AN ABSTRACT OF THE THESIS OF

Brett M. Sherer for the degree of Master of Science in Agricultural Engineering presented on August 10, 1990.

Title: Bacteria Die-off in Stream Sediments.

Redacted for Privacy

Abstract approved: _____

James A. Moore

The purpose of this study was to evaluate the impact sediment has on the survival of bacteria in a typical rangeland stream. This information is an important component in determining a time integrated prediction of bacterial numbers in the stream sediment and overlying water. Bacterial survival in stream is a crucial factor in the complex relationship between stream quality and range management. Once this relationship has been defined, it will lead to a scientifically-based, rational process for rangeland management decisions.

Bear Creek flows through a semi-arid rangeland in Central Oregon. Two sediment samples (clay loam and sandy loam) were collected from Bear Creek. Sediment samples were combined by weight with fresh bovine feces at 250:1, 20:1, and 6.67:1 ratios (sediment:feces). The inoculated sediment samples and a contaminated water sample were stored a 8°C and monitored to determine the change in concentrations of fecal coliform (FC) and fecal streptococci (FS) with time.

Stream sediments were found to increase the survival of fecal coliform and fecal streptococci in an aquatic environment. FC was found to exhibit a significantly lower

die-off rate than FS in sediments inoculated with bovine feces. No significant difference was observed in the die-off rate of FS between sediment types or inoculation levels with a half-life ranging from 9 to 12 days. Die-off rates for FC were found (half-life ranging from 13 days to 31.5 days) to be significantly different between inoculation levels and sediment types. No relationships were observed between FC and FS die-off rates to particle size or inoculation level.

This study concluded that stream sediment allows enteric bacteria to survive, possibly for several months, in an aquatic environment. Resuspension of these bacteria may account for the erratic FC and FS levels often encountered in water monitoring programs since grab samples of water give only an immediate measure of bacterial levels. If enteric pathogens behave similarly, significant public health hazards could arise. Existing state bacteriological standards and monitoring procedures fail to address these problems. Therefore, a more meaningful and accurate indication of water-quality conditions would be obtained by also monitoring indicator bacteria levels in surface sediments.

BACTERIA DIE-OFF IN STREAM SEDIMENTS

by

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A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirement for the
degree of

Master of Science

Completed August 10, 1990

Commencement June 1991

APPROVED:

Redacted for Privacy

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Date thesis is presented August 10, 1990

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ACKNOWLEDGEMENTS

I wish to extend my sincere appreciation and thanks to the many people who contributed in one way or another to the development of this thesis. Without these contributions this document would never have come into existence.

First of all my thanks to the United States Department of Agriculture Research Services Grant No. 85-CSRS-2-2718 for providing financial assistance for this project.

Special recognition is unquestionably due to Dr J. Ronald Miner for his help, cooperation, continued encouragement and last minute heroics during the completion of this thesis. My thanks to my major professor Dr. James A. Moore for his guidance, support, and words of encouragement during my graduate student career which I will always remember and appreciate. I would like to thank my minor professor Dr. Richard H. Cuenca for providing guidance and support throughout the writing of this thesis, and for the time spent proof-reading. Thanks are also due to Drs. Milton Larson and Boone Kauffman for substituting in as my Graduate Faculty Representative and Committee Member, respectively, on short notice. Also, I would like to express my appreciation to all graduate students, faculty, and staff members of the Bioresource Engineering Department at Oregon State University.

Much gratitude is express to my family for their encouragement and support during the many years I have been a student. Without their support I could have never completed my college education.

Finally, my sincere thanks go to my wife Kristi for her love, companionship we have shared and support she has given me throughout the development and completion of this thesis.

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BACTERIA DIE-OFF IN STREAM SEDIMENTS

1 INTRODUCTION

Streams throughout the United States have been studied to determine how recreational uses, resort homes, domestic and big game animals cause bacterial contamination to streams. Enteric organisms from these sources reach the stream in run-off or by direct deposition. Upon reaching the stream they are carried down stream, die-off, or settle to the stream bottom. Their survival in the aquatic environment may be prolonged if they settle to the stream sediment .

The importance of aquatic sediments as a reservoir and source of microorganism water quality contamination depends on two factors; (1) the possibility of extended survival or growth of bacteria populations and (2) the potential for resuspension of the sediment and associated bacteria into the overlying water. Once enteric organisms settle out of the overlying water into the stream sediment, their survival is controlled by many factors. Some of these factors are the physical and chemical nature of the sediment as well as interactions with other benthic organisms.

The objective of this study is to evaluate the impact sediment has on the survival of bacteria in a rangeland stream. This information is an important component in determining a time integrated prediction of bacterial numbers in the stream sediment and overlying water. Bacterial survival in stream sediment is a crucial factor in the complex relationship between stream quality and range management. Once this relationship has been defined, it will lead to a scientifically-based rational, process for rangeland management decisions.

2 LITERATURE REVIEW

2.1 Die-off in Natural Environments

Enteric organisms are native to the intestinal tract, both of humans and warm blooded animals, and are generally present in the intestinal tract in large numbers. When excreted into a hostile environment, the bacteria eventually die.

The die-off of enteric organisms in the environment is dependent upon many factors. Crane and Moore (1986) reviewed the effects that chemical and physical characteristics of the environment have on bacterial die-off in storage, soil, and fresh/sea water environments. Table 2.1 reviews many of the factors which influence bacterial die-off. Of these, temperature, pH, moisture, nutrient supply and solar radiation seem to have the greatest effect on enteric bacterial survival.

Extensive literature reviews on bacterial disappearance in the environment have been prepared by Crane and Moore, 1986; Geldreich, 1981; Rudolfs et al., 1950, Ellis and McCalla, 1978; Mitchell and Starzyk, 1975; and Geldreich, 1980. To summarize the literature as to the effects these factors have on the die-off rate of enteric organisms is not only beyond the scope of this review, but also would duplicate the efforts of others. Therefore, this literature review will focus on bacterial die-off in water and sediments.

Table 2.1 Factors affecting bacteria survival.

I. The organism and its physiological state

II. The physical and chemical nature of aquatic or soil system
  a. pH
  b. porosity
  c. organic matter content
  d. texture and particle size distribution
  e. elemental composition
  f. temperature
  g. moisture content
  h. adsorption and filtration properties
  i. availability of nutrients

III. Atmospheric conditions
  a. sunlight
  b. moisture (humidity and precipitation)
  c. temperature

IV. Biological interaction of organisms
  a. competition from indigenous microflora
  b. antibiotics
  c. toxic substances

V. Application method
  a. technique (surface or incorporated)
  b. frequency of application or discharge
  c. organism density in waste material

Source: S. R. Crane and J. A. Moore, 1986.

2.2 Die-off in Water

An understanding of the survival of enteric bacteria in water is important to the meaningful interpretation of sanitary water quality data. Coliform, fecal streptococci, or fecal coliform are typically used to signify the potential presence of intestinal pathogens (APHA, 1985; McFeters et. al., 1974,). While these indicator bacteria are relatively harmless themselves, they are almost always present in water containing enteric pathogens. Due to the fact that they are relatively easy to isolate and normally survive

longer than the disease-producing organisms, indicator bacteria are useful as a measure of the likely presence of enteric pathogenic bacteria and viruses. Once these bacteria are deposited into water they are in an environment that is unfavorable to their viability.

Many studies have been conducted to determine the survival of enteric bacteria in water (McFeters et. al., 1974; Mitchell and Starzyk, 1975; Hood and Ness, 1982; Fujioka et. al., 1981). Reviews by Carlucci and Pramer, 1959 and Mitchell, 1968 have concluded that die-off of coliforms in marine waters is fairly rapid and controlled by a variety of factors including toxicity due to high salt concentrations, predation, competition by native microflora, heavy metals, and limited nutrient supply. Typical die-off curves for Escherichia coli (E. coli) in seawater show an initial lag phase followed by a mortality of up to 90% in 3 to 5 days.

Mitchell and Starzyk (1975) investigated the survival for enteric bacteria and fecal streptococci at various temperatures using filter-sterilized water from a northern Illinois river. Samples were stored at 0, 5, 10, and 20 degrees centigrade. They concluded that the survival of Salmonella typhimurium was essentially the same as E. coli, both revealing a 90 percent reduction in 12 days at 0° C and 8 days at 20° C, while the 90 percent reduction in fecal streptococci took almost twice as long.

According to Fujioda et al., 1981 the presence of sunlight is a major factor controlling the survival of indicator bacteria in seawater. In the presence of sunlight the bacteria revealed a 90% reduction between 30 and 180 minutes, whereas the bacteria without sunlight survived for days. The same bacteria were relatively resistant to the bactericidal effect of sunlight when diluted in fresh mountain stream waters.

A stable well water supply was studied by McFeters et al., 1974 to compare the survival of various fecal indicator bacteria and enteric pathogens. Fecal coliform (FC)

die-off rate (half-life = 18.4 h) was found to be more rapid than that of the fecal streptococci (FS) (half-life = 22.2 h). In addition the fecal coliform population was consistently four to five times greater than the fecal streptococci present.

Sinclair and Alexander, 1984 investigated the role of resistance to starvation in bacterial survival in sewage and lake water. They suggested that starvation-susceptible bacteria will not persist in environments that are nutrient poor or in which they fail to compete for organic nutrients and starvation resistance is a necessary but not sufficient condition for persistence in environments that are nutrient poor or support intense competition.

2.3 Relationships in Sediment and Overlying Water

Various studies have been conducted to determine the effect of livestock on the quality of surface water and have shown that the quality decreases during grazing of cattle and/or sheep (Gary and Adams, 1985; Sherer et al., 1988; Stephenson and Street, 1978). When cattle are present in the area they may deposit fecal matter directly into the stream (Larsen et al., 1988). Once fecal matter enters the stream the majority of the enteric bacteria settle rapidly into the stream bottom and can be resuspended in the future (Biskie et al., 1988). Many times enteric organisms may be isolated from sediments even when they are not detectable in the overlying water (Gerba et al., 1977; Bitton et al. 1982; Gerba and McLeod, 1976; Loutit and Lewis, 1985). Bacteria in the sediment may create a potential for elevated bacterial concentrations in the overlying water for an extended period of time (Jawson et al., 1982)

Benthic sediments have been found to harbor significantly higher concentrations of enteric bacteria than the overlying water (Tunnicliff and Brickler, 1984; Van Donsel and Geldreich, 1971; Sherer et al., 1988; Rychert and Stephenson, 1981; Hendricks, 1971; Lewis et al., 1986; Goyal et al., 1977). Several investigators have found that coliforms, fecal coliforms, and salmonellae tend to concentrate in the upper layers (top 5 cm) of sediment (Allen et al., 1953; Van Donsel and Geldreich, 1971).

The distribution of fecal coliform bacteria in the Colorado River corridor of the Grand Canyon (Arizona) was reported by Tunnicliff and Brickler, 1984 to be generally uniform along the entire river segment. The river and tributary bottom sediments harbored fecal coliform densities 10 to 100 times larger than the densities in the overlying water. The fecal coliform densities in the sediment were not found to be a reliable indicator of the quality of the overlying water when storm and non-storm flows were compared.

LaBelle et al., 1980 found viruses in estuarine sediments had a positive correlation to the number of fecal coliforms in sediments; however, no correlation was found between bacterial indicators and virus in overlying waters. This study suggests that evaluation for the presence of bacteria and viruses in the sediment may provide additional insight into long-term water quality conditions.

The release of adsorbed bacteria from bottom sediments may be an important factor as a source of enteric bacterial densities in streams. Varness et al. (1978) suggests that such releases may be increased by human and animal disturbances of bottom sediments. Grimes (1975 and 1980) reported that dredging in the Mississippi River caused release of fecal coliforms adsorbed to the bottom sediments to be resuspended into the overlying water. He also reported that dredging may heavily contaminate the water with enteric

pathogens and produce a temporary health hazard in recreational areas in contact with downstream water.

Many studies have been conducted to gain an insight to the relationship between the concentration of enteric bacteria in streams and hydrological events (Matson et al., 1978; McDonald and Kay, 1981; Jawson et al., 1982; Stephenson and Street, 1978). Benthic bacteria in the Shetucket River, Connecticut were reported by Matson et al. (1978) to vary with local hydrographic events. They found that during stable flow conditions sediment and bacterial populations achieve a relative "steady-state" level. Then during rapid runoff, when river discharge increases, sediment organisms appeared to be scoured from the bottom surfaces of the stream. Populations of bacteria in the water increased from runoff in the basin, abrasion of the bottom sediments, and increased transport velocity. Both of the events appeared to reach a maximum just before the slope of the river hydrograph reached zero. During the peak flow the bacteria numbers decreased through dilution due to the end of resuspension and runoff activities. Later, things went back to their original "steady state" conditions, increasing sediment concentrations and reducing the concentrations in the overlying water.

Van Donsel and Geldreich (1971) performed a study to compare the relationship of indicator organisms in sediment to those in water and to determine whether sediment sampling in a freshwater environment would provide insight to previous bacterial contamination. Of the total organisms recovered, they found 100-1000 times more fecal coliforms in the sediment than in the overlying water. Total coliforms and fecal streptococci found in the sediment were extremely variable when compared to the overlying water and exhibited no clear relationship to previous contamination. They suggested the survival rate of salmonellae closely resembled that of fecal coliform in

sediment with both showing a 90% die-away in seven days. However, total coliform and fecal streptococci were found to die at a slower rate than either fecal coliform and salmonellae.

In the Nash Fork watershed in southern Wyoming, Gary and Adams (1985) determined numerical densities of fecal coliform and fecal streptococci indicator bacteria in stream water while monitoring the principle land uses. They disrupted the stream bottom several times throughout the summer and fall. The mean concentration of fecal coliforms increased by 1.7 times the initial concentration after the steam bottom was disrupted and fecal streptococci increased by 2.7 times. They believed the main sources of fecal coliform to be large herds of sheep and cattle which were present throughout the summer, and stream sediment played a minute roll. The concentrations of fecal streptococci remained high throughout the entire study period. They suggested a potential for high stream flows to flush, suspend, and cause subsequent downstream movement of the fecal streptococci. However, there was not evidence of long term storage or cumulative adsorption and/or multiplication of fecal coliforms in the sediments. Their concentrations were high only during the summer months when livestock were present.

While grazing some animals directly deposit fecal matter into the stream. The survival of these bacteria in the sediment suggests that some of this fecal matter may remain in the benthic environment for extended periods of time. In the Bear Creek watershed in Central Oregon, Sherer et al. (1988) found that by disrupting the stream bottom with a rake 1.8 to 760 million FC per m^2 and from 0.8 to 5,610 million FS per m^2 bacteria could be resuspended. Cattle locations were monitored during the study and their presence was believed to increase organism concentration in the underlying sediments.

Stephenson and Street (1978) found elevated numbers of enteric bacteria in the stream shortly after cattle were moved from the vicinity. The elevated concentrations persisted for up to three months after the cattle were removed.

2.4 Survival in Sediments

Survival of bacteria in an aquatic environment is affected by numerous interacting factors including protozoa, antibiosis, organic matter, algal toxins, dissolved nutrients, heavy metals, temperature, and the physiochemical nature of the aquatic environment (Faust et al., 1975). LaBelle et al., (1980) measured 12 environmental variables in a marine environment, none of which could be correlated to numbers of indicator bacteria densities in the sediments. Gerba and McLeod, 1976 attributed the longer survival of E. Coli, in estuarine sediments to an increased amount of organic matter present in the sediment than that in seawater.

In many studies the existence of fine soil particles and high organic matter have been shown to increase E. Coli survival (Saylor et al., 1975; Tate, 1978). Tate (1978) suggested that E. Coli can catabolize organic soil constituents and that fine particles and high organic matter substrates may support populations three times larger than sand. Tate found that initial bacterial die-off was dramatically increased when the inoculum size was on the order of 107 organisms per gram of soil as compared to one of 102 or 103 per gram of soil. Grimes, 1980 suggested that as a result of surface area or particle charge differences, higher fecal coliform densities occur in silty clay sediments rather than in sandy sediments . However, results failed to show that particle size effects bacterial die-off rates. Burton et al., 1987 found a greater survival of E. coli and Streptococci

newport (S. newport) in sediments of higher clay content. This was believed to be due to higher concentrations of organic matter and nutrients in the silty clay sediment.

Stream and lake sediments and algal blooms are known to bind organic nutrients and prolong the survival of enteric bacteria (Hendricks and Morrison, 1967; Hendricks, 1971; McFeters et al., 1978). Through chemical analysis Chan et al. (1979) found that fine-grained, silty-clay sediments contained the highest amounts of organic nutrients compared to larger particle sizes, as in silt and sand. The release of these nutrients to enterobacter aerogenes cells from the sediment by wave action and human activities was suggested as one factor that may explain, in part, the high counts of total coliforms in some coastal waters.

The sediments in Lynnhaven estuary were reported by Erkenbrecker (1980) to serve as a reservoir for indicator bacteria in densities sufficient to pose potential health hazards. Based on calculated fecal coliform to fecal streptococci ratios in overlying water, primary sources of bacteria pollution in this estuary appeared to be typical of urban and agricultural runoff, although failure of septic tank systems was suspected as a problem in the western branch. As a consequence, sediments containing higher concentrations of organic nutrients than the overlying seawater prolonged survival of Enterobacter aerogenes and even enabled growth.

Studies by Malaney et al., 1962 and Boyd and Boyd, 1962 indicated that sediments enhance the growth of bacterial species natural to freshwater lakes and streams. Work by Hendricks and Morrison, 1967 has shown that stream sediments have the capacity to bind basal nutrients loosely and that aqueous extracts of sediments will increase the growth rate of various enteric species in high-quality water at 15°C and less. It was assumed by these investigators that this loosely bound material was probably available for microbial

use within the natural environment. Hendricks (1971) investigated the nutrient binding capabilities of river bottom sediments and what conditions must be present for their removal and use by enteric bacteria. He found that nutrients bound to the sediment were very tightly adsorbed and that they may not be readily available for metabolism by aquatic microorganisms. He suggested that once the adsorptive capacity of the sediments had been reached, as perhaps exists around sewage plant effluents, stream nutrients then could be removed from the system and much growth of aquatic organisms could result.

Bacterial adsorption to suspended particles may result in increased settling velocities. Sedimentation of attached bacteria may be an important disappearance mechanism in the natural purification of polluted surface waters (Gannon et al., 1980). Many instances of high sediment bacteria concentrations have been reported, and these bacteria in the sediment may experience a more favorable chemical and biological micro-environment.

Bacteria in bottom sediments have been shown to be protected from the destructive action of sunlight (Bitton et al., 1972). Coliform bacteria associated with particles greater than 8 μm were shown to be more resistant to ultraviolet disinfection than the more numerous single cells in experiments with secondary wastewater effluents by Qualls et al., 1983.

Roper and Marshall, 1978 determined that interactions of bacteria and particle may result in decreased predation by other microorganisms. In an earlier investigation Roper and Marshall, 1974 concluded that saline sediments appear to provide some protection for E. coli against bacteriophages. All of these factors contribute to the formation of a highly concentrated layer of bacteria at the interface of the sediment and overlying water.

3 EXPERIMENTAL METHODS

Four experiments were performed on two sediment types in an attempt to evaluate the impact that sediment has on the survival of bacteria in a typical rangeland stream. This information is an important component in determining a time integrated prediction of bacterial numbers in the stream sediment and overlying water. Bacteria survival in stream sediment is a crucial factor in the complex relationship between stream quality and range management. Once this relationship has been defined, it will lead to a scientifically-based, rational process for rangeland management decisions. The experiments were constructed to allow for variations in the inoculation level of enteric organisms into natural sediments.

Sediment samples were collected from the Bear Creek watershed located in Central Oregon, approximately 21 km southeast of the Prineville Reservoir. The watershed comprises an area of approximately 540 square km. The stream has an extensive drainage pattern which drains the southwest portion of the Maury Mountains to Antelope Reservoir and Soldier Creek on the east. The southern boundary comprises the northern edge of Rodman Rim. Nearly all of the watershed is used for rangeland, both public and private, except for 67 km^2 which is forested with Ponderosa Pine and some cultivated bottom lands. During the spring and summer the cultivated bottom land is irrigated with water diverted directly from the creek. The watershed ranges in elevations from 1,536 meters at the headwaters to 988 meters at the outlet.

Two samples of sediment, collected within 10 meters of each other, were taken from high and low velocity sections in the stream. This provided for two extreme sediment samples with physically different characteristics within the stream section.

