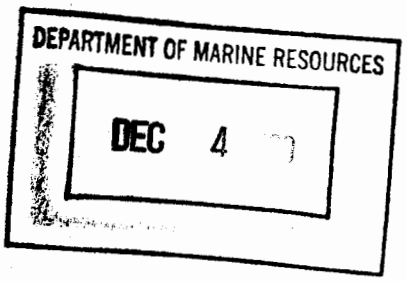
DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
Washington DC 20204

November 28, 2000

Ms. Amy M. Fitzpatrick, Director
Public Health Division
Maine Department of Marine Resources
PO Box 8
West Boothbay Harbor, ME 04575



Dear Ms. Fitzpatrick:

Please find enclosed the final copy of the FDA report on the review of the Biddeford Pool shellfish growing area. The review was conducted in response to a request by the Interstate Shellfish Sanitation Conference (ISSC) to investigate concerns raised by Spinney Creek Shellfish, Inc. regarding Maine's classification of Biddeford Pool.

The support you and your staff provided to the FDA team is greatly appreciated, and was instrumental in FDA being able to complete the requested review. Please forward any comments or questions you may have regarding the findings and recommendations in the report to:

Virgil Carr
Food and Drug Administration
Center for Food Safety and
Applied Nutrition
Shellfish Safety Team, HFS - 628
200 C St. S.W.
Washington D.C. 20204

Sincerely,

Stanley D. Ratcliffe, Chief
Shellfish Safety Team
Division of Cooperative Programs

Enclosure

cc: w/report
Ira Somerset NFR-NE27
Paul Distefano HFS-407
ISSC, Attn. Ken Moore
Spinney Creek Shellfish Inc.

GROWING AREA CLASSIFICATION REVIEW OF BIDDEFORD POOL AND THE AFFECTS OF TIDAL STAGE ON WATER QUALITY AUGUST 21-25, 2000

Introduction:

A file and field review of the Biddeford Pool shellfish growing area in Maine was conducted the week of August 21, 2000. Ira Somerset, NE Regional Shellfish Specialist; Paul DiStefano, Office of Seafood; and Virgil Carr, Office of Field Programs, conducted the review. Maine Department of Marine Resources (DMR) personnel, including Amy Fitzpatrick, Laura Livingston, Jan Barter, and Bob Goodwin, assisted FDA and participated in the review.

This review was conducted in response to a request by the Interstate Shellfish Sanitation Conference (ISSC) for FDA to investigate concerns raised by Spinney Creek Shellfish, Inc. regarding Maine's classification of Biddeford Pool. Specifically, it was questioned whether varying tidal stages affect water quality in Biddeford Pool and whether Biddeford Pool was properly reclassified as "Conditionally Approved" for shellfish harvesting based on seasonal differences in water quality and pollution potential. Effective June 5, 2000, the DMR reclassified Biddeford Pool from "Restricted" for depuration harvest to "Conditionally Approved" in the Open status from October 1 through May 31. This time period coincides with that time of year when summer populations and the use of summer homes in the area are no longer a significant factor associated with potential pollution of Biddeford Pool.

In addition to concerns regarding Biddeford Pool, it was also questioned whether the growing area classification approach used by the DMR is consistent with the requirements of the National Shellfish Sanitation Program (NSSP) Model Ordinance Chapter IV.02. In particular, it was questioned whether tidal stage affects water quality and whether Maine adequately examined tidal stage during the classification of shellfish waters. FDA examined additional growing areas to address this concern and will submit its findings to DMR in a separate report.

Background Information and DMR Approach to Classification:

1. Shoreline surveys are performed by the DMR to identify actual and potential pollution sources, including house to house visits in unsewered areas. Observations of homes are made and those with actual or potential problems (discharge pipes, failing septic systems, etc.) are referred to local authorities for follow-up verification and correction/elimination. Maine's comprehensive shoreline survey of Biddeford Pool identified pollution sources of actual or potential impact to the growing area.

2. The DMR's assessment of water quality in Biddeford Pool is based on a systematic random sampling (SRS) program as provided for in the National Shellfish Sanitation Program (NSSP) Model Ordinance. Samples are collected from 4 monitoring stations represented as G8.9, G8.8, G8.5, and G8.1 on the attached map (Figure 1). Sampling schedules are established in January for the calendar year. Schedules are maintained in a central file and are distributed to monitoring personnel well in advance of scheduled sampling dates.

3. Data analyses are conducted using, at a minimum, the most recent 30 samples. For Biddeford Pool, in an effort to determine whether the growing area could be opened on a seasonal basis

(October 1 - May 31), sample collection was increased to twice a month beginning in January 2000. At the time of this review, the database for Biddeford Pool extended from January 26, 1993 through August 3, 2000. (See Attachment.)

4. In Biddeford Pool, the shellfish resource is comprised of soft shell clams (*Mya arenaria*), which grow in intertidal flats. The flats are exposed at low tide (1 hour) and for a period of approximately 1.5 hours before and after low tide (a total time of approximately 4 hours). From observations at Station 8.5 in Biddeford Pool, it was estimated that clam flats have enough water over them to enable water sample collection for approximately 1 hour at high tide, approximately 3.5 hours before high tide, and approximately 3.5 hours after high tide. Therefore, the tidal dynamics in Biddeford Pool provide a window of approximately 8 hours during which representative samples of the water quality to which the soft shell clams are exposed can be collected. During the remaining time (approximately 4 hours), flats in Biddeford Pool are exposed and the soft shell clams are not actively pumping. It is important to note that these time frames are approximate, based on a single day's observations at Biddeford Pool. Time may vary slightly, depending on the particular day within the monthly tidal cycle.

5. In Biddeford Pool, the DMR has designed the water quality monitoring program to collect samples during those periods when water covers the clam flats. Samples are collected by wading into the water from shore and dipping collection containers below the water surface. The DMR SOP and the DMR Shellfish Sanitation Program Volunteers Manual (p. 29) state the water must be at least 12" deep, that samples should be collected 6-8" below the water surface, and that care should be exercised to prevent stirring up sediment. Monitoring stations are located near-shore and at locations where small streams discharge into Biddeford Pool. The purpose of these "stream" stations is to capture the effect of stream discharges on water quality. The potential effects of stream discharges and other non-point pollution sources, such as septic systems and rainfall runoff, on soft shell clams in Biddeford Pool are best examined by collecting water samples when the clam flats are covered with water. Targeting water quality monitoring to those times when the tidal stage is low enough to expose the flats, i.e. low tide and 1.5 hours on either side of low tide, will not provide data representative of water which soft shell clams are exposed to and actively pumping. The reason for this is, at lower tides, only small streams, perhaps eight to ten feet wide, and rivulets flow through meandrous channels of Biddeford Pool's tide flats. During this time, soft shell clams are not exposed to water and are not actively pumping. Logic dictates that, if there is a time when water quality in Biddeford Pool will be of lesser quality, it will be during the ebb tide when the maximum pollution load from streams and other land based sources will be draining back into growing area waters. This coincides with the time soft shell clams are submerged and are pumping. Therefore, an analysis of water quality data was conducted to determine if in fact a difference in water quality exists between ebb, high, and flood tide data. (See Data Analysis and Discussion.)

6. The approach to water quality monitoring, discussed above, is generally adequate for small tidal embayments, such as Biddeford Pool, where potential pollution sources are located upland and the area is not impacted by point source pollution or by up-river pollution sources entering the mouth of the embayment. However, this approach may not be adequate in situations where sources may originate from an up-river source, such as the Saco River, where potentially polluted water brought down on the ebb tide may move into the embayment on the subsequent flood tide. In these instances, the greatest potential for contaminated water to move over the flats may be at the beginning of the flood tide. Station 8.1 at the entrance to Biddeford Pool is a good example of where such a scenario could occur. Here, water in the Saco River, which receives the discharge from several wastewater treatment plants, moves toward the mouth of the river on ebb tide and

could potentially be carried into Biddeford Pool on the subsequent flood tide. However, a 1991 dye study of the Saco River demonstrated this not to be the case for Biddeford Pool. (See Data Analysis and Discussion.)

