Draft

Monitoring Effects of a Potential Increased Tidal Range in the Cape Fear River Ecosystem Due to Deepening Wilmington Harbor, North Carolina
Year 6: June 1, 2005 – May 31, 2006

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ABSTRACT

Measurement of water levels in the main channel of the Cape Fear River, the Northeast Cape Fear River, and Town Creek continue to provide data necessary to determine the potential impact associated with the widening and deepening project. More than 1,400 tide ranges measured between 1 June 2005 and 31 May 2006 were used to conduct analyses of changes in tidal amplitude as well as changes of ebb and flood duration. A good correlation between measured tidal range from the base station at Ft Caswell and the predicted tidal range for this station continues to exist. The slope of the regression is less steep than in 2004-2005, but nonetheless consistent to that reported for most previous reporting periods. The mean tidal range at P1 was not significantly different from the mean reported in the previous monitoring period, but was significantly lower than the range reported in Year 1. Tidal ranges within the estuary were fairly constant, including the lowermost of the upstream stations, and were higher than tidal ranges measured at most upstream stations. Water levels in the most upstream sites and the inner Town Creek station continued to be affected by discharge rates in the river. This reporting period was characterized by fewer high discharge events than in the previous two reporting periods. Some significant differences in yearly mean tidal ranges between this reporting period and 2004-2005 were observed and these occurred primarily in the most upstream mainstem stations. Few differences in tidal range between this reporting period and the previous period occurred in the Northeast Cape Fear River. Only two stations, P1 and P7 showed significant differences in tidal range between this reporting period and the first year of monitoring.

The observation that mean tidal range observed at P1 (Ft. Caswell) is again significantly less than in Year 1 continues to complicate interpretation of the results as this station was initially expected to be unimpacted by river widening activities. Consequently, we have used the longer time series of water level data available from P4. Using this longer data base (1994-2006) for P4, our initial comparisons of the mean difference between observed and predicted tidal ranges in 1994 to the mean difference between observed and predicted tidal ranges in 2005 did not yield significant differences even though the mean water levels between the two years were significantly different. Additional analyses are in progress.

Similar to the pattern reported last year, mean monthly maximum water levels for this reporting period were not significantly different from the values reported for the previous monitoring period with the exception of site P2. There also was no significant difference in mean monthly minimum water level between this reporting period and last year with the exception of site P6. Comparisons of the regression slopes when tidal range at each site was regressed against P1 tidal range yielded significant differences between this reporting period and the previous reporting period for all stations except P3, P6, P13,

and P14. When the slopes from this reporting period were compared to slopes calculated for Year 1 (2000-2001), all sites yielded a significant difference between years except for sites P3, P6, and P13.

Both the high tide and low tide lag values were comparable to those reported last year. In the mainstem, the mean high tide lag from P1 increased at all stations except P7 relative to the lag times reported in 2004-2005. This trend is consistent with the previous reporting period. Changes in mean low tide lag relative to the previous reporting period did not show any consistent pattern. In the Northeast Cape Fear River, changes in tidal lag were minor and inconsistent among stations. During this reporting period, mean flood duration changed by less than 1% at all stations except for P8 and P11. Mean flood duration also varied little from those values reported in the last monitoring period (<1%) except for stations P8 and P11. For the minor flood and ebb durations that were observed, there was no consistent pattern of increase or decrease with distance upstream or between major tributaries. The duration of flooding tide has increased slightly (by less than 1.5%) at all mainstem stations since the last reporting period. This pattern is consistent with the previous reporting period where flooding duration had increased by less than 2% at all stations. With the exception of P6, the duration of ebb tide decreased by less than 1.5% at all stations. At station P6, the duration of ebb tide was essentially the same as in 2004-2005.

Periods of lower, drought-induced water levels and extreme flooding in the system over the last 5 years have contributed to differing tidal conditions in the Cape Fear and Northeast Cape Fear Rivers between monitoring years. These effects are confounded by the shortened data set for Year 1 which included data collected from October to June, only, and covered a period when monthly river discharge was below the long-term average (~5,531 ft^3/s) reported by the USGS at Lock and Dam 1 on the Cape Fear mainstem. This reporting period, the mean discharge was comparable to the mean discharge that existed during Year 1. This condition allows for more direct comparison between this year's data and Year 1. The similarity in discharge rates between the first project year and the current year, may explain the lack of significant difference in many of the statistical comparisons this year compared to previous reporting periods.

We have begun harmonic analyses of tidal constituents. For all stations, the M2 component is the dominant constituent, as was expected. We are now aggregating the phase/amplitude data for various years and these data will eventually be used to identify differences in tidal dynamics between stations along the river that have been impacted by channel modification activities. Further, the extended water level time series available at P4 allows for examination of pre-dredging conditions to post-dredging conditions. Over the 11 year period between 1994 and 2005, neither the amplitude nor the phase of the M2 constituent has changed appreciably.

An adequate data base was obtained from water level monitors on both swamp and marsh substations for both fall 2005 and spring 2006 to determine flood frequency, flood duration, flood water depth, and salinity of flooding water. Most subsites flooded with about the same frequency and duration as previous years; one station was noteworthy because several subsites rarely flooded during the two-weeks when data were collected in spring. This was likely a random anomaly related to water levels on the river. In general, there were shorter flood durations of water on the marsh/swamp surface at subsites compared to the initial year despite the very similar release of water over Lock & Dam # 1 noted earlier. No trend of increasing or decreasing salinity at subsites was apparent in the data base with the exception of subsites at two stations, P11 and P12, which are becoming more saline through time.

Geochemical data have been collected since winter 2000. The microbial modes of organic matter remineralization of the study sites range from sulfate reducing to methanogenic. Analysis of porewater chloride, sulfate, and methane was performed at six substations per station and at 6 sub-depths per substation. Samples were collected during the winter and summer at eight sites and monthly at one station within the estuary. These data were used to classify the geochemical setting of each substation at each station as methanogenic (M), sulfate reducing (SR), methanogenic with evidence of past sulfate reduction (MPSR), and sulfate reducing with a non-seawater source of sulfate (SRNS). Classifications were compared to the previous data for these sites.

The station where samples were collected monthly exhibited a steady decrease in salinity from June of 2002 until June of 2003. Salinity slightly rebounded during the winters of 2004 and 2005; however, it was still lower than previous years. The previous winter (2005) had almost identical conditions as 2004 with the exception of a salinity peak in November. Although salinity pulses were of similar magnitude to the previous year, it appears that the consumption of sulfate was more rapid during 2005-2006 resulting in conditions unable to support active sulfate reduction.

Infaunal community patterns at 9 sites distributed among the Cape Fear River, Northeast Cape Fear River and Town Creek from 1999-2005 follow a period that covered three major potential system-level impacts: a developing drought in 2001-2002, a period of recovery and relatively higher freshwater input late in 2003 and in 2004, as well as the initiation of channel widening construction in 2001-2002. Diversity was generally lowest in 2000 and species richness and diversity were generally highest in 2004. However, there were no consistent patterns for either diversity or richness among the remaining years. Richness and diversity for 2005 was intermediate and not significantly different from either 2003 or 2004. Similarity and Multidimensional Scaling Analysis indicated that 1999-2001 samples did not have significantly dissimilar faunal assemblages. However, subsequent years did have distinct infaunal assemblages, both from the 1999-2001 grouping as well as from each other. The overall separation of 2002-2005 from 1999-2001 was greater than differences among the 2002-2005 grouping as indicated by Analysis of Similarity. There has been a shift in species dominance related primarily to increasing drought impacts. Many sites initially dominated by tidal freshwater and oligohaline species shifted toward dominance by oligohaline-mesohaline polychaetes in 2002 followed by a subsequent recovery in 2003. Summer 2004 showed the highest mean abundances or second highest mean abundance among major taxonomic groupings and functional groups for all but a few sites. Dominance patterns varied among sites, but in general oligochaetes and insect taxa were the most abundant taxa at most sites in 2004. Patterns in 2005 for both major taxa and functional guilds continued this trend, with increases in oligochaetes at 3 sites, insects at 3 sites, and amphipods at 2 sites.

The epibenthic community is strongly influenced by shifts in the physical environment and changes in prey availability. Most of these organisms are highly motile and long term trends must be evaluated against short- and long-term variables that affect populations. Previous findings indicated changes in species patterns consistent with developing drought conditions in 2001 and 2002, though this period was also coincident with initial construction activity. Annual and seasonal differences exist for most sites Evaluation of species richness by season show that 2004, 2005, and 2006 spring sampling periods tended to have significantly higher species richness measures, but fall sampling was inconsistent. Analysis of total abundance shows a high degree of variation among years for each of the three tributaries. Spring 2006 tended to show the highest total abundances.

It seems clear that these tidal wetland systems are controlled largely by salinity incursions in the upper estuary/lower river and changes in vegetation largely reflect past events. The area of *Zizaniopsis miliacea* at the Inner Town Creek site (P3), has expanded from 710 ft^2, measured in 2000, to 3,619 ft^2 measured this year, but had undergone both expansion and contraction in the interim. There has been more than a two-fold increase in polygon size between last year (1,518 ft^2) and the current year. At stations above salinity incursions, e.g., Indian Creek, sensitive herbaceous vegetation was largely unaffected by arrival of ocean-derived salts. Above the area of saltwater intrusion, vegetation change may still occur after extended periods of river flooding. Changes in the sensitive herbaceous polygon at Rat Island since last year have been remarkable. *Schoenoplectus americanus* has recovered to the extent that it is again comparable to coverage in 2000, the first year of sampling. The sensitive herbaceous vegetation polygon for the Fishing Creek station has decreased in size this year by 233.5 ft^2, mostly due to slight narrowing in some areas, but has remained considerably larger than the polygon measured in 2000. *Pontederia cordata*, the main sensitive herbaceous species used to define the polygon, has continued to rebound following the extremes of 2001-2003. At Prince George Creek, *Saururus cernuus* and *Polygonum hydropiperoides* were the two most abundant sensitive herbaceous species within the polygon at Prince George Creek. These two species have dominated the polygon each year except in 2002 when *Polygonum hydropiperoides* was not visible. Both have generally rebounded from the high salinity, but this year *Saururus cernuus* has diminished in cover compared to 2002. Reasons for this decrease in cover are uncertain. With this cover decrease there has been a strong increase in abundance by the annual, *Polygonum arifolium*.

The composition and cover of vascular herbaceous species in tidal brackish marsh systems is not only mutable, but a reversible as well. Oligohaline and mesohaline subsystems are changed or rebound relative to water salinity both accompanying and following an event. It seems clear that these systems are driven largely by salinity regime. The salinity regime in middle estuarine reaches, at least, is under the influence of weather and climate. It follows that in tidal marsh systems in an estuarine environment vegetation patterns are linked to weather and climate, making plant cover and dominance an extension of a naturally chaotic system.

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1.0 STATION OPERATION

1.1 Summary

Measurement of water levels in the main channel of the Cape Fear River, the Northeast Cape Fear River, and Town Creek continue to provide data necessary to determine the potential impact associated with the widening and deepening project. Differences between the high and low points of each tide, referred to as ranges in this report, can be followed upstream from the base station at Ft Caswell (P1) to any individual station. Differences between stations with respect to tidal range, time to high or low tide, length of low and high tides were also determined. Comparisons of these variables before and after channel modifications will provide the statistical testing mechanism to examine whether the project has impacted adjacent wetlands. In addition, the absolute elevation of floodwater when related to measurements of water levels at marsh/swamp substations allows the determination of both flood duration and flood depth for any tide. This report includes data collected from June 2005 through May 2006. During this period, problems of communication with instruments or minor instrument malfunction were solved as they occurred. Mechanical errors were slightly higher at some sites this year than during previous reporting periods, reflects the age of some equipment. As was the case in previous monitoring years, each tide has been examined for each station and a determination made as to whether each tidal datum collected were reliable.

1.2 Methodology

Water level is sampled by a UNIDATA shaft-encoded water level recorder housed in an aluminum stilling well at 1-second intervals. A UNIDATA Starlogger logs the average, maximum and minimum values every 3 minutes. Conductivity and temperature are also sampled by a UNIDATA conductivity instrument and recorded by the Starlogger every 3 minutes. Data are downloaded to a PC housed in the laboratory every 2 weeks via modem. In instances when the modem has not functioned properly, technicians on site download data loggers using a laptop. Preliminary data quality review consists of visually reviewing data for major problems (e.g. float hang-ups in the stilling well, data transmission errors, large jumps/shifts in water level, loss of data) within 2-3 days of download. This process is done so that any major problems identified can be rectified immediately. Data are then compiled into files each of which contains 1 month of data for each station. Data files are then sorted at 6 minutes intervals and the resulting data set is stored for subsequent data analysis. Table 1.1-1 provides a general summary of data loss that affects statistical analysis for present and future comparisons. As in previous reporting periods, the terms used to describe general mechanisms through which data are lost or compromised are defined below:

<u>Loss at Station P1</u>: Because the response of each variable upstream (Figure 1.2-1) is related to the base station at Ft Caswell (P1), the loss of a variable from P1 during a particular tide means that there is no means of comparison with other stations. Reasons for data loss at P1 as well as other stations are: 1) <u>QA/QC Procedure</u>, which refers to tides that were removed from the data set when measurements coincided with QA/QC

and equipment maintenance procedures. In these instances, recorded water levels were inaccurate due to cleaning the water level float, removing/replacing the water level recorder, replacing the beaded cable, or performing a field reset when in-situ observations of water level were inconsistent with water levels reported by the data logger. 2) Under ranging events refers to tides that were removed from the data set when the actual water level fell below the elevation of the stilling well cap. In these instances, the instruments were unable to detect the minimum water level. 3) Absence of Data refers to tides that were lost when the data were not recorded by the data logger or were not transmitted properly via the modem or PC download process. 4) Freezing of surface water in the stilling well prohibited the float from following the rise and fall of the tides and these tides were removed. 5) Mechanical Errors refer to tides removed from the data set during the data review process because of likely mechanical malfunction. Mechanical malfunctions were suspected when the plotted data exhibited misshapen curves, large jumps, and flat lines (i.e. hang-ups).