They were placed on ice for approximately four hours until bacterial analysis could be performed in the laboratory.

Upon return to the laboratory (Agricultural Engineering Department, Oregon State University) a preliminary analysis was performed to determine initial fecal coliform concentrations. The preliminary results revealed bacterial concentrations of less than 200 FC per gram wet weight of sediment. These bacterial concentrations were not high enough to allow an adequate bacterial die-off analysis. Therefore, inoculation of the study samples was necessary in order to provide bacterial counts large enough for an adequate die-off analysis. Inoculation of the sediment was added in the form of fresh bovine feces collected from the Oregon State University dairy farm.

Bacterial analysis was performed every five days for each treatment during a twenty-five day study period to determine fecal coliform (FC) and fecal streptococcus (FS) concentration. Treatments were stored in a refrigerator and maintained at a constant 8°C. Determination of FC and FS were made using the membrane filter technique outlined in APHA (1985). The samples were removed from the refrigerator and shaken vigorously for approximately one minute and serially diluted with a phosphate buffer solution to appropriate concentrations for analysis. The dilutions were filtered in triplicate through a 0.45 μm filter. The membrane filters were placed onto pads saturated with M-FC broth (Difco) for FC and KF agar (Difco) for FS enumeration. FC were incubated in a water bath at 44.5 ± 0.5 °C for 24 hours and FS in a water bath at 35 ± 0.5 °C for 48 hours. After the incubation period the plates were removed from the incubators and the appropriate colored colonies were counted under a low power (10-20X) stereoscope.

Total solids were determined in duplicate on all samples by gravimetric analysis techniques and pH by combination electrode as outlined in APHA (1985). Sediment particle size analysis was performed on each sediment by the hydrometer technique outlined in Methods of Soil Analysis: Part 1 - Physical and Mineralogical Methods (1986). This analysis was performed by the Oregon State University Soil Physics Laboratory. Total organic content was determined for each sediment using the Walkley-Black Method outlined in Methods of Soil Analysis used in the Soil Testing Laboratory at Oregon State University (in press). The analysis was performed by the Oregon State University Soil Testing Laboratory.

3.1 Experiment 1

Five hundred grams of sediment, 25 grams of bovine feces, and 100 grams of distilled water were placed in a 4 liter plastic jar. Three separate jars were prepared for each sediment type (see Table 3.1) for a total of 6 individual jars. The samples were stored at 8°C to approximate typical spring time conditions in the Bear Creek Basin. Glass beads were added to each of the jars to achieve a homogeneous bacterial suspension by shaking the container at the time of sampling. Samples from each jar were taken every five days throughout the 25 day study period for analysis. Three sub-samples were taken from two treatments (C and F) and independent bacterial analysis was performed for each sub-sample to determine sample variability and accuracy of sampling and analysis techniques. Bacterial analysis was performed in triplicate for each treatment as outlined in the preceding section.

TABLE 3.1 Treatment descriptions.

Treatment	Experiment	Treatment description
A,B,C	1	500 g fine sediment + 25 g bovine feces + 100 g distilled water
D,E,F	1	500 g coarse sediment + 25 g bovine feces + 100 g distilled water
G,H,I	2	Supernatant of 500 g fine sediment + 25 g bovine feces + 100 g distilled water
J,K,L	3	500 g fine sediment + 75 g bovine feces + 100 g distilled water
M,N,O	3	500 g coarse sediment + 75 g bovine feces + 100 g distilled water
P	4	500 g fine sediment + 2 g bovine feces + 100 g distilled water
Q	4	500 g coarse sediment + 2 g bovine feces + 100 g distilled water

3.2 Experiment 2

Five hundred grams of the fine sediment, 25 grams of bovine feces, 100 grams of distilled water, and glass beads were placed into a 4 liter plastic jar. The jar was shaken vigorously for 3 minutes. Portions of the mixture were placed into a centrifuge on low for 1 minute. Twenty-five milliliters of the supernatant were placed into 3 separate 50 milliliter jars (see Table 3.1). The treatments were stored at 8°C. Three sub-samples were taken from one treatment (I) and independent bacterial analysis was performed. Bacterial analysis was performed in triplicate for each treatment every 5 days throughout

a 25 day study period. Upon completion of experiments 1 and 2 it was decided to extend the period for 5 days (for treatments A, B, C, G, H, and I) to allow for a stronger comparison.

3.3 Experiment 3

Five hundred grams of sediment, 75 grams of bovine feces, 100 grams of distilled water, and glass beads were placed into a 4 liter plastic jar. Three separate jars were prepared for each sediment type (see Table 3.1) for a total of six separate jars. The samples were stored at 8°C. Samples from each jar were taken every five days during the 25 day study period for analysis. Three sub-samples were taken from these samples on two treatments (L and O) and independent bacterial analysis was performed.

3.4 Experiment 4

Five hundred grams of sediment, 2 grams of bovine feces, 100 grams of distilled water, and glass beads were placed into a 4 liter plastic jar. One jar was prepared and analyzed for each sediment type (see Table 3.1). Samples were stored at 8°C. Samples from each jar were taken every five days for analysis during the remainder of study period (20 days).

4 RESULTS

4.1 Sediment Descriptions

Two samples of sediment were selected from high and low velocity sections of Bear Creek within 10 meters of each other in anticipation that their physical characteristics would be somewhat different. Sediment particle size analysis was performed on each sediment by the hydrometer technique in the Oregon State University Soil Physics Laboratory. The coarse sediment was found to belong to the textural class sandy loam (73% sand, 12% silt, and 14% clay) while the fine sediment was determined to be a clay loam (32% sand, 34% silt, and 34% clay). The textural characteristics of the sediments are summarized in Table 4.1.1.1.

TABLE 4.1.1.1 Physical characteristics of sediments.

Sediment	%Sand	%Silt	%Clay	Textural Class
Fine	31.7%	34.4%	33.9%	Clay Loam
Coarse	73.3%	12.4%	14.3%	Sandy Loam

The percent of total solids (%TS) for the various treatments are shown in Table 4.1.1.2. Little change was observed in the contents of solids over time in any of the treatments. For this reason, the average values during the experimental period were used. The total solids content per gram wet weight from the sandy loam treatments were higher than those from the clay loam treatments in all four of the experiments.

Organic matter content is reported for each of the treatments in terms of percent total carbon. The organic matter content was determined by the Oregon State University Soil Testing Laboratory using the Walkley-Black Method. The percent total carbon in

the clay loam sediment (4.77) was twice that in the sandy loam sediment (2.17) without any inoculation. The organic matter in the bovine feces was determined to be 84.8 percent total carbon.

TABLE 4.1.1.2 Physical characteristics of treatments.

Treatment	%TS	Organic matter %Total Carbon
A,B,C	31.1%	7.21%
D,E,F	51.7%	5.13%
G,H,I	0.173%	7.21%
J,K,L	31.4%	13.0%
M,N,O	40.8%	11.0%
P	32.8%	4.24%
Q	59.0%	2.08%

4.2 Bacteria Survival

The term die-off rate will be used to describe the disappearance of bacterial densities with time. It was assumed that a first order equation of the Chick (1908) type described die-off. This equation can be expressed as:

$$\frac{N_t}{N_o} = 10^{-kt} \tag{1}$$

where N_t = number of bacteria at some time t, N_o = initial number of bacteria, t = time in days, and k = die-off rate for some period of time (t). The major assumption of the logarithmic model (equation 1) is that bacterial die-off is caused by a combination of physical, chemical and biological factors that remain constant, or at least their combined influence remains constant, with time of incubation.

The value k was used to identify the die-off rate of a given bacteria concentration in a particular environment. Die-off rates were determined by applying simple linear

regression of the dependent variable, log-bacteria concentration and the independent variable, time, in days. The coefficient of determination was used to suggest the percentage of the variation in log-bacteria concentration that could be attributed to the variation in time. The P value was used to suggest if the slope was significantly different from zero.

The time required until one-half of the original bacteria concentration remained was determined for each of the treatments. This value was referred to as the half-life. Once the die-off rate k was determined the half-life was determined from equation (1). By assuming the initial bacteria concentration is twice the concentration at some time, expressed as

$$\log_{10}\left(\frac{N_t}{N_o}\right) = \log_{10}\left(\frac{1}{2}\right) = -k(t_{1/2}) \tag{2}$$

where $t_{1/2}$ = the half-life. The half-life was computed with the following equation:

$$\frac{\log_{10}(2)}{(-k)} = t_{1/2} \tag{3}$$

Analysis of variance on the die-off rates for combinations of data sets was used to determine if the die-off rate of one treatment was significantly different from the die-off rate of the other treatment or between log FC and log FS. Appropriate forms of the t-test were used to test various null hypothesis (Table 4.2.1).

Figures 4.2.1 and 4.2.2 present the results obtained for FC and FS analysis from repeated sampling of treatments C, F, I, L, and O. The purpose of the replicated sampling was to estimate the accuracy of the sampling and analysis techniques used. Observing the close correlation between curves associated with each treatment, these results indicate that little of the variation in the results of fecal bacterial analysis was

Table 4.2.1 Hypothesis tested to compare treatments.

Null Hypothesis	Alternative Hypothesis
$H_o:\beta_1 = \beta_2$	$H_a:\beta_1 \neq \beta_2$
$H_o:\beta_1 \leq \beta_2$	$H_a:\beta_1 > \beta_2$
$H_o:\mu_1 = \mu_2$	$H_a:\mu_1 \neq \mu_2$
$H_o:\mu_1 \leq \mu_2$	$H_a:\mu_1 > \mu_2$

β equals the die-off rate of a population with time.
μ represents the average population of a given data set.

caused by the sampling and dilution techniques involved in these experiments.

An equality test of 3 regression lines was performed on the three samples taken from the same storage vessel. It was concluded that the samples were not significantly different. Therefore, to obtain a representative sample for the treatment, the concentrations of similar treatments were pooled together and average of these pooled treatments (ABC, DEF, GHI, JKL, and MNO) was used when making comparisons to other treatments.

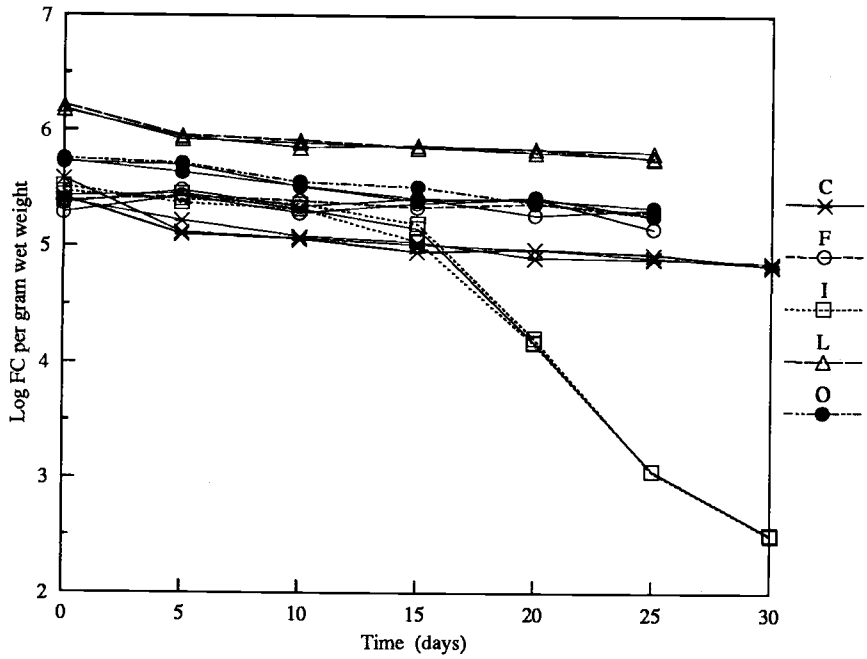

Figure 4.2.1 Fecal coliform die-off from replicated samples.

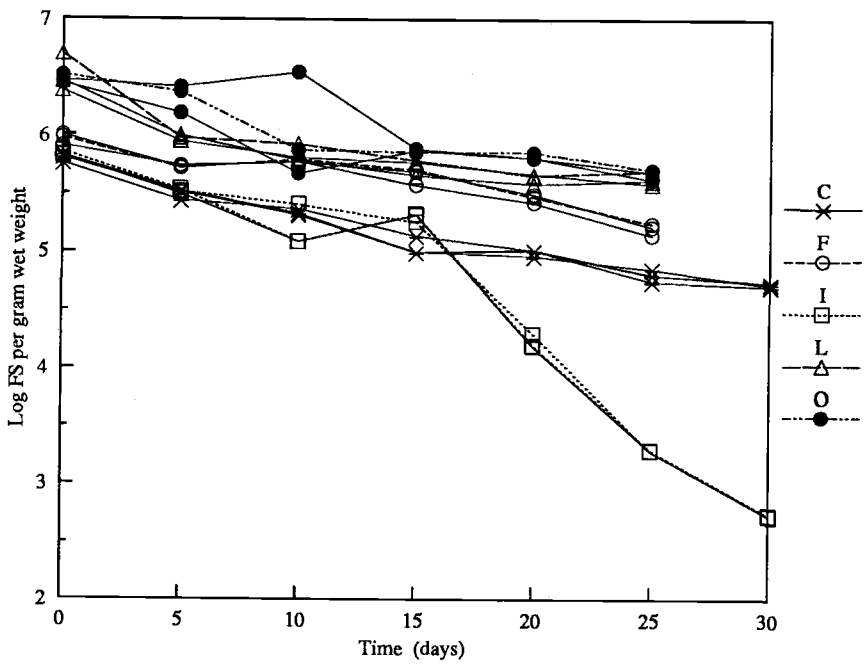

Figure 4.2.2 Fecal strep. die-off from replicated samples.

4.2.1 Experiment 1

The results of the fecal coliform analysis for each sampling period are displayed graphically in Figures 4.2.1.1 and 4.2.1.2, expressed as log bacteria count per gram wet weight and plotted against time in days. These figures reveal that the fecal coliform in the clay loam treatments (A, B, and C) reduced linearly with time. The FC in the sandy loam treatments (D, E, and F) remained relatively constant with time. The initial concentration of FC and FS in the sandy loam treatments were higher than in the clay loam.

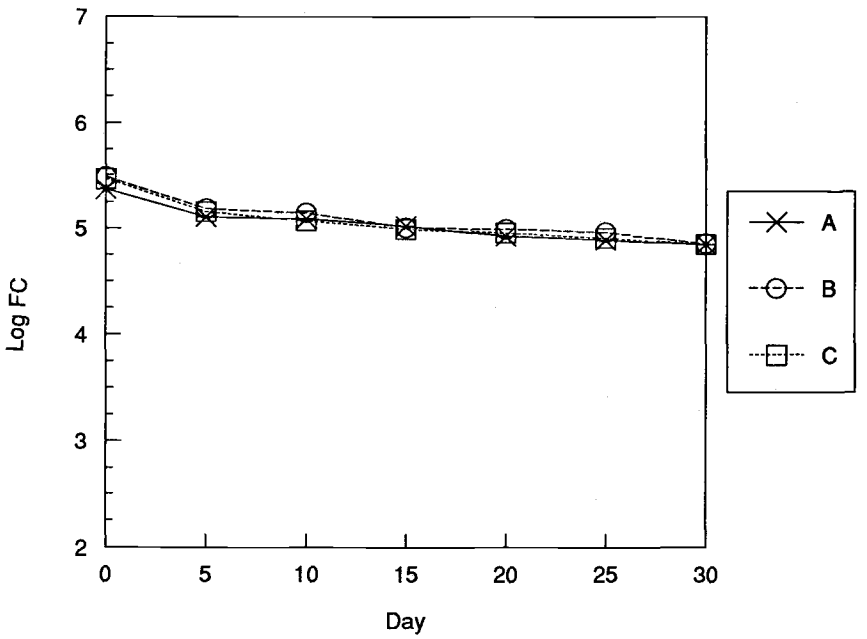

Figure 4.2.1.1 FC die-off in clay loam sediment (Exp. 1).

The results of the fecal streptococci analysis for each sampling period are shown in Figures 4.2.1.3 and 4.2.1.4. The FS analysis revealed a higher die-off rate than the FC

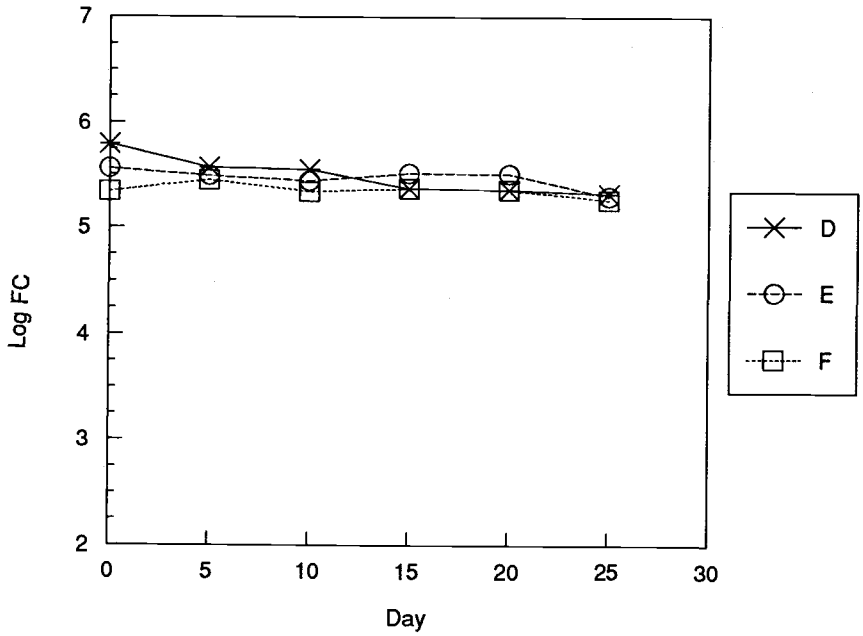

Figure 4.2.1.2 FC die-off in sandy loam sediment (Exp. 1).

for all treatments, with the clay loam treatments (A, B, & C) experiencing a higher die-off than the sandy loam treatments (D, E, & F). The initial concentration for the FS bacteria was larger than that for FC for all treatments.

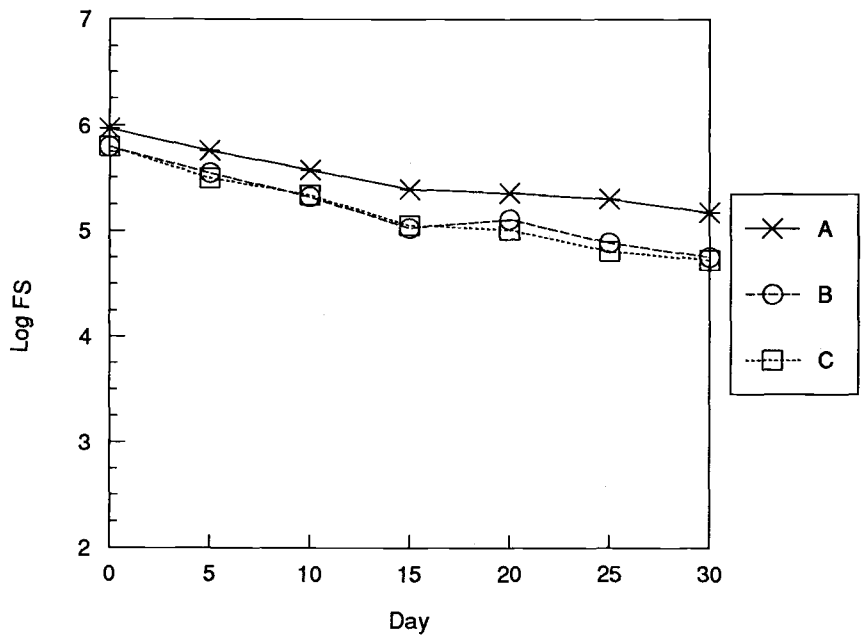

Figure 4.2.1.3 FS die-off in clay loam sediment (Exp. 1).