Data Analysis and Discussion:

1. In an effort to analyze the effects of rainfall on Biddeford Pool, sample dates, beginning in January 1993, were superimposed on rainfall data. Figure 2 summarizes the results of this analysis. Seven samples were collected since 1993 following 0.25 inch of rainfall or greater, where rainfall is recorded at 7:00am, on the day of sampling, for the previous 24 hours. While the data set used for the rainfall analysis is small, it appears that rainfall had minimal effects on fecal coliform levels in Biddeford Pool during the winter months. However, rainfall occurring during the summer months (June, July, August, September), resulted in failure of all 4 stations in Biddeford Pool to meet NSSP approved growing water criteria. In fact, for all 4 stations in Biddeford Pool, samples collected in connection with rainfall during the summer almost always exhibited higher fecal coliform levels than rainfall associated samples collected in the winter. Furthermore, the data set does not suggest a need for targeted rainfall monitoring. Continued systematic random sampling in Biddeford Pool should be adequate to collect additional samples following rainfall as part of Maine's ongoing effort to monitor the effect of rainfall on water quality. Maine's current classification strategy to close Biddeford Pool from June 1 through September 30 includes those periods when summer populations inhabit the area and when water quality does not meet the NSSP criteria for an Approved or a Conditionally Approved Area in the Open status.

2. An effort was made to evaluate the effects of high river flow in the Saco River on Biddeford Pool, and of the potential for wastewater treatment plant discharges in the Saco River to affect Biddeford Pool. A hydrographic study of the Saco River was conducted by the DMR and FDA in 1991 to determine the downstream impact of the Biddeford and Saco wastewater treatment plants. That study did not demonstrate an influence on water quality in Biddeford Pool from the Saco River. It was determined that a 51,000:1 dilution of the Saco wastewater treatment plant effluent existed at the end of the rock jetty in the mouth of the Saco River. The distance from the jetty to Biddeford Pool is approximately one mile, and affords additional dilution before waters from the Saco River could reach the entrance to Biddeford Pool. In addition, the recent bacteriological data were reviewed and sampling dates were superimposed on river flows for the Saco River.

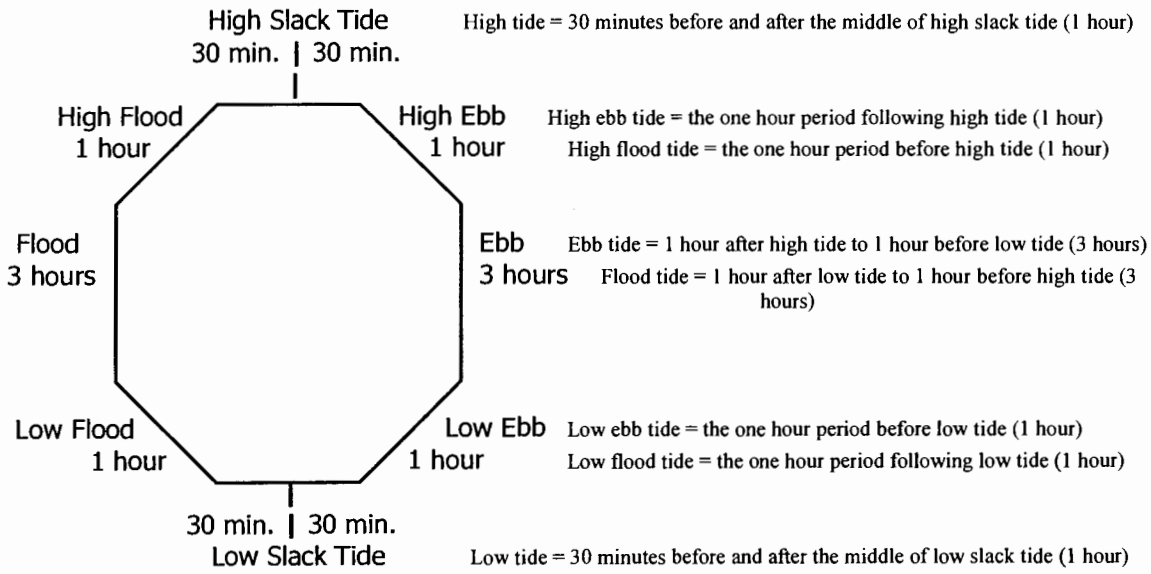
   Only two water sampling runs were conducted on days when river flow was high. These are shown in Figure 2. One sample run was conducted in April 1996 when river flow was 12,900 cfs and one in June 1998 when river flow was 10,200 cfs. The average river flows in April and June from 1993 through 1999 were 7520 cfs and 2754 cfs, respectively. Fecal coliform counts in Biddeford Pool were marginally higher during the 10,200 cfs flow (summer) than the 12,900 cfs flow (winter). These fecal coliform levels are typical of the difference seen between summer and winter water quality in Biddeford Pool. In addition, year round disinfection of effluent discharged to the Saco River from the Biddeford and Saco wastewater treatment plants was instituted in the fall of 1999. Prior to that time, effluent disinfection was practiced only during the summer from May through September. It could reasonably be expected that, if river flow in the Saco River impacted water quality in Biddeford Pool, it would be most noticeable during the winter, when effluent from the treatment plants was not disinfected.

While difficult to draw conclusions based on only two sampling runs, these data support the conclusion of the hydrographic study that the Saco River has little affect on water quality in Biddeford Pool.

Salinities were compared to fecal coliform values for each station in Biddeford Pool. Most samples were associated with salinities of 25 ppt or higher. There did not appear to be a relationship between salinity and fecal coliform concentration, suggesting that water from the Saco River does not influence Biddeford Pool. The general observation that lower salinities in Biddeford Pool did not correlate with increased fecal coliform levels, even during winter months when WWTP effluent disinfection was not practiced, is consistent with results of the 1991 hydrographic study of the Saco wastewater treatment plant, which, as previously stated, determined there was a 51,000:1 dilution ratio.

3. In an effort to analyze the effects of tidal stage on Biddeford Pool, ebb tide, flood tide, and high tide fecal coliform values were compared. Figure 3 provides a graphical representation of these data. The time scale in Figure 3 refers to time in hours before and after high tide, where high tide is represented as 0 hours.

The DMR data system assigns each sample a tidal stage based on predicted times for high and low tide. The DMR uses the Old Orchard Beach tidal station (43°45' North Latitude by 70°38' West Longitude) for this purpose. DMR uses 8 tidal stage designations. They are described and represented below.



In order to define the time of sample collection before and after high tide, the DMR provided FDA with computer printouts and the actual collection times for samples designated as ebb and flood in the DMR data base. By comparing the actual collection times with tide tables for Fort Popham, FDA was able to plot (Figure 3) the exact time before and after high tide that samples were collected. This enabled FDA to identify those samples to be included in the tidal analysis. Samples not used in the analysis are represented by data points in Figure 3 which fall within the 4 to 6 hour period before and after high tide. As discussed earlier, field observations made by FDA determined that the flats in Biddeford Pool are exposed for a period of 1.5 hours before and after

low tide. Because soft shell clams are not actively pumping during this time, water samples collected from the small streams and rivulets in the channels of Biddeford Pool when the flats were exposed are not representative, and were not used in the analysis.

While Figure 3 depicts the number of hours before or after high tide for samples in the DMR data base designated as flood (F) and ebb (E), the exact hour of high tide samples in Figure 3 is not provided. These "high tide" data points include samples collected on tidal stages designated in the DMR data base as high (H), high flood (HF), and high ebb (HE). No effort was made to define the exact time before or after high tide since these samples were all collected when the tidal flats in Biddeford Pool were submerged, i.e., soft shell clams were actively pumping. High tide data points in Figure 3 are plotted at one of three positions (times) relative to high tide (0 hours, 0.5 hours before high, and 0.5 hours after high). This, combined with the fact that the 3-tube MPN has relatively few values for positive tube combinations, resulted in the superimposing of high tide samples in Figure 3 and the inability to distinguish each sample separately in Figure 3. Although all data points are used in the statistical analysis below, Figure 3 only depicts about half of the samples.

The number of water quality samples collected at each station in Biddeford Pool varied from 57 to 65. The number of high tide samples was much larger than the number of samples collected on either flood or ebb tide. The number of high tide samples ranged from 33 to 40. The number of flood tide samples ranged from 9 to 11 and the number of ebb tide samples ranged from 10 to 14. Figure 3 suggests a strong similarity in water quality among ebb tide, flood tide, and high tide. To further examine this, a statistical analysis of tidal data was performed using Statgraphics Plus 6. For reasons stated earlier, samples collected at low tide, as defined by FDA's field observations, were not used in the analysis. While high tide was represented by a much larger number of samples, the data set for each tidal stage was statistically large enough for a comparative analysis. The analysis determined that, at the 95% confidence level, there is no significant difference in water quality between high tide and flood tide, between high tide and ebb tide, or between flood tide and ebb tide. Results of the analysis are presented in Table 1.

The NSSP Model Ordinance Chapter IV. @.02.F and H, requires that, "If the tidal stage increases the fecal coliform concentration, the Authority shall use sample results collected during that tidal stage to classify the area". Having demonstrated that existing water quality shows no significant difference between tidal stages, that requirement is not applicable to Biddeford Pool.

