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# Coliphage as an Indicator of Fecal Pollution in Marine Waters: Assay, Validation, and Application

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# COLIPHAGE AS AN INDICATOR OF FECAL POLLUTION IN MARINE WATERS: ASSAY, VALIDATION, AND APPLICATION

BY

DONALD SINCLAIR MCCORQUODALE, JR.

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN OCEAN SCIENCE

NOVA UNIVERSITY

1987

DOCTOR OF PHILOSOPHY DISSERTATION

OF

DONALD SINCLAIR MCCORQUODALE, JR.

Approved:

Dissertation Committee

Major Professor Curtis M. Burney

Gary L. Hitchcock

Murray R. Streitfeld

Richard E. Dodge

NOVA UNIVERSITY

1987

# ABSTRACT

Escherichia coli, the perferred bacterial indicator for fecal pollution in fresh waters, does not conform to the concept of an indicator microorganism because it is rapidly killed or inactivated by seawater. This series of papers investigated the value of coliphage, a virus which infects E. coli, as an indicator of pollution in saline waters. In order to be an accurate indicator an organism must (1) be ubiquitous in wastewater, (2) survive and be detectable at least as long as the harmful organisms, and (3) be easy to isolate and identify.

A review of the literature determined that coliphage were more resistant than the common bacterial indicators to physico-chemical factors such as inorganic ions, temperature, heavy metals, nutrients, and antibiotics. Coliphage correlation with their bacterial hosts and similarities in behavior to the pathogenic viruses make them both bacterial and viral indicators.

Various culture media and host culture strains were investigated for maximum plaque forming unit (pfu) production. Two way analysis of variance showed that selection of a suitable host was of paramount importance. While selection of the culture medium was significant, it was of lesser importance. Host strain ATCC 13706 and

tryptic soy agar gave the highest recovery of pfu's.

One ml log phase E. coli host culture, five ml of water sample or dilution, and five ml of culture media (maintained at 44.5 C) were combined in a sterile screw cap tube, mixed, poured into a sterile 100 X 15 mm petri dish, and incubated at 35 C. Plaque forming units were counted after 24 hrs. and expressed per 100 ml of sample.

The method proved repeatable; the titer of frozen phage aliquots declined slightly over 77 days but, the slope of the trend was not significantly different from zero at the 0.10 level ($r = 0.55$). These repeated analyses were done with different batches of media and hosts and represent a test of total method repeatability. Bench studies utilizing a decimal dilution series of sewage contaminated freshwater and uncontaminated seawater showed that both coliform and coliphage closely follow a theoretical dilution curve immediately after dilution with seawater. However, coliform bacteria die off at a higher rate than coliphage at higher salinities over time .

Field validation studies in fresh and brackish water (<10 ppt) compared coliphage with total and fecal coliforms ($n = 53$) and gave correlation coefficients of 0.98 and 0.91 respectively. The regression equation for these samples was:

$$\log \text{coliphage} = 0.983(\log \text{total coliform}) - 1.001$$

The combined total coliform/coliphage relationship at 68 saltwater (>10 ppt) stations yielded a correlation coefficient of 0.45.

Coliphage are a logical choice for a fecal indicator in marine waters since their titers are closely related to total and fecal coliform in freshwater, survive much better than coliforms in seawater, and they can be enumerated by a simple method which is not subject to salinity artifacts. The constant relation of coliphage and coliforms in freshwater indicate a possible link to current water quality standards based on total or fecal coliforms. Since coliphage pfu are a rather constant 8 - 10 % of total coliform cfu in low salinity waters where coliform inactivation is less severe, a coliphage titer of 80 - 100 pfu per 100 ml in seawater may indicate water quality equivalent to that indicated by a coliform count of 1000 cfu per 100 ml. This could aid in the interpretation of coliphage data relative to current coliform-based water quality codes.

Monitoring of sanitary water quality in Bell Channel Bay, Bahamas, during repair of a sewer plant showed that following chlorination and diversion of the effluent to a deep well, total coliform declined rapidly below detection limits. Coliphage remained easily detectable ten days later. Two canals and two marinas on Biscayne Bay were assayed for coliphage to compare sanitary water quality related to point and non-point source pollution. The Biscayne Canal was impacted by periodic upstream sewage spills, while the Little River displayed chronic contamination along its length by liveaboard boats or sewer leaks. Coliphage were shown to persist six days longer than coliform after a sewage spill was tracked in the Canal. The liveaboard Dinner Key marina displayed low-level, spotty contamination with no seasonal pattern. King's Bay marina was free of detectable fecal contamination during the study. The use of coliphage allowed the assessment and monitoring of fecal contamination in marine waters where coliform bacteria were not suitable.

ACKNOWLEDGEMENTS

I would like to thank my major professor, Dr. Curtis M. Burney for his assistance, patience, and long hours "crunching the data" with me. Thanks to Dr. Richard Dodge for his support and valuable help on the computer and Dr. Gary Hitchcock whose positive attitude was a great help. Special thanks to Dr. Murray M. Streitfeld whose teaching and example was of great influence to a young man many years ago.

Fondest appreciation go out to the team at Spectrum Laboratories. Firstly, to Lyle A. Johnson who put up with having his partner return to graduate school. To Carla Taeffner, Jane Kettler and John DiTuro for their assistance in sampling, analyses, and review of the data.

This research was supported by contracts from the Department of Environmental Resource Management, Dade County, Florida. I can not overemphasize the help given by this agency, particularly Rick Alleman, project manager. Part of this work was supported by the Grand Bahama Development Corporation with the full cooperation and assistance of Dennis Garcia.

And finally my special thanks to my family. To my parents for encouraging me early in life to ask questions

and wonder why. To my wife, Beverly, without whose understanding and love I could not have succeeded in this effort. To Donald and Amanda who were so understanding when Papa didn't have time to go fishing or read with them as often as they wished.

## PREFACE

This dissertation is presented in manuscript form in accordance with the requirements of the Graduate School of Nova University and consists of three manuscripts (to be published with Curtis M. Burney) and two appendices. The first manuscript, COLIPHAGE ARE SUPERIOR INDICATORS OF FECAL POLLUTION IN MARINE WATERS, has been submitted for publication as a Letter to Nature. The manuscript makes the points that coliphage are closely related to coliform bacteria, survive much better than coliforms in saltwater, and can be enumerated by a simple method not affected by saline samples. Therefore coliphage can be directly related to current coliform water quality standards. The second manuscript, COLIPHAGE AS AN INDICATOR OF FECAL POLLUTION IN MARINE WATERS: ASSAY AND VALIDATION,' is written in the format of the Journal of Applied and Environmental Microbiology. This paper describes method development and validation of the method through laboratory and field studies. The third manuscript, THE USE OF COLIPHAGE AS AN INDICATOR OF FECAL POLLUTION IN MARINE WATERS OF BISCAYNE BAY, FLORIDA AND BELL CHANNEL BAY, BAHAMAS, is to be submitted to the Marine Pollution Bulletin. The application of the coliphage method in actual field studies is presented and discussed. Appendix I consists of results of the "Phase I" survey of Biscayne Bay which was used to validate the method. Appendix II presents the data from "Phase II" monitoring of Biscayne Canal, Little River, Dinner Key marina, and King's Bay marina discussed in the third paper.

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## COLIPHAGE ARE SUPERIOR INDICATORS OF FECAL POLLUTION IN MARINE WATERS

In the marine environment, *E. coli* does not conform to the concept of an indicator microorganism because it is rapidly killed or inactivated by seawater[1,2,3,4,5]. Sampling near wastewater outfalls often yields very low concentrations of *E. coli*, which are far less than can be explained by dilution alone[6]. Several authors have proposed the use of coliphage as a good indicator of fecal pollution[7,8,1]. The relation of coliphage to their bacterial hosts and their similarities to the pathogenic viruses[9] make them both bacterial and viral indicators. Coliphage are much more resistant than are *E. coli* to inactivation in seawater under laboratory conditions, and in natural bay waters[10]. Coliphage were highly correlated (R = 0.98) with total coliform counts in fifty three samples from freshwater tributaries of Biscayne Bay, collected on six different days over a six months period. Since coliphage titers are closely related to an accepted indicator of fecal pollution in freshwater (where severe coliform inactivation does not occur), survive much better than coliforms in saltwater, and can be enumerated by a simple method which is not adversely affected by saline samples, coliphage qualify as a very effective quantitative indicator of fecal pollution in marine waters which can be directly related to current coliform-based water quality standards.

Surface water samples were collected at predominantly freshwater stations in the Miami River, Biscayne Canal, Little River and at saltwater stations within Biscayne Bay (Dade County, Florida). Samples were collected at two week intervals during May 1986 and monthly from August to October 1986,and were analyzed for total coliform, fecal coliform, fecal streptococcus, enterococcus[8], and coliphage. Figure 1 represents the relationship between total coliform and coliphage in the low salinity stations. Comparison of the combined data (n = 53) gave a correlation coefficient of 0.98. The regression equation was:

$$\log \text{coliphage} = 0.983(\log \text{coliform}) - 1.001.$$

The same comparison of 68 samples from saltwater stations gave a correlation coefficient of 0.45. Fecal coliforms and coliphage also were highly correlated in the fresh water samples ($r = 0.91$, $n = 53$), but not in the salt water samples ($r = 0.03$, $n = 68$). The high correlation coefficients mean that coliphage is essentially as good an indicator of fecal pollution as total or fecal coliform in fresh water. No significant relationships were found between fecal streptococci or enterococci and any of the other indicators.

To check for any possible detrimental effects of saline samples on the assay, a decimal dilution series was prepared using a contaminated freshwater sample (salinity <0.1 parts per thousand) and an uncontaminated seawater

FIG. 1 Relationship between 53 samples of total coliform and coliphage in low salinity (<10 parts per thousand) stations in Biscayne Bay and its tributaries (regression coefficient = 0.98). Total coliforms were assayed by membrane filter method (8). Host culture for coliphage assay was prepared by inoculating Tryptic Soy Broth with <u>E. coli</u> ATCC 13706 and incubating for 18 hours at 35 C. Aliquots (5 ml) were chilled at 9C with 10% (w/v) glycerol and frozen at -20C for up to 6 weeks. For use, a host culture tube was thawed at 44.5C, inoculated into 25 ml of sterile Tryptic Soy broth and incubated for one hour at 35 C. One ml host culture aliquots were each mixed with 5 ml of Tryptic Soy agar (44.5C) and a 5 ml water sample (or dilution), poured into sterile 100X15 mm petri dishes and incubated at 35C. Plaques were counted after 24 hrs. Details of method development will be published elsewhere.

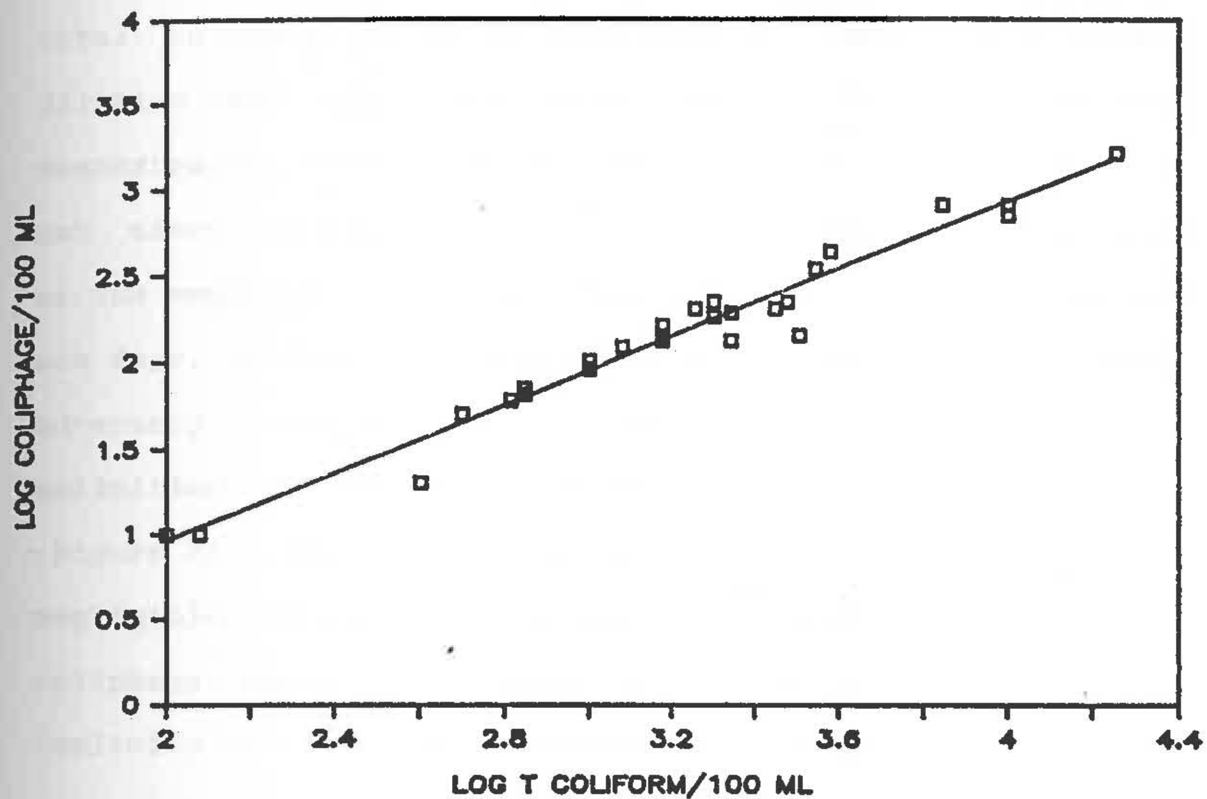
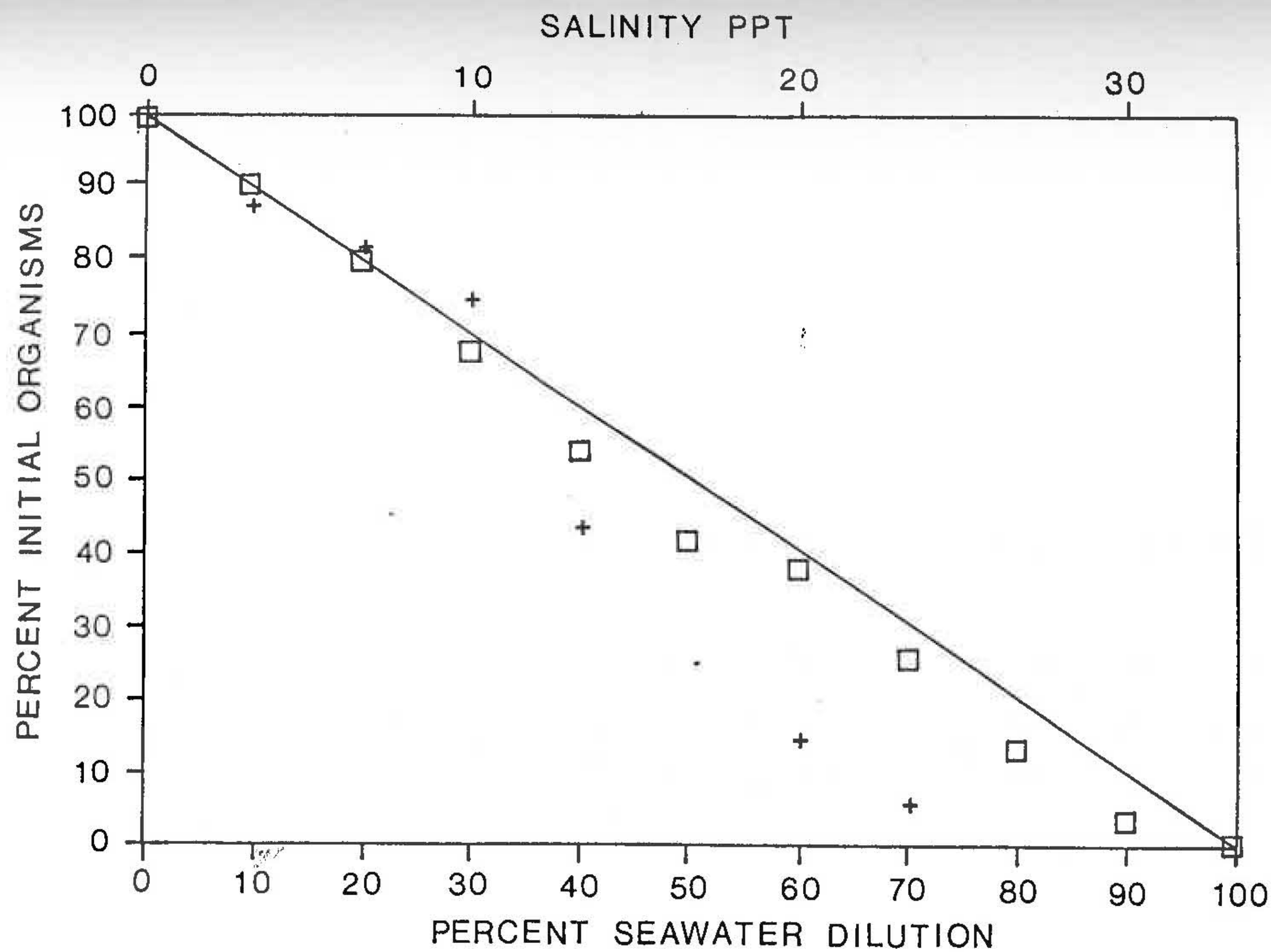

LOG COLIPHAGE/100 ML
LOG T COLIFORM/100 ML
0
0.5
1
1.5
2
2.5
3
3.5
4
2
2.4
2.8
3.2
3.6
4
4.4

Figure 1.

sample (salinity = 33.4 parts per thousand). Coliphage and total coliform bacteria were assayed immediately after dilution and again six days later. Initial results demonstrated that the high ionic strength of seawater did not alter the response of the coliphage plating technique or the membrane filter technique for total coliform. After six days, neither coliphage or total coliform bacteria were adversely affected at low salinities but at higher salinities the bacterial die off was considerably greater (Figure 2). Therefore, high ionic strength samples caused negligible viral adsorption or inactivation in the coliphage assay. In fresh or brackish water samples (salinity <10 parts per thousand), coliphage are usually 7-10% of total coliform; however in salt water, coliphage counts are usually far in excess of total coliform. This relationship is also true for coliphage and fecal coliforms and is not due to a variation in methods response to fresh and salt water samples. Therefore a coliphage count of 100 plaque forming units (pfu) per 100 ml in marine samples may indicate a total coliform titer of about 1000 colony forming units (cfu) which is the maximum allowable level for recreational waters in the state of Florida[11]. Figure 3 shows stations with more than 1000 total coliforms per 100 ml, 1 mg coprostanol (a highly labile component of mammalian feces, indicating severe sewage contamination[12]) per gram of sediment, or 100 coliphage pfu per 100 ml. All parameters exceeded these values in the Miami River. An additional seven bay stations had high sediment coprostanol

FIG. 2 Coliform and coliphage assay of a decimal dilution series of a fresh water sewage sample with uncontaminated sea water, six days after mixing; (+) total coliform, (□) coliphage. Line indicates theoretical dilution curve with no inactivation.


SALINITY PPT
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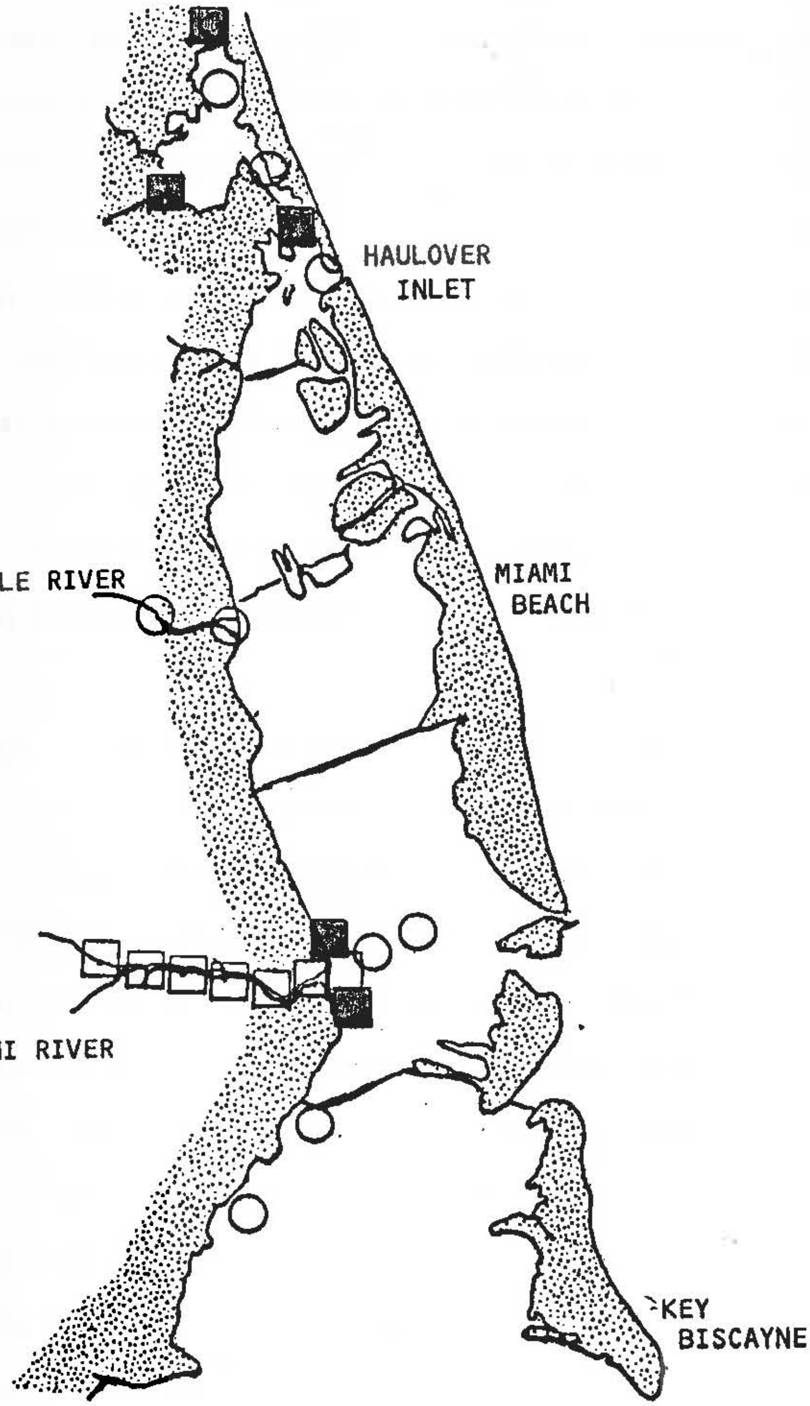
PERCENT SEAWATER DILUTION
0
10
20
30
40
50
60
70
80
90
100

FIG. 3 Map of Biscayne Bay stations which exceeded 1000 cfu$(100\ ml)^{-1}$ total coliform, 1 $mgg^{-1}$ coprostanol, and/or 100 pfu$(100\ ml)^{-1}$ coliphage. All three indicators, (□); coprostanol and coliphage, (■); coliphage only, (O). Coprostanol was determined by gas chromatography by Mote Marine Labs, St. Petersburg, Fl.


HAULOVER
INLET
LITTLE RIVER
MIAMI
BEACH
MIAMI RIVER
KEY
BISCAYNE

levels and high suspended water phage titers, but were within state water quality standards for total coliforms. Total coliforms were an ineffective indicator in these salt water stations, but the contamination was detected by coliphage counts in all seven instances. An additional ten stations had coliphage titers in excess of 100 pfu(100 ml)-1 without elevated coprostanol or total coliform levels, probably due to the longer persistence of phage. These stations were all associated with obvious sources of fecal pollution such as liveaboard boats, marinas, and surface runoff.

Phage titers greater than 10,000 pfu(100 ml)-1 were detected in one northern Biscayne Bay station eleven days after a reported raw sewage discharge into a tributary creek, while total and fecal coliforms indicated no violation of water quality standards. Analyses of samples taken shortly after the discharge by the Dade County Health Department in the fresh water creek where the spill occurred, detected total coliform counts exceeding 24,000 cfu per 100 ml.

It is clear that coliphage assays can detect instances of fecal contamination in marine waters which are undetectable by fecal and total coliform methods. The tight correlation of coliphage and coliform counts in fresh water, coupled with the lower deactivation rate in sea water may allow coliphage titers to be directly interpreted and related to current coliform-based water quality standards.

This work was supported by contracts from the Department of Environmental Resource Management, Dade County, Florida. We thank the staff at Spectrum Laboratories, Inc., Fort Lauderdale, Florida for their assistance.

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# COLIPHAGE AS AN INDICATOR OF FECAL POLLUTION IN MARINE WATERS: ASSAY AND VALIDATION

*Escherichia coli* does not conform to the concept of an indicator microorganism in marine waters because it is rapidly inactivated in seawater. Coliphage is more resistant to this inactivation than other microbial indicator systems. A simple method was developed for the determination of coliphage in marine waters. In field studies, total and fecal coliform and coliphage counts were highly correlated in water samples of <10 parts per thousand (ppt) (r = 0.98 and 0.91 respectively), while higher salinity samples yielded much lower correlations due to coliform inactivation. The coliphage assay is reproducible and is not adversely affected by saline samples. Since phage are highly correlated with an accepted indicator in fresh water, survive much better than coliforms in saltwater, and can be identified by a simple method which is unaffected by samples of high ionic strength, they qualify as a valuable indicator of fecal pollution in marine waters. Their highly significant correlation with total and fecal coliforms at low salinities allows assessment of the quality of marine waters relative to current coliform based codes.

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Evaluation of marine pollution requires chemical examination of waste components and assessment of the fate of materials in natural waters. It would be impossible to identify all pathogens or toxic substances discharged in domestic wastewater. It is more practical to establish an indicator organism or substance which: 1) is ubiquitous in the wastewater, 2) survives or is detectable at least as long as the harmful contaminants, and 3) is easy to isolate and identify. Total coliform counts are the official criterion of the sanitary quality of potable water in the United States of America. In the case of fresh water lakes and rivers a sub-group of the total coliforms, the fecal coli, are the indicator of choice. Fecal coliforms are mainly varieties of Escherichia coli which are found predominantly in the intestines of warm-blooded animals, including man.

It is apparent that in the marine environment, E. coli does not conform to the concept of an indicator microorganism because it is rapidly killed or inactivated by seawater (4, 7, 8, 13, 24). Near wastewater outfalls, E. coli concentrations decline at rates far faster than can be explained by dilution alone (18). Although the validity of the fecal coliform indicator system continues to be questioned, a suitable alternative has not been developed. Selection of a reliable indicator requires information concerning its fate in a marine system (1).

Many factors have been reported to be important in the inactivation of coliform bacteria. Among these are sunlight (10, 12), salinity (6), predation (9), lysis by bacteriophage (6), and microbial toxins (2). Borrego et al.

(4) compared the degree of inactivation of various organisms in marine water. Total coliform, fecal coliform, and Salmonella-Shigella lose their viability rapidly because of poor adaptive capacity and the need for previous enrichment before they can grow in selective media. Fecal streptococci exhibited a lower degree of seawater inactivation; however, Borrego et al. (4) also showed that fecal streptococci abundance was strongly influenced by temperature. Berry and Notom (3) investigated the stability of T2 coliphage in seawater under laboratory conditions and in natural bay waters. They concluded that coliphage are much more resistant to inactivation than E. coli and may be a better indicator of pollution. Inactivation of coliphage was temperature dependent and was enhanced by sunlight. Chemical inactivation did not appear to play a major role. Coliphage were more resistant than any of the bacteria to physico-chemical factors such as inorganic ions, temperature, heavy metals, nutrients, and antibiotics (4). Borrego concluded that coliphage appeared to be an attractive indicator of marine pollution, but before replacing current criteria it would be advisable to study coliform/coliphage index which would be very useful to determine horizontal distance and extent of pollution from its origin. Kenard and Valentine (16) determined coliform and coliphage levels for over 150 water samples of varying salinity; however, salinity was not correlated with indicator results. Kott (19) stated that since no standard method for coliphage determination based on performance had

been published, realistic evaluations on waters of varying salinities was difficult.

Since bacteriophage are not cellular organisms, they may possess different inactivation mechanisms. In the first inactivation stage the coliphage, like other viruses, undergo adsorption and subsequent sedimentation which impedes their detection in surface waters. Enteric viruses were found to be present all year in sewage treatment plant effluent, with the highest concentrations occurring in the warmer months (5). Enteroviruses, such as poliovirus 1 and echovirus 6, were isolated from freshwater samples containing no detectable fecal or total coliform bacteria (23). No significant statistical correlation could be determined between the occurrence of bacterial indicators and the presence of these viruses. LaBelle _et al._ (21) found a similar lack of correlation between bacterial indicators and enteric viruses in seawater samples.

## MATERIALS AND METHODS

**Bacterial Host.** Based on a review of the literature the following strains of _E. coli_ were obtained from the American Type Culture Collection: ATCC 11303, 12435, 13706, 1097, 1279, 1077, 8677, and 15597. In addition, two wild strains were isolated from a domestic raw sewage and a contaminated canal in western Broward County, Florida.

**Culture and Plating.** Nutrient broth (BBL) with 0.5% NaCl and 1.5% agar (BBL), Tryptone Glucose Extract Agar (DIFCO), EC Agar (BBL),and Tryptic Soy Agar (DIFCO) were tested for suitability as host media using a modification of a single agar layer method (14). Five ml of host medium (45 C) was mixed with a 5 ml water sample and 1 ml of host culture and poured into a 100 X 15 mm petri dish. In order to determine the optimal growth phase of the host culture, a 100 ml flask of nutrient broth was inoculated with E. coli and one ml samples were plated at one hour intervals using the single agar layer method. To determine if host culture could be preserved for future use, the culture was mixed with 10% glycerol and frozen in 10 ml aliquots. Periodically aliquots were thawed and assayed over two and a half months.

**Method Development.** Coliphage recovery was compared using all combinations of host strains and media, with several incubation times and sample volumes. For method development only, a 0.45 um (Millipore HA) filtrate of raw sewage was used as the phage source with replicate platings of either 0.1, 1, or 5 ml on each medium/host combination. Plaques were counted after 4 and 24 hours.

**Effect of saltwater dilution.** A decimal dilution series was prepared using a sewage contaminated freshwater sample (salinity <0.1 parts per thousand) and an uncontaminated seawater sample (salinity = 33.4 ppt). Coliphage and total coliform bacteria were assayed immediately and again after six days.

**Final Method.** A flask containing Tryptic Soy Broth was inoculated with E. coli ATCC 13706 and incubated overnight

(18 hours) at 35 C to prepare host culture. After incubation, 10% glycerol (w/v) was aseptically added and 5 ml portions of the culture were dispensed into sterile screw cap tubes. Tubes were chilled to 9 C and frozen at -20 C for no longer than six weeks. For use, tubes of frozen E. coli were thawed in a 60 C water bath, inoculated into sterile Tryptic Soy Broth (1 ml culture to 5 ml broth) and incubated for one hour at 35 C. One ml of this early log phase host culture, 5 ml of water sample or dilution, and 5 ml of sterile Tryptic Soy Agar (maintained at 60 C) were combined in a sterile screw cap tube and mixed. Contents of the tube were poured into a sterile 100 X 15 mm petri dish, covered, and allowed to solidify. Inverted plates were incubated at 35 C. Plaques were counted after incubating for 24 hrs.

**Field Studies.** Surface water samples were collected at predominantly freshwater stations in the Miami River, Biscayne Canal, Little River and at saltwater stations within Biscayne Bay (Dade County, Florida). Samples were analyzed for total coliform bacteria and fecal coliform bacteria by membrane filter method (Standard Methods 1985) and coliphage by the final method described above.

## RESULTS

**Influence of Media and Host Strain.** Table 1 shows that E. coli strain ATCC 13706 gave consistently higher plaque recovery on all media tested. Tryptic Soy Agar gave

TABLE 1. Coliphage pfu from duplicate 5.0 ml filtered sewage effluent samples plated on three host strains growing on three media types after 24 hr incubation period, with results of two way ANOVA with replication. Critical values F 0.01(2,9) = 8.02

| | Nutrient Agar | Tryptic Soy Agar | Tryptose Glucose Extract Agar<br>Media Effects<br>F = 19.5 |
|---|---|---|---|
| Organism | | | |
| 13706 | 26,27 | 31,31 | 25,27 |
| 12435 | 2,3 | 4,5 | 2,3 |
| 11303 | 1,2 | 2,4 | 1,2 |
| Organism Effects<br>F = 1642 | | | |

marginally (but significantly) better results than the other two media. EC Agar medium (not shown) was inferior as were the other E. coli strains. About 60% of the plaques were visible after four hours of incubation; however, full plaque development required 18 to 24 hours. Plaques formed from salt water samples were considerably smaller than those previously observed from a fresh water source of coliphage.

**Host culture preparation.** Plating of E. coli at different stages of growth showed that the best seed lawn was obtained by use of organisms in the early logarithmic growth phase. Cells in the lag phase do not grow quickly enough to produce an even lawn and cells in the late log growth phase tend to overgrow the plaques. Optimal results were obtained by growing a culture for 18 hours and then inoculating fresh, sterile broth with the 18 hour culture at a ratio of 1.0 ml culture to 5.0 ml of sterile broth. After one hour of incubation the cells were in rapid growth phase and remained in this optimal phase for several hours. Addition of 10% glycerol to the 18 hour culture protected the viability of frozen 10 ml aliquots for 30-40 days.

**Replication.** Aliquots of the frozen filtered sewage phage source were periodically thawed and analyzed. The titer declined linearly ($r = 0.920$) by about 20% over 77 days (Table 2). The average coefficient of variation of the seven replicate analyses was 7.9%.

**Saltwater dilution effect.** Figure 1 shows that both total coliform and coliphage closely follow the theoretical

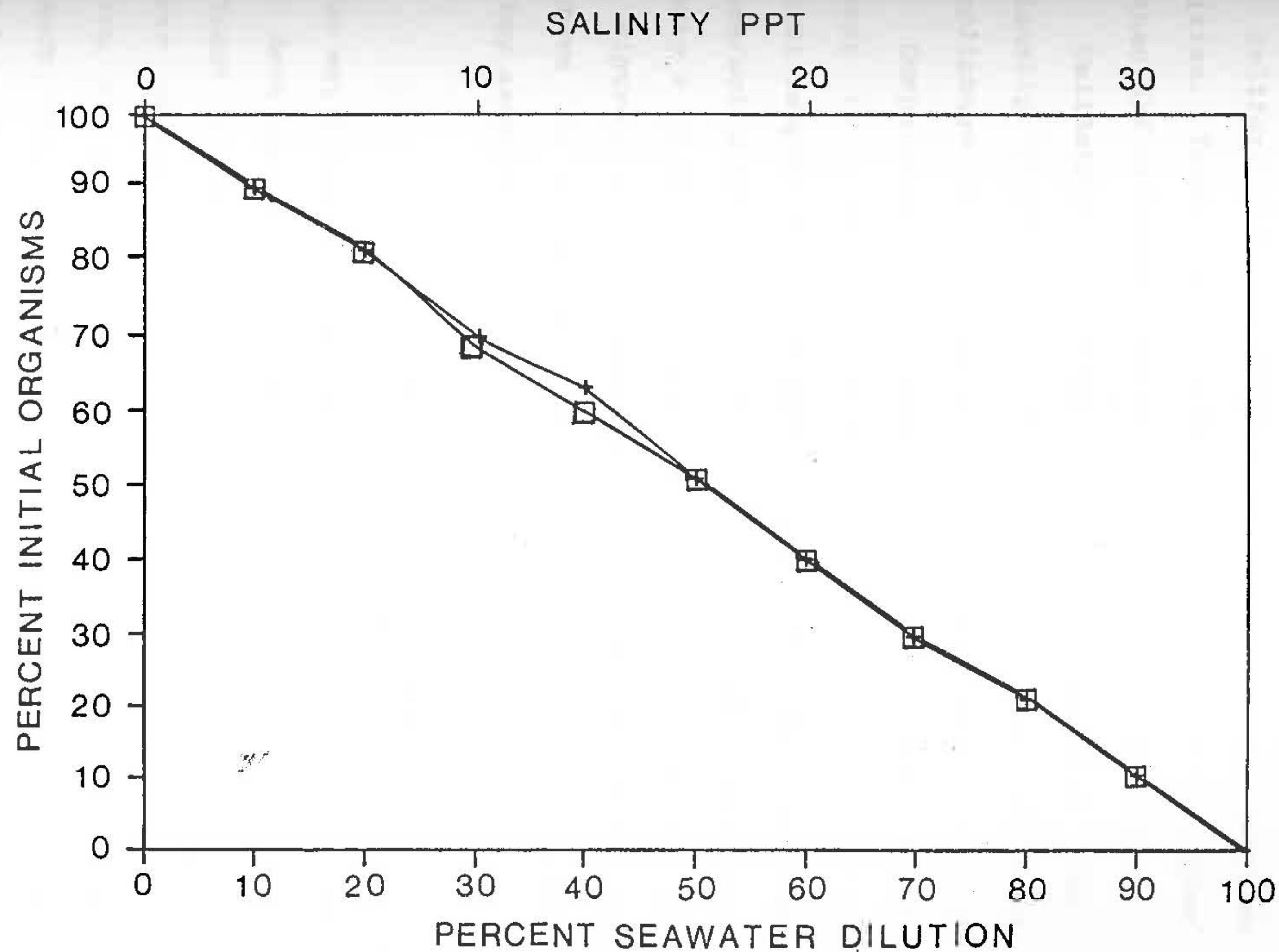
Table 2. Repeated analysis of frozen phage aliquots with different batches of media and host, with standard deviation and coefficient of variation for five replicates.

| DAYS FROZEN | PFU/ML MEANS | STD | COEF. of VAR. |
|---|---|---|---|
| 1 | 6.2 | 0.1 | 1.6 |
| 7 | 5.9 | 0.3 | 5.1 |
| 19 | 5.6 | 0.3 | 5.4 |
| 31 | 5.3 | 0.8 | 15.1 |
| 36 | 5.5 | 0.6 | 10.9 |
| 38 | 5.5 | 0.5 | 9.1 |
| 77 | 5.0 | 0.4 | 8.0 |
| | 5.6 | 0.4 | 7.9 |

Means represent five replicates

Coef. of Var. = STD/X * 100

FIG. 1 Effect of saltwater dilution at zero days. Coliform and coliphage assay of a decimal dilution series of fresh water (salinity <0.1 parts per thousand) and a seawater sample (salinity = 33.4 parts per thousand) immediately aftere mixing; (+) total coliform, (0) coliphage.