Table 1.1-1. Percentages of tides unavailable for analysis and reasons for loss. Detailed descriptions of "loss" categories are listed in Section 1.2 above.

Station	% Loss At Station P1	% QA/QC	% Under-ranging Events	% Absence of Data	% Freezing	% Mechanical Errors	Total % Lost Tides
P1	N/A	0	0.3	1.2	0	5.4	6.9
P2	6.9	0	4.4	0.4	0	0.0	11.7
P3	6.9	0.1	0.2	0	0	4.8	12.0
P4	6.9	0	0	0	0	0	6.9
P6	6.9	0.3	5.4	0	0	20.7	33.3
P7	6.9	0	4.2	0	0	0.4	11.5
P8	6.9	0.7	0	3.8	0	19.8	31.2
P9	6.9	0.3	0	4.7	0	4.2	16.1
P11	6.9	0.3	0	0	0	0.6	7.8
P12	6.9	0.5	0	0	0	2.4	9.8
P13	6.9	0	0	0	0	0	6.9
P14	6.9	0.1	0	2.2	0	8.4	17.6

1.3 Ft Caswell (P1)

Ft Caswell is the most important station because this station experiences amplitude changes that are essentially oceanic tides. All upstream water levels are related to this station. This station functioned well during the reporting period. The total percentage of lost tides at this station from June 2005 to May 2006 (6.9%) was lower than during the previous two reporting periods (10.2% and 8.0%, respectively). Data collected at this station still show occasional irregularities in the shape of the water level curves but these variations do not affect the reported minimum and maximum water level values (i.e. reported tidal range). Under-ranging, which was previously non-existent during the last two reporting periods, was a minor problem during this reporting period. Monthly QA/QC checks and cleaning of probes and the well interior seem to prevent most minor problems before they occur. Corrosion of the beaded cable at this saline site also affects data quality; therefore, cable integrity is assessed each month and the cable replaced when necessary.

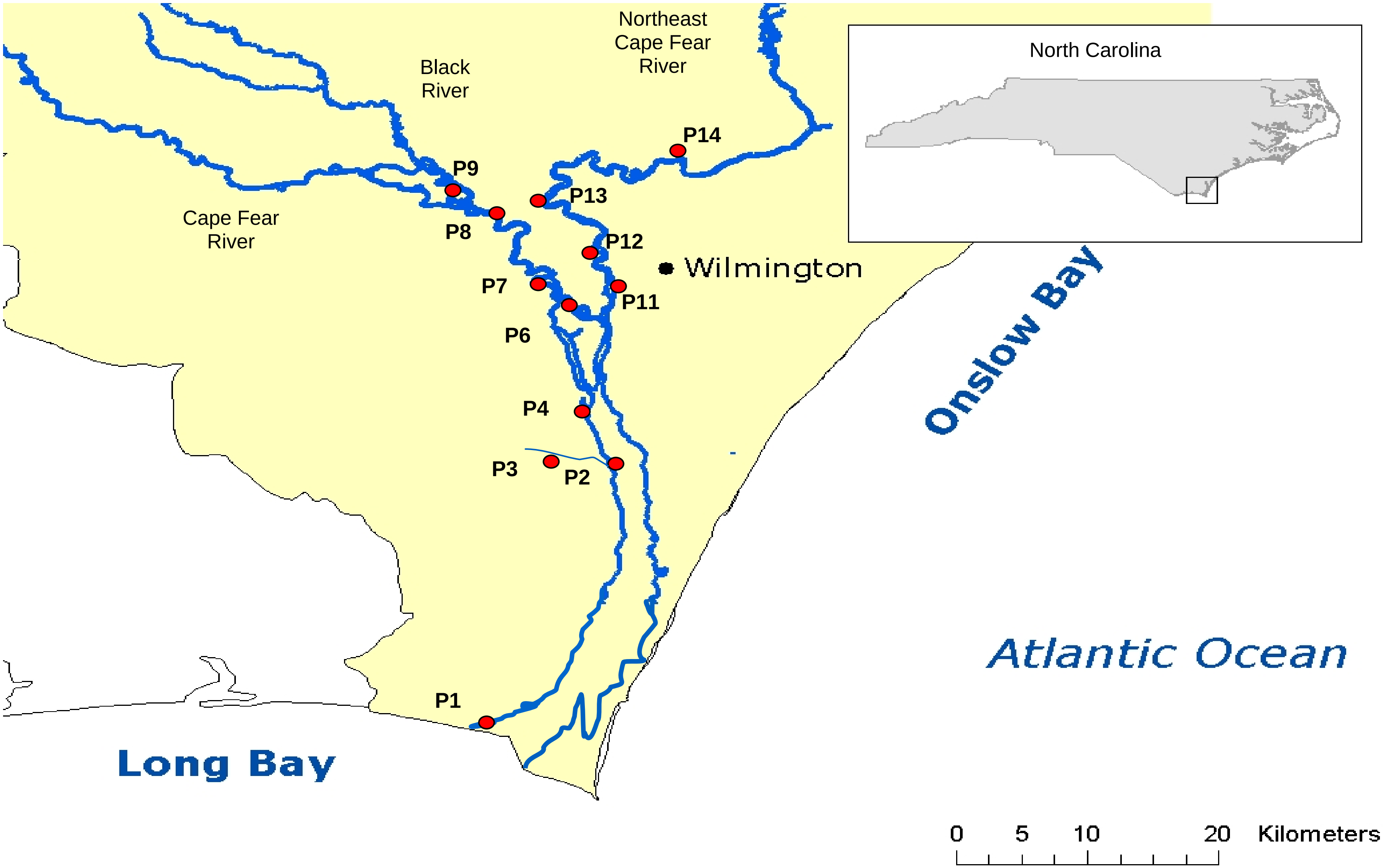


Figure 1.2-1. Location of permanent stations on the Cape Fear River estuary and tributaries.

1.4 Town Creek Mouth (P2)

Water level curves at this station can be noisy due to periods of what appear to be high frequency variations in water level. These episodes do not occur with any regular periodicity and are believed to be associated with nearby ship traffic. Nonetheless, the data are of sufficient quality to regularly identify maximum and minimum water levels and these data correspond well with the data from P1. The total percentage of lost tides at this station (11.7%) was less than during 2004-2005 (15.7%). Station P2 experienced far fewer mechanical errors this reporting period, but was subject to a series of under-ranging events in November and December of 2005. There were also scattered under-ranging events throughout January, February, and March of 2006. Water relatively high in salinity at this site continues to affect the beaded cables, necessitating their replacement on occasion.

1.5 Inner Town Creek (P3)

This station generally experiences few problems and continues to generate smooth tidal curves. Data loss during this reporting period was slightly higher than last year (12 and 10.8%, respectively) due largely to minor mechanical problems. There were also two events during September and October during which the water level was higher than normal and the tide range was suppressed, resulting in a loss of tide data. These resulted in a loss of just less than 5% of total tides.

1.6 Corps Yard (P4)

NOAA operates the tidal gauge at this site and data are available at their website after curve-smoothing procedures are applied. The UNCW conductivity/salinity gauges located at this site have operated with only a few problems over the reporting period.

1.7 Eagle Island (P6)

During this reporting period, data loss at this station was considerably greater (33.3%) than during the 2004 to 2005 project year (10.3%). The primary cause of failure was mechanical error which accounted for 20.7% loss of total tides. Specific issues included: 1) Repeated under-ranging events from August 2005 through January 2006 and 2) a single mechanical failure lasting from February 1, 2006 to March 27, 2005. This mechanical failure was due to the water level instrument repeatedly resetting itself to new default values when certain threshold water levels were reached. This problem was resolved by replacing the stilling well cap and resetting the instrument in late March. Slightly more than 5% of the total tides lost was due to under-ranging events during this reporting period. Large wakes, 4-6’, from the testing of recreational yachts by the manufacturer, just upstream, have heavily impacted both the DCP and adjacent marsh and likely led to some of these problems.

1.8 Indian Creek (P7)

This DCP and associated stilling well was originally set higher than others along the Cape Fear River making under ranging events problematic at the site. The stilling well was lengthened, although, the under ranging problem continued during the 2004-2005 sampling period (4.2 % of total tides). Less than 1% of the tides at this site were lost due to mechanical errors.

1.9 Dollisons Landing (P8)

As was the case during the 2004-2005 reporting period, this station experienced a high percentage of total tides lost (31.2%) due to absence of data and mechanical errors. The percentage of tides lost due to mechanical errors was comparable to the number lost at P6. Data loss resulted from the water level cable becoming snagged within the stilling well on numerous occasions. In addition, this station now must be downloaded manually in the field due to problems with the cellular modem. The problem appears to be the presence of a new cell phone tower, which is incompatible with our telemetry system. Approximately two weeks of data were lost in January 2006 during a manual download of the equipment.

1.10 Black River (P9)

This site typically experiences few operational difficulties. During this reporting period, the percentage of total tides lost was slightly higher (16.1%) than during the previous reporting period (11.6%). Tide data loss occurred as a result of absence of data (4.7%) and mechanical errors (4.2%). The increase in mechanical errors seen at this site and others may reflect the age of the equipment, which has been in place for almost 5 years. The major issue at this site is highly irregular and jagged water level curves over consecutive tidal cycles. This problem occurred numerous times throughout the sampling period and has no obvious explanation. Thus, these data are omitted from the analyses.

1.11 Smith Creek (P11)

Unlike previous reporting periods, this site has operated with very few problems during this reporting period. The percentage of total tides lost was 7.8%. Less than 1% of the total tides were lost due to QA/QC and minor mechanical problems combined.

1.12 Rat Island (P12)

The percentage of total tides lost from this site was comparable to the 2004-2005 reporting period. Similar to the previous reporting period, tide loss resulted from water level jumps and subsequent QA/QC visits required to correct the problem. Further, some mechanical problems resulted in loss of water level data. The total tide loss for this site was approximately 3% of total tides.

1.13 Fishing Creek (P13)

This site operated exceedingly well during this reporting period with no loss of tides due to mechanical or other problems.

1.14 Prince George Creek (P14)

During this reporting period, the percentage of total tides lost due to mechanical errors was considerably greater (8.4 %) than during the 2004 to 2005 project year. As stated above the increase in mechanical errors seen at this site and others may reflect the age of the equipment, which has been in place for almost 5 years. Specific issues included: loss of data from telemetry reprogramming failure, cable issues (including snagging on the stilling well and slipping from the spindle), highly erratic water levels over consecutive tidal cycles, and weather.

2.0 MONUMENT AND STATION SURVEY VERIFICATION

2.1 Summary

No subsite data indicated a problem with either sinking or rising of monuments during the reporting year. Subsites near the river at P6 have undergone some scouring from wakes, but monuments are remaining stable. Subsites far from the established concrete benchmarks near the water's edge cannot be accurately evaluated using the standard survey methodology employed here. These will need to be resurveyed at the end of the project using the survey instrumentation initially used to establish elevation.

3.0 RIVER WATER LEVEL/SALINITY MONITORING

3.1 Summary

More than 1,400 tide ranges measured between 1 June 2005 and 31 May 2006 (Appendix A) were used to conduct analyses of changes in tidal amplitude as well as changes of ebb and flood duration. A good correlation between measured tidal range from the base station at Ft Caswell and the predicted tidal range for this station continues to exist. The slope of the regression is less steep than in 2004-2005, but nonetheless consistent to that reported for most previous reporting periods. The mean tidal range at P1 was not significantly different from the mean reported in the previous monitoring period, but was significantly lower than the range reported in Year 1. Tidal ranges within the estuary were fairly constant, including the lowermost of the upstream stations, and were higher than tidal ranges measured at most upstream stations. Water levels in the most upstream sites and the inner Town Creek station continued to be affected by discharge rates in the river, however, this reporting period was characterized by fewer high discharge events than in the previous two reporting periods. Some significant differences in yearly mean tidal ranges between this reporting period and 2004-2005 were observed and these occurred primarily in the most upstream mainstem stations. Few differences in tidal range between this reporting period and the previous period occurred in the Northeast Cape Fear River. Only two stations, P1 and P7 showed significant differences in tidal range between this reporting period and the first year of monitoring.

The observation that mean tidal range observed at P1 (Ft. Caswell) is again significantly less than in Year 1 continues to complicate interpretation of the results as this station was initially expected to be unimpacted by river widening activities. Consequently, we have begun to examine in greater detail the longer time series of water level data available from P4. Using this longer data base (1994-2006) for P4, our initial comparisons of the mean difference between observed and predicted tidal ranges in 1994 to the mean difference between observed and predicted tidal ranges in 2005 did not yield significant differences even though the mean water levels between the two years were significantly different. Additional analyses are in progress.

Similar to the pattern reported last year, mean monthly maximum water levels for this reporting period were not significantly different from the values reported for the previous monitoring period with the exception of site P2. There also was no significant difference in mean monthly minimum water level between this reporting period and last year with the exception of site P6. Comparisons of the regression slopes when tidal range at each site was regressed against P1 tidal range yielded significant differences between this reporting period and the previous reporting period for all stations except P3, P6, P13 and P14. When the slopes from this reporting period were compared to slopes calculated for Year 1 (2000-2001), all sites yielded a significant difference between years except for sites P3, P6, and P13.

Both the high tide and low tide lag values were comparable to those reported last year. In the mainstem, the mean high tide lag from P1 increased at all stations except P7 relative to the lag times reported in 2004-2005. This trend is consistent with the previous reporting period. Changes in mean low tide lag relative to the previous reporting period did not show any consistent pattern. In the Northeast Cape Fear River, changes in tidal lag were minor and inconsistent among stations. During this reporting period, mean flood duration changed by less than 1% at all stations except for P8 and P11. Mean flood duration also varied little from those values reported in the last monitoring period (<1%) except for stations P8 and P11. For the minor flood and ebb durations that were observed, there was no consistent pattern of increase or decrease with distance upstream or between major tributaries. The duration of flooding tide has increased slightly (by less than 1.5%) at all mainstem stations since the last reporting period. This pattern is consistent with the previous reporting period where flooding duration had increased by less than 2% at all stations. With the exception of P6, the duration of ebb tide decreased by less than 1.5% at all stations. At station P6, the duration of ebb tide was essentially the same as in 2004-2005.