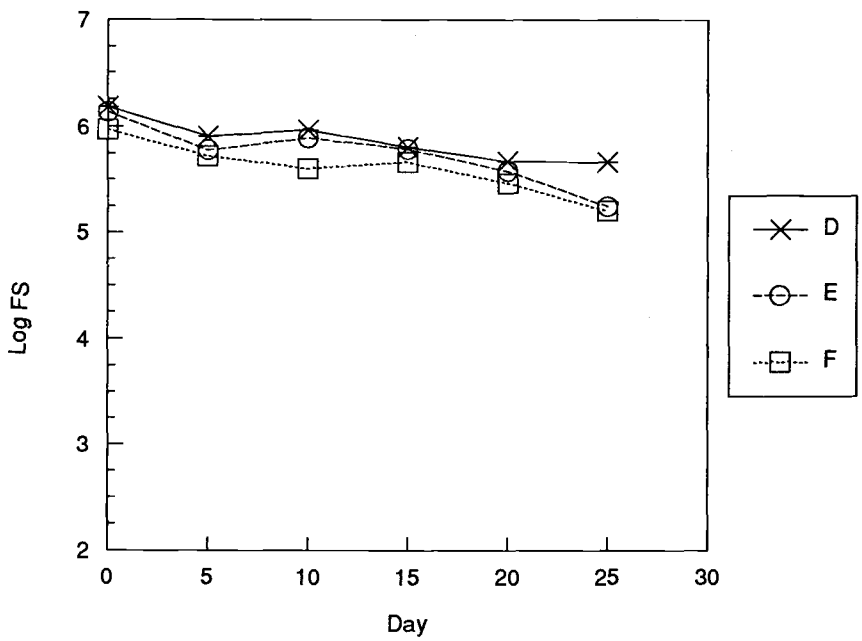

Figure 4.2.1.4 FS die-off in sandy loam sediment (Exp. 1).

The data sets were analyzed statistically to determine if a significant difference in the data existed. Table 4.2.1.1 summarizes the results of linear regression for each of the treatments in experiment 1 and for the pooled data for similar treatments. All bacteria data sets showed the slope was significant ($P<0.05$), except for FC in two of the sandy loam treatments (E and F) ($P>0.05$). The FC in these two sandy loam sediments (E and F) showed that the slope was not significant and the mean would reveal a better estimate of the log-bacteria concentration throughout time. However, when the data for all three similar subsets of the sandy loam sediment (D, E, and F) were analyzed together, averaged, the slope was found to be significant ($P<0.05$).

TABLE 4.2.1.1 Die-off statistics for Exp. 1.

Treatment	intercept	slope	r^2	P
Fecal Coliform				
A	5.23	-0.016	89.2	< 0.05
B	5.35	-0.018	86.9	< 0.05
C	5.32	-0.018	84.6	< 0.05
ABC	5.32	-0.017	85.1	< 0.05
D	5.72	-0.018	89.0	< 0.05
E	5.55	-0.007	47.5	> 0.05
F	5.40	-0.004	34.2	> 0.05
DEF	5.56	-0.010	41.3	< 0.05
Fecal Streptococcus				
A	5.88	-0.025	93.9	< 0.05
B	5.71	-0.033	94.0	< 0.05
C	5.70	-0.035	96.5	< 0.05
ABC	5.76	-0.031	77.0	< 0.05
D	6.11	-0.020	88.2	< 0.05
E	6.10	-0.030	83.5	< 0.05
F	5.93	-0.026	89.3	< 0.05
DEF	6.05	-0.025	69.5	< 0.05

Analysis of variance of the die-off rates for combinations of data sets was used to determine if the die-off rate of one treatment was significantly different from the die-off

rate of the other treatment or between log FC and log FS. Results showed that the FC die-off rate of -0.010 $days^{-1}$ in the sandy loam treatment (DEF) was significantly less ($P<0.05$) than the die-off rate of -0.017 $days^{-1}$ in the clay loam treatment (ABC). Comparison of the FS die-off rates showed the sandy loam treatment (DEF) experienced a die-off rate of -0.031 $days^{-1}$ which was not significantly different ($P>0.05$) from the die-off rate of -0.025 $days^{-1}$ in the clay loam treatment (ABC). This implies that the FC bacteria in the clay loam treatments (ABC) experienced a significantly higher die-off rate than the sandy loam treatments (DEF).

A comparison between the die-off rate of FC and FS in the clay loam treatments (ABC) and sandy loam treatments revealed that FC experienced a significantly higher ($P<0.05$) die-off rate than FS throughout time.

The time required for the bacteria concentration to be reduced to one-half (half-life) the original concentration for the clay loam treatments (ABC) was 17.7 days for FC and 9.7 days for FS. The half-life for the sandy loam treatments (DEF) was 31.5 days for FC and 12.1 days for FS.

4.2.2 Experiment 2

The concentration of the FC and FS in the supernatant of treatments G, H, and I (500 g clay loam sediment and 25 g bovine feces) are displayed in Figures 4.2.2.1 and 4.2.2.2, expressed as log bacteria count per gram wet weight and plotted against time in days. Both FC and FS showed a 90 percent die-off during the 30 day study period. The initial concentrations of FS were higher than those for FC.

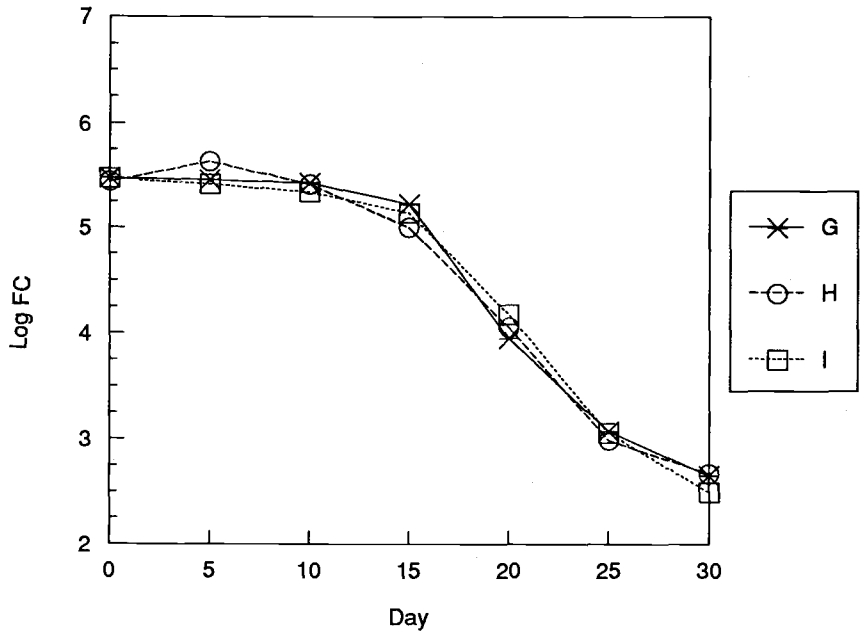

Figure 4.2.2.1 FC die-off in Supernatant (Exp. 2).

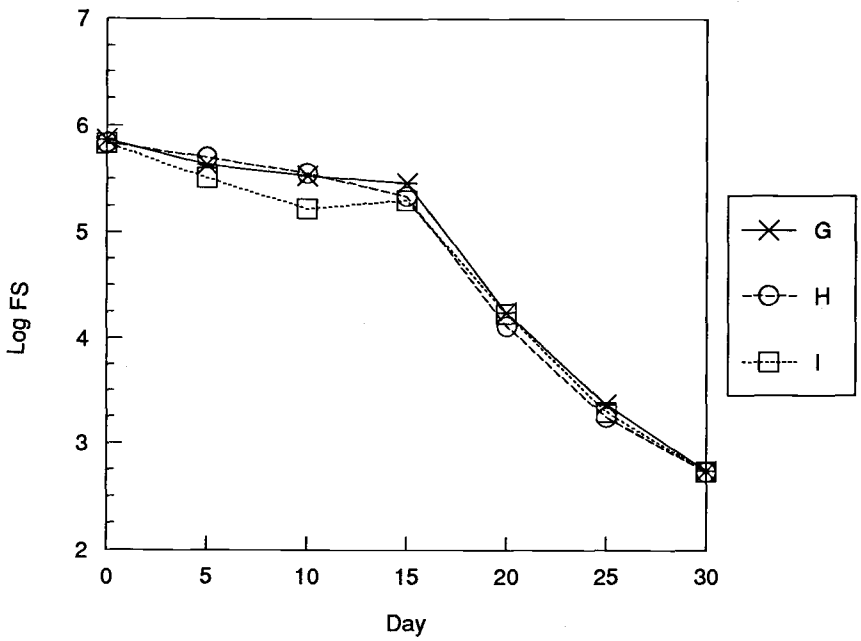

Figure 4.2.2.2 FS die-off in Supernatant (Exp. 2).

The bacteria die-off rates, assuming simple linear die-off, are summarized in Table 4.2.2.1. Both FC and FS showed that the slope was significantly ($P<0.05$) greater than zero and the model accounted for an average of 88% of the variation in the concentrations of the log-bacteria with time. No significant difference ($P>0.05$) was found between the die-off rates of FC and FS in the supernatant (GHI).

TABLE 4.2.2.1 Die-off statistics for Exp. 2.

Treatment	intercept	slope	r^2	P
Fecal Coliform				
G	6.03	-0.105	86.1	< 0.05
H	6.05	-0.106	88.1	< 0.05
I	6.03	-0.106	86.3	< 0.05
GHI	6.04	-0.106	87.0	< 0.05
Fecal Streptococcus				
G	6.33	-0.108	88.4	< 0.05
H	6.33	-0.112	89.9	< 0.05
I	6.17	-0.105	90.5	< 0.05
GHI	6.27	-0.109	89.4	< 0.05

The time required for the bacteria concentration to be reduced to one-half (half-life) the original concentration in the supernatant treatments (GHI) was 2.8 days for FC and 2.8 days for FS, assuming a simple first-order die-off. The bacteria die-off rate for the supernatant of the clay loam treatment (GHI) showed a significantly higher ($P<0.05$) die-off rate for FC and FS than in the clay loam treatment (ABC) for the 30 day study period.

By observing Figures 4.2.2.1 and 4.2.2.2, it appears the bacteria die-off in the supernatant occurred in two stages, a mild slope for the first 15 days and steeper slope during the following 15 days. Multiple regression was performed to determine if there was significantly different stages of die-off for FC and FS concentrations during the 30

day study period divided into time less than or equal to 15 days and time greater than 15 days. Multiple regression revealed that the difference between the die-off rate for FC and FS data sets was significant ($P<0.05$) for time greater than 15 days. This suggests that the slope of the last 15 days were significantly less than the slope for the entire 30 days. The resulting coefficient of variation in all treatments, FC and FS, for the two stage die-off was greater than 0.96 indicating that 96% of the variation in the concentration can be explained by the two-stage die-off model.

Analysis of variance for the die-off rates was used to estimate whether there was a significant difference between the die-off rates/slopes for the first 15 days, last 15 days, and the entire 30 days in treatments G, H, and I relative to the entire 30 day clay loam treatment (ABC) for each bacteria type, FC and FS. The results indicate that die-off rates of 0.023 $days^{-1}$ for FC ($P>0.05$) and 0.032 $days^{-1}$ for FS ($P>0.05$) for the first 15 days were not significantly different from the die-off of 0.017 $days^{-1}$ for FC and 0.031 $days^{-1}$ for FS in the clay loam treatment (ABC). The last 15 days of the study showed a significant difference between the die-off rates for the two treatments ($P<0.05$). The die-off rates of 0.17 $days^{-1}$ for FC and 0.18 $days^{-1}$ for FS in treatment GHI is significantly higher ($P>0.05$) than treatment ABC during the last 15 days.

4.2.3 Experiment 3

The die-off of fecal coliform and fecal streptococci analysis for each sampling period are displayed graphically in Figures 4.2.3.1 through 4.2.3.4 expressed as log bacteria count per gram wet weight and plotted against time in days. These figures suggest the fecal coliform in the clay loam treatments (J, K, and L) and the sandy loam treatments (M, N, and O) decreased linear with time, with the bacteria in the sandy loam

treatments experiencing a slightly higher die-off. The initial concentrations of FC in the clay loam treatments (J, K, and L) were larger than those in the sandy loam treatments (M, N, and O).

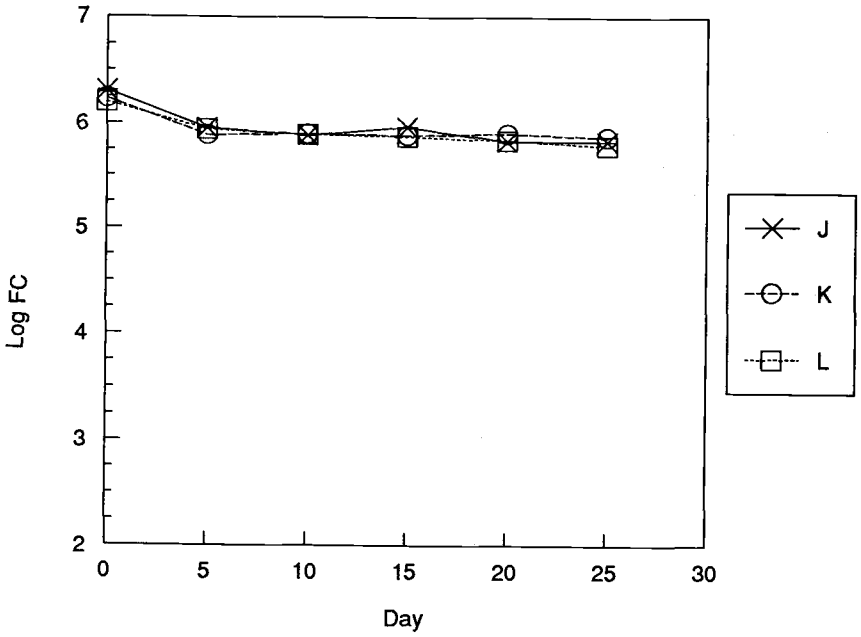

Figure 4.2.3.1 FC die-off in clay loam sediment (Exp. 3).

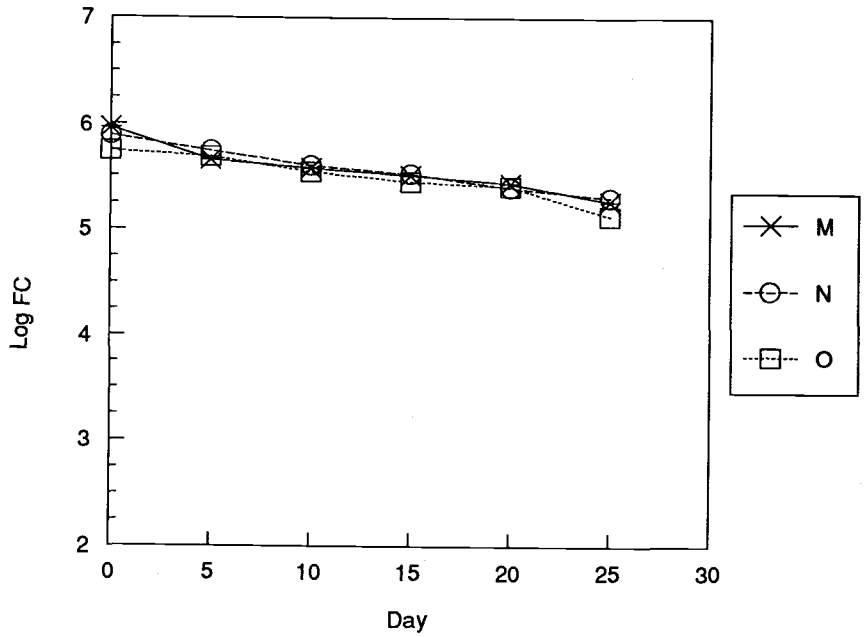

Figure 4.2.3.2 FC die-off in sandy loam sediment (Exp. 3).

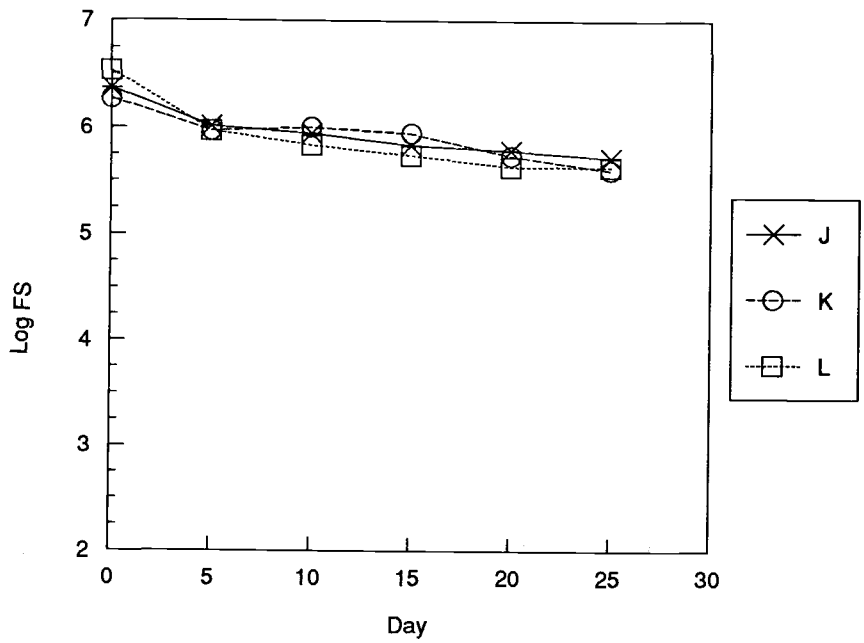

Figure 4.2.3.3 FS die-off in clay loam sediment (Exp. 3).

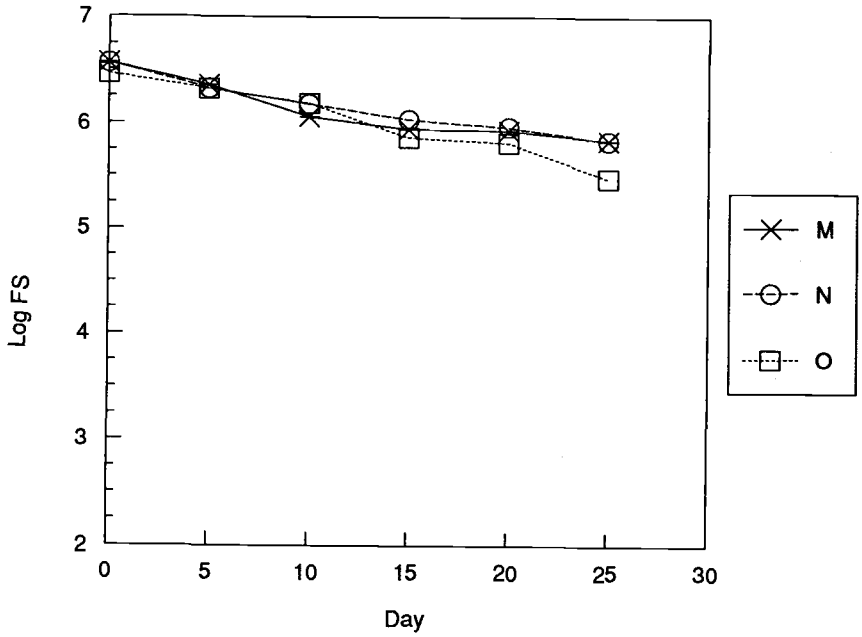

Figure 4.2.3.4 FS die-off in sandy loam sediment (Exp. 3).

The summary of the regression analysis are contained in Table 4.2.3.1. The FC model for one of the clay loam treatments (K) produced a low coefficient of determination ($R^2 = 45.3$) which suggests that the percentage of the variation in the dependent variable (log FC) cannot be attributed to the variation of the independent variable (time) and that the mean would be a better estimate of the concentration throughout time ($P>0.05$). However, when all three treatments (JKL) were analyzed together, the model was found to be a good prediction of the bacteria concentration with time ($P<0.05$). The FC and FS for the sandy loam (M, N, and O) treatments and FS in the clay loam treatments (J, K, and L) yielded a coefficient of determination greater than 0.8 ($P<0.05$), suggesting the die-off rate (slope) was significantly greater than zero.

TABLE 4.2.3.1 Die-off statistics for Exp. 3.

Treatment	intercept	slope	r^2	P
Fecal Coliform				
J	6.15	-0.015	63.5	< 0.05
K	6.08	-0.010	45.3	> 0.05
L	6.10	-0.014	78.4	< 0.05
JKL	6.11	-0.013	60.4	< 0.05
M	5.87	-0.024	92.1	< 0.05
N	5.87	-0.023	99.2	< 0.05
O	5.78	-0.023	93.4	< 0.05
MNO	5.84	-0.023	91.6	< 0.05
Fecal Streptococcus				
J	6.23	-0.023	85.5	< 0.05
K	6.21	-0.023	89.8	< 0.05
L	6.29	-0.031	78.0	< 0.05
JKL	6.24	-0.026	80.0	< 0.05
M	6.47	-0.029	89.2	< 0.05
N	6.50	-0.028	96.9	< 0.05
O	6.50	-0.039	96.9	< 0.05
MNO	6.49	-0.032	89.3	< 0.05

The time required for the bacteria concentration to be reduced to one-half (half-life) their original concentration for the clay loam treatments (JKL) was 23.2 days for FC and 11.6 days for FS. The half-life for the sandy loam treatments (MNO) was 13.1 days for FC and 9.4 days for FS.