SALINITY PPT
0
10
20
30
PERCENT INITIAL ORGANISMS
100
90
80
70
60
50
40
30
20
10
0
PERCENT SEAWATER DILUTION

dilution curve immediately after dilution with seawater. Figure 2 illustrates the differences in the inactivation of total coliform and coliphage after six days at various salinities. Total coliform bacteria died off at a higher rate than did coliphage, particularly at higher salinities. **Field Validation.** Figures 3 and 4 represent the relationship between total coliform and fecal coliform with coliphage in the fresh or brackish water stations (<10 ppt). Comparison of coliphage with total and fecal coliforms (n = 53) gave correlation coefficients of 0.98 and 0.91 respectively. Figure 5 represents the combined coliform/coliphage relationship at 68 saltwater stations (salinity > 10 ppt) yielding a correlation coefficient of 0.45. Figures 6 - 9 illustrate the relation of bacterial indicators to coliphage obtained during the second and third bay samplings.

## DISCUSSION

Two way analyses of variance for the parameters in the method development experiment (Table 1) indicate a very significant difference between host strains of <u>E. coli</u> and a lower degree of significance among culture media. Selection of a suitable host is clearly of paramount importance. The selection of ATCC strain 13706 as the optimal host is an independent confirmation of the results of Stetler (26).

Table 2 demonstrates the overall reproducibility of the method. These analyses were done with different batches

FIG. 2 Effect of saltwater dilution at six days. Coliform and coliphage assay of a decimal series of fresh water (salinity <0.1 parts per thousand) and a seawater sample six days after mixing; (+) total coliform, (0) coliphage. Straight line represents dilution line.

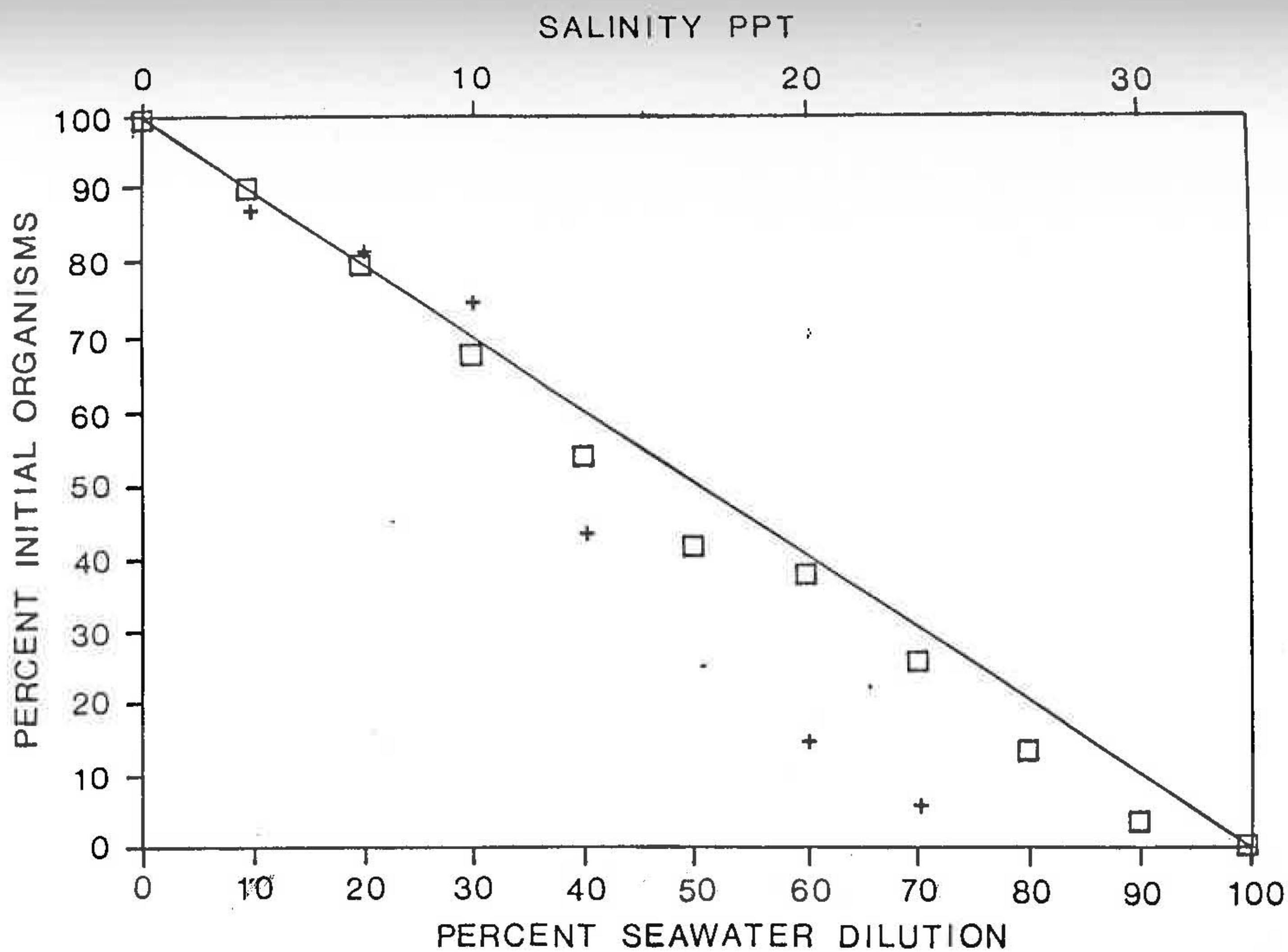

SALINITY PPT
0
10
20
30
100
90
80
70
60
50
40
30
20
10
0
PERCENT INITIAL ORGANISMS
0
10
20
30
40
50
60
70
80
90
100
PERCENT SEAWATER DILUTION

FIG. 3 Relationship between 53 samples of total coliform and coliphage in low salinity (<10 parts per thousand) stations in Biscayne Bay and its tributaries (correlation coefficient = 0.98).

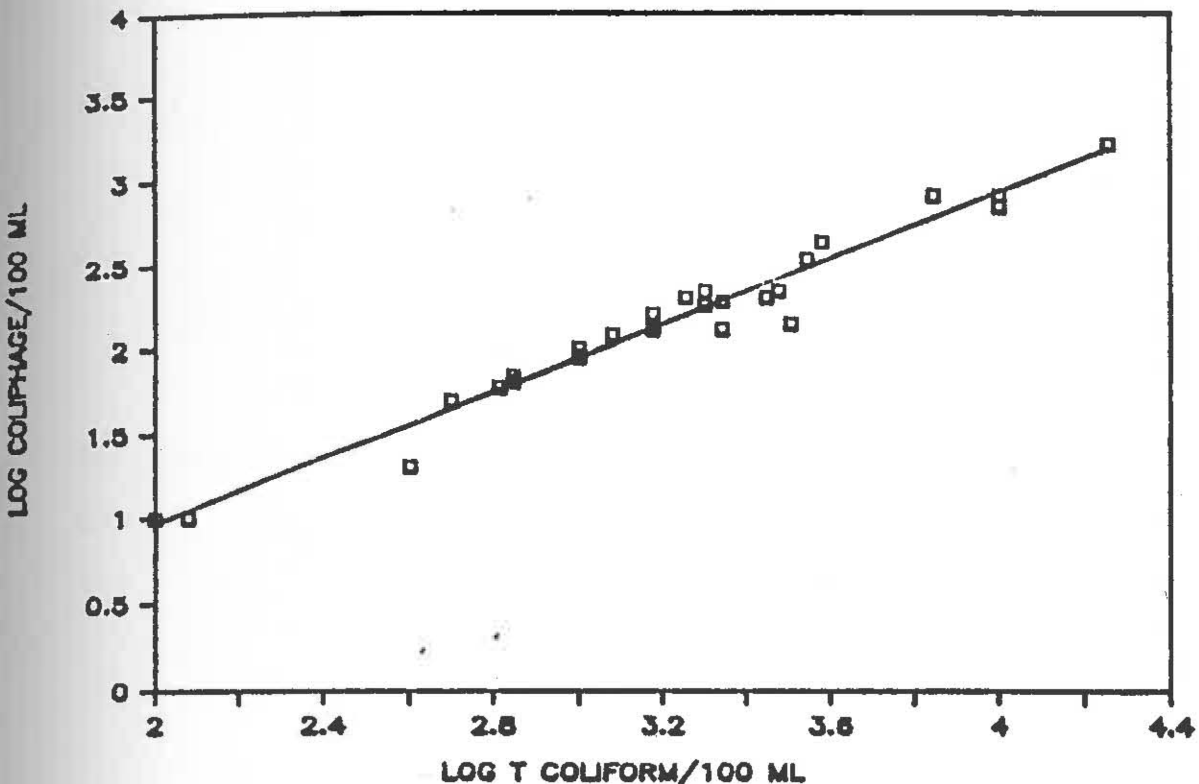
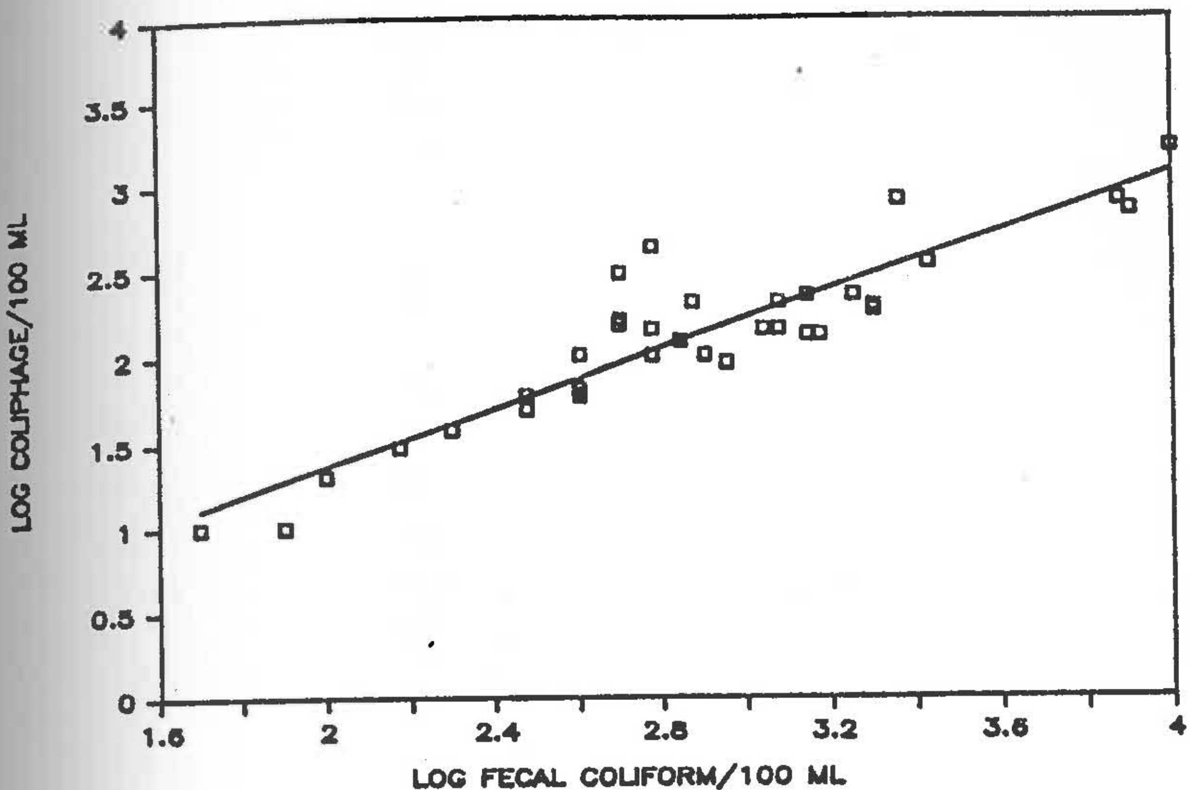

LOG COLIPHAGE/100 ML
LOG T COLIFORM/100 ML
0
0.5
1
1.5
2
2.5
3
3.5
4
2
2.4
2.8
3.2
3.6
4
4.4

Figure 3.

FIG. 4 Relationship between 53 samples of fecal coliform and coliphage in low salinity (<10 ppt) stations in Biscayne Bay (correlation coefficient = 0.91).



LOG COLIPHAGE/100 ML
4
3.5
3
2.5
2
1.5
1
0.5
0
1.6
2
2.4
2.8
3.2
3.6
4
LOG FECAL COLIFORM/100 ML


Figure 4.

FIG. 5 Relationship between 68 data pairs of total coliform and coliphage in high salinity (>10 ppt) stations in Biscayne Bay (correlation coefficient = 0.45).

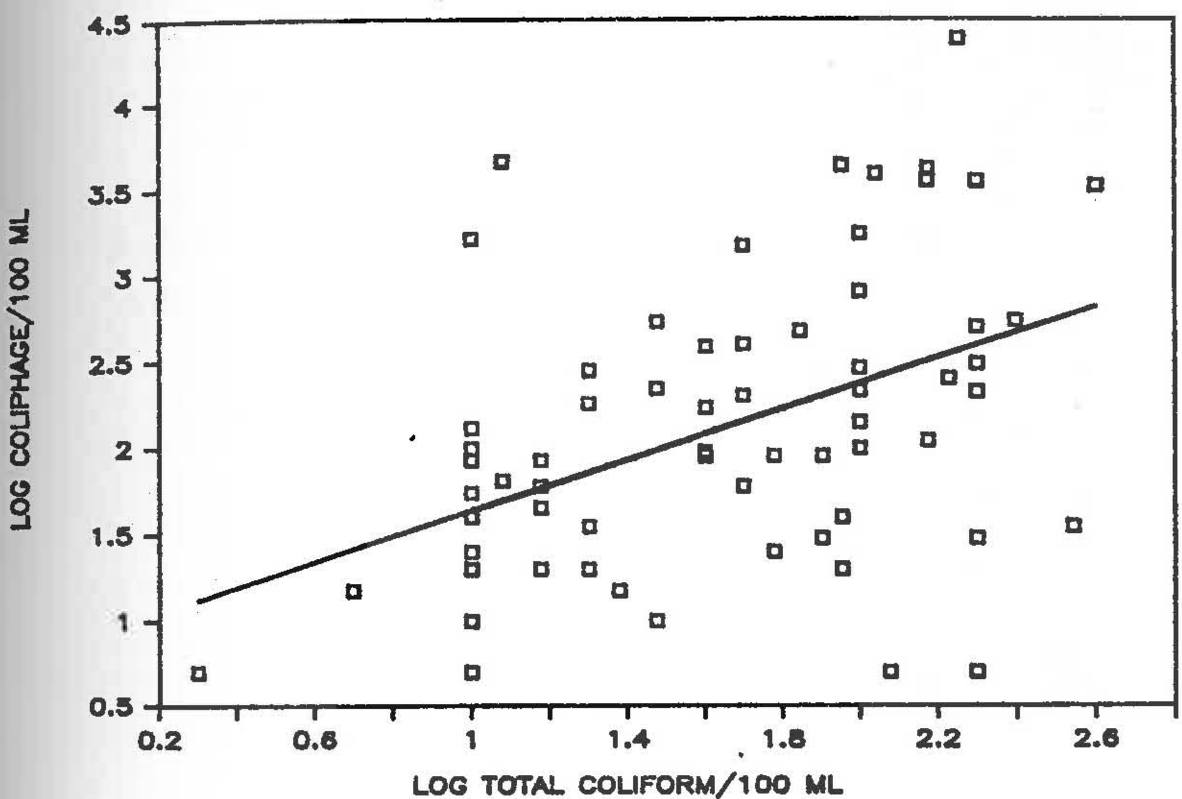

LOG COLIPHAGE/100 ML
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0.2
0.6
1
1.4
1.8
2.2
2.6
LOG TOTAL COLIFORM/100 ML

Figure 5.

FIG. 6 Correlation of total coliform and coliphage in high salinity stations (>10 ppt) in Biscayne Bay May 20th and 21st, 1986 ($r^2$ = 0.15, n = 24).

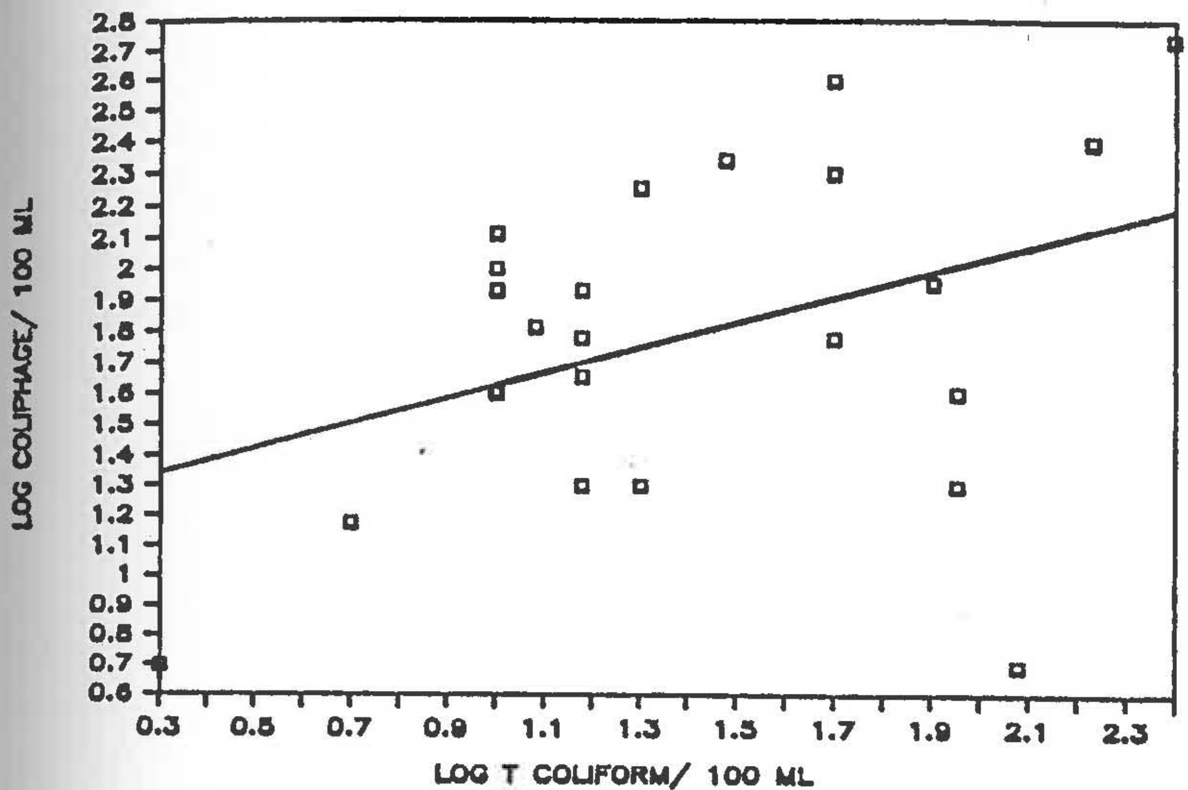



Figure 6.

FIG. 7 Correlation of fecal coliform and coliphage in high salinity stations (>10 ppt) in Biscayne Bay, May 20th and 21st, 1986 ($r^2$ = 0.27, n = 22).

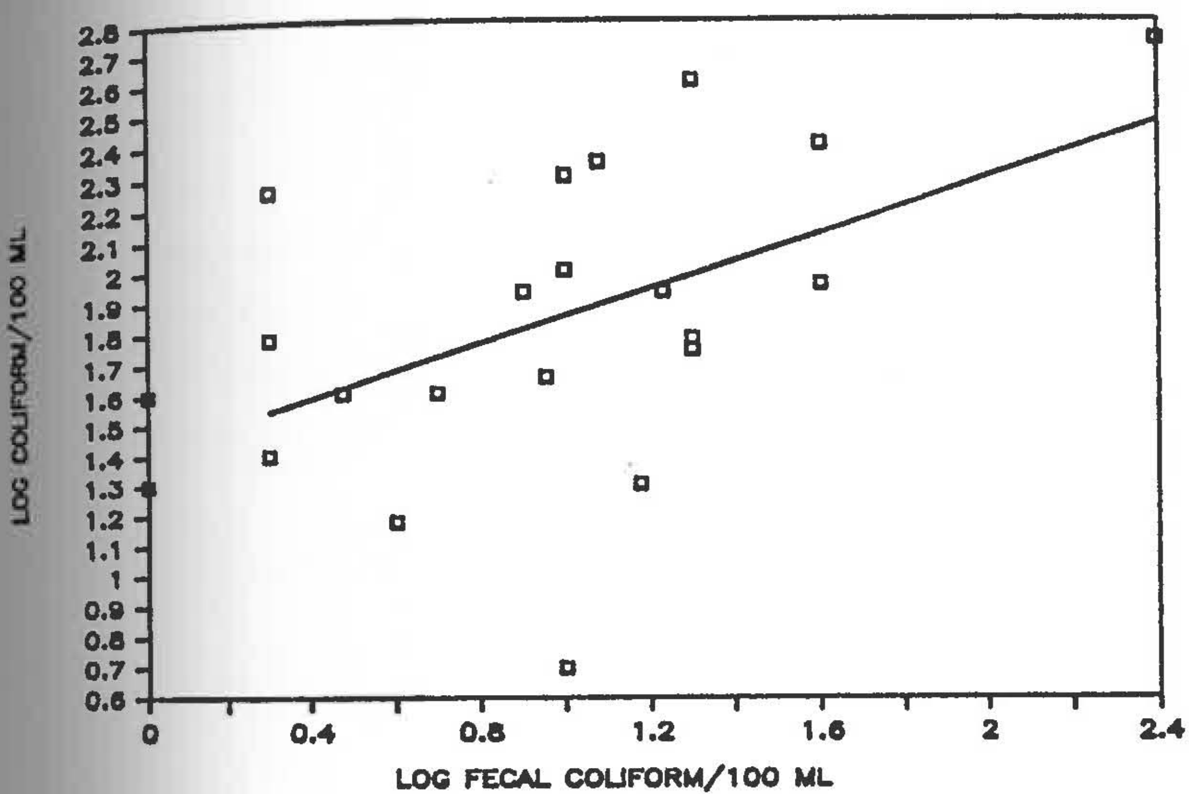

2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
LOG COLIFORM/100 ML
0
0.4
0.8
1.2
1.6
2
2.4
LOG FECAL COLIFORM/100 ML

Figure 7.

FIG. 8 Correlation of total coliform and coliphage in high salinity stations (>10 ppt) in Biscayne Bay, June 10th and 11th, 1986 ($r^2$ = 0.0.72, n = 19).

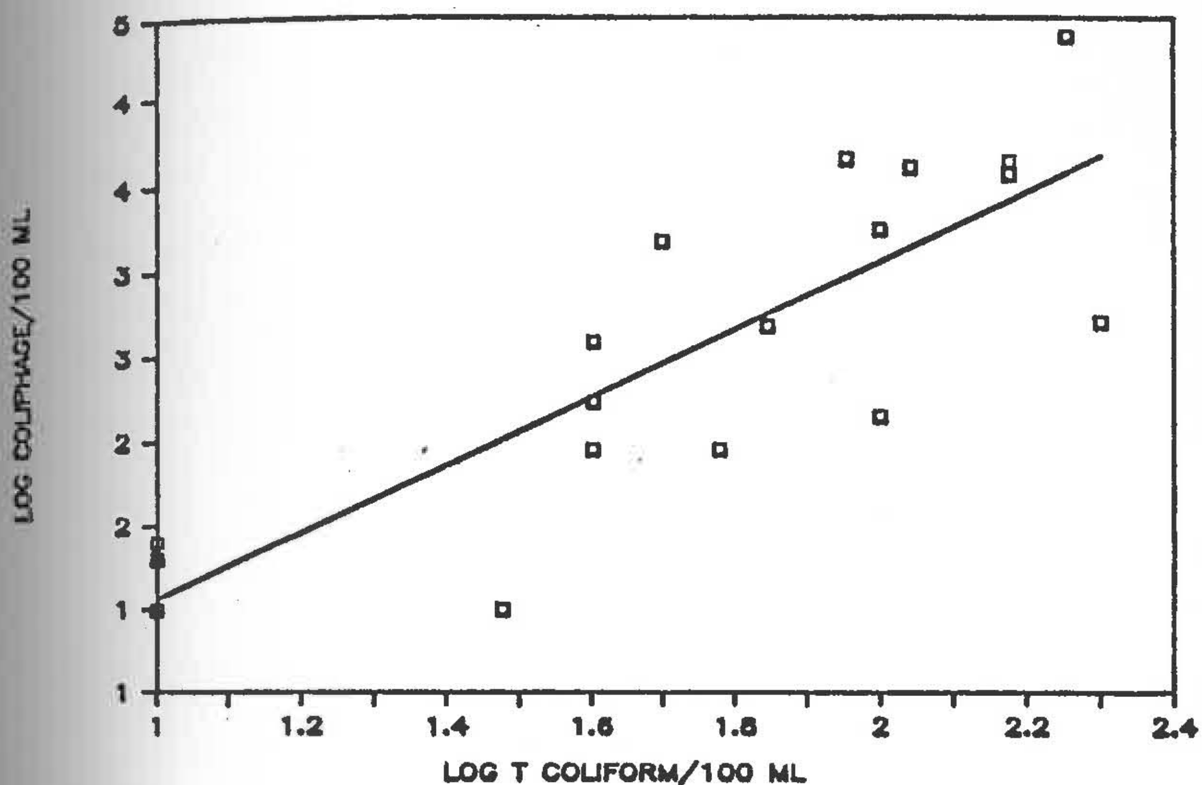

LOG COLIPHAGE/100 ML
LOG T COLIFORM/100 ML
1
1.2
1.4
1.6
1.8
2
2.2
2.4
5
4
4
3
3
2
2
1
1

Figure 8.

FIG. 9 Correlation of fecal coliform and coliphage in high salinity stations (>10 ppt) in Biscayne Bay, June 10th and 11th, 1986 ($r = 0.11$, $n = 12$).

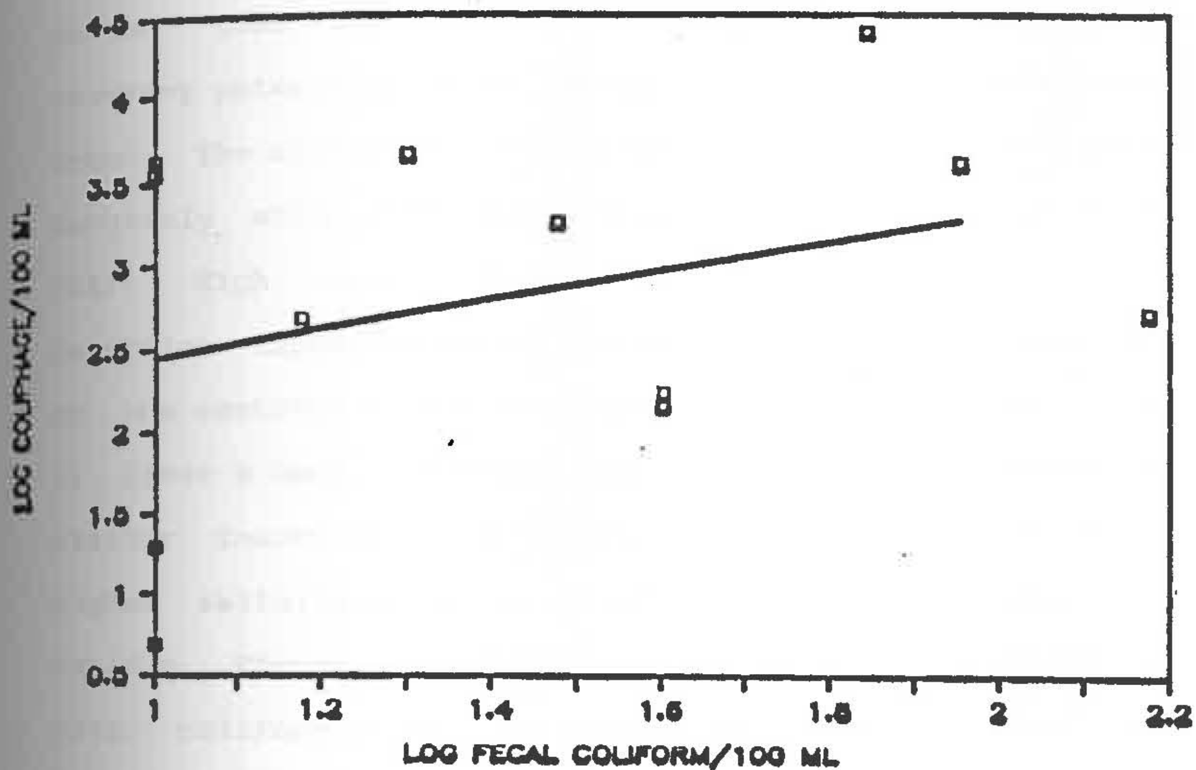
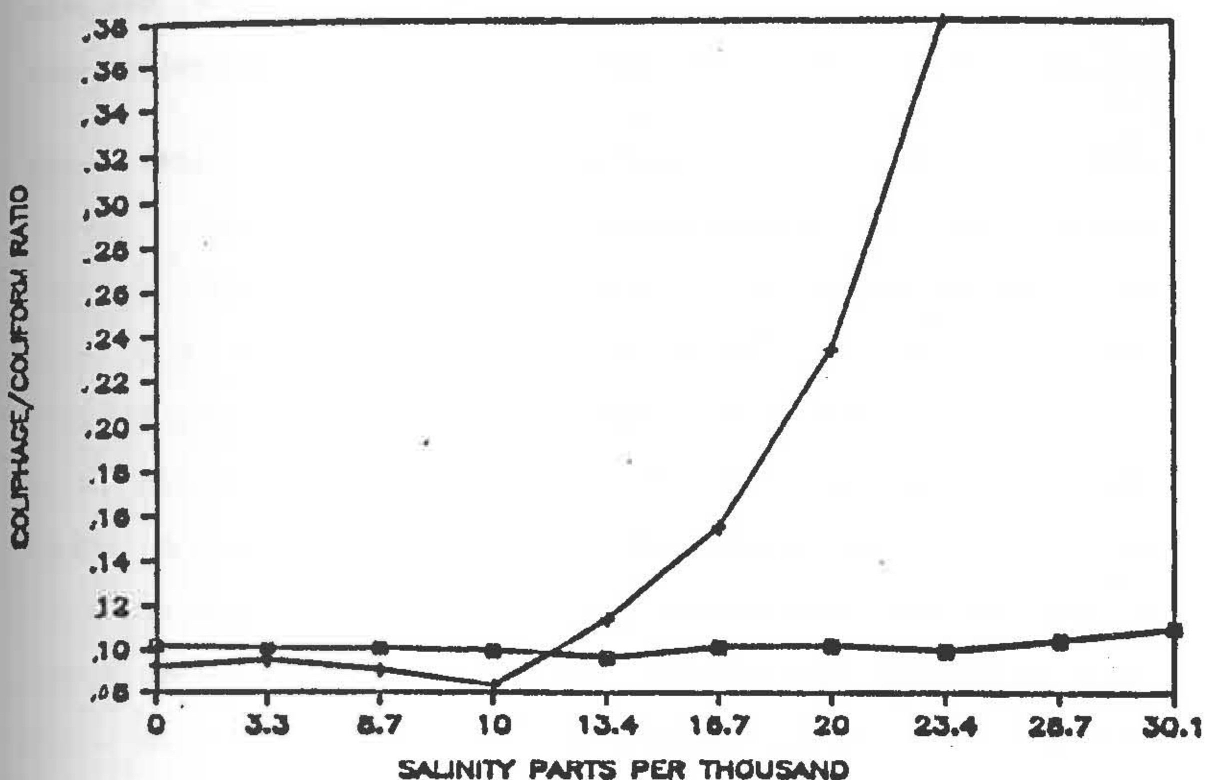

LOG COLIPHAGE/100 ML
LOG FECAL COLIFORM/100 ML
4.5
4
3.5
3
2.5
2
1.5
1
0.5
1
1.2
1.4
1.6
1.8
2
2.2

Figure 9.

of media and host and represent full procedural replicates, a test of total method repeatability. The linear decline in phage recovery observed over 77 days was most likely due to progressive phage inactivation in the frozen aliquots rather then batch-to-batch variability in the phage recovery potential, which should not produce the consistent trend. The coefficient of variation of 7.9% compares quite favorably with that of coliform analyses (usually about 25%). High ionic strength samples do not alter the detection capabilities of the coliphage plating technique or the membrane filter technique for total coliform (Fig. 1). After 6 days, coliphage and total coliform bacteria had similar inactivation profiles at low salinities while at higher salinities the bacteria were inactivated much more rapidly. Figure 10 illustrates the ratio of coliphage to total coliform at varying salinities for the initial and six day samples in the seawater dilution experiment (Fig. 1 and 2). The rapidly increasing ratios at higher salinities are clearly due to more rapid inactivation of coliforms relative to phage. Coliphage/coliform ratios exceeding unity were common in the high salinity Biscayne Bay samples, but were never observed at low salinity locations. The initial phage/total coliform ratio of approximately 0.10 was salinity independent and very similar to that observed at the fresh and brackish water stations (Fig. 3). This must represent a rather consistent dynamic equilibrium between virus and host, before bacterial inactivation causes the ratio to increase.

Fig 10. Ratio of coliphage and total coliform at various salinities over initial (■) and six days (+).



COLIPHAGE/COLIFORM RATIO
.38
.36
.34
.32
.30
.28
.26
.24
.22
.20
.18
.16
.14
.12
.10
.08
0
3.3
6.7
10
13.4
16.7
20
23.4
26.7
30.1
SALINITY PARTS PER THOUSAND


Figure 10.

In freshwater samples coliphage and total coliform showed a highly significant predictive relationship ($r^2$ = 0.96) which remained fairly constant in twelve samplings over a one year period. The regression equation for these samples (Fig 3) was:

log coliphage = 0.983(log total coliform) - 1.001 (Eq. 1)

Since the slope of this log-log relationship is nearly unity, the untransformed relationship is also nearly linear. The ratio of phage to total coliform varies only from 9.2 to 8.5% over a range of $10^2$ to $10^4$ coliforms cfu(100 ml)$^{-1}$. This is to be expected if both coliphage and total coliform behaved as conservative water mass tracers, whose concentration varied in the same proportions though dilution and mixing (27). These ratios are very similar to those observed in raw sewage. Kenard and Valentine (16) also reported a highly significant correlation between fecal coliform and coliphage in 150 freshwater samples; however, the culture medium and host bacterial strain were not reported. Isbister <u>et</u> <u>al</u>. (15) reported the regression equation:

log coliphage = 1.595(log total coliform) - 2.973 (Eq. 2)

This equation is based on freshwater samples from lakes and rivers assayed with the same medium and host as used in this study. Equation 2 was marketly non-linear and gave higher coliphage ratios at higher coliform counts than did equation 1.