Periods of lower, drought-induced water levels and extreme flooding in the system over the last 5 years have contributed to differing tidal conditions in the Cape Fear and Northeast Cape Fear Rivers between monitoring years. These effects are confounded by the shortened data set for Year 1 which included data collected from

October to June, only, and covered a period when monthly river discharge was below the long-term average (~5,531 ft^3/s) reported by the USGS at Lock and Dam 1 on the Cape Fear mainstem. This reporting period, the mean discharge is comparable to the mean discharge that existed during Year 1. This condition allows for more direct comparison between this year's data and Year 1. The similarity in discharge rates between the first project year and the current year, may explain the lack of significant difference in many of the statistical comparisons this year compared to previous reporting periods. At present, our observations are inconclusive and somewhat inconsistent with the expected effects of dredging and additional types of data analyses are necessary to conclusively evaluate the effects of channel modification on tidal attributes. To this end, we have begun harmonic analyses of tidal constituents. For all stations, the M2 component is the dominant constituent, as was expected. We are now aggregating the phase/amplitude data for various years and these data will eventually be used to identify differences in tidal dynamics between stations along the river that have been impacted by channel modification activities. Further, the extended water level time series available at P4 allows for examination of pre-dredging conditions to post-dredging conditions. Over the 11 year period between 1994 and 2005, neither the amplitude nor the phase of the M2 constituent has changed appreciably. Preliminary evaluations suggest that changes in harmonic amplitude may be more closely linked to variations in discharge than dredging activities. This relationship will be examined in greater detail following completion of dredging activities.

3.2 Database

Water level, conductivity, and temperature data collected at DCP stations from June 2005 through May 2006 are incorporated in this report. This year's database includes approximately 1400 tides of sufficient quality to be used in the analyses of each of the 11 DCP stations. Specific problems associated with each station have been described in Section 1 of this report. Table 1.1-1 summarizes the percentage of tides unavailable for analysis due to the various reasons cited above.

3.3 Data Analyses Methods

Maximum, minimum, and mean water level and conductivity/ temperature were recorded every 3 minutes. The final data set used for analyses consists of 3-minute averages of water level and conductivity collected every 6 minutes. The 6-minute means were plotted after each two-week interval and the resulting curves visually inspected by a senior analyst for quality control purposes. Suspect data, such as outliers or data points that deviate from a smooth curve, were discarded. Unreliable data, such as those collected during periods of mechanical malfunction, equipment maintenance, under-ranging events, and freezing events, were also removed. The remaining data were then filtered to extract the maximum and minimum water levels associated with each tidal event. For this report, a tidal event consists of one high water/low water pair.

The high and low water values contained in the final data set were used to determine the mean tidal range and to compute tidal lags between sites. The mean tidal range was computed from the difference in water level between each high and low tide event for each station (Table 3.3-1). Unlike the previous two previous reporting periods, the mean tidal ranges measured during this reporting period were not significantly different (P<0.05) than the means reported during the first year of monitoring (2000-2001), or pre-dredging, at most stations. The two exceptions were stations P1 (decrease) and P7 (increase) -- The mean tidal range at stations P1 and P7 were not significantly different from the mean range reported for the previous reporting period.

Table 3.3-1. Monthly maximum, minimum, and range of salinity values for each station. Monthly maximum, minimum, and range of water level for each station are also given. All water levels are relative to NAVD88 with the exception of P4 (USACE yard), which is relative to MSL. "XXX" indicates periods of extended data loss due to mechanical failure of water level instrument.

			Salinity (ppt)			**Water Level (ft)**	
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P1	Jun-05	28.7	12.5	16.2	2.69	-4.10	6.79
	Jul-05	31.8	10.7	21.1	2.58	-4.23	6.81
	Aug-05	29.8	9.5	20.3	2.83	-4.00	6.83
	Sep-05	31.6	0.0	31.6	3.16	-3.54	6.70
	Oct-05	30.0	0.5	29.5	3.31	-3.54	6.85
	Nov-05	32.6	1.5	31.1	2.35	-4.05	6.40
	Dec-05	32.2	3.0	29.2	2.41	-4.74	7.15
	Jan-06	30.0	3.7	26.3	2.53	-4.23	6.76
	Feb-06	31.9	12.0	19.9	2.44	-4.25	6.69
	Mar-06	32.3	13.3	19.0	2.31	-4.23	6.54
	Apr-06	31.7	10.3	21.4	2.65	-4.16	6.81
	May-06	34.2	13.7	20.5	2.16	-3.73	5.89
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P2	Jun-05	13.1	0.1	13.0	3.38	-2.97	6.35
	Jul-05	18.6	0.7	17.9	3.44	-3.02	6.46
	Aug-05	11.2	0.1	11.1	3.58	-2.61	6.19
	Sep-05	27.8	0.1	27.7	3.85	-3.01	6.86
	Oct-05	19.1	0.0	19.1	4.25	-2.42	6.67
	Nov-05	22.1	0.1	22.0	3.22	-2.62	5.84
	Dec-05	11.5	0.1	11.4	3.39	-2.64	6.03
	Jan-06	7.8	0.1	7.7	3.41	-2.72	6.13
	Feb-06	10.0	0.1	9.9	3.43	-2.75	6.18
	Mar-06	15.3	0.1	15.2	3.16	-2.63	5.79
	Apr-06	19.3	3.0	16.3	3.37	-2.75	6.12
	May-06	10.0	3.6	6.4	3.24	-2.63	5.87
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P3	Jun-05	14.8	0.0	14.8	1.91	-2.23	4.14
	Jul-05	10.6	0.1	10.6	1.99	-2.17	4.16
	Aug-05	10.9	0.0	10.9	2.20	-1.75	3.95
	Sep-05	19.2	0.0	19.1	2.78	-1.48	4.26
	Oct-05	14.3	0.0	14.3	3.33	-1.13	4.46
	Nov-05	30.7	0.0	30.7	2.14	-2.12	4.26
	Dec-05	3.1	0.0	3.0	2.35	-1.99	4.34
	Jan-06	6.1	0.0	6.1	2.48	-2.29	4.77
	Feb-06	5.3	0.0	5.3	2.30	-2.04	4.34
	Mar-06	0.0	0.0	0.0	2.10	-2.13	4.23
	Apr-06	12.5	0.1	12.5	1.86	-2.23	4.09
	May-06	10.4	0.1	10.4	1.89	-1.98	3.87
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P4	Jun-05	15.3	1.0	14.3	3.06	-3.39	6.45
	Jul-05	7.2	2.7	4.5	3.06	-3.39	6.45
	Aug-05	9.5	1.4	8.1	3.22	-2.97	6.19

Table 3.3-1. (continued)

		Salinity (ppt)			Water Level (ft)		
	Sep-05	23.2	1.0	22.2	3.46	-3.66	7.12
	Oct-05	19.1	0.1	19.0	3.89	-2.85	6.74
	Nov-05	18.4	1.6	16.8	2.74	-3.50	6.24
	Dec-05	4.4	0.0	4.4	3.03	-3.78	6.81
	Jan-06	5.8	0.0	5.8	3.02	-3.60	6.62
	Feb-06	7.9	0.1	7.8	3.12	-3.33	6.45
	Mar-06	11.0	0.3	10.7	2.79	-3.39	6.18
	Apr-06	14.4	2.6	11.8	3.15	-3.20	6.35
	May-06	7.2	0.4	6.8	2.93	-3.06	5.99
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P6	Jun-05	13.7	0.0	13.7	2.99	-2.55	5.54
	Jul-05	10.6	0.0	10.6	3.22	-2.35	5.57
	Aug-05	13.9	0.0	13.9	3.35	-2.15	5.50
	Sep-05	23.1	0.0	23.1	3.47	-2.34	5.81
	Oct-05	17.7	0.0	17.7	3.87	-2.29	6.16
	Nov-05	17.0	0.0	17.0	3.05	-2.98	6.03
	Dec-05	4.5	0.0	4.5	3.26	-2.28	5.54
	Jan-06	5.7	0.0	5.7	3.92	-2.41	6.33
	Feb-06	8.5	0.1	8.4	xxx	xxx	xxx
	Mar-06	12.0	0.0	12.0	2.85	-2.98	5.83
	Apr-06	13.4	0.1	13.3	3.33	-2.93	6.26
	May-06	10.3	0.0	10.3	3.29	-2.54	5.83
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P7	Jun-05	0.2	0.1	0.1	2.97	-2.24	5.21
	Jul-05	0.1	0.0	0.1	3.02	-2.23	5.25
	Aug-05	0.1	0.0	0.1	3.14	-2.18	5.32
	Sep-05	6.0	0.0	6.0	3.43	-2.38	5.81
	Oct-05	0.2	0.0	0.2	3.75	-2.08	5.83
	Nov-05	0.7	0.0	0.7	2.89	-2.31	5.20
	Dec-05	0.1	0.1	0.0	3.13	-2.31	5.44
	Jan-06	0.1	0.0	0.1	3.11	-2.30	5.41
	Feb-06	0.1	0.0	0.1	3.20	-2.29	5.49
	Mar-06	0.1	0.0	0.1	2.83	-2.28	5.11
	Apr-06	0.2	0.1	0.1	3.13	-2.28	5.41
	May-06	0.1	0.0	0.1	3.09	-2.23	5.32
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P8	Jun-05	0.1	0.0	0.1	2.82	-2.43	5.25
	Jul-05	0.1	0.1	0.0	2.83	-2.37	5.20
	Aug-05	0.1	0.0	0.1	2.91	-2.03	4.94
	Sep-05	5.4	0.0	5.4	3.34	-2.06	5.40
	Oct-05	0.2	0.0	0.2	3.77	-1.81	5.58
	Nov-05	0.2	0.1	0.1	2.77	-2.65	5.42
	Dec-05	0.1	0.0	0.1	3.07	-1.89	4.96
	Jan-06	0.1	0.1	0.0	3.06	-2.14	5.20
	Feb-06	0.1	0.1	0.0	2.91	-2.09	5.00
	Mar-06	0.1	0.0	0.1	2.80	-2.36	5.16
	Apr-06	0.1	0.1	0.0	2.77	-2.61	5.38
	May-06	0.1	0.0	0.1	3.09	-1.17	4.26
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P9	Jun-05	0.1	0.1	0.0	3.67	-1.21	4.88
	Jul-05	0.1	0.0	0.1	4.47	-0.46	4.93
	Aug-05	0.1	0.0	0.1	2.91	-1.76	4.67
	Sep-05	0.1	0.0	0.1	2.91	-1.44	4.35
	Oct-05	0.1	0.0	0.1	3.09	-1.63	4.72
	Nov-05	0.1	0.0	0.1	2.90	-2.34	5.24
	Dec-05	0.1	0.0	0.1	3.20	-2.04	5.24
	Jan-06	0.1	0.0	0.1	3.24	-1.97	5.21
	Feb-06	0.1	0.0	0.1	3.27	-1.87	5.14
	Mar-06	0.1	0.1	0.0	2.71	-1.70	4.41
	Apr-06	0.1	0.0	0.1	2.72	-1.80	4.52
	May-06	0.1	0.0	0.1	3.14	-1.62	4.76

Table 3.3-1. (continued)

		Salinity (ppt)			Water Level (ft)		
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P11	Jun-05	13.2	0.1	13.1	3.20	-2.89	6.09
	Jul-05	10.5	0.2	10.3	3.07	-3.24	6.31
	Aug-05	13.2	0.3	12.9	3.01	-3.04	6.05
	Sep-05	23.7	0.1	23.6	2.95	-2.46	5.41
	Oct-05	14.6	0.0	14.6	3.82	-2.54	6.36
	Nov-05	16.1	0.1	16.0	2.94	-3.21	6.15
	Dec-05	4.6	0.1	4.5	3.22	-3.18	6.40
	Jan-06	7.5	0.1	7.4	3.85	-2.97	6.82
	Feb-06	9.6	0.1	9.5	4.02	-3.05	7.07
	Mar-06	13.5	0.1	13.4	3.05	-2.86	5.91
	Apr-06	14.1	0.3	13.8	3.05	-2.86	5.91
	May-06	10.9	0.1	10.8	2.97	-2.83	5.80
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P12	Jun-05	12.6	0.0	12.6	2.76	-2.72	5.48
	Jul-05	8.7	0.0	8.7	3.50	-2.81	6.31
	Aug-05	12.1	0.1	12.0	2.76	-2.49	5.25
	Sep-05	22.8	0.1	22.7	2.66	-2.12	4.78
	Oct-05	13.8	0.0	13.8	3.39	-2.31	5.70
	Nov-05	15.2	0.1	15.1	2.33	-3.23	5.56
	Dec-05	3.7	0.0	3.7	2.50	-3.28	5.78
	Jan-06	5.3	0.1	5.2	2.50	-3.34	5.84
	Feb-06	7.9	0.0	7.9	2.63	-3.02	5.65
	Mar-06	11.9	0.1	11.8	2.25	-3.11	5.36
	Apr-06	12.8	0.1	12.7	3.13	-2.28	5.41
	May-06	9.9	0.1	9.8	2.45	-2.70	5.15
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P13	Jun-05	5.6	0.1	5.6	2.32	-2.44	4.76
	Jul-05	3.2	0.1	3.1	2.32	-2.46	4.78
	Aug-05	4.4	0.1	4.4	2.41	-2.17	4.58
	Sep-05	16.7	0.0	16.7	2.96	-2.45	5.41
	Oct-05	13.7	8.5	5.2	3.66	-1.54	5.20
	Nov-05	3.2	0.0	3.1	2.47	-2.62	5.09
	Dec-05	0.1	0.1	0.1	2.60	-2.51	5.11
	Jan-06	0.1	0.0	0.1	2.66	-2.62	5.28
	Feb-06	0.1	0.1	0.0	2.72	-2.31	5.03
	Mar-06	1.4	0.1	1.3	2.53	-2.35	4.88
	Apr-06	3.4	0.1	3.3	2.53	-2.24	4.77
	May-06	1.7	0.1	1.6	2.53	-1.94	4.47
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P14	Jun-05	0.1	0.1	0.0	1.91	-1.74	3.65
	Jul-05	0.1	0.1	0.0	1.88	-1.76	3.64
	Aug-05	0.2	0.1	0.1	1.97	-1.54	3.51
	Sep-05	0.8	0.0	0.8	2.41	-1.34	3.75
	Oct-05	0.3	0.0	0.3	xxx	xxx	xxx
	Nov-05	0.1	0.1	0.0	2.01	-2.20	4.21
	Dec-05	0.1	0.1	0.0	2.12	-1.94	4.06
	Jan-06	0.1	0.0	0.1	2.25	-2.08	4.33
	Feb-06	0.1	0.0	0.1	2.23	-1.98	4.21
	Mar-06	0.2	0.0	0.2	1.89	-1.81	3.70
	Apr-06	0.1	0.1	0.0	1.95	-1.91	3.86
	May-06	0.1	0.1	0.0	2.09	-1.45	3.54

A summary of statistical analyses of mean annual wate level comparisons for each of the 11 DCP stations are shown in Table 3.3-2. Yearly mean tidal ranges were compared using Tukey-Kramer highest significant difference ($p<0.05$). Table 3.3-3 shows a summary of statistical tests for yearly data collected at the 11 DCP stations.