As previously stated, there were a greater number of water samples collected from Biddeford Pool during high tide than during other tidal stages. FDA recommends that less focus be placed on the collection of high tide samples and that DMR collect samples distributed more equally across tidal stages when clam flats are submerged and there is sufficient water to collect samples. A random sampling strategy of this nature will promote periodic examination of water quality in Biddeford Pool during varying tidal stages.

4. Water quality data was also examined to determine if seasonal differences needed to be considered in the classification of Biddeford Pool. Figure 3 illustrates that sample collection was uniformly distributed over winter months (designated with a "W" over the sample point) and summer months, where winter months (cold weather months) include the period from October 1 to May 31 and summer months (warm weather months) include the period from June 1 to September 30. The winter period represents those months recently designated by the DMR as Conditionally Approved in the Open Status for the harvesting of shellfish from Biddeford Pool. Further examination of Figure 3 suggests that water quality in Biddeford Pool is acceptable in the

winter and unacceptable in the summer, regardless of tidal stage. Table 2 takes data presented in Figure 3 , breaks it out by season, and provides the geometric mean, number of samples >49, and 90th percentile for each station in Biddeford Pool. Table 2 exemplifies the difference between summer and winter water quality. Summertime water quality at all four stations in Biddeford Pool exceeds NSSP approved growing area standards, while wintertime water quality meets NSSP approved growing area standards, even for station 8.1 which remains closed year round because of potential pollution from adjacent land use. These data, and the analysis, support the conditional classification of Biddeford Pool based on time of year (season).

Summary:

The FDA was requested by the ISSC to determine whether varying tidal stages affect water quality in Biddeford Pool and whether Biddeford Pool was properly reclassified as "Conditionally Approved" for shellfish harvesting based on seasonal differences in water quality and pollution potential. FDA's evaluation included a file and field review of Biddeford Pool and the analyses of water quality data collected since 1993. Finding of FDA's review are as follow:

- The effect of rainfall on water quality in Biddeford Pool is minimal during the winter period. However, rainfall results in unacceptable water quality during the summer.
- Limited bacteriological data suggest that the Saco River has little affect on water quality in Biddeford Pool.
- The discharge of effluent from the Saco and Biddeford wastewater treatment plants to the Saco River has little, if any, affect on water quality in Biddeford Pool.
- Tidal stage in Biddeford Pool has no demonstrable affect on water quality.
- Water quality meets the NSSP Standard for the Approved Area Classification in the winter, but not in the Summer.
- Historically, DMR has emphasized collection of water samples at high tide in Biddeford Pool.

Conclusions:

- Existing water quality data indicate that NSSP Model Ordinance Chapter IV. @.02.F and H requirements are not applicable for classification purposes in Biddeford Pool.
- The Biddeford Pool shellfish growing area is properly classified as Conditionally Approved in the Open Status from October 1 through May 31.
- FDA recommends that DMR conducts sampling in Biddeford Pool to distribute sample collection across those tidal stages representative of times when clam flats are submerged and there is sufficient water to collect samples.

FIGURE 1

Map

(1 Page follows)

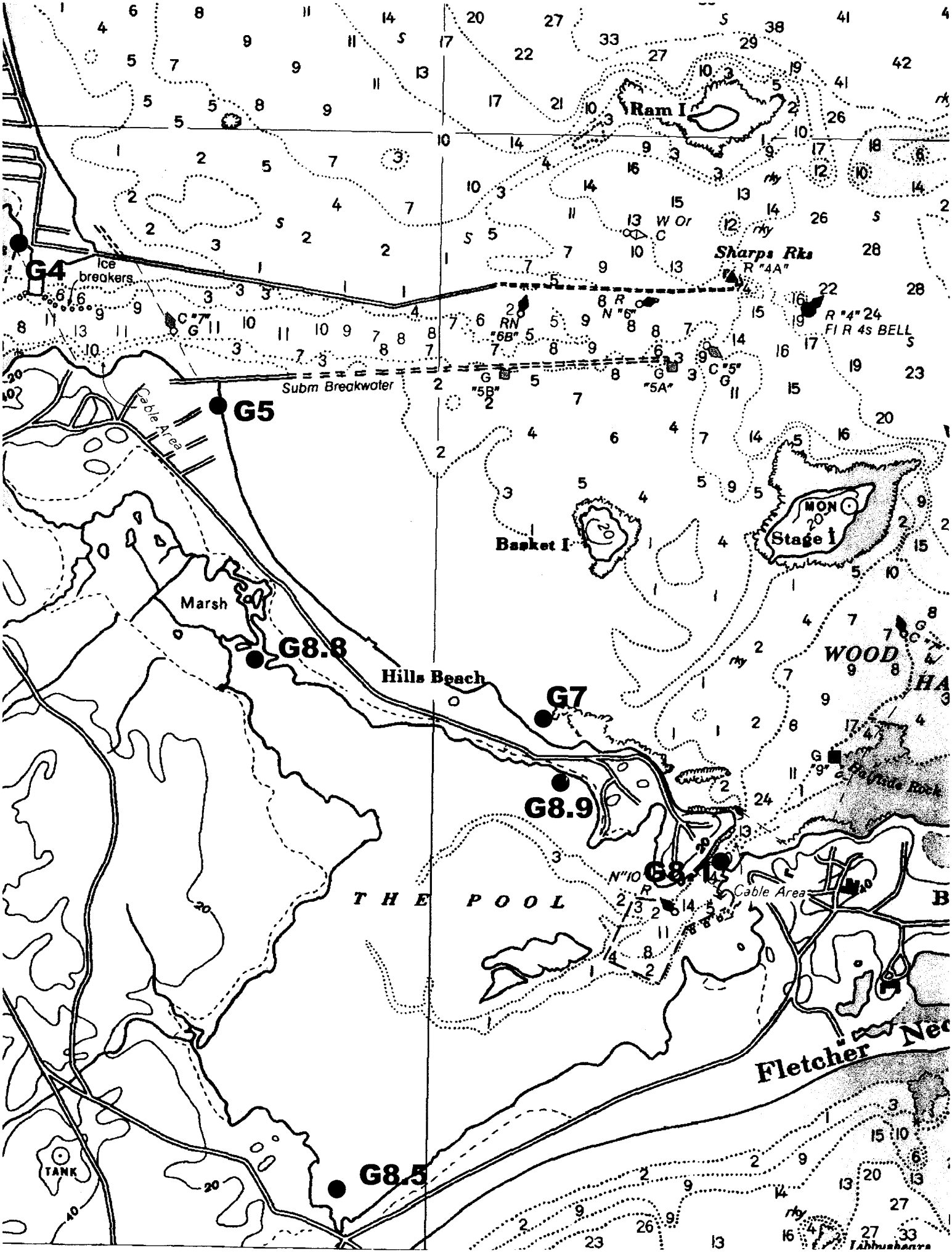

G4
Ice breakers
G5
Subm Breakwater
Cable Area
Marsh
G8.8
Hills Beach
G7
G8.9
G8.1
THE POOL
Cable Area
G8.5
TANK
Ram I
Sharps Rks
R "4A"
R "4" 24
Fl R 4s BELL
Basket I
Stage I
MON
WOOD
Fletcher