The data indicate that this constant relationship of total coliform to coliphage does not persist at higher salinities. The relationship between coliphage and coliform varied on different sampling days for high salinity stations (Fig. 6 - 9). In the first Biscayne Bay sampling (May 5-6), no significant correlation between coliphage and either total or fecal coliform bacteria were found. However, significant ($p < 0.05$) correlation of total and fecal coliforms with coliphage were found in the second and third Bay samplings (Fig.6 - Fig.9). In the second day (May 20-21) results, the ratio of coliphage to coliform decreased as the degree of pollution increased, finally leveling off at nearly 0.10 which is the approximate ratio in fresh and brackish water. This may indicate that the contamination was recently introduced before sampling on that day. Coliphage and coliform bacteria were often related in high salinity waters, but unlike lower salinity waters, the slopes of these relationships were not consistent. Table 3 compares the linear regression slopes and significance of the relationships of coliphage and bacterial indicators for high salinity and combined low salinity stations. While the values for the relationship between coliphage and total coliform in the combined high salinity samples was significant, it was not useful as a predictive model. The day-to-day variability in these relationships is most likely due to the different survival times of the bacteria and the viruses in saline waters. In less saline waters (salinity <10 parts per thousand),

Table 3. Comparison of linear regression slopes and significance of the relationships of coliphage (y) to total and fecal coliforms (x) for high salinity and combined low salinity stations.

| Date | Total Coliform Slope | r2 | n | p | Fecal Coliform Slope | r2 | n | p |
|---|---|---|---|---|---|---|---|---|
| High Salinity Stations | | | | | | | | |
| May 5-6 | 0.274 | 0.03 | 25 | >0.05 | -0.733 | 0.24 | 13 | 0.045 |
| May 20-21 | 0.404 | 0.15 | 24 | 0.03 | 0.443 | 0.27 | 22 | 0.007 |
| June 10-11 | 1.999 | 0.72 | 19 | <0.001 | 0.850 | 0.11 | 12 | >0.05 |
| Total | 0.768 | 0.20 | 68 | <0.001 | 0.384 | 0.00 | 47 | >0.05 |
| Low Salinity Stations | | | | | | | | |
| Combined (3 locations 9 dates) | 0.983 | 0.96 | 53 | <<0.001 | 0.721 | 0.83 | 53 | <0.001 |

coliphage are usually 7-10% of total coliform; however, in salt water coliphage counts are usually far in excess of total coliform. This relationship also holds for coliphage and fecal coliform counts and is not due to a variation in method response in fresh and salt water (Fig. 4). Total coliform and fecal coliform counts are reduced by marine conditions, while coliphage counts may increase in the marine environment due to additional release of phage by bacterial lysing.

Several authors have proposed the use of coliphage as a good indicator of fecal pollution (16, 25, 4). Coliphage correlation with their bacterial hosts and similarities in behavior to the pathogenic viruses (20) make them both bacterial and viral indicators.

Coliphage meet the general requirements of an improved indicator of fecal pollution because they are present in fecal waste along with the pathogens and they survive as long as or longer than the pathogens. Coliphage are a logical choice for a fecal indicator in marine water since their titers are closely related to total and fecal coliform in freshwater, survive much better than coliforms in saltwater, and they can be enumerated by a simple method which is not subject to salinity artifacts. The constant relation of coliphage and coliforms in freshwater indicate a possible link to current water quality standards based on total or fecal coliforms. Since coliphage pfu are a rather constant 8-10% of total coliform cfu in low salinity waters (Eq. 1) where coliform inactivation is less severe, a coliphage titer of 80 - 100 pfu(100 ml)$^{-1}$ in seawater may indicate water quality equivalent to that indicated by a coliform count of 1000 cfu (100 ml)$^{-1}$. This could aid in the interpretation of coliphage data relative to current coliform-based water quality codes.

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The Use of Coliphage as an Indicator of Fecal Pollution in Marine Waters of Biscayne Bay, Florida and Bell Channel Bay, Bahamas.

Coliphage and total coliform were used as indicators of fecal pollution to monitor the sanitary water quality and depuration rate of Bell Channel Bay during the repair of a malfunctioning sewer plant. Chlorination followed by diversion of the effluent to a deep well resulted in the rapid decline of total coliform below detection limits, while phage remained easily detectable ten days later. Two canals and two marinas on Biscayne Bay were assayed for coliphage to compare sanitary water quality related to point and non-point source fecal pollution. Biscayne Bay was impacted by periodic upstream sewage spills, while the Little River showed evidence of more chronic contamination from liveaboard boats or sewer leaks along its length. Seasonal patterns with winter phage maxima were found upstream, while the opposite pattern was observed downstream near a liveaboard marina. Total coliforms were undetectable at the mouth of the Biscayne Canal within 4 days after a sewage spill upstream of the salinity control lock, while coliphage persisted for at least an additional six days and tracked the polluted low-salinity water mass as it moved back and forth in the canal with the tides. Coliphage was monitored in two Biscayne Bay marinas to assess the water quality impact of liveaboard boats. The

liveaboard Dinner Key marina showed usually low-level, spotty contamination with no seasonal or station-to-station pattern. King's Bay marina, which does not allow liveaboards, showed no evidence of fecal contamination throughout the nine month study. The use of coliphage allows the assessment and monitoring of fecal pollution in marine waters where coliform bacteria are unsuitable.

Coastal canals and enclosed bays and estuaries are particularly sensitive to fecal contamination because of their low flushing rate and their proximity to wastewater outfalls, leaking sewage systems, septic tanks and liveaboard boats. Coliform bacteria are inadequate indicators of this pollution because some property of seawater causes a dramatic decline in the coliform bacteria count, the official criterion of sanitary quality of drinking and recreational waters (Greenberg 1956, Savage 1968, Dawe 1977, Lessard and Siebruth 1983, No.1 & 2, this series). In the marine environment <u>E. coli</u> does not conform to the concept of an indicator microorganism particularly because of this low environmental resistance (Dukta 1973, Borrego 1983). Coliphage have been shown to be more resistant to seawater inactivation than other microbial indicator systems (Berry 1976, No.2 this series). Total coliform and coliphage counts are highly correlated and consistently related in fresh and brackish water samples, but not in predominantly salt water samples (No. 1 & 2 this series). Since coliphage are a good indicator of fecal pollution in fresh water, survive in saltwater, and can be enumerated by a simple method which is not adversely affected by salt water samples, they qualify as a potentially valuable indicator of fecal pollution in marine waters.

## MATERIALS AND METHODS

**Sampling Locations:**

Bell Channel Bay is located in Freeport, on Grand Bahama Island. The bay consisted of five interconnecting sections. The study was conducted in the central section which is surrounded by private homes, a sport diving club, and resort condominiums. Initial coliform analyses of bay waters, conducted by the Bahamian health service because of complaints of dirty water, bad odors, algal blooms, and fish kills, showed no violation of water quality standards. This study was initiated in December, 1985 at the request of the Grand Bahama Development Company to evaluate the problem. A package sewage treatment plant was located adjacent to the south bank of the bay. The sewer plant was designed for aerobic treatment and deep well discharge, but was later found to be discharging directly into the Bay

The comparative sanitary water quality of areas in Biscayne Bay and its tributaries was examined for nine months by analysis of surface water and sediment samples from four locations suspected to be impacted by either point or non-point source pollution, and a nonimpacted control area. The study sites were in the Biscayne Canal, Little River, Kings Bay marina, and Dinner Key marina. The control station was located in open, well flushed waters of the south bay (Fig. 1). Sample locations and land usage adjacent to the Biscayne Canal and Little River are shown in Figure 2. Stations BC1 and LR1 are located upstream of salinity control locks. Seven Kings Bay stations were scattered throughout the marina which was surrounded by non-sewered residences, non-liveaboard boat docks, and a golf course. The Dinner Key marina contained a large number of liveaboard boats and moored recreational boats. This area has been used for boating activities for over one hundred years. Twelve stations were located within this area.

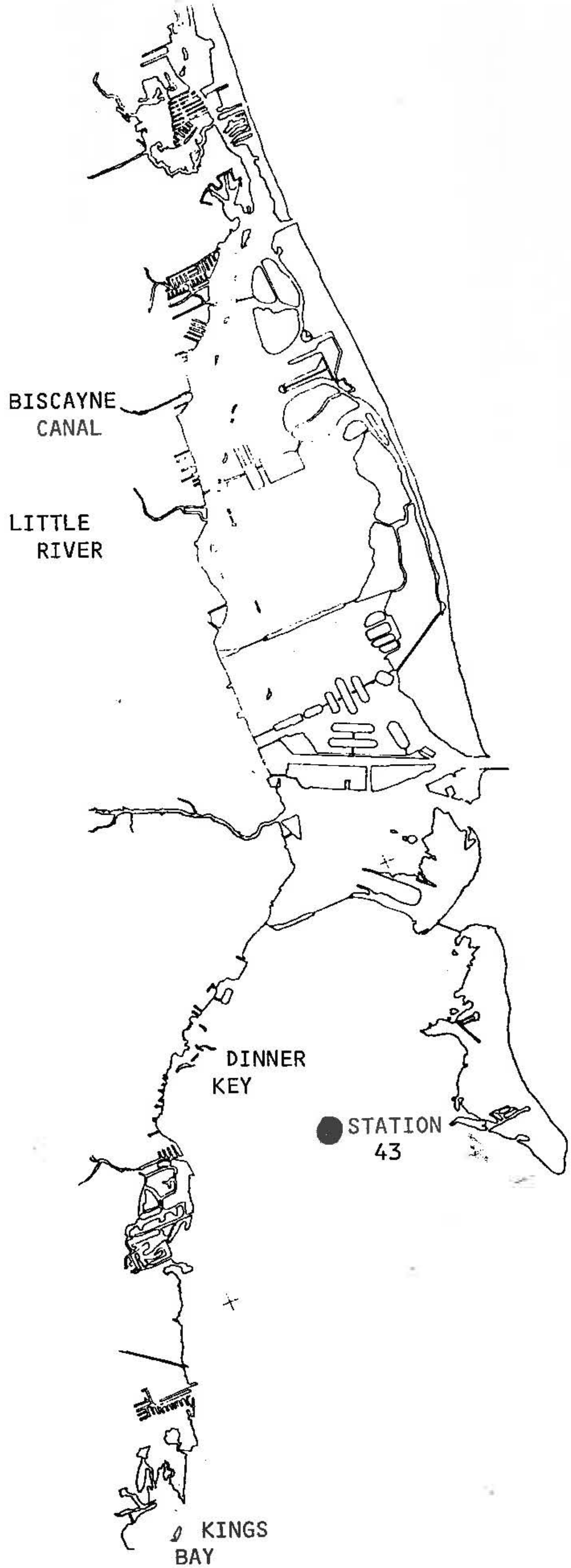
Sample collection:

Surface water samples were collected in duplicate 530 ml sterile polyethylene Whirl-Pak* bags (Nasco). The bags were transported to the laboratory in an ice chest. Sediment samples were collected with a petite Ponar dredge, placed in sterile Whirl-Pak bags and refrigerated.

Analyses:

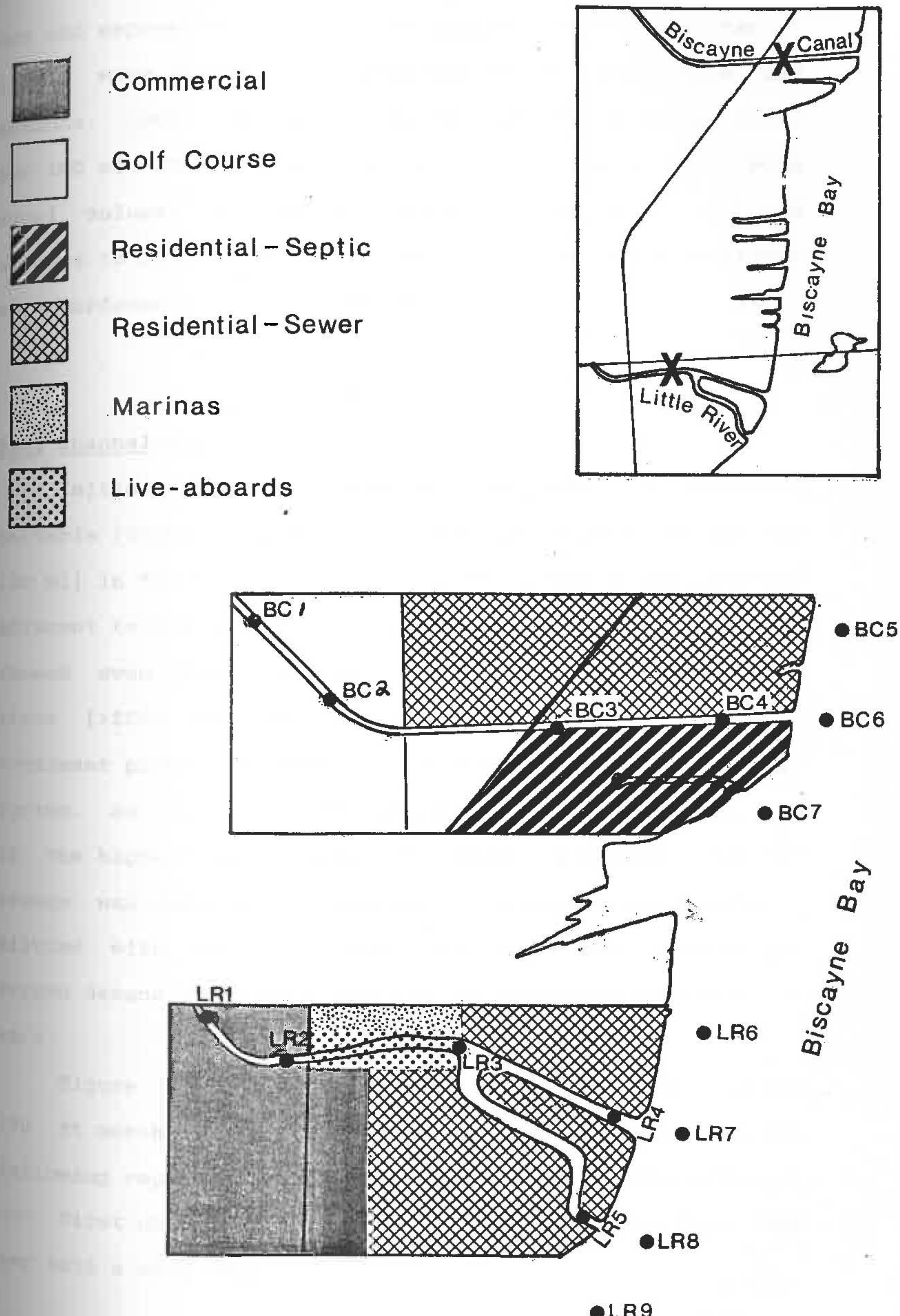
Coliphage were determined as described previously (No. 2, this series). Briefly, one ml of log phase E. coli host culture (ATCC 13706), five ml of water sample or dilution, and five ml of Tryptic Soy Agar (maintained at 44.5 C) were combined in a sterile screw cap tube, mixed, poured into a sterile 100 X 15 mm petri dish, and incubated at 35 C. Plaque forming units (pfu) were counted after 24

Figure 1. Site map of the five study areas in Biscayne Bay.



BISCAYNE
CANAL
LITTLE
RIVER
DINNER
KEY
STATION
43
KINGS
BAY

Figure 2. Expanded view of Biscayne Canal and Little River showing sample stations and land useage.


Commercial
Golf Course
Residential - Septic
Residential - Sewer
Marinas
Live-aboards
Biscayne
Canal
Biscayne Bay
Little River
BC1
BC2
BC3
BC4
BC5
BC6
BC7
Biscayne Bay
LR1
LR2
LR3
LR4
LR5
LR6
LR7
LR8
LR9

hrs and expressed per 100 ml of sample. Coliform bacterial levels were determined by membrane filter method (Standard Methods, 1985) and reported as colony forming units (cfu) per 100 ml. Sediment samples were shaken for 30 sec. with equal volumes of sterile phosphate buffer (pH = 7.0) and allowed to settle for fifteen minutes. The above analyses were performed on the supernatant.

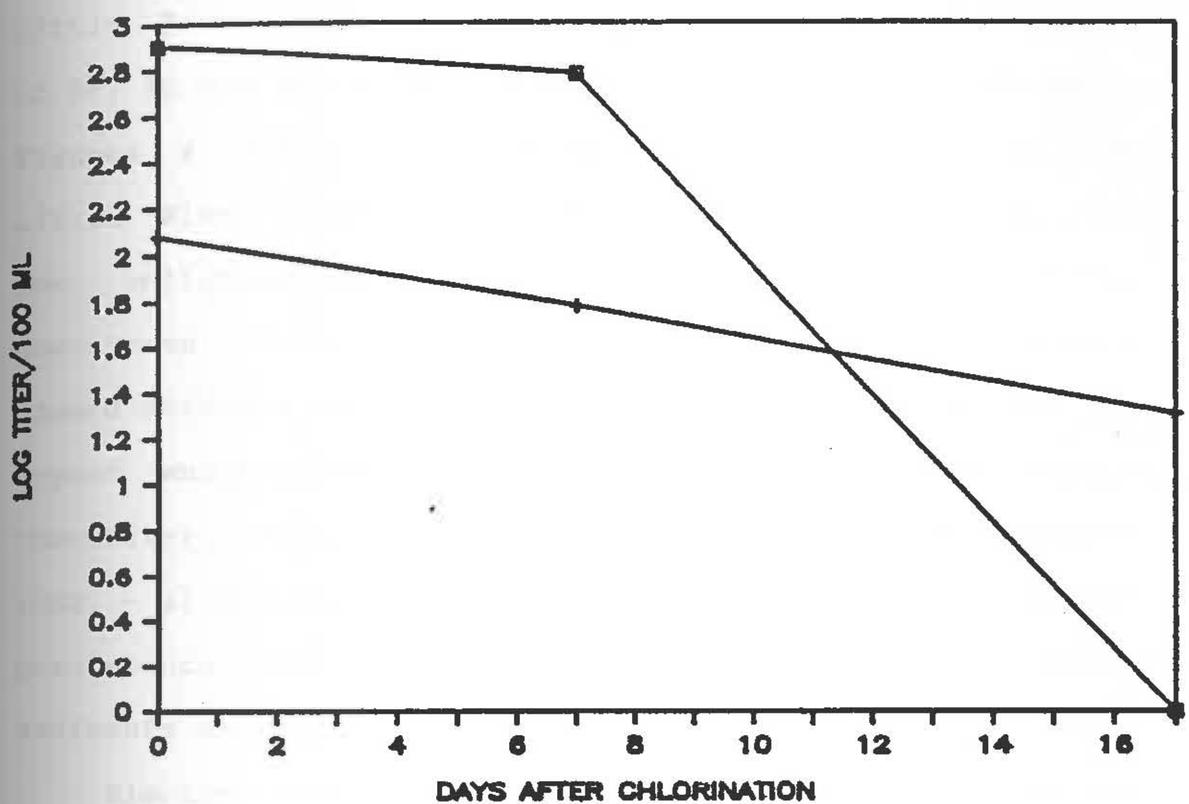
## RESULTS

Bell Channel Bay

Initial sampling revealed high levels of coliform bacteria (>1000 cfu per 100 ml) and coliphage (>100 pfu per 100 ml) in the bay, with the highest values found directly adjacent to the sewage treatment plant. Subsequent testing showed even higher bacteria (>20,000 cfu per 100 ml) and virus (>2000 pfu per 100 ml) levels adjacent to the treatment plant. Viruses were detected throughout the bay system. An illegal discharge pipe was located in the area of the highest fecal indicator counts. A steady flow of sewage was observed and sampled. The sample was partially diluted with bay water and had a five day biochemical oxygen demand of 69 mg/l and a total suspended solids of 75 mg/l.

Figure 3 shows coliform and coliphage titers sampled 100 ft north of the discharge point over a 17 day period following repair of the sewage plant. At day 0 the effluent was first chlorinated. On day 7 it was diverted from the bay into a deep well.

Figure 3. Log coliform (□) and log coliphage (+) in water samples from Bell Channel Bay, Bahamas over 17 days after chlorination of effluent.



LOG TITER/100 ML
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
2
4
6
8
10
12
14
16
DAYS AFTER CHLORINATION


Figure 3.

Biscayne Bay

Table 1 shows results of coliphage analyses over the nine month period for the Little River. Coliphage levels in Little River water samples increased significantly ($p = <0.05$) in the downstream direction. This trend is shown in Figures 4 and 5 for the north and south branches of the Little River respectively. A typical monthly pattern had low coliphage upstream and two high peaks of virus downstream. Little River sediments downstream of station 4 showed evidence of relatively heavy fecal contamination in August which diminished in September and was undetectable thereafter. Phage was detectable in upstream sediments (LR2 - 4) for longer periods, with a trend of increased persistence with distance upstream. All Little River sediments were negative for coliphage after March.

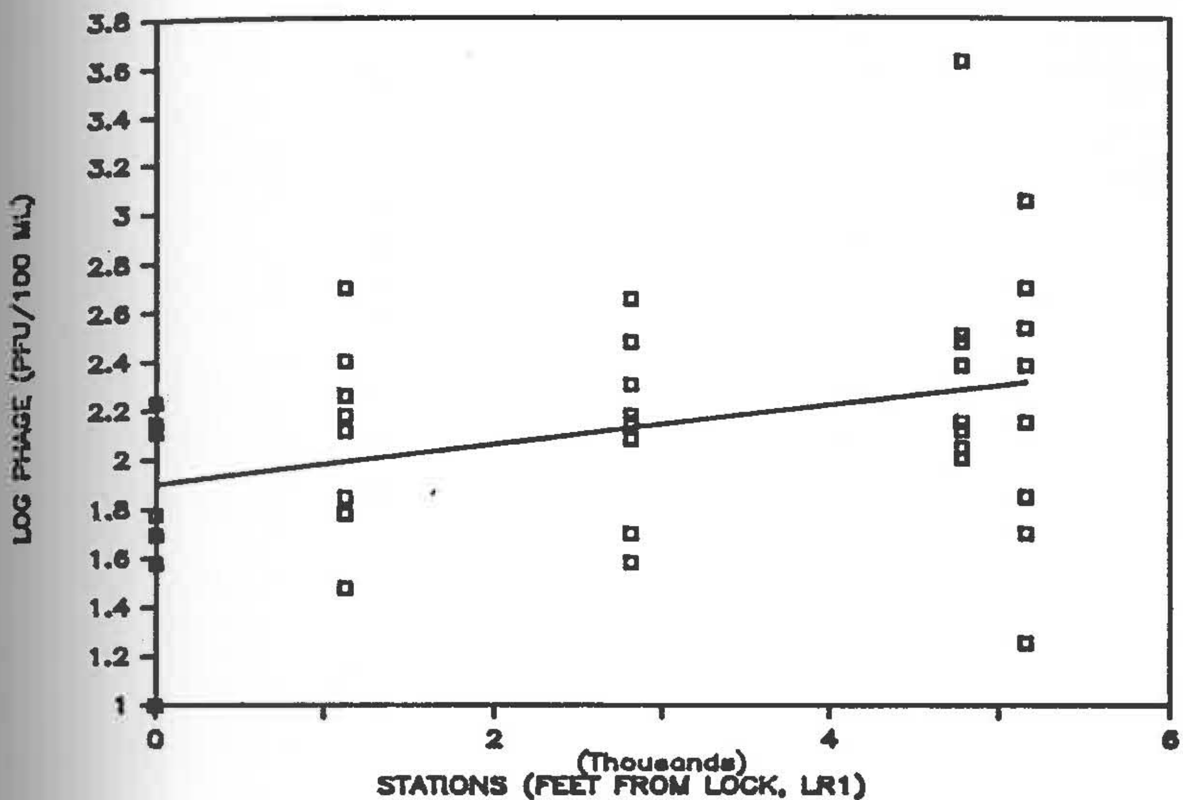
Biscayne Canal water samples were usually negative for coliphage, except for periodic pulses which occurred intermittently along the canal (Table 2). The sediment samples were all negative for coliphage except for three positive samples in January. Figure 6 shows the results of the short interval monitoring a sewage spill in the Biscayne Canal. Figure 7 illustrates the inverse relation of coliphage and salinity in this study.

Dinner Key results are shown in Table 3. Coliphage in water samples varied throughout the marina and sediment levels were relatively low compared to the Little River stations. Two-way analysis of variance showed no significant difference between stations; however, there

TABLE 1. MONTHLY COLIPHAGE RESULTS FOR THE LITTLE RIVER

| MONTH | LR1 | LR2 | LR3 | LR4 | LR5 | LR6 | LR7 | LR8 | LR9 |
|---|---|---|---|---|---|---|---|---|---|
| WATER | | | | | | | | | |
| Aug | | 60 | 50 | 140 | 1190 | 245 | 340 | 1410 | 255 |
| Sept | 10 | 30 | 38 | 100 | 800 | 245 | 18 | 1000 | 100 |
| Oct | 60 | 150 | 140 | 300 | 700 | 400 | 140 | 200 | 300 |
| Dec | 170 | 180 | 300 | 240 | 440 | 20 | 240 | 460 | 160 |
| Jan | 38 | 250 | 200 | 320 | 380 | 700 | 500 | 800 | 0 |
| Feb | 50 | 180 | 120 | 110 | 170 | 30 | 70 | 80 | 10 |
| March | 50 | 70 | 150 | 130 | 240 | 10 | 70 | 160 | 0 |
| April | 130 | 130 | 140 | 240 | 650 | 1110 | 1130 | 870 | 80 |
| May | 140 | 500 | 450 | 4200 | 1220 | 60 | 50 | 170 | 560 |
| SEDIMENTS | | | | | | | | | |
| Aug | | 60 | 1000 | 400 | 2000 | 120 | 360 | 960 | 2400 |
| Sept | | 20 | 480 | 20 | 1200 | 80 | 190 | 200 | 50 |
| Oct | | 20 | 20 | 240 | 0 | 0 | 0 | 0 | 0 |
| Dec | | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jan | | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Feb | | 140 | 10 | 0 | 0 | 0 | 0 | 0 | 0 |
| March | | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| April | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| May | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

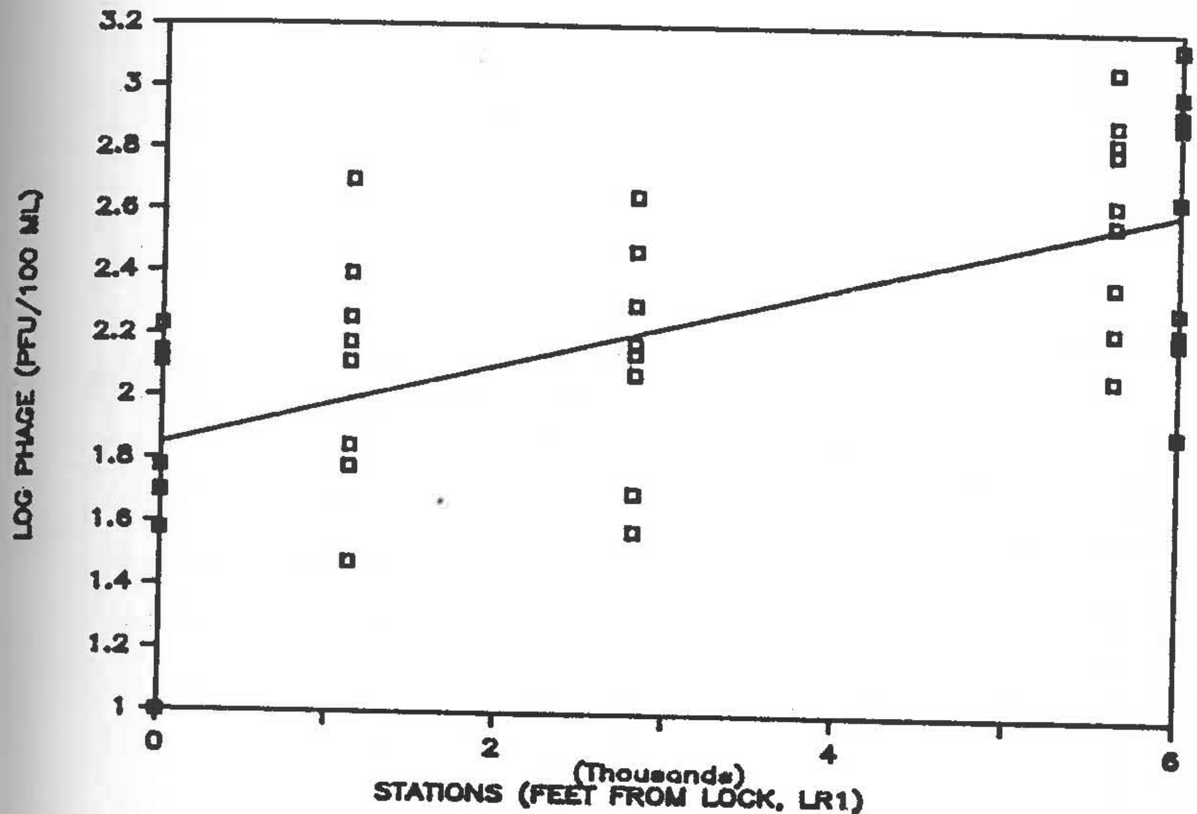
Figure 4. Relationship of coliphage pfu per 100 ml to distance in the north branch (Stations 1-4, 7) of the Little River ($r = 0.34$, $p = 0.05$, $n = 44$).



3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
LOG PHAGE (PFU/100 ML)
0
2
4
6
(Thousands)
STATIONS (FEET FROM LOCK, LR1)


Figure 4.

Figure 5. Relationship of coliphage pfu per 100 ml to distance in the south branch (Stations 1-3, 5 and 8) of the Little River ($r =$ , $p = 0.05$, $n = 44$).



3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
LOG PHAGE (PFU/100 ML)
0
2
4
6
(Thousands)
STATIONS (FEET FROM LOCK, LR1)


Figure 5.

Table 2. Monthly coliphage (pfu) and salinity (ppt) for four stations (BC1-4) in Biscayne Canal and in adjacent Biscayne Bay (BC5-6).

STATION

| WATER | BC1 | | BC2 | | BC3 | | BC4 | | BC5 | | BC6 | | BC7 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PFU | SAL | PFU | SAL | PFU | SAL | PFU | SAL | PFU | SAL | PFU | SAL | PFU | SAL |
| Aug | 10 | 24.9 | 0 | 24.9 | 0 | 23.9 | 0 | 25.4 | 15 | 28.8 | 0 | 28.8 | 45 | 27.8 |
| Sept | 10 | 0 | 0 | 19.5 | 0 | 19.9 | 0 | 20.1 | 0 | 22.7 | 0 | 22.6 | 0 | 23.4 |
| Oct | 65 | 0 | 70 | 1.2 | 0 | 2.1 | 20 | 4.7 | 0 | 24.4 | 10 | 12.6 | 20 | 21.9 |
| Dec | 150 | 0.1 | 80 | 11.2 | 120 | 10.6 | 60 | 23.1 | 5 | 29.5 | 0 | 29.1 | 0 | 29.2 |
| Jan | 50 | 0 | 10 | 0 | 60 | 1.3 | 80 | 3.8 | 300 | 27.6 | 200 | 29.2 | 60 | 26.2 |
| Feb | 0 | 0 | 0 | 24.5 | 0 | 24.5 | 0 | 25.6 | 0 | 29.3 | 0 | 27.3 | 0 | 10.9 |
| March | 120 | 0 | 140 | 0.8 | 240 | 2.3 | 160 | 4.9 | 40 | 32.3 | 80 | 11.3 | 60 | 31.6 |
| April | 20 | 0 | 10 | 3.7 | 20 | 3.7 | 60 | 18.4 | 30 | 23.3 | 60 | 25.2 | 130 | 29.0 |
| May | 40 | 0 | 150 | 6.3 | 130 | 5.1 | 140 | 10.1 | 100 | 9.3 | 70 | 24.5 | 170 | 20.6 |

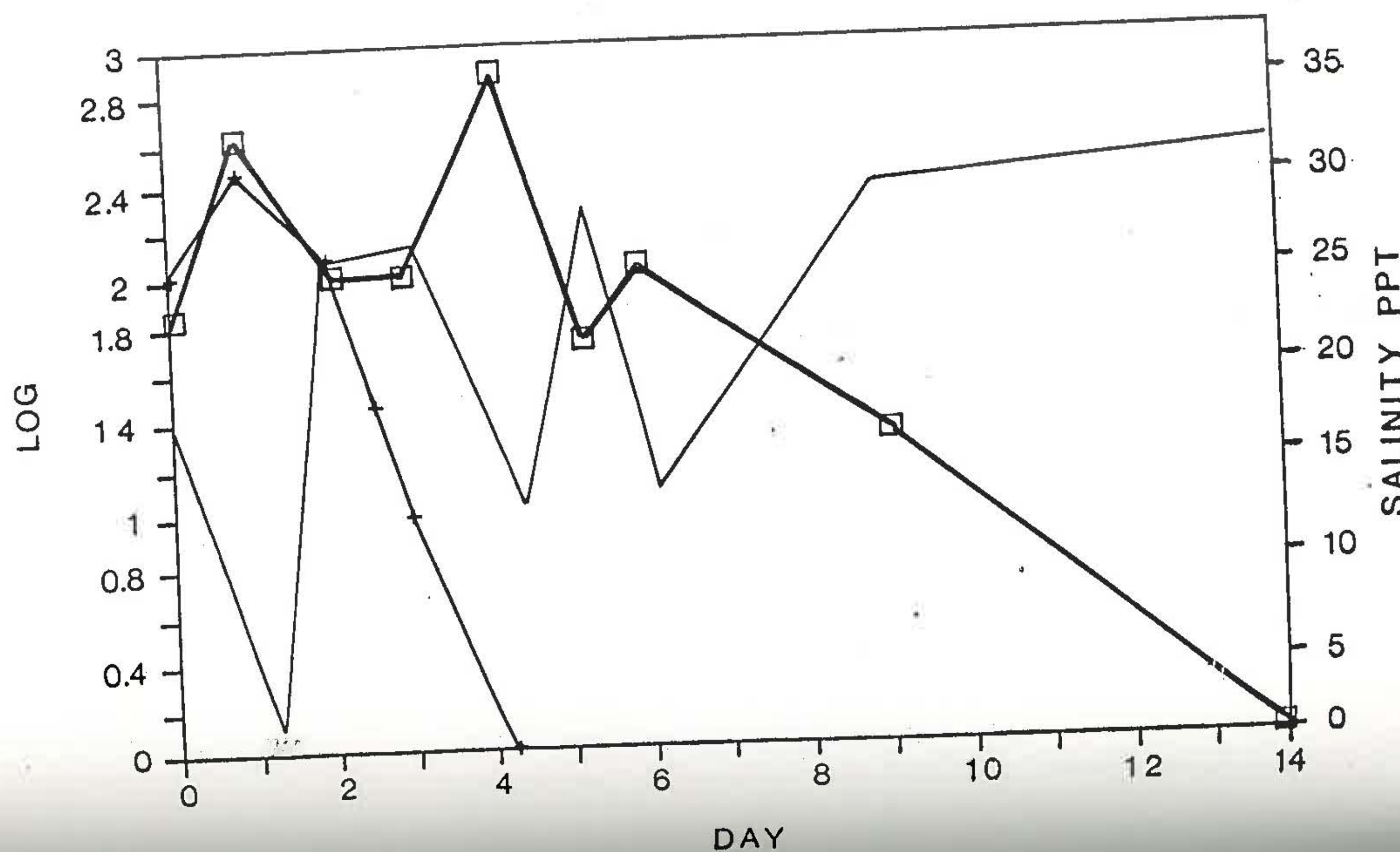
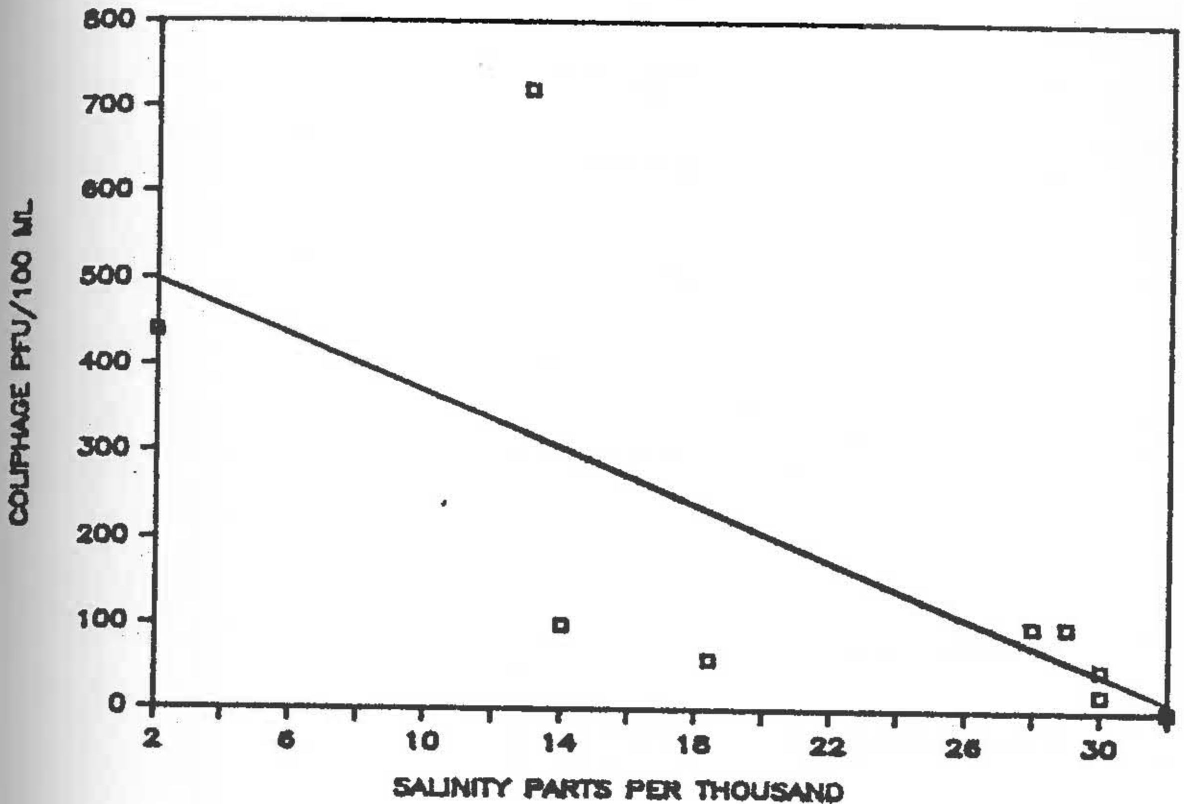

LOG
3
2.8
2.4
2
1.8
1.4
1
0.8
0.4
0
SALINITY PPT
35
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
DAY

Figure 6. Results of coliform (+), coliphage (□), and salinity (◆) for a raw sewage spill in the Biscayne Canal measured at station BC4.