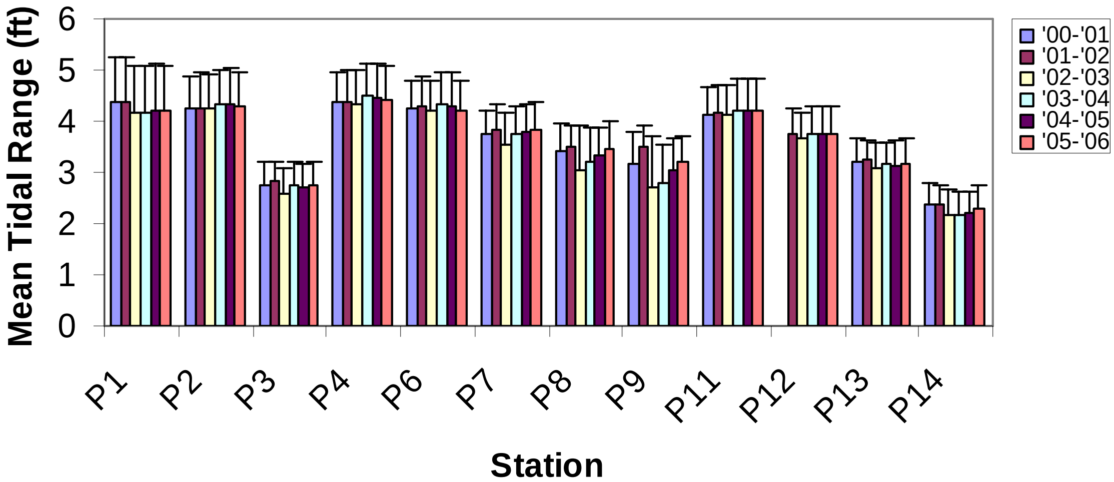


Figure 3.3-1. Mean tidal range for each station for all monitoring years. All water levels are relative to NAVD88 with the exception of P4 (USACE yard), which is relative to MSL. Error bars show one standard deviation. Significant differences between yearly means ($p<0.05$) for one or more monitoring periods are shown in Table 3-3.2.

Table 3.3-2. Summary of statistical analyses of mean annual water level comparisons for each of the 11 DCP stations. Yearly mean tidal ranges were compared using Tukey-Kramer highest significant difference ($p<0.05$). Years with different letter superscripts were significantly different. Asterisks denote where significant differences occurred between this reporting period and Year 1. Ampersands denote where significant differences exist between this reporting period and the previous reporting period. Note that the Year 1 reporting period only included the period of October to May and alls subsequent period have included a complete calendar year. No data (NA) were available for Year 1 for station P12.

Station	Significant	Effect (Year)
P1	*	1^{a} 2^{a} 3^{b} 4^{b} 5^{b} 6^{b}
P2		1^{a} 2^{ab} 3^{a} 4^{b} 5^{b} 6^{ab}
P3		1^{ad} 2^{b} 3^{c} 4^{a} 5^{d} 6^{ad}
P4		1^{ac} 2^{ac} 3^{a} 4^{b} 5^{b} 6^{bc}
P6	@	1^{a} 2^{b} 3^{a} 4^{b} 5^{b} 6^{a}
P7	*	1^{a} 2^{b} 3^{c} 4^{a} 5^{ab} 6^{b}
P8	@	1^{a} 2^{a} 3^{b} 4^{c} 5^{d} 6^{a}
P9	@	1^{a} 2^{b} 3^{c} 4^{d} 5^{e} 6^{a}
P11		1^{ab} 2^{ac} 3^{b} 4^{c} 5^{c} 6^{ac}
P12		NA 2^{a} 3^{b} 4^{a} 5^{a} 6^{a}
P13		1^{a} 2^{a} 3^{b} 4^{c} 5^{c} 6^{ac}
P14	@	1^{a} 2^{a} 3^{b} 4^{bc} 5^{c} 6^{a}

Table 3.3-3. Summary of statistical tests for yearly data collected at the 11 DCP stations. Yearly means of tidal ranges were compared. Also shown are yearly differences in the slopes of the best-fit lines generated by regressing each tidal range for each station on the corresponding tidal range for P1. These were compared using analysis of covariance. NS indicates no significant difference at P <0.05. Asterisks denote significant differences between years and p values are given. N/A indicates insufficient data to complete analyses.

Station	Y1/Y2 Regression Slope	Y1/Y3 Regression Slope	Y1/Y4 Regression Slope	Y1/Y5 Regression Slope	Y1/Y6 Regression Slope	Y5/Y6 Regression Slope
	---	---	---	---	---	---
P2	*(<0.0001)	NS	NS	* (<0.0001)	* (0.0101)	* (<0.0001)
P3	* (<0.0001)	NS	* (0.0227)	NS	NS	NS
P4	NS	NS	* (<0.0001)	* (<0.0001)	* (<0.0001)	NS
P6	NS	NS	* (<0.0001)	* (<0.0001)	NS	* (<0.0041)
P7	*(0.0247)	NS	* (0.0064)	* (<0.0001)	* (<0.0001)	NS
P8	NS	NS	NS	* (0.0005)	* (<0.0001)	NS
P9	NS	NS	* (0.0001)	* (0.0020)	* (<0.0052)	NS
P11	NS	NS	* (<0.0001)	* (<0.0001)	* (<0.0001)	NS
P12	N/A	N/A	N/A	N/A	N/A	NS
P13	NS	NS	NS	* (<0.0001)	NS	* (<0.0001)
P14	* (0.0088)	NS	* (<0.0001)	NS	* (0.0020)	* (0.0282)

Tidal lags were determined by measuring the difference in time for high (or low) tide at 2 different stations as described in the Year 1 report. All tidal lags were calculated relative to station P1 and are being used to evaluate the impact of dredging on the propagation of the tidal wave upriver. Mean tidal range, flood duration, ebb duration and tidal lags for each station are given in Table 3.3-4. During this reporting period, both the high tide and low tide lag values were comparable to those reported last year. During this reporting period, mean flood duration changed by less than 1% at all stations except for P8 and P11. Mean flood duration also varied little from those values reported in the last monitoring period (<1%) except for stations P8 and P11 (Table 3.3-4). For the minor flood and ebb durations that were observed, there was no consistent pattern of increase or decrease with distance upstream or between major tributaries. Yearly comparisons of mean monthly maximum and minimum water levels collected at the 11 DCP stations are summarized in Table 3.3-5.

Table 3.3-4. Summary of tidal data generated from data collection platforms (DCP) at 11 stations along the Cape Fear River and tributaries. Values in italicized parens are the percent change between the current monitoring interval and the previous reporting period. Positive values indicate an increase and negative values a decrease. ND indicates that a change was not measurable. N/A indicates that data were insufficient to measure a reliable change. Mean lag times for the previous reporting period are also given in parentheses for both high and low tide.

Station Number	Mean Tidal Range (ft)	Mean Flood Duration (hr) *(% change)*	Mean Ebb Duration (hr) *(%change)*	Mean High Tide Lag From P1 (hr) ('04-'05 lag time)	Mean Low Tide Lag From P1 (hr) ('04-'05 lag time)
P1	4.21 ± 21.20%	6.28 (-0.31)	6.12 (+0.16)	N/A	N/A
P2	4.30 ± 15.37%	5.63 (-0.35)	6.75 (0.00)	1.38 (1.33)	1.98 (1.97)
P3	2.75 ± 16.11%	6.35 (+0.15)	6.5 (+0.32)	2.95 (2.97)	2.88 (2.98)
P4	4.42 ± 15.09%	5.68 (-0.52)	6.72 (+0.30)	1.62 (1.62)	2.18 (2.21)
P6	4.22 ± 13.92	5.98 (+0.11)	6.6 (+0.07)	2.15 (2.12)	2.57 (2.55)
P7	3.84 ± 14.05%	5.83 (+0.87)	6.55 (-0.46)	2.60 (2.55)	3.02 (3.02)
P8	3.46 ± 15.22%	5.90 (+1.37)	6.50 (-1.22)	3.07 (3.17)	3.45 (3.63)
P9	3.21 ± 15.89%	5.83 (+0.86)	6.55 (-0.91)	3.37 (3.33)	3.82 (3.63)
P11	4.21 ± 14.32%	5.90 (+1.37)	6.50 (-1.06)	2.15 (2.13)	2.57 (2.58)
P12	3.75 ± 14.53%	5.87 (0.00)	6.50 (-0.46)	2.52 (2.53)	2.90 (2.91)
P13	3.18 ± 14.92%	5.88 (-0.12)	6.50 (+0.10)	3.17 (3.10)	3.42 (3.38)
P14	2.31 ± 18.18%	5.91 (0.00)	6.48 (0.00)	4.12 (4.13)	4.48 (4.50)

Table 3.3-5. Yearly comparisons of mean monthly maximum and minimum water levels collected at the 11 DCP stations. Significant differences were identified using a Wilcoxon Rank Sum test. NS indicates no significant difference at P <0.05. Asterisks denote significant differences between years and p values are given. N/A indicates insufficient data to complete analyses. Additional yearly comparisons are available in previous reports.

Station	Yr1/Yr6 Mean Monthly Maximum WL	Yr5/Yr6 Mean Monthly Maximum WL	Yr1/Yr6 Mean Monthly Minimum WL	Yr5/Yr6 Mean Monthly Minimum WL
P1	NS	NS	NS	NS
P2	*(0.0087)	*(0.0027)	*(0.0048)	NS
P3	*(0.0448)	NS	*(0.0020)	NS
P4	NS	NS	NS	NS
P6	*(0.0186)	NS	*(0.0004)	*(0.0097)
P7	NS	NS	*(0.0015)	NS
P8	NS	NS	NS	NS
P9	*(0.0252)	NS	*(0.0009)	NS
P11	*(0.0370)	NS	*(0.0448)	NS
P12	N/A	NS	N/A	NS
P13	*(0.0033)	NS	*(0.0337)	NS
P14	NS	NS	NS	NS

Statistical differences between tidal range values for upstream stations, before versus after channel deepening for specified tidal changes at the river mouth (P1) comprise one key approach to determining if the project has resulted in detectable changes in tidal range upstream. One assumption of this approach is that the tidal range at the base station at Ft Caswell (P1) is in equilibrium with open ocean tides and not subject to changes associated with dredging activities. To verify this condition, the observed tidal range at P1 for each reporting period is regressed against the predicted (astronomical) range. Analysis of Covariance (ANCOVA) is then used to determine if significant differences exist between the each yearly regression (i.e. slope). The tidal ranges observed at each upstream station are then regressed on the corresponding tidal range for P1. Comparisons of the resultant regression slopes are then conducted between subsequent reporting periods using ANCOVA ($p<0.05$).

3.4 Upstream Tidal Effects

Stations upstream of Point Peter are increasingly influenced by river flow in both branches of the Cape Fear Estuary and are considered separately from estuarine stations P1, P2, and P4, and from each other.

3.41 Ft Caswell (P1) and Outer Town Creek (P2)

The tidal ranges observed at the Ft Caswell base station show good agreement with the predicted tides for the area (Figure 3.41-1). When observed tidal ranges are regressed against the predicted tidal ranges, the R^2 value is similar to those documented in previous reports. The slope is less steep than in 2004-2005, but nonetheless consistent to that reported for most previous reporting periods. The mean tidal range at P1 was not significantly different from the mean reported in the previous monitoring period, but was significantly lower than the range reported in Year 1 (Table 3.3-2, Figure 3.3-1). Mean tidal range at P1 has not significantly differed between subsequent years since the significant decrease noted in Year 2 of this study. There continues to be no significant difference in either the mean monthly maximum and minimum water levels relative to last year's reporting period or relative to Year 1 (Table 3.3-5). The mean tidal range at the Outer Town Creek (P2) site was not significantly different from the means reported in any previous monitoring period. At station P2, both the mean monthly maximum water level and mean monthly minimum water level were significantly higher than in the first year of reporting. The mean monthly maximum water level also was significantly lower than the value reported in the previous monitoring period. As seen in Figure 3.41-2, the tidal range at P2 is strongly and positively correlated with observed tidal ranges at P1. The slope of the P1 versus P2 regression for this monitoring period was significantly lower ($p<0.0001$) than the slope reported during 2004-2005 reporting period (Table 3.3-3). Given the large number of data points and the very minimum difference in magnitude of the slope, however, this result is most likely not meaningful even though statistically significant. The slope measured during this reporting period at P2 also is significantly different from the slope measured in the first monitoring period ($p<0.0101$) at the $p<0.05$ significance level. These results are consistent with the previous (2004-2005) reporting period and reiterate the influence of regional climatology (e.g. drought and flooding) on water levels and tidal fluctuation in the river. Station P2 was not appreciably affected by climatological events this year as evidenced by the low range in water level variability (r^2 = 0.95). This result also is consistent with the previous reporting period and again demonstrates that the overall impact of climatologically driven events on water level at this site remains much less than other up river sites.