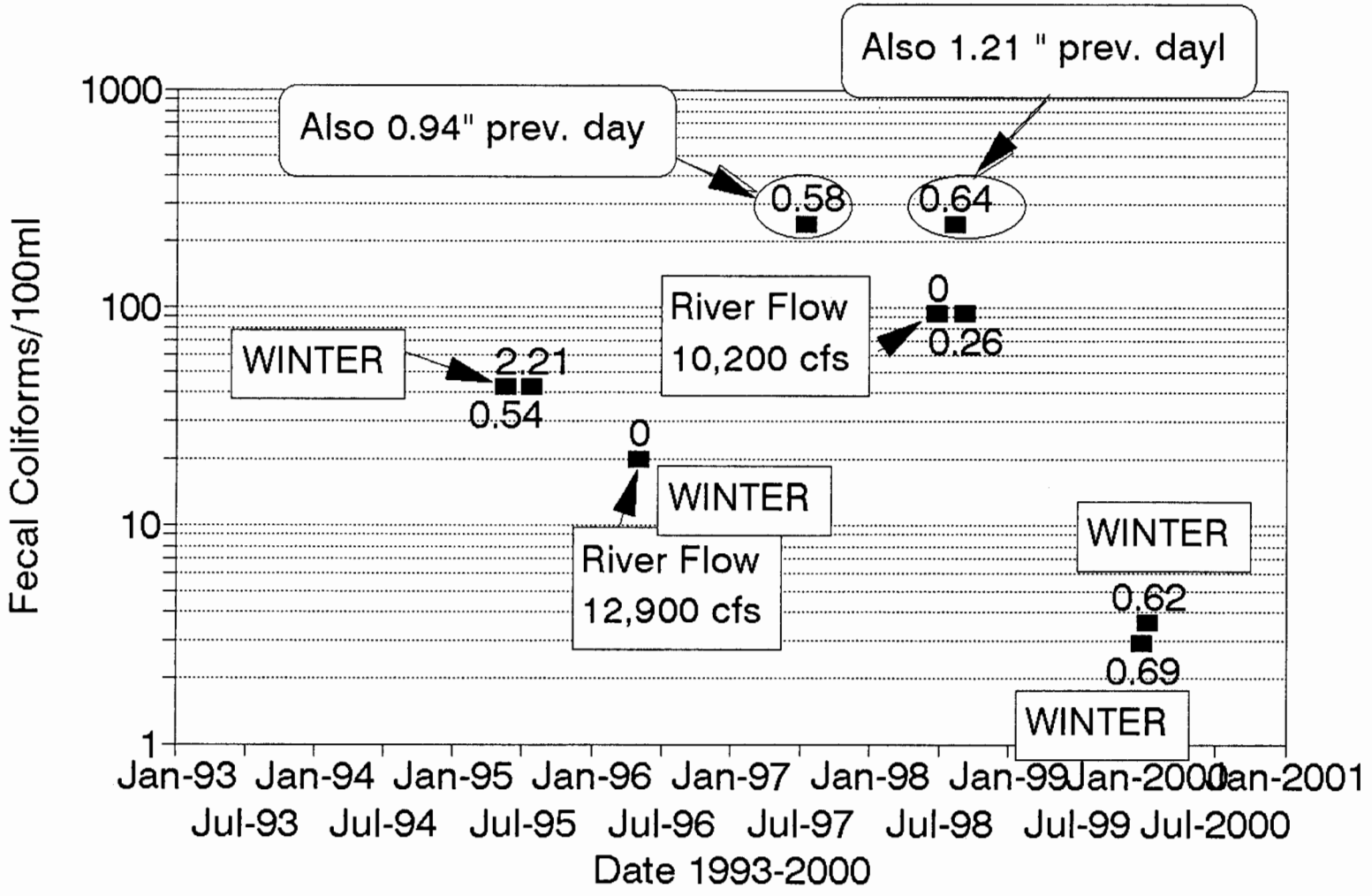
FIGURE 2

Fecal Coliform Relative to Precipitation

(4 Pages follow)

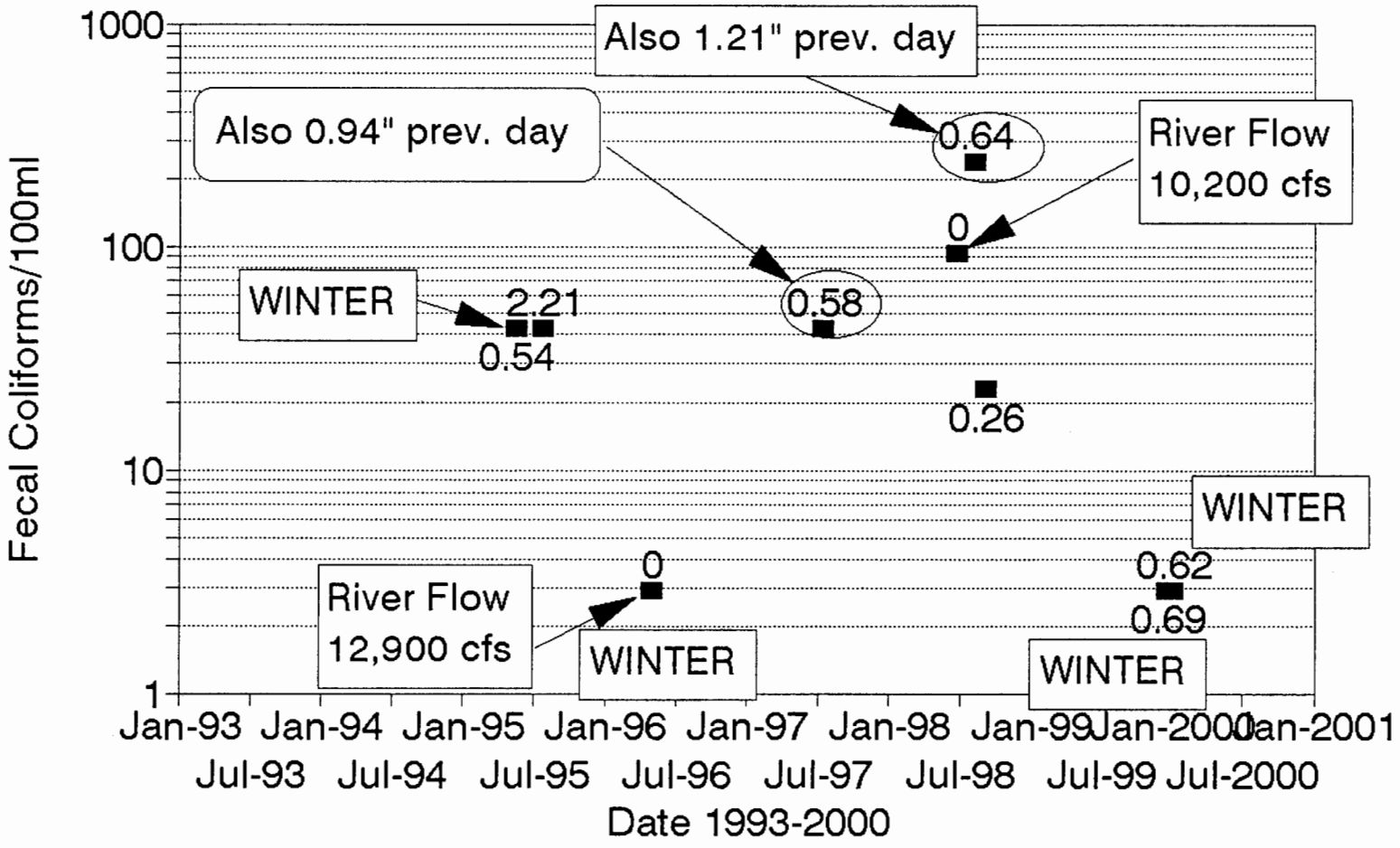
Sta 8.1 Samples with Precip. > 0.25 in.

Reported at 0700 at Kennebunkport



Sta 8.5 Samples with Precip. > 0.25 in.

Reported at 0700 at Kennebunkport



Sta 8.8 Samples with Precip. > 0.25 in.

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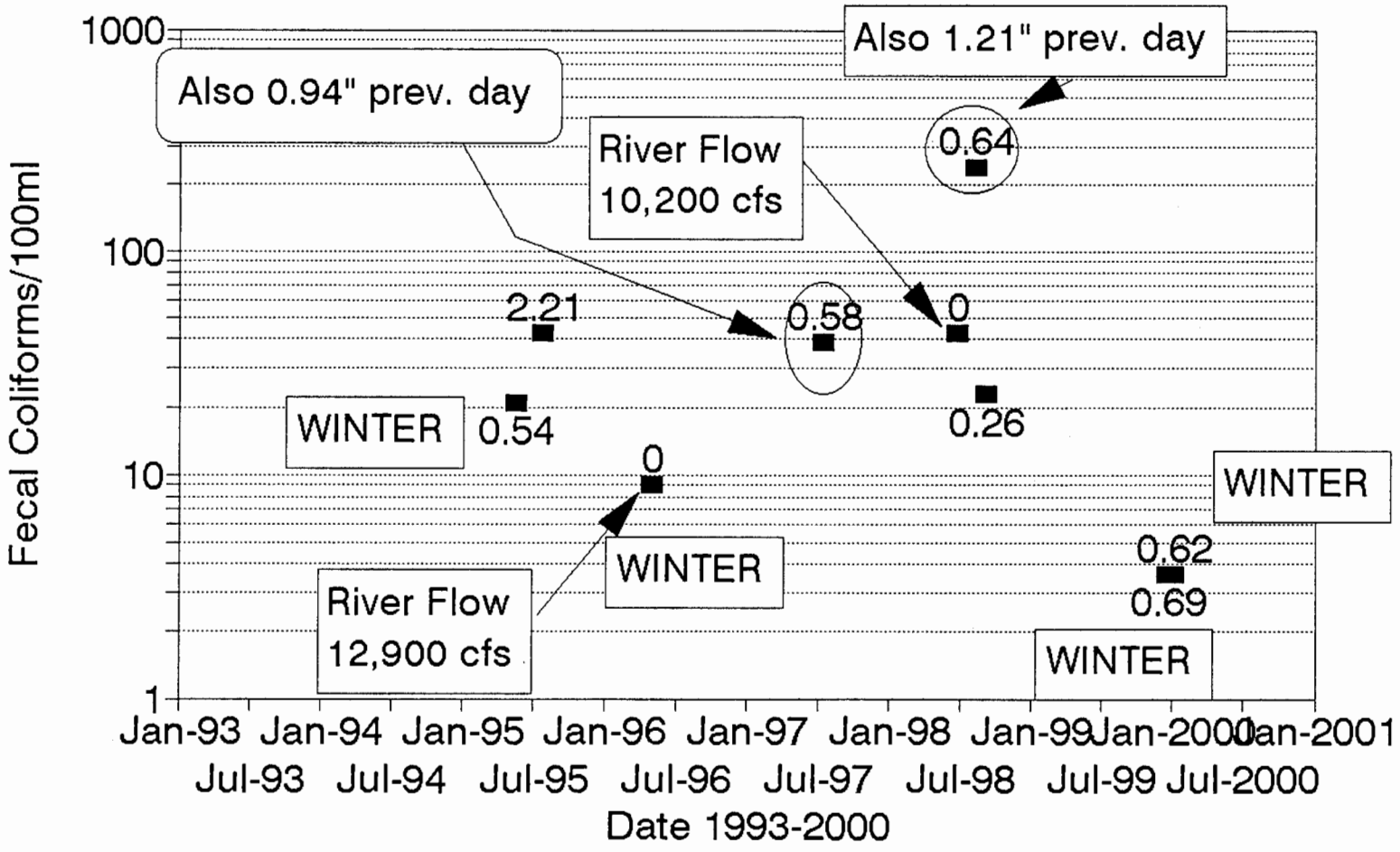