Analysis of variance for the die-off rates suggests that the FS in the sandy loam treatment (MNO) experienced a die-off rate of 0.032 $days^{-1}$, while the FC was found to have a significantly lower ($P<0.05$) die-off rate of 0.023 $days^{-1}$. The FC in the clay loam treatments (MNO) experienced a die-off rate of 0.013 $days^{-1}$ and 0.026 $days^{-1}$ for FS. The FC in the clay loam treatments (JKL) showed a significantly lower ($P<0.05$) die-off rate than the sandy loam treatments (MNO). The die-off rates of FS in the clay loam treatments (JKL) and sandy loam treatments (MNO) were not significantly different

($P>0.05$).

The FC and FS in the clay loam sediment were not found to die-off at a significantly different ($P>0.05$) rate if inoculated with 75 grams of fresh bovine feces (JKL) compared to the same sediment inoculated with 25 grams (ABC). The FC in the sandy loam sediment inoculated with 75 grams of fresh bovine feces (MNO) died-off at a significantly lower rate ($P<0.05$) than the same sandy loam sediment inoculated with 25 grams of fresh bovine feces (DEF). While the die-off of FC in the sandy loam sediment was not significantly different ($P>0.05$) when inoculated with 25 grams (DEF) or 75 grams (MNO).

4.2.4 Experiment 4

The results of the fecal coliform and fecal streptococci analysis for clay loam (P) and sandy loam (Q) treatments are displayed graphically in Figures 4.2.4.1 and 4.2.4.2. These figures show that both treatments experienced some die-off, appearing nonlinear during the study period. The bacteria concentrations were consistently higher in the sandy loam sediment (Q).

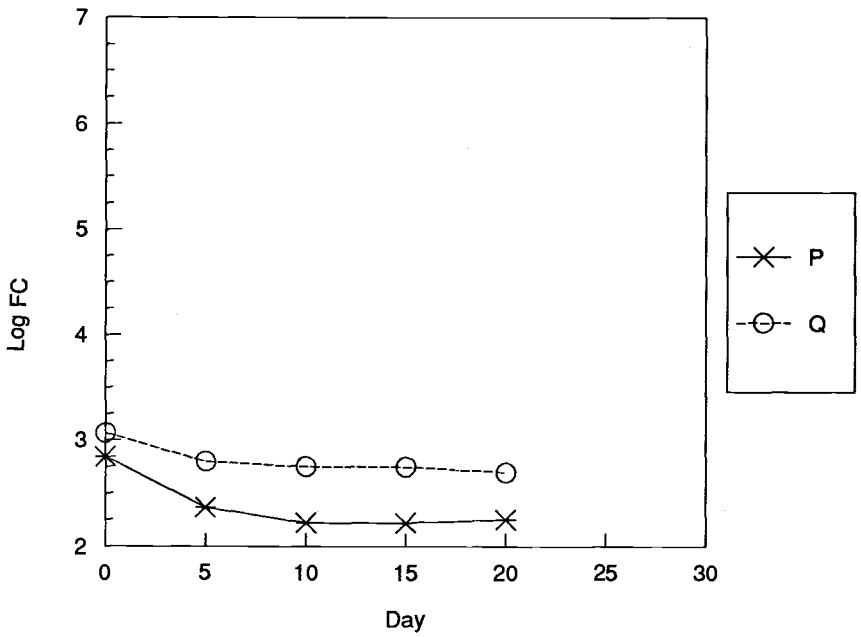

Figure 4.2.4.1 FC die-off in sediments (Exp. 4).

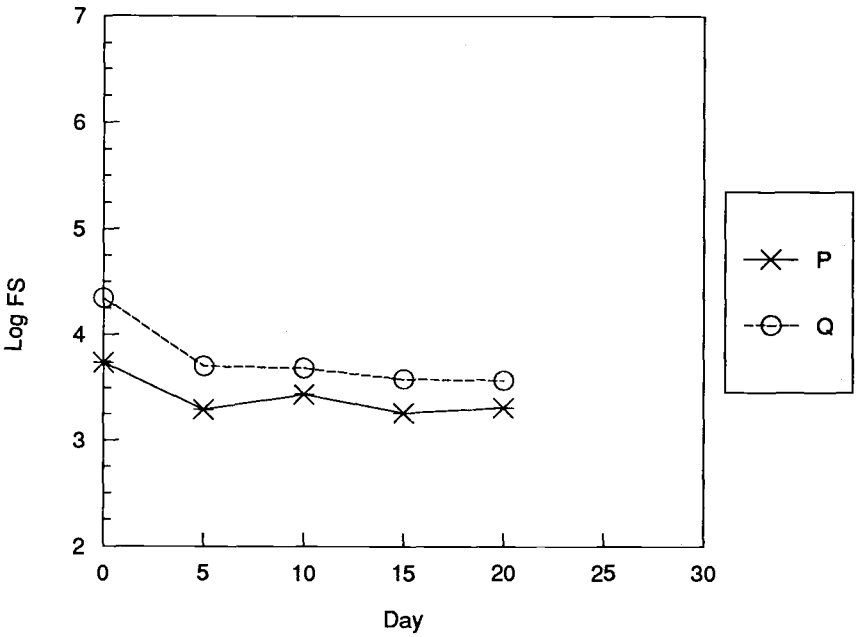

Figure 4.2.4.2 FS die-off in sediments (Exp. 4).

Due to the large amount of trash and sediment collected on the filter, at times it was very difficult to determine the bacteria concentration during enumeration of the agar plates. The bacteria colonies sometimes were smeared making it nearly impossible to differentiate between colonies. The results from this experiment should be used with caution due to the low confidence in the counts.

The regression analysis was performed on each of the treatments, summarized in Table 4.2.4.1. The coefficient of determination suggest that approximately 50 percent of the variation in the bacteria concentrations can be explained by the variation in time ($P>0.05$). These results suggest that the mean is a better estimate of the future population than the simple linear regression model analyzed.

TABLE 4.2.4.1 Die-off statistics for Exp. 4.

Treatment	intercept	slope	r^2	P
Fecal Coliform				
P	2.65	-0.0269	63.4	> 0.05
Q	2.97	-0.0157	72.6	> 0.05
Fecal Streptococcus				
P	3.60	-0.0176	50.3	> 0.05
Q	4.11	-0.0331	67.0	> 0.05

Analysis of variance on the average concentration of bacteria throughout time for combinations of data sets was used to determine if the mean of one treatment was significantly different than the mean of the other treatment or between FC and FS. Results suggested the average concentration of FC in the clay loam treatment (P) was significantly less ($P<0.05$) than the concentration of FC in the sandy loam treatment (Q). While the FS were suggested to have similar means at the 5 percent level ($P>0.05$) in

both treatments. In the clay loam treatment (P) and the sandy loam treatment (Q), the average concentration of FC was significantly less than the average concentration of FS ($P<0.05$).

5 DISCUSSION

A major objective of this study was to evaluate the impact that sediment has on the survival of bacteria. These studies have shown that indicator bacteria in sediment samples stored at 8°C may exhibit a simple first order die-off rate ranging from 0.023 $days^{-1}$ to 0.010 $days^{-1}$ for FC and 0.033 $days^{-1}$ to 0.018 $days^{-1}$ for FS. At initial concentrations of 10^8 viable cells per milliliter, such as are found in feces, these bacteria and related pathogens could survive in sediments for months in contrast to a faster die-off in water.

Many studies have been performed to determine enteric bacteria die-off in aquatic environments (Geldreich et al., 1968; McFeters et al., 1974). To compare the results of these experiments with past research in water, the logarithmic model was applied to data from other investigations and the computed die-off coefficients are shown in Appendix B. The die-off rate of the bacteria in the stream sediments seem to be approximately ten times lower than those calculated from previous research. This research found that bacteria in a contaminated water sample died-off at a significantly higher rate than sediment bound indicator bacteria. This suggests that stream sediment prolongs the existence of indicator bacteria in the stream system.

Grazing animals directly deposit fecal mater into the stream and the survival of these bacteria in the sediment suggests that enteric pathogens of fecal origin may remain in the bethic environment for extended periods of time. This would agree with what various researchers (Sherer et al., 1988; Stephenson and Street, 1978) have found. Elevated bacteria counts can be seen in a stream for up to three months after actual grazing ceases, particularly if grazing has been intense.

Analysis of variance of the die-off rates between combinations of treatments was performed to determine if the die-off of one treatment was different than the die-off of another. The results are summarized as:

1. A significantly lower die-off rate was observed for FC than for FS in a clay loam sediment inoculated with 25 grams of bovine feces (7.21 percent total carbon), a sandy loam sediment inoculated with 25 grams of bovine feces (5.14 percent total carbon), a clay loam sediment inoculated with 75 grams bovine feces (13.0 percent total carbon), and a sandy loam sediment inoculated with 75 grams bovine feces (11.0 percent total carbon).
2. A significantly higher die-off rate for FC was observed in a clay loam sediment (half-life of 18 days) than in a sandy loam sediment (half-life of 32 days), when each sediment was combined by weight with bovine feces at a 20:1 ratio (sediment:feces).
3. No significance difference was observed in the die-off rate of FS in a clay loam (half-life of 10 days) and a sandy loam sediment (half-life of 12 days), when each sediment was combined by weight with bovine feces at a 20:1 ratio (sediment:feces).
4. A significantly lower die-off rate for FC was observed in a clay loam sediment (half-life of 10 days) than in a sandy loam sediment (half-life of 12 days), when each sediment was combined by weight with bovine feces at a 6.67:1 ratio (sediment:feces).
5. No significant difference was observed in the die-off rate of FS in a clay loam (half-life of 12 days) and sandy loam sediment (half-life of 9 days), when each sediment was combined by weight with bovine feces at a 6.67:1 ratio (sediment:feces).

6. No significant difference was observed in the die-off rate when the inoculation level was increased from 25 to 75 grams of bovine feces in 500 grams of clay loam sediment for FC and FS.
7. No significant difference was observed in the die-off rate when the inoculation level was increased from 25 to 75 grams of bovine feces in 500 grams of sandy loam sediment for FS.
8. A significantly higher die-off rate was observed when the inoculation level was increased from 25 to 75 grams of bovine feces in 500 grams of sandy loam sediment for FC.

The ratio of FC to FS on the first day ranged from 0.2 to 0.7 for all treatments. According to APHA, 1985 the ratio of FC to FS may provide information on possible sources of pollution in water. A ratio of greater than 4.1 is considered an indication of pollution derived from domestic wastes composed of human fecal contamination whereas ratios less than 0.7 suggest that the pollution was due to nonhuman sources. Ratios between 0.7 and 4.4 usually indicate wastes of mixed human and animal sources. The estimated per capita contributions of FC and FS for animals indicate that the FC to FS ratio is 0.2 for cattle and 4.4 for humans.

Fecal streptococci were observed to experience a significantly higher die-off and a higher y-intercept (initial concentration at day zero) than fecal coliform in both sediment types and for the various inoculation levels analyzed. Since FS observed a higher die-off rate than FC for all treatments the ratio of FC to FS increased an average of 2.1 times the initial ratio during the 25 to 30 day study periods. The difference in the FC to FS ratio over time for the various treatments can be explained by the findings of Geldreich, 1976 that prolong storage or stream residence time of fecal pollution from cattle can cause this

ratio to increase from 0.2 to as high as 3.0. He stated that population of FS in domestic cattle feces is comprised of approximately 25 percent of Streptococcus bovis (half-life of 4.3 days) which died-off at a much higher rate than FS from human sources (half-life of 19.5 days).

Other researchers have suggested that FC die-off is significantly higher than for FS (Van Donsel and Geldreich, 1971; and Gary and Adams, 1985). Van Donsel and Geldreich (1971) found fecal coliform in sediment to have a 90% die-away in seven days at a 20 °C storage temperature. While, fecal streptococci and total coliform died at a much slower rate. This disagrees with the findings of this study due to the fact that the source of pollution in this thesis was of domestic cattle origin while the other researchers examined sources from local storm water run-off or domestic sewage from very small populations of humans.

Literature and the findings of this study suggest that while some of the FS may persist in the aquatic environment for long periods of time, some of the species analyzed may perish at a much higher rate. Some species specific to domestic animals (S. bovis and S. equinus) have been determined to experience a much higher die-off rate than other species such as S. faecalis, which has been shown to exists for extended periods of time in soil and water (Geldreich, 1976). This suggests that while some of the FS species die-off, others remain for extended periods of time. The die-off rate of FS reduced as the population of FS is transformed to a population with a lower die-off rate.

The FC and FS die-off for the supernatant (GHI) of the clay loam sediment appeared to occur in two stages. The first stage occurred during the first 15 days of the study at a rate of 0.026 $days^{-1}$ for FC and 0.032 $days^{-1}$ for FS while the second stage occurred during the final 15 days with a significantly higher die-off rates of 0.17 $days^{-1}$

for FC and 0.18 $days^{-1}$ for FS. Statistical comparisons were made between the FC and FS of the supernatant with those of an identical treatment (ABC) that was not centrifuged and contained the sediment in its natural state. No significant difference was found between the die-off rates of the two treatments during the initial 15 days for FC and FS. During the final 15 days of the study the supernatant experienced a significantly higher die-off rate.

The comparison of the clay loam sediment (ABC) and the supernatant of the same treatment (GHI) suggest that by centrifuging the sample enough organic matter was released to support the population FC and FS for a period of time. After this initial die-off phase, the bacteria show a 90 percent reduction in 1 to 3 days. Typical die-off curves for coliforms in water show an initial lag phase followed by a 90% die-off in 3 to 5 days (Gerba and McLeod, 1976).

In many studies the existence of fine soil particles and high organic matter have been shown to increase E. Coli survival (Saylor et al., 1975; Tate, 1978). Tate (1978) suggested that E. Coli can catabolize organic soil constituents and that fine particles and high organic matter substrates may support populations three times greater than sand. This relationship was not observed in this study and little or no difference was observed between the die-off rates of the sandy loam and clay loam sediments inoculated with various levels of bovine feces. This disagreement of these two results might support the inference of Allen et al., 1953 who felt that the amount of organic matter in sediment was not a good index of its ability to support enteric indicator bacteria. However, the observed effects of organic matter and competing bacteria vary a great deal (Orlab, 1956), apparently depending on the aquatic system being studied.

The source of variation in the results obtained from bacterial analysis in sediments were investigated. Repeated samples from the same storage container undergoing identical treatment produced die-off curves that were statistically equivalent. This implied that the sampling and analysis techniques employed accurately determined the bacterial densities present in the sediment treatments.

6 CONCLUSIONS

With the results obtained from these experiments several conclusions can be expressed with regard to bacterial die-off and the bacterial analysis techniques employed. Observation of the data (Figures 4.1.1 and 4.1.2) reveals that minimal variability existed in the number of bacteria determined from samples taken from the same storage vessel. This indicates that the sampling techniques and analysis procedures accurately determined the bacterial densities present in the sediment treatments. The major treatments in all four experiments, replicated in triplicate, give an estimate of the variation that might be determined for an individual experiment that was not replicated. The variation in bacterial densities between replicated storage containers is greater than between sub-samples from the same container. The regression curves among the replicated storage containers proved to be statistically equivalent allowing for a pooled estimate of bacterial die-off on those treatments. Visual observations of the bacterial die-off curves for these treatments would lead to similar conclusions.

The lack of variation in survival between replicate tests permits the estimation of die-off rates for FC and FS. Although statistically significant differences did not exist among survival slopes in most cases, constant trends were observed, i.e. FC survived longer than FS. The inability to detect significant differences is most probably due to the robust nature of the analysis of covariance and inadequate number of data. Theoretical calculations of bacterial densities that involve the use of survival models show that significant differences will exist between the test bacteria with increasing time.

Much care should be used when using FC to FS ratios to indicate the source of fecal contamination. This study indicated that FC to FS ratios from domestic cattle feces would be expected to increase as a function of exposure time in an aquatic environment.

Past research has shown that the FC to FS ratio of many animals and humans may be sufficiently stable in an aquatic environment to be useful tool in determining the source of fecal pollution, where as this is not the case for bacteria from cattle. In practise, where one is unable to determine the specific source of pollution that contaminated a body of water, the FC to FS ratio is of doubtful validity in identifying the source after the bacteria have been exposed to the aquatic environment for as short a period of time as 5 days.

This study concluded that stream sediment allows enteric bacteria to survive, possibly for several months, in an aquatic environment. Resuspension of these bacteria may account for the erratic FC and FS levels often encountered in water monitoring programs since grab samples of water give only an immediate measure of bacterial levels. If enteric pathogens behave similarly, significant public health hazards could arise. Existing state bacteriological standards and monitoring procedures fail to address these problems. Therefore, a more meaningful and accurate indication of water-quality conditions would be obtained by also monitoring indicator bacteria and virus levels in surface sediments.

A recommended procedure to monitor indicator bacteria levels in surface streams would be to disrupt a section of the stream bottom with a rake and collect water samples immediately downstream, as outlined in Sherer et al., 1988. This method would allow an indication of the potential bacteria pose for resuspension and an indication of previous fecal pollution. This method would allow for enumeration of indicator bacteria in water rather than sediment. This would be an advantage since results from enumeration of bacteria in sediments using the membrane filtration technique may be difficult when counts per gram of sediment are less than 1000. This is due to the interference of particles with bacteria colony growth during incubation which results in smearing of

colonies, as occurred in this study (experiment 4). There are other methods of enumerating bacteria in sediments such as the most-probable-number (MPN) method which can be cumbersome and require 48-96 hours to obtain results.

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APPENDICES

APPENDIX A: PRELIMINARY STUDY

Objective: How time effects the duration of subsample removal.

Procedure: Stream sediment was collected from a local stream. A 500 g sample of sediment, 100g distilled water, 40 g fresh bovine feces (collected from the Oregon State University dairy barn), and glass beads were placed into an empty sterile 1,000 mL jar. The sample was then shaken for 1 minute and then subsamples were removed 10 seconds, 30 seconds, 1 minute, 1.5 minutes, and 5 minutes after the initial suspension. The subsamples were then serially diluted to various concentrations and plated in triplicate for fecal coliform enumeration.

Table A.1 Data from prelimanary study.

Subsample removal	dilution	1	2	3	Mean
10 sec.	.00001	4	7	5	
	.0001	60	65	63	63
	.001	trash	trash	trash	
30 sec.	.00001	6	7	10	
	.0001	32	65	44	47
	.001	trash	trash	trash	
1 minute	.00001	4	7	8	
	.0001	61	60	59	60
	.001	trash	trash	trash	
1.5 minutes	.00001	4	7	6	
	.0001	64	59	54	59
	.001	trash	trash	trash	
5 minutes	.00001	11	5	8	
	.0001	55	48	56	53
	.001	trash	trash	trash	

APPENDIX B: SUMMARY OF BACTERIA DIE-OFF IN AQUATIC ENVIRONMENTS

Table B.1 Summary of bacteria die-off in water.

Aquatic system Description	Organism Type	pH	Season or temp. °C	Length of Study	Die-off rate, k (days-1)
Well water inoculated with pure cultures (field, membrane filter) (McFeters et al., 1974)	Coliforms	7.48	'10-12	4 days	0.285
	Enterococci				0.221
	Coliforms				0.227
	Strep.				0.249
	Strep. equinus				0.485
	Strep. bovis				0.128
	Shig. dysenteriae				0.217
	Strep. sonnei				0.198
	Strep. flexneri				0.181
	Sal. paratyphi A				0.303
	Strep. paratyphi D				0.253
	Strep. typhimurium				0.303
	Strep. typhi				0.809
	Vibrio cholerai				0.673
	Strep. paratyphi B				2.022
Stream water (membrane filter) (Mcfeters and Stuart, 1972)	field study E. coli	8.37	4-6	5 days	1.970
		8.1			3.140
	lab study E. coli	8.1	5		0.151
			10		0.231
			15		0.495
			20		0.990
			25		1.386
		2.5	10		6.930
		4			0.630
		5			0.433
		5.5			0.330
		7.3			0.347
		10			0.770
		12			6.930

Table B.1 continued.