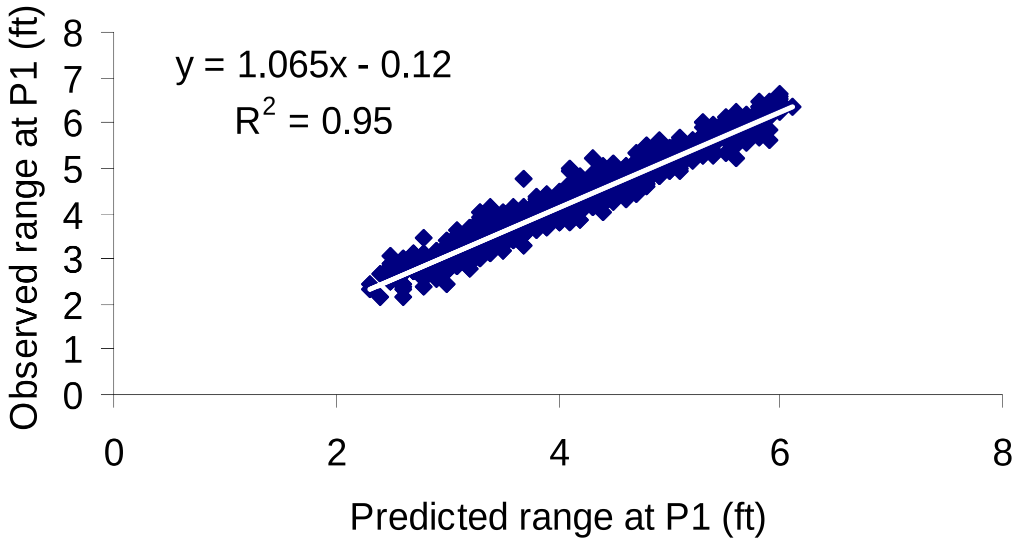


Figure 3.41-1. Plot of predicted tidal range at P1 relative to measured tidal range at P1 for June 2005 to May 2006.

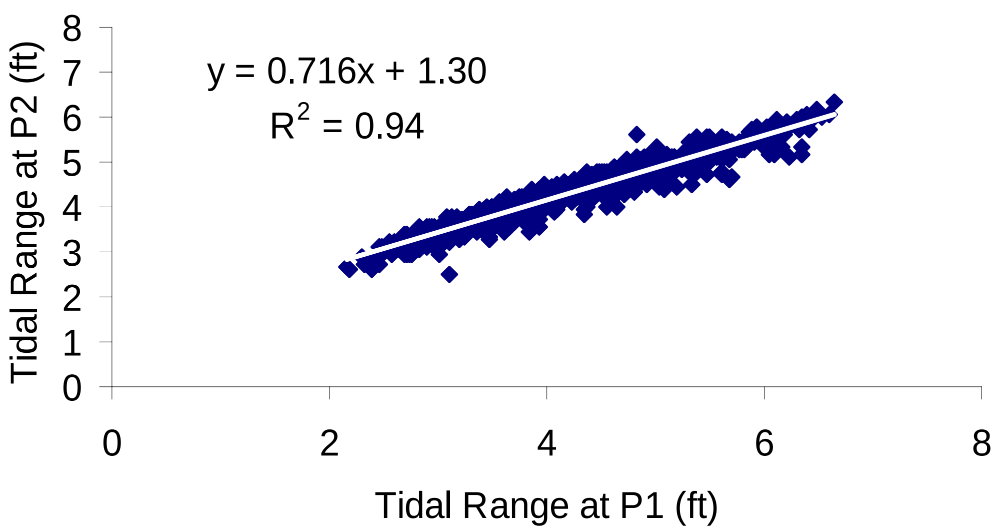


Figure 3.41-2. Plot showing relationship between tidal ranges observed at Ft. Caswell (P1) and Outer Town Creek (P2).

The water level curve at P1 has remained generally symmetrical and continues to show less evidence of the time asymmetries (Table 3.3-3) measured at other stations. These asymmetries, as evidenced by the unequal flood and ebb durations shown in Table 3.3-3, begin at site P2 and continue up river to all monitoring sites. The duration of flooding tide at P2 decreased during this reporting period relative to the duration reported in 2004-2005. This trend has persisted since the 2002-2003 reporting period. The ebb tide duration at P2 did not change relative to the previous reporting period. Neither the mean high tide nor mean low tide lag changed appreciably since the last reporting period. When coupled with data presented in previous monitoring reports, the tidal lags show no consistent pattern and do not indicate a definitive change in the rate of the tidal wave propagation up-estuary.

3.42 Inner Town Creek (P3)

The mean tidal range observed at this site during this reporting period was approximately 1.5 feet less than the tidal range observed at the creek mouth (Table 3.3-4) and lower than the mean tidal ranges of all other sites except P14. This result is consistent with last year's findings. The mean tidal range from June 2005 to May 2006 was not significantly different from the mean tidal range reported for June 2004 to May 2005 or from the mean reported for Year 1. The mean tidal range at P3 during this reporting period is significantly different from the means reported in Year 2 and 3, only. These reporting periods were strongly influenced by climatological events including regional drought and increased localized precipitation events in the watershed, respectively. As reported previously, water level curves generated for this station and computed tidal ranges continue to exhibit a wide range of variability and to depend on flow conditions in the creek. Both the mean flood and mean ebb duration increased slightly during this reporting period relative to the previous reporting period (Table 3.3-4). Last year, only mean ebb duration increased. There was no significant difference in either mean monthly maximum or mean monthly minimum water level when this reporting period was compared to the previous reporting period. Both the mean monthly maximum and minimum water levels, however, are significantly different from those reported during the first year of monitoring.

The correlation between tides at P3 and P1 this year was higher than the values reported since project Year 2 (each of these years exhibited $R^2 < 0.38$). The slope of the P1 versus P3 regression for this monitoring period was not significantly different from the slope reported in 2004 -2005 or significantly different from the slope reported for Year 1 (Table 3.3-2).

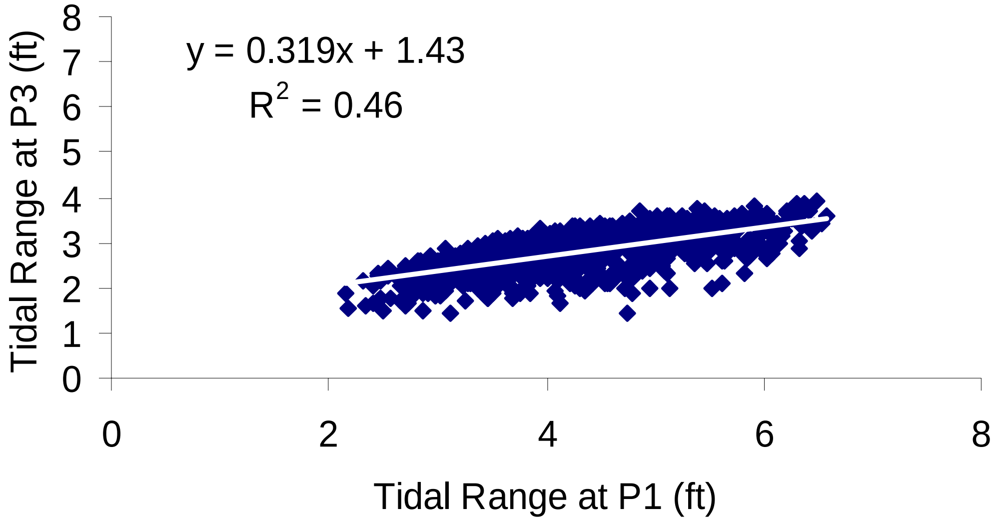


Figure 3.42-1. Plot showing relationship between tidal ranges observed at Ft. Caswell (P1) and Inner Town Creek (P3).

3.43 Corps Yard (P4)

As has been noted for during previous reporting periods, the mean tidal range observed at P4 is significantly higher than the mean tidal range at the P1 base station (Figure 3.43-1). Whereas the mean tidal range at this station during the 2003-2004 reporting period was significantly greater than the mean reported for Years 1, 2, and 3, this year, an inter-year comparison indicates no significant difference between this reporting period and any other except for Year 3. Year 3 was exceptional due to the large degree of flooding and high discharge that persisted during most of that reporting period. The slope (0.718) of the P1/P4 regression was significantly greater than the slope reported for the first monitoring period (Table 3.3-3), but not significantly different from the slope reported last year (0.716). This result is consistent with results reported for 2004-2005. Water level curves generated for P4 continue to show a slight time asymmetry that does not occur at P1. The mean ebb and flood durations, 6.7 and 5.7 hours, respectively, are comparable to those reported in 2004-2005 and have changed by 1% or less since the previous reporting periods. The mean high tide lag has not changed since the last reporting period; however, the mean low tide lag has decreased slightly (Table 3.3-4). Both the mean high and low tide lags at this station, are less than those reported for 2002-2003 when the river was characterized by higher than average discharge (Figure 3.5-1). Mean maximum and minimum water levels at this station are not significantly different from those reported in 2004-2005 or 2000-2001 (Table 3.3-5). These results are consistent with those reported last year. Water levels at the Corps yard continue to be impacted by changes in river discharge, but to a much lesser degree than stations further upstream and to lesser degree than in 2003-2004.

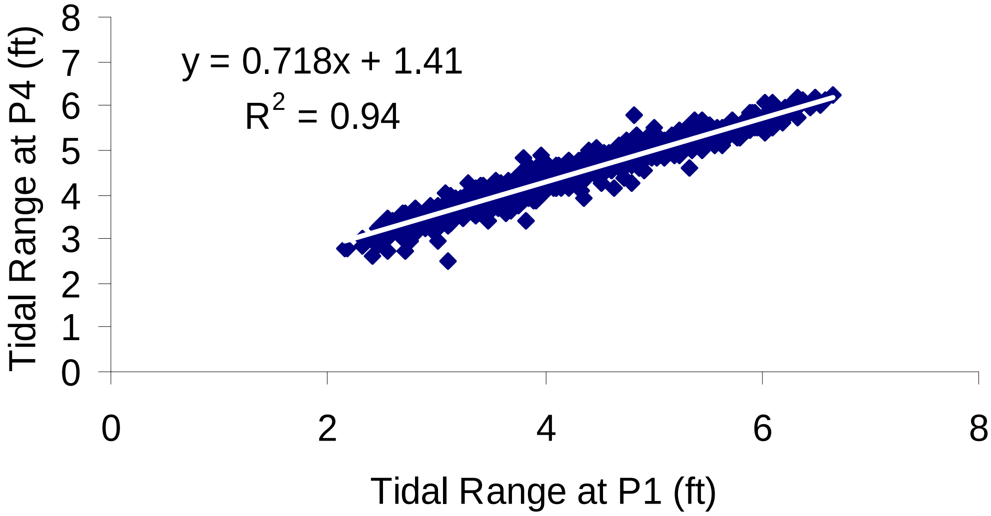


Figure 3.43-1. Plot showing relationship between tidal ranges observed at Ft. Caswell (P1) and the Corps Yard station (P4).

One of the difficulties in determining whether or not dredging activities in the river have resulted in significant and meaningful changes in tidal amplitude has been the lack of sufficient pre-dredging data at most stations. An extensive water level time series exists at station P4, however, that includes data collected prior to the initiation of dredging activities. We have begun to aggregate these data and to process the data for statistical comparisons. All water level data from 1994 through 2005 have been downloaded and tidal ranges computed. The mean tidal ranges for the 1994 and 2005 calendar years were 4.28 ft and 4.38 ft, respectively, and their difference is significant. All of the predicted tidal ranges over this period also have been aggregated and the magnitude of the difference between the predicted tidal range and the observed tidal range has been computed for every tide in 1994 and 2005. This approach assumes that if dredging activities have significantly altered tidal range, the mean difference between observed and predicted should differ between years. A one-way analysis of variance was used to compare the mean differences between observed and predicted tidal ranges in 1994 to the mean difference between observed and predicted tidal ranges in 2005 for extended periods of base flow conditions in the river that occurred in May -June and September – October of both years. However, the means were not significantly different ($p = 0.6293$, $n=8759$). The observed tidal range at P4 also has been regressed against the predicted (astronomical) tidal range for 1994 (pre-dredging) and 2005 (during dredging) and there appears to be little change in the slope of the regression line (Figure 3.43-2). This approach is identical to that employed at station P1. The underlying assumption is that if dredging activities have not affected the tidal dynamics in the river, the slope of the predicted versus observed regression will not significantly differ between years.