Figure 7. Correlation of salinity to coliphage for a raw sewage spill in Biscayne Canal (Spearmans rank correlation coefficient = 0.896, $p < 0.01$).



800
700
600
500
400
300
200
100
0
COLIPHAGE PFU/100 ML
2
6
10
14
18
22
26
30
SALINITY PARTS PER THOUSAND


Figure 7.

TABLE 3. MONTHLY COLIPHAGE RESULTS FOR DINNER KEY

| MONTH | DK2 | DK3 | DK4 | DK5 | DK6 | DK7 | DK8 | DK9 | DK10 | DK11 | DK12 | DK13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **WATER** | | | | | | | | | | | | |
| Aug | 0 | 0 | 0 | 10 | 0 | 20 | 10 | 0 | 0 | 40 | 0 | 0 |
| Sept | 0 | 0 | 0 | 0 | 0 | 10 | 5 | 0 | 10 | 0 | 0 | 0 |
| Oct | 600 | 0 | 0 | 140 | 60 | 0 | 0 | 20 | 20 | 0 | 100 | 160 |
| Dec | 160 | 0 | 0 | 20 | 80 | 20 | 40 | 20 | 30 | 20 | 0 | 0 |
| Jan | 0 | 0 | 0 | 0 | 0 | 10 | 5 | 0 | 10 | 0 | 0 | 0 |
| Feb | 50 | 50 | 70 | 70 | 20 | 30 | 30 | 30 | 30 | 40 | 0 | 0 |
| March | 20 | 0 | 40 | 0 | 10 | 0 | 0 | 20 | 0 | 0 | 0 | 0 |
| April | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 20 | 10 | 80 |
| May | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 20 | 10 | 0 |
| **SEDIMENTS** | | | | | | | | | | | | |
| Aug | 40 | 0 | 0 | 0 | 0 | 0 | 60 | 20 | 0 | 0 | 20 | 0 |
| Sept | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 |
| Oct | 20 | 0 | 0 | 0 | 10 | 0 | 0 | 10 | 0 | 0 | 0 | 0 |
| Dec | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 0 | 0 |
| Jan | 40 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Feb | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| March | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| April | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| May | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

were significant differences between months ($p < 0.005$). Maximum fecal contamination occurred in October, December and February; however, the levels were relatively low and the distribution of contaminated stations throughout the marina showed no consistent pattern. King's Bay sediments and water samples yielded the lowest indicator results (not shown) of all except the control station. Coliphage were only detected six times and all less than 20 pfu (100 ml)$^{-1}$. Control Bay station number 43 tested negative for all indicators in water and sediment samples over the entire period.

## DISCUSSION

### Bell Channel Bay

It was determined that the discharge pipe was an emergency overflow in the event of a blockage of the deep well. Apparently the well had been clogged for some time and increasing amounts of effluent from the treatment plant had been discharging into the bay. No real treatment of the sewage had been accomplished due to complete breakdown of the air blowers and solids return system in the plant.

This situation had probably existed for at least one year and resulted in widespread contamination of the entire bay area. Bacterial (100,000 cfu per 100 ml) and viral (16,000 pfu per 100 ml) levels adjacent to the discharge pipe exceeded acceptable levels by as much as one hundred fold. Two months later, the treatment plant was taken over from the private owners by the Grand Bahama Development Company and quickly renovated to facilitate effective treatment. The effluent was chlorinated to decrease the health risk to divers repairing the overflow pipe (Day 0, Fig. 3). Chlorination (at least 1 part per million residual) appears to have reduced total coliform and phage titers by 25 and 46% respectively within seven days. Coliphage were still detectable in sediments at the discharge point (120 pfu per 100 g) and in the outer bay (20 pfu per 100 g). On day 7, all effluent was diverted from the Bay to the redeveloped deep well (Fig. 3). Ten days later total coliforms were undetectable in water or sediment samples; however, coliphage were still easily measurable. Coliphage declined exponentially after chlorination commenced, probably due to tidal dilution. Extrapolation of this significant ($p < 0.05$) trend indicates that the phage detection threshold of 5 pfu per 100 ml would have been reached on approximately the 30th day after chlorination. Using a $T_{90}$ rate of 33 hrs for coliform die-off (Lessard and Sieburth 1985) suggests that coliform titers would have reached their detection threshold (1 cfu/100 ml) within about 4 days after cessation of discharge. This may have occurred more rapidly due to the chlorination; therefore, coliphage may have persisted in these waters for at least 19 days longer than total coliforms. This means that phage would have been detectable almost five times longer than coliforms after the discharge was diverted. This is indicative of the potential survival of enteric viral pathogens well after coliform standards have been met, even in the case of well chlorinated effluents (Havelaar and Hogeboom 1983).

It appears that the level of fecal contamination in Bell Channel Bay rapidly depurated within about three weeks after upgrading of the sewer plant and the cessation of effluent discharge into the bay (Fig 3).

Biscayne Bay

The significant positive downstream correlations of coliphage with distance along the Little River for the northern branch (Fig. 4) and the southern branch (Fig. 5) suggest that fecal contamination accumulated in the downstream direction and was not originating upstream of the salinity control lock. This suggests that the Little River was primarily impacted by non-point source pollution along its length, especially between LR3 and LR5 in the south fork. This section of the river passes through a sewered residential area with a history of sewage leaks and is downstream from an area of liveaboard boats (Fig. 2). Table 4 shows elevated modes, medians, and ranges at the stations adjacent to or downstream from the liveaboards. The Little River clearly receives a greater sewage load than the Biscayne Canal, since sediment indicator levels are much higher in the river (Table 1), especially in the late summer.

Figure 8 shows seasonal plots for Little River stations 2 and 3 which showed a clear winter maximum with

TABLE 4. STATISTICAL DATA COLIPHAGE ANALYSIS

| STATION | NO. | RANGE | MEDIAN | MODE |
|---|---|---|---|---|
| BISCAYNE CANAL | | | | |
| BC1 | 8 | 0-150 | 40 | 10 |
| BC2 | 6 | 0-150 | 10 | 0 |
| BC3 | 5 | 0-240 | 20 | 0 |
| BC4 | 6 | 0-160 | 60 | 0 |
| BC5 | 6 | 0-300 | 15 | 0 |
| BC6 | 5 | 0-200 | 10 | 0 |
| BC7 | 6 | 0-170 | 45 | 0 |
| LITTLE RIVER | | | | |
| LR1 | 9 | 10-170 | 50 | 50 |
| LR2 | 9 | 30-500 | 150 | 180 |
| LR3 | 9 | 38-450 | 140 | 140 |
| LR4 | 9 | 100-4200 | 240 | 240 |
| LR5 | 9 | 170-1220 | 440 | 675 |
| LR6 | 9 | 10-1110 | 245 | 245 |
| LR7 | 9 | 18-1130 | 140 | 70 |
| LR8 | 9 | 80-1410 | 460 | 165 |
| LR9 | 7 | 0-560 | 100 | 0 |

NO. - NUMBER OF MONTHS COLIPHAGE PRESENT PER STATION
RANGE - MINIMUM AND MAXIMUM VALUES PER STATION

the exception of the May sample. This may directly relate to the tourist season and the increased winter use of the surrounding commercial housing and marina facilities. Figure 9 shows the seasonal plots for the two mouths of the Little River. Again excluding the very high May results, phage titers in the northern mouth (LR4) also show a similar pattern with a January maximum. However these results were dwarfed by phage titers observed in the southern mouth of the canal (LR5) which showed the opposite pattern with a similar decreasing trend from August to February and an increase thereafter. A possible explanation may be the presence during winter of larger yachts with holding tanks instead of smaller local boats during the off-season. This could also be due to lower flushing rates in the south branch. Since phage titers were consistently higher at LR5 than at LR3, which is directly adjacent to the liveaboard area, at least two other possibilities may exist. Sampling was routinely done between 9:00 and 10:30 AM and may have picked up an early morning introduction of human waste which was released near LR3 and has drifted to the mouth at LR5. If this were the case one would expect the values at LR4 to be similar to LR5, which they are not. It is more likely that there is an additional source of contamination between LR3 and LR5 which has not been observed. The large phage peak observed in May was detected upstream (Fig. 8) as well as near the mouths of both branches and was probably the result of a

Figure 8. Seasonal plots of coliphage (pfu/ 100 ml) for Little River stations 2 and 3.

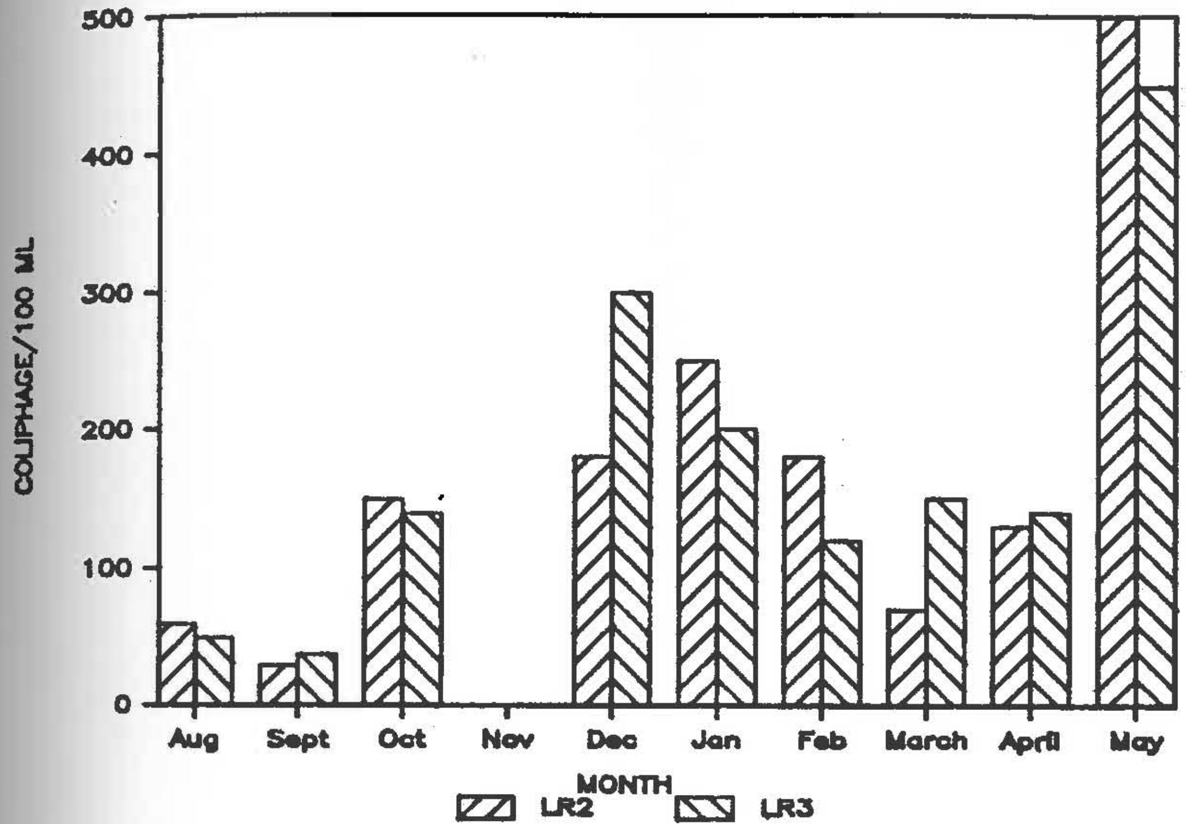
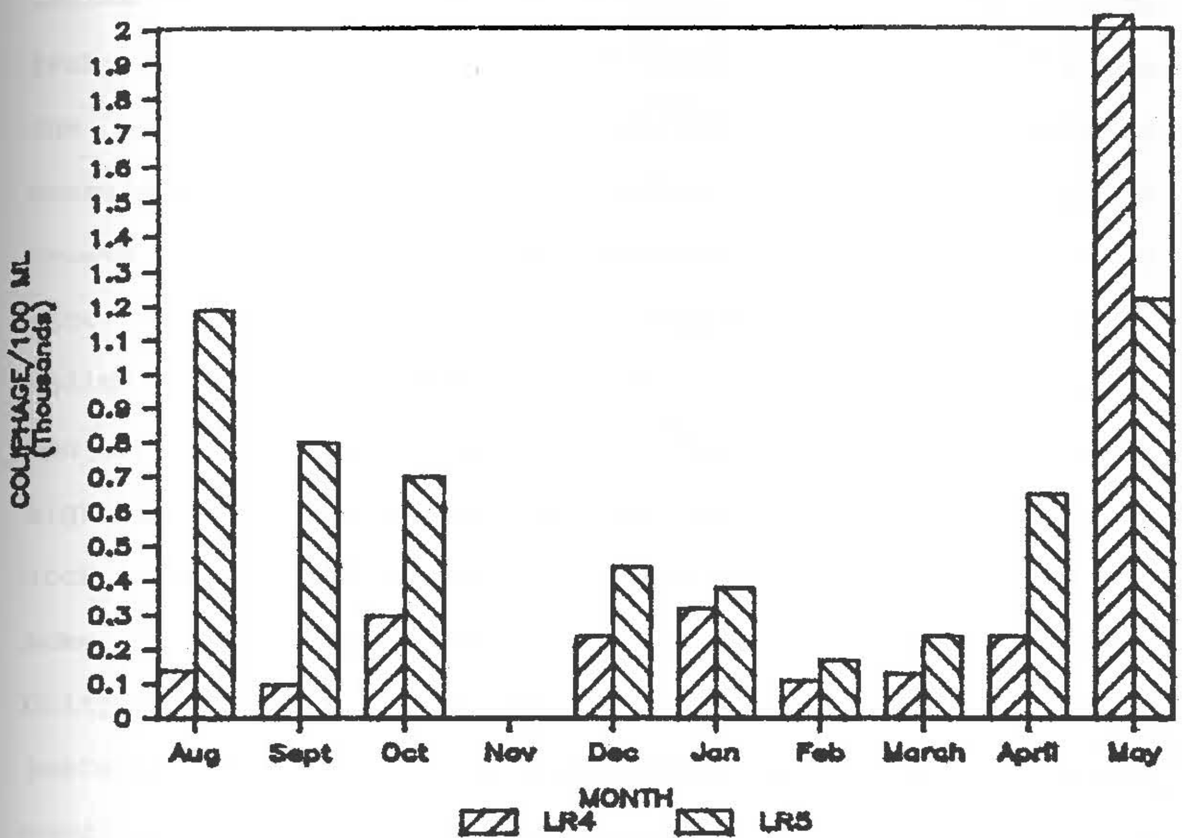

500
400
300
200
100
0
COLIPHAGE/100 ML
Aug
Sept
Oct
Nov
Dec
Jan
Feb
March
April
May
MONTH
LR2
LR3

Figure 8.

Figure 9. Seasonal plots of coliphage (pfu/100 ml) for Little River stations 4 and 5.



COLIPHAGE/100 ML
(Thousands)
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Aug
Sept
Oct
Nov
Dec
Jan
Feb
March
April
May
MONTH
LR4
LR5


Figure 9.

large upstream sewage spill or leak.

The Biscayne Canal stations were less impacted by sewage contamination than were those of the Little River. Contamination in the Biscayne Canal appeared to be coming from the upstream areas rather than from activities along the canal. This can be seen in Fig. 10 by the inverse correlation of salinity to coliphage (Fig. 10). Coliphage counts at the low salinity (upstream) locations were much more variable and often much higher than at the higher salinity stations nearer the bay. In three of the nine months (Aug., Sept., and Feb.; Table 1) salinities were high and uniform in the Biscayne Canal stations below the lock. This indicates that the lock had remained closed for some time and the lower canal had become tidally mixed. Coliphage counts were low or zero in all three of these instances. Figure 11 is representative of this well mixed condition. In the other six months (Table 2) salinities increased in the downstream direction, indicating a net flow of freshwater from the canal to the bay. Coliphage peaks occurred at various positions along the canal during these samplings. This condition is illustrated in Fig. 12. Two-way ANOVA showed no significant differences between months or stations on these dates. This additionally implicates the contamination of the canal by upstream freshwater sources. Table 4 shows the modes to be zero and the medians in the low range of 10 - 60 pfu $(100\ ml)^{-1}$. Range data demonstrates that high peaks do occur through-

Figure 10. Correlation of coliphage (pfu/100 ml) to salinity (ppt) in Biscayne Canal stations 2-4 ($r = 0.52$, $p < 0.003$, $n = 27$).

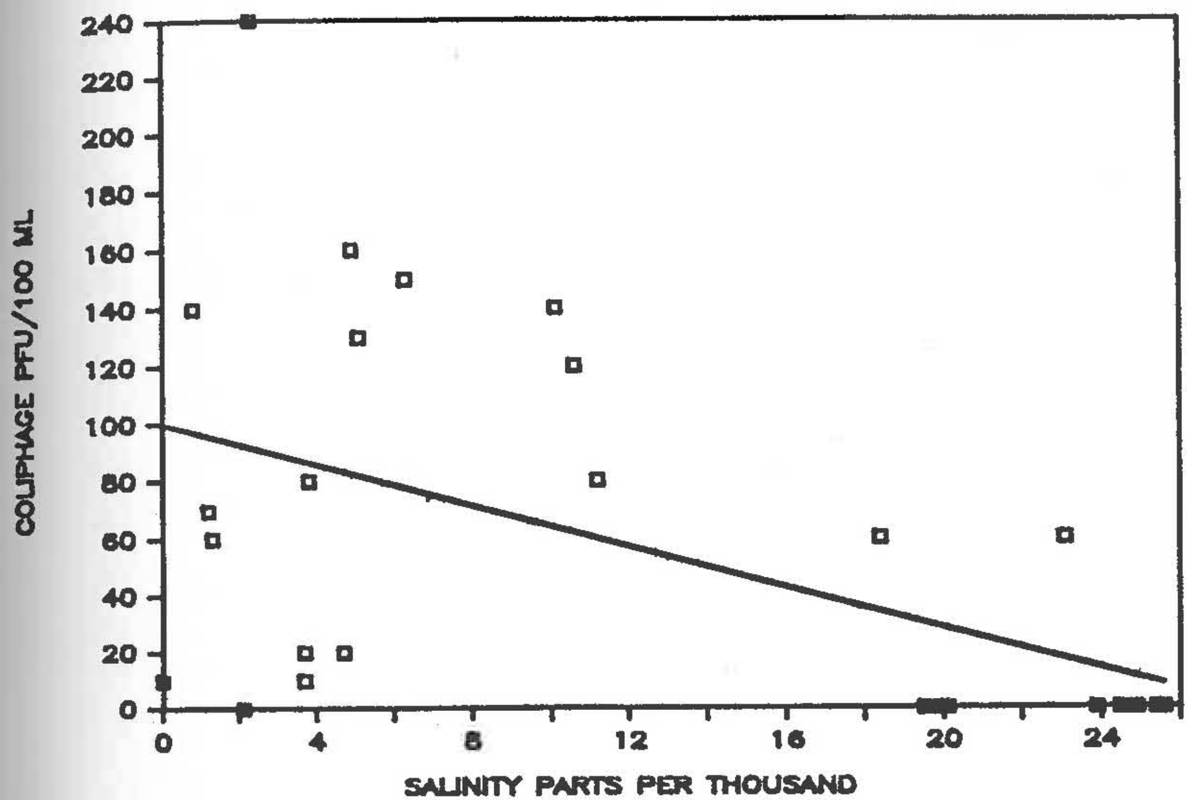

COLIPHAGE PFU/100 ML
240
220
200
180
160
140
120
100
80
60
40
20
0
0
4
8
12
16
20
24
SALINITY PARTS PER THOUSAND

Figure 10.

Figure 11. Coliphage (□) pfu per 100 ml and salinity (+) ppt times ten in Biscayne Canal stations 1 through 6 in February.

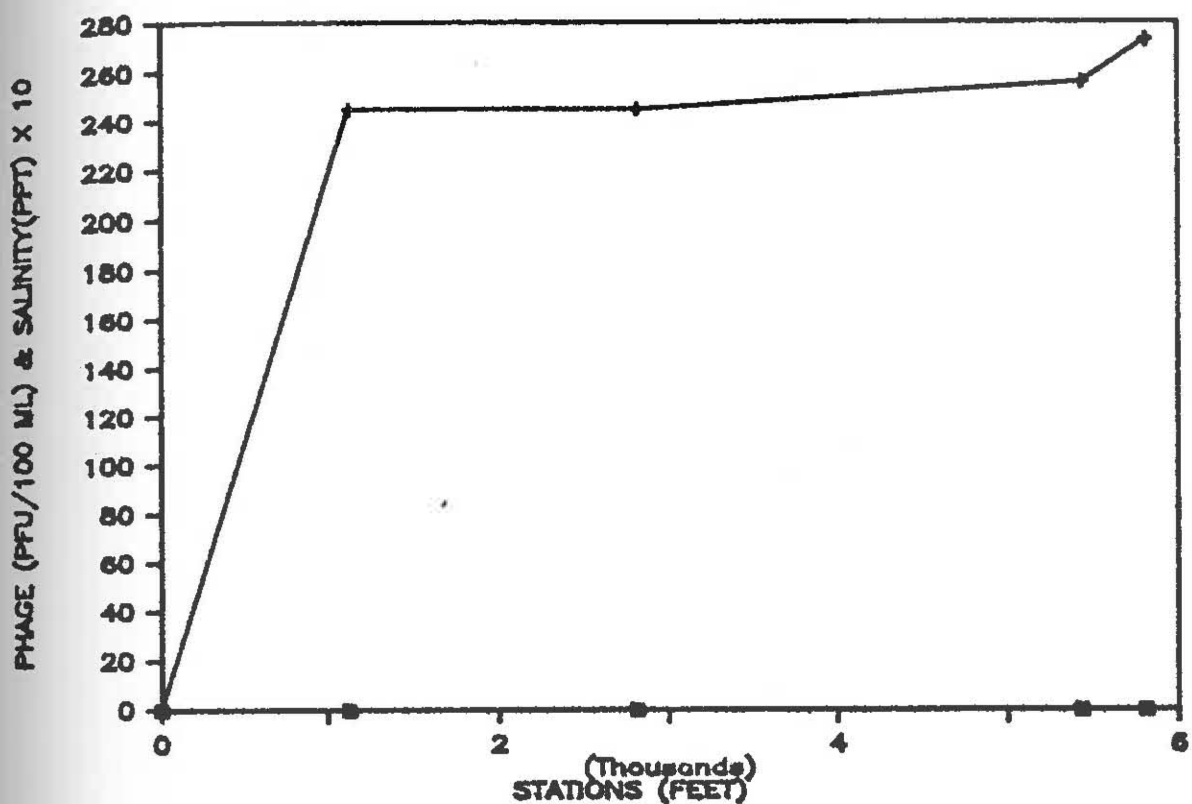

280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
PHAGE (PFU/100 ML) & SALINITY(PPT) X 10
0
2
4
6
(Thousands)
STATIONS (FEET)

Figure 11.

Figure 12. Coliphage (□) pfu/100 ml and salinity (+) ppt times ten in Biscayne Canal stations 1 through 6 in March.

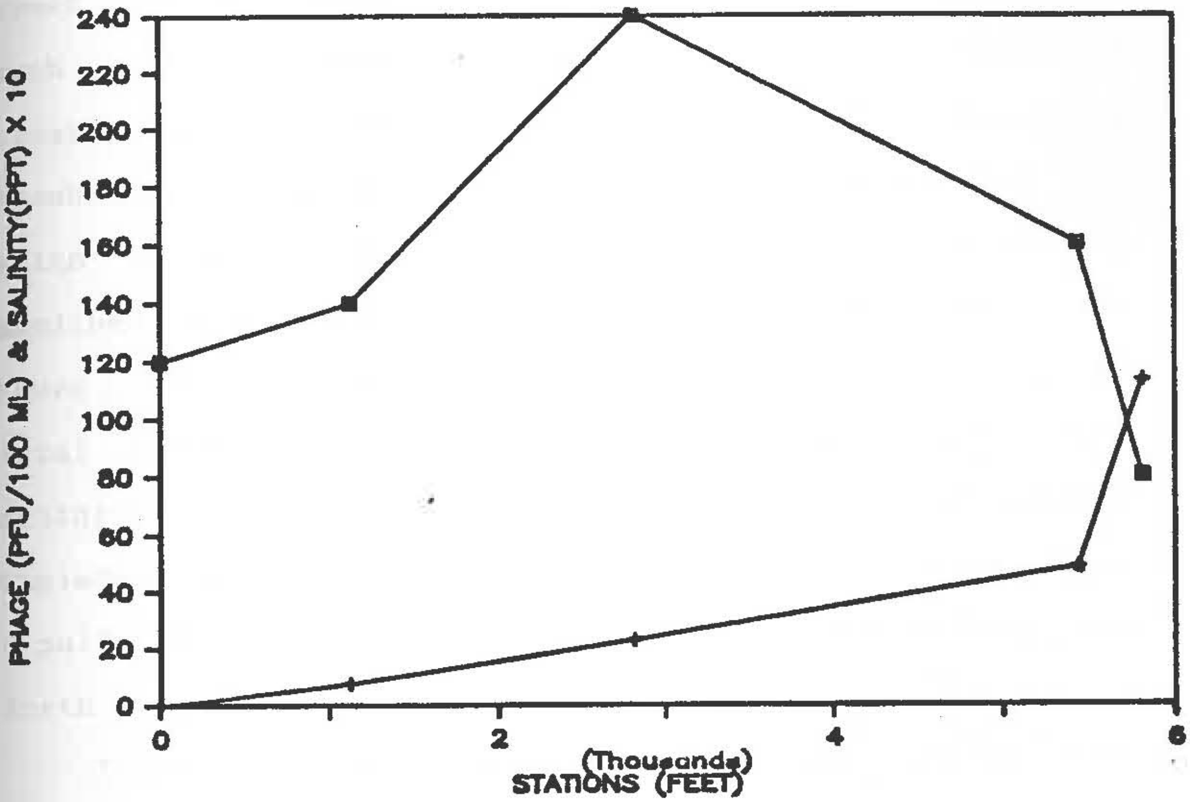

PHAGE (PFU/100 ML) & SALINITY(PPT) X 10
240
220
200
180
160
140
120
100
80
60
40
20
0
0
2
4
6
(Thousands)
STATIONS (FEET)

Figure 12.

out the canal. There have been several reported raw sewage spills upstream from the Biscayne Canal stations due to sewer force main breaks and lift station malfunctions. One such spill monitored over a period of 14 days (Figure 6) clearly showed the relation of higher phage with relatively fresher water masses. Samples were taken at station BC4 which is at the mouth of the Canal. Coliform counts declined after 24 hours and were not detectable after 102 hours. Coliphage persisted over three times as long as total coliforms. Variation in coliphage counts with salinity was significant (Figure 7), but not simply explained by tidal variation. It was more likely caused by a polluted mass (or masses) of fresh water moving back and forth in the canal.

Indicator levels in water and sediment samples from Dinner Key marina (Table 3) varied over the nine month period. Coliform and coliphage were ubiquitous throughout the water stations which indicates the widespread contamination of the marina, however the levels seldom exceeded maximum contaminant levels. The low indicator levels in the sediment indicate that the marina area has sufficient flushing capacity to withstand the impact of the liveaboards. Phage titers were highest in the water during October, December and February which may reflect higher use of the marinas during the winter tourist season. Higher titers in the sediments during August and September may indicate a build-up due to warmer and calmer weather conditions.

King's Bay showed very little impact of sewage contamination. The marina is isolated in an area without liveaboards and with relatively low density housing. There was no evidence of fecal contamination from residential septic systems.

In both study areas coliphage proved to be an effective indicator of marine pollution. It enabled the detection and monitoring of a sewage spill in a large body of saltwater and also was sensitive enough to differentiate between different possible sources and origins of fecal contamination in waters of varying salinities.

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# APPENDIX I

## BISCAYNE BAY RAW DATA PHASE I

BISCAYNE BAY INDICATOR STUDY 1 MAY 5-7th, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE |
|---|---|---|---|---|---|
| 1 | 24 | 0 | 0 | 0 | 15 |
| 2 | 20 | 0 | 0 | 0 | 280 |
| 3 | 10 | 3 | 5 | 0 | 1650 |
| 4 | 0 | 0 | 1 | 0 | 10000 |
| 5 | 200 | 20 | 0 | 0 | 3560 |
| 6 | 12 | 2 | 0 | 0 | 4620 |
| 7 | 200 | 20 | 1 | 0 | 305 |
| 8 | 60 | 0 | 2 | 0 | 25 |
| 9 | 20 | 0 | 1 | 0 | 0 |
| 10 | 0 | 0 | 4 | 0 | 0 |
| 11 | 20 | 4 | 1 | 0 | 35 |
| 12 | 50 | 16 | 2 | 0 | 0 |
| 13 | 80 | 0 | 1 | 0 | 30 |
| 14 | 100 | 100 | 18 | 0 | 290 |
| 15 | 100 | 60 | 15 | 0 | 215 |
| 16 | 200 | 200 | 13 | 0 | 5 |
| 17 | 10 | 0 | 0 | 0 | 55 |
| 18 | 0 | 0 | 0 | 0 | 90 |
| 19 | 40 | 10 | 2 | 0 | 95 |
| 20 | 100 | 38 | 21 | 0 | 810 |
| 21 | 200 | 40 | 22 | 1 | 210 |
| 22 | 350 | 20 | 1 | 0 | 35 |
| 23 | 0 | 0 | 0 | 0 | 0 |
| 24 | 150 | 0 | 4 | 0 | 110 |
| 25 | 1000 | 800 | 14 | 0 | 100 |
| 26 | 1000 | 600 | 5 | 0 | 100 |
| 27 | 7000 | 2300 | 18 | 1 | 800 |
| 28 | 10000 | 8000 | 30 | 1 | 700 |
| 29 | 10000 | 7500 | 18 | 3 | 800 |
| 30 | 18000 | 10000 | 12 | 2 | 1600 |
| 31 | 1800 | 750 | 8 | 0 | 200 |
| 32 | 30 | 0 | 9 | 0 | 540 |
| 34 | 0 | 0 | 0 | 0 | 100 |
| 35 | 0 | 0 | 0 | 0 | 210 |
| 36 | 0 | 0 | 1 | 0 | 20 |
| 37 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 0 | 4 | 0 | 5 |
| 39 | 10 | 0 | 2 | 1 | 20 |
| 41 | 200 | 0 | 5 | 0 | 30 |
| 42 | 0 | 0 | 2 | 0 | 5 |
| 43 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 0 | 0 | 0 | 0 |
| 45 | 0 | 0 | 12 | 0 | 85 |
| 46 | 0 | 0 | 0 | 0 | 0 |
| 47 | 100 | 0 | 0 | 0 | 100 |
| 48 | 0 | 0 | 0 | 0 | 5 |
| 49 | 400 | 10 | 14 | 0 | 3350 |
| 50 | 0 | 0 | 0 | 0 | 0 |
| 51 | 0 | 0 | 5 | 0 | 0 |
| 53 | 0 | 0 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 0 | 0 |
| 56 | 10 | 7 | 1 | 0 | 20 |
| 57 | 0 | 0 | 0 | 0 | 5 |
| 58 | 8 | 0 | 0 | 0 | 5 |

BISCAYNE BAY INDICATOR STUDY 2 MAY 20-22, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL. |
|---|---|---|---|---|---|---|
| 1 | 10 | 3 | 0 | 0 | 40 | 29.34 |
| 2 | 15 | 2 | 0 | 0 | 60 | 29.21 |
| 3 | 10 | 10 | 2 | 0 | 100 | 18.09 |
| 4 | 0 | 0 | 14 | 0 | 10000 | 28.10 |
| 5 | 90 | 0 | 1 | 0 | 20 | 32.86 |
| 6 | 15 | 1 | 0 | 0 | 20 | 30.15 |
| 7 | 90 | 1 | 6 | 0 | 40 | 30.98 |
| 8 | 0 | 0 | 0 | 0 | 30 | 30.56 |
| 9 | 0 | 20 | 12 | 0 | 55 | 22.16 |
| 10 | 0 | 0 | 10 | 0 | 70 | 25.60 |
| 11 | 5 | 4 | 1 | 0 | 15 | 27.89 |
| 12 | 0 | 0 | 8 | 0 | 0 | 30.29 |
| 13 | 40 | 20 | 0 | 1 | 0 | 32.02 |
| 14 | 250 | 250 | 28 | 6 | 545 | 18.39 |
| 15 | 80 | 40 | 8 | 4 | 90 | 29.95 |
| 16 | 120 | 10 | 0 | 0 | 5 | 31.60 |
| 17 | 0 | 0 | 0 | 0 | 5 | 31.74 |
| 18 | 0 | 2 | 9 | 0 | 25 | 31.95 |
| 19 | 50 | 20 | 0 | 0 | 60 | 33.15 |
| 20 | 50 | 20 | 0 | 0 | 400 | 32.38 |
| 21 | 50 | 10 | 18 | 0 | 200 | 32.50 |
| 22 | 0 | 0 | 0 | 0 | 0 | 31.88 |
| 23 | 10 | 5 | 0 | 0 | 40 | 32.58 |
| 24 | 170 | 40 | 0 | 0 | 250 | 32.09 |
| 25 | 2000 | 1800 | 5 | 27 | 220 | 5.22 |
| 26 | 1000 | 900 | 100 | 74 | 90 | 10.28 |
| 27 | 1500 | 1400 | 25 | 25 | 130 | 15.56 |
| 28 | 2200 | 1500 | 25 | 16 | 130 | 17.05 |
| 29 | 3500 | 2700 | 140 | 110 | 340 | 17.63 |
| 30 | 2200 | 2000 | 70 | 30 | 190 | 20.50 |
| 31 | 2000 | 2000 | 70 | 30 | 180 | 30.91 |
| 32 | 15 | 17 | 8 | 6 | 85 | 32.71 |
| 34 | 0 | 0 | 0 | 0 | 5 | 33.26 |
| 35 | 20 | 15 | 5 | 0 | 20 | 33.41 |
| 36 | 0 | 0 | 70 | 52 | 3360 | 32.29 |
| 37 | 12 | 0 | 0 | 1 | 65 | 33.84 |
| 38 | 0 | 0 | 2 | 3 | 5 | 31.80 |
| 39 | 0 | 0 | 10 | 10 | 5 | 30.03 |
| 41 | 0 | 0 | 30 | 20 | 20 | 29.74 |
| 42 | 10 | 0 | 41 | 36 | 130 | 27.80 |
| 43 | 2 | 0 | 0 | 0 | 0 | 32.37 |
| 44 | 0 | 0 | 20 | 18 | 20 | 32.58 |
| 45 | 10 | 8 | 20 | 15 | 85 | 27.33 |
| 46 | 20 | 2 | 50 | 48 | 180 | 10.07 |
| 47 | 0 | 0 | 0 | 0 | 65 | 29.99 |
| 48 | 0 | 0 | 0 | 0 | 5 | 35.28 |
| 49 | 30 | 12 | 0 | 0 | 220 | 19.64 |
| 50 | 0 | 0 | 0 | 0 | 0 | 35.37 |
| 51 | 0 | 0 | 0 | 0 | 0 | 29.85 |
| 53 | 0 | 0 | 0 | 0 | 10 | 29.78 |
| 54 | 0 | 0 | 0 | 0 | 20 | 35.59 |
| 56 | 15 | 9 | 1 | 5 | 45 | 32.44 |
| 57 | 2 | 0 | 0 | 0 | 5 | 31.74 |
| 58 | 8 | 0 | 0 | 0 | 0 | 33.26 |