Sta 8.9 Samples with Precip. > 0.25 in.

Reported at 0700 at Kennebunkport

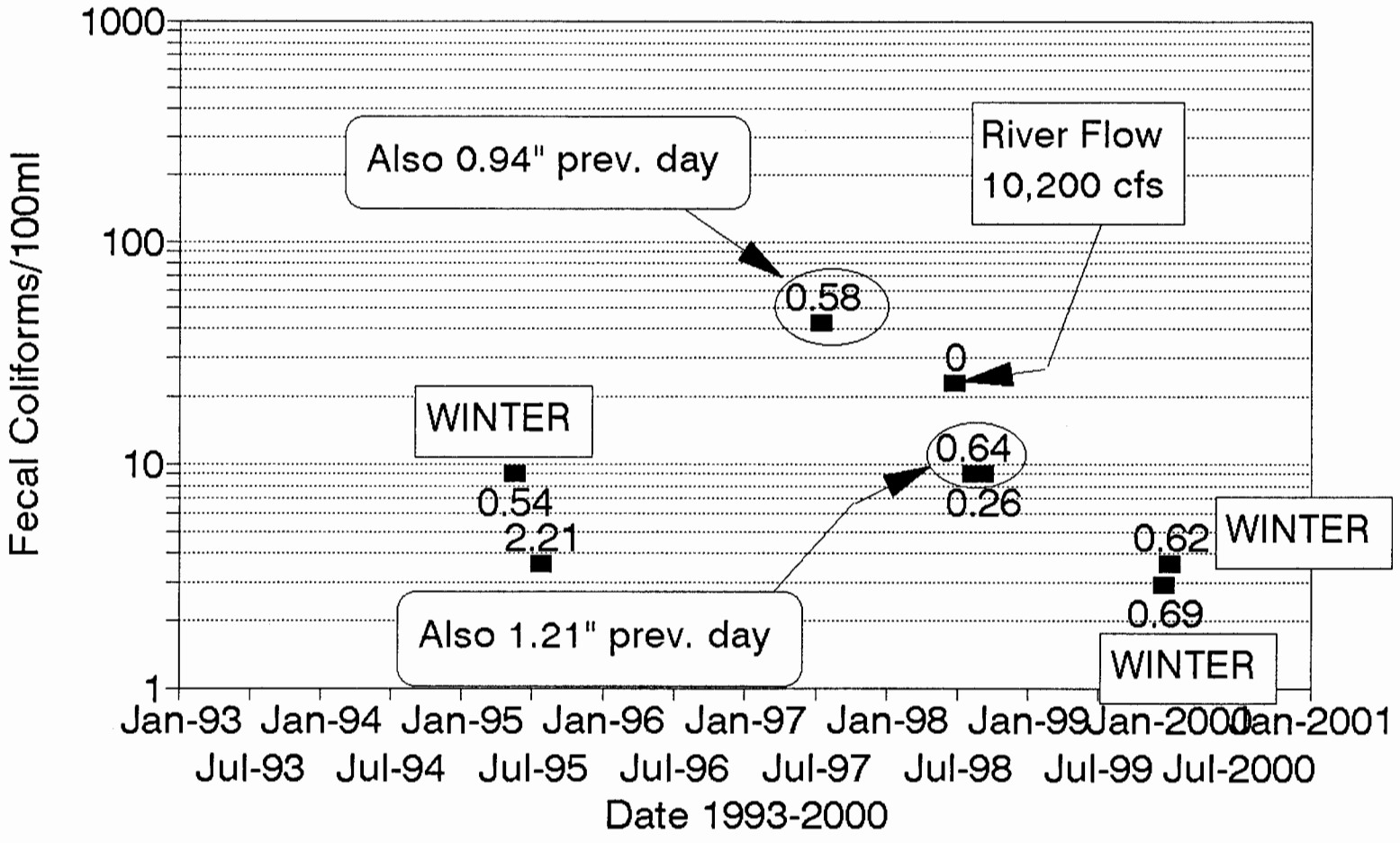
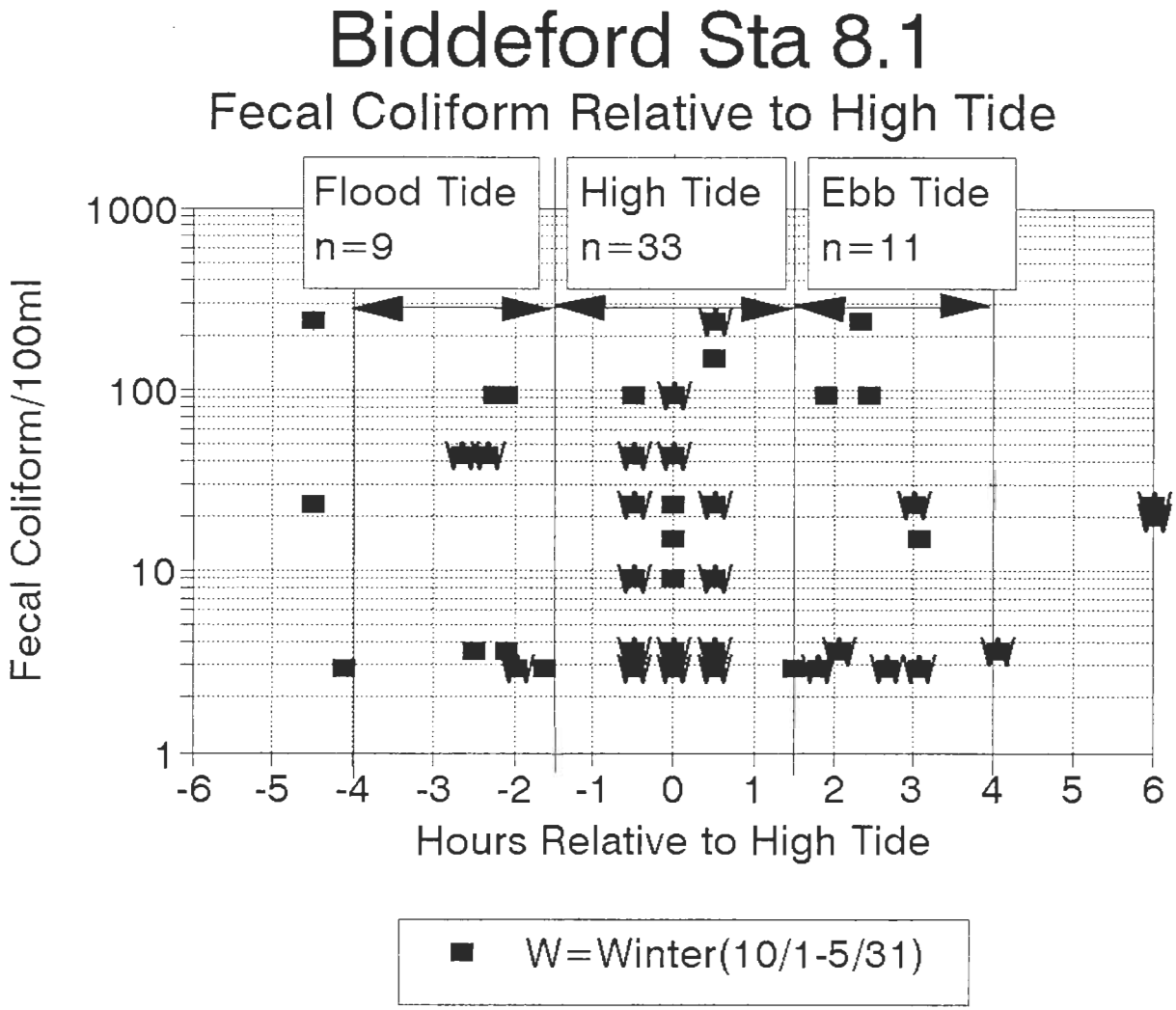
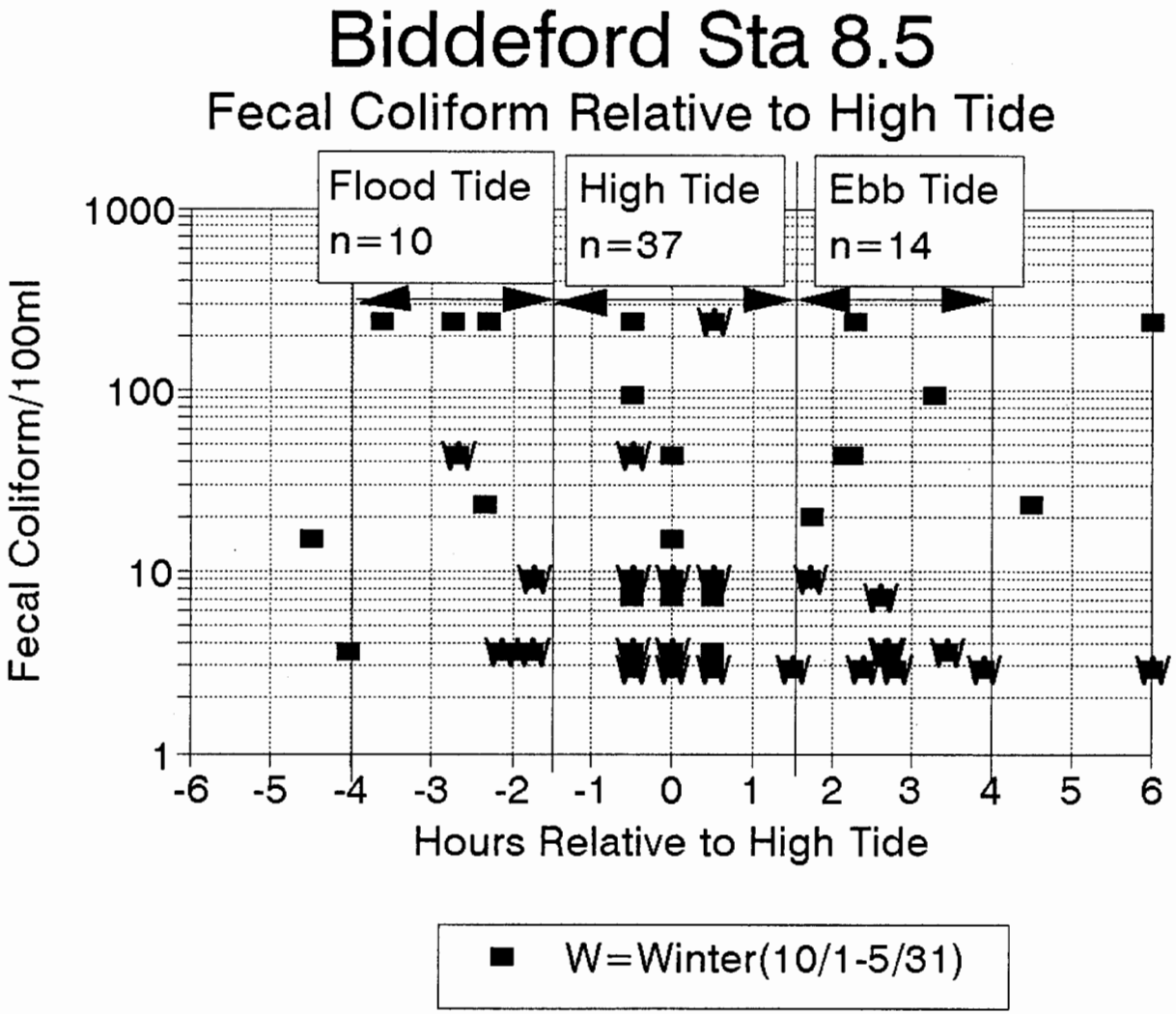