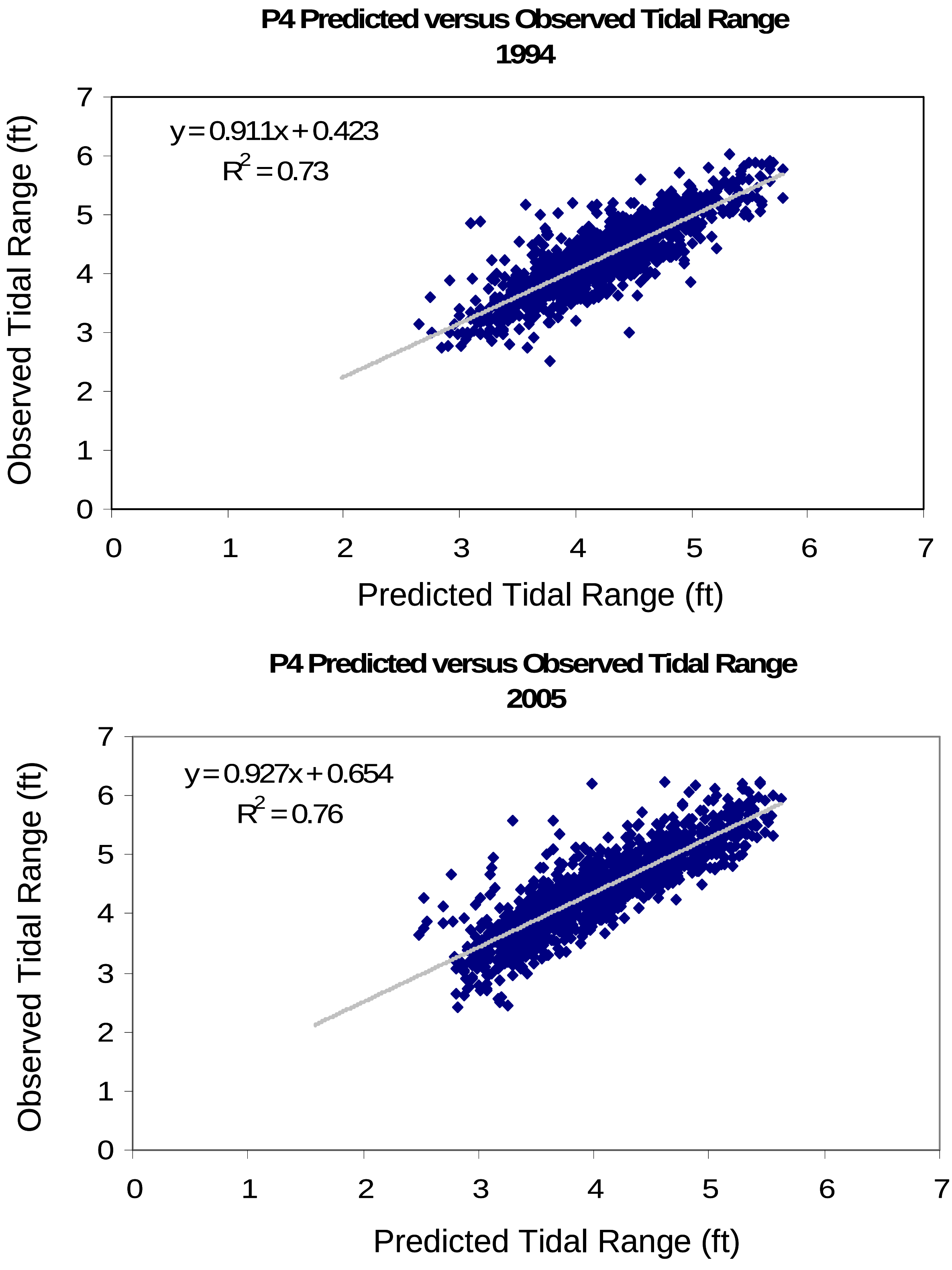


Figure 3.43-2. Plot showing relationship between predicted tidal range and observed tidal range the Corps Yard station (P4) in 1994 (pre-dredging) and 2005 (post-dredging).

3.44 Cape Fear River: Eagle Island (P6), Indian Creek (P7), Dollisons Landing (P8), and Black River (P9)

With the exception of P6, mean tidal ranges computed for mainstem river sites were lower than the mean determined for P1. During this reporting period, the mean tidal range for P6 was only 0.01 ft greater than the mean tidal range reported for P1. For the second consecutive year, the mean tidal range at P6 was less than the mean tidal range reported for P2 (Table 3.3-4). During the 2003-2004 reporting period, the mean tidal range at P6 was identical to the mean reported at P2. Consistent with previous years, tidal range decreased with distance upriver (Table 3.3-4) with P9 exhibiting the lowest tidal range of these sites. The mean tidal ranges measured over this reporting period at the mainstem river sites were higher than last year, with the exception of site P6 which decreased by 0.07 ft. The mean tidal range has consistently increased at all sites in the mainstem since the 2002-2003 reporting period. The 2002-2003 year was characterized by high river discharge, which tends to suppress tidal fluctuations. The mean tidal ranges were significantly higher than those measured during the previous reporting period at sites P6, P8, and P9. With the exception of site P7, mean tidal ranges at all mainstem sites were not significantly different from ranges reported for the first year of monitoring (Figure 3.3-1, Table 3.3-2). This finding contrasts with last year's report when P7 was the only site in the mainstem that did not exhibit a mean tidal range significantly different from Year 1. Nonetheless, these results are not unexpected given the similarity in mean discharge between this reporting period and the mean discharge recorded in Year 1 (Figure 3.5-1). With the exception of site P6, neither the mean monthly maximum nor minimum water levels for these stations differed significantly from the values reported in 2004-2005 (Table 3.3-2). At P6, the mean monthly minimum water level was significantly lower from the previous reporting period. When compared to Year 1 values, the mean monthly maximum values were significantly higher at stations P6 and P9. This differs from the most recent reporting period when mean monthly maximum water levels were significantly different from Year 1 values for all sites except P8. The mean monthly minimum values were significantly different from Year 1 values at all stations except P8. In the previous reporting period, the mean monthly minimum values for all stations were significantly different from Year 1.

Figures 3.44-1, 3.44-2, 3.44-3, and 3.44-4 illustrate the relationship between tidal range at these Cape Fear River sites and tidal range at Ft. Caswell. In general, tidal range at each upriver site is positively correlated with tidal range at the mouth. However, unlike previous reporting periods where R^2 values decreased upriver, P6 exhibited a lower R^2 than station P7 this year. The R^2 value at site P7 was comparable to last year's value whereas the R^2 values at P8 and P9 were higher. Of particular note is the R^2 value for P9, which has increased from 0.11 in 2002-2003 to 0.45 during this reporting period. These results are consistent with the reported river discharge (Figure 3.5-1) which fell below the long-term discharge mean during this reporting period. These data suggest fewer impacts associated with rainfall and runoff in the system; particularly at the most upstream sites. When this observation is considered in conjunction with the unexpectedly lower R^2 value at P6, it raises the possibility that P6 is being affected by some type of localized disturbance, such as boat wakes, or more likely, is exhibiting a degradation of data quality due to the age of the equipment. Site P6 experienced the largest number of lost tides of all stations due to a combination of mechanical errors that persisted over extended periods of time (Section 1.7). Comparisons of the regression slopes between this reporting period and Year 5 were not significant at any of the sites with the exception of P6 (Table 3.3-3). This result contrasts with last year's report where all of the stations showed a significant steepening in slope relative to Year 4 except for station P6. When regression slopes for this reporting period were compared to Year 1, significant differences existed for all sites except P6. In the previous reporting period, all of the sites exhibited regression slopes that were significantly different from Year 1.

The mainstem upriver sites continue to exhibit pronounced time asymmetries as shown in previous reports. The duration of flooding tide at these stations has increased slightly (by less than 1.5 %) at all mainstem stations since the last reporting period (Table 3.3-4). This pattern is consistent with the previous reporting period where flooding duration had increased by less than 2% at all stations. With the exception of P6, the duration of ebb tide decreased by less than 1.5% at all stations. At station P6, the duration of ebb tide was essentially the same as in 2004-2005. The mean high tide lag from P1 increased at all stations except P7 relative to the lag times reported in 2004-2005. This trend is consistent with the previous reporting period. Changes in mean low tide lag relative to the previous reporting period did not show any consistent pattern. Mean low tide lag decreased at P8, but increased at P6 and P9. The mean low tide lag at P7 was identical to the value reported in 2004-2005 (Table 3.3-4).

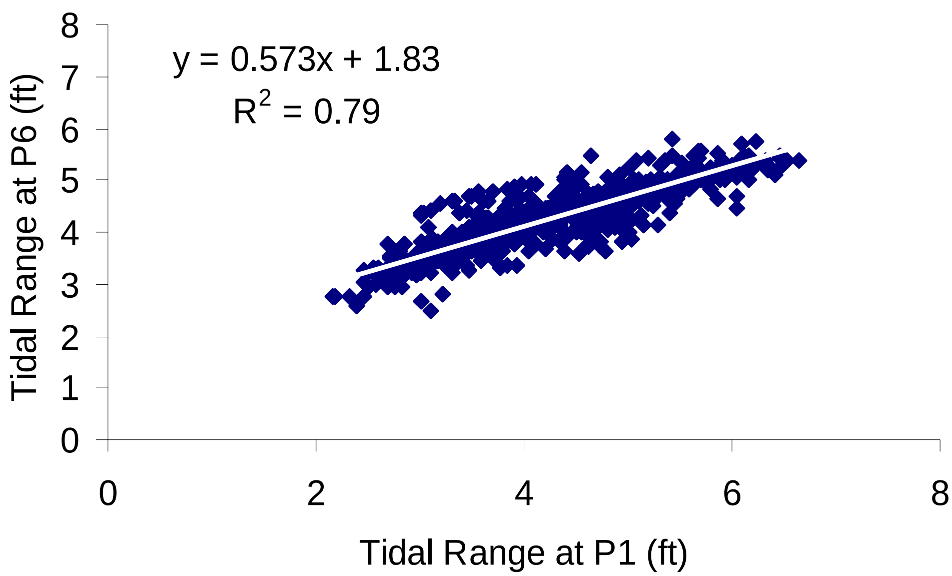


Figure 3.44-1. Plot showing relationship between tidal ranges observed at Ft. Caswell (P1) and Eagle Island (P6). 0.641x+1.61r=0.92

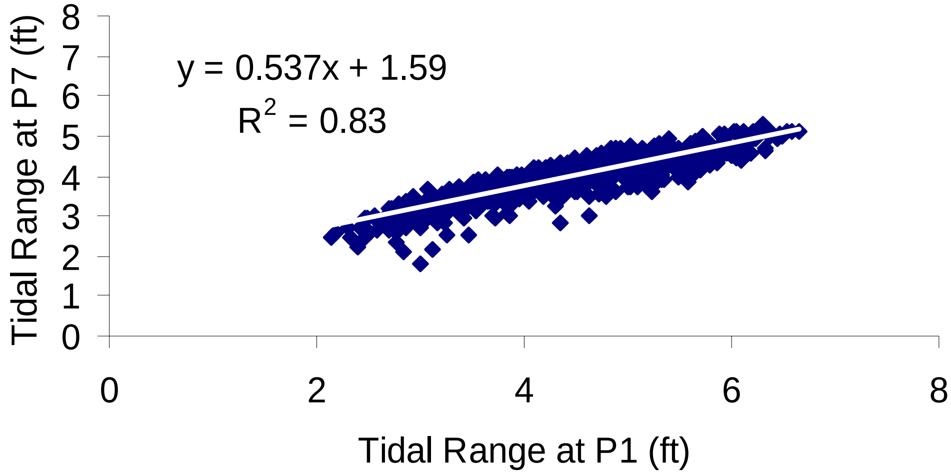


Figure 3.44-2. Plot showing relationship between tidal ranges observed at Ft. Caswell (P1) and Indian Creek (P7).

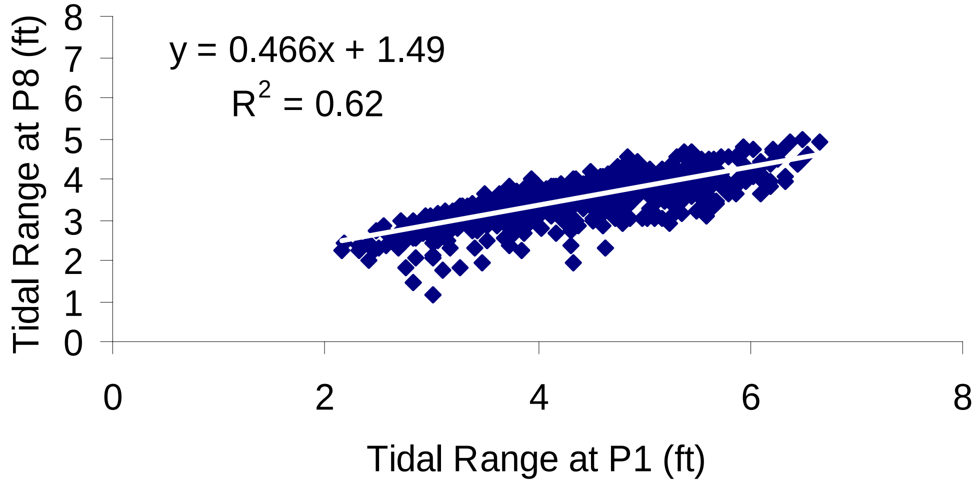


Figure 3.44-3. Plot showing relationship between tidal ranges observed at Ft. Caswell (P1) and Dollisons Landing (P8).

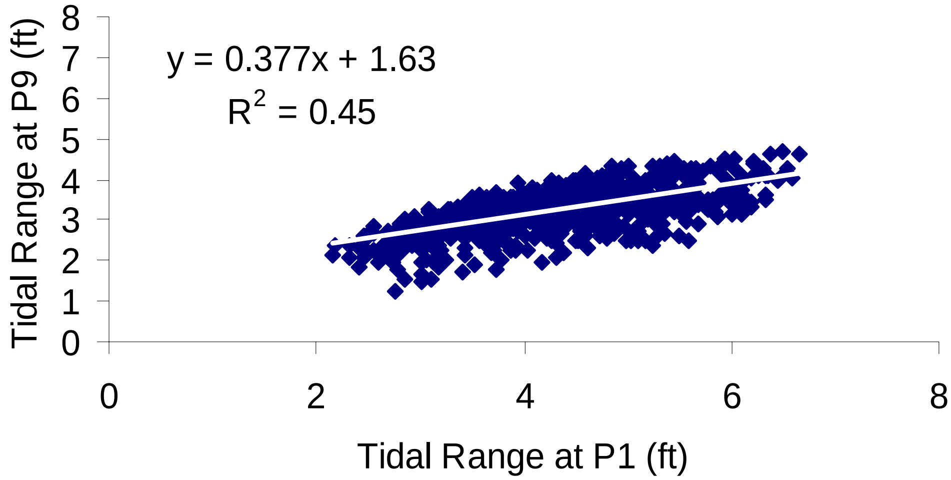


Figure 3.44-4. Plot showing relationship between tidal ranges observed at Ft. Caswell (P1) and Black River (P9).