BISCAYNE BAY INDICATOR STUDY 3 JUNE 10-12th, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE |
|---|---|---|---|---|---|
| 1 | 150 | 10 | 0 | 0 | 3600 |
| 2 | 110 | 90 | 0 | 0 | 3960 |
| 3 | 70 | 15 | 2 | 0 | 475 |
| 4 | 180 | 70 | 4 | 0 | 24320 |
| 5 | 150 | 10 | 0 | 0 | 4200 |
| 6 | 50 | 0 | 0 | 0 | 1500 |
| 7 | 90 | 20 | 14 | 0 | 4400 |
| 8 | 40 | 0 | 0 | 0 | 385 |
| 9 | 0 | 0 | 6 | 3 | 50 |
| 10 | 0 | 0 | 0 | 0 | 10 |
| 11 | 10 | 0 | 0 | 0 | 25 |
| 12 | 0 | 0 | 10 | 4 | 40 |
| 13 | 10 | 0 | 0 | 0 | 10 |
| 14 | 100 | 40 | 16 | 12 | 140 |
| 15 | 0 | 0 | 14 | 0 | 150 |
| 16 | 0 | 0 | 0 | 0 | 0 |
| 17 | 0 | 0 | 0 | 0 | 0 |
| 18 | 0 | 0 | 0 | 0 | 0 |
| 19 | 100 | 30 | 8 | 2 | 1770 |
| 20 | 0 | 0 | 6 | 0 | 10 |
| 21 | 0 | 0 | 0 | 0 | 40 |
| 22 | 0 | 0 | 0 | 0 | 0 |
| 23 | 0 | 0 | 0 | 0 | 0 |
| 24 | 10 | 0 | 2 | 0 | 10 |
| 25 | 1000 | 400 | 18 | 6 | 100 |
| 26 | 2800 | 1200 | 8 | 8 | 200 |
| 27 | 1200 | 700 | 14 | 12 | 120 |
| 28 | 1500 | 500 | 51 | 40 | 160 |
| 29 | 3200 | 1100 | 20 | 10 | 140 |
| 30 | 3000 | 1400 | 36 | 12 | 220 |
| 31 | 3800 | 600 | 12 | 5 | 430 |
| 32 | 200 | 150 | 14 | 2 | 500 |
| 34 | 0 | 0 | 0 | 0 | 0 |
| 35 | 0 | 0 | 0 | 0 | 0 |
| 36 | 0 | 0 | 0 | 0 | 10 |
| 37 | 0 | 0 | 0 | 0 | 10 |
| 38 | 60 | 0 | 0 | 0 | 90 |
| 39 | 40 | 40 | 15 | 10 | 170 |
| 41 | 10 | 10 | 4 | 2 | 20 |
| 42 | 30 | 0 | 0 | 0 | 10 |
| 43 | 0 | 0 | 0 | 0 | 80 |
| 44 | 0 | 0 | 0 | 0 | 0 |
| 45 | 0 | 0 | 0 | 0 | 500 |
| 46 | 40 | 0 | 5 | 4 | 90 |
| 47 | 0 | 0 | 0 | 0 | 90 |
| 48 | 0 | 0 | 0 | 0 | 0 |
| 49 | 0 | 0 | 0 | 0 | 0 |
| 50 | 0 | 0 | 0 | 0 | 0 |
| 51 | 0 | 0 | 0 | 0 | 160 |
| 53 | 0 | 0 | 0 | 0 | 5 |
| 54 | 0 | 0 | 0 | 0 | 0 |
| 56 | 0 | 0 | 0 | 0 | 0 |
| 57 | 10 | 10 | 0 | 0 | 5 |
| 58 | 0 | 0 | 0 | 0 | 0 |

APPENDIX II

RAW DATA PHASE II

BISCAYNE CANAL AUGUST 27TH, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | AMMONIA | T-P | SAL |
|---|---|---|---|---|---|---|---|---|
| WATER | | | | | | | | |
| BC1 | 100 | 90 | 5 | 2 | 10 | 0.17 | 0.05 | 24.9 |
| BC2 | 0 | 0 | 0 | 0 | 0 | 0.12 | 0.04 | 24.9 |
| BC3 | 0 | 0 | 0 | 0 | 0 | 0.24 | 0.05 | 23.9 |
| BC4 | 0 | 0 | 0 | 0 | 0 | 0.18 | 0.03 | 25.4 |
| BC5 | 0 | 0 | 0 | 0 | 15 | 0.1 | 0.01 | 28.8 |
| BC6 | 0 | 0 | 0 | 0 | 0 | 0.09 | 0.39 | 28.8 |
| BC7 | 0 | 0 | 1 | 0 | 45 | 0.09 | 0.06 | 27.8 |
| SEDIMENTS | | | | | | | | |
| BC1 | 20000 | 10000 | 180 | 170 | 100 | | | |
| BC2 | 1500 | 0 | 0 | 0 | 0 | | | |
| BC3 | 100 | 0 | 0 | 0 | 0 | | | |
| BC4 | 0 | 0 | 0 | 0 | 0 | | | |
| BC5 | 0 | 0 | 0 | 0 | 0 | | | |
| BC6 | 0 | 0 | 0 | 0 | 0 | | | |
| BC7 | 400 | 0 | 0 | 0 | 0 | | | |

## LITTLE RIVER AUGUST 28TH, 1986

### WATER

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | AMMONIA | T-P | SAL |
|---|---|---|---|---|---|---|---|---|
| LR1 | 650 | 400 | 18 | 8 | 60 | 0.14 | 0.04 | 2.4 |
| LR2 | 500 | 300 | 30 | 12 | 50 | 0.11 | 0.08 | 5.1 |
| LR3 | 1500 | 1200 | 50 | 10 | 140 | 0.09 | 0.03 | 6.6 |
| LR4 | 500 | 370 | 34 | 20 | 1190 | 0.09 | 0.01 | 12.9 |
| LR5 | 300 | 200 | 12 | 8 | 245 | 0.07 | 0.01 | 28.5 |
| LR6 | 100 | 50 | 54 | 24 | 340 | 0.05 | 0.01 | 27.8 |
| LR7 | 300 | 200 | 38 | 28 | 1410 | 0.07 | 0.03 | 29.2 |
| LR8 | 200 | 100 | 16 | 4 | 255 | 0.05 | 0.01 | 27.4 |
| LR9 | | | | | | | | |

### SEDIMENTS

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE |
|---|---|---|---|---|---|
| LR1 | 15000 | 10000 | 300 | 240 | 60 |
| LR2 | 10000 | 0 | 5 | 1 | 1000 |
| LR3 | 7800 | 3400 | 0 | 0 | 400 |
| LR4 | 1000 | 0 | 0 | 1 | 2000 |
| LR5 | 2000 | 0 | 0 | 0 | 120 |
| LR6 | 400 | 0 | 0 | 0 | 360 |
| LR7 | 4000 | 2000 | 0 | 0 | 960 |
| LR8 | 2000 | 1200 | 0 | 0 | 2400 |
| LR9 | | | | | |

DINNER KEY AUGUST 29TH, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | AMMONIA | T-P | SAL |
|---|---|---|---|---|---|---|---|---|
| **WATER** | | | | | | | | |
| DK1 | | | | | | | | |
| DK2 | 0 | 0 | 0 | 0 | 0 | 0.17 | 0.03 | 33.2 |
| DK3 | 0 | 0 | 0 | 0 | 0 | 0.12 | 0.03 | 32.9 |
| DK4 | 50 | 0 | 0 | 0 | 0 | 0.07 | 0.01 | 32.9 |
| DK5 | 100 | 70 | 0 | 0 | 10 | 0.1 | 0.04 | 32.4 |
| DK6 | 0 | 0 | 0 | 0 | 0 | 0.11 | 0.03 | 32.2 |
| DK7 | 80 | 10 | 0 | 0 | 20 | 0.1 | 0.03 | 32 |
| DK8 | 100 | 70 | 0 | 0 | 10 | 0.12 | 0.02 | 31.7 |
| DK9 | 20 | 0 | 0 | 0 | 0 | 0.09 | 0.03 | 31.9 |
| DK10 | 50 | 0 | 0 | 0 | 0 | 0.1 | 0.08 | 32.2 |
| DK11 | 0 | 0 | 0 | 0 | 40 | 0.08 | 0.02 | 31.5 |
| DK12 | 50 | 0 | 0 | 0 | 0 | 0.08 | 0.01 | 31 |
| DK13 | 100 | 0 | 0 | 0 | 0 | 0.07 | 0.03 | 30.8 |
| **SEDIMENTS** | | | | | | | | |
| DK1 | | | | | | | | |
| DK2 | 91 | 0 | 0 | 0 | 40 | | | |
| DK3 | 12 | 0 | 0 | 0 | 0 | | | |
| DK4 | 13 | 0 | 0 | 0 | 0 | | | |
| DK5 | 37 | 0 | 0 | 0 | 0 | | | |
| DK6 | 32 | 0 | 0 | 0 | 0 | | | |
| DK7 | 22 | 0 | 0 | 0 | 0 | | | |
| DK8 | 7 | 0 | 10 | 0 | 60 | | | |
| DK9 | 8 | 13 | 0 | 0 | 20 | | | |
| DK10 | 3 | 0 | 0 | 0 | 0 | | | |
| DK11 | 8 | 0 | 0 | 0 | 0 | | | |
| DK12 | 2 | 0 | 0 | 0 | 20 | | | |
| DK13 | 6 | 0 | 0 | 0 | 0 | | | |

KING'S BAY AUGUST 28TH, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | AMMONIA | T-P | SAL |
|---|---|---|---|---|---|---|---|---|
| WATER | | | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 0 | 0.07 | 0.04 | 30.1 |
| KB2 | 0 | 0 | 0 | 0 | 0 | 0.04 | 0.02 | 29.7 |
| KB3 | 0 | 0 | 0 | 0 | 0 | 0.06 | 0.06 | 30.6 |
| KB4 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0.02 | 30.7 |
| KB5 | 0 | 0 | 0 | 0 | 0 | 0.04 | 0.02 | 30.1 |
| KB6 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0.02 | 29.9 |
| KB7 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0.02 | 30.5 |
| SEDIMENTS | | | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 0 | | | |
| KB2 | 20 | 0 | 0 | 0 | 0 | | | |
| KB3 | 0 | 0 | 0 | 0 | 0 | | | |
| KB4 | 0 | 0 | 0 | 0 | 0 | | | |
| KB5 | 0 | 0 | 0 | 0 | 0 | | | |
| KB6 | 0 | 0 | 0 | 0 | 0 | | | |
| KB7 | 0 | 0 | 0 | 0 | 0 | | | |

BISCAYNE CANAL SEPTEMBER 25TH, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| BC1 | 120 | 50 | 20 | 16 | 10 | 0 |
| BC2 | 0 | 0 | 0 | 0 | 0 | 19.5 |
| BC3 | 0 | 0 | 0 | 0 | 0 | 19.9 |
| BC4 | 0 | 0 | 35 | 30 | 0 | 20.1 |
| BC5 | 0 | 0 | 30 | 18 | 0 | 22.7 |
| BC6 | 10 | 0 | 0 | 0 | 0 | 22.6 |
| BC7 | 0 | 0 | 0 | 0 | 0 | 23.4 |
| SEDIMENTS | | | | | | |
| BC1 | | | | | | |
| BC2 | 0 | 0 | 0 | 0 | 0 | |
| BC3 | 100 | 0 | 0 | 0 | 0 | |
| BC4 | 0 | 0 | 0 | 0 | 0 | |
| BC5 | 300 | 0 | 0 | 0 | 0 | |
| BC6 | 0 | 0 | 0 | 0 | 0 | |
| BC7 | 0 | 0 | 0 | 0 | 0 | |

LITTLE RIVER SEPTEMBER 25TH, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| LR1 | 100 | 80 | 42 | 36 | 10 | 0.0 |
| LR2 | 300 | 150 | 50 | 40 | 30 | 2.0 |
| LR3 | 400 | 200 | 50 | 45 | 38 | 6.0 |
| LR4 | 1000 | 300 | 65 | 54 | 100 | 11.0 |
| LR5 | 200 | 80 | 36 | 28 | 800 | 17.1 |
| LR6 | 200 | 100 | 34 | 28 | 245 | 19.7 |
| LR7 | 200 | 140 | 70 | 60 | 18 | 18.8 |
| LR8 | 120 | 80 | 72 | 68 | 1000 | 22.3 |
| LR9 | 400 | 0 | 44 | 32 | 100 | 20.6 |
| SEDIMENTS | | | | | | |
| LR1 | | | | | | |
| LR2 | 7000 | 5600 | 180 | 120 | 20 | |
| LR3 | 500 | 0 | 0 | 0 | 480 | |
| LR4 | 400 | 0 | 0 | 0 | 20 | |
| LR5 | 600 | 0 | 0 | 0 | 1200 | |
| LR6 | 1200 | 0 | 0 | 0 | 80 | |
| LR7 | 200 | 0 | 0 | 0 | 190 | |
| LR8 | 500 | 0 | 0 | 0 | 200 | |
| LR9 | 200 | 0 | 0 | 0 | 50 | |

DINNER KEY SEPTEMBER 23RD, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| DK1 | | | | | | 29.0 |
| DK2 | 60 | 10 | 0 | 0 | 0 | 28.1 |
| DK3 | 30 | 0 | 5 | 1 | 0 | 28.7 |
| DK4 | 70 | 0 | 3 | 2 | 0 | 29.1 |
| DK5 | 100 | [illegible] | 10 | 5 | 0 | 28.5 |
| DK6 | 70 | 60 | 4 | 2 | 0 | 28.7 |
| DK7 | 250 | 10 | 0 | 0 | 10 | 29.1 |
| DK8 | 100 | 80 | 0 | 0 | 5 | 28.7 |
| DK9 | 40 | 30 | 3 | 2 | 0 | 28.4 |
| DK10 | 250 | 0 | 0 | 0 | 10 | 28.7 |
| DK11 | 100 | 0 | 0 | 0 | 0 | 28.6 |
| DK12 | 270 | 0 | 0 | 0 | 0 | 28.3 |
| DK13 | 70 | 0 | 0 | 0 | 0 | 27.7 |
| SEDIMENTS | | | | | | |
| DK1 | 70 | 0 | 0 | 0 | 0 | |
| DK2 | 80 | 0 | 0 | 0 | 10 | |
| DK3 | 30 | 0 | 0 | 0 | 0 | |
| DK4 | 50 | 10 | 0 | 0 | 0 | |
| DK5 | 300 | 0 | 0 | 0 | 0 | |
| DK6 | 100 | 0 | 0 | 0 | 0 | |
| DK7 | 0 | 0 | 0 | 0 | 0 | |
| DK8 | 100 | 0 | 0 | 0 | 10 | |
| DK9 | 10 | 0 | 0 | 0 | 0 | |
| DK10 | 0 | 0 | 0 | 0 | 0 | |
| DK11 | 30 | 0 | 0 | 0 | 0 | |
| DK12 | 50 | 0 | 0 | 0 | 0 | |
| DK13 | 10 | 0 | 0 | 0 | 0 | |

KING'S BAY SEPTEMBER 25TH, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 0 | 26.2 |
| KB2 | 30 | 0 | 0 | 0 | 5 | 26.4 |
| KB3 | 0 | 0 | 0 | 0 | 0 | 25.6 |
| KB4 | 20 | 10 | 0 | 0 | 0 | 26.6 |
| KB5 | 0 | 0 | 0 | 0 | 0 | 26.7 |
| KB6 | | | | | | 26.2 |
| KB7 | 0 | 0 | 0 | 0 | 0 | 28.1 |
| SEDIMENTS | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 0 | |
| KB2 | 0 | 0 | 0 | 0 | 0 | |
| KB3 | 0 | 0 | 0 | 0 | 0 | |
| KB4 | 0 | 0 | 0 | 0 | 0 | |
| KB5 | 0 | 0 | 0 | 0 | 0 | |
| KB6 | 0 | 0 | 0 | 0 | 0 | |
| KB7 | 0 | 0 | 0 | 0 | 0 | |

BISCAYNE CANAL OCTOBER 28TH, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| BC1 | 700 | 400 | 18 | 12 | 65 | 0 |
| BC2 | 700 | 0 | 8 | 4 | 70 | 1.2 |
| BC3 | 200 | 0 | 2 | 0 | 0 | 2.1 |
| BC4 | 400 | 100 | 0 | 0 | 20 | 4.7 |
| BC5 | 100 | 0 | 0 | 0 | 0 | 24.4 |
| BC6 | 100 | 0 | 0 | 0 | 10 | 12.6 |
| BC7 | 0 | 0 | 0 | 0 | 20 | 21.9 |
| SEDIMENTS | | | | | | |
| BC1 | | | | | | |
| BC2 | 0 | 0 | 0 | 0 | 0 | |
| BC3 | 0 | 0 | 0 | 0 | 0 | |
| BC4 | 0 | 0 | 0 | 0 | 0 | |
| BC5 | 300 | 0 | 0 | 0 | 0 | |
| BC6 | 0 | 0 | 0 | 0 | 0 | |
| BC7 | 0 | 0 | 0 | 0 | 0 | |

LITTLE RIVER OCTOBER 28TH, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| LR1 | 610 | 300 | 36 | 10 | 60 | 0.0 |
| LR2 | 1700 | 500 | 50 | 20 | 150 | 0.2 |
| LR3 | 1500 | 600 | 60 | 24 | 140 | 2.3 |
| LR4 | 1000 | 500 | 65 | 30 | 300 | 0.4 |
| LR5 | 1100 | 600 | 38 | 22 | 700 | 13.2 |
| LR6 | 100 | 0 | 0 | 0 | 400 | 29.2 |
| LR7 | 600 | 300 | 32 | 12 | 140 | 19.6 |
| LR8 | 500 | 200 | 16 | 12 | 200 | 21.0 |
| LR9 | 100 | 0 | 0 | 0 | 300 | 30.2 |
| SEDIMENTS | | | | | | |
| LR1 | | | | | | |
| LR2 | 10000 | 100 | 0 | 0 | 20 | |
| LR3 | 200 | 0 | 5 | 2 | 20 | |
| LR4 | 500 | 0 | 0 | 0 | 240 | |
| LR5 | 700 | 0 | 0 | 0 | 0 | |
| LR6 | 6000 | 100 | 0 | 0 | 0 | |
| LR7 | 100 | 0 | 0 | 0 | 0 | |
| LR8 | 100 | 0 | 0 | 0 | 0 | |
| LR9 | 500 | 0 | 0 | 0 | 0 | |

DINNER KEY OCTOBER 30TH, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| DK1 | | | | | | 33.4 |
| DK2 | 110 | 50 | 8 | 4 | 600 | 32.8 |
| DK3 | 100 | 10 | 0 | 0 | 0 | 33.4 |
| DK4 | 220 | 60 | 0 | 0 | 0 | 32.8 |
| DK5 | 160 | 0 | 0 | 0 | 140 | 32.8 |
| DK6 | 180 | 80 | 10 | 5 | 60 | 32.8 |
| DK7 | 160 | 0 | 0 | 0 | 0 | 33.0 |
| DK8 | 150 | 20 | 0 | 0 | 0 | 32.8 |
| DK9 | 110 | 0 | 2 | 2 | 20 | 32.8 |
| DK10 | 120 | 10 | 0 | 0 | 20 | 33.0 |
| DK11 | 60 | 0 | 0 | 0 | 0 | 32.6 |
| DK12 | 20 | 0 | 0 | 0 | 100 | 32.3 |
| DK13 | 90 | 0 | 0 | 0 | 160 | 31.0 |
| SEDIMENTS | | | | | | |
| DK1 | 60 | 10 | 0 | 0 | 20 | |
| DK2 | 40 | 0 | 0 | 0 | 0 | |
| DK3 | 20 | 0 | 0 | 0 | 0 | |
| DK4 | 22 | 0 | 0 | 0 | 0 | |
| DK5 | 100 | 10 | 0 | 0 | 10 | |
| DK6 | 40 | 0 | 0 | 0 | 0 | |
| DK7 | 10 | 0 | 0 | 0 | 0 | |
| DK8 | 36 | 0 | 0 | 0 | 10 | |
| DK9 | 0 | 0 | 0 | 0 | 0 | |
| DK10 | 0 | 0 | 0 | 0 | 0 | |
| DK11 | 5 | 0 | 0 | 0 | 0 | |
| DK12 | 0 | 0 | 0 | 0 | 0 | |
| DK13 | 0 | 0 | 0 | 0 | 0 | |

KING'S BAY OCTOBER 30TH, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 0 | 31.4 |
| KB2 | 20 | 0 | 0 | 0 | 10 | 31.4 |
| KB3 | 0 | 0 | 0 | 0 | 0 | 31.5 |
| KB4 | 0 | 0 | 0 | 0 | 0 | 31.9 |
| KB5 | 10 | 0 | 0 | 0 | 0 | 32.3 |
| KB6 | | | | | | 31.6 |
| KB7 | 10 | 0 | 0 | 0 | 10 | 32.8 |
| SEDIMENTS | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 0 | |
| KB2 | 10 | 0 | 0 | 0 | 0 | |
| KB3 | 0 | 0 | 0 | 0 | 0 | |
| KB4 | 0 | 0 | 0 | 0 | 0 | |
| KB5 | 0 | 0 | 0 | 0 | 0 | |
| KB6 | 0 | 0 | 0 | 0 | 0 | |
| KB7 | 0 | 0 | 0 | 0 | 0 | |

BISCAYNE CANAL DECEMBER 1ST, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | AMMONIA | T-P | SAL |
|---|---|---|---|---|---|---|---|---|
| WATER | | | | | | | | |
| BC1 | 1400 | 200 | 2 | 0 | 150 | 0.46 | 0.47 | 0.1 |
| BC2 | 2600 | 500 | 4 | 0 | 80 | 0.16 | 0.54 | 11.2 |
| BC3 | 1000 | 100 | 0 | 0 | 120 | 0.26 | 0.08 | 10.6 |
| BC4 | 200 | 90 | 0 | 0 | 60 | 0.14 | 0.43 | 23.1 |
| BC5 | 50 | 0 | 0 | 0 | 5 | 0.10 | 0.03 | 29.5 |
| BC6 | 10 | 1 | 0 | 0 | 0 | 0.21 | 0.63 | 29.1 |
| BC7 | 10 | 1 | 0 | 0 | 0 | 0.09 | 0.06 | 29.2 |
| SEDIMENTS | | | | | | | | |
| BC1 | | | | | | | | |
| BC2 | 0 | 0 | 0 | 0 | 0 | | | |
| BC3 | 0 | 0 | 0 | 0 | 0 | | | |
| BC4 | 0 | 0 | 0 | 0 | 0 | | | |
| BC5 | 0 | 0 | 0 | 0 | 0 | | | |
| BC6 | 0 | 0 | 0 | 0 | 0 | | | |
| BC7 | 0 | 0 | 0 | 0 | 0 | | | |

LITTLE RIVER DECEMBER 1ST, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | AMMONIA | T-P | SAL |
|---|---|---|---|---|---|---|---|---|
| WATER | | | | | | | | |
| LR1 | 2900 | 1800 | 12 | 3 | 170 | 0.64 | 0.03 | 0.1 |
| LR2 | 4000 | 2000 | 10 | 6 | 180 | 0.61 | 0.01 | 3.7 |
| LR3 | 3800 | 1000 | 18 | 12 | 300 | 0.2 | 0.01 | 9.5 |
| LR4 | 4400 | 2300 | 26 | 18 | 240 | 0.18 | 0.01 | 8.6 |
| LR5 | 3200 | 1900 | 24 | 15 | 440 | 0.22 | 0.01 | 8.5 |
| LR6 | 400 | 100 | 7 | 3 | 20 | 0.16 | 0.91 | 20.5 |
| LR7 | 1500 | 1200 | 28 | 16 | 240 | 0.19 | 0.01 | 21.5 |
| LR8 | 2000 | 1400 | 30 | 18 | 460 | 0.13 | 0.18 | 20.9 |
| LR9 | 200 | 100 | 16 | 4 | 255 | 0.05 | 0.01 | 27.4 |
| SEDIMENTS | | | | | | | | |
| LR1 | | | | | | | | |
| LR2 | 100 | 90 | 0 | 0 | 0 | | | |
| LR3 | 100 | 0 | 0 | 0 | 20 | | | |
| LR4 | 400 | 0 | 0 | 0 | 0 | | | |
| LR5 | 400 | 0 | 0 | 0 | 0 | | | |
| LR6 | 300 | 100 | 0 | 0 | 0 | | | |
| LR7 | 0 | 0 | 0 | 0 | 0 | | | |
| LR8 | 0 | 0 | 0 | 0 | 0 | | | |
| LR9 | 0 | 0 | 0 | 0 | 0 | | | |

DINNER KEY DECEMBER 3RD, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | AMMONIA | T-P | SAL |
|---|---|---|---|---|---|---|---|---|
| **WATER** | | | | | | | | |
| DK1 | 600 | 600 | 10 | 5 | 160 | 0.09 | 0.06 | 32.6 |
| DK2 | 40 | 0 | 0 | 0 | 0 | 0.09 | 0.01 | 33.6 |
| DK3 | 350 | 300 | 2 | 0 | 0 | 0.17 | 0.07 | 32.9 |
| DK4 | 90 | 70 | 0 | 0 | 20 | 0.13 | 0.03 | 32.4 |
| DK5 | 420 | 400 | 8 | 5 | 80 | 0.15 | 0.06 | 32.6 |
| DK6 | 70 | 30 | 1 | 0 | 20 | 0.10 | 0.03 | 32.8 |
| DK7 | 200 | 200 | 0 | 0 | 40 | 0.11 | 0.06 | 32.7 |
| DK8 | 580 | 400 | 5 | 3 | 20 | 0.12 | 0.07 | 32.6 |
| DK9 | 0 | 0 | 0 | 0 | 30 | 0.09 | 0.04 | 32.8 |
| DK10 | 50 | 10 | 0 | 0 | 20 | 0.12 | 0.10 | 32.7 |
| DK11 | 300 | 200 | 0 | 0 | 0 | 0.12 | 0.55 | 32.6 |
| DK12 | 500 | 400 | 1 | 1 | 0 | 0.11 | 0.04 | 32.3 |
| DK13 | | | | | | | | |
| **SEDIMENTS** | | | | | | | | |
| DK1 | 200 | 20 | 0 | 0 | 20 | | | |
| DK2 | 10 | 0 | 0 | 0 | 0 | | | |
| DK3 | 20 | 0 | 0 | 0 | 0 | | | |
| DK4 | 20 | 0 | 0 | 0 | 0 | | | |
| DK5 | 0 | 0 | 0 | 0 | 0 | | | |
| DK6 | 0 | 0 | 0 | 0 | 0 | | | |
| DK7 | 10 | 0 | 0 | 0 | 0 | | | |
| DK8 | 10 | 0 | 0 | 0 | 0 | | | |
| DK9 | 80 | 0 | 0 | 0 | 0 | | | |
| DK10 | 0 | 0 | 0 | 0 | 0 | | | |
| DK11 | 50 | 10 | 0 | 0 | 20 | | | |
| DK12 | 0 | 0 | 0 | 0 | 0 | | | |
| DK13 | 0 | 0 | 0 | 0 | 0 | | | |

KING'S BAY DECEMBER 3RD, 1986

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | AMMONIA | T-P | SAL |
|---|---|---|---|---|---|---|---|---|
| WATER | | | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 2 | 0.2 | 0.01 | 29.3 |
| KB2 | 0 | 0 | 0 | 0 | 0 | 0.22 | 0.02 | 29.7 |
| KB3 | 30 | 0 | 0 | 0 | 0 | 0.26 | 0.06 | 30.6 |
| KB4 | 10 | 0 | 0 | 0 | 0 | 0.15 | 0.02 | 30.7 |
| KB5 | 0 | 0 | 0 | 0 | 0 | 0.11 | 0.02 | 30.1 |
| KB6 | | | | | | | | |
| KB7 | 0 | 0 | 0 | 0 | 0 | 0.09 | 0.07 | 30.6 |
| SEDIMENTS | | | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 0 | | | |
| KB2 | 20 | 0 | 0 | 0 | 0 | | | |
| KB3 | 0 | 0 | 0 | 0 | 0 | | | |
| KB4 | 0 | 0 | 0 | 0 | 0 | | | |
| KB5 | 0 | 0 | 0 | 0 | 0 | | | |
| KB6 | 0 | 0 | 0 | 0 | 0 | | | |
| KB7 | 0 | 0 | 0 | 0 | 0 | | | |

BISCAYNE CANAL JANUARY 6TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| BC1 | 600 | 500 | 28 | 14 | 50 | 0 |
| BC2 | 900 | 0 | 0 | 0 | 10 | 0 |
| BC3 | 700 | 100 | 8 | 2 | 60 | 1.3 |
| BC4 | 900 | 400 | 54 | 28 | 80 | 3.8 |
| BC5 | 1300 | 0 | 0 | 0 | 300 | 27.6 |
| BC6 | 1200 | 100 | 18 | 6 | 200 | 29.2 |
| BC7 | 300 | 100 | 6 | 0 | 60 | 26.2 |
| SEDIMENTS | | | | | | |
| BC1 | | | | | | |
| BC2 | 100 | 0 | 0 | 0 | 0 | |
| BC3 | 1600 | 200 | 0 | 0 | 30 | |
| BC4 | 2900 | 300 | 0 | 0 | 50 | |
| BC5 | 1800 | 100 | 0 | 0 | 10 | |
| BC6 | 0 | 0 | 0 | 0 | 0 | |
| BC7 | 0 | 0 | 0 | 0 | 0 | |

LITTLE RIVER JANUARY 6TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| LR1 | 400 | 200 | 28 | 18 | 38 | 0 |
| LR2 | 2700 | 1300 | 60 | 45 | 250 | 0.3 |
| LR3 | 2100 | 1300 | 45 | 28 | 200 | 1.4 |
| LR4 | 3400 | 1300 | 120 | 96 | 320 | 3.5 |
| LR5 | 40000 | 700 | 54 | 40 | 380 | 6.9 |
| LR6 | 700 | 100 | 14 | 7 | 700 | 27.5 |
| LR7 | 1200 | 200 | 30 | 22 | 500 | 28.6 |
| LR8 | 1600 | 100 | 18 | 12 | 800 | 29.6 |
| LR9 | 0 | 200 | 6 | 0 | 0 | 28.2 |
| SEDIMENTS | | | | | | |
| LR1 | | | | | | |
| LR2 | 5000 | 800 | 60 | 120 | 20 | |
| LR3 | 2000 | 100 | 0 | 0 | 0 | |
| LR4 | 1500 | 10 | 0 | 0 | 0 | |
| LR5 | 3000 | 100 | 0 | 0 | 0 | |
| LR6 | 3200 | 100 | 0 | 0 | 0 | |
| LR7 | 1600 | 0 | 0 | 0 | 0 | |
| LR8 | 3300 | 50 | 0 | 0 | 0 | |
| LR9 | 2300 | 0 | 0 | 0 | 0 | |

DINNER KEY JANUARY 8TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| DK1 | | | | | | |
| DK2 | 70 | 10 | 5 | 1 | 0 | 31.9 |
| DK3 | 40 | 50 | 0 | 0 | 0 | 31.9 |
| DK4 | 50 | 20 | 0 | 0 | 0 | 31.8 |
| DK5 | 100 | 30 | 4 | 1 | 0 | 31.6 |
| DK6 | 180 | 80 | 6 | 1 | 0 | 31.8 |
| DK7 | 140 | 40 | 2 | 0 | 10 | 31.8 |
| DK8 | 140 | 80 | 0 | 0 | 5 | 31.8 |
| DK9 | 120 | 40 | 0 | 0 | 0 | 31.7 |
| DK10 | 90 | 30 | 0 | 0 | 10 | 31.7 |
| DK11 | 40 | 20 | 0 | 0 | 0 | 31.7 |
| DK12 | 100 | 90 | 0 | 0 | 0 | 31.0 |
| DK13 | 30 | 0 | 0 | 0 | 0 | 31.3 |
| SEDIMENTS | | | | | | |
| DK1 | 200 | 100 | 0 | 0 | 40 | |
| DK2 | 10 | 0 | 0 | 0 | 0 | |
| DK3 | 0 | 0 | 0 | 0 | 0 | |
| DK4 | 0 | 0 | 0 | 0 | 0 | |
| DK5 | 0 | 0 | 0 | 0 | 0 | |
| DK6 | 0 | 0 | 0 | 0 | 0 | |
| DK7 | 0 | 0 | 0 | 0 | 0 | |
| DK8 | 0 | 0 | 0 | 0 | 0 | |
| DK9 | 40 | 10 | 0 | 0 | 0 | |
| DK10 | 0 | 0 | 0 | 0 | 0 | |
| DK11 | 0 | 0 | 0 | 0 | 0 | |
| DK12 | 0 | 0 | 0 | 0 | 0 | |
| DK13 | 0 | 0 | 0 | 0 | 0 | |

KING'S BAY JANUARY 8TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 0 | 29.9 |
| KB2 | 0 | 0 | 0 | 0 | 0 | 30.1 |
| KB3 | 10 | 0 | 0 | 0 | 0 | 29.7 |
| KB4 | 10 | 10 | 0 | 0 | 0 | 30.1 |
| KB5 | 0 | 0 | 0 | 0 | 0 | 28.5 |
| KB6 | | | | | | |
| KB7 | 20 | 20 | 0 | 0 | 0 | 29.5 |
| BAY 43 | 0 | 0 | 0 | 0 | 0 | 33.4 |
| SEDIMENTS | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 0 | |
| KB2 | 0 | 0 | 0 | 0 | 0 | |
| KB3 | 0 | 0 | 0 | 0 | 0 | |
| KB4 | 0 | 0 | 0 | 0 | 0 | |
| KB5 | 0 | 0 | 0 | 0 | 0 | |
| KB6 | 0 | 0 | 0 | 0 | 0 | |
| KB7 | 0 | 0 | 0 | 0 | 0 | |

BISCAYNE CANAL FEBRUARY 10TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE |
|---|---|---|---|---|---|
| WATER | | | | | |
| BC1 | 60 | 0 | 0 | 0 | 0 |
| BC2 | 10 | 0 | 0 | 0 | 0 |
| BC3 | 50 | 10 | 0 | 0 | 0 |
| BC4 | 0 | 0 | 0 | 0 | 0 |
| BC5 | 0 | 0 | 0 | 0 | 0 |
| BC6 | 0 | 0 | 0 | 0 | 0 |
| BC7 | 0 | 0 | 0 | 0 | 0 |
| SEDIMENTS | | | | | |
| BC1 | | | | | |
| BC2 | 0 | 0 | 0 | 0 | 0 |
| BC3 | 800 | 200 | 4 | 0 | 0 |
| BC4 | 1200 | 300 | 0 | 0 | 0 |
| BC5 | 1200 | 100 | 0 | 0 | 0 |
| BC6 | 0 | 0 | 0 | 0 | 0 |
| BC7 | 0 | 0 | 0 | 0 | 0 |

LITTLE RIVER FEBRUARY 10TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| LR1 | 2200 | 800 | 21 | 12 | 50 | 0 |
| LR2 | 1000 | 400 | 32 | 12 | 180 | 3.2 |
| LR3 | 1700 | 100 | 19 | 5 | 120 | 6.1 |
| LR4 | 2000 | 0 | 25 | 10 | 110 | 8.5 |
| LR5 | 700 | 100 | 20 | 5 | 170 | 12.8 |
| LR6 | 0 | 0 | 1 | 0 | 30 | 28.4 |
| LR7 | 900 | 300 | 1 | 7 | 70 | 18.2 |
| LR8 | 800 | 200 | 18 | 5 | 80 | 24.1 |
| LR9 | 600 | 0 | 0 | 0 | 10 | 26.2 |
| SEDIMENTS | | | | | | |
| LR1 | | | | | | |
| LR2 | 1500 | 110 | 12 | 2 | 140 | |
| LR3 | 100 | 0 | 0 | 0 | 10 | |
| LR4 | 0 | 0 | 0 | 0 | 0 | |
| LR5 | 0 | 0 | 0 | 0 | 0 | |
| LR6 | 0 | 0 | 0 | 0 | 0 | |
| LR7 | 100 | 100 | 0 | 0 | 0 | |
| LR8 | 0 | 0 | 0 | 0 | 0 | |
| LR9 | 0 | 0 | 0 | 0 | 0 | |

DINNER KEY FEBRUARY 10TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| DK1 | | | | | | |
| DK2 | 100 | 0 | 4 | 0 | 50 | 18.6 |
| DK3 | 100 | 0 | 0 | 0 | 50 | 27.5 |
| DK4 | 100 | 0 | 0 | 0 | 70 | 28.4 |
| DK5 | 1200 | 200 | 7 | 1 | 70 | 27.7 |
| DK6 | 600 | 100 | 3 | 0 | 20 | 29.2 |
| DK7 | 100 | 0 | 0 | 0 | 30 | 29.7 |
| DK8 | 400 | 100 | 5 | 1 | 30 | 29.6 |
| DK9 | 0 | 0 | 2 | 0 | 30 | 29.6 |
| DK10 | 300 | 0 | 0 | 0 | 30 | 29.3 |
| DK11 | 300 | 100 | 0 | 0 | 40 | 29.5 |
| DK12 | 0 | 0 | 0 | 0 | 0 | 29.6 |
| DK13 | 0 | 0 | 0 | 0 | 0 | 29.1 |