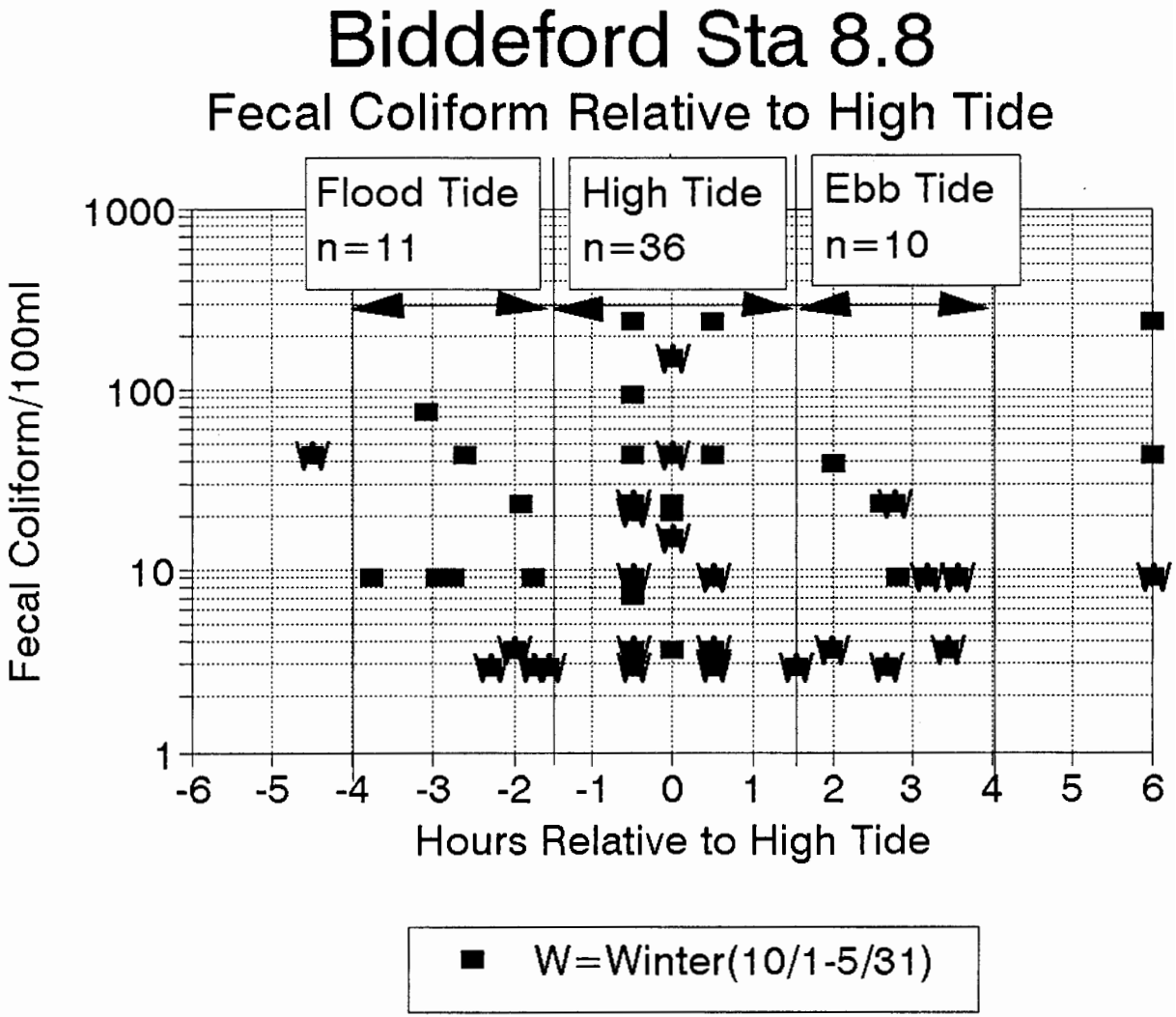
FIGURE 3

Fecal Coliform Relative to High Tide

(4 Pages follow)


Biddeford Sta 8.1
Fecal Coliform Relative to High Tide
Flood Tide
n=9
High Tide
n=33
Ebb Tide
n=11
Fecal Coliform/100ml
1000
100
10
1
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
Hours Relative to High Tide
W=Winter(10/1-5/31)