3.45 Northeast Cape Fear: Smith Creek (P11), Rat Island (P12), Fishing Creek (P13), and Prince George Creek (P14)

The mean tidal ranges computed for Northeast Cape Fear sites over the current reporting period were not significantly different from those reported in 2004-2005 except at station P14 (Figure 3.3-1, Table 3.3-2). Sites P11, P12, and P13 have not exhibited significant differences in mean tidal range since the 2002-2003 reporting period. The 2002-2003 reporting period was a period characterized by increased precipitation and discharge rates in the mainstem Cape Fear that were greater than subsequent monitoring periods. This year, mean tidal ranges did not significantly differ from the ranges reported in Year 1 at any station (Table 3.3-2). This result contrasts with the previous reporting period where mean tidal ranges were significantly lower than the Year 1 values at all of the stations except for P11. Similar comparisons are unavailable for site P12 due to an incomplete data set at that station during the first year of monitoring. These results most likely reflect discharge variability in the river. Although discharge data are no longer publically available for the Northeast Cape Fear, drought conditions are believed to have reduced river discharge. Reduced discharge was observed in the Cape Fear mainstem (Figure 3.5-1). Mean tidal ranges for all of the Northeast Cape Fear River stations decrease upstream and continue to be lower than the mean determined for P1 with the exception of station P11 which had the same mean as station P1 (Table 3.3-3). This result is consistent with results from the previous reporting period. Neither the mean monthly minimum water level nor the mean monthly maximum water level significantly differed from values reported in 2004-2005 (Table 3.3-5). This result is consistent with previous reporting periods. All of the sites in the Northeast Cape Fear River continue to exhibit time asymmetries. Mean flood durations are shorter than ebb durations and show little variability among the sites (Table 3.3-4). During this monitoring period, mean flood duration changed little. The greatest change occurred at P11 where the flood duration increased by less than 2% (Table 3.3-4). The mean ebb durations also changed little (~1% or less). Where changes were noted, they did not change in a consistent manner. Sites P11 and P12 decreased slightly, site P13 exhibited a minimal increase and P14 remained the same.

Tidal ranges at upstream stations in the Northeast Cape Fear are positively correlated with the tidal range at P1 (Figure 3.45-1, Figure 3.45-2, Figure 3.45-3, and Figure 3.45-4). The mean tidal range at P14 on the Northeast Cape Fear River continues to be less than the mean range measured at P9, 12 mi from convergence on the Cape Fear River. Consistent with previous years, tidal ranges at stations P11 and P12 are more strongly correlated to tidal ranges observed at P1 than the tidal ranges at P13 and P14. Water levels at these upriver stations continue to be impacted strongly by other types of events; especially increased rainfall and upriver discharge as suggested by the lower R^2 values for the most upstream stations (Figure 3.5-1 and Figure 3.5-2). Comparisons of the regression slopes between this reporting period and last year yielded no significant difference for sites P11 and P12. The slope increased significantly at P13, but significantly decreased at P14 (Table 3.3-2). Significant differences in regression slope between this reporting period and 2000-2001 were also detected for sites P11 (increase) and P14 (decrease). No Year 1 data were available for P12 with which to make a similar comparison.

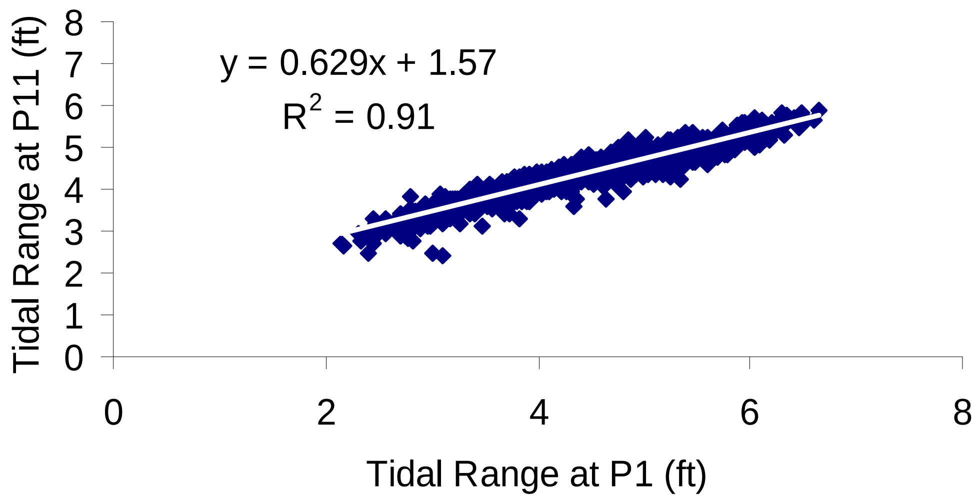


Figure 3.45-1. Plot showing relationship between tidal ranges observed at Ft. Caswell (P1) and Smith Creek (P11).

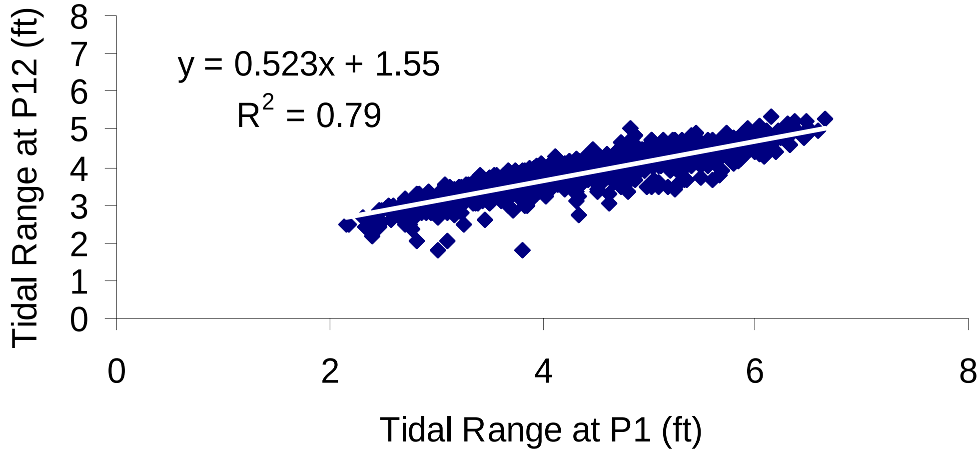


Figure 3.45-2. Plot showing relationship between tidal ranges observed at Ft. Caswell (P1) and Smith Creek (P12).

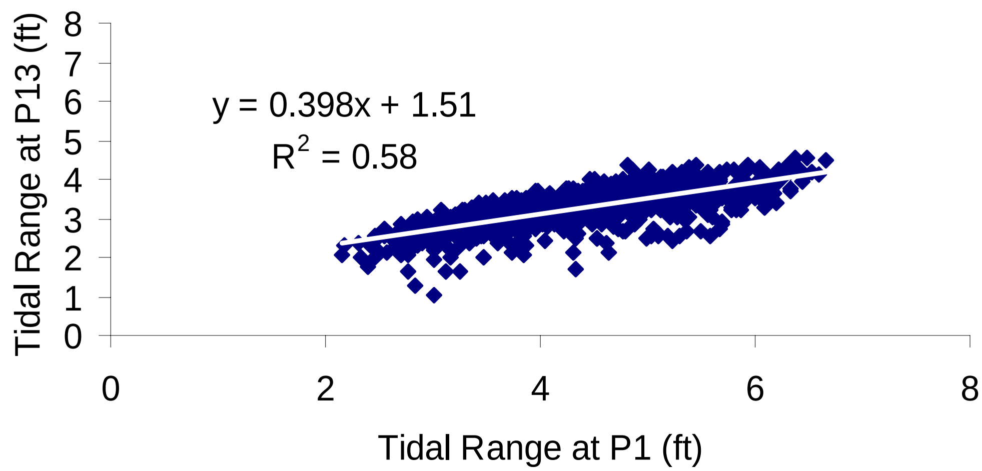


Figure 3.45-3. Plot showing relationship between tidal ranges observed at Ft. Caswell (P1) and Fishing Creek (P13).

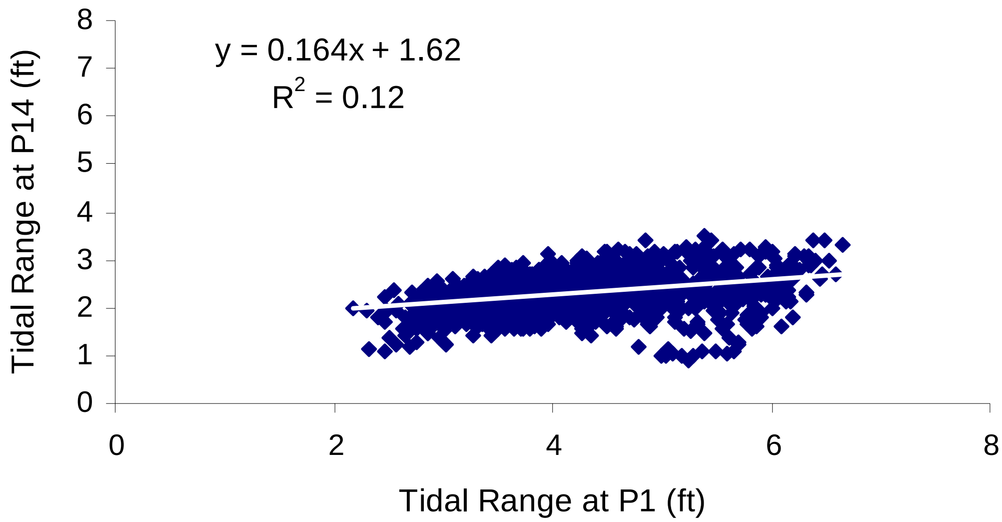


Figure 3.45-4. Plot showing relationship between tidal ranges observed at Ft. Caswell (P1) and Prince George Creek (P14).

3.5 Influence of Upstream Flow

Periods of lower, drought-induced water levels and extreme flooding in the system over the last 5 years have contributed to differing tidal conditions in the Cape Fear and Northeast Cape Fear Rivers between monitoring years. These effects are confounded by the shortened data set for Year 1, which included data collected from October to June, only, and covered a period when monthly river discharge was below the long-term average (~5,531 ft^3/s) reported by the USGS at Lock and Dam 1 on the Cape Fear mainstem (Figure 3.5-1). The discharge time series for the Northeast Cape Fear River is no longer available. According to Ramona Traynor at the USGS in Reston, VA "streamflow data collection at this station was only funded for a short term project. With the completion of the data-collection phase of the project, the station has returned to gage-only data collection". Nonetheless, data from previous years indicate that even though discharge rates in the Northeast Cape Fear River are much lower than in the mainstem, periods of increased discharge frequently occur. As discussed in last year's report, the higher tidal ranges observed for P1 for the first two monitoring periods may reflect lower than average flows in the river which have a tendency to produce higher tidal ranges. In contrast, the above average discharges recorded during monitoring years 3 and 4, may explain the lower mean tidal ranges observed at P1 and other stations during those years. The Year 4 discharge data included fewer high flow events and more closely approximated mean conditions for the river (Figure 3.5-1 and Figure 3.5-2) than the previous 3 years. This reporting period, the mean discharge is comparable to the mean discharge that existed during Year 1. This condition allows for more direct comparison between this year's data and Year 1. The similarity in discharge rates between the first project year and the current year, may explain the lack of significant difference in many of the statistical comparisons this year compared to previous reporting periods.

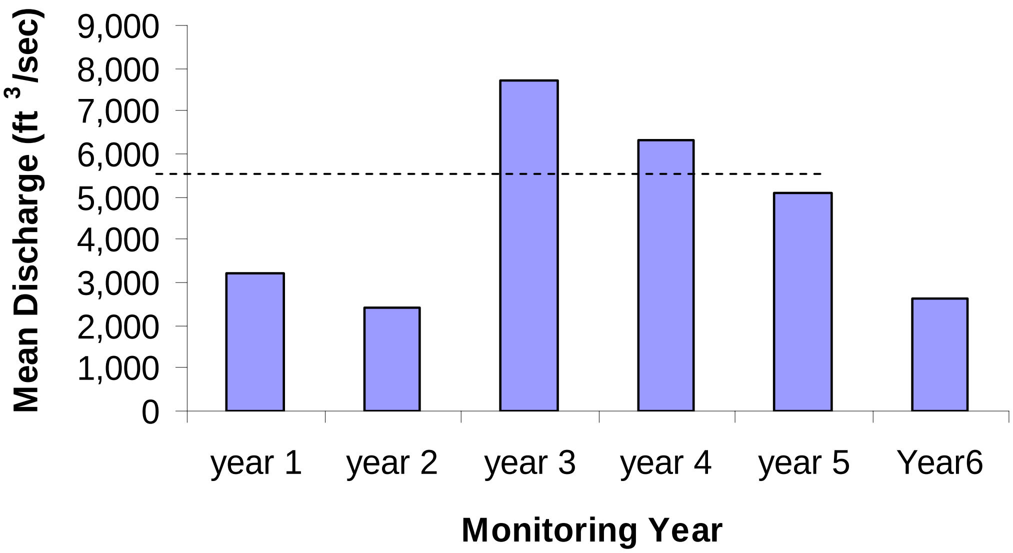


Figure 3.5-1. Mean discharge for each monitoring period. Monitoring Year 1 is October 2000 to May 2001; monitoring Year 2 in June 2001 to May 2002; monitoring Year 3 is June 2002 to May 2003; monitoring Year 4 is June 2003 to May 2004; monitoring Year 5 is June 2004 to May 2005 and monitoring Year 6 is June 2005 to May 2006. The line denotes the long-term mean discharge for the Cape Fear River as measured at Lock 1 by a USGS gauging station.