SEDIMENTS

| | | | | | |
|---|---|---|---|---|---|
| DK1 | 0 | 0 | 0 | 0 | 0 |
| DK2 | 0 | 0 | 0 | 0 | 0 |
| DK3 | 0 | 0 | 0 | 0 | 0 |
| DK4 | 0 | 0 | 0 | 0 | 0 |
| DK5 | 100 | 0 | 0 | 0 | 0 |
| DK6 | 10 | 0 | 0 | 0 | 0 |
| DK7 | 0 | 0 | 0 | 0 | 0 |
| DK8 | 0 | 0 | 0 | 0 | 0 |
| DK9 | 0 | 0 | 0 | 0 | 0 |
| DK10 | 0 | 0 | 0 | 0 | 0 |
| DK11 | 0 | 0 | 0 | 0 | 0 |
| DK12 | 0 | 0 | 0 | 0 | 0 |
| DK13 | 0 | 0 | 0 | 0 | 0 |

KING'S BAY FEBRUARY 12TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 0 | 28.0 |
| KB2 | 0 | 0 | 0 | 0 | 5 | 27.6 |
| KB3 | 0 | 0 | 0 | 0 | 0 | 27.7 |
| KB4 | 0 | 0 | 0 | 0 | 0 | 27.5 |
| KB5 | 0 | 0 | 0 | 0 | 0 | 25.2 |
| KB6 | | | | | | |
| KB7 | 0 | 0 | 0 | 0 | 0 | 27.6 |
| BAY 43 | 0 | 0 | 0 | 0 | 0 | 30.8 |
| SEDIMENTS | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 0 | |
| KB2 | 0 | 0 | 0 | 0 | 0 | |
| KB3 | 0 | 0 | 0 | 0 | 0 | |
| KB4 | 0 | 0 | 0 | 0 | 0 | |
| KB5 | 0 | 0 | 0 | 0 | 0 | |
| KB6 | 0 | 0 | 0 | 0 | 0 | |
| KB7 | 0 | 0 | 0 | 0 | 0 | |

BISCAYNE CANAL MARCH 9TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL | NH3 | T-P |
|---|---|---|---|---|---|---|---|---|
| WATER | | | | | | | | |
| BC1 | 1400 | 100 | 20 | 10 | 120 | 0.0 | 0.09 | 0.16 |
| BC2 | 1200 | 0 | 4 | 1 | 140 | 0.8 | 0.08 | 0.18 |
| BC3 | 2000 | 0 | 5 | 0 | 240 | 2.3 | 0.06 | 0.01 |
| BC4 | 1000 | 0 | 0 | 0 | 160 | 4.9 | 0.06 | 0.01 |
| BC5 | 380 | 0 | 0 | 0 | 40 | 32.3 | 0.06 | 0.9 |
| BC6 | 500 | 0 | 0 | 0 | 80 | 11.3 | 0.06 | 0.19 |
| BC7 | 200 | 0 | 0 | 0 | 60 | 31.6 | 0.11 | 0.35 |

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE |
|---|---|---|---|---|---|
| SEDIMENTS | | | | | |
| BC1 | | | | | |
| BC2 | 0 | 0 | 0 | 0 | 0 |
| BC3 | 10 | 0 | 0 | 0 | 0 |
| BC4 | 100 | 0 | 0 | 0 | 0 |
| BC5 | 0 | 0 | 0 | 0 | 0 |
| BC6 | 0 | 0 | 0 | 0 | 0 |
| BC7 | 0 | 0 | 0 | 0 | 0 |

LITTLE RIVER MARCH 9TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL | NH3 | T-P |
|---|---|---|---|---|---|---|---|---|
| WATER | | | | | | | | |
| LR1 | 500 | 300 | 10 | 4 | 50 | 0 | 0.23 | 0.23 |
| LR2 | 700 | 600 | 12 | 4 | 70 | 0 | 0.27 | 0.12 |
| LR3 | 600 | 100 | 18 | 8 | 150 | 1.8 | <0.06 | 1.9 |
| LR4 | 300 | 200 | 4 | 0 | 130 | 6.5 | <0.06 | 0.03 |
| LR5 | 100 | 0 | 0 | 0 | 240 | 8.2 | <0.06 | 0.74 |
| LR6 | 100 | 0 | 0 | 0 | 10 | 28.9 | <0.06 | 0.19 |
| LR7 | 300 | 0 | 10 | 4 | 70 | 24.5 | <0.06 | 0.1 |
| LR8 | 100 | 100 | 2 | 1 | 160 | 29.7 | <0.06 | 0.01 |
| LR9 | 0 | 0 | 0 | 0 | 0 | 35.8 | <0.06 | 0.25 |
| SEDIMENTS | | | | | | | | |
| LR1 | | | | | | | | |
| LR2 | 400 | 100 | 0 | 0 | 20 | | | |
| LR3 | 0 | 0 | 0 | 0 | 0 | | | |
| LR4 | 0 | 0 | 0 | 0 | 0 | | | |
| LR5 | 10 | 0 | 0 | 0 | 0 | | | |
| LR6 | 0 | 0 | 0 | 0 | 0 | | | |
| LR7 | 0 | 0 | 0 | 0 | 0 | | | |
| LR8 | 0 | 0 | 0 | 0 | 0 | | | |
| LR9 | 0 | 0 | 0 | 0 | 0 | | | |

DINNER KEY MARCH 11TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL | NH3 | T-P |
|---|---|---|---|---|---|---|---|---|
| WATER | | | | | | | | |
| DK1 | | | | | | | | |
| DK2 | 0 | 0 | 0 | 0 | 20 | 38.7 | <0.04 | 0.1 |
| DK3 | 0 | 0 | 0 | 0 | 0 | | <0.04 | 0.08 |
| DK4 | 200 | 100 | 2 | 0 | 40 | | <0.04 | 0.02 |
| DK5 | 0 | 0 | 0 | 0 | 0 | 38.4 | <0.04 | 0.08 |
| DK6 | 600 | 400 | 4 | 0 | 10 | 39.1 | <0.04 | 0.34 |
| DK7 | 0 | 0 | 0 | 0 | 0 | 38.4 | <0.04 | 0.35 |
| DK8 | 200 | 100 | 1 | 0 | 0 | 38.2 | <0.04 | 0.83 |
| DK9 | 100 | 100 | 0 | 0 | 20 | 28.5 | 0.05 | 0.24 |
| DK10 | 0 | 0 | 0 | 0 | 0 | 28.6 | <0.04 | <0.01 |
| DK11 | 0 | 0 | 0 | 0 | 0 | 37.9 | <0.04 | 0.07 |
| DK12 | 0 | 0 | 0 | 0 | 0 | 38.3 | <0.04 | 0.95 |
| DK13 | 0 | 0 | 0 | 0 | 0 | 38.0 | <0.04 | <0.01 |
| SEDIMENTS | | | | | | | | |
| DK1 | 50 | 0 | 0 | 0 | 0 | | | |
| DK2 | 200 | 0 | 0 | 0 | 20 | | | |
| DK3 | 0 | 0 | 0 | 0 | 0 | | | |
| DK4 | 0 | 0 | 0 | 0 | 0 | | | |
| DK5 | 0 | 0 | 0 | 0 | 0 | | | |
| DK6 | 0 | 0 | 0 | 0 | 0 | | | |
| DK7 | 0 | 0 | 0 | 0 | 0 | | | |
| DK8 | 0 | 0 | 0 | 0 | 0 | | | |
| DK9 | 0 | 0 | 0 | 0 | 0 | | | |
| DK10 | 0 | 0 | 0 | 0 | 0 | | | |
| DK11 | 0 | 0 | 0 | 0 | 0 | | | |
| DK12 | 0 | 0 | 0 | 0 | 0 | | | |
| DK13 | 0 | 0 | 0 | 0 | 0 | | | |

KING'S BAY MARCH 11TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL | $NH_3$ | T-P |
|---|---|---|---|---|---|---|---|---|
| WATER | | | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 0 | 37.7 | <0.03 | 0.01 |
| KB2 | 0 | 0 | 0 | 0 | 5 | 38.2 | <0.03 | 0.11 |
| KB3 | 0 | 0 | 0 | 0 | 0 | 37.7 | <0.03 | 0.10 |
| KB4 | 0 | 0 | 0 | 0 | 0 | 37.5 | <0.03 | 0.17 |
| KB5 | 0 | 0 | 0 | 0 | 0 | 34.5 | <0.03 | 0.02 |
| KB6 | | | | | | 37.6 | | |
| KB7 | 0 | 0 | 0 | 0 | 0 | 36.6 | <0.03 | 0.10 |
| BAY 43 | 0 | 0 | 0 | 0 | 0 | 40.8 | <0.04 | 0.02 |
| SEDIMENTS | | | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 0 | | | |
| KB2 | 0 | 0 | 0 | 0 | 0 | | | |
| KB3 | 0 | 0 | 0 | 0 | 0 | | | |
| KB4 | 0 | 0 | 0 | 0 | 0 | | | |
| KB5 | 0 | 0 | 0 | 0 | 0 | | | |
| KB6 | 0 | 0 | 0 | 0 | 0 | | | |
| KB7 | 0 | 0 | 0 | 0 | 0 | | | |

BISCAYNE CANAL APRIL 14TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| BC1 | 100 | 0 | 0 | 0 | 20 | 0.0 |
| BC2 | 100 | 0 | 0 | 0 | 10 | 3.7 |
| BC3 | 0 | 0 | 0 | 0 | 20 | 3.7 |
| BC4 | 100 | 0 | 0 | 0 | 60 | 18.4 |
| BC5 | 0 | 0 | 0 | 0 | 30 | 23.3 |
| BC6 | 100 | 0 | 0 | 0 | 60 | 25.2 |
| BC7 | 0 | 0 | 0 | 0 | 130 | 29.0 |
| SEDIMENTS | | | | | | |
| BC1 | | | | | | |
| BC2 | 0 | 0 | 0 | 0 | 0 | |
| BC3 | 0 | 0 | 0 | 0 | 0 | |
| BC4 | 0 | 0 | 0 | 0 | 0 | |
| BC5 | 0 | 0 | 0 | 0 | 0 | |
| BC6 | 0 | 0 | 0 | 0 | 0 | |
| BC7 | 0 | 0 | 0 | 0 | 0 | |

LITTLE RIVER APRIL 14TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| LR1 | 1200 | 0 | 0 | 0 | 130 | 0.0 |
| LR2 | 1300 | 400 | 28 | 10 | 130 | 1.2 |
| LR3 | 1400 | 0 | 4 | 0 | 140 | 8.8 |
| LR4 | 300 | 0 | 0 | 0 | 240 | 22.4 |
| LR5 | 300 | 300 | 10 | 2 | 650 | 7.5 |
| LR6 | 0 | 0 | 0 | 0 | 1110 | 30.0 |
| LR7 | 0 | 0 | 0 | 0 | 1130 | 34.7 |
| LR8 | 0 | 0 | 0 | 0 | 870 | 34.8 |
| LR9 | 0 | 0 | 0 | 0 | 80 | 34.4 |
| SEDIMENTS | | | | | | |
| LR1 | | | | | | |
| LR2 | 0 | 0 | 0 | 0 | 0 | |
| LR3 | 0 | 0 | 0 | 0 | 0 | |
| LR4 | 0 | 0 | 0 | 0 | 0 | |
| LR5 | 200 | 0 | 0 | 0 | 0 | |
| LR6 | 100 | 0 | 0 | 0 | 0 | |
| LR7 | 0 | 0 | 0 | 0 | 0 | |
| LR8 | 0 | 0 | 0 | 0 | 0 | |
| LR9 | 0 | 0 | 0 | 0 | 0 | |

DINNER KEY APRIL 16TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| **WATER** | | | | | | |
| DK1 | | | | | | |
| DK2 | 0 | 0 | 0 | 0 | 0 | 36.4 |
| DK3 | 0 | 0 | 0 | 0 | 0 | 37.2 |
| DK4 | 300 | 200 | 10 | 2 | 0 | 36.4 |
| DK5 | 800 | 600 | 20 | 4 | 0 | 36.2 |
| DK6 | 0 | 0 | 0 | 0 | 0 | 36.0 |
| DK7 | 0 | 0 | 0 | 0 | 0 | 36.6 |
| DK8 | 100 | 0 | 0 | 0 | 10 | 36.4 |
| DK9 | 0 | 0 | 0 | 0 | 0 | 36.5 |
| DK10 | 0 | 0 | 0 | 0 | 0 | 36.5 |
| DK11 | 400 | 300 | 10 | 1 | 20 | 36.3 |
| DK12 | 0 | 0 | 0 | 0 | 10 | 36.5 |
| DK13 | 0 | 0 | 0 | 0 | 80 | 35.7 |
| **SEDIMENTS** | | | | | | |
| DK1 | 0 | 0 | 0 | 0 | 0 | |
| DK2 | 0 | 0 | 0 | 0 | 0 | |
| DK3 | 0 | 0 | 0 | 0 | 0 | |
| DK4 | 0 | 0 | 0 | 0 | 0 | |
| DK5 | 0 | 0 | 0 | 0 | 0 | |
| DK6 | 0 | 0 | 0 | 0 | 0 | |
| DK7 | 0 | 0 | 0 | 0 | 0 | |
| DK8 | 0 | 0 | 0 | 0 | 0 | |
| DK9 | 0 | 0 | 0 | 0 | 0 | |
| DK10 | 0 | 0 | 0 | 0 | 0 | |
| DK11 | 0 | 0 | 0 | 0 | 0 | |
| DK12 | 0 | 0 | 0 | 0 | 0 | |
| DK13 | 0 | 0 | 0 | 0 | 0 | |

KING'S BAY APRIL 14TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 0 | 34.9 |
| KB2 | 0 | 0 | 0 | 0 | 5 | 34.9 |
| KB3 | 0 | 0 | 0 | 0 | 0 | 34.9 |
| KB4 | 0 | 0 | 0 | 0 | 0 | 35.0 |
| KB5 | 0 | 0 | 0 | 0 | 0 | 35.2 |
| KB6 | | | | | | 35.5 |
| KB7 | 0 | 0 | 0 | 0 | 0 | 35.7 |
| BAY 43 | 0 | 0 | 0 | 0 | 0 | 39.4 |
| SEDIMENTS | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 0 | |
| KB2 | 0 | 0 | 0 | 0 | 0 | |
| KB3 | 0 | 0 | 0 | 0 | 0 | |
| KB4 | 0 | 0 | 0 | 0 | 0 | |
| KB5 | 0 | 0 | 0 | 0 | 0 | |
| KB6 | 0 | 0 | 0 | 0 | 0 | |
| KB7 | 0 | 0 | 0 | 0 | 0 | |

BISCAYNE CANAL MAY 12TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| BC1 | 100 | 100 | 12 | 1 | 40 | 0 |
| BC2 | 0 | 0 | 0 | 0 | 150 | 6.3 |
| BC3 | 0 | 0 | 0 | 0 | 130 | 5.1 |
| BC4 | 0 | 0 | 0 | 0 | 140 | 10.1 |
| BC5 | 0 | 0 | 0 | 0 | 100 | 9.3 |
| BC6 | 0 | 0 | 0 | 0 | 70 | 24.5 |
| BC7 | 0 | 0 | 0 | 0 | 170 | 20.6 |
| SEDIMENTS | | | | | | |
| BC1 | | | | | | |
| BC2 | 0 | 0 | 0 | 0 | 0 | |
| BC3 | 0 | 0 | 0 | 0 | 0 | |
| BC4 | 0 | 0 | 0 | 0 | 0 | |
| BC5 | 0 | 0 | 0 | 0 | 0 | |
| BC6 | 0 | 0 | 0 | 0 | 0 | |
| BC7 | 0 | 0 | 0 | 0 | 0 | |

LITTLE RIVER MAY 13TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| LR1 | 0 | 0 | 0 | 0 | 140 | 0 |
| LR2 | 0 | 0 | 0 | 0 | 500 | 7.1 |
| LR3 | 0 | 0 | 0 | 0 | 450 | 4.3 |
| LR4 | 0 | 0 | 0 | 0 | 4200 | 7.4 |
| LR5 | 0 | 0 | 0 | 0 | 1220 | 20.9 |
| LR6 | 100 | 100 | 0 | 0 | 60 | 25.7 |
| LR7 | 200 | 100 | 2 | 0 | 50 | 24.7 |
| LR8 | 0 | 0 | 0 | 0 | 170 | 24.2 |
| LR9 | 0 | 0 | 0 | 0 | 560 | 24.2 |
| SEDIMENTS | | | | | | |
| LR1 | | | | | | |
| LR2 | 0 | 0 | 0 | 0 | 0 | |
| LR3 | 0 | 0 | 0 | 0 | 0 | |
| LR4 | 0 | 0 | 0 | 0 | 0 | |
| LR5 | 0 | 0 | 0 | 0 | 0 | |
| LR6 | 0 | 0 | 0 | 0 | 0 | |
| LR7 | 0 | 0 | 0 | 0 | 0 | |
| LR8 | 0 | 0 | 0 | 0 | 0 | |
| LR9 | 0 | 0 | 0 | 0 | 0 | |

DINNER KEY MAY 14TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| DK1 | | | | | | |
| DK2 | 0 | 0 | 0 | 0 | 0 | 29.8 |
| DK3 | 0 | 0 | 0 | 0 | 0 | 30.8 |
| DK4 | 0 | 0 | 0 | 0 | 0 | 30.4 |
| DK5 | 100 | 20 | 0 | 0 | 0 | 29.3 |
| DK6 | 200 | 120 | 10 | 1 | 0 | 29.9 |
| DK7 | 50 | 10 | 2 | 0 | 0 | 30.1 |
| DK8 | 100 | 20 | 1 | 0 | 10 | 30.1 |
| DK9 | 40 | 10 | 0 | 0 | 0 | 29.9 |
| DK10 | 100 | 40 | 0 | 0 | 0 | 30.1 |
| DK11 | 100 | 50 | 0 | 0 | 20 | 29.8 |
| DK12 | 100 | 60 | 0 | 0 | 10 | 29.5 |
| DK13 | 0 | 0 | 0 | 0 | 0 | 28.8 |
| SEDIMENTS | | | | | | |
| DK1 | 0 | 0 | 0 | 0 | 0 | |
| DK2 | 0 | 0 | 0 | 0 | 0 | |
| DK3 | 0 | 0 | 0 | 0 | 0 | |
| DK4 | 0 | 0 | 0 | 0 | 0 | |
| DK5 | 0 | 0 | 0 | 0 | 0 | |
| DK6 | 0 | 0 | 0 | 0 | 0 | |
| DK7 | 0 | 0 | 0 | 0 | 0 | |
| DK8 | 0 | 0 | 0 | 0 | 0 | |
| DK9 | 0 | 0 | 0 | 0 | 0 | |
| DK10 | 0 | 0 | 0 | 0 | 0 | |
| DK11 | 0 | 0 | 0 | 0 | 0 | |
| DK12 | 0 | 0 | 0 | 0 | 0 | |
| DK13 | 0 | 0 | 0 | 0 | 0 | |

KING'S BAY MAY 14TH, 1987

| STATION | T COLI | F COLI | F STREP | ENTERO | PHAGE | SAL |
|---|---|---|---|---|---|---|
| WATER | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 0 | 25.5 |
| KB2 | 0 | 0 | 0 | 0 | 5 | 25.0 |
| KB3 | 0 | 0 | 0 | 0 | 0 | 25.0 |
| KB4 | 0 | 0 | 0 | 0 | 0 | 26.9 |
| KB5 | 0 | 0 | 0 | 0 | 0 | 26.7 |
| KB6 | | | | | | |
| KB7 | 0 | 0 | 0 | 0 | 0 | 29.6 |
| BAY 43 | 0 | 0 | 0 | 0 | 0 | 33.5 |
| SEDIMENTS | | | | | | |
| KB1 | 0 | 0 | 0 | 0 | 0 | |
| KB2 | 0 | 0 | 0 | 0 | 0 | |
| KB3 | 0 | 0 | 0 | 0 | 0 | |
| KB4 | 0 | 0 | 0 | 0 | 0 | |
| KB5 | 0 | 0 | 0 | 0 | 0 | |
| KB6 | 0 | 0 | 0 | 0 | 0 | |
| KB7 | 0 | 0 | 0 | 0 | 0 | |
| BAY 43 | 0 | 0 | 0 | 0 | 0 | |

| | | | | | | SURFACE | | | | | MID | | | | | BOTTOM | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | DATE | TIME | DEPTH | TEMP | COND | SAL | DO | pH | TEMP | COND | SAL | DO | pH | TEMP | COND | SAL | DO | pH |
| BC1 | 8-27-86 | 12:38 | 16 | 29.7 | 0.9 | 0.2 | 6.5 | 8.5 | 29.2 | 1.0 | 0.3 | 5.5 | 8.8 | 29.4 | 1.0 | 0.3 | 0.6 | 9.0 |
| BC2 | 8-27-86 | 11:57 | 15 | 30.4 | 43.3 | 24.9 | 3.1 | 8.1 | 30.7 | 50.1 | 29.1 | 3.2 | 8.1 | 30.7 | 52.1 | 30.4 | 3.7 | 8.1 |
| BC3 | 8-27-86 | 11:20 | 21 | 30.5 | 41.8 | 23.9 | 4.5 | 8.0 | 30.6 | 53.7 | 31.5 | 2.5 | 8.1 | 30.2 | 53.4 | 31.6 | 0.5 | 8.1 |
| BC4 | 8-27-86 | 10:55 | 17 | 30.9 | 44.6 | 25.4 | 3.6 | 8.1 | 30.6 | 53.7 | 31.5 | 5.0 | 8.2 | 30.5 | 54.0 | 31.8 | 2.4 | 8.2 |
| BC5 | 8-27-86 | 10:30 | 14 | 29.7 | 48.7 | 28.8 | 6.5 | 8.2 | 30.5 | 53.0 | 31.1 | 5.4 | 8.2 | 30.6 | 52.6 | 30.8 | 3.3 | 8.2 |
| BC6 | 8-27-86 | 10:07 | 14 | 29.8 | 48.8 | 28.8 | 6.2 | 8.2 | 30.5 | 53.3 | 31.3 | 5.5 | 8.2 | 30.5 | 52.6 | 30.8 | 3.8 | 8.3 |
| BC7 | 8-27-86 | 09:22 | 6 | 29.5 | 47.0 | 27.8 | 6.0 | 8.2 | 30.8 | 52.4 | 30.5 | 5.5 | 8.3 | 30.6 | 52.4 | 30.6 | 4.7 | 8.5 |
| LR1 | | | | | | | | | | | | | | | | | | |
| LR2 | 8-28-86 | 09:55 | 6 | 29.1 | 5.0 | 2.4 | 1.9 | 8.3 | 29.2 | 5.2 | 2.5 | 1.8 | 8.5 | 30.4 | 29.5 | 16.3 | 2.5 | 7.9 |
| LR3 | 8-28-86 | 09:40 | 10 | 29.4 | 10.0 | 5.1 | 2.1 | 8.6 | 31.0 | 52.2 | 30.3 | 4.2 | 8.1 | 31.0 | 51.0 | 29.5 | 3.7 | 8.1 |
| LR4 | 8-28-86 | 09:22 | 9 | 29.6 | 12.6 | 6.6 | 2.5 | 8.4 | 31.0 | 52.8 | 30.7 | 3.9 | 8.3 | 31.0 | 52.6 | 30.5 | 4.2 | 8.3 |
| LR5 | 8-28-86 | 08:30 | 6 | 30.7 | 24.0 | 12.9 | 2.9 | 8.3 | 30.9 | 51.0 | 29.6 | 3.9 | 8.2 | 30.8 | 50.0 | 29.0 | 3.7 | 8.2 |
| LR6 | 8-28-86 | 09:10 | 6 | 30.2 | 48.7 | 28.5 | 5.0 | 8.3 | 30.5 | 52.0 | 30.4 | 5.3 | 8.3 | 30.9 | 52.6 | 30.6 | 4.8 | 8.2 |
| LR7 | 8-28-86 | 09:00 | 9 | 30.2 | 47.7 | 27.8 | 3.0 | 8.2 | 30.5 | 50.8 | 29.7 | 5.4 | 8.2 | 30.8 | 51.8 | 30.1 | 5.3 | 8.1 |
| LR8 | 8-28-86 | 08:17 | 12 | 30.1 | 49.7 | 29.2 | 3.2 | 8.2 | 30.6 | 50.5 | 29.2 | 4.9 | 8.2 | 30.9 | 52.5 | 30.5 | 4.4 | 8.2 |
| LR9 | 8-28-86 | 08:00 | 9 | 30.2 | 47.0 | 27.4 | 4.3 | 8.3 | 30.2 | 49.4 | 28.9 | 5.1 | 8.3 | 30.3 | 49.5 | 28.9 | 4.7 | 8.3 |
| DK1 | 8-29-86 | 07:55 | 11 | 29.5 | 55.7 | 33.6 | 4.4 | 8.5 | 29.5 | 55.8 | 33.6 | 4.2 | 8.5 | 29.4 | 55.6 | 33.6 | 3.7 | 8.5 |
| DK2 | 8-29-86 | 08:15 | 6 | 29.5 | 55.1 | 33.2 | 5.1 | 8.6 | 29.6 | 55.1 | 33.1 | 5.1 | 8.6 | 29.6 | 55.2 | 33.2 | 4.2 | 8.6 |
| DK3 | 8-29-86 | 08:45 | 8 | 29.6 | 54.8 | 32.9 | 4.8 | 8.6 | 29.6 | 55.2 | 33.2 | 4.7 | 8.6 | 29.7 | 55.9 | 33.6 | 4.6 | 8.6 |
| DK4 | 8-29-86 | 08:30 | 9 | 29.8 | 55.0 | 32.9 | 5.2 | 8.6 | 29.9 | 55.3 | 33.0 | 4.8 | 8.6 | 30.0 | 56.2 | 33.6 | 4.3 | 8.6 |
| DK5 | 8-29-86 | 09:00 | 9 | 29.5 | 53.9 | 32.4 | 5.2 | 8.6 | 29.6 | 55.2 | 33.2 | 5.1 | 8.6 | 30.4 | 54.4 | 32.1 | 4.4 | 8.6 |
| DK6 | 8-29-86 | 09:20 | 8 | 29.6 | 53.8 | 32.2 | 5.0 | 8.6 | 30.3 | 55.7 | 33.0 | 4.8 | 8.6 | 30.5 | 55.3 | 32.6 | 4.4 | 8.6 |
| DK7 | 8-29-86 | 09:48 | 10 | 29.7 | 53.6 | 32.0 | 4.4 | 8.5 | 29.8 | 54.7 | 32.7 | 4.4 | 8.6 | 30.5 | 55.2 | 32.6 | 4.7 | 8.6 |
| DK8 | 8-29-86 | 09:32 | 8 | 29.7 | 53.1 | 31.7 | 4.8 | 8.6 | 29.6 | 54.1 | 32.4 | 4.8 | 8.6 | 30.5 | 54.4 | 32.0 | 4.7 | 8.6 |
| DK9 | 8-29-86 | 10:08 | 9 | 29.6 | 53.3 | 31.9 | 4.8 | 8.6 | 29.7 | 54.3 | 32.5 | 4.3 | 8.6 | 30.6 | 55.1 | 32.4 | 3.5 | 8.6 |
| DK10 | 8-29-86 | 10:20 | 8 | 29.6 | 53.7 | 32.2 | 4.6 | 8.5 | 29.8 | 54.9 | 32.8 | 4.3 | 8.6 | 30.7 | 56.0 | 33.0 | 3.5 | 8.6 |
| DK11 | 8-29-86 | 10:40 | 8 | 29.5 | 52.6 | 31.5 | 4.9 | 8.6 | 29.4 | 53.1 | 31.9 | 4.6 | 8.6 | 29.6 | 53.2 | 31.8 | 3.9 | 8.6 |
| DK12 | 8-29-86 | 10:55 | 7 | 29.6 | 52.0 | 31.0 | 4.6 | 8.6 | 29.6 | 52.3 | 31.2 | 4.9 | 8.6 | 29.7 | 52.7 | 31.4 | 5.0 | 8.6 |
| DK13 | 8-29-86 | 11:25 | 9 | 29.8 | 51.8 | 30.8 | 5.2 | 8.6 | 29.8 | 52.2 | 31.0 | 5.1 | 8.6 | 30.0 | 52.1 | 30.8 | 2.6 | 8.6 |
| KB1 | 8-28-86 | 14:13 | 11 | 31.2 | 52.2 | 30.1 | 5.2 | 8.5 | 30.7 | 52.3 | 30.5 | 4.1 | 8.5 | 30.6 | 52.2 | 30.5 | 3.6 | 8.6 |
| KB2 | 8-28-86 | 14:02 | 11 | 31.8 | 52.0 | 29.7 | 4.9 | 8.5 | 30.6 | 52.1 | 30.5 | 5.2 | 8.6 | 30.6 | 52.7 | 30.8 | 4.2 | 8.6 |
| KB3 | 8-28-86 | 13:50 | 11 | 30.6 | 52.4 | 30.6 | 5.2 | 8.5 | 30.5 | 52.8 | 31.0 | 4.6 | 8.5 | 30.4 | 52.8 | 31.0 | 4.4 | 8.6 |
| KB4 | 8-28-86 | 13:35 | 12 | 31 | 52.8 | 30.7 | 5.4 | 8.5 | 30.0 | 53.5 | 31.8 | 4.9 | 8.6 | 29.3 | 53.5 | 32.2 | 4.0 | 8.6 |
| KB5 | 8-28-86 | 13:00 | 11 | 31.7 | 52.6 | 30.1 | 5.3 | 8.4 | 30.7 | 52.4 | 30.6 | 5.3 | 8.4 | 30.6 | 52.4 | 30.6 | 5.3 | 8.4 |
| KB6 | 8-28-86 | 13:25 | 9 | 31.1 | 51.7 | 29.9 | 5.8 | 8.4 | 30.7 | 51.8 | 30.2 | 5.4 | 8.4 | 30.2 | 51.8 | 30.5 | 4.4 | 8.3 |
| KB7 | 8-28-86 | 12:20 | 10 | 30.6 | 52.1 | 30.5 | 5.2 | 8.4 | 30.4 | 52.1 | 36.0 | 5.1 | 8.4 | 30.3 | 51.9 | 30.5 | 4.7 | 8.3 |
| 43 | 8-28-86 | 15:00 | 13 | 30.5 | 60.3 | 36.0 | 6.5 | 8.5 | 29.9 | 60.3 | 36.4 | 6.2 | 8.5 | 29.9 | 60.6 | 36.6 | 6.8 | 8.4 |

| STATION | DATE | TIME | DEPTH | SURFACE TEMP | COND | SAL | DO | pH | MID TEMP | COND | SAL | DO | pH | BOTTOM TEMP | COND | SAL | DO | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BC1 | 9-25-86 | 09:24 | 15 | 28.4 | 0.5 | 0.0 | | 8.0 | 28.4 | 2.4 | 1.0 | | 8.0 | 29.0 | 24.3 | 13.5 | | 7.7 |
| BC2 | 9-25-86 | 09:12 | 16 | 28.4 | 33.5 | 19.5 | | 7.8 | 28.9 | 41.6 | 24.5 | | 8.0 | 29.1 | 45.0 | 26.7 | | 8.1 |
| BC3 | 9-25-86 | 08:50 | 20 | 28.5 | 34.2 | 19.9 | | 7.8 | 29.1 | 44.8 | 26.5 | | 8.1 | 29.1 | 46.0 | 27.3 | | 8.1 |
| BC4 | 9-25-86 | 08:37 | 10 | 28.6 | 34.6 | 20.1 | | 7.8 | 28.9 | 40.6 | 23.9 | | 8.3 | 29.2 | 45.6 | 27.0 | | 8.1 |
| BC5 | 9-25-86 | 08:30 | 15 | 28.6 | 38.6 | 22.7 | | 8.2 | 29.3 | 44.3 | 26.1 | | 8.2 | 29.3 | 46.0 | 27.2 | | 8.1 |
| BC6 | 9-25-86 | 08:22 | 15 | 29.1 | 38.8 | 22.6 | | 8.2 | 29.2 | 44.9 | 26.5 | | 8.2 | 29.2 | 44.9 | 26.5 | | 8.0 |
| BC7 | 9-25-86 | 08:16 | 4 | 28.4 | 39.5 | 23.4 | | 8.2 | | | | | | 28.9 | 40.8 | 24.0 | | 8.1 |
| LR1 | 9-25-86 | 11:11 | 7 | 28.3 | 0.1 | 0.0 | | 7.8 | 28.2 | 0.1 | 0.0 | | 7.9 | 28.2 | 0.1 | 0.0 | | 7.9 |
| LR2 | 9-25-86 | 10:49 | 6 | 28.2 | 4.1 | 2.0 | | 7.8 | 28.2 | 4.5 | 2.2 | | 7.7 | 28.6 | 22.7 | 12.7 | | 7.6 |
| LR3 | 9-25-86 | 10:38 | 11 | 28.4 | 11.3 | 6.0 | | 7.7 | 29.0 | 32.0 | 18.3 | | 7.8 | 29.1 | 40.8 | 23.9 | | 8.1 |
| LR4 | 9-25-86 | 10:28 | 9 | 28.7 | 20.0 | 11.0 | | 7.8 | 29.0 | 39.4 | 23.0 | | 8.1 | 29.0 | 41.7 | 24.5 | | 8.1 |
| LR5 | 9-25-86 | 10:18 | 6 | 28.9 | 30.0 | 17.1 | | 8.0 | 29.1 | 37.7 | 21.9 | | 8.1 | 29.1 | 41.8 | 24.6 | | 8.1 |
| LR6 | 9-25-86 | 09:50 | 11 | 28.2 | 33.7 | 19.7 | | 8.2 | 29.1 | 41.2 | 24.2 | | 8.1 | 29.1 | 43.8 | 25.9 | | 8.1 |
| LR7 | 9-25-86 | 09:58 | 8 | 28.5 | 32.4 | 18.8 | | 8.0 | 28.6 | 39.1 | 23.0 | | 8.1 | 28.7 | 41.6 | 24.6 | | 8.2 |
| LR8 | 9-25-86 | 10:05 | 12 | 28.9 | 38.1 | 22.3 | | 8.2 | 28.8 | 41.1 | 24.3 | | 8.2 | 29.0 | 42.6 | 25.1 | | 8.1 |
| LR9 | 9-25-86 | 10:12 | 8 | 28.8 | 35.4 | 20.6 | | 8.1 | 28.7 | 37.5 | 22.0 | | 7.1 | 28.9 | 41.6 | 24.5 | | 8.1 |
| DK1 | 9-23-86 | 08:40 | 11 | 27.0 | 46.7 | 29.0 | | 8.3 | 27.5 | 48.2 | 29.8 | | 8.3 | 27.5 | 48.3 | 29.8 | | 8.3 |
| DK2 | 9-23-86 | 09:40 | 6 | 28.3 | 46.4 | 28.1 | | 8.3 | 27.4 | 46.5 | 28.7 | | 8.3 | 27.6 | 46.9 | 28.8 | | 8.3 |
| DK3 | 9-23-86 | 08:52 | 9 | 28.2 | 47.3 | 28.7 | | 8.3 | 27.4 | 47.8 | 29.6 | | 8.4 | 27.5 | 48.4 | 29.9 | | 8.3 |
| DK4 | 9-23-86 | 09:29 | 9 | 27.1 | 46.8 | 29.1 | | 8.4 | 27.2 | 46.7 | 28.9 | | 8.3 | 27.5 | 48.0 | 29.6 | | 8.4 |
| DK5 | 9-23-86 | 09:20 | 9 | 27.5 | 46.3 | 28.5 | | 8.3 | 27.8 | 46.6 | 28.5 | | 8.3 | 28.0 | 47.8 | 29.2 | | 8.3 |
| DK6 | 9-23-86 | 09:12 | 8 | 27.6 | 46.8 | 28.7 | | 8.3 | 27.9 | 47.1 | 28.8 | | 8.3 | 27.6 | 47.1 | 29.0 | | 8.2 |
| DK7 | 9-23-86 | 09:04 | 9 | 27.6 | 47.3 | 29.1 | | 8.2 | 27.7 | 47.7 | 29.3 | | 8.3 | 27.8 | 48.5 | 29.8 | | 8.3 |
| DK8 | 9-23-86 | 09:50 | 9 | 27.5 | 46.6 | 28.7 | | 8.4 | 27.7 | 46.8 | 28.7 | | 8.4 | 27.7 | 47.2 | 29.0 | | 8.3 |
| DK9 | 9-23-86 | 09:59 | 9 | 27.7 | 46.4 | 28.4 | | 8.4 | 27.8 | 46.8 | 28.6 | | 8.4 | 28.0 | 47.4 | 28.9 | | 8.4 |
| DK10 | 9-23-86 | 10:07 | 9 | 27.6 | 46.7 | 28.7 | | 8.4 | 28.0 | 47.0 | 28.6 | | 8.4 | 28.0 | 47.5 | 29.0 | | 8.4 |
| DK11 | 9-23-86 | 10:15 | 9 | 28.1 | 47.0 | 28.6 | | 8.4 | 28.2 | 47.4 | 28.8 | | 8.4 | 28.1 | 47.5 | 28.9 | | 8.4 |
| DK12 | 9-23-86 | 10:24 | 8 | 27.5 | 46.0 | 28.3 | | 8.4 | 27.7 | 46.4 | 28.4 | | 8.4 | 27.9 | 46.7 | 28.5 | | 8.3 |
| DK13 | 9-23-86 | 10:45 | 9 | 27.6 | 45.2 | 27.7 | | 8.3 | 27.6 | 45.7 | 28.0 | | 8.3 | 27.7 | 46.2 | 28.3 | | 8.3 |
| KB1 | 9-23-86 | 12:32 | 13 | 28.1 | 43.5 | 26.2 | | 8.2 | 27.9 | 44.1 | 26.7 | | 8.2 | 27.9 | 45.3 | 27.5 | | 8.2 |
| KB2 | 9-23-86 | 12:25 | 12 | 28.0 | 43.7 | 26.4 | | 8.2 | 27.9 | 44.5 | 27.0 | | 8.2 | 27.9 | 45.1 | 27.4 | | 8.2 |
| KB3 | 9-23-86 | 12:16 | 12 | 28.2 | 42.7 | 25.6 | | 8.3 | 28.0 | 44.4 | 26.9 | | 8.2 | 27.8 | 45.6 | 27.8 | | 8.3 |
| KB4 | 9-23-86 | 12:07 | 12 | 28.8 | 44.7 | 26.6 | | 8.3 | 28.0 | 45.3 | 27.5 | | 8.2 | 27.5 | 45.7 | 28.1 | | 8.2 |
| KB5 | 9-23-86 | 11:41 | 11 | 28.0 | 44.1 | 26.7 | | 8.3 | 28.0 | 44.4 | 26.9 | | 8.3 | 28.3 | 45.1 | 27.2 | | 8.2 |
| KB6 | 9-23-86 | 11:59 | 11 | 28.2 | 43.6 | 26.2 | | 8.3 | 27.4 | 44.6 | 27.4 | | 8.3 | 26.9 | 45.2 | 28.1 | | 8.3 |
| KB7 | 9-23-86 | 11:21 | 8 | 26.8 | 45.2 | 28.1 | | 8.4 | 26.9 | 45.3 | 28.1 | | 8.4 | 26.8 | 45.6 | 28.4 | | 8.4 |
| 43 | 9-23-86 | 13:01 | 14 | 27.0 | 52.1 | 32.8 | | 8.4 | 26.6 | 52.5 | 33.4 | | 8.5 | 26.7 | 52.9 | 33.6 | | 8.5 |