Biddeford Sta 8.5
Fecal Coliform Relative to High Tide
Flood Tide
n=10
High Tide
n=37
Ebb Tide
n=14
Fecal Coliform/100ml
1000
100
10
1
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
Hours Relative to High Tide
W=Winter(10/1-5/31)


Biddeford Sta 8.8
Fecal Coliform Relative to High Tide
Flood Tide
n=11
High Tide
n=36
Ebb Tide
n=10
Fecal Coliform/100ml
1000
100
10
1
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
Hours Relative to High Tide
W=Winter(10/1-5/31)

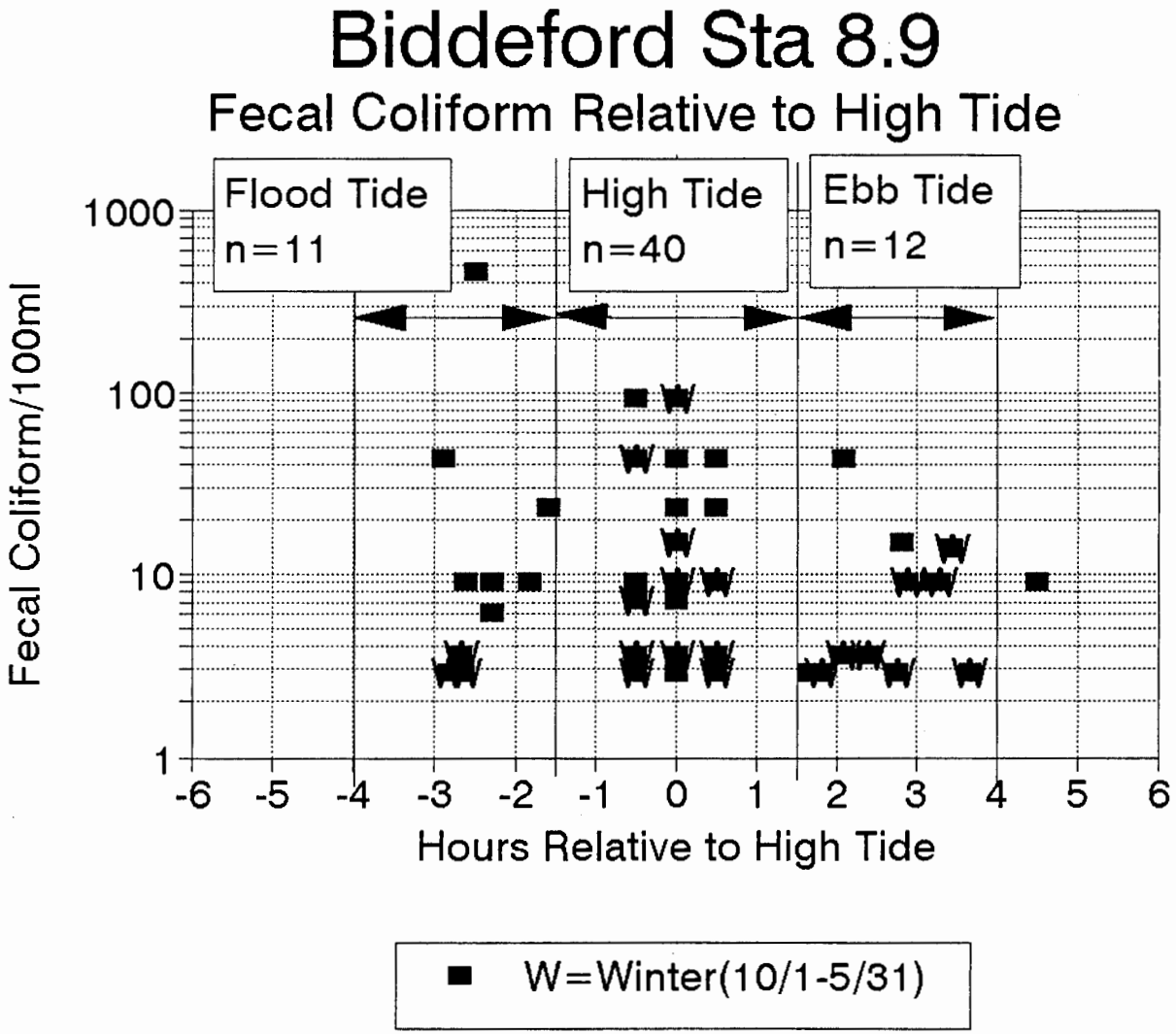

Biddeford Sta 8.9
Fecal Coliform Relative to High Tide
Flood Tide
n=11
High Tide
n=40
Ebb Tide
n=12
Fecal Coliform/100ml
1000
100
10
1
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
Hours Relative to High Tide
W=Winter(10/1-5/31)

TABLE 1

Statistics for Biddeford Pool

Station	8.1			8.5			8.8			8.9		
Tide	Ebb	High	Flood	Ebb	High	Flood	Ebb	High	Flood	Ebb	High	Flood
No. of samples	11	33	9	14	37	10	10	36	11	12	40	11
Geometric Mean	11.7	13.2	12.0	10.5	8.7	21.4	8.4	13.2	9.3	6.5	7.9	10.5
Log Std. Dev.	0.73	0.57	0.70	0.65	0.56	0.81	0.41	0.62	0.49	0.39	0.48	0.66
Est. 90^{th} Percentile	102	70	95	71	45	234	28	83	39	20	32	74

* A "T" Test was performed between sets of log numbers for high and ebb, flood and high, and flood and ebb tides for each station. No significant difference was found at the 95% confidence limits.

TABLE 2

Comparison of Winter and Summer Data

Station	Winter (Oct. 1 – May 31)				Summer (June 1 – Sept. 30)			
	Geo. Mean	No. of Samples	No. Samples >49	Est. 90^{th} Percentile	Geo. Mean	No. of Samples	No. Samples >49	Est. 90^{th} Percentile
8.1	9.3	29	2	47	20.6	28	8	131
8.5	5.6	32	1	18	21.4	33	9	162
8.8	7.1	30	1	27	21.6	31	6	121
8.9	5.2	32	1	15	12.4	32	2	57

ATTACHMENT

Biddeford Pool Data Used in Analyses (DMR Data)

Station 8.1

Station	Date	Time	Salinity (ppt)	FColi MPN/100ml	Tide
8.1	01/26/93		40	3.6	HF
8.1	05/11/93		24	2.9	HF
8.1	06/21/93		16	93	HF
8.1	08/24/93	14:51	31	3.6	F
8.1	09/14/93		32	2.9	HE
8.1	10/19/93		31	9.1	HF
8.1	03/25/94	11:55	24	23	E
8.1	05/27/94	11:20	19	43	F
8.1	06/24/94		31	23	HF
8.1	07/25/94		32	23	H
8.1	08/26/94	13:10	29	3.6	F
8.1	09/28/94	08:05	25	93	E
8.1	01/18/95		20	240	HE
8.1	04/06/95	14:30	31	2.9	F
8.1	05/18/95		30	43	HF
8.1	06/29/95	11:30	31	2.9	F
8.1	07/27/95		30	43	H
8.1	08/24/95	12:20	33	2.9	E
8.1	09/28/95		31	9.1	H
8.1	04/29/96		14	20	L
8.1	06/03/96		30	2.9	H
8.1	07/18/96		30	9.1	HF
8.1	09/12/96		31	23	HE
8.1	11/14/96		20	43	H
8.1	11/20/96		30	23	L
8.1	04/03/97	10:55	30	2.9	E
8.1	05/13/97	08:40	32	3.6	E
8.1	06/10/97	11:00	21	2.9	F
8.1	07/16/97	10:50	25	240	E
8.1	06/25/98	14:50	21	93	E
8.1	08/06/97		30	9.1	H
8.1	10/15/97		30	9.1	HE
8.1	07/09/98	09:45	23	93	F
8.1	08/13/98		30	240	LF
8.1	08/27/98		31	23	LF
8.1	09/10/98	12:30	32	93	F
8.1	10/29/98	15:40	25	43	F
8.1	02/16/99	12:45	30	2.9	E
8.1	04/14/99		28	3.6	HE
8.1	07/15/99		31	23	HF
8.1	07/29/99		32	15	H
8.1	08/26/99		31	150	HE
8.1	09/08/99		31	93	HF
8.1	10/26/99		30	2.9	H
8.1	11/17/99	08:04	30	2.9	E
8.1	12/21/99		31	2.9	HE

Biddeford Pool Data Used in Analyses (DMR Data) - 2

Station 8.1

Station	Date	Time	Salinity (ppt)	FColi MPN/100ml	Tide
8.1	01/05/2000		30	3.6	H
8.1	01/19/2000	10:58	30	3.6	E
8.1	02/16/2000		33	23	HE
8.1	02/23/2000		30	2.9	HF
8.1	03/01/2000		20	93	H
8.1	03/15/2000		30	9.1	HE
8.1	04/05/2000		25	3.6	H
8.1	04/19/2000		28	23	HF
8.1	07/06/2000	06:16	30	15	E
8.1	05/03/2000		25	2.9	H
8.1	06/01/2000		29	9.1	HE

Biddeford Pool Data Used in Analyses (DMR Data)

Station 8.5

Station	Date	Time	Salinity (ppt)	FColi MPN/100ml	Tide
8.5	01/26/93		32	2.9	HF
8.5	05/11/93	14:33	29	3.6	F
8.5	06/21/93		15	93	HF
8.5	07/28/93	09:35	31	43	E
8.5	08/24/93	13:17	31	3.6	F
8.5	09/14/93		32	240	HF
8.5	10/19/93		31	3.6	HF
8.5	03/25/94	11:35	16	3.6	E
8.5	05/27/94	11:00	24	43	F
8.5	06/24/94		29	9.1	HF
8.5	07/25/94		17	3.6	H
8.5	08/26/94	13:15	30	3.6	F
8.5	09/26/94	13:20	20	240	F
8.5	09/28/94	07:55	18	240	E
8.5	09/30/94		26	23	LE
8.5	10/01/94	11:00	28	7.3	E
8.5	10/19/94		32	9.1	HE
8.5	12/04/94	14:10	32	3.6	E
8.5	01/18/95		18	240	HE
8.5	03/15/95	13:05	20	3.6	E
8.5	04/06/95	14:20	20	3.6	F
8.5	05/18/95		29	43	HF
8.5	06/29/95		31	7.3	HF
8.5	07/27/95		30	43	H
8.5	08/24/95		33	3.6	HE
8.5	09/28/95		31	2.9	H
8.5	04/29/96		13	2.9	L

Biddeford Pool Data Used in Analyses (DMR Data) - 3

Station 8.5

Station	Date	Time	Salinity (ppt)	FColi MPN/100ml	Tide
8.5	06/03/96		30	3.6	HF
8.5	07/18/96		30	9.1	HF
8.5	09/12/96		31	3.6	HE
8.5	11/14/96		25	9.1	H
8.5	12/11/96		23	9.1	HE
8.5	04/09/97		22	2.9	H
8.5	05/13/97	08:30	31	2.9	E
8.5	06/18/97		20	7.3	HE
8.5	07/16/97	10:45	25	43	E
8.5	08/06/97		30	3.6	H
8.5	10/15/97		29	9.1	HE
8.5	06/25/98	14:40	20	20	E
8.5	07/09/98	09:32	19	240	F
8.5	08/13/98		20	240	L
8.5	08/27/98		26	15	LF
8.5	09/10/98	12:25	30	23	F
8.5	10/29/98	15:35	30	9.1	F
8.5	02/16/99	12:40	30	9.1	E
8.5	04/14/99		29	9.1	HE
8.5	07/15/99		31	9.1	HF
8.5	07/29/99		31	15	H
8.5	08/26/99		31	7.3	H
8.5	09/08/99		31	240	HF
8.5	10/26/99		29	9.1	HE
8.5	11/17/99	08:12	30	2.9	E
8.5	12/21/99		31	2.9	HE
8.5	01/05/2000		28	2.9	H
8.5	01/19/2000	11:18	32	2.9	E
8.5	02/16/2000	09:11	30	2.9	E
8.5	02/23/2000		30	2.9	HF
8.5	03/01/2000		28	9.1	H
8.5	03/15/2000		30	2.9	HE
8.5	04/05/2000		28	2.9	H
8.5	04/19/2000		25	9.1	HF
8.5	05/03/2000		25	3.6	H
8.5	06/01/2000		30	3.6	HE
8.5	06/07/2000	12:39	29	240	F
8.5	07/06/2000	06:29	30	93	E

Biddeford Pool Data Used in Analyses (DMR Data) -4

Station 8.8

Station	Date	Time	Salinity (ppt)	FColi MPN/100ml	Tide
8.8	01/26/93		32	2.9	HF
8.8	05/11/93		28	3.6	HF
8.8	06/21/93		12	240	HF
8.8	07/28/93	10:15	31	9.1	E
8.8	08/24/93	14:35	32	9.1	F
8.8	09/14/93		32	3.6	H
8.8	05/27/94		24	23	HF
8.8	06/24/94		31	43	HF
8.8	07/25/94		32	3.6	H
8.8	08/26/94	12:20	27	9.1	F
8.8	09/26/94	13:00	26	75	F
8.8	10/19/94		32	9.1	HE
8.8	12/04/94	14:15	31	23	E
8.8	01/18/95		21	150	H
8.8	03/15/95	12:50	18	9.1	E
8.8	04/06/95	14:10	28	2.9	F
8.8	05/18/95		29	21	HF
8.8	06/29/95		31	7.3	HF
8.8	07/27/95		30	43	HE
8.8	08/24/95		33	2.9	HE
8.8	09/28/95		31	3.6	H
8.8	04/29/96		11	9.1	L
8.8	06/03/96		30	23	H
8.8	07/18/96		25	240	HF
8.8	09/12/96		30	43	HE
8.8	11/14/96		25	43	H
8.8	12/04/96		5	43	LF
8.8	04/03/97	10:30	12	2.9	E
8.8	05/13/97	08:10	21	9.1	E
8.8	06/18/97		30	3.6	HE
8.8	07/16/97	10:30	25	39	E
8.8	08/06/97		30	9.1	HE
8.8	10/08/97	14:35	28	2.9	F
8.8	06/25/98		15	43	HE
8.8	07/09/98	09:15	25	43	F
8.8	08/13/98		18	240	L
8.8	08/27/98		20	43	L
8.8	09/10/98	12:50	31	23	F
8.8	10/29/98	15:20	31	3.6	F
8.8	02/16/99	12:55	30	3.6	E
8.8	04/14/99		28	3.6	HE
8.8	07/15/99		31	23	HF
8.8	07/29/99		33	21	H
8.8	08/26/99		31	240	HE
8.8	09/08/99		31	93	HF
8.8	10/26/99		29	15	H
8.8	11/17/99	07:30	30	3.6	E
8.8	12/21/99		30	3.6	HE
8.8	01/05/2000		30	3.6	HF

Biddeford Pool Data Used in Analyses (DMR Data) - 5

Station 8.8

Station	Date	Time	Salinity (ppt)	FColi MPN/100ml	Tide
8.8	01/19/2000	10:27	32	2.9	E
8.8	02/16/2000		31	3	HE
8.8	02/23/2000	12:06	29	2.9	F
8.8	03/01/2000		20	23	HF
8.8	03/15/2000		28	2.9	HE
8.8	04/05/2000		30	2.9	HF
8.8	04/19/2000		20	9.1	HF
8.8	05/03/2000		22	3.6	HF
8.8	06/01/2000		30	3.6	HE
8.8	06/07/2000	12:30	30	9.1	F
8.8	07/06/2000	05:49	30	23	E
8.8	08/03/2000	12:50	27	9.1	F

Biddeford Pool Data Used in Analyses (DMR Data)

Station 8.9

Station	Date	Time	Salinity (ppt)	FColi MPN/100ml	Tide
8.9	01/26/93		41	2.9	HF
8.9	05/11/93		29	3.6	HF
8.9	06/21/93		12	43	HF
8.9	07/28/93	10:37	32	9.1	E
8.9	08/24/93	14:43	31	9.1	F
8.9	09/14/93		33	7.3	H
8.9	10/19/93		31	3.6	HF
8.9	03/25/94	12:20	25	14	E
8.9	05/27/94		23	7.3	HF
8.9	06/24/94		30	9.1	HF
8.9	07/25/94		32	23	H
8.9	08/26/94	12:35	31	2.9	F
8.9	09/26/94	13:10	30	43	F
8.9	09/30/94		30	9.1	LE
8.9	10/19/94		32	3.6	HE
8.9	12/04/94	14:20	33	9.1	E
8.9	01/18/95		20	93	H
8.9	03/15/95	12:55	28	9.1	E
8.9	04/06/95	13:50	30	2.9	F
8.9	05/18/95		28	9.1	H
8.9	06/29/95		31	43	H
8.9	07/27/95		29	3.6	HE
8.9	08/24/95		32	3.6	HE
8.9	09/28/95		31	2.9	H
8.9	06/03/96		30	2.9	H
8.9	07/18/96		21	3.6	HF
8.9	09/12/96		31	9.1	HE