Aquatic system Description	Organism Type	pH	Season or temp. °C	Length of Study	Die-off rate, k (days-1)
Inoculate river water (lab study in flasks) (Mitchell and Starzyk, 1975)	E. coli	NG	0	20 days	0.192
			5		0.144
			10		0.256
			20		0.288
	E. aerogenes	NG	0		0.256
			5		0.288
			10		0.383
			20		0.461
	Sal. typphimurium	NG	0		0.177
			5		0.144
			10		0.288
			20		0.329
	Strep. faecalis	NG	0		<0.115
			5		0.192
			10		0.192
			20		0.177
	Strep. faecium	NG	0		<0.115
			5		0.121
			10		<0.115
			20		<0.115
	S. bovis	NG	0		2.310
			5		1.150
			10		2.310
			20		2.310
Storm water runoff (lab study) Geldreich et al., 1968)	Fecal coliform	NG	Su (20)	14 days	1.450
	A. aerogenes				0.649
	S. faecalis				1.690
	S. typhimurium				<0.164
	Fecal coliform	NG	W (10)	14 days	0.246
	A. aerogenes				0.397
	S. faecalis				0.307
	S. typhimurium				<0.164

Table B.1 continued.

Aquatic system Description	Organism Type	pH	Season or temp. °C	Length of Study	Die-off rate, k (days-1)
Storm water runoff (lab study) (Geldreich and Kenner, 1969)	S. faecalis	NG	Su (20)	14 days	<0.164
	S. faecalis var				<0.164
	S. bovis				4.605
	A. aerogenes				0.404
	Fecal coliform				0.227
	S. typhimurium				0.324
	S. faecalis	NG	W (10)		<0.164
	S. faecalis var				0.354
	S. bovis				2.303
	A. aerogenes				0.649
	Fecal coliform				1.354
	S. typhimurium				1.588
BOD dilution water (lab flask study) Hanes and Fragola, 1987) 0% seawater	Total coliforms	6.8	20	10 days	0.219
	E. coli				0.217
	Enterococci				0.339
33 % seawater	Total coliforms	7			0.431
	E. coli				0.274
	Enterococci				0.366
67% seawater	Total coliforms	7.2			0.543
	E. coli				0.774
	Enterococci				0.426
100% seawater	Total coliforms	7.6			1.102
	E. coli				1.332
	Enterococci				0.526
Seawater mortality studies from many sources (Orlob, 1956)	S. typhosa	NG	10	12 days	2.000
				28 days	1.670
	E. coli	NG		35 days	0.320
			Su (25)	NG	0.960
			W		0.520
			Sp		0.850
			Su		1.000
			14		0.670
field study	Total Coliform	NG	14	NG	1.330
lab study			20		1.790
			5		0.690
			21		0.800
			30		1.670

Table B.1 continued.

Aquatic system Description	Organism Type	pH	Season or temp. °C	Length of Study	Die-off rate, k (days-1)
Water supply Reservoir depth membrane filter study surface with pure cultures (Geldreich et al., 1980)	S. bern		20	24 days	0.743
			10	24 days	0.368
	E. coli		20	24 days	0.768
20 ft. surface	E. coli		10	24 days	0.209
	Fecal Strep.		20	24 days	2.424
20 ft. surface					
Seawater in aquarium (lab study with membrane filter chamber (Vasconcelos and Swartz, 1976)	E. coli	NG	10.7	6 days	1.727
			14.5		2.520
			13		2.239
			10.7		0.708
			8.9		0.512
	Sal. enteriditis		14.5		0.568
Fresh water bay Lake Ontario bay Lake Ontario bay Lake Ontario (membrane chamber in field) (Dutka and Kwan, 1980)	E. coli	NG	18.5	28 days	1.100
			18		1.417
	S. faecalis	NG	18		1.317
			18		0.847
	Sal. thompson	NG	18.5		1.256
			17.8		0.834
Bay seawater Sewage effluent bags (Slanetz and Bartley, 1965)	Total Coliform	6.8-7.6	18	7 days	0.429
	Fecal Coliform				0.358
	Fecal Strep.				0.210
pure cultures	S. faecalis				0.306-1.97
	S. faecium				0.357-1.454
					0.291-0.86
	S. bovis				2.760
	E. coli				0.710
	Salmonella sp.				0.447

Su = summer; F = fall; Sp = spring; W = winter; NG = not given
Source: S.R. Crane and J.A. Moore, 1986

APPENDIX C: REGRESSION RESULTS FOR INDIVIDUAL AND POOLED TREATMENTS

Table C.1 Regression statistics.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC Treatment A — Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	5.26819	0.0435014	121.104	.00000
Slope	-0.0154777	2.41302E-3	-6.41423	.00137

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.167691	1	.167691	41.14235	.00137
Error	.0203793	5	.0040759		
Total (Corr.)	.1880702	6			

Correlation Coefficient = -0.944267 R-squared = 89.16 percent
Stnd. Error of Est. = 0.0638425

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT A — Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	5.87942	0.051225	114.776	.00000
Slope	-0.02502	2.84145E-3	-8.80537	.00031

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.438202	1	.438202	77.53449	.00031
Error	.0282585	5	.0056517		
Total (Corr.)	.4664603	6			

Correlation Coefficient = -0.969236 R-squared = 93.94 percent
Stnd. Error of Est. = 0.0751778

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT B Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	5.35672	0.0558217	95.9612	.00000
Slope	-0.0178245	3.09643E-3	-5.75646	.00222

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.222398	1	.222398	33.13685	.00222
Error	.0335576	5	.0067115		
Total (Corr.)	.2559560	6			

Correlation Coefficient = -0.932144 R-squared = 86.89 percent
Stnd. Error of Est. = 0.0819238

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT B Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	5.70567	0.0675777	84.4312	.00000
Slope	-0.0333241	3.74854E-3	-8.88991	.00030

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.777349	1	.777349	79.03051	.00030
Error	.0491803	5	.0098361		
Total (Corr.)	.8265294	6			

Correlation Coefficient = -0.969793 R-squared = 94.05 percent
Stnd. Error of Est. = 0.0991769

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT C Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	5.3232	0.0613317	86.7937	.00000
Slope	-0.017805	3.40207E-3	-5.23356	.00337

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.221911	1	.221911	27.39019	.00337
Error	.0405093	5	.0081019		
Total (Corr.)	.2624208	6			

Correlation Coefficient = -0.919583 R-squared = 84.56 percent
Stnd. Error of Est. = 0.0900103

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT C Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	5.70478	0.0542308	105.195	.00000
Slope	-0.035272	3.00818E-3	-11.7254	.00008

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.87088	1	.87088	137.4839	.00008
Error	.0316721	5	.0063344		
Total (Corr.)	.9025519	6			

Correlation Coefficient = -0.982297 R-squared = 96.49 percent
Stnd. Error of Est. = 0.079589

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT ABC — Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	5.31604	0.0522605	101.722	.00000
Slope	-0.0170357	2.89889E-3	-5.87662	.00203

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.203151	1	.203151	34.53471	.00203
Error	.0294125	5	.0058825		
Total (Corr.)	.2325631	6			

Correlation Coefficient = -0.934628 R-squared = 87.35 percent
Stnd. Error of Est. = 0.0766975

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT ABC — Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	5.76329	0.0550184	104.752	.00000
Slope	-0.0312054	3.05187E-3	-10.225	.00015

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.68164	1	.68164	104.5508	.00015
Error	.0325987	5	.0065197		
Total (Corr.)	.7142424	6			

Correlation Coefficient = -0.976913 R-squared = 95.44 percent
Stnd. Error of Est. = 0.0807449

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT D Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	5.71848	0.0479217	119.33	.00000
Slope	-0.0179587	3.1656E-3	-5.67308	.00476

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.141101	1	.141101	32.18387	.00476
Error	.0175368	4	.0043842		
Total (Corr.)	.1586377	5			

Correlation Coefficient = -0.943108 R-squared = 88.95 percent
Stnd. Error of Est. = 0.0662134

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT D Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.11296	0.0541568	112.875	.00000
Slope	-0.0195612	3.57748E-3	-5.46787	.00544

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.167405	1	.167405	29.89762	.00544
Error	.0223971	4	.0055993		
Total (Corr.)	.1898022	5			

Correlation Coefficient = -0.939147 R-squared = 88.20 percent
Stnd. Error of Est. = 0.0748283

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT E Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	5.55465	0.055119	100.776	.00000
Slope	-6.89062E-3	3.64104E-3	-1.89248	.13137

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.0207728	1	.0207728	3.581499	.13137
Error	.0232001	4	.0058000		
Total (Corr.)	.0439728	5			

Correlation Coefficient = -0.687314 R-squared = 47.24 percent
Stnd. Error of Est. = 0.0761579

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT E Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.10455	0.0986458	61.8835	.00000
Slope	-0.0293198	6.51633E-3	-4.49943	.01083

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.376096	1	.376096	20.24486	.01083
Error	.0743095	4	.0185774		
Total (Corr.)	.4504056	5			

Correlation Coefficient = -0.913792 R-squared = 83.50 percent
Stnd. Error of Est. = 0.136299

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT F Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	5.39938	0.0399623	135.112	.00000
Slope	-3.80384E-3	2.63982E-3	-1.44095	.22304

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.0063303	1	.0063303	2.076326	.22304
Error	.0121952	4	.0030488		
Total (Corr.)	.0185255	5			

Correlation Coefficient = -0.584557 R-squared = 34.17 percent
Stnd. Error of Est. = 0.0552159

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT F Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	5.92958	0.0675986	87.7175	.00000
Slope	-0.0257778	4.46542E-3	-5.77276	.00447

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.290716	1	.290716	33.32470	.00447
Error	.0348949	4	.0087237		
Total (Corr.)	.3256105	5			

Correlation Coefficient = -0.944898 R-squared = 89.28 percent
Stnd. Error of Est. = 0.0934009

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT DEF Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	5.5575	0.0196829	282.351	.00000
Slope	-9.55107E-3	1.30021E-3	-7.34578	.00183

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.039910	1	.039910	53.96047	.00183
Error	.0029585	4	.0007396		
Total (Corr.)	.0428685	5			

Correlation Coefficient = -0.964877 R-squared = 93.10 percent
Stnd. Error of Est. = 0.0271959

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT DEF Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.04903	0.0584641	103.466	.00000
Slope	-0.0248862	3.86201E-3	-6.44386	.00298

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.270955	1	.270955	41.52331	.00298
Error	.0261014	4	.0065254		
Total (Corr.)	.2970560	5			

Correlation Coefficient = -0.955057 R-squared = 91.21 percent
Stnd. Error of Est. = 0.0807797

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT G Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.03976	0.342305	17.6444	.00001
Slope	-0.104948	0.0189877	-5.52717	.00266

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	7.709865	1	7.709865	30.54956	.00266
Error	1.2618621	5	.2523724		
Total (Corr.)	8.9717274	6			

Correlation Coefficient = -0.927012 R-squared = 85.94 percent
Stnd. Error of Est. = 0.502367

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT G Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.32638	0.317229	19.9426	.00001
Slope	-0.108812	0.0175967	-6.18363	.00161

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	8.287983	1	8.287983	38.23734	.00161
Error	1.0837552	5	.2167510		
Total (Corr.)	9.3717383	6			

Correlation Coefficient = -0.940404 R-squared = 88.44 percent
Stnd. Error of Est. = 0.465565

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT H Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.05463	0.31667	19.1197	.00001
Slope	-0.106633	0.0175657	-6.07052	.00175

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	7.959415	1	7.959415	36.85120	.00175
Error	1.0799397	5	.2159879		
Total (Corr.)	9.0393547	6			

Correlation Coefficient = -0.938365 R-squared = 88.05 percent
Stnd. Error of Est. = 0.464745

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT H Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.32757	0.3024	20.9245	.00000
Slope	-0.112052	0.0167741	-6.68007	.00114

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	8.788992	1	8.788992	44.62333	.00114
Error	.9847978	5	.1969596		
Total (Corr.)	9.7737896	6			

Correlation Coefficient = -0.948283 R-squared = 89.92 percent
Stnd. Error of Est. = 0.443801

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT I — Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.02513	0.339886	17.7269	.00001
Slope	-0.105617	0.0188535	-5.60199	.00250

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	7.808475	1	7.808475	31.38229	.00250
Error	1.2440894	5	.2488179		
Total (Corr.)	9.0525640	6			

Correlation Coefficient = -0.928747 R-squared = 86.26 percent
Stnd. Error of Est. = 0.498816

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT I — Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.16751	0.274908	22.4348	.00000
Slope	-0.105197	0.0152491	-6.89858	.00098

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	7.746550	1	7.746550	47.59040	.00098
Error	.8138774	5	.1627755		
Total (Corr.)	8.5604270	6			

Correlation Coefficient = -0.951276 R-squared = 90.49 percent
Stnd. Error of Est. = 0.403454

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT GHI Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.03984	0.328419	18.3906	.00001
Slope	-0.105733	0.0182174	-5.80393	.00214

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	7.825582	1	7.825582	33.68564	.00214
Error	1.1615606	5	.2323121		
Total (Corr.)	8.9871431	6			

Correlation Coefficient = -0.933142 R-squared = 87.08 percent
Stnd. Error of Est. = 0.481988

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT GHI Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.27382	0.29533	21.2434	.00000
Slope	-0.108687	0.016382	-6.63455	.00117

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	8.269021	1	8.269021	44.01728	.00117
Error	.9392926	5	.1878585		
Total (Corr.)	9.2083134	6			

Correlation Coefficient = -0.947626 R-squared = 89.80 percent
Stnd. Error of Est. = 0.433426

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT J Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.15387	0.0873235	70.4721	.00000
Slope	-0.0152147	5.7684E-3	-2.63759	.05773

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.1012753	1	.1012753	6.956888	.05773
Error	.0582302	4	.0145576		
Total (Corr.)	.1595055	5			

Correlation Coefficient = -0.796827 R-squared = 63.49 percent
Stnd. Error of Est. = 0.120655

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT J Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.22677	0.0713808	87.2331	.00000
Slope	-0.0228612	4.71526E-3	-4.84835	.00835

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.228653	1	.228653	23.50648	.00835
Error	.0389090	4	.0097272		
Total (Corr.)	.2675623	5			

Correlation Coefficient = -0.924435 R-squared = 85.46 percent
Stnd. Error of Est. = 0.0986268

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT K Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.07702	0.0853176	71.2282	.00000
Slope	-0.0102539	5.63589E-3	-1.8194	.14298

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.0460001	1	.0460001	3.310208	.14298
Error	.0555857	4	.0138964		
Total (Corr.)	.1015858	5			

Correlation Coefficient = -0.672919 R-squared = 45.28 percent
Stnd. Error of Est. = 0.117883

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT K Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.20901	0.0592073	104.869	.00000
Slope	-0.0232096	3.91111E-3	-5.93427	.00404

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.235674	1	.235674	35.21559	.00404
Error	.0267693	4	.0066923		
Total (Corr.)	.2624436	5			

Correlation Coefficient = -0.947628 R-squared = 89.80 percent
Stnd. Error of Est. = 0.0818067

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT L — Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.09527	0.0542874	112.278	.00000
Slope	-0.0136582	3.5861E-3	-3.80864	.01896

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.081614	1	.081614	14.50573	.01896
Error	.0225053	4	.0056263		
Total (Corr.)	.1041191	5			

Correlation Coefficient = -0.885353 R-squared = 78.39 percent
Stnd. Error of Est. = 0.0750088

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT L — Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.28617	0.127886	49.1546	.00000
Slope	-0.0318902	8.44786E-3	-3.77494	.01952

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.444930	1	.444930	14.25020	.01952
Error	.1248910	4	.0312228		
Total (Corr.)	.5698215	5			

Correlation Coefficient = -0.883643 R-squared = 78.08 percent
Stnd. Error of Est. = 0.1767

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT JKL — Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.10872	0.0742466	82.276	.00000
Slope	-0.0130423	4.90457E-3	-2.65921	.05644

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.0744190	1	.0744190	7.071375	.05644
Error	.0420959	4	.0105240		
Total (Corr.)	.1165149	5			

Correlation Coefficient = -0.799192 R-squared = 63.87 percent
Stnd. Error of Est. = 0.102586

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT JKL — Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.24065	0.0756225	82.5238	.00000
Slope	-0.025987	4.99546E-3	-5.20213	.00651

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.295454	1	.295454	27.06214	.00651
Error	.0436705	4	.0109176		
Total (Corr.)	.3391247	5			

Correlation Coefficient = -0.933395 R-squared = 87.12 percent
Stnd. Error of Est. = 0.104487

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT M — Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	5.8689	0.0532882	110.135	.00000
Slope	-0.0240928	3.5201E-3	-6.84436	.00238

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.253953	1	.253953	46.84520	.00238
Error	.0216845	4	.0054211		
Total (Corr.)	.2756380	5			

Correlation Coefficient = -0.959859 R-squared = 92.13 percent
Stnd. Error of Est. = 0.0736283

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT M — Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.47347	0.0755873	85.6422	.00000
Slope	-0.0287015	4.99314E-3	-5.74819	.00454

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.360402	1	.360402	33.04174	.00454
Error	.0436299	4	.0109075		
Total (Corr.)	.4040322	5			

Correlation Coefficient = -0.944465 R-squared = 89.20 percent
Stnd. Error of Est. = 0.104439

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT N Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	5.86565	0.0157403	372.651	.00000
Slope	-0.0231239	1.03977E-3	-22.2394	.00002

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.23394	1	.23394	494.5905	.00002
Error	.0018920	4	.0004730		
Total (Corr.)	.2358299	5			

Correlation Coefficient = -0.995981 R-squared = 99.20 percent
Stnd. Error of Est. = 0.0217484

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT N Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.49506	0.0373649	173.828	.00000
Slope	-0.027781	2.46824E-3	-11.2554	.00035

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.33766	1	.33766	126.6832	.00035
Error	.0106614	4	.0026654		
Total (Corr.)	.3483166	5			

Correlation Coefficient = -0.984577 R-squared = 96.94 percent
Stnd. Error of Est. = 0.051627

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT O — Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	5.7778	0.0460399	125.495	.00000
Slope	-0.0228258	3.04129E-3	-7.50529	.00169

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.227945	1	.227945	56.32940	.00169
Error	.0161866	4	.0040466		
Total (Corr.)	.2441317	5			

Correlation Coefficient = -0.96628 R-squared = 93.37 percent
Stnd. Error of Est. = 0.0636132

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT O — Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.50366	0.0525573	123.744	.00000
Slope	-0.0386169	3.47182E-3	-11.1229	.00037

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.65243	1	.65243	123.7199	.00037
Error	.0210937	4	.0052734		
Total (Corr.)	.6735215	5			

Correlation Coefficient = -0.984216 R-squared = 96.87 percent
Stnd. Error of Est. = 0.0726184

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FC TREATMENT MNO — Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	5.83745	0.0247314	236.034	.00000
Slope	-0.0233475	1.6337E-3	-14.2912	.00014

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.23848	1	.23848	204.2380	.00014
Error	.0046707	4	.0011677		
Total (Corr.)	.2431549	5			

Correlation Coefficient = -0.990349 R-squared = 98.08 percent
Stnd. Error of Est. = 0.0341713

Regression Analysis - Linear model: Y = a+bX

Dependent variable: FS TREATMENT MNO — Independent variable: time

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	6.49073	0.0361139	179.729	.00000
Slope	-0.0316998	2.3856E-3	-13.288	.00019

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.43963	1	.43963	176.5696	.00019
Error	.0099594	4	.0024899		
Total (Corr.)	.4495931	5			

Correlation Coefficient = -0.988862 R-squared = 97.78 percent
Stnd. Error of Est. = 0.0498985

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: PQ.fcp — Independent variable: PQ.timepq

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	2.64919	0.144242	18.3663	.00035
Slope	-0.0268403	0.0117773	-2.27898	.10704

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.1801004	1	.1801004	5.193766	.10704
Error	.1040288	3	.0346763		
Total (Corr.)	.2841292	4			

Correlation Coefficient = -0.796158 R-squared = 63.39 percent
Stnd. Error of Est. = 0.186216

Regression Analysis - Linear model: Y = a+bX

Dependent variable: PQ.fsp — Independent variable: PQ.timepq

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	3.58705	0.123797	28.9753	.00009
Slope	-0.0176135	0.010108	-1.74253	.17978

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.0775586	1	.0775586	3.036425	.17978
Error	.0766282	3	.0255427		
Total (Corr.)	.1541869	4			

Correlation Coefficient = -0.709237 R-squared = 50.30 percent
Stnd. Error of Est. = 0.159821

Table C.1 continued.