| | | | | | | SURFACE | | | | | MID | | | | | BOTTOM | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | DATE | TIME | DEPTH | TEMP | COND | SAL | DO | pH | TEMP | COND | SAL | DO | pH | TEMP | COND | SAL | DO | pH |
| BC1 | 10-28-86 | 09:31 | 6 | 27.0 | 0.1 | 0.0 | 2.6 | 7.8 | 26.8 | 0.0 | 0.0 | 2.5 | 7.7 | 26.8 | 0.0 | 0.0 | 2.5 | 7.7 |
| BC2 | 10-28-86 | 09:18 | 16 | 26.9 | 2.6 | 1.2 | 4.6 | 7.8 | 26.8 | 3.9 | 1.9 | 4.2 | 7.6 | 26.8 | 50.2 | 31.6 | 3.9 | 8.0 |
| BC3 | 10-28-86 | 09:08 | 18 | 26.8 | 4.3 | 2.1 | 2.8 | 7.6 | 26.8 | 51.2 | 32.3 | 4.2 | 8.0 | 26.6 | 51.6 | 32.8 | 3.7 | 8.0 |
| BC4 | 10-28-86 | 08:53 | 20 | 26.8 | 8.8 | 4.7 | 3.1 | 7.6 | 27.2 | 51.0 | 31.9 | 3.6 | 8.0 | 26.6 | 51.5 | 32.7 | 4.3 | 8.1 |
| BC5 | 10-28-86 | 08:47 | 14 | 27.1 | 40.0 | 24.4 | 5.5 | 7.9 | 27.3 | 51.1 | 31.9 | 4.9 | 8.0 | 26.6 | 51.9 | 33.0 | 3.7 | 8.0 |
| BC6 | 10-28-86 | 08:44 | 15 | 26.9 | 21.8 | 12.6 | 3.9 | 7.6 | 27.2 | 50.5 | 31.6 | 3.9 | 8.0 | 26.6 | 51.7 | 32.8 | 3.9 | 8.0 |
| BC7 | 10-28-86 | 08:33 | 7 | 26.9 | 36.2 | 21.9 | 5.2 | 7.9 | 27.2 | 48.0 | 29.8 | 5.7 | 8.1 | 27.3 | 51.6 | 32.3 | 3.3 | 7.9 |
| LR1 | 10-28-86 | 11:13 | 8 | 27.1 | 0.3 | 0.0 | 1.8 | 7.7 | 27.1 | 0.2 | 0.0 | 1.2 | 7.7 | 27.1 | 0.2 | 0.0 | 1.0 | 7.7 |
| LR2 | 10-28-86 | 10:48 | 5 | 27.0 | 0.7 | 0.2 | 1.4 | 7.5 | 27.0 | 0.6 | 0.1 | 1.3 | 7.5 | 27.0 | 0.6 | 0.1 | 1.2 | 7.4 |
| LR3 | 10-28-86 | 10:38 | 10 | 27.1 | 4.6 | 2.3 | 1.8 | 7.5 | 27.0 | 12.7 | 7.0 | 1.8 | 7.4 | 27.2 | 49.8 | 31.1 | 4.0 | 8.0 |
| LR4 | 10-28-86 | 10:28 | 9 | 27.2 | 1.2 | 0.4 | 2.3 | 7.4 | 27.1 | 50.7 | 31.8 | 4.2 | 8.0 | 27.1 | 51.4 | 32.3 | 4.3 | 8.0 |
| LR5 | 10-28-86 | 10:23 | 6 | 27.2 | 23.0 | 13.2 | 3.2 | 7.5 | 27.2 | 49.8 | 31.1 | 4.5 | 8.0 | 27.1 | 51.3 | 32.2 | 4.6 | 8.1 |
| LR6 | 10-28-86 | 09:58 | 6 | 26.8 | 46.7 | 29.2 | 5.9 | 8.1 | 26.7 | 48.5 | 30.5 | 5.1 | 8.1 | 27.0 | 51.8 | 32.6 | 4.5 | 8.0 |
| LR7 | 10-28-86 | 10:04 | 9 | 27.0 | 32.7 | 19.6 | 4.1 | 7.7 | 27.1 | 49.9 | 31.2 | 5.1 | 8.1 | 27.0 | 51.9 | 32.7 | 5.0 | 8.1 |
| LR8 | 10-28-86 | 10:10 | 13 | 27.1 | 35.0 | 21.0 | 3.3 | 7.7 | 27.1 | 51.0 | 32.0 | 4.8 | 8.1 | 27.0 | 51.7 | 32.6 | 4.8 | 8.1 |
| LR9 | 10-28-86 | 10:17 | 8 | 27.0 | 48.4 | 30.2 | 5.5 | 8.1 | 27.0 | 49.5 | 31.0 | 5.0 | 8.1 | 27.1 | 51.4 | 32.3 | 5.0 | 8.1 |
| DK1 | 10-30-86 | 08:09 | 12 | 27.7 | 53.6 | 33.4 | 5.7 | 8.2 | 27.7 | 53.7 | 33.5 | 5.7 | 8.2 | 27.8 | 53.8 | 33.5 | 5.8 | 8.2 |
| DK2 | 10-30-86 | 08:33 | 7 | 27.9 | 52.9 | 32.8 | 5.4 | 8.1 | 27.8 | 52.9 | 32.8 | 5.3 | 8.1 | 27.7 | 53.2 | 33.1 | 3.7 | 8.0 |
| DK3 | 10-30-86 | 08:18 | 10 | 27.7 | 53.6 | 33.4 | 5.8 | 8.2 | 27.8 | 53.7 | 33.4 | 5.9 | 8.2 | 27.8 | 54.2 | 33.7 | 5.9 | 8.2 |
| DK4 | 10-30-86 | 08:23 | 10 | 27.9 | 53.0 | 32.8 | 5.5 | 8.1 | 27.9 | 53.0 | 32.8 | 5.2 | 8.1 | 27.8 | 53.2 | 33.0 | 5.2 | 8.1 |
| DK5 | 10-30-86 | 08:42 | 10 | 28.2 | 53.2 | 32.8 | 5.3 | 8.2 | 28.2 | 53.4 | 32.9 | 4.8 | 8.1 | 28.0 | 53.3 | 33.0 | 4.2 | 8.1 |
| DK6 | 10-30-86 | 08:50 | 10 | 28.3 | 53.3 | 32.8 | 4.9 | 8.2 | 28.2 | 53.4 | 32.9 | 4.9 | 8.2 | 28.2 | 53.7 | 33.1 | 4.7 | 8.2 |
| DK7 | 10-30-86 | 09:05 | 11 | 27.9 | 53.3 | 33.0 | 5.2 | 8.2 | 28.0 | 53.4 | 33.0 | 4.9 | 8.2 | 28.0 | 53.9 | 33.4 | 4.8 | 8.2 |
| DK8 | 10-30-86 | 08:57 | 9 | 28.4 | 53.5 | 32.8 | 5.3 | 8.2 | 28.3 | 53.5 | 32.9 | 5.1 | 8.2 | 28.1 | 53.8 | 33.3 | 4.9 | 8.2 |
| DK9 | 10-30-86 | 09:14 | 10 | 28.3 | 53.3 | 32.8 | 5.7 | 8.2 | 28.4 | 53.3 | 32.7 | 5.7 | 8.2 | 28.2 | 53.8 | 33.2 | 4.7 | 8.2 |
| DK10 | 10-30-86 | 09:23 | 10 | 28.0 | 53.3 | 33.0 | 5.2 | 8.2 | 28.0 | 53.4 | 33.0 | 5.0 | 8.2 | 27.9 | 53.7 | 33.3 | 4.7 | 8.2 |
| DK11 | 10-30-86 | 09:33 | 9 | 28.4 | 53.2 | 32.6 | 5.6 | 8.2 | 28.4 | 53.2 | 32.6 | 5.4 | 8.2 | 28.3 | 53.4 | 32.8 | 5.1 | 8.2 |
| DK12 | 10-30-86 | 09:43 | 8 | 28.3 | 52.6 | 32.3 | 5.0 | 8.2 | 28.3 | 52.8 | 32.4 | 5.1 | 8.2 | 28.4 | 53.3 | 32.7 | 5.3 | 8.2 |
| DK13 | 10-30-86 | 10:04 | 10 | 27.7 | 50.2 | 31.0 | 6.2 | 8.1 | 28.0 | 51.5 | 31.7 | 6.1 | 8.1 | 28.2 | 53.0 | 32.6 | 5.2 | 8.2 |
| KB1 | 10-30-86 | 11:36 | 12 | 28.7 | 51.7 | 31.4 | 4.3 | 8.0 | 28.6 | 52.6 | 32.1 | 3.4 | 8.0 | 28.4 | 54.0 | 33.2 | 3.9 | 8.1 |
| KB2 | 10-30-86 | 11:24 | 11 | 28.6 | 51.6 | 31.4 | 4.5 | 8.0 | 28.5 | 52.4 | 32.0 | 3.9 | 8.0 | 28.3 | 54.1 | 33.3 | 3.8 | 8.2 |
| KB3 | 10-30-86 | 11:29 | 12 | 28.8 | 51.9 | 31.5 | 4.4 | 8.0 | 28.6 | 53.1 | 32.4 | 3.8 | 8.1 | 28.4 | 54.1 | 33.2 | 3.8 | 8.1 |
| KB4 | 10-30-86 | 11:13 | 12 | 28.5 | 52.3 | 31.9 | 4.2 | 8.0 | 28.4 | 52.5 | 32.1 | 3.8 | 8.0 | 28.0 | 53.9 | 33.4 | 3.5 | 8.1 |
| KB5 | 10-30-86 | 10:48 | 11 | 28.4 | 52.7 | 32.3 | 5.0 | 8.0 | 28.3 | 52.5 | 32.2 | 5.0 | 8.0 | 28.5 | 53.1 | 32.5 | 3.8 | 7.9 |
| KB6 | 10-30-86 | 11:05 | 10 | 28.7 | 52.0 | 31.6 | 4.6 | 8.0 | 28.5 | 53.2 | 32.6 | 4.2 | 8.1 | 27.9 | 54.0 | 33.5 | 3.5 | 8.2 |
| KB7 | 10-30-86 | 10:32 | 11 | 28.3 | 53.4 | 32.8 | 4.0 | 8.1 | 28.3 | 53.6 | 33.0 | 3.8 | 8.1 | 28.1 | 54.0 | 33.4 | 3.6 | 8.1 |
| 43 | 10-30-86 | 12:07 | 13 | 27.6 | 57.7 | 36.4 | 5.5 | 8.2 | 27.6 | 57.6 | 36.3 | 5.5 | 8.2 | 27.4 | 57.4 | 36.3 | 5.7 | 8.2 |

| STATION | DATE | TIME | DEPTH | SURFACE TEMP | SURFACE COND | SURFACE SAL | SURFACE DO | SURFACE pH | MID TEMP | MID COND | MID SAL | MID DO | MID pH | BOTTOM TEMP | BOTTOM COND | BOTTOM SAL | BOTTOM DO | BOTTOM pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BC1 | 12-01-86 | 10:20 | 13 | 26.5 | 0.3 | 0.1 | 2.9 | 7.7 | 26.5 | 2.4 | 1.1 | 3.0 | 7.7 | 26.8 | 19.8 | 11.3 | 2.9 | 7.5 |
| BC2 | 12-01-86 | 10:10 | 17 | 26.8 | 19.6 | 11.2 | 3.0 | 7.5 | 27.4 | 48.0 | 29.7 | 3.6 | 8.0 | 27.4 | 48.7 | 30.2 | 3.7 | 8.0 |
| BC3 | 12-01-86 | 09:55 | 17 | 26.7 | 18.5 | 10.6 | 3.0 | 7.8 | 27.3 | 49.3 | 30.7 | 4.3 | 8.1 | 27.4 | 51.7 | 32.3 | 3.1 | 8.0 |
| BC4 | 12-01-86 | 09:40 | 19 | 26.9 | 38.0 | 23.1 | 2.9 | 7.6 | 27.5 | 51.5 | 32.1 | 3.3 | 8.2 | 27.4 | 51.2 | 31.9 | 2.8 | 8.0 |
| BC5 | 12-01-86 | 09:25 | 12 | 27.3 | 47.6 | 29.5 | 3.1 | 7.9 | 27.0 | 48.5 | 30.3 | 5.0 | 8.2 | 27.4 | 51.2 | 31.9 | 3.3 | 8.0 |
| BC6 | 12-01-86 | 09:15 | 16 | 27.1 | 46.8 | 29.1 | 3.5 | 8.0 | 27.1 | 48.2 | 30.0 | 4.1 | 8.2 | 27.4 | 51.8 | 32.3 | 3.2 | 8.1 |
| BC7 | 12-01-86 | 09:00 | 10 | 26.7 | 46.6 | 29.2 | 3.4 | 7.9 | 26.8 | 48.0 | 30.1 | 5.1 | 8.2 | 27.0 | 48.5 | 30.3 | 5.4 | 8.2 |
| LR1 | 12-01-86 | 13:00 | | 26.0 | 0.2 | 0.0 | 1.5 | 7.5 | 26.1 | 0.2 | 0.0 | 1.5 | 7.5 | 26.1 | 0.2 | 0.0 | 1.6 | 7.6 |
| LR2 | 12-01-86 | 12:40 | 4 | 26.2 | 6.9 | 3.7 | 1.9 | 7.4 | 26.2 | 7.0 | 3.7 | 2.0 | 7.4 | 26.2 | 8.1 | 4.4 | 2.2 | 7.4 |
| LR3 | 12-01-86 | 12:22 | 7 | 26.4 | 16.7 | 9.5 | 2.3 | 7.4 | 26.4 | 20.2 | 11.7 | 2.6 | 7.4 | 26.6 | 44.3 | 27.6 | 4.2 | 7.9 |
| LR4 | 12-01-86 | 12:05 | 9 | 26.3 | 15.2 | 8.6 | 2.9 | 7.5 | 26.6 | 47.1 | 29.6 | 4.0 | 8.0 | 26.5 | 47.4 | 29.9 | 4.3 | 8.0 |
| LR5 | 12-01-86 | 11:55 | 7 | 26.2 | 15.0 | 8.5 | 3.3 | 7.5 | 26.8 | 44.2 | 27.4 | 3.6 | 7.9 | 26.6 | 46.6 | 29.2 | 4.0 | 8.0 |
| LR6 | 12-01-86 | 11:45 | 7 | 26.1 | 33.5 | 20.5 | 5.2 | 7.9 | 26.4 | 38.7 | 23.9 | 4.9 | 7.9 | 26.5 | 44.9 | 28.1 | 4.7 | 8.0 |
| LR7 | 12-01-86 | 11:36 | 10 | 26.0 | 35.0 | 21.5 | 4.8 | 8.0 | 26.4 | 43.6 | 27.3 | 4.6 | 8.0 | 26.7 | 49.0 | 30.8 | 4.4 | 8.1 |
| LR8 | 12-01-86 | 11:24 | 12 | 26.3 | 34.2 | 20.9 | 4.7 | 7.9 | 26.6 | 45.5 | 28.5 | 4.3 | 8.0 | 26.5 | 48.8 | 30.8 | 4.5 | 8.0 |
| LR9 | 12-01-86 | 11:15 | 9 | 26.5 | 40.4 | 25.0 | 4.5 | 8.0 | 26.4 | 45.1 | 28.3 | 4.5 | 8.0 | 26.5 | 47.9 | 30.2 | 4.4 | 8.0 |
| DK1 | 12-03-86 | 08:25 | 12 | 26.2 | 53.2 | 34.2 | 4.4 | 8.2 | 26.3 | 53.4 | 34.3 | 4.3 | 8.2 | 26.9 | 54.5 | 34.6 | 3.5 | 8.1 |
| DK2 | 12-03-86 | 09:00 | 6 | 25.7 | 50.5 | 32.6 | 3.4 | 8.0 | 25.8 | 50.6 | 32.6 | 3.2 | 8.0 | 25.8 | 50.7 | 32.7 | 3.2 | 8.0 |
| DK3 | 12-03-86 | 08:35 | 10 | 25.8 | 52.0 | 33.6 | 4.5 | 8.2 | 25.9 | 52.0 | 33.6 | 4.5 | 8.2 | 25.9 | 52.0 | 33.6 | 4.5 | 8.2 |
| DK4 | 12-03-86 | 09:10 | 10 | 25.9 | 51.1 | 32.9 | 4.2 | 8.2 | 25.9 | 51.2 | 33.0 | 4.1 | 8.2 | 26.0 | 51.2 | 32.9 | 4.2 | 8.2 |
| DK5 | 12-03-86 | 09:35 | 10 | 26.7 | 51.2 | 32.4 | 3.9 | 8.2 | 26.6 | 51.4 | 32.6 | 3.9 | 8.2 | 26.6 | 51.5 | 32.7 | 3.7 | 8.2 |
| DK6 | 12-03-86 | 09:20 | 9 | 26.5 | 51.3 | 32.6 | 5.4 | 8.1 | 26.3 | 51.2 | 32.7 | 3.9 | 8.1 | 26.2 | 51.2 | 32.8 | 3.8 | 8.1 |
| DK7 | 12-03-86 | 10:00 | 12 | 25.9 | 51.0 | 32.8 | 3.7 | 8.1 | 26.0 | 51.1 | 32.8 | 3.7 | 8.1 | 25.9 | 51.2 | 33.0 | 3.8 | 8.2 |
| DK8 | 12-03-86 | 10:10 | 10 | 26.2 | 51.1 | 32.7 | 3.6 | 8.1 | 26.2 | 51.1 | 32.7 | 3.7 | 8.1 | 26.2 | 51.2 | 32.8 | 3.7 | 8.1 |
| DK9 | 12-03-86 | 10:25 | 10 | 26.5 | 51.3 | 32.6 | 3.4 | 8.1 | 26.3 | 51.2 | 32.7 | 3.4 | 8.1 | 26.2 | 51.2 | 32.8 | 3.4 | 8.1 |
| DK10 | 12-03-86 | 10:40 | 10 | 26.2 | 51.2 | 32.8 | 3.7 | 8.1 | 26.2 | 51.2 | 32.8 | 3.7 | 8.1 | 26.1 | 51.2 | 32.8 | 3.7 | 8.1 |
| DK11 | 12-03-86 | 10:50 | 11 | 26.4 | 51.3 | 32.7 | 3.4 | 8.1 | 26.4 | 51.3 | 32.7 | 3.4 | 8.1 | 26.3 | 51.1 | 32.6 | 3.4 | 8.1 |
| DK12 | 12-03-86 | 11:00 | 9 | 26.4 | 51.2 | 32.6 | 5.5 | 8.1 | 26.5 | 51.3 | 32.6 | 3.6 | 8.1 | 26.5 | 51.2 | 32.5 | 3.7 | 8.1 |
| DK13 | 12-03-86 | 11:20 | 9 | 26.6 | 50.9 | 32.3 | 3.4 | 8.1 | 26.6 | 50.9 | 32.3 | 3.3 | 8.1 | 26.6 | 50.9 | 32.3 | 3.4 | 8.1 |
| KB1 | 12-03-86 | 13:10 | 13 | 27.1 | 47.2 | 29.3 | 2.5 | 7.9 | 26.9 | 47.4 | 29.6 | 2.0 | 7.9 | 26.4 | 47.1 | 29.7 | 2.2 | 8.0 |
| KB2 | 12-03-86 | 12:50 | 12 | 26.8 | 46.9 | 29.3 | 2.4 | 7.9 | 27.0 | 47.0 | 29.3 | 2.3 | 7.9 | 26.2 | 46.8 | 29.6 | 2.2 | 8.0 |
| KB3 | 12-03-86 | 13:00 | 13 | 27.3 | 47.1 | 29.1 | 2.5 | 7.9 | 27.0 | 47.1 | 29.3 | 2.3 | 7.9 | 26.5 | 47.2 | 29.7 | 2.1 | 7.9 |
| KB4 | 12-03-86 | 12:40 | 12 | 26.8 | 47.0 | 29.4 | 2.4 | 7.9 | 26.6 | 47.1 | 29.6 | 2.3 | 8.0 | 25.9 | 46.6 | 29.7 | 2.4 | 8.1 |
| KB5 | 12-03-86 | 12:15 | 12 | 26.6 | 48.2 | 30.4 | 2.9 | 8.0 | 26.6 | 48.4 | 30.5 | 2.8 | 8.0 | 27.4 | 50.1 | 31.2 | 1.6 | 7.9 |
| KB6 | 12-03-86 | 12:30 | 11 | 26.6 | 46.9 | 29.4 | 2.8 | 8.0 | 26.7 | 47.1 | 29.5 | 2.8 | 8.0 | 26.0 | 46.6 | 29.6 | 2.4 | 8.0 |
| KB7 | 12-03-86 | 11:55 | 9 | 26.0 | 47.1 | 30.0 | 2.4 | 8.0 | 26.1 | 47.0 | 29.8 | 2.4 | 8.0 | 26.1 | 47.1 | 29.9 | 2.4 | 8.0 |
| 43 | 12-03-86 | 13:40 | 13 | 26.2 | 54.3 | 35.0 | 4.4 | 8.2 | 26.2 | 54.3 | 35.0 | 4.4 | 8.2 | 26.1 | 54.5 | 35.2 | 4.7 | 8.2 |

| | | | | SURFACE | | | | | MID | | | | | BOTTOM | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | DATE | TIME | DEPTH | TEMP | COND | SAL | DO | pH | TEMP | COND | SAL | DO | pH | TEMP | COND | SAL | DO | pH |
| BC1 | 01-06-87 | 09:44 | 15 | 20.6 | 0.1 | 0.0 | 5.6 | 7.9 | 20.6 | 0.0 | 0.0 | 3.6 | 7.7 | 20.5 | 0.0 | 0.0 | 3.6 | 7.7 |
| BC2 | 01-06-87 | 09:33 | 18 | 20.6 | 0.2 | 0.0 | 3.9 | 7.7 | 20.4 | 38.3 | 27.0 | 4.5 | 8.0 | 20.3 | 44.4 | 31.9 | 4.2 | 8.1 |
| BC3 | 01-06-87 | 09:22 | 21 | 20.5 | 2.4 | 1.3 | 4.0 | 8.1 | 19.6 | 44.2 | 32.3 | 5.2 | 8.4 | 19.6 | 45.7 | 33.5 | 5.2 | 8.3 |
| BC4 | 01-06-87 | 09:09 | 20 | 20.4 | 6.3 | 3.8 | 4.1 | 7.7 | 19.5 | 45.1 | 33.1 | 5.5 | 8.2 | 19.6 | 46.0 | 33.8 | 5.4 | 8.2 |
| BC5 | 01-06-87 | 08:57 | 16 | 19.1 | 38.0 | 27.6 | 5.8 | 8.1 | 19.5 | 45.2 | 33.2 | 5.5 | 8.2 | 19.5 | 45.9 | 33.8 | 5.5 | 8.2 |
| BC6 | 01-06-87 | 08:48 | 16 | 19.1 | 39.9 | 29.2 | 5.7 | 8.1 | 19.5 | 45.7 | 33.6 | 5.6 | 8.2 | 19.6 | 45.5 | 33.4 | 5.5 | 7.7 |
| BC7 | 01-06-87 | 08:32 | 7 | 19 | 36.2 | 26.2 | 6.0 | 8 | 19.3 | 44 | 32.4 | 5.8 | 8.2 | 19.4 | 46 | 33.9 | 5.6 | 8.2 |
| LR1 | 01-06-87 | 11:24 | 8 | 21.4 | 0.1 | 0.0 | 1.6 | 7.6 | 21.3 | 0.1 | 0.0 | 1.5 | 7.7 | 21.2 | 0.1 | 0.0 | 1.6 | 7.7 |
| LR2 | 01-06-87 | 11:05 | 8 | 21.2 | 0.8 | 0.3 | 2.7 | 7.7 | 21.2 | 0.6 | 0.1 | 2.5 | 7.6 | 20.3 | 22 | 14.7 | 2.9 | 7.5 |
| LR3 | 01-06-87 | 10:54 | 13 | 21.1 | 2.6 | 1.4 | 2.0 | 7.5 | 18.2 | 37.6 | 27.9 | 5.2 | 8 | 18.2 | 40.9 | 30.6 | 5.3 | 8.1 |
| LR4 | 01-06-87 | 10:45 | 11 | 21.1 | 5.9 | 3.5 | 2.3 | 7.5 | 18.1 | 40.5 | 30.4 | 5.4 | 8.1 | 18 | 40.9 | 30.8 | 5.5 | 8.1 |
| LR5 | 01-06-87 | 10:38 | 10 | 20.8 | 11 | 6.9 | 2.9 | 7.5 | 18.2 | 40.2 | 30.1 | 5.4 | 8 | 18.2 | 40.7 | 30.5 | 5.5 | 8 |
| LR6 | 01-06-87 | 10:11 | 8 | 18.6 | 37.4 | 27.5 | 7.1 | 8.1 | 18 | 40.5 | 30.4 | 7.2 | 8.1 | 18 | 40.7 | 30.6 | 7.1 | 8.1 |
| LR7 | 01-06-87 | 10:18 | 10 | 18.3 | 38.5 | 28.6 | 6.3 | 8 | 18.1 | 40.6 | 30.5 | 6.2 | 8.1 | 18 | 40.7 | 30.6 | 6.2 | 8.1 |
| LR8 | 01-06-87 | 10:24 | 14 | 18.3 | 39.7 | 29.6 | 5.8 | 8 | 18.1 | 40.4 | 30.3 | 5.8 | 8.1 | 18 | 40.6 | 30.5 | 5.6 | 8.1 |
| LR9 | 01-06-87 | 10:31 | 10 | 18.7 | 38.4 | 28.2 | 5.5 | 8 | 18.3 | 40.2 | 30.0 | 6.0 | 8.1 | 18.2 | 40.7 | 30.5 | 6.0 | 8.1 |
| DK1 | 01-08-87 | 08:18 | 11 | 19.2 | 43.3 | 31.9 | 5.9 | 8.2 | 19.5 | 43.8 | 32.0 | 6.0 | 8.2 | 19.7 | 44.6 | 32.5 | 6.1 | 8.2 |
| DK2 | 01-08-87 | 08:32 | 6 | 19 | 43.1 | 31.9 | 5.9 | 8.2 | 19 | 43.1 | 31.9 | 5.9 | 8.2 | 19 | 43.1 | 31.9 | 5.9 | 8.2 |
| DK3 | 01-08-87 | 08:17 | 8 | 18.8 | 43 | 31.9 | 6.2 | 8.2 | 18.9 | 43.2 | 32.0 | 6.3 | 8.2 | 19.3 | 44.3 | 32.6 | 6.3 | 8.2 |
| DK4 | 01-08-87 | 08:23 | 9 | 18.9 | 43 | 31.8 | 6.2 | 8.2 | 18.9 | 43 | 31.8 | 6.2 | 8.2 | 18.9 | 43 | 31.8 | 6.2 | 8.2 |
| DK5 | 01-08-87 | 08:43 | 9 | 19.2 | 43 | 31.6 | 5.5 | 8.2 | 19.2 | 43.1 | 31.7 | 5.5 | 8.2 | 19.1 | 43.1 | 31.8 | 5.5 | 8.2 |
| DK6 | 01-08-87 | 08:53 | 10 | 19.1 | 43.1 | 31.8 | 5.7 | 8.3 | 19.1 | 43.1 | 31.8 | 6.0 | 8.3 | 19.1 | 43.3 | 31.9 | 5.9 | 8.3 |
| DK7 | 01-08-87 | 09:09 | 10 | 18.9 | 43 | 31.8 | 5.8 | 8.3 | 18.9 | 43.2 | 32.0 | 6.0 | 8.3 | 19 | 43.6 | 32.3 | 5.7 | 8.2 |
| DK8 | 01-08-87 | 09:01 | 9 | 19.1 | 43.1 | 31.8 | 5.8 | 8.3 | 19.2 | 43.2 | 31.8 | 6.0 | 8.3 | 19.1 | 43.3 | 31.9 | 5.7 | 8.2 |
| DK9 | 01-08-87 | 09:16 | 9 | 19.2 | 43.1 | 31.7 | 5.8 | 8.3 | 19.1 | 43.1 | 31.8 | 6.0 | 8.3 | 19.2 | 43.3 | 31.9 | 5.9 | 8.3 |
| DK10 | 01-08-87 | 09:25 | 8 | 19 | 42.9 | 31.7 | 5.7 | 8.3 | 19 | 43.1 | 31.9 | 5.7 | 8.3 | 19 | 43.6 | 32.3 | 5.7 | 8.3 |
| DK11 | 01-08-87 | 09:32 | 9 | 19.2 | 43.1 | 31.7 | 5.6 | 8.3 | 19.2 | 43.2 | 31.8 | 5.6 | 8.3 | 19.3 | 43.4 | 31.9 | 5.8 | 8.3 |
| DK12 | 01-08-87 | 09:40 | 8 | 19.5 | 42.5 | 31.0 | 5.4 | 8.2 | 19.3 | 42.8 | 31.4 | 5.5 | 8.2 | 19.3 | 43.2 | 31.7 | 5.8 | 8.2 |
| DK13 | 01-08-87 | 09:53 | 8 | 19.7 | 43.1 | 31.3 | 5.3 | 8.2 | 19.5 | 43.2 | 31.6 | 5.3 | 8.2 | 19.5 | 43.4 | 31.7 | 5.4 | 8.2 |
| KB1 | 01-08-87 | 11:13 | 12 | 19.8 | 41.4 | 29.9 | 4.9 | 8.2 | 19.2 | 41.4 | 30.3 | 5.0 | 8.2 | 19 | 41.4 | 30.5 | 5.0 | 8.2 |
| KB2 | 01-08-87 | 11:07 | 11 | 19.1 | 41 | 30.1 | 5.0 | 8.2 | 18.8 | 40.9 | 30.2 | 5.0 | 8.2 | 19.2 | 42 | 30.8 | 5.2 | 8.2 |
| KB3 | 01-08-87 | 11:00 | 12 | 19.8 | 41.2 | 29.7 | 5.0 | 8.2 | 19 | 40.9 | 30.0 | 5.0 | 8.2 | 19 | 41.5 | 30.5 | 5.1 | 8.2 |
| KB4 | 01-08-87 | 10:51 | 12 | 19 | 41 | 30.1 | 5.1 | 8.2 | 18.9 | 41 | 30.2 | 5.2 | 8.2 | 19.5 | 42.2 | 30.7 | 5.6 | 8.3 |
| KB5 | 01-08-87 | 10:34 | 13 | 19.4 | 39.3 | 28.5 | 6.1 | 8.1 | 19.3 | 39.8 | 28.9 | 6.0 | 8.2 | 19.6 | 40.8 | 29.5 | 4.8 | 8.2 |
| KB6 | 01-08-87 | 10:44 | 9 | 19.3 | 41.1 | 30.0 | 5.2 | 8.2 | 19.2 | 41 | 30.0 | 5.2 | 8.2 | 19.3 | 42 | 30.7 | 5.6 | 8.2 |
| KB7 | 01-08-87 | 10:18 | 10 | 19.3 | 40.5 | 29.5 | 6.7 | 8.2 | 19.2 | 40.9 | 29.9 | 7.2 | 8.2 | 19.3 | 41.6 | 30.4 | 7.3 | 8.3 |
| 43 | 01-08-87 | 11:41 | 13 | 19.6 | 45.5 | 33.4 | 5.6 | 8.2 | 19 | 45 | 33.4 | 5.7 | 8.2 | 19.2 | 45.5 | 33.7 | 5.8 | 8.2 |

| | | | | | | SURFACE | | | | | MID | | | | | BOTTOM | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | DATE | TIME | DEPTH | TEMP | COND | SAL | DO | pH | TEMP | COND | SAL | DO | pH | TEMP | COND | SAL | DO | pH |
| BC1 | 02-10-87 | 10:15 | 14 | 20.8 | 0 | 0.0 | 6.6 | 8.2 | 22.8 | 0 | 0.0 | 7.8 | 8.2 | 20.7 | 0 | 0.0 | 7.3 | 8.2 |
| BC2 | 02-10-87 | 09:58 | 17 | 21.4 | 35.8 | 24.5 | 6.9 | 8 | 22.6 | 41.6 | 28.1 | 7.1 | 8.3 | 22.1 | 43.3 | 29.8 | 4.5 | 8.3 |
| BC3 | 02-10-87 | 09:46 | 21 | 20.9 | 35.5 | 24.5 | 4.8 | 8 | 22 | 43 | 29.6 | 5.5 | 8.4 | 22.5 | 44.2 | 30.2 | 5.3 | 8.4 |
| BC4 | 02-10-87 | 09:35 | 9 | 21.3 | 37.2 | 25.6 | 5.5 | 8.1 | 20.2 | 41 | 29.3 | 6.3 | 8.4 | 19.7 | 41 | 29.6 | 6.3 | 8.4 |
| BC5 | 02-10-87 | 09:26 | 15 | 19.2 | 40.1 | 29.3 | 7.5 | 8.4 | 19 | 40.2 | 29.5 | 8.7 | 8.4 | 18.9 | 40 | 29.4 | 6.6 | 8.4 |
| BC6 | 02-10-87 | 09:21 | 15 | 20.4 | 38.7 | 27.3 | 5.6 | 8.3 | 19.4 | 40.3 | 29.3 | 6.5 | 8.4 | 20.1 | 41.5 | 29.7 | 6.2 | 8.5 |
| BC7 | 02-10-87 | 09:13 | 8 | 19.9 | 16.5 | 10.9 | 7.3 | 8.4 | 19.8 | 16.5 | 10.9 | 7.4 | 8.4 | 18.9 | 16.4 | 11.0 | 7.5 | 8.5 |
| LR1 | 02-10-87 | 12:02 | 9 | 21.4 | 0 | 0.0 | 3.0 | 7.7 | 21 | 0 | 0.0 | 2.8 | 7.7 | 20.9 | 0 | 0.0 | 3.0 | 7.7 |
| LR2 | 02-10-87 | 11:39 | 6 | 21.4 | 5.6 | 3.2 | 4.9 | 7.6 | 21.3 | 7.8 | 4.7 | 3.4 | 7.6 | 20.4 | 37.3 | 26.2 | 5.2 | 8.2 |
| LR3 | 02-10-87 | 11:27 | 10 | 21.3 | 10 | 6.1 | 5.4 | 7.6 | 19.9 | 38 | 27.1 | 7.3 | 8.3 | 20 | 40.8 | 29.3 | 6.0 | 8.3 |
| LR4 | 02-10-87 | 11:15 | 12 | 21.1 | 13.5 | 8.5 | 4.9 | 7.7 | 19.2 | 35 | 25.2 | 6.7 | 8.4 | 19.5 | 40.1 | 29.0 | 6.8 | 8.3 |
| LR5 | 02-10-87 | 11:09 | 6 | 20.8 | 19.6 | 12.8 | 8.3 | 7.9 | 20.1 | 38.4 | 27.3 | 6.1 | 8.3 | 20 | 39.7 | 28.4 | 6.0 | 8.3 |
| LR6 | 02-10-87 | 10:42 | 7 | 18.6 | 38.5 | 28.4 | 7.9 | 8.2 | 18.6 | 38.9 | 28.7 | 8.6 | 8.3 | 18.6 | 38.8 | 28.6 | 6.7 | 8.3 |
| LR7 | 02-10-87 | 10:51 | 9 | 20.1 | 26.6 | 18.2 | 5.6 | 8.1 | 18.5 | 38.2 | 28.2 | 6.8 | 8.3 | 18.5 | 38.7 | 28.6 | 6.7 | 8.3 |
| LR8 | 02-10-87 | 10:57 | 12 | 19.4 | 33.8 | 24.1 | 8.3 | 8.1 | 18.6 | 37.9 | 27.9 | 8.9 | 8.3 | 18.5 | 38.5 | 28.4 | 6.8 | 8.3 |
| LR9 | 02-10-87 | 11:03 | 8 | 19 | 36.2 | 26.2 | 7.3 | 8.2 | 18.7 | 38.3 | 28.1 | 7.4 | 8.3 | 18.7 | 38.5 | 28.3 | 7.0 | 8.3 |
| DK1 | 02-12-87 | 08:25 | 12 | 19.8 | 27 | 18.6 | 6.0 | 8.2 | 19.8 | 27.1 | 18.7 | 6.4 | 8.2 | 19.9 | 27 | 18.6 | 6.3 | 8.2 |
| DK2 | 02-12-87 | 08:57 | 7 | 19.2 | 37.9 | 27.5 | 7.3 | 8.2 | 19.5 | 38.4 | 27.7 | 7.6 | 8.2 | 19.2 | 36.4 | 26.3 | 5.1 | 8.2 |
| DK3 | 02-12-87 | 08:40 | 10 | 19.2 | 39.1 | 28.4 | 7.0 | 8.3 | 19.2 | 39.1 | 28.4 | 7.3 | 8.3 | 19.2 | 39.1 | 28.4 | 6.4 | 8.3 |
| DK4 | 02-12-87 | 08:47 | 9 | 19.3 | 38.3 | 27.7 | 6.8 | 8.2 | 19.3 | 38.8 | 28.1 | 6.9 | 8.2 | 19.4 | 39 | 28.2 | 6.9 | 8.3 |
| DK5 | 02-12-87 | 09:07 | 10 | 19.6 | 40.4 | 29.2 | 6.9 | 8.3 | 19.6 | 41.1 | 29.8 | 7.6 | 8.3 | 19.5 | 41.3 | 30.0 | 5.3 | 8.2 |
| DK6 | 02-12-87 | 09:17 | 9 | 19.3 | 40.8 | 29.7 | 5.5 | 8.3 | 19.2 | 40.7 | 29.7 | 5.6 | 8.3 | 19.3 | 40.7 | 29.7 | 5.7 | 8.3 |
| DK7 | 02-12-87 | 09:34 | 11 | 19.1 | 40.5 | 29.6 | 6.6 | 8.2 | 19.1 | 40.6 | 29.7 | 7.2 | 8.3 | 19.1 | 40.7 | 29.8 | 5.6 | 8.3 |
| DK8 | 02-12-87 | 09:25 | 9 | 19.3 | 40.3 | 29.3 | 5.5 | 8.3 | 19.2 | 40.7 | 29.7 | 5.5 | 8.3 | 19.2 | 40.8 | 29.8 | 5.4 | 8.3 |
| DK9 | 02-12-87 | 09:44 | 9 | 19.5 | 40.8 | 29.6 | 5.7 | 8.2 | 19.4 | 41 | 29.8 | 5.9 | 8.2 | 19.3 | 41.1 | 30.0 | 5.4 | 8.2 |
| DK10 | 02-12-87 | 09:53 | 9 | 19.3 | 40.2 | 29.3 | 5.8 | 8.3 | 19.2 | 40.7 | 29.7 | 5.9 | 8.3 | 19.5 | 41.2 | 29.9 | 5.8 | 8.3 |
| DK11 | 02-12-87 | 10:02 | 10 | 19.6 | 40.8 | 29.5 | 5.5 | 8.2 | 19.5 | 40.9 | 29.7 | 5.5 | 8.2 | 19.5 | 41.3 | 30.0 | 5.5 | 8.2 |
| DK12 | 02-12-87 | 10:09 | 8 | 19.5 | 40.8 | 29.6 | 5.7 | 8.3 | 19.4 | 40.8 | 29.7 | 5.7 | 8.3 | 19.4 | 40.8 | 29.7 | 5.9 | 8.3 |
| DK13 | 02-12-87 | 10:23 | 9 | 20 | 40.6 | 29.1 | 5.6 | 8.2 | 19.4 | 40.5 | 29.4 | 5.5 | 8.2 | 19.5 | 40.5 | 29.4 | 5.3 | 8.2 |
| KB1 | 02-12-87 | 11:52 | 13 | 19.8 | 39 | 28.0 | 5.5 | 8.3 | 19.6 | 39 | 28.1 | 5.6 | 8.4 | 19.6 | 39.3 | 28.3 | 5.7 | 8.3 |
| KB2 | 02-12-87 | 11:39 | 11 | 19.8 | 38.5 | 27.6 | 5.6 | 8.3 | 19.5 | 38.9 | 28.1 | 5.6 | 8.3 | 19.6 | 39.4 | 28.4 | 5.6 | 8.4 |
| KB3 | 02-12-87 | 11:45 | 11 | 20 | 38.9 | 27.7 | 5.6 | 8.3 | 19.6 | 39 | 28.1 | 5.8 | 8.4 | 19.7 | 39.4 | 28.3 | 5.5 | 8.3 |
| KB4 | 02-12-87 | 11:31 | 11 | 19.7 | 38.4 | 27.5 | 7.1 | 8.3 | 19.5 | 38.6 | 27.8 | 7.5 | 8.3 | 19.5 | 39.2 | 28.3 | 7.4 | 8.3 |
| KB5 | 02-12-87 | 11:03 | 11 | 20.4 | 36 | 25.2 | 6.7 | 8.2 | 20.4 | 37.8 | 26.6 | 6.8 | 8.2 | 20.4 | 38.6 | 27.2 | 5.0 | 8.2 |
| KB6 | 02-12-87 | 11:24 | 10 | 20 | 38.6 | 27.5 | 5.5 | 8.3 | 19.4 | 38.7 | 28.0 | 5.5 | 8.3 | 19.6 | 39.5 | 28.5 | 5.7 | 8.4 |
| KB7 | 02-12-87 | 10:49 | 11 | 19.5 | 38.3 | 27.6 | 5.5 | 8.3 | 19.5 | 38.4 | 27.7 | 5.4 | 8.3 | 19.4 | 39 | 28.2 | 5.4 | 8.3 |
| 43 | 02-12-87 | 12:19 | 13 | 20.5 | 43.2 | 30.8 | 6.0 | 8.3 | 19.4 | 42.4 | 31.0 | 6.3 | 8.3 | 19.7 | 43.2 | 31.4 | 6.0 | 8.3 |

| STATION | DATE | TIME | DEPTH | SURFACE TEMP | COND | SAL | DO | pH | MID TEMP | COND | SAL | DO | pH | BOTTOM TEMP | COND | SAL | DO | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BC1 | 03-09-87 | 11:32 | 15 | 22.6 | 0.3 | 0.0 | 5.0 | 7.9 | 22.6 | 0 | 0.0 | 4.8 | 7.8 | 22.6 | 0 | 0.0 | 4.7 | 7.8 |
| BC2 | 03-09-87 | 11:13 | 17 | 22.6 | 1.8 | 0.8 | 5.0 | 7.7 | 22.6 | 20 | 12.6 | 4.4 | 7.7 | 21.8 | 48.2 | 33.8 | 3.5 | 7.6 |
| BC3 | 03-09-87 | 10:46 | 19 | 22.6 | 4.2 | 2.3 | 4.6 | 7.5 | 22.1 | 50.4 | 35.3 | 5.5 | 7.9 | 21.3 | 53 | 38.0 | 4.6 | 7.9 |
| BC4 | 03-09-87 | 10:21 | 18 | 22.6 | 8.4 | 4.9 | 5.0 | 7.6 | 21.5 | 52.2 | 37.2 | 5.2 | 8 | 21.2 | 53.2 | 38.3 | 4.8 | 7.9 |
| BC5 | 03-09-87 | 10:10 | 14 | 22.5 | 47 | 32.3 | 6.4 | 7.9 | 22.3 | 51.6 | 36.1 | 6.2 | 8 | 21.7 | 52.8 | 37.5 | 6.2 | 7.8 |
| BC6 | 03-09-87 | 09:59 | 14 | 22.4 | 18 | 11.3 | 7.1 | 7.7 | 22.3 | 51.3 | 35.8 | 5.8 | 7.9 | 21.4 | 53 | 38.0 | 5.0 | 7.9 |
| BC7 | 03-09-87 | 09:39 | 8 | 22.4 | 46 | 31.6 | 6.0 | 7.2 | 22.3 | 50.9 | 35.5 | 6.3 | 7.9 | 22.2 | 52.3 | 36.7 | 5.3 | 7.8 |
| LR1 | 03-09-87 | 14:09 | | 23.6 | 0.1 | 0.0 | 2.4 | 7.4 | 23.6 | 0.2 | 0.0 | 2.1 | 7.4 | 23.7 | 0.2 | 0.0 | 2.0 | 7.4 |
| LR2 | 03-09-87 | 13:40 | 7 | 23.5 | 0.4 | 0.0 | 2.3 | 7.3 | 23.6 | 0.5 | 0.1 | 2.3 | 7.3 | 23.6 | 2 | 0.9 | 2.1 | 7.3 |
| LR3 | 03-09-87 | 13:25 | 11 | 23.5 | 3.5 | 1.8 | 2.4 | 7.3 | 22.3 | 46.2 | 31.9 | 5.5 | 7.9 | 22.2 | 52.2 | 36.6 | 5.3 | 7.7 |
| LR4 | 03-09-87 | 13:11 | 10 | 23.4 | 11.1 | 6.5 | 2.9 | 7.3 | 22.3 | 48.9 | 33.9 | 5.5 | 7.9 | 22.2 | 52.2 | 36.6 | 5.4 | 8 |
| LR5 | 03-09-87 | 12:57 | 7 | 23.6 | 13.7 | 8.2 | 3.1 | 7.3 | 22.3 | 45.8 | 31.5 | 5.4 | 7.9 | 22.3 | 51.4 | 35.9 | 5.4 | 7.9 |
| LR6 | 03-09-87 | 12:02 | 7 | 22.5 | 42.5 | 28.9 | 7.0 | 7.8 | 22.3 | 50.2 | 35.0 | 5.6 | 8 | 22.2 | 51.2 | 35.8 | 5.5 | 8 |
| LR7 | 03-09-87 | 12:18 | 8 | 22.8 | 36.9 | 24.5 | 5.2 | 7.9 | 22.4 | 50.4 | 35.0 | 5.5 | 8 | 22.2 | 50.8 | 35.5 | 5.5 | 8 |
| LR8 | 03-09-87 | 12:32 | 12 | 22.7 | 43.8 | 29.7 | 5.1 | 7.9 | 22.4 | 51.1 | 35.6 | 5.5 | 7.9 | 22.3 | 50.9 | 35.5 | 5.5 | 7.9 |
| LR9 | 03-09-87 | 12:46 | 9 | 22.5 | 51.5 | 35.8 | 5.9 | 8 | 22.5 | 51.3 | 35.7 | 5.8 | 8 | 22.4 | 51.3 | 35.7 | 5.5 | 8 |
| DK1 | 03-11-87 | 08:36 | 11 | 20.6 | | | 8.1 | 7.6 | 21.4 | | | 8.2 | 7.8 | 21.5 | | | 7.5 | 7.8 |
| DK2 | 03-11-87 | 09:38 | 6 | 20.9 | 53.4 | 38.7 | 5.9 | 7.9 | 21.4 | 53.8 | 38.6 | 6.0 | 7.9 | 21.3 | 53.9 | 38.8 | 5.7 | 7.9 |
| DK3 | 03-11-87 | 09:07 | 8 | 20.7 | | | 7.9 | 7.9 | 20.9 | | | 8.3 | 7.9 | 20.9 | | | 8.6 | 7.9 |
| DK4 | 03-11-87 | 09:23 | 9 | 21 | | | 8.4 | 7.9 | 21.1 | | | 8.4 | 7.9 | 20.9 | | | 8.4 | 7.9 |
| DK5 | 03-11-87 | 09:56 | 9 | 21.5 | 53.7 | 38.4 | 6.2 | 8 | 21.6 | 54.2 | 38.7 | 6.9 | 8 | 21.3 | 54.2 | 39.0 | 5.1 | 8 |
| DK6 | 03-11-87 | 10:10 | 10 | 20.9 | 53.9 | 39.1 | 5.8 | 8 | 21.4 | 54.2 | 38.9 | 6.1 | 8 | 21.5 | 54.3 | 38.9 | 6.0 | 7.9 |
| DK7 | 03-11-87 | 10:39 | 10 | 21.4 | 53.6 | 38.4 | 6.1 | 8.1 | 21.2 | 53.9 | 38.9 | 6.6 | 8.1 | 21.1 | 54.1 | 39.1 | 6.8 | 8.1 |
| DK8 | 03-11-87 | 10:25 | 8 | 21.6 | 53.5 | 38.2 | 6.0 | 8 | 21.5 | 54.4 | 39.0 | 6.1 | 8 | 21.2 | 54 | 38.9 | 6.4 | 8.1 |
| DK9 | 03-11-87 | 10:55 | 9 | 21.8 | 54.1 | 38.5 | 6.0 | 8 | 21.8 | 54.6 | 38.9 | 6.2 | 8 | 21.7 | 54.5 | 38.9 | 6.5 | 8 |
| DK10 | 03-11-87 | 11:13 | 9 | 21.7 | 54.1 | 38.6 | 6.3 | 8.1 | 21.3 | 54.4 | 39.2 | 6.7 | 8.1 | 21.2 | 54.3 | 39.2 | 7.3 | 8.1 |
| DK11 | 03-11-87 | 11:55 | 9 | 22.2 | 53.8 | 37.9 | 6.8 | 8.1 | 22.1 | 54.2 | 38.3 | 6.7 | 8.1 | 21.5 | 54.2 | 38.8 | 6.6 | 8.1 |
| DK12 | 03-11-87 | 12:10 | 7 | 22.3 | 54.4 | 38.3 | 6.3 | 8.1 | 22.2 | 54.7 | 38.6 | 6.7 | 8.1 | 22.1 | 54.7 | 38.7 | 6.9 | 8.1 |
| DK13 | 03-11-87 | 12:36 | 8 | 22.9 | 54.7 | 38.0 | 6.7 | 8 | 22.9 | 55.1 | 38.3 | 7.2 | 8 | 22.4 | 54.8 | 38.5 | 7.0 | 8 |
| KB1 | 03-11-87 | 14:46 | 13 | 23.6 | 55.1 | 37.7 | 5.7 | 8 | 22.7 | 55.4 | 38.7 | 6.7 | 8.1 | 22.5 | 55.7 | 39.1 | 6.5 | 8.1 |
| KB2 | 03-11-87 | 14:23 | 11 | 23.6 | 55.8 | 38.2 | 5.8 | 8 | 23.4 | 55.7 | 38.3 | 6.2 | 8 | 22.3 | 55.9 | 39.5 | 6.6 | 8.1 |
| KB3 | 03-11-87 | 14:34 | 12 | 23.7 | 55.2 | 37.7 | 6.0 | 8 | 23.7 | 55.8 | 38.1 | 6.1 | 8 | 22.3 | 55.9 | 39.5 | 6.7 | 8.1 |
| KB4 | 03-11-87 | 15:00 | 12 | 24.1 | 55.4 | 37.5 | 6.3 | 8.1 | 23.3 | 55.6 | 38.3 | 6.6 | 8 | 22.2 | 56.4 | 40.0 | 7.0 | 8.1 |
| KB5 | 03-11-87 | 13:26 | 11 | 23.4 | 50.7 | 34.5 | 6.7 | 7.9 | 23 | 50.6 | 34.7 | 7.4 | 8.1 | 22.8 | 52.3 | 36.2 | 7.1 | 7.9 |
| KB6 | 03-11-87 | 13:58 | 9 | 23.4 | 54.8 | 37.6 | 6.3 | 8.1 | 23.1 | 55 | 38.0 | 6.9 | 8.1 | 22 | 56.1 | 39.9 | 7.4 | 8.1 |
| KB7 | 03-11-87 | 13:05 | 10 | 22.6 | 52.6 | 36.6 | 6.8 | 7.9 | 22.3 | 54.6 | 38.4 | 6.4 | 8.1 | 22.3 | 54.1 | 38.0 | 6.5 | 8.1 |
| 43 | 03-11-87 | 15:37 | 13 | 21.7 | 56.9 | 40.8 | 6.1 | 8.1 | 21.5 | 57.2 | 41.3 | 7.2 | 8.7 | 21.5 | 57.2 | 41.3 | 7.5 | 8.1 |

| | | | | | | SURFACE | | | | | MID | | | | | BOTTOM | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | DATE | TIME | DEPTH | TEMP | COND | SAL | DO | pH | TEMP | COND | SAL | DO | pH | TEMP | COND | SAL | DO | pH |
| BC1 | 04-14-87 | 10:00 | | 23.5 | 0 | 0.0 | 6.4 | 7.9 | 23.4 | 2.1 | 1.0 | 5.7 | 8 | 23.6 | 44.1 | 29.4 | 4.6 | 7.8 |
| BC2 | 04-14-87 | 09:48 | 14 | 23.7 | 6.6 | 3.7 | 6.1 | 7.8 | 23.6 | 33.6 | 21.7 | 5.4 | 7.8 | 23.7 | 53.2 | 36.2 | 4.9 | 8 |
| BC3 | 04-14-87 | 09:33 | 21 | 23.6 | 6.6 | 3.7 | 6.6 | 7.7 | 23.8 | 54.4 | 37.0 | 5.4 | 8 | 22.8 | 55.7 | 38.9 | 3.4 | 7.9 |
| BC4 | 04-14-87 | 09:21 | 18 | 23.7 | 29 | 18.4 | 5.3 | 7.8 | 23.8 | 55.3 | 37.7 | 4.7 | 8 | 23.2 | 55.9 | 38.7 | 3.7 | 7.8 |
| BC5 | 04-14-87 | 09:13 | 13 | 23.5 | 35.8 | 23.3 | 6.2 | 7.9 | 24.1 | 52.8 | 35.5 | 5.7 | 8 | 23.6 | 56 | 38.4 | 4.4 | 7.8 |
| BC6 | 04-14-87 | 09:08 | 16 | 23.3 | 38.2 | 25.2 | 6.1 | 7.9 | 24.2 | 54.8 | 37.0 | 5.5 | 8 | 23.2 | 56 | 38.7 | 4.1 | 7.7 |
| BC7 | 04-14-87 | 09:00 | 9 | 23.3 | 43.6 | 29.2 | 7.1 | 7.8 | 24.1 | 54.2 | 36.6 | 5.4 | 8 | 24 | 54.8 | 37.1 | 5.3 | 7.9 |
| LR1 | 04-14-87 | 11:50 | | 24.7 | 0.2 | 0.0 | 4.6 | 7.5 | 24.2 | 0.2 | 0.0 | 4.2 | 7.5 | 24.5 | 0.2 | 0.0 | 4.4 | 7.5 |
| LR2 | 04-14-87 | 11:28 | 7 | 24.4 | 2.5 | 1.2 | 4.5 | 7.6 | 24.2 | 46.1 | 30.4 | 5.0 | 7.9 | 24.2 | 50.4 | 33.6 | 5.2 | 8 |
| LR3 | 04-14-87 | 11:18 | 12 | 24.4 | 15 | 8.8 | 4.0 | 7.5 | 24 | 50.3 | 33.7 | 5.6 | 8.1 | 24 | 52.3 | 35.2 | 5.4 | 7.6 |
| LR4 | 04-14-87 | 11:09 | 11 | 24.3 | 35 | 22.4 | 5.3 | 7.9 | 23.9 | 51.6 | 34.8 | 5.5 | 8.1 | 24 | 52.8 | 35.6 | 5.1 | 7.8 |
| LR5 | 04-14-87 | 11:00 | 8 | 24.7 | 13 | 7.5 | 6.6 | 7.5 | 24 | 49.5 | 33.1 | 5.5 | 8.1 | 23.9 | 57.8 | 39.5 | 5.4 | 8 |
| LR6 | 04-14-87 | 10:32 | 8 | 24.2 | 45.5 | 30.0 | 6.2 | 7.9 | 23.8 | 51.3 | 34.6 | 6.1 | 8 | 23.8 | 52.6 | 35.6 | 5.0 | 8 |
| LR7 | 04-14-87 | 10:41 | 10 | 23.9 | 51.5 | 34.7 | 5.7 | 8 | 23.8 | 52.2 | 35.3 | 5.6 | 8 | 23.8 | 53.3 | 36.1 | 5.4 | 7.5 |
| LR8 | 04-14-87 | 10:48 | 14 | 23.9 | 51.7 | 34.8 | 6.1 | 8.1 | 23.8 | 52.4 | 35.5 | 5.5 | 8.1 | 23.8 | 53.5 | 36.3 | 5.3 | 7.8 |
| LR9 | 04-14-87 | 10:53 | 10 | 24.1 | 51.3 | 34.4 | 5.5 | 8.1 | 24 | 52.1 | 35.1 | 5.4 | 8.1 | 24 | 52.4 | 35.3 | 5.5 | 8.1 |
| DK1 | 04-16-87 | 08:43 | 10 | 24.6 | 55.4 | 37.1 | 4.8 | 8.2 | 24.6 | 55.8 | 37.4 | 4.8 | 8.2 | 24.7 | 55.7 | 37.2 | 4.7 | 8.2 |
| DK2 | 04-16-87 | 09:11 | 7 | 24 | 53.8 | 36.4 | 6.2 | 8.3 | 24 | 54 | 36.5 | 6.2 | 8.3 | 23.8 | 54 | 36.7 | 4.5 | 8.3 |
| DK3 | 04-16-87 | 08:49 | 8 | 24 | 54.9 | 37.2 | 5.7 | 8.4 | 24 | 54.7 | 37.0 | 5.8 | 8.4 | 24 | 54.8 | 37.1 | 5.3 | 8.4 |
| DK4 | 04-16-87 | 08:56 | 9 | 24.1 | 54 | 36.4 | 5.2 | 8.4 | 24.2 | 54.3 | 36.6 | 5.3 | 8.4 | 24.2 | 54.5 | 36.7 | 4.9 | 8.4 |
| DK5 | 04-16-87 | 09:20 | 9 | 25.1 | 54.8 | 36.2 | 5.0 | 8.4 | 25 | 54.8 | 36.3 | 5.2 | 8.4 | 25 | 54.9 | 36.4 | 5.3 | 8.4 |
| DK6 | 04-16-87 | 09:29 | 10 | 24.9 | 54.3 | 36.0 | 5.2 | 8.3 | 25 | 54.7 | 36.2 | 5.2 | 8.4 | 24.8 | 54.8 | 36.5 | 5.4 | 8.4 |
| DK7 | 04-16-87 | 09:37 | 11 | 24.5 | 54.7 | 36.6 | 6.7 | 8.4 | 24.4 | 54.7 | 36.7 | 7.5 | 8.4 | 24.3 | 54.8 | 36.9 | 5.5 | 8.4 |
| DK8 | 04-16-87 | 09:44 | 9 | 24.8 | 54.7 | 36.4 | 5.4 | 8.4 | 24.8 | 54.6 | 36.3 | 5.4 | 8.4 | 24.6 | 54.5 | 36.4 | 5.4 | 8.4 |
| DK9 | 04-16-87 | 09:52 | 10 | 24.8 | 54.8 | 36.5 | 5.4 | 8.4 | 24.9 | 54.7 | 36.3 | 5.4 | 8.4 | 24.9 | 54.8 | 36.4 | 5.4 | 8.4 |
| DK10 | 04-16-87 | 10:00 | 10 | 24.8 | 54.9 | 36.5 | 5.5 | 8.4 | 24.6 | 54.9 | 36.7 | 5.7 | 8.4 | 24.6 | 55 | 36.8 | 5.8 | 8.4 |
| DK11 | 04-16-87 | 10:08 | 10 | 24.9 | 54.7 | 36.3 | 5.5 | 8.4 | 24.9 | 54.7 | 36.3 | 5.5 | 8.4 | 24.9 | 54.8 | 36.4 | 5.5 | 8.4 |
| DK12 | 04-16-87 | 10:16 | 8 | 24.8 | 54.8 | 36.5 | 5.9 | 8.4 | 24.9 | 54.8 | 36.4 | 6.1 | 8.4 | 24.9 | 54.9 | 36.5 | 6.3 | 8.4 |
| DK13 | 04-16-87 | 10:30 | 8 | 24.9 | 53.9 | 35.7 | 7.0 | 8.3 | 25 | 54.3 | 35.9 | 7.4 | 8.3 | 25 | 54.4 | 36.0 | 7.7 | 8.4 |
| KB1 | 04-16-87 | 12:02 | 13 | 25.8 | 53.8 | 34.9 | 5.5 | 8.3 | 25.7 | 53.7 | 34.9 | 5.4 | 8.3 | 25.7 | 53.9 | 35.1 | 5.5 | 8.3 |
| KB2 | 04-16-87 | 11:49 | 12 | 25.7 | 53.7 | 34.9 | 5.4 | 8.3 | 25.5 | 53.5 | 34.9 | 5.3 | 8.3 | 25.5 | 54.1 | 35.4 | 5.2 | 8.3 |
| KB3 | 04-16-87 | 11:55 | 13 | 26 | 54 | 34.9 | 5.5 | 8.3 | 25.6 | 53.5 | 34.9 | 5.4 | 8.3 | 26.6 | 54 | 34.5 | 5.8 | 8.3 |
| KB4 | 04-16-87 | 11:41 | 13 | 25.6 | 53.7 | 35.0 | 5.4 | 8.3 | 25.4 | 53.8 | 35.2 | 5.2 | 8.3 | 25.1 | 53.7 | 35.4 | 4.7 | 8.3 |
| KB5 | 04-16-87 | 11:22 | 12 | 25.7 | 54.1 | 35.2 | 4.9 | 8.2 | 25.8 | 54.1 | 35.2 | 5.0 | 8.3 | 25.6 | 53.9 | 35.2 | 4.9 | 8.3 |
| KB6 | 04-16-87 | 11:35 | 12 | 25.2 | 53.9 | 35.5 | 4.9 | 8.3 | 25.2 | 53.8 | 35.4 | 5.0 | 8.3 | 25 | 53.9 | 35.6 | 4.3 | 8.3 |
| KB7 | 04-16-87 | 10:59 | 10 | 24.8 | 53.8 | 35.7 | 5.1 | 8.3 | 24.9 | 53.9 | 35.7 | | | | | | | |

| | | | | | | SURFACE | | | | | MID | | | | | BOTTOM | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | DATE | TIME | DEPTH | TEMP | COND | SAL | DO | pH | TEMP | COND | SAL | DO | pH | TEMP | COND | SAL | DO | pH |
| BC1 | 05-12-87 | 10:06 | | 27.5 | 0.1 | 0.0 | 4 | 8 | 27.5 | 0.1 | 0.0 | 3.8 | 8 | 27.9 | 0.1 | 0.0 | 4 | 8 |
| BC2 | 05-12-87 | 09:53 | 19 | 27.7 | 11.7 | 6.3 | 3.9 | 7.8 | 28.6 | 42.7 | 25.4 | 3.3 | 8 | 28.8 | 48.4 | 29.1 | 2.8 | 8 |
| BC3 | 05-12-87 | 09:34 | 23 | 27.3 | 9.5 | 5.1 | 3.7 | 7.6 | 28.8 | 46.2 | 27.6 | 3.6 | 8 | 28.8 | 49.6 | 29.9 | 2.5 | 8 |
| BC4 | 05-12-87 | 09:18 | 20 | 27.8 | 18.2 | 10.1 | 3.7 | 7.9 | 28.6 | 47.1 | 28.3 | 4.0 | 8.1 | 28.8 | 49.6 | 29.9 | 2.9 | 8 |
| BC5 | 05-12-87 | 09:10 | 16 | 27.8 | 16.8 | 9.3 | 6.0 | 8.1 | 28.6 | 21.5 | 11.9 | 3.3 | 8 | 28.9 | 21.1 | 11.6 | 6.6 | 8 |
| BC6 | 05-12-87 | 09:02 | 16 | 27.1 | 40.2 | 24.5 | 5.1 | 8.2 | 28.6 | 42.8 | 25.5 | 3.9 | 8.1 | 28.8 | 43.9 | 26.1 | 6.0 | 7.7 |
| BC7 | 05-12-87 | 08:55 | 9 | 26.9 | 34.2 | 20.6 | 6.3 | 8.1 | 28.1 | 44.6 | 27.0 | 4.1 | 8.1 | 28.5 | 48.9 | 29.6 | 3.1 | 8 |
| LR1 | 05-12-87 | 11:58 | | 26.8 | 0.1 | 0.0 | 1.7 | 7.5 | 26.8 | 0.1 | 0.0 | 1.6 | 7.6 | 26.9 | 0.1 | 0.0 | 1.6 | 7.6 |
| LR2 | 05-12-87 | 11:35 | 8 | 26.8 | 12.9 | 7.1 | 1.6 | 7.4 | 27 | 5.6 | 2.9 | 1.5 | 7.4 | 27 | 6.7 | 3.5 | 1.5 | 7.4 |
| LR3 | 05-12-87 | 11:22 | 11 | 27 | 8.2 | 4.3 | 1.8 | 7.6 | 27.5 | 26.8 | 15.6 | 2.3 | 7.8 | 28.2 | 43.6 | 26.2 | 3.7 | 8.1 |
| LR4 | 05-12-87 | 11:12 | 11 | 27.2 | 13.4 | 7.4 | 2.1 | 7.5 | 28 | 39.3 | 23.5 | 4.8 | 8 | 28.2 | 44.5 | 26.8 | 4.9 | 8.2 |
| LR5 | 05-12-87 | 11:06 | 7 | 27.6 | 35.1 | 20.9 | 3.0 | 7.9 | 27.9 | 39 | 23.3 | 3.6 | 8 | 28 | 42 | 25.3 | 3.8 | 8.1 |
| LR6 | 05-12-87 | 10:33 | 12 | 27.6 | 42.4 | 25.7 | 5.2 | 8.1 | 27.7 | 43.1 | 26.2 | 5.0 | 8.1 | 28.4 | 46.3 | 27.9 | 2.8 | 8.1 |
| LR7 | 05-12-87 | 10:41 | 10 | 27.6 | 40.9 | 24.7 | 5.4 | 8.1 | 27.6 | 42 | 25.5 | 5.3 | 8.2 | 28.3 | 45.7 | 27.6 | 3.5 | 8.1 |
| LR8 | 05-12-87 | 10:49 | 13 | 27.7 | 40.1 | 24.2 | 5.4 | 8.1 | 27.7 | 42.4 | 25.7 | 5.4 | 8.1 | 27.8 | 45 | 27.4 | 3.9 | 8.1 |
| LR9 | 05-12-87 | 10:57 | 9 | 27.9 | 40.4 | 24.2 | 5.3 | 8.1 | 27.6 | 43 | 26.2 | 4.9 | 8.2 | 27.6 | 43.9 | 26.8 | 5.0 | 8.2 |
| DK1 | 05-14-87 | 08:31 | 9 | 26.5 | 48.9 | 30.9 | 5.5 | 8.2 | 26.6 | 48.9 | 30.8 | 5.4 | 8.2 | 26.6 | 49 | 30.9 | 4.8 | 8.2 |
| DK2 | 05-14-87 | 08:54 | 7 | 26.3 | 47.2 | 29.8 | 5.2 | 8.2 | 26.3 | 47.5 | 30.1 | 4.8 | 8.2 | 26.4 | 48.1 | 30.4 | 4.6 | 8.1 |
| DK3 | 05-14-87 | 08:39 | 10 | 26.7 | 49 | 30.8 | 5.6 | 8.3 | 26.7 | 48.9 | 30.8 | 5.4 | 8.3 | 26.7 | 48.9 | 30.8 | 5.4 | 8.3 |
| DK4 | 05-14-87 | 08:45 | 10 | 26.8 | 48.4 | 30.4 | 5.2 | 8.2 | 26.8 | 48.4 | 30.4 | 5.2 | 8.2 | 26.8 | 48.5 | 30.4 | 5.2 | 8.3 |
| DK5 | 05-14-87 | 09:05 | 10 | 27 | 47.1 | 29.3 | 5.3 | 8.3 | 27.1 | 47.7 | 29.7 | 5.2 | 8.3 | 27 | 47.9 | 29.9 | 5.2 | 8.3 |
| DK6 | 05-14-87 | 09:13 | 10 | 26.9 | 47.9 | 29.9 | 5.6 | 8.3 | 26.9 | 47.9 | 29.9 | 5.4 | 8.4 | 26.9 | 48 | 30.0 | 5.2 | 8.3 |
| DK7 | 05-14-87 | 09:25 | 11 | 26.8 | 48 | 30.1 | 5.3 | 8.3 | 26.8 | 47.9 | 30.0 | 5.2 | 8.3 | 26.7 | 48.3 | 30.4 | 5.1 | 8.3 |
| DK8 | 05-14-87 | 09:19 | 9 | 26.8 | 48 | 30.1 | 5.5 | 8.3 | 26.8 | 47.9 | 30.0 | 5.3 | 8.3 | 26.8 | 47.9 | 30.0 | 5.2 | 8.3 |
| DK9 | 05-14-87 | 09:37 | 10 | 27 | 47.9 | 29.9 | 6.0 | 8.3 | 26.9 | 47.7 | 29.8 | 5.9 | 8.3 | 26.8 | 47.8 | 29.9 | 5.9 | 8.3 |
| DK10 | 05-14-87 | 09:43 | 11 | 26.7 | 47.9 | 30.1 | 5.9 | 8.3 | 26.7 | 48.1 | 30.2 | 5.6 | 8.2 | 26.6 | 48.3 | 30.4 | 5.6 | 8.2 |
| DK11 | 05-14-87 | 09:53 | 11 | 26.8 | 47.6 | 29.8 | 6.2 | 8.3 | 26.7 | 47.8 | 30.0 | 5.7 | 8.3 | 26.6 | 47.8 | 30.1 | 5.5 | 8.3 |
| DK12 | 05-14-87 | 09:59 | 8 | 26.7 | 47.1 | 29.5 | 5.8 | 8.4 | 26.7 | 47.1 | 29.5 | 5.7 | 8.3 | 26.6 | 47.1 | 29.6 | 5.7 | 8.4 |
| DK13 | 05-14-87 | 10:09 | 9 | 26.6 | 46 | 28.8 | 6.0 | 8.3 | 26.5 | 46.5 | 29.2 | 5.5 | 8.3 | 26.5 | 47 | 29.6 | 5.3 | 8.3 |
| KB1 | 05-14-87 | 11:28 | 13 | 27.4 | 41.8 | 25.5 | 5.5 | 8.2 | 28.6 | 47.8 | 28.8 | 4.8 | 8.2 | 28.3 | 48.6 | 29.5 | 4.8 | 8.3 |
| KB2 | 05-14-87 | 11:17 | 12 | 27 | 40.8 | 25.0 | 6.3 | 8.3 | 28.5 | 47.4 | 28.6 | 6.0 | 8.2 | 27.8 | 48 | 29.4 | 4.9 | 8.3 |
| KB3 | 05-14-87 | 11:22 | 12 | 26.9 | 40.7 | 25.0 | 5.9 | 8.3 | 28.5 | 46.5 | 28.0 | 4.9 | 8.2 | 28.4 | 48.6 | 29.5 | 4.8 | 8.3 |
| KB4 | 05-14-87 | 11:08 | 12 | 27.7 | 44.2 | 26.9 | 6.1 | 8.2 | 27.9 | 47.1 | 28.8 | 5.1 | 8.3 | 26.8 | 47 | 29.4 | 4.9 | 8.3 |
| KB5 | 05-14-87 | 10:50 | 12 | 27.3 | 43.6 | 26.7 | 6.4 | 8.3 | 29.1 | 49 | 29.3 | 5.3 | 8.2 | 29.8 | 50.6 | 30.0 | 4.4 | 8.2 |
| KB6 | 05-14-87 | 11:03 | 11 | 27.5 | 46.1 | 28.3 | 5.9 | 8.2 | 26.8 | 46.4 | 29.0 | 5.8 | 8.2 | 26.5 | 47 | 29.6 | 5.3 | 8.2 |
| KB7 | 05-14-87 | 10:41 | 8 | 26.4 | 47 | 29.6 | 5.6 | 8.3 | 26.4 | 46.9 | 29.6 | 5.6 | 8.3 | 26.4 | 47.1 | 29.7 | 5.4 | 8.3 |
| 43 | 05-14-87 | 12:07 | 14 | 27 | 53.1 | 33.5 | 6.0 | 8.3 | 27 | 53 | 33.5 | 6.0 | 8.3 | 27.1 | 53 | 33.4 | 6.1 | 8.3 |