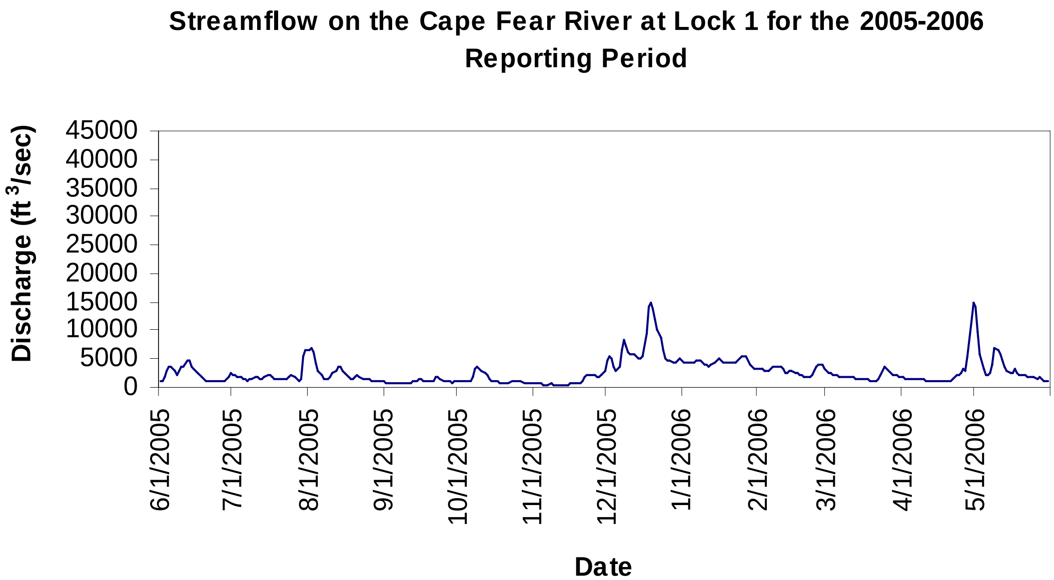


Figure 3.5-2. Plot showing discharge in the Cape Fear River at Lock 1 for the current monitoring period. Data available at http://nwis.waterdata.usgs.gov/nc/nwis site number 02105769.

3.6 Tidal Harmonics

A classical tidal harmonics analysis was performed on each of the individual stations of the Cape Fear River Project using the MATLAB version of T-Tide (Pawlowicz et al. 2002) (Table 3.6-1). The relative phase and amplitude of the major frequencies in the measured 6-minute water level data have been determined with error estimates and a 95% confidence level. Constituents were considered significant if the signal-to-noise ratio was greater than 1. As expected the M2 component is the dominant constituent at every station. These phase/amplitude data provide a compression of the data in the complete time series and will eventually be used to identify differences in tidal dynamics between the stations along the river that have been impacted by channel modification activities. Table 3.6-2 shows tidal harmonics for station P4 over the years spanning 1994 to 2005. Station P4 was selected because water level time series data were available for several years prior to the initiation of dredging activities and because harmonic constituents have been well-established. T-tide was used to determine the phase and amplitude of the dominant tidal constituents by year. While the relative dominance of the lesser constituents varied among years, the M2 component was the dominant constituent every year. Neither the amplitude nor the phase of the M2 constituent has changed appreciably over the years examined. For the most part, the amplitude has varied between 2.03 and 2.09. Higher amplitudes were noted in 1997 (pre-dredging) and in 2003 and 2004 (during dredging modifications). Lower amplitudes occurred in 1994, 1995 and 1998 (prior to dredging activities) and again in 2001 and 2002 after dredging had been initiated. There does not appear to be a consistent pattern in amplitude change over the 11 year period examined. Changes in harmonic amplitude initially appear to be more closely linked to variations in discharge than dredging activities. This relationship will be examined in greater detail following completion of dredging activities.

Table 3.6-1 Summary of tidal harmonics for reporting period 2005-2006. Errors shown represent the standard error association with each respective data set.

Station	Tide	Amp	Amp_err	Pha	Pha_err
P01	M2	1.973	0.017	222.38	0.5
	N2	0.4224	0.016	209.72	2.14
	K1	0.3296	0.014	122.4	3.08
	S2	0.3273	0.015	241.06	3.01
	O1	0.2673	0.016	129.9	3.4
	P1	0.0991	0.015	125.74	9.79
P02	M2	2.0085	0.035	258.57	1.04
	N2	0.3587	0.033	249.69	6.1
	K1	0.3014	0.021	143.19	3.78
	S2	0.2727	0.034	285.4	6.97
	O1	0.2552	0.02	150.37	4.47
	P1	0.096	0.022	148.05	12.68
P03	M2	1.198	0.048	280.06	2.37
	K1	0.2087	0.015	168.41	4.06
	N2	0.1975	0.044	280.26	15.67
	O1	0.1787	0.016	175.19	4.47

Table 3.6-1. (continued)

Station	Tide	Amp	Amp_err	Pha	Pha_err
	S2	0.1244	0.053	312.67	23.04
	P1	0.0676	0.016	181.37	12.74
P06	M2	1.9965	0.017	281.81	0.51
	N2	0.3419	0.018	275.18	2.98
	K1	0.2973	0.02	158.87	3.85
	S2	0.2543	0.023	312.1	4.33
	O1	0.2437	0.018	165.59	4.39
	P1	0.0812	0.022	152.15	12.96
P07	M2	1.7703	0.024	290.25	0.77
	N2	0.2957	0.026	284.89	4.05
	K1	0.2755	0.02	167.01	3.8
	O1	0.2415	0.019	174.72	4.6
	S2	0.2149	0.024	319.99	5.82
	K2	0.089	0.024	317.87	15.79
P08	M2	1.389	0.06	297.79	2.72
	K1	0.2738	0.064	178.43	12.7
	O1	0.2034	0.06	182.29	18.59
	N2	0.1581	0.066	279.28	22.39
	S2	0.1489	0.064	312.76	24.15
	P1	0.0631	0.06	144.21	62.6
P09	M2	1.4029	0.037	304.61	1.44
	K1	0.2522	0.018	182.25	4.06
	O1	0.2282	0.019	188.54	5.27
	N2	0.2157	0.031	301.31	10.38
	S2	0.1495	0.035	333.28	12.55
	P1	0.0704	0.017	182.12	15.96
P11	M2	1.9595	0.027	279.28	0.98
	N2	0.3247	0.032	271.75	5.28
	K1	0.2824	0.046	156.65	11.22
	O1	0.26	0.048	158.67	11.34
	S2	0.258	0.03	308.68	6.89
	P1	0.0879	0.047	163.48	35.85
P12	M2	1.6992	0.034	274.34	1.19
	N2	0.2736	0.038	265.27	7.59
	K1	0.2553	0.03	159.38	6.34
	S2	0.2169	0.036	305.21	8.78
	O1	0.2167	0.031	159.83	7.75
	P1	0.0828	0.028	173.01	20.45
P13	M2	1.9965	0.018	281.81	0.55
	N2	0.3419	0.019	275.18	3.48
	K1	0.2973	0.022	158.87	3.9
	S2	0.2543	0.017	312.1	4.79
	O1	0.2437	0.021	165.59	4.53
	P1	0.0812	0.019	152.15	13.81
P14	M2	0.8906	0.069	328.94	4.41
	N2	0.189	0.067	336.25	25.23
	K1	0.1765	0.043	205.38	13.63

Table 3.6-1. (continued)

Station	Tide	Amp	Amp_err	Pha	Pha_err
	O1	0.1644	0.042	211.38	14.75
	S2	0.1227	0.073	354.72	31.44
	P1	0.0607	0.044	195.16	41.23

Table 3.6.2 Summary of yearly tidal harmonics for station P4 from 1994 to 2006. Errors shown represent the standard error association with each respective data set.

Year	Tide	Amp	Amp_err	Pha	Pha_err
1994	M2	2.0292	0.019	278.61	0.53
	N2	0.4042	0.016	273.67	2.49
	K1	0.2552	0.016	148.7	3.59
	S2	0.2475	0.018	310.98	4.5
	O1	0.1759	0.019	172.29	5.39
	P1	0.092	0.016	158.88	11.02
1995	M2	2.0374	0.016	278.72	0.52
	N2	0.3876	0.018	273.44	2.6
	S2	0.2349	0.017	311.04	4.78
	K1	0.2236	0.016	149.54	4.57
	O1	0.1776	0.017	174.01	5.37
	P1	0.0829	0.017	157.01	11.85
1996	M2	2.0925	0.023	279.22	0.58
	N2	0.3901	0.02	271.06	3.41
	S2	0.2511	0.021	312.45	5.64
	K1	0.2328	0.022	155.42	5.51
	O1	0.1635	0.02	169.37	6.59
	P1	0.0936	0.021	163.6	12.77
1997	M2	2.0934	0.017	279.78	0.42
	N2	0.3757	0.018	272.17	2.46
	S2	0.2399	0.017	312.47	3.72
	K1	0.2268	0.019	156.46	4.81
	O1	0.1611	0.017	163.3	6.95
	P1	0.0898	0.019	160.1	11.54
1998	M2	2.0315	0.024	281.11	0.63
	N2	0.3747	0.02	267.61	2.8
	K1	0.2347	0.017	160.05	5.52
	S2	0.2306	0.022	311.18	5.14
	O1	0.1831	0.016	161.94	5.91
	P1	0.0976	0.017	147.25	10.41
1999	M2	2.0322	0.032	281.45	0.89
	N2	0.3835	0.033	269.1	4.19
	S2	0.2437	0.031	311.72	6.5
	K1	0.233	0.018	163.4	3.84
	O1	0.1775	0.018	155.05	5.63

Table 3.6-2. (continued)

Year	Tide	Amp	Amp_err	Pha	Pha_err
	P1	0.101	0.018	163.96	10.7
2000	M2	2.061	0.012	281.36	0.3
	N2	0.3999	0.011	270.58	1.63
	S2	0.246	0.013	308.76	2.42
	K1	0.2412	0.014	165.5	2.74
	O1	0.172	0.012	151.74	4.37
	P1	0.1016	0.012	164.04	6.32
2001	M2	2.0368	0.015	280.83	0.45
	N2	0.4185	0.018	269.97	2.45
	K1	0.2626	0.016	162.8	3.58
	S2	0.2594	0.017	308.46	3.42
	O1	0.1945	0.016	155.4	4.36
	P1	0.0896	0.015	161.15	10.74
2002	M2	2.0304	0.013	279.96	0.5
	N2	0.4274	0.016	272.48	2.26
	K1	0.2818	0.015	162.31	2.95
	S2	0.2722	0.015	307.5	3.2
	O1	0.213	0.013	151.06	4.41
	P1	0.1047	0.016	167.79	8.28
2003	M2	2.1106	0.019	277.22	0.48
	N2	0.4341	0.021	272	2.86
	K1	0.2883	0.019	158.71	3.81
	S2	0.2703	0.018	303.72	4.1
	O1	0.2267	0.016	157.51	4.85
	P1	0.0776	0.017	147.96	13.59
2004	M2	2.1067	0.016	276.66	0.42
	N2	0.4145	0.019	271.6	1.97
	K1	0.2957	0.015	155.28	2.92
	S2	0.2844	0.016	307.37	3.18
	O1	0.236	0.015	157.85	3.7
	P1	0.0909	0.014	159.76	10.99
2005	M2	2.0998	0.018	275.82	0.58
	N2	0.3863	0.021	269.08	2.91
	K1	0.304	0.016	156.03	3.01
	S2	0.2826	0.02	304.19	3.44
	O1	0.2494	0.016	159.28	3.5
	P1	0.0933	0.018	152.62	9.17

4.0 MARSH/SWAMP FLOOD AND SALINITY LEVELS

4.1 Summary

An adequate data base was obtained for both fall 2005 and spring 2006 to determine flood frequency, flood water depth, and salinity of flooding water. Most subsites flooded with about the same frequency and duration of previous years; one was noteworthy because several subsites rarely flooded during the two-weeks when data were collected in spring. This was likely a random anomaly in water levels on the river. There were shorter flood durations at subsites compared to the initial year despite very similar release of water over Lock & Dam # 1. No trend of increasing or decreasing salinity at subsites is apparent in the data base with the exception of subsites at two stations, P11 and P12, which are becoming more saline through time.

4.2 Data Base

Despite equipment loss from heavy rainfall associated with a fast-moving tropical storm in September, 2005, complete two-week data sets were collected for all stations in fall 2005 and spring 2006 (Tables 4.2-1 and. 4.2-2). Conductivity and temperature (used to determine salinity) data were collected concurrently with flood water data. Some data were lost from specific subsites due to either instrument flooding, e.g. during fall at P6 at subsite 1, or data logger failure, e.g. .in fall at P9, subsite 4, and in spring at P11, subsite 6. Data sets for salinity (Tables 4.2-3 and 4.2-4) were similar to previous years.

4.3 Marsh/Swamp Flooding

River discharge data (See Section 3) indicated that this reporting year (1 June 2005- 30 May 2006) was very close to the mean annual discharge rate for the Cape Fear River during the first year of study (Figure 3.5-1) and lower than the overall mean for river discharge averaged over all years. Discharge this reporting year was lower than Year 5, last year. While most stations continue to flood with just about every tide, there were some exceptions noted. Station P12 on the Northeast Cape Fear River experienced very low levels of flooding in spring with four of the six substations flooding rarely, if at all (Table 4.2-2). It is important to note that the two-week interval chosen for each station can coincide with an unusual water level event, in this case low levels of water in the adjacent river. River levels were near normal when measurements were made for two weeks the previous fall and as a consequence, flooