	37	40
T-3	12	2.19	30.4	2.72	27	33	34	34	30	29	28	32	27	30
T-3	14	2.05	28.4	3.20	23	27	33	29	34	28	29	26	28	27
T-3	16	2.12	29.3	2.83	31	26	31	31	27	26	31	26	30	34
T-3	18	1.81	25.1	3.07	28	30	24	21	25	26	23	29	22	23
T-3	20	1.80	24.9	3.81	22	25	28	25	23	23	29	19	23	32
T-3	22	2.16	29.9	4.28	25	26	24	33	29	32	27	35	36	32
T-3	24	2.04	28.3	2.67	27	26	28	29	30	31	24	26	33	29
T-3	26	2.08	28.8	4.64	25	31	37	33	26	23	33	25	30	25
T-3	28	2.21	30.6	4.77	30	24	29	36	25	34	32	34	37	25
T-3	30	1.83	25.4	4.45	30	28	27	20	34	22	24	24	25	20
T-3	32	2.04	28.3	3.59	27	25	28	26	26	30	31	27	37	26
T-3	34	2.09	28.9	4.56	30	30	36	36	26	23	25	24	29	30
T-3	36	2.39	33.1	3.48	30	27	31	35	36	36	32	33	39	32
T-3	38	2.14	29.7	3.30	27	28	27	31	37	26	33	29	29	30
T-3	40	2.45	34.0	5.33	28	39	32	33	25	33	31	39	41	39
T-3	42	2.05	28.4	3.72	28	28	31	28	29	27	35	29	29	20
T-3	44	2.35	32.5	2.46	33	30	34	33	34	33	36	32	33	27
T-3	46	2.17	30.0	4.59	35	29	29	24	36	25	32	24	31	35
T-3	48	2.19	30.3	3.47	29	27	29	26	31	28	32	33	38	30
T-4	2	1.66	23.0	2.00	22	23	24	24	21	21	22	27	25	21
T-4	4	1.91	26.4	4.45	27	25	25	23	19	36	25	29	29	26
T-4	6	1.73	24.0	3.06	24	21	22	25	23	27	23	23	21	31
T-4	8	1.82	25.2	3.49	28	23	27	24	21	32	22	22	28	25
T-4	10													
T-4	12	1.73	23.9	5.45	23	25	18	29	23	29	16	17	28	31
T-4	14	2.14	29.6	4.93	35	29	32	30	29	32	23	20	36	30
T-4	16	1.85	25.6	3.95	20	25	19	30	26	27	31	24	25	29
T-4	18	1.83	25.3	3.16	24	32	24	24	25	27	21	22	26	28
T-4	20	1.58	21.9	3.96	26	22	24	18	25	19	17	29	19	20
T-4	22	1.72	23.8	2.53	24	23	20	21	24	23	26	23	25	29
T-4	24	1.39	19.2	2.35	22	16	18	18	19	16	20	19	23	21
T-4	26	1.97	27.3	3.40	30	24	29	31	27	31	28	26	20	27
T-4	28	1.87	25.9	4.15	31	20	31	29	20	23	28	27	27	23
T-4	30	1.62	22.4	3.27	25	19	24	21	18	29	23	20	21	24
T-4	32	1.67	23.1	2.64	19	23	24	24	23	24	23	21	21	29
T-4	34	1.53	21.2	3.16	17	22	15	24	21	25	22	20	24	22
T-4	36	1.97	27.3	5.06	28	21	27	34	23	29	19	32	27	33
T-4	38	1.79	24.8	3.52	22	33	22	23	29	25	23	24	24	23
T-4	40	2.04	28.2	4.29	25	21	25	27	32	32	29	36	27	28
T-4	42	1.49	20.6	3.10	15	24	16	23	23	22	23	21	20	19
T-4	44	1.82	25.2	3.33	28	24	18	25	29	27	23	25	24	29
T-4	46	1.88	26.1	4.04	22	24	29	23	28	26	34	20	27	28

Bacterial Counts - Experiment 4a
November 1993 - Cypress Grove (Station 08)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
T-4	48	2.08	28.8	5.55	22	38	26	30	25	20	33	29	33	32
T-5	2	1.73	23.9	4.68	20	31	28	16	22	22	29	21	27	23
T-5	4	1.73	24.0	3.43	23	27	20	26	26	19	26	19	27	27
T-5	6	1.72	23.8	2.90	27	20	23	21	27	25	25	26	19	25
T-5	8	1.59	22.0	3.50	21	18	26	29	24	23	19	21	19	20
T-5	10	1.64	22.7	3.06	20	25	20	26	23	23	17	22	27	24
T-5	12	1.68	23.3	2.21	25	24	22	26	24	22	20	20	26	24
T-5	14	1.83	25.4	2.84	21	27	23	24	25	22	29	27	29	27
T-5	16	1.73	23.9	2.69	24	22	23	22	30	25	20	25	23	25
T-5	18	1.44	19.9	3.51	16	20	14	21	22	20	16	25	23	22
T-5	20	1.36	18.8	3.16	23	14	14	16	21	22	20	20	19	19
T-5	22	1.41	19.5	2.59	20	16	21	19	19	21	21	24	19	15
T-5	24	1.34	18.5	4.53	22	15	13	16	24	18	18	12	24	23
T-5	26	1.53	21.2	2.82	26	19	22	19	18	18	20	24	24	22
T-5	28	1.36	18.9	2.08	17	17	21	20	15	18	21	21	20	19
T-5	30	1.42	19.7	2.91	21	24	19	18	19	20	21	20	22	13
T-5	32	1.36	18.9	2.73	20	23	21	19	18	19	19	14	15	21
T-5	34	1.62	22.5	5.10	21	30	23	14	18	24	25	29	24	17
T-5	36	1.63	22.6	3.27	23	26	18	18	20	23	25	22	28	23
T-5	38	1.44	20.0	3.94	24	15	18	20	25	18	18	18	17	27
T-5	40	1.82	25.2	4.34	26	28	28	25	31	30	25	20	21	18
T-5	42	1.80	25.0	5.75	22	19	18	22	24	29	36	29	30	21
T-5	44	1.62	22.4	4.70	15	20	29	22	17	20	29	26	22	24
T-5	46	1.77	24.5	2.51	27	25	22	24	24	22	24	28	21	28
T-5	48	1.68	23.3	2.98	19	27	26	22	22	22	25	19	27	24

Bacterial Counts - Experiment 4b
November 1993 - Cypress Grove (Station 08)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
All	0	1.96	27.2	5.75	23	35	17	26	24	27	34	28	34	24
T-1	2	1.52	21.1	3.35	18	23	23	24	20	23	26	15	18	21
T-1	4	1.36	18.9	3.45	15	22	22	18	20	15	22	22	13	20
T-1	6	1.22	16.9	2.33	18	16	22	15	17	15	17	19	16	14
T-1	8	1.36	18.8	2.25	17	18	20	17	16	18	18	22	23	19
T-1	10	1.31	18.2	4.10	17	14	18	15	20	26	23	20	13	16
T-1	12	1.29	17.8	3.29	14	20	15	18	24	14	18	20	20	15
T-1	14	1.30	18.0	2.16	15	20	17	19	18	16	19	21	15	20
T-1	16	1.22	16.9	3.14	22	18	12	18	16	15	17	21	17	13
T-1	18	1.23	17.1	1.79	16	17	21	17	17	19	15	15	17	17
T-1	20	1.20	16.6	4.95	22	16	15	13	18	14	12	15	28	13
T-1	22	1.36	18.9	3.31	21	19	17	15	25	23	20	17	16	16
T-1	24	1.30	18.0	2.49	16	16	16	16	21	19	19	18	16	23
T-1	26	1.36	18.9	3.51	16	16	18	21	24	20	19	12	22	21
T-1	28	0.97	13.5	1.72	14	13	16	12	15	11	15	11	14	14
T-1	30	1.35	18.7	3.33	25	22	14	21	18	20	17	15	18	17
T-1	32	1.19	16.5	1.72	16	18	13	17	18	18	17	15	18	15
T-1	34	1.34	18.6	2.99	14	20	14	17	17	21	19	22	22	20
T-1	36	1.45	20.1	3.35	17	23	20	22	15	20	24	22	23	15
T-1	38	1.45	20.1	2.96	16	22	19	26	19	22	22	18	20	17
T-1	40	1.34	18.5	2.37	16	19	17	17	20	24	17	18	17	20
T-1	42	1.42	19.6	3.84	23	21	27	19	17	22	20	16	17	14
T-1	44	1.70	23.6	4.06	29	25	24	16	29	27	22	21	21	22
T-1	46	1.68	23.2	3.77	27	16	20	26	27	22	25	25	19	25
T-1	48	1.31	18.1	2.23	16	21	20	18	19	17	21	17	14	18
T-2	2	1.65	22.8	3.33	19	17	25	24	23	27	22	27	20	24
T-2	4	1.36	18.8	2.44	17	20	22	15	22	17	16	20	19	20
T-2	6	1.45	20.1	3.03	18	16	22	22	21	17	22	26	18	19
T-2	8	1.46	20.2	4.02	17	18	18	22	25	15	15	25	24	23
T-2	10	1.56	21.6	3.44	17	22	28	18	24	25	22	19	22	19
T-2	12	1.62	22.4	3.92	18	19	26	30	23	22	21	21	26	18
T-2	14	1.54	21.3	3.83	24	20	29	20	21	25	19	20	15	20
T-2	16	1.38	19.1	3.51	22	17	14	15	16	20	20	25	22	20
T-2	18	1.51	20.9	4.98	20	16	18	29	18	14	21	22	22	29
T-2	20	1.88	26.1	5.28	27	33	28	24	26	36	18	24	23	22
T-2	22	1.60	22.2	4.05	19	19	26	21	15	24	20	24	28	26
T-2	24	1.63	22.6	2.76	20	25	25	18	23	22	27	22	24	20
T-2	26	1.46	20.2	2.62	19	17	21	21	20	17	26	19	22	20
T-2	28	1.39	19.3	3.53	17	18	18	22	24	17	14	25	17	21
T-2	30	1.39	19.3	4.40	17	18	13	19	20	15	28	19	19	25
T-2	32	1.48	20.5	3.17	18	17	17	26	21	21	25	18	22	20
T-2	34	1.54	21.3	2.58	24	20	26	20	18	22	22	23	18	20
T-2	36	1.76	24.4	5.19	16	25	26	29	28	33	20	24	25	18
T-2	38	1.81	25.1	3.57	25	30	30	24	24	28	18	24	23	25
T-2	40	1.66	23.0	4.22	21	24	30	17	28	26	20	22	18	24
T-2	42	1.82	25.2	3.58	25	25	30	27	25	16	26	27	26	25
T-2	44	2.12	29.3	5.50	22	25	22	33	34	25	36	31	36	29

Bacterial Counts - Experiment 4b
November 1993 - Cypress Grove (Station 08)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
T-2	46	1.75	24.3	2.79	23	25	27	25	21	28	23	28	20	23
T-2	48													
T-3	2	1.79	24.8	4.39	26	22	26	27	35	22	22	26	19	23
T-3	4	1.79	24.8	2.94	25	30	22	25	28	24	27	24	20	23
T-3	6	1.80	24.9	2.51	27	25	23	23	27	23	29	21	27	24
T-3	8	1.70	23.5	2.95	22	20	26	23	21	21	23	25	24	30
T-3	10													
T-3	12	1.75	24.2	3.46	20	23	22	18	25	28	25	25	28	28
T-3	14	1.52	21.1	4.12	17	24	17	22	17	30	21	23	18	22
T-3	16	1.71	23.7	3.71	23	20	31	25	20	23	24	28	24	19
T-3	18	1.96	27.1	4.23	29	27	29	34	24	23	32	22	29	22
T-3	20	1.66	23.0	4.29	21	25	22	17	24	26	21	32	24	18
T-3	22	1.78	24.7	3.13	24	22	24	21	27	29	29	26	20	25
T-3	24	1.77	24.5	4.45	21	25	24	30	23	20	25	34	23	20
T-3	26	1.92	26.6	4.50	27	26	26	30	18	26	26	27	36	24
T-3	28	2.05	28.4	3.53	29	24	27	29	27	25	28	30	37	28
T-3	30	1.90	26.3	2.31	30	26	24	23	25	27	27	30	25	26
T-3	32	1.75	24.3	2.16	23	22	25	24	24	30	23	24	24	24
T-3	34	1.96	27.2	3.46	31	22	29	29	29	32	23	24	28	25
T-3	36	1.69	23.4	3.37	24	30	25	22	20	22	22	20	28	21
T-3	38	1.97	27.3	4.06	28	22	27	25	25	37	28	24	28	29
T-3	40	2.11	29.2	3.52	23	28	34	33	29	30	32	25	31	27
T-3	42	2.31	32.0	2.26	30	33	33	34	31	29	32	36	33	29
T-3	44	2.14	29.7	3.37	30	29	35	29	28	24	31	35	27	29
T-3	46	1.90	26.3	2.87	27	26	20	25	29	28	26	28	30	24
T-3	48	2.22	30.7	6.91	30	28	28	22	31	33	32	25	30	48
T-4	2	1.75	24.3	3.06	25	21	19	28	27	22	24	28	26	23
T-4	4	1.44	19.9	2.51	20	22	20	19	19	19	23	16	17	24
T-4	6	1.58	21.9	2.60	21	22	17	21	22	24	22	20	27	23
T-4	8	1.48	20.5	1.90	22	23	19	19	17	20	20	21	21	23
T-4	10	1.36	18.9	3.45	23	16	22	14	20	14	17	20	20	23
T-4	12	1.61	22.3	4.92	17	18	16	21	20	26	24	32	26	23
T-4	14	1.50	20.8	3.77	24	24	24	22	23	14	24	19	16	18
T-4	16	1.60	22.1	3.18	22	24	19	23	18	23	23	27	17	25
T-4	18	1.65	22.8	3.52	28	18	23	19	25	23	22	19	28	23
T-4	20	1.50	20.8	2.44	16	20	18	21	21	25	22	22	22	21
T-4	22	1.55	21.4	3.06	26	21	22	19	22	18	16	22	23	25
T-4	24	1.68	23.2	3.55	20	29	21	28	24	23	18	21	22	26
T-4	26	1.76	24.4	3.75	26	26	19	27	27	30	22	25	18	24
T-4	28	1.73	24.0	1.70	24	23	22	27	23	26	22	25	25	23
T-4	30	1.60	22.2	3.46	23	24	20	21	26	18	21	28	17	24
T-4	32	1.62	22.5	3.31	19	24	24	19	25	23	26	24	16	25
T-4	34	1.88	26.0	2.94	20	26	30	28	26	24	28	28	27	23
T-4	36	1.67	23.1	3.75	20	19	26	25	19	21	27	30	23	21
T-4	38	2.09	29.0	5.23	34	32	21	22	27	26	29	38	30	31
T-4	40	1.84	25.5	4.67	23	28	29	25	19	23	28	19	27	34
T-4	42	1.58	21.9	2.85	25	18	25	20	18	21	20	25	23	24

Bacterial Counts - Experiment 4b
November 1993 - Cypress Grove (Station 08)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts -->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
T-4	44	1.91	26.5	4.35	23	30	25	35	28	21	22	27	30	24
T-4	46	1.93	26.7	1.89	24	28	27	28	24	30	26	28	26	26
T-4	48	1.99	27.6	2.37	30	27	30	26	28	22	29	27	28	29
T-5	2	1.39	19.3	1.77	21	18	20	20	19	18	17	23	18	19
T-5	4	1.29	17.9	4.07	13	22	13	24	18	22	15	21	15	16
T-5	6	1.54	21.3	2.75	25	21	15	22	22	24	21	23	20	20
T-5	8	1.40	19.4	3.69	18	27	17	23	15	16	19	22	20	17
T-5	10	1.31	18.1	3.11	14	16	19	25	18	18	16	16	21	18
T-5	12	1.55	21.4	1.84	21	18	24	22	22	21	21	19	23	23
T-5	14	1.27	17.6	2.63	16	17	19	16	14	20	18	21	14	21
T-5	16	1.51	20.9	3.00	26	20	24	20	21	23	17	21	16	21
T-5	18	1.46	20.2	4.37	20	18	24	26	25	20	11	17	21	20
T-5	20	1.42	19.6	3.66	15	15	23	19	18	18	25	20	25	18
T-5	22	1.21	16.7	2.67	18	14	18	18	20	18	13	18	12	18
T-5	24	1.39	19.2	3.82	17	23	10	17	22	21	22	21	20	19
T-5	26	1.47	20.4	2.50	17	22	23	23	23	21	19	16	20	20
T-5	28	1.47	20.3	4.50	16	28	22	17	23	18	14	24	24	17
T-5	30	1.43	19.8	2.25	23	17	19	20	20	21	22	17	17	22
T-5	32	1.47	20.3	2.79	21	17	21	19	21	18	23	17	26	20
T-5	34	1.56	21.6	2.84	20	17	26	22	24	24	22	18	23	20
T-5	36	1.43	19.8	3.36	20	22	16	21	15	19	18	27	21	19
T-5	38	1.80	25.0	4.78	26	29	22	22	24	32	20	21	33	21
T-5	40	1.65	22.9	3.41	25	24	24	22	21	20	25	30	19	19
T-5	42	1.47	20.4	3.47	19	18	19	18	17	25	26	25	19	18
T-5	44	1.63	22.6	2.99	22	21	20	22	21	21	28	19	26	26
T-5	46	1.50	20.8	4.02	25	16	21	24	27	21	19	23	15	17
T-5	48	1.83	25.3	3.95	26	28	24	32	19	22	25	27	21	29

Bacterial Counts - Experiment 5
March 1994 - Cypress Grove (Station 08)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
All	0	2.64	36.6	3.57	37	36	44	38	32	36	40	32	36	35
t-1a	2	2.71	37.5	2.99	36	41	35	36	43	35	35	36	41	37
t-1a	4	2.28	31.6	2.76	29	30	30	31	31	37	32	33	28	35
t-1a	6	2.03	28.1	3.28	33	31	23	29	31	23	27	28	29	27
t-1a	8	2.12	29.4	2.95	25	27	27	35	30	30	29	30	28	33
t-1a	10	2.03	28.1	4.31	38	25	24	31	29	26	23	29	29	27
t-1a	12	2.15	29.8	1.62	27	29	31	28	31	31	28	31	31	31
t-1a	14	1.89	26.2	3.26	28	25	28	20	30	31	23	26	25	26
t-1a	16	2.00	27.7	2.71	32	29	27	32	24	25	28	26	28	26
t-1a	18	1.81	25.1	3.48	31	23	27	27	24	20	20	25	26	28
t-1a	20	1.71	23.7	2.75	24	24	27	27	20	23	27	21	20	24
t-1a	22	1.80	24.9	2.13	23	25	25	27	28	22	24	26	27	22
t-1a	24	2.48	34.3	3.83	31	37	35	39	38	35	32	34	36	26
t-2a	2	2.90	40.1	5.34	47	36	38	40	33	45	41	49	36	36
t-2a	4	2.71	37.5	4.74	33	42	35	34	32	35	46	43	36	39
t-2a	6	2.95	40.8	3.36	37	40	42	39	40	43	40	49	38	40
t-2a	8	2.90	40.2	5.16	39	39	41	48	46	42	29	38	42	38
t-2a	10	3.03	41.9	3.38	40	42	43	46	49	38	42	39	40	40
t-2a	12	3.05	42.2	6.21	42	44	37	36	47	52	34	40	39	51
t-2a	14	2.90	40.2	6.07	38	39	35	35	51	41	48	41	43	31
t-2a	16	2.81	38.9	3.07	40	36	41	44	39	38	36	43	37	35
t-2a	18	2.68	37.1	4.41	31	39	35	36	40	33	47	35	37	38
t-2a	20	2.50	34.6	6.20	33	29	29	26	39	33	32	40	39	46
t-2a	22	2.21	30.6	4.01	28	27	39	25	31	32	32	28	34	30
t-2a	24	2.35	32.6	1.78	35	35	32	32	30	33	33	32	34	30
t-3a	2	2.45	33.9	4.28	32	34	34	30	35	31	44	29	33	37
t-3a	4	2.30	31.8	4.29	32	33	31	30	30	29	43	28	29	33
t-3a	6	2.03	28.1	4.98	24	28	19	33	27	32	29	23	35	31
t-3a	8	2.20	30.5	2.68	33	33	27	32	34	31	30	31	27	27
t-3a	10	2.17	30.0	3.56	36	30	34	29	25	29	33	30	25	29
t-3a	12	2.00	27.7	3.71	32	24	33	30	31	29	25	26	23	24
t-3a	14	2.29	31.7	3.95	34	29	28	32	33	33	40	29	33	26
t-3a	16	1.93	26.7	4.81	21	30	26	29	21	21	26	29	28	36
t-3a	18	2.11	29.2	4.34	24	25	31	32	28	34	25	37	26	30
t-3a	20	1.90	26.3	4.27	33	26	28	27	28	32	23	20	25	21
t-3a	22	1.78	24.7	3.62	26	26	18	23	23	26	25	22	32	26
t-3a	24	2.14	29.6	3.57	29	36	25	32	26	31	27	28	34	28
t-1b	2	2.83	39.2	5.25	40	42	36	45	41	39	47	34	39	29
t-1b	4	2.51	34.8	4.66	35	31	33	31	42	29	32	39	34	42
t-1b	6	2.35	32.5	3.63	30	32	29	35	30	29	35	35	40	30
t-1b	8	1.91	26.4	2.50	25	29	22	31	25	25	26	26	28	27
t-1b	10	2.05	28.4	3.92	27	20	30	27	32	34	27	28	27	32
t-1b	12	1.91	26.5	4.93	34	20	29	28	31	27	29	18	26	23
t-1b	14	2.40	33.2	6.99	29	32	31	23	36	35	38	49	29	30
t-1b	16	2.35	32.5	3.98	31	30	28	36	32	37	35	29	39	28
t-1b	18	1.74	24.1	3.51	23	22	24	25	26	27	30	26	20	18
t-1b	20	2.16	29.9	3.60	31	29	32	28	23	29	32	37	28	30

Bacterial Counts - Experiment 5
March 1994 - Cypress Grove (Station 08)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts -->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
t-1b	22	2.08	28.8	4.66	32	29	30	20	28	34	28	22	34	31
t-1b	24	2.57	35.6	5.52	34	30	41	30	42	35	46	33	31	34
t-2b	2	3.00	41.6	5.83	38	42	46	37	32	43	40	54	41	43
t-2b	4	2.97	41.1	2.69	45	43	42	39	42	40	41	36	39	44
t-2b	6	2.93	40.6	4.81	35	39	41	36	39	35	49	41	45	46
t-2b	8	2.54	35.2	3.61	34	40	35	38	31	28	37	37	38	34
t-2b	10	3.23	44.7	6.04	37	47	43	51	46	44	50	54	38	37
t-2b	12	2.93	40.6	5.68	34	32	41	43	44	40	44	34	44	50
t-2b	14	2.97	41.1	5.86	42	36	44	32	35	36	45	49	45	47
t-2b	16	2.53	35.1	4.63	32	36	34	29	34	39	43	41	30	33
t-2b	18	2.58	35.8	6.12	35	40	28	26	36	34	39	36	36	48
t-2b	20	2.53	35.0	4.32	36	33	43	39	33	33	40	32	30	31
t-2b	22	2.10	29.1	4.84	32	26	27	28	24	21	30	34	37	32
t-2b	24	2.71	37.5	4.33	36	49	38	38	34	36	38	34	35	37
t-3b	2	2.47	34.2	4.29	31	29	31	37	37	32	41	34	30	40
t-3b	4	1.57	21.7	2.63	19	26	24	20	23	23	21	21	17	23
t-3b	6	2.17	30.0	4.85	28	28	32	40	34	31	22	27	27	31
t-3b	8	2.27	31.5	3.34	33	27	35	33	35	29	31	28	36	28
t-3b	10	2.08	28.8	3.71	26	31	32	25	35	27	28	23	32	29
t-3b	12	2.04	28.2	3.05	30	31	27	25	25	23	28	31	31	31
t-3b	14	2.24	31.0	4.57	33	30	29	27	26	31	28	29	41	36
t-3b	16	2.09	29.0	5.70	26	31	27	26	35	22	39	26	35	23
t-3b	18	1.78	24.6	3.27	21	22	20	23	25	26	30	26	24	29
t-3b	20	2.16	29.9	4.70	32	32	32	34	35	28	34	24	21	27
t-3b	22	1.84	25.5	3.84	24	24	32	23	26	25	23	26	20	32
t-3b	24	1.89	26.2	5.05	27	21	22	23	31	38	27	24	25	24
t-1c	2	2.27	31.4	4.06	35	28	30	33	28	27	33	40	28	32
t-1c	4	2.13	29.5	2.64	32	31	27	29	26	28	33	32	31	26
t-1c	6	2.22	30.8	3.85	26	37	25	31	27	31	31	32	33	35
t-1c	8	2.08	28.8	3.01	31	33	29	28	34	29	26	26	26	26
t-1c	10	2.06	28.5	3.63	33	26	28	33	28	32	31	23	24	27
t-1c	12	1.99	27.6	4.45	32	23	36	23	22	29	26	29	26	30
t-1c	14	2.52	34.9	3.90	35	35	34	41	33	38	26	34	37	36
t-1c	16	1.93	26.7	4.11	23	30	18	27	29	28	26	33	28	25
t-1c	18	2.05	28.4	4.20	22	32	28	26	29	22	32	33	27	33
t-1c	20	2.46	34.1	2.73	36	37	33	28	33	33	35	33	37	36
t-1c	22	2.40	33.3	4.40	32	36	40	29	34	30	35	39	32	26
t-1c	24	2.64	36.5	4.01	38	34	34	42	34	35	33	36	45	34
t-2c	2	2.89	40.0	5.12	41	40	40	34	39	34	39	36	49	48
t-2c	4	2.82	39.1	2.47	38	37	34	40	43	41	38	40	40	40
t-2c	6	2.78	38.5	5.34	26	36	44	39	43	41	38	44	36	38
t-2c	8	2.66	36.9	4.38	36	40	33	36	36	35	36	47	39	31
t-2c	10	2.57	35.6	5.13	32	43	34	40	40	32	26	35	40	34
t-2c	12	2.84	39.4	9.01	41	41	32	31	40	63	37	37	38	34
t-2c	14	2.62	36.3	5.68	41	31	29	33	43	39	32	36	33	46
t-2c	16	2.62	36.3	4.35	39	45	36	32	32	34	32	40	34	39
t-2c	18	1.93	26.8	2.25	25	28	31	28	29	27	26	26	24	24

Bacterial Counts - Experiment 5
March 1994 - Cypress Grove (Station 08)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
t-2c	20	2.77	38.4	4.81	30	37	35	47	38	36	43	43	37	38
t-2c	22	2.51	34.8	4.13	36	27	37	33	31	39	41	32	37	35
t-2c	24	2.22	30.7	3.13	34	28	30	24	34	31	32	30	34	30
t-3c	2	2.58	35.7	3.30	34	34	39	35	38	31	40	34	32	40
t-3c	4	2.34	32.4	4.14	31	34	31	42	34	32	27	28	34	31
t-3c	6	2.17	30.1	4.65	24	35	25	29	33	28	29	39	27	32
t-3c	8	2.08	28.8	2.86	26	33	28	27	33	26	26	28	32	29
t-3c	10	2.00	27.7	3.77	30	23	32	22	27	28	31	33	26	25
t-3c	12	2.14	29.7	3.40	25	27	28	29	33	32	26	30	36	31
t-3c	14	2.19	30.4	3.17	29	25	35	29	30	32	35	31	27	31
t-3c	16	2.28	31.6	3.50	27	31	34	26	32	31	37	30	36	32
t-3c	18	2.09	28.9	7.17	21	28	16	32	40	30	27	38	26	31
t-3c	20	2.19	30.3	3.20	34	31	26	30	27	31	30	35	33	26
t-3c	22	2.17	30.1	4.77	34	20	30	35	25	35	30	31	28	33
t-3c	24	2.12	29.3	3.86	24	30	30	33	32	21	33	30	30	30

Bacterial Counts - Experiment 6
March 1994- Tomacini Point (Station 14)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
t-2a	22	2.20	30.5	3.34	26	31	25	30	36	32	34	29	32	30
t-2a	24	2.72	37.7	4.72	33	44	44	33	41	31	38	39	34	40
t-2b	2	2.37	32.8	4.10	34	31	30	34	32	28	30	43	34	32
t-2b	4	1.91	26.4	2.63	28	28	21	30	27	24	28	27	24	27
t-2b	6	2.33	32.3	3.47	31	31	35	33	35	33	33	38	27	27
t-2b	8	2.28	31.6	3.41	29	39	33	34	28	34	30	31	29	29
t-2b	10	2.70	37.4	4.97	33	36	39	41	40	38	33	35	31	48
t-2b	12	3.49	48.4	4.53	57	53	47	44	49	44	49	52	46	43
t-2b	14	2.22	30.8	6.48	25	34	43	20	29	38	28	30	29	32
t-2b	16	1.96	27.2	3.68	26	30	23	31	27	28	34	25	26	22
t-2b	18	2.83	39.2	5.09	34	43	47	34	46	43	37	38	36	34
t-2b	20	2.78	38.5	3.75	42	31	36	39	43	41	36	42	36	39
t-2b	22	2.08	28.8	3.82	23	30	35	32	25	27	27	33	26	30
t-2b	24	2.54	35.2	4.21	42	32	38	32	33	30	33	42	36	34
t-2c	2													
t-2c	4	2.12	29.3	3.50	28	32	32	31	33	27	29	23	33	25
t-2c	6	2.69	37.3	4.45	34	36	32	32	38	42	37	42	45	35
t-2c	8	1.91	26.5	2.84	29	21	25	27	30	27	25	27	30	24
t-2c	10	2.58	35.8	5.98	46	33	38	41	27	31	29	40	34	39
t-2c	12	2.56	35.5	6.28	40	33	38	33	34	43	30	33	25	46
t-2c	14	2.35	32.6	4.38	30	32	29	30	29	32	37	36	29	42
t-2c	16	2.40	33.2	4.87	37	25	28	36	35	38	36	26	35	36
t-2c	18	2.81	38.9	3.87	40	35	41	35	39	34	47	41	37	40
t-2c	20	2.71	37.5	5.36	39	45	43	36	36	36	38	37	25	40
t-2c	22	2.84	39.4	4.58	41	38	34	49	45	37	39	35	37	39
t-2c	24	2.36	32.7	3.83	29	37	30	34	36	31	31	40	29	30
t-3a	2	1.83	25.4	3.27	30	27	26	29	25	22	28	25	22	20
t-3a	4	1.61	22.3	3.43	26	26	20	18	18	25	21	19	24	26
t-3a	6	1.62	22.4	3.41	25	17	22	24	22	18	27	25	25	19
t-3a	8	1.66	23.0	2.16	22	22	21	23	24	28	24	23	23	20
t-3a	10	1.97	27.3	5.48	29	25	20	30	20	33	23	33	25	35
t-3a	12	1.84	25.5	3.03	21	30	23	27	28	23	27	26	22	28
t-3a	14	2.15	29.8	2.15	30	31	31	31	27	26	33	31	28	30
t-3a	16	1.56	21.6	3.95	26	23	22	24	25	20	21	25	15	15
t-3a	18	1.83	25.4	2.63	30	27	25	27	22	23	27	27	24	22
t-3a	20	1.80	24.9	1.97	22	26	27	22	26	24	26	23	26	27
t-3a	22	1.64	22.7	2.87	21	23	24	23	23	17	22	25	28	21
t-3a	24	2.30	31.8	4.44	24	30	34	31	27	38	30	32	38	34
t-3b	2	2.06	28.6	4.12	32	23	37	26	31	27	31	25	27	27
t-3b	4	1.68	23.3	2.83	23	22	23	27	22	25	28	18	23	22
t-3b	6	2.04	28.3	4.42	23	31	22	25	33	29	24	30	34	32
t-3b	8	1.62	22.4	3.13	25	20	25	20	23	22	21	28	17	23
t-3b	10	1.93	26.7	4.06	25	24	34	25	23	27	24	34	27	24
t-3b	12	2.17	30.0	5.79	21	32	33	29	22	33	29	26	39	36
t-3b	14	1.67	23.1	4.41	19	21	26	18	25	18	26	30	20	28
t-3b	16	2.26	31.3	3.68	26	34	35	28	29	29	29	37	35	31
t-3b	18	1.92	26.6	4.01	30	25	24	34	26	23	23	31	28	22

Bacterial Counts - Experiment 6
March 1994- Tomacini Point (Station 14)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts -->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
All	0	2.01	27.9	4.53	26	25	24	28	29	23	33	38	26	27
t-1a	2	1.60	22.1	5.07	17	24	20	27	15	25	18	31	19	25
t-1a	4	1.88	26.0	4.47	22	28	22	24	21	31	28	35	24	25
t-1a	6	1.74	24.1	4.20	27	29	15	24	20	23	24	25	25	29
t-1a	8	1.83	25.3	3.13	28	23	28	20	25	28	27	29	22	23
t-1a	10	1.91	26.5	3.89	30	31	22	31	27	19	27	25	28	25
t-1a	12	1.80	24.9	4.31	21	25	27	29	29	29	26	16	26	21
t-1a	14	1.85	25.6	5.97	30	24	26	30	20	39	24	20	22	21
t-1a	16													
t-1a	18													
t-1a	20	2.02	28.0	3.27	31	27	22	31	27	27	25	33	27	30
t-1a	22	1.77	24.5	3.37	23	21	22	23	26	26	32	24	27	21
t-1a	24													
t-1b	2	1.34	18.6	3.41	13	16	16	20	18	23	21	18	17	24
t-1b	4	1.70	23.6	3.20	26	21	25	23	23	25	20	28	27	18
t-1b	6	1.92	26.6	5.48	21	29	22	20	28	25	39	28	25	29
t-1b	8	1.60	22.1	4.86	24	21	26	17	15	21	16	28	28	25
t-1b	10	1.91	26.5	3.72	27	28	33	30	26	28	26	20	25	22
t-1b	12	1.93	26.8	2.70	27	29	26	26	21	25	29	27	31	27
t-1b	14	1.61	22.3	3.89	27	19	25	22	22	27	17	24	24	16
t-1b	16	2.12	29.3	3.16	30	28	34	32	30	29	29	32	26	23
t-1b	18	1.80	24.9	3.81	26	29	27	18	28	20	26	21	28	26
t-1b	20	2.20	30.5	5.23	33	25	24	27	25	30	38	31	38	34
t-1b	22	1.63	22.6	4.81	23	20	21	21	17	25	17	31	21	30
t-1b	24	1.99	27.6	2.63	24	29	23	27	32	28	30	28	28	27
t-1c	2													
t-1c	4	1.75	24.3	3.47	27	22	25	24	29	28	22	25	24	17
t-1c	6	1.89	26.2	4.26	21	23	28	21	23	33	30	31	27	25
t-1c	8	1.93	26.8	2.62	31	25	26	23	30	25	28	28	28	24
t-1c	10	2.29	31.7	5.76	30	28	46	32	31	34	29	25	34	28
t-1c	12													
t-1c	14	2.15	29.8	3.05	26	26	28	33	27	30	34	29	32	33
t-1c	16	2.19	30.4	3.47	33	26	31	31	31	29	30	38	26	29
t-1c	18	2.37	32.8	4.47	36	41	26	29	33	31	31	33	30	38
t-1c	20	2.21	30.6	2.72	29	27	33	27	32	33	30	34	33	28
t-1c	22	2.03	28.1	2.88	25	27	33	29	24	28	30	29	31	25
t-1c	24	2.41	33.4	4.14	39	31	35	36	38	35	25	32	30	33
t-2a	2	2.03	28.1	3.31	27	29	30	30	25	29	21	33	27	30
t-2a	4	2.50	34.6	4.58	33	40	40	32	26	33	31	36	40	35
t-2a	6	2.27	31.4	6.15	45	32	31	32	28	23	28	29	38	28
t-2a	8	2.02	28.0	4.90	24	30	30	18	28	29	33	35	29	24
t-2a	10	2.79	38.7	4.42	40	36	29	40	41	36	39	38	45	43
t-2a	12	2.35	32.6	3.95	34	28	34	37	38	27	31	36	33	28
t-2a	14	2.21	30.6	5.21	33	27	29	39	33	28	33	20	35	29
t-2a	16	3.05	42.2	7.50	40	28	39	37	45	44	47	55	38	49
t-2a	18	2.63	36.4	6.17	35	22	36	44	42	40	35	34	35	41
t-2a	20	2.88	39.9	4.58	46	39	37	44	38	46	38	39	41	31

Bacterial Counts - Experiment 6
March 1994- Tomacini Point (Station 14)
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
t-3b	20	1.58	21.9	2.77	19	22	24	26	18	25	24	21	21	19
t-3b	22	1.85	25.6	3.60	24	27	28	24	24	30	18	30	27	24
t-3b	24	1.75	24.3	3.20	26	23	20	24	19	23	29	26	28	25
t-3c	2	1.62	22.4	1.78	21	21	21	20	24	23	21	25	24	24
t-3c	4	1.36	18.9	2.81	15	21	21	24	18	20	19	17	15	19
t-3c	6	1.99	27.5	3.72	26	25	27	28	30	29	21	25	35	29
t-3c	8	1.93	26.7	2.50	30	26	21	28	29	25	26	28	27	27
t-3c	10	1.87	25.9	3.03	21	25	28	26	29	27	30	27	21	25
t-3c	12	1.82	25.2	4.61	18	25	17	28	32	26	27	25	25	29
t-3c	14	1.53	21.2	3.05	23	25	23	21	25	16	20	20	17	22
t-3c	16	1.91	26.4	3.47	24	28	20	25	32	24	29	26	30	26
t-3c	18	2.25	31.2	2.86	33	32	30	32	26	34	35	28	33	29
t-3c	20	1.89	26.2	2.82	31	26	30	22	26	26	24	23	27	27
t-3c	22	2.06	28.6	2.84	25	28	30	27	32	30	32	31	27	24
t-3c	24	1.65	22.9	2.81	24	21	25	23	19	19	24	27	26	21