Regression Analysis - Linear model: Y = a+bX

Dependent variable: PQ.fcq — Independent variable: PQ.timepq

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	2.97169	0.0681463	43.6076	.00003
Slope	-0.0156852	5.56412E-3	-2.81898	.06679

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.0615061	1	.0615061	7.946673	.06679
Error	.0232196	3	.0077399		
Total (Corr.)	.0847257	4			

Correlation Coefficient = -0.852024 R-squared = 72.59 percent
Stnd. Error of Est. = 0.0879764

Regression Analysis - Linear model: Y = a+bX

Dependent variable: PQ.fsq — Independent variable: PQ.timepq

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	4.11133	0.164368	25.0129	.00014
Slope	-0.0330633	0.0134206	-2.46362	.09058

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	.2732953	1	.2732953	6.069406	.09058
Error	.1350850	3	.0450283		
Total (Corr.)	.4083803	4			

Correlation Coefficient = -0.818057 R-squared = 66.92 percent
Stnd. Error of Est. = 0.212199

APPENDIX D: RAW DATA

Table D.1 Summary of data for day 0.

PLATE #	Sediment type	Dilution factor	FC counted	FS counted	FC per gram sed.	FS per gram sed.
1	A	1.0E+02	tntc	tntc		
2	A	1.0E+02	tntc	tntc		
3	A	1.0E+02	tntc	tntc		
4	A	1.0E+03	tntc	tntc		
5	A	1.0E+03	tntc	tntc		
6	A	1.0E+03	tntc	tntc		
7	A	1.0E+04	19	95	2.3E+05	9.3E+05
8	A	1.0E+04	24	89		
9	A	1.0E+04	27	95		
10	B	1.0E+02	tntc	tntc		
11	B	1.0E+02	tntc	tntc		
12	B	1.0E+02	tntc	tntc		
13	B	1.0E+03	tntc	tntc		
14	B	1.0E+03	tntc	tntc		
15	B	1.0E+03	tntc	tntc		
16	B	1.0E+04	31	59	3.0E+05	6.2E+05
17	B	1.0E+04	29	65		
18	B	1.0E+04	31	63		
19	C1	1.0E+02	tntc	tntc		
20	C1	1.0E+02	tntc	tntc		
21	C1	1.0E+02	tntc	tntc		
22	C1	1.0E+03	tntc	tntc		
23	C1	1.0E+03	tntc	tntc		
24	C1	1.0E+03	tntc	tntc		
25	C1	1.0E+04	30	69	2.6E+05	6.5E+05
26	C1	1.0E+04	25	64		
27	C1	1.0E+04	24	62		
28	C2	1.0E+02	tntc	tntc		
29	C2	1.0E+02	tntc	tntc		
30	C2	1.0E+02	tntc	tntc		
31	C2	1.0E+03	tntc	tntc		
32	C2	1.0E+03	tntc	tntc		
33	C2	1.0E+03	tntc	tntc		
34	C2	1.0E+04	31	76	3.8E+05	6.7E+05
35	C2	1.0E+04	46	67		
36	C2	1.0E+04	36	58		
37	C3	1.0E+02	tntc	tntc		
38	C3	1.0E+02	tntc	tntc		
39	C3	1.0E+02	tntc	tntc		
40	C3	1.0E+03	tntc	tntc		
41	C3	1.0E+03	tntc	tntc		

Table D.1 continued.

PLATE #	Sediment type	Dilution factor	FC counted	FS counted	FC per gram sed.	FS per gram sed.
42	C3	1.0E+03	tntc	tntc		
43	C3	1.0E+04	31	66	2.4E+05	5.8E+05
44	C3	1.0E+04	20	60		
45	C3	1.0E+04	22	47		
46	D	1.0E+02	tntc	tntc		
47	D	1.0E+02	tntc	tntc		
48	D	1.0E+02	tntc	tntc		
49	D	1.0E+03	tntc	tntc		
50	D	1.0E+03	tntc	tntc		
51	D	1.0E+03	tntc	tntc		
52	D	1.0E+04	60	164	6.1E+05	1.5E+06
53	D	1.0E+04	34	151		
54	D	1.0E+04	90	140		
55	E	1.0E+02	tntc	tntc		
56	E	1.0E+02	tntc	tntc		
57	E	1.0E+02	tntc	tntc		
58	E	1.0E+03	tntc	tntc		
59	E	1.0E+03	tntc	tntc		
60	E	1.0E+03	tntc	tntc		
61	E	1.0E+04	42	133	3.6E+05	1.4E+06
62	E	1.0E+04	29	139		
63	E	1.0E+04	38	136		
64	F1	1.0E+02	tntc	tntc		
65	F1	1.0E+02	tntc	tntc		
66	F1	1.0E+02	tntc	tntc		
67	F1	1.0E+03	tntc	tntc		
68	F1	1.0E+03	tntc	tntc		
69	F1	1.0E+03	tntc	tntc		
70	F1	1.0E+04	19	87	2.4E+05	9.5E+05
71	F1	1.0E+04	31	98		
72	F1	1.0E+04	22	101		
73	F2	1.0E+02	tntc	tntc		
74	F2	1.0E+02	tntc	tntc		
75	F2	1.0E+02	tntc	tntc		
76	F2	1.0E+03	tntc	tntc		
77	F2	1.0E+03	tntc	tntc		
78	F2	1.0E+03	tntc	tntc		
79	F2	1.0E+04	22	106	2.3E+05	1.0E+06
80	F2	1.0E+04	24	97		
81	F2	1.0E+04	23	97		
82	F3	1.0E+02	tntc	tntc		
83	F3	1.0E+02	tntc	tntc		
84	F3	1.0E+02	tntc	tntc		
85	F3	1.0E+03	tntc	tntc		

Table D.1 continued.

PLATE #	Sediment type	Dilution factor	FC counted	FS counted	FC per gram sed.	FS per gram sed.
86	F3	1.0E+03	tntc	tntc		
87	F3	1.0E+03	tntc	tntc		
88	F3	1.0E+04	20	75	1.9E+05	8.2E+05
89	F3	1.0E+04	14	82		
90	F3	1.0E+04	23	89		
91	G	1.0E+02	tntc	tntc		
92	G	1.0E+02	tntc	tntc		
93	G	1.0E+02	tntc	tntc		
94	G	1.0E+03	tntc	tntc		
95	G	1.0E+03	tntc	tntc		
96	G	1.0E+03	tntc	tntc		
97	G	1.0E+04	21	76	3.0E+05	7.4E+05
98	G	1.0E+04	39	63		
99	G	1.0E+04	29	84		
100	H	1.0E+02	tntc	tntc		
101	H	1.0E+02	tntc	tntc		
102	H	1.0E+02	tntc	tntc		
103	H	1.0E+03	tntc	tntc		
104	H	1.0E+03	tntc	tntc		
105	H	1.0E+03	tntc	tntc		
106	H	1.0E+04	27	67	2.7E+05	6.9E+05
107	H	1.0E+04	25	70		
108	H	1.0E+04	30	70		
109	I1	1.0E+02	tntc	tntc		
110	I1	1.0E+02	tntc	tntc		
111	I1	1.0E+02	tntc	tntc		
112	I1	1.0E+03	tntc	tntc		
113	I1	1.0E+03	tntc	tntc		
114	I1	1.0E+03	tntc	tntc		
115	I1	1.0E+04	35	68	3.2E+05	6.5E+05
116	I1	1.0E+04	34	63		
117	I1	1.0E+04	27	65		
118	I2	1.0E+02	tntc	tntc		
119	I2	1.0E+02	tntc	tntc		
120	I2	1.0E+02	tntc	tntc		
121	I2	1.0E+03	tntc	tntc		
122	I2	1.0E+03	tntc	tntc		
123	I2	1.0E+03	tntc	tntc		
124	I2	1.0E+04	39	70	2.7E+05	6.7E+05
125	I2	1.0E+04	21	61		
126	I2	1.0E+04	21	70		
127	I3	1.0E+02	tntc	tntc		
128	I3	1.0E+02	tntc	tntc		
129	I3	1.0E+02	tntc	tntc		

Table D.1 continued.

PLATE #	Sediment type	Dilution factor	FC counted	FS counted	FC per gram sed.	FS per gram sed.
130	I3	1.0E+03	tntc	tntc		
131	I3	1.0E+03	tntc	tntc		
132	I3	1.0E+03	tntc	tntc		
133	I3	1.0E+04	28	66	2.9E+05	7.0E+05
134	I3	1.0E+04	30	73		
135	I3	1.0E+04	30	71		
136	J	1.0E+04	tntc	tntc		
137	J	1.0E+04	tntc	tntc		
138	J	1.0E+04	tntc	tntc		
139	J	1.0E+05	23	21	2.0E+06	2.3E+06
140	J	1.0E+05	16	25		
141	J	1.0E+05	22	23		
142	J	1.0E+06	1	0		
143	J	1.0E+06	2	3		
144	J	1.0E+06	2	4		
145	K	1.0E+04	tntc	tntc		
146	K	1.0E+04	tntc	tntc		
147	K	1.0E+04	tntc	tntc		
148	K	1.0E+05	16	16	1.7E+06	1.8E+06
149	K	1.0E+05	18	16		
150	K	1.0E+05	18	23		
151	K	1.0E+06	3	1		
152	K	1.0E+06	1	2		
153	K	1.0E+06	2	2		
154	L1	1.0E+04	tntc	tntc		
155	L1	1.0E+04	tntc	tntc		
156	L1	1.0E+04	tntc	tntc		
157	L1	1.0E+05	17	42	1.7E+06	4.9E+06
158	L1	1.0E+05	11	52		
159	L1	1.0E+05	22	53		
160	L1	1.0E+06	5	6		
161	L1	1.0E+06	2	6		
162	L1	1.0E+06	1	5		
163	L2	1.0E+04	181	tntc		
164	L2	1.0E+04	152	tntc		
165	L2	1.0E+04	165	tntc		
166	L2	1.0E+05	14	32	1.6E+06	2.3E+06
167	L2	1.0E+05	18	24		
168	L2	1.0E+05	15	14		
169	L2	1.0E+06	2	3		
170	L2	1.0E+06	2	2		
171	L2	1.0E+06	2	4		
172	L3	1.0E+04	145	tntc		
173	L3	1.0E+04	136	tntc		

Table D.1 continued.

PLATE #	Sediment type	Dilution factor	FC counted	FS counted	FC per gram sed.	FS per gram sed.
174	L3	1.0E+04	169	tntc		
175	L3	1.0E+05	18	21	1.5E+06	2.8E+06
176	L3	1.0E+05	7	37		
177	L3	1.0E+05	20	26		
178	L3	1.0E+06	2	2		
179	L3	1.0E+06	0	4		
180	L3	1.0E+06	3	5		
181	M	1.0E+04	92	tntc		
182	M	1.0E+04	95	tntc		
183	M	1.0E+04	87	tntc		
184	M	1.0E+05	6	29	7.7E+05	3.7E+06
185	M	1.0E+05	7	36		
186	M	1.0E+05	10	45		
187	M	1.0E+06	1	6		
188	M	1.0E+06	2	1		
189	M	1.0E+06	0	1		
190	N	1.0E+04	72	tntc	7.7E+05	
191	N	1.0E+04	79	tntc		
192	N	1.0E+04	81	tntc		
193	N	1.0E+05	3	32		3.6E+06
194	N	1.0E+05	5	29		
195	N	1.0E+05	7	48		
196	N	1.0E+06	0	0		
197	N	1.0E+06	1	4		
198	N	1.0E+06	2	3		
199	O1	1.0E+04	55	tntc	5.7E+05	
200	O1	1.0E+04	56	tntc		
201	O1	1.0E+04	60	tntc		
202	O1	1.0E+05	4	24		3.1E+06
203	O1	1.0E+05	7	31		
204	O1	1.0E+05	4	39		
205	O1	1.0E+06	0	5		
206	O1	1.0E+06	0	1		
207	O1	1.0E+06	0	2		
208	O2	1.0E+04	51	tntc	5.4E+05	
209	O2	1.0E+04	56	tntc		
210	O2	1.0E+04	29*	tntc		
211	O2	1.0E+05	5	35		2.7E+06
212	O2	1.0E+05	6	21		
213	O2	1.0E+05	11	24		
214	O2	1.0E+06	1	5		
215	O2	1.0E+06	1	2		
216	O2	1.0E+06	0	3		
217	O3	1.0E+04	54	tntc	5.4E+05	

Table D.1 continued.

PLATE #	Sediment type	Dilution factor	FC counted	FS counted	FC per gram sed.	FS per gram sed.
218	O3	1.0E+04	60	tntc		
219	O3	1.0E+04	49	tntc		
220	O3	1.0E+05	6	29		2.9E+06
221	O3	1.0E+05	8	24		
222	O3	1.0E+05	7	34		
223	O3	1.0E+06	1	2		
224	O3	1.0E+06	0	3		
225	O3	1.0E+06	1	3		

Table D.2 Summary of data for day 5.

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
1	A	1.0E+03	124	1.0E+04	51	1.3E+05	5.7E+05
2	A	1.0E+03	128	1.0E+04	57		
3	A	1.0E+03	135	1.0E+04	63		
4	A	1.0E+04	17	1.0E+05	11		
5	A	1.0E+04	10	1.0E+05	9		
6	A	1.0E+04	12	1.0E+05	8		
7	B	1.0E+04	18	1.0E+04	34	1.5E+05	3.5E+05
8	B	1.0E+04	16	1.0E+04	41		
9	B	1.0E+04	12	1.0E+04	31		
10	B	1.0E+05	<10	1.0E+05	3		
11	B	1.0E+05	<10	1.0E+05	8		
12	B	1.0E+05	<10	1.0E+05	2		
13	C1	1.0E+04	12	1.0E+04	29	1.3E+05	3.3E+05
14	C1	1.0E+04	12	1.0E+04	38		
15	C1	1.0E+04	14	1.0E+04	32		
16	C1	1.0E+05	<10	1.0E+05	1		
17	C1	1.0E+05	<10	1.0E+05	4		
18	C1	1.0E+05	<10	1.0E+05	5		
19	C2	1.0E+04	13	1.0E+04	39	1.3E+05	3.4E+05
20	C2	1.0E+04	12	1.0E+04	34		
21	C2	1.0E+04	15	1.0E+04	28		
22	C2	1.0E+05	<10	1.0E+05	4		
23	C2	1.0E+05	<10	1.0E+05	4		
24	C2	1.0E+05	<10	1.0E+05	1		
25	C3	1.0E+04	18	1.0E+04	28	1.7E+05	2.8E+05
26	C3	1.0E+04	15	1.0E+04	25		
27	C3	1.0E+04	17	1.0E+04	30		
28	C3	1.0E+05	<10	1.0E+05	3		
29	C3	1.0E+05	<10	1.0E+05	1		
30	C3	1.0E+05	<10	1.0E+05	1		
31	D	1.0E+04	40	1.0E+04	74	3.7E+05	8.1E+05
32	D	1.0E+04	34	1.0E+04	79		
33	D	1.0E+04	38	1.0E+04	91		
34	D	1.0E+05	<10	1.0E+05	13		
35	D	1.0E+05	<10	1.0E+05	9		
36	D	1.0E+05	<10	1.0E+05	14		
37	E	1.0E+04	34	1.0E+04	58	3.1E+05	6.0E+05
38	E	1.0E+04	30	1.0E+04	60		
39	E	1.0E+04	29	1.0E+04	63		
40	E	1.0E+05	<10	1.0E+05	3		
41	E	1.0E+05	<10	1.0E+05	2		
42	E	1.0E+05	<10	1.0E+05	4		
43	F1	1.0E+03	tntc	1.0E+04	48		5.2E+05

Table D.2 continued.

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
44	F1	1.0E+03	tntc	1.0E+04	65		
45	F1	1.0E+03	tntc	1.0E+04	43		
46	F1	1.0E+04	27	1.0E+05	tntc	2.7E+05	
47	F1	1.0E+04	28	1.0E+05	tntc		
48	F1	1.0E+04	26	1.0E+05	tntc		
49	F2	1.0E+03	tntc	1.0E+04	47		5.4E+05
50	F2	1.0E+03	tntc	1.0E+04	56		
51	F2	1.0E+03	tntc	1.0E+04	58		
52	F2	1.0E+04	33	1.0E+05	tntc	3.0E+05	
53	F2	1.0E+04	36	1.0E+05	tntc		
54	F2	1.0E+04	22	1.0E+05	tntc		
55	F3	1.0E+03	tntc	1.0E+04	65		5.4E+05
56	F3	1.0E+03	tntc	1.0E+04	50		
57	F3	1.0E+03	tntc	1.0E+04	48		
58	F3	1.0E+04	25	1.0E+05	tntc	2.7E+05	
59	F3	1.0E+04	30	1.0E+05	tntc		
60	F3	1.0E+04	25	1.0E+05	tntc		
61	G	1.0E+03	tntc	1.0E+04	42		4.4E+05
62	G	1.0E+03	tntc	1.0E+04	54		
63	G	1.0E+03	tntc	1.0E+04	35		
64	G	1.0E+04	32	1.0E+05	tntc	2.9E+05	
65	G	1.0E+04	24	1.0E+05	tntc		
66	G	1.0E+04	30	1.0E+05	tntc		
67	H	1.0E+03	tntc	1.0E+04	52		5.0E+05
68	H	1.0E+03	tntc	1.0E+04	58		
69	H	1.0E+03	tntc	1.0E+04	41		
70	H	1.0E+04	48	1.0E+05	tntc	4.2E+05	
71	H	1.0E+04	44	1.0E+05	tntc		
72	H	1.0E+04	35	1.0E+05	tntc		
73	I1	1.0E+03	tntc	1.0E+04	38		3.3E+05
74	I1	1.0E+03	tntc	1.0E+04	33		
75	I1	1.0E+03	tntc	1.0E+04	28		
76	I1	1.0E+04	26	1.0E+05	tntc	2.3E+05	
77	I1	1.0E+04	23	1.0E+05	tntc		
78	I1	1.0E+04	21	1.0E+05	tntc		
79	I2	1.0E+03	tntc	1.0E+04	29		3.1E+05
80	I2	1.0E+03	tntc	1.0E+04	35		
81	I2	1.0E+03	tntc	1.0E+04	30		
82	I2	1.0E+04	28	1.0E+05	tntc	2.8E+05	
83	I2	1.0E+04	28	1.0E+05	tntc		
84	I2	1.0E+04	28	1.0E+05	tntc		
85	I3	1.0E+03	tntc	1.0E+04	35		3.4E+05
86	I3	1.0E+03	tntc	1.0E+04	36		
87	I3	1.0E+03	tntc	1.0E+04	31		

Table D.2 continued.

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
88	I3	1.0E+04	30	1.0E+05	tntc	2.6E+05	
89	I3	1.0E+04	27	1.0E+05	tntc		
90	I3	1.0E+04	21	1.0E+05	tntc		
91	J	1.0E+04	90	1.0E+04	103	9.0E+05	1.0E+06
92	J	1.0E+04	93	1.0E+04	98		
93	J	1.0E+04	87	1.0E+04	104		
94	J	1.0E+05	5	1.0E+05	?		
95	J	1.0E+05	6	1.0E+05	?		
96	J	1.0E+05	4	1.0E+05	?		
97	K	1.0E+04	77	1.0E+04	82	7.7E+05	9.3E+05
98	K	1.0E+04	74	1.0E+04	112		
99	K	1.0E+04	81	1.0E+04	85		
100	K	1.0E+05	3	1.0E+05	13		
101	K	1.0E+05	0	1.0E+05	20		
102	K	1.0E+05	10	1.0E+05	19		
103	L1	1.0E+04	80	1.0E+04	80	9.2E+05	9.4E+05
104	L1	1.0E+04	87	1.0E+04	95		
105	L1	1.0E+04	109	1.0E+04	108		
106	L1	1.0E+05	12	1.0E+05	6		
107	L1	1.0E+05	5	1.0E+05	7		
108	L1	1.0E+05	8	1.0E+05	10		
109	L2	1.0E+04	90	1.0E+04	76	8.5E+05	8.7E+05
110	L2	1.0E+04	82	1.0E+04	86		
111	L2	1.0E+04	83	1.0E+04	100		
112	L2	1.0E+05	12	1.0E+05	9		
113	L2	1.0E+05	13	1.0E+05	7		
114	L2	1.0E+05	15	1.0E+05	10		
115	L3	1.0E+04	81	1.0E+04	86	8.9E+05	9.7E+05
116	L3	1.0E+04	89	1.0E+04	88		
117	L3	1.0E+04	96	1.0E+04	118		
118	L3	1.0E+05	10	1.0E+05	12		
119	L3	1.0E+05	9	1.0E+05	11		
120	L3	1.0E+05	7	1.0E+05	11		
121	M	1.0E+04	45	1.0E+04	tntc	4.5E+05	
122	M	1.0E+04	40	1.0E+04	tntc		
123	M	1.0E+04	51	1.0E+04	tntc		
124	M	1.0E+05	2	1.0E+05	23		2.3E+06
125	M	1.0E+05	6	1.0E+05	21		
126	M	1.0E+05	2	1.0E+05	24		
127	N	1.0E+04	51	1.0E+04	tntc	5.5E+05	
128	N	1.0E+04	57	1.0E+04	tntc		
129	N	1.0E+04	58	1.0E+04	tntc		
130	N	1.0E+05	6	1.0E+05	23		2.1E+06
131	N	1.0E+05	6	1.0E+05	17		

Table D.2 continued.

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
132	N	1.0E+05	3	1.0E+05	23		
133	O1	1.0E+04	47	1.0E+04	tntc	5.3E+05	
134	O1	1.0E+04	53	1.0E+04	tntc		
135	O1	1.0E+04	59	1.0E+04	tntc		
136	O1	1.0E+05	5	1.0E+05	27		2.3E+06
137	O1	1.0E+05	1	1.0E+05	24		
138	O1	1.0E+05	2	1.0E+05	17		
139	O2	1.0E+04	51	1.0E+04	tntc	5.1E+05	
140	O2	1.0E+04	54	1.0E+04	tntc		
141	O2	1.0E+04	48	1.0E+04	223		
142	O2	1.0E+05	4	1.0E+05	13		1.5E+06
143	O2	1.0E+05	6	1.0E+05	15		
144	O2	1.0E+05	3	1.0E+05	17		
145	O3	1.0E+04	48	1.0E+04	tntc	4.3E+05	
146	O3	1.0E+04	43	1.0E+04	tntc		
147	O3	1.0E+04	39	1.0E+04	tntc		
148	O3	1.0E+05	6	1.0E+05	31		2.5E+06
149	O3	1.0E+05	4	1.0E+05	11		
150	O3	1.0E+05	5	1.0E+05	33		
151	P	1.0E+02	6	1.0E+02	52*	7.0E+02	5.5E+03
152	P	1.0E+02	8	1.0E+02	68*		
153	P	1.0E+02	7	1.0E+02	76*		
154	P	1.0E+03	6	1.0E+03	5		
155	P	1.0E+03	4	1.0E+03	5		
156	P	1.0E+03	0	1.0E+03	4		
157	P	1.0E+04	0	1.0E+04	1		
158	P	1.0E+04	0	1.0E+04	0		
159	P	1.0E+04	1	1.0E+04	2		
160	Q	1.0E+02	11	1.0E+02	trash	1.2E+03	
161	Q	1.0E+02	12	1.0E+02	trash		
162	Q	1.0E+02	12	1.0E+02	trash		
163	Q	1.0E+03	0	1.0E+03	20		2.2E+04
164	Q	1.0E+03	0	1.0E+03	22		
165	Q	1.0E+03	2	1.0E+03	24		
166	Q	1.0E+04	0	1.0E+04	3		
167	Q	1.0E+04	0	1.0E+04	1		
168	Q	1.0E+04	0	1.0E+04	3		

Table D.3 Summary of data for day 10.

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
1	A	1.0E+03	117	1.0E+03		1.2E+05	
2	A	1.0E+03	120	1.0E+03			
3	A	1.0E+03	133	1.0E+03			
4	A	1.0E+04	14	1.0E+04	40	1.4E+05	3.8E+05
5	A	1.0E+04	15	1.0E+04	40		
6	A	1.0E+04	14	1.0E+04	33		
7	B	1.0E+03	110	1.0E+03		1.2E+05	
8	B	1.0E+03	129	1.0E+03			
9	B	1.0E+03	121	1.0E+03			
10	B	1.0E+04	11	1.0E+04	22	1.4E+05	2.1E+05
11	B	1.0E+04	16	1.0E+04	24		
12	B	1.0E+04	15	1.0E+04	17		
13	C1	1.0E+03	122	1.0E+03		1.2E+05	
14	C1	1.0E+03	115	1.0E+03			
15	C1	1.0E+03	109	1.0E+03			
16	C1	1.0E+04	17	1.0E+04	16	1.6E+05	2.1E+05
17	C1	1.0E+04	16	1.0E+04	25		
18	C1	1.0E+04	16	1.0E+04	21		
19	C2	1.0E+03	131	1.0E+03		1.2E+05	
20	C2	1.0E+03	115	1.0E+03			
21	C2	1.0E+03	110	1.0E+03			
22	C2	1.0E+04	12	1.0E+04	21	1.3E+05	2.1E+05
23	C2	1.0E+04	12	1.0E+04	18		
24	C2	1.0E+04	16	1.0E+04	25		
25	C3	1.0E+03	129	1.0E+03		1.2E+05	
26	C3	1.0E+03	109	1.0E+03			
27	C3	1.0E+03	125	1.0E+03			
28	C3	1.0E+04	14	1.0E+04	19	1.4E+05	2.3E+05
29	C3	1.0E+04	13	1.0E+04	17		
30	C3	1.0E+04	14	1.0E+04	34		
31	D	1.0E+03	254	1.0E+03		2.5E+05	
32	D	1.0E+03	248	1.0E+03			
33	D	1.0E+03	tntc	1.0E+03			
34	D	1.0E+04	23	1.0E+04	94	3.6E+05	9.3E+05
35	D	1.0E+04	43	1.0E+04	85		
36	D	1.0E+04	41	1.0E+04	99		
37	E	1.0E+03	213	1.0E+03		2.2E+05	
38	E	1.0E+03	tntc	1.0E+03			
39	E	1.0E+03	217	1.0E+03			
40	E	1.0E+04	31	1.0E+04	83	2.8E+05	7.9E+05
41	E	1.0E+04	28	1.0E+04	91		
42	E	1.0E+04	24	1.0E+04	62		
43	F1	1.0E+03	193	1.0E+03		1.9E+05	ERR

Table D.3 continued

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
44	F1	1.0E+03	tntc	1.0E+03			
45	F1	1.0E+03	193	1.0E+03			
46	F1	1.0E+04	29	1.0E+04	58	2.5E+05	6.2E+05
47	F1	1.0E+04	29	1.0E+04	63		
48	F1	1.0E+04	16	1.0E+04	64		
49	F2	1.0E+03	142	1.0E+03		1.5E+05	
50	F2	1.0E+03	155	1.0E+03			
51	F2	1.0E+03	tntc	1.0E+03			
52	F2	1.0E+04	25	1.0E+04	60	2.2E+05	6.0E+05
53	F2	1.0E+04	20	1.0E+04	58		
54	F2	1.0E+04	20	1.0E+04	63		
55	F3	1.0E+03	166	1.0E+03		1.6E+05	
56	F3	1.0E+03	149	1.0E+03			
57	F3	1.0E+03	tntc	1.0E+03			
58	F3	1.0E+04	19	1.0E+04	61	1.9E+05	5.9E+05
59	F3	1.0E+04	19	1.0E+04	59		
60	F3	1.0E+04	19	1.0E+04	58		
61	G	1.0E+03	247	1.0E+03		2.4E+05	
62	G	1.0E+03	231	1.0E+03			
63	G	1.0E+03	tntc	1.0E+03			
64	G	1.0E+04	26	1.0E+04	36	2.7E+05	3.4E+05
65	G	1.0E+04	28	1.0E+04	31		
66	G	1.0E+04	26	1.0E+04	35		
67	H	1.0E+03	216	1.0E+03		2.1E+05	
68	H	1.0E+03	205	1.0E+03			
69	H	1.0E+03	tntc	1.0E+03			
70	H	1.0E+04	26	1.0E+04	36	2.6E+05	3.6E+05
71	H	1.0E+04	26	1.0E+04	38		
72	H	1.0E+04	25	1.0E+04	34		
73	I1	1.0E+03	tntc	1.0E+03		2.1E+05	
74	I1	1.0E+03	205	1.0E+03			
75	I1	1.0E+03	tntc	1.0E+03			
76	I1	1.0E+04	19	1.0E+04	26	2.1E+05	2.6E+05
77	I1	1.0E+04	24	1.0E+04	29		
78	I1	1.0E+04	20	1.0E+04	23		
79	I2	1.0E+03	tntc	1.0E+03	124	1.6E+05	1.1E+05
80	I2	1.0E+03	169	1.0E+03	103		
81	I2	1.0E+03	149	1.0E+03	117		
82	I2	1.0E+04	20	1.0E+04	14	2.1E+05	1.2E+05
83	I2	1.0E+04	20	1.0E+04	11		
84	I2	1.0E+04	23	1.0E+04	12		
85	I3	1.0E+03	212	1.0E+03	78	2.1E+05	1.0E+05
86	I3	1.0E+03	tntc	1.0E+03	118		
87	I3	1.0E+03	201	1.0E+03	107		

Table D.3 continued

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
88	I3	1.0E+04	16	1.0E+04	17	2.3E+05	1.2E+05
89	I3	1.0E+04	30	1.0E+04	12		
90	I3	1.0E+04	24	1.0E+04	7		
91	J	1.0E+03		1.0E+03			
92	J	1.0E+03		1.0E+03			
93	J	1.0E+03		1.0E+03			
94	J	1.0E+04	72	1.0E+04	88	7.7E+05	8.7E+05
95	J	1.0E+04	80	1.0E+04	103		
96	J	1.0E+04	78	1.0E+04	71		
97	K	1.0E+03		1.0E+03			
98	K	1.0E+03		1.0E+03			
99	K	1.0E+03		1.0E+03			
100	K	1.0E+04	92	1.0E+04	100	7.9E+05	1.0E+06
101	K	1.0E+04	75	1.0E+04	84		
102	K	1.0E+04	70	1.0E+04	116		
103	L1	1.0E+03		1.0E+03			
104	L1	1.0E+03		1.0E+03			
105	L1	1.0E+03		1.0E+03			
106	L1	1.0E+04	76	1.0E+04	85	8.3E+05	8.3E+05
107	L1	1.0E+04	94	1.0E+04	79		
108	L1	1.0E+04	80	1.0E+04	84		
109	L2	1.0E+03		1.0E+03			
110	L2	1.0E+03		1.0E+03			
111	L2	1.0E+03		1.0E+03			
112	L2	1.0E+04	89	1.0E+04	54	8.0E+05	6.3E+05
113	L2	1.0E+04	82	1.0E+04	63		
114	L2	1.0E+04	69	1.0E+04	71		
115	L3	1.0E+03		1.0E+03			
116	L3	1.0E+03		1.0E+03			
117	L3	1.0E+03		1.0E+03			
118	L3	1.0E+04	48	1.0E+04	68	7.3E+05	6.1E+05
119	L3	1.0E+04	84	1.0E+04	58		
120	L3	1.0E+04	86	1.0E+04	56		
121	M	1.0E+03		1.0E+04	115		1.2E+06
122	M	1.0E+03		1.0E+04	120		
123	M	1.0E+03		1.0E+04	110		
124	M	1.0E+04	42	1.0E+05	6	3.8E+05	5.0E+05
125	M	1.0E+04	39	1.0E+05	6		
126	M	1.0E+04	33	1.0E+05	3		
127	N	1.0E+03		1.0E+04	118		1.2E+06
128	N	1.0E+03		1.0E+04			
129	N	1.0E+03		1.0E+04			
130	N	1.0E+04	32	1.0E+05	14	4.0E+05	1.5E+06
131	N	1.0E+04	38	1.0E+05	16		

Table D.3 continued

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
132	N	1.0E+04	50	1.0E+05	15		
133	O1	1.0E+03		1.0E+04	66		7.3E+05
134	O1	1.0E+03		1.0E+04	78		
135	O1	1.0E+03		1.0E+04	76		
136	O1	1.0E+04	30	1.0E+05	8	3.6E+05	7.3E+05
137	O1	1.0E+04	42	1.0E+05	7		
138	O1	1.0E+04	37	1.0E+05	7		
139	O2	1.0E+03		1.0E+04	82		8.6E+05
140	O2	1.0E+03		1.0E+04	77		
141	O2	1.0E+03		1.0E+04	98		
142	O2	1.0E+04	27	1.0E+05	5	3.3E+05	4.7E+05
143	O2	1.0E+04	32	1.0E+05	5		
144	O2	1.0E+04	40	1.0E+05	4		
145	O3	1.0E+03		1.0E+04			
146	O3	1.0E+03		1.0E+04			
147	O3	1.0E+03		1.0E+04			
148	O3	1.0E+04	35	1.0E+05	35	3.4E+05	3.4E+06
149	O3	1.0E+04	31	1.0E+05	31		
150	O3	1.0E+04	36	1.0E+05	36		
151	P	1.0E+02	4	1.0E+02	19	2.3E+02	2.0E+03
152	P	1.0E+02	2	1.0E+02	21		
153	P	1.0E+02	1	1.0E+02	19		
154	P	1.0E+03	1	1.0E+03	3		4.0E+03
155	P	1.0E+03	0	1.0E+03	6		
156	P	1.0E+03	0	1.0E+03	3		
157	Q	1.0E+02	4	1.0E+02	48	6.3E+02	5.1E+03
158	Q	1.0E+02	7	1.0E+02	52		
159	Q	1.0E+02	8	1.0E+02	53		
160	Q	1.0E+03	1	1.0E+03	5		6.3E+03
161	Q	1.0E+03	0	1.0E+03	7		
162	Q	1.0E+03	0	1.0E+03	7		

Table D.4 Summary of data for day 15.

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
1	A	1.0E+03	104	1.0E+03		1.0E+05	
2	A	1.0E+03	99	1.0E+03			
3	A	1.0E+03	111	1.0E+03			
4	A	1.0E+04		1.0E+04	23		2.5E+05
5	A	1.0E+04		1.0E+04	21		
6	A	1.0E+04		1.0E+04	30		
7	B	1.0E+03	105	1.0E+03	101	1.0E+05	1.1E+05
8	B	1.0E+03	98	1.0E+03	110		
9	B	1.0E+03	102	1.0E+03	109		
10	B	1.0E+04		1.0E+04	11		9.3E+04
11	B	1.0E+04		1.0E+04	7		
12	B	1.0E+04		1.0E+04	10		
13	C1	1.0E+03	84	1.0E+03	100	9.0E+04	1.0E+05
14	C1	1.0E+03	90	1.0E+03	92		
15	C1	1.0E+03	95	1.0E+03	109		
16	C1	1.0E+04		1.0E+04	10		8.7E+04
17	C1	1.0E+04		1.0E+04	8		
18	C1	1.0E+04		1.0E+04	8		
19	C2	1.0E+03	93	1.0E+03	85	1.0E+05	1.0E+05
20	C2	1.0E+03	106	1.0E+03	101		
21	C2	1.0E+03	106	1.0E+03	116		
22	C2	1.0E+04		1.0E+04	13		1.2E+05
23	C2	1.0E+04		1.0E+04	11		
24	C2	1.0E+04		1.0E+04	12		
25	C3	1.0E+03	101	1.0E+03	137	1.1E+05	1.4E+05
26	C3	1.0E+03	118	1.0E+03	138		
27	C3	1.0E+03	100	1.0E+03	141		
28	C3	1.0E+04		1.0E+04	6		9.3E+04
29	C3	1.0E+04		1.0E+04	9		
30	C3	1.0E+04		1.0E+04	13		
31	D	1.0E+03		1.0E+03		1.9E+05	ERR
32	D	1.0E+03		1.0E+03			
33	D	1.0E+03	188	1.0E+03			
34	D	1.0E+04	38	1.0E+04	66	2.3E+05	6.4E+05
35	D	1.0E+04	14	1.0E+04	59		
36	D	1.0E+04	18	1.0E+04	68		
37	E	1.0E+03		1.0E+03		2.5E+05	
38	E	1.0E+03	245	1.0E+03			
39	E	1.0E+03		1.0E+03			
40	E	1.0E+04	30	1.0E+04	60	3.3E+05	6.1E+05
41	E	1.0E+04	32	1.0E+04	54		
42	E	1.0E+04	36	1.0E+04	70		
43	F1	1.0E+03		1.0E+03			

Table D.4 continued.

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
44	F1	1.0E+03		1.0E+03			
45	F1	1.0E+03		1.0E+03			
46	F1	1.0E+04	28	1.0E+04	60	2.1E+05	5.2E+05
47	F1	1.0E+04	17	1.0E+04	54		
48	F1	1.0E+04	19	1.0E+04	41		
49	F2	1.0E+03		1.0E+03		1.6E+05	
50	F2	1.0E+03		1.0E+03			
51	F2	1.0E+03	163	1.0E+03			
52	F2	1.0E+04	21	1.0E+04	40	2.6E+05	3.8E+05
53	F2	1.0E+04	19	1.0E+04	36		
54	F2	1.0E+04	37	1.0E+04	39		
55	F3	1.0E+03		1.0E+03		1.5E+05	
56	F3	1.0E+03		1.0E+03			
57	F3	1.0E+03	149	1.0E+03			
58	F3	1.0E+04	19	1.0E+04	58	2.3E+05	4.9E+05
59	F3	1.0E+04	22	1.0E+04	42		
60	F3	1.0E+04	29	1.0E+04	47		
61	G	1.0E+03		1.0E+03		1.1E+05	
62	G	1.0E+03		1.0E+03			
63	G	1.0E+03	112	1.0E+03			
64	G	1.0E+04	15	1.0E+04	33	1.7E+05	2.9E+05
65	G	1.0E+04	17	1.0E+04	29		
66	G	1.0E+04	18	1.0E+04	26		
67	H	1.0E+03	125	1.0E+03			
68	H	1.0E+03	153	1.0E+03			
69	H	1.0E+03	120	1.0E+03			
70	H	1.0E+04	11	1.0E+04	21	1.0E+05	2.2E+05
71	H	1.0E+04	9	1.0E+04	20		
72	H	1.0E+04	10	1.0E+04	25		
73	I1	1.0E+03	116	1.0E+03		1.2E+05	
74	I1	1.0E+03	121	1.0E+03			
75	I1	1.0E+03	125	1.0E+03			
76	I1	1.0E+04	10	1.0E+04	19	1.1E+05	1.8E+05
77	I1	1.0E+04	15	1.0E+04	15		
78	I1	1.0E+04	8	1.0E+04	21		
79	I2	1.0E+03	108	1.0E+03		1.1E+05	2.6E+05
80	I2	1.0E+03	107	1.0E+03			
81	I2	1.0E+03	125	1.0E+03	258		
82	I2	1.0E+04	18	1.0E+04	19	1.4E+05	2.1E+05
83	I2	1.0E+04	10	1.0E+04	21		
84	I2	1.0E+04	14	1.0E+04	22		
85	I3	1.0E+03	101	1.0E+03		1.2E+05	
86	I3	1.0E+03	125	1.0E+03			
87	I3	1.0E+03	128	1.0E+03			

Table D.4 continued.

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
88	I3	1.0E+04	8	1.0E+04	19	1.6E+05	2.1E+05
89	I3	1.0E+04	20	1.0E+04	21		
90	I3	1.0E+04	20	1.0E+04	23		
91	J	1.0E+03		1.0E+03			
92	J	1.0E+03		1.0E+03			
93	J	1.0E+03		1.0E+03			
94	J	1.0E+04	94	1.0E+04	62	9.3E+05	6.8E+05
95	J	1.0E+04	99	1.0E+04	76		
96	J	1.0E+04	87	1.0E+04	67		
97	K	1.0E+03		1.0E+03			
98	K	1.0E+03		1.0E+03			
99	K	1.0E+03		1.0E+03			
100	K	1.0E+04	83	1.0E+04	83	7.8E+05	8.8E+05
101	K	1.0E+04	73	1.0E+04	93		
102	K	1.0E+04	78	1.0E+04	88		
103	L1	1.0E+03		1.0E+03			
104	L1	1.0E+03		1.0E+03			
105	L1	1.0E+03		1.0E+03			
106	L1	1.0E+04	71	1.0E+04	57	7.2E+05	6.0E+05
107	L1	1.0E+04	77	1.0E+04	64		
108	L1	1.0E+04	69	1.0E+04	59		
109	L2	1.0E+03		1.0E+03			
110	L2	1.0E+03		1.0E+03			
111	L2	1.0E+03		1.0E+03			
112	L2	1.0E+04	72	1.0E+04	57	7.8E+05	5.8E+05
113	L2	1.0E+04	78	1.0E+04	66		
114	L2	1.0E+04	84	1.0E+04	50		
115	L3	1.0E+03		1.0E+03			
116	L3	1.0E+03		1.0E+03			
117	L3	1.0E+03		1.0E+03			
118	L3	1.0E+04	79	1.0E+04	41	7.6E+05	4.5E+05
119	L3	1.0E+04	82	1.0E+04	38		
120	L3	1.0E+04	68	1.0E+04	55		
121	M	1.0E+03		1.0E+03			
122	M	1.0E+03		1.0E+03			
123	M	1.0E+03		1.0E+03			
124	M	1.0E+04	25	1.0E+04	94	3.2E+05	8.7E+05
125	M	1.0E+04	36	1.0E+04	80		
126	M	1.0E+04	36	1.0E+04	86		
127	N	1.0E+03		1.0E+03			
128	N	1.0E+03		1.0E+03			
129	N	1.0E+03		1.0E+03			
130	N	1.0E+04	29	1.0E+04	97	3.4E+05	1.1E+06
131	N	1.0E+04	36	1.0E+04	118		

Table D.4 continued.

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
132	N	1.0E+04	36	1.0E+04	109		
133	O1	1.0E+03		1.0E+03			
134	O1	1.0E+03		1.0E+03			
135	O1	1.0E+03		1.0E+03			
136	O1	1.0E+04	32	1.0E+04	72	3.3E+05	7.0E+05
137	O1	1.0E+04	33	1.0E+04	69		
138	O1	1.0E+04	34	1.0E+04	70		
139	O2	1.0E+03		1.0E+03			
140	O2	1.0E+03		1.0E+03			
141	O2	1.0E+03		1.0E+03			
142	O2	1.0E+04	35	1.0E+04	70	2.5E+05	7.3E+05
143	O2	1.0E+04	19	1.0E+04	75		
144	O2	1.0E+04	22	1.0E+04	74		
145	O3	1.0E+03		1.0E+03			
146	O3	1.0E+03		1.0E+03			
147	O3	1.0E+03		1.0E+03			
148	O3	1.0E+04	27	1.0E+04	71	2.6E+05	7.6E+05
149	O3	1.0E+04	31	1.0E+04	81		
150	O3	1.0E+04	21	1.0E+04			
151	P	1.0E+02	0	1.0E+02	28	1.7E+02	2.8E+03
152	P	1.0E+02	3	1.0E+02	29		
153	P	1.0E+02	2	1.0E+02	26		
154	Q	1.0E+02	4	1.0E+02	40	5.7E+02	4.9E+03
155	Q	1.0E+02	7	1.0E+02	48		
156	Q	1.0E+02	6	1.0E+02	59		

Table D.5 Summary of data for day 20.

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
1	A	1.0E+03	81	1.0E+03	220	8.4E+04	2.3E+05
2	A	1.0E+03	80	1.0E+03	230		
3	A	1.0E+03	91	1.0E+03	235		
4	B	1.0E+03	87	1.0E+03	130	9.8E+04	1.3E+05
5	B	1.0E+03	110	1.0E+03	125		
6	B	1.0E+03	98	1.0E+03	130		
7	C1	1.0E+03	105	1.0E+03	99	9.4E+04	1.1E+05
8	C1	1.0E+03	92	1.0E+03	105		
9	C1	1.0E+03	86	1.0E+03	113		
10	C2	1.0E+03	100	1.0E+03	99	9.4E+04	9.4E+04
11	C2	1.0E+03	88	1.0E+03	88		
12	C2	1.0E+03	94	1.0E+03	95		
13	C3	1.0E+03	73	1.0E+03	110	8.0E+04	1.1E+05
14	C3	1.0E+03	80	1.0E+03	104		
15	C3	1.0E+03	88	1.0E+03	101		
16	D	1.0E+03	201	1.0E+03		2.0E+05	ERR
17	D	1.0E+03		1.0E+03			
18	D	1.0E+03		1.0E+03			
19	D	1.0E+04	25	1.0E+04	49	2.3E+05	4.7E+05
20	D	1.0E+04	13	1.0E+04	52		
21	D	1.0E+04	31	1.0E+04	41		
22	E	1.0E+03		1.0E+03		ERR	
23	E	1.0E+03		1.0E+03			
24	E	1.0E+03		1.0E+03			
25	E	1.0E+04	33	1.0E+04	41	3.2E+05	3.8E+05
26	E	1.0E+04	32	1.0E+04	33		
27	E	1.0E+04	32	1.0E+04	41		
28	F1	1.0E+03		1.0E+03			
29	F1	1.0E+03		1.0E+03			
30	F1	1.0E+03		1.0E+03			
31	F1	1.0E+04	23	1.0E+04	25	2.3E+05	3.0E+05
32	F1	1.0E+04	24	1.0E+04	33		
33	F1	1.0E+04	23	1.0E+04	33		
34	F2	1.0E+03		1.0E+03		ERR	
35	F2	1.0E+03		1.0E+03			
36	F2	1.0E+03		1.0E+03			
37	F2	1.0E+04	14	1.0E+04	33	1.9E+05	2.7E+05
38	F2	1.0E+04	22	1.0E+04	23		
39	F2	1.0E+04	20	1.0E+04	24		
40	F3	1.0E+03		1.0E+03		ERR	
41	F3	1.0E+03		1.0E+03			
42	F3	1.0E+03		1.0E+03			
43	F3	1.0E+04	30	1.0E+04	33	2.6E+05	3.1E+05

Table D.5 continued

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
44	F3	1.0E+04	25	1.0E+04	32		
45	F3	1.0E+04	23	1.0E+04	29		
46	G	1.0E+03	9	1.0E+03	21	9.0E+03	1.8E+04
47	G	1.0E+03	9	1.0E+03	14		
48	G	1.0E+03	9	1.0E+03	18		
49	G	1.0E+04		1.0E+04		ERR	ERR
50	G	1.0E+04		1.0E+04			
51	G	1.0E+04		1.0E+04			
52	H	1.0E+03	15	1.0E+03	13	1.1E+04	1.3E+04
53	H	1.0E+03	10	1.0E+03	13		
54	H	1.0E+03	9	1.0E+03	13		
55	H	1.0E+04		1.0E+04		ERR	ERR
56	H	1.0E+04		1.0E+04			
57	H	1.0E+04		1.0E+04			
58	I1	1.0E+03	18	1.0E+03	22	1.4E+04	2.0E+04
59	I1	1.0E+03	19	1.0E+03	17		
60	I1	1.0E+03	6	1.0E+03	21		
61	I1	1.0E+04		1.0E+04		ERR	ERR
62	I1	1.0E+04		1.0E+04			
63	I1	1.0E+04		1.0E+04			
64	I2	1.0E+03	14	1.0E+03	12	1.5E+04	1.5E+04
65	I2	1.0E+03	15	1.0E+03	20		
66	I2	1.0E+03	15	1.0E+03	14		
67	I2	1.0E+04		1.0E+04		ERR	ERR
68	I2	1.0E+04		1.0E+04			
69	I2	1.0E+04		1.0E+04			
70	I3	1.0E+03	18	1.0E+03	16	1.6E+04	1.6E+04
71	I3	1.0E+03	13	1.0E+03	15		
72	I3	1.0E+03	18	1.0E+03	16		
73	I3	1.0E+04		1.0E+04		ERR	ERR
74	I3	1.0E+04		1.0E+04			
75	I3	1.0E+04		1.0E+04			
76	J	1.0E+04	68	1.0E+04	60	6.8E+05	6.1E+05
77	J	1.0E+04	70	1.0E+04	64		
78	J	1.0E+04	67	1.0E+04	59		
79	K	1.0E+04	96	1.0E+04	50	8.0E+05	5.4E+05
80	K	1.0E+04	65	1.0E+04	50		
81	K	1.0E+04	80	1.0E+04	63		
82	L1	1.0E+04	73	1.0E+04	43	7.1E+05	4.5E+05
83	L1	1.0E+04	67	1.0E+04	40		
84	L1	1.0E+04	74	1.0E+04	52		
85	L2	1.0E+04	65	1.0E+04	34	6.6E+05	4.5E+05
86	L2	1.0E+04	75	1.0E+04	61		
87	L2	1.0E+04	59	1.0E+04	41		

Table D.5 continued

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
88	L3	1.0E+04	80	1.0E+04	38	7.0E+05	3.8E+05
89	L3	1.0E+04	62	1.0E+04	38		
90	L3	1.0E+04	68	1.0E+04	38		
91	M	1.0E+03		1.0E+03			
92	M	1.0E+03		1.0E+03			
93	M	1.0E+03		1.0E+03			
94	M	1.0E+04	30	1.0E+04	80	2.7E+05	8.5E+05
95	M	1.0E+04	26	1.0E+04	88		
96	M	1.0E+04	26	1.0E+04	88		
97	N	1.0E+03		1.0E+03			
98	N	1.0E+03		1.0E+03			
99	N	1.0E+03		1.0E+03			
100	N	1.0E+04	20	1.0E+04	96	2.5E+05	9.2E+05
101	N	1.0E+04	27	1.0E+04	88		
102	N	1.0E+04	28	1.0E+04	91		
103	O1	1.0E+03		1.0E+03			
104	O1	1.0E+03		1.0E+03			
105	O1	1.0E+03		1.0E+03			
106	O1	1.0E+04	25	1.0E+04	71	2.4E+05	7.1E+05
107	O1	1.0E+04	28	1.0E+04	68		
108	O1	1.0E+04	19	1.0E+04	73		
109	O2	1.0E+03		1.0E+03			
110	O2	1.0E+03		1.0E+03			
111	O2	1.0E+03		1.0E+03			
112	O2	1.0E+04	28	1.0E+04	58	2.7E+05	6.3E+05
113	O2	1.0E+04	24	1.0E+04	66		
114	O2	1.0E+04	29	1.0E+04	66		
115	O3	1.0E+03		1.0E+03			
116	O3	1.0E+03		1.0E+03			
117	O3	1.0E+03		1.0E+03			
118	O3	1.0E+04	30	1.0E+04	68	2.6E+05	6.3E+05
119	O3	1.0E+04	27	1.0E+04	61		
120	O3	1.0E+04	20	1.0E+04	59		
121	P	1.0E+02	2	1.0E+02	19	1.7E+02	1.8E+03
122	P	1.0E+02	1	1.0E+02	22		
123	P	1.0E+02	2	1.0E+02	14		
124	Q	1.0E+02	5	1.0E+02	34	5.7E+02	3.9E+03
125	Q	1.0E+02	4	1.0E+02	40		
126	Q	1.0E+02	8	1.0E+02	42		

Table D.6 Summary of data for day 25.

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
1	A	1.0E+03	78	1.0E+03	198	7.8E+04	2.0E+05
2	A	1.0E+03	85	1.0E+03	193		
3	A	1.0E+03	70	1.0E+03	210		
4	B	1.0E+03	88	1.0E+03	72	9.1E+04	7.7E+04
5	B	1.0E+03	98	1.0E+03	75		
6	B	1.0E+03	88	1.0E+03	85		
7	C1	1.0E+03	83	1.0E+03	58	8.5E+04	6.4E+04
8	C1	1.0E+03	78	1.0E+03	64		
9	C1	1.0E+03	93	1.0E+03	70		
10	C2	1.0E+03	82	1.0E+03	72	7.9E+04	7.3E+04
11	C2	1.0E+03	78	1.0E+03	77		
12	C2	1.0E+03	77	1.0E+03	69		
13	C3	1.0E+03	74	1.0E+03	56	7.8E+04	5.6E+04
14	C3	1.0E+03	70	1.0E+03	63		
15	C3	1.0E+03	90	1.0E+03	49		
16	D	1.0E+03		1.0E+03		ERR	ERR
17	D	1.0E+03		1.0E+03			
18	D	1.0E+03		1.0E+03			
19	D	1.0E+04	17	1.0E+04	45	2.1E+05	4.7E+05
20	D	1.0E+04	23	1.0E+04	47		
21	D	1.0E+04	23	1.0E+04	48		
22	E	1.0E+03		1.0E+03		ERR	ERR
23	E	1.0E+03		1.0E+03			
24	E	1.0E+03		1.0E+03			
25	E	1.0E+04	25	1.0E+04	32	2.0E+05	2.7E+05
26	E	1.0E+04	12	1.0E+04	24		
27	E	1.0E+04	24	1.0E+04	25		
28	F1	1.0E+03		1.0E+03			ERR
29	F1	1.0E+03		1.0E+03			
30	F1	1.0E+03		1.0E+03			
31	F1	1.0E+04	21	1.0E+04	18	2.0E+05	1.8E+05
32	F1	1.0E+04	18	1.0E+04	18		
33	F1	1.0E+04	20	1.0E+04	17		
34	F2	1.0E+03		1.0E+03		ERR	ERR
35	F2	1.0E+03		1.0E+03			
36	F2	1.0E+03		1.0E+03			
37	F2	1.0E+04	19	1.0E+04	14	2.1E+05	1.4E+05
38	F2	1.0E+04	19	1.0E+04	12		
39	F2	1.0E+04	24	1.0E+04	16		
40	F3	1.0E+03		1.0E+03		ERR	ERR
41	F3	1.0E+03		1.0E+03			
42	F3	1.0E+03		1.0E+03			
43	F3	1.0E+04	15	1.0E+04	20	1.4E+05	1.7E+05

Table D.6 continued.

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
44	F3	1.0E+04	14	1.0E+04	16		
45	F3	1.0E+04	13	1.0E+04	14		
46	G	1.0E+00		1.0E+01		ERR	ERR
47	G	1.0E+00		1.0E+01			
48	G	1.0E+00		1.0E+01			
49	G	1.0E+01	125	1.0E+02	21	1.2E+03	2.3E+03
50	G	1.0E+01	130	1.0E+02	23		
51	G	1.0E+01	98	1.0E+02	25		
52	H	1.0E+00		1.0E+01		ERR	ERR
53	H	1.0E+00		1.0E+01			
54	H	1.0E+00		1.0E+01			
55	H	1.0E+01	100	1.0E+02	19	9.7E+02	1.8E+03
56	H	1.0E+01	96	1.0E+02	18		
57	H	1.0E+01	95	1.0E+02	16		
58	I1	1.0E+00		1.0E+01		ERR	ERR
59	I1	1.0E+00		1.0E+01			
60	I1	1.0E+00		1.0E+01			
61	I1	1.0E+01	110	1.0E+02	20	1.1E+03	2.0E+03
62	I1	1.0E+01	114	1.0E+02	21		
63	I1	1.0E+01	118	1.0E+02	18		
64	I2	1.0E+00		1.0E+01		ERR	ERR
65	I2	1.0E+00		1.0E+01			
66	I2	1.0E+00		1.0E+01			
67	I2	1.0E+01		1.0E+02		ERR	ERR
68	I2	1.0E+01		1.0E+02			
69	I2	1.0E+01		1.0E+02			
70	I3	1.0E+00		1.0E+01		ERR	ERR
71	I3	1.0E+00		1.0E+01			
72	I3	1.0E+00		1.0E+01			
73	I3	1.0E+01		1.0E+02		ERR	ERR
74	I3	1.0E+01		1.0E+02			
75	I3	1.0E+01		1.0E+02			
76	J	1.0E+04	64	1.0E+04	55	6.8E+05	5.2E+05
77	J	1.0E+04	74	1.0E+04	52		
78	J	1.0E+04	65	1.0E+04	49		
79	K	1.0E+04	70	1.0E+04	48	7.4E+05	4.0E+05
80	K	1.0E+04	70	1.0E+04			
81	K	1.0E+04	83	1.0E+04	32		
82	L1	1.0E+04	65	1.0E+04	42	5.9E+05	4.9E+05
83	L1	1.0E+04	60	1.0E+04	56		
84	L1	1.0E+04	51	1.0E+04	50		
85	L2	1.0E+04	57	1.0E+04	39	6.0E+05	3.8E+05
86	L2	1.0E+04	62	1.0E+04	35		
87	L2	1.0E+04	60	1.0E+04	41		

Table D.6 continued.

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
88	L3	1.0E+04	69	1.0E+04	39	6.6E+05	4.1E+05
89	L3	1.0E+04	65	1.0E+04	39		
90	L3	1.0E+04	63	1.0E+04	44		
91	M	1.0E+03		1.0E+03			ERR
92	M	1.0E+03		1.0E+03			
93	M	1.0E+03		1.0E+03			
94	M	1.0E+04	17	1.0E+04	72	1.8E+05	6.9E+05
95	M	1.0E+04	19	1.0E+04	60		
96	M	1.0E+04	19	1.0E+04	75		
97	N	1.0E+03		1.0E+03			ERR
98	N	1.0E+03		1.0E+03			
99	N	1.0E+03		1.0E+03			
100	N	1.0E+04	17	1.0E+04	67	2.0E+05	6.8E+05
101	N	1.0E+04	22	1.0E+04	68		
102	N	1.0E+04	21	1.0E+04	69		
103	O1	1.0E+03		1.0E+03			ERR
104	O1	1.0E+03		1.0E+03			
105	O1	1.0E+03		1.0E+03			
106	O1	1.0E+04	17	1.0E+04	52	1.9E+05	5.0E+05
107	O1	1.0E+04	20	1.0E+04	51		
108	O1	1.0E+04	19	1.0E+04	46		
109	O2	1.0E+03		1.0E+03			ERR
110	O2	1.0E+03		1.0E+03			
111	O2	1.0E+03		1.0E+03			
112	O2	1.0E+04	18	1.0E+04	54	1.9E+05	4.8E+05
113	O2	1.0E+04	18	1.0E+04	43		
114	O2	1.0E+04	20	1.0E+04	47		
115	O3	1.0E+03		1.0E+03			ERR
116	O3	1.0E+03		1.0E+03			
117	O3	1.0E+03		1.0E+03			
118	O3	1.0E+04	24	1.0E+04	48	2.2E+05	4.2E+05
119	O3	1.0E+04	19	1.0E+04	44		
120	O3	1.0E+04	22	1.0E+04	34		
121	P	1.0E+01	19	1.0E+02	19	1.8E+02	2.1E+03
122	P	1.0E+01	16	1.0E+02	21		
123	P	1.0E+01	18	1.0E+02	22		
124	Q	1.0E+02	6	1.0E+02	33	5.0E+02	3.8E+03
125	Q	1.0E+02	4	1.0E+02	40		
126	Q	1.0E+02	5	1.0E+02	40		

Table D.7 Summary of data for day 30.

PLATE #	Sediment type	Dilution factor	FC counted	Dilution factor	FS counted	FC per gram sed.	FS per gram sed.
1	A	1.0E+03		1.0E+03	150	7.1E+04	1.5E+05
2	A	1.0E+03	69	1.0E+03			
3	A	1.0E+03	72	1.0E+03			
4	B	1.0E+03		1.0E+03	60	7.1E+04	5.6E+04
5	B	1.0E+03	74	1.0E+03	55		
6	B	1.0E+03	68	1.0E+03	54		
7	C1	1.0E+03		1.0E+03	58	6.8E+04	5.5E+04
8	C1	1.0E+03	72	1.0E+03	51		
9	C1	1.0E+03	63	1.0E+03	57		
10	C2	1.0E+03	73	1.0E+03	55	7.0E+04	5.2E+04
11	C2	1.0E+03		1.0E+03	52		
12	C2	1.0E+03	66	1.0E+03	50		
13	C3	1.0E+03		1.0E+03	56	7.2E+04	5.2E+04
14	C3	1.0E+03	72	1.0E+03	50		
15	C3	1.0E+03	72	1.0E+03	49		
16	G	1.0E+01	51	1.0E+01	56	4.5E+02	5.5E+02
17	G	1.0E+01	44	1.0E+01	54		
18	G	1.0E+01	41	1.0E+01	55		
19	H	1.0E+01	43	1.0E+01	48	4.7E+02	5.3E+02
20	H	1.0E+01	47	1.0E+01	58		
21	H	1.0E+01	51	1.0E+01	54		
22	I	1.0E+01	29	1.0E+01	55	3.1E+02	5.4E+02
23	I	1.0E+01	37	1.0E+01	49		
24	I	1.0E+01	28	1.0E+01	58		