Bacterial Counts - Experiment 7
March 1994 - Cypress Grove 1994
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
t-1a	2	2.06	27.6	3.27	29	29	28	30	27	26	29	23	22	33
t-2a	2	2.81	37.6	5.93	32	30	38	35	35	49	39	45	33	40
t-3a	2	3.05	40.8	4.83	43	39	40	50	40	42	38	31	44	41
t-4a	2	3.02	40.4	4.86	42	39	33	35	40	50	37	44	41	43
t-5a	2	3.17	42.4	3.69	44	39	44	42	39	44	49	42	36	45
t-1b	2	2.57	34.4	6.04	41	41	29	35	24	38	27	40	36	33
t-2b	2	3.11	41.6	5.15	47	37	31	48	41	43	40	47	41	41
t-3b	2	2.83	37.9	4.07	39	36	31	37	36	35	43	36	44	42
t-4b	2	2.88	38.6	3.89	43	39	44	40	42	32	34	36	37	39
t-5b	2	2.94	39.3	4.08	40	42	35	44	42	39	32	35	40	44
t-1a	4	2.49	33.3	4.85	31	33	31	24	42	35	36	32	31	38
t-2a	4	2.82	37.7	6.50	32	48	37	31	29	36	47	35	42	40
t-3a	4	2.96	39.6	6.90	42	33	55	43	40	43	34	36	39	31
t-4a	4	2.69	36.0	4.71	40	31	36	34	31	32	39	41	32	44
t-5a	4	2.61	34.9	4.58	26	36	40	42	33	36	38	32	32	34
t-1b	4	2.17	29.1	4.15	24	32	27	35	32	29	33	25	31	23
t-2b	4	2.67	35.7	5.48	32	35	44	27	42	33	40	40	32	32
t-3b	4	2.70	36.2	5.16	39	48	38	31	37	33	38	34	34	30
t-4b	4	2.52	33.7	4.99	30	31	43	36	37	33	34	36	24	33
t-5b	4	2.82	37.8	4.76	39	35	38	29	34	38	46	36	43	40
t-1a	6	2.51	33.6	4.67	38	37	42	35	34	31	31	29	26	33
t-2a	6	3.00	40.2	6.41	33	38	39	48	36	35	47	37	37	52
t-3a	6	3.03	40.6	4.50	42	47	37	48	43	36	37	40	41	35
t-4a	6	3.13	41.9	6.94	50	44	39	50	43	33	43	33	34	50
t-5a	6	2.82	37.8	5.27	31	40	33	38	43	33	44	45	32	39
t-1b	6	2.53	33.9	6.97	40	41	35	41	38	39	25	26	24	30
t-2b	6	3.05	40.8	4.02	37	43	41	37	35	46	47	38	41	43
t-3b	6	2.64	35.3	4.92	30	42	40	37	33	27	37	33	41	33
t-4b	6	3.32	44.5	4.99	44	48	44	47	46	47	46	51	38	34
t-5b	6	2.94	39.3	5.03	40	31	38	41	37	40	39	36	51	40
t-1a	8	3.00	40.2	5.57	44	32	41	43	34	38	44	51	38	37
t-2a	8	2.67	35.8	3.26	34	33	39	35	35	39	29	38	37	39
t-3a	8	2.74	36.7	4.24	33	31	35	39	33	42	34	37	44	39
t-4a	8	2.86	38.3	4.83	44	42	45	36	39	40	36	38	34	29
t-5a	8	3.32	44.4	5.82	47	54	53	44	46	42	37	37	43	41
t-1b	8	2.59	34.7	2.87	30	34	34	36	38	36	36	31	33	39
t-2b	8	2.96	39.6	5.60	33	42	52	33	37	41	44	38	38	38
t-3b	8	3.00	40.1	5.61	37	44	50	43	33	45	40	35	33	41
t-4b	8	2.79	37.4	4.33	30	35	39	36	38	34	43	45	38	36
t-5b	8	2.48	33.2	4.94	38	35	36	40	37	28	30	24	32	32
t-1a	10	3.15	42.2	8.08	31	41	48	40	30	39	55	44	42	52
t-2a	10	3.10	41.5	5.02	40	35	36	43	38	40	48	43	51	41
t-3a	10	3.12	41.7	6.00	43	40	41	35	48	46	46	30	49	39
t-4a	10	3.03	40.5	6.19	28	39	49	41	38	46	40	40	48	36
t-5a	10	3.06	41.0	6.02	42	50	49	36	31	37	38	39	42	46
t-1b	10	2.61	35.0	8.74	29	42	51	27	43	33	41	32	28	24
t-2b	10	3.06	41.0	4.99	37	34	44	38	46	44	40	36	50	41

Bacterial Counts - Experiment 7
March 1994 - Cypress Grove 1994
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
t-3b	10	2.62	35.1	5.92	32	27	26	45	39	35	33	40	35	39
t-4b	10	2.97	39.7	3.50	36	39	38	41	48	38	36	39	40	42
t-5b	10	2.51	33.6	3.10	36	31	36	34	29	35	38	31	36	30
t-1a	12	2.50	33.4	5.15	31	29	32	28	37	35	37	44	34	27
t-2a	12	2.68	35.9	3.45	38	29	33	38	40	40	37	36	34	34
t-3a	12	3.38	45.2	3.39	46	42	46	50	42	48	45	41	50	42
t-4a	12	3.14	42.0	5.77	32	41	33	49	49	45	45	41	42	43
t-5a	12	2.83	37.9	3.11	36	40	36	44	34	34	37	39	40	39
t-1b	12	2.79	37.3	7.47	28	41	39	36	40	42	51	36	24	36
t-2b	12	2.97	39.8	5.47	39	40	37	53	36	37	45	39	38	34
t-3b	12	2.41	32.3	3.43	29	31	28	34	35	39	31	35	29	32
t-4b	12	2.59	34.7	3.92	31	31	33	36	41	35	37	38	28	37
t-5b	12	2.52	33.7	2.83	31	35	30	35	32	38	33	38	34	31
t-1a	14	2.20	29.5	4.74	35	28	23	25	29	37	35	29	25	29
t-2a	14	2.54	34.0	5.54	36	30	24	40	35	31	38	41	28	37
t-3a	14	2.79	37.3	6.75	39	26	30	33	37	43	41	37	50	37
t-4a	14	2.44	32.7	5.01	28	33	40	41	32	29	27	31	29	37
t-5a	14	2.50	33.5	6.13	26	33	37	36	22	36	29	35	39	42
t-1b	14	2.29	30.7	5.12	30	26	29	22	33	36	25	37	34	35
t-2b	14	2.69	36.0	4.03	40	37	34	43	36	29	37	31	36	37
t-3b	14	2.65	35.5	3.47	36	32	32	39	39	32	36	40	31	38
t-4b	14	2.44	32.7	4.06	31	32	32	29	39	38	34	34	33	25
t-5b	14	2.35	31.5	5.36	31	34	29	30	23	31	44	34	29	30
t-1a	16	2.59	34.7	6.34	31	25	38	28	44	35	44	30	36	36
t-2a	16	2.68	35.9	5.76	28	34	39	28	43	32	42	40	41	32
t-3a	16	3.09	41.3	7.36	45	48	40	27	47	34	37	38	47	50
t-4a	16	3.03	40.6	2.46	45	39	39	40	39	44	38	40	39	43
t-5a	16	3.19	42.7	3.40	44	42	44	42	47	41	37	47	38	45
t-1b	16	2.60	34.8	5.09	35	36	37	30	23	40	40	38	34	35
t-2b	16	2.82	37.8	6.46	36	33	52	30	43	34	36	42	39	33
t-3b	16	2.73	36.5	4.01	45	38	38	36	32	39	32	37	36	32
t-4b	16	3.06	40.9	6.45	34	43	35	38	45	48	50	44	30	42
t-5b	16	2.79	37.4	5.72	29	42	36	33	35	35	33	46	39	46
t-1a	18	2.92	39.1	2.23	38	39	34	41	41	40	39	42	39	38
t-2a	18	3.08	41.2	5.03	33	46	43	45	42	35	49	40	42	37
t-3a	18	3.47	46.4	5.32	56	47	45	42	48	54	47	42	39	44
t-4a	18	3.23	43.3	7.04	45	52	38	51	38	45	44	52	34	34
t-5a	18	3.67	49.1	5.63	42	42	55	51	47	44	48	53	50	59
t-1b	18	2.78	37.2	5.37	36	29	37	36	36	37	39	50	33	39
t-2b	18	2.77	37.1	5.59	29	29	38	38	36	43	36	35	47	40
t-3b	18	3.18	42.5	2.68	44	41	41	48	42	38	42	42	45	42
t-4b	18	3.03	40.6	4.93	36	42	40	35	36	44	50	37	46	40
t-5b	18	2.94	39.4	3.84	34	33	39	40	38	43	42	45	42	38
t-1a	20	2.88	38.6	4.20	34	38	33	42	44	38	37	34	44	42
t-2a	20	3.19	42.7	4.99	40	45	54	37	46	42	39	45	39	40
t-3a	20	2.61	34.9	3.73	39	39	33	31	36	30	37	32	40	32
t-4a	20	2.97	39.8	5.63	37	38	37	38	32	47	36	39	43	51

Bacterial Counts - Experiment 7
March 1994 - Cypress Grove 1994
10 grids of a 2 ml sample were counted

	Elapse	Cells/ml			Actual Counts --->									
Tube	t (h)	(Millions)	Ave	StDev	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Grid 7	Grid 8	Grid 9	Grid 10
t-5a	20	3.20	42.8	5.09	44	45	40	50	40	34	47	49	41	38
t-1b	20	2.71	36.3	2.91	35	32	37	31	38	39	40	37	38	36
t-2b	20	3.29	44.1	7.49	34	41	41	37	60	39	49	44	48	48
t-3b	20	3.06	41.0	5.70	44	39	38	48	34	39	37	51	45	35
t-4b	20	3.13	41.9	4.63	50	38	37	43	47	38	38	47	40	41
t-5b	20	2.99	40.0	5.25	46	42	29	38	39	35	42	47	42	40
t-1a	22	3.00	40.2	3.58	42	45	38	43	40	36	45	36	36	41
t-2a	22	3.56	47.7	5.46	50	38	52	50	49	58	45	47	45	43
t-3a	22													
t-4a	22	2.74	36.7	2.98	37	38	35	34	44	34	37	38	35	35
t-5a	22	3.23	43.2	5.49	53	44	51	44	38	43	39	38	37	45
t-1b	22	2.97	39.7	3.65	45	43	41	40	40	32	37	42	40	37
t-2b	22	2.88	38.5	4.48	37	40	31	36	42	42	40	32	40	45
t-3b	22	2.76	37.0	5.14	33	37	36	43	34	30	48	36	35	38
t-4b	22	3.00	40.2	6.73	38	32	49	40	33	32	46	50	39	43
t-5b	22	2.77	37.1	4.51	33	36	39	40	39	33	35	45	30	41
t-1a	24	3.18	42.6	6.65	50	45	55	35	43	39	46	42	35	36
t-2a	24	2.64	35.4	4.43	44	29	35	32	37	40	34	38	33	32
t-3a	24	2.79	37.4	4.01	40	28	42	40	39	40	37	38	35	35
t-4a	24	3.04	40.7	4.76	38	42	37	43	41	43	37	36	38	52
t-5a	24	3.21	43.0	2.83	41	46	40	43	39	42	45	46	47	41
t-1b	24	2.72	36.4	3.60	38	41	32	37	42	39	33	32	35	35
t-2b	24	2.80	37.5	3.98	39	31	40	44	35	42	36	34	35	39
t-3b	24	2.75	36.8	3.22	31	36	38	38	32	36	41	37	39	40
t-4b	24	2.74	36.7	3.33	36	42	35	41	32	38	39	37	34	33
t-5b	24	2.76	37.0	5.58	32	38	35	39	34	45	26	43	37	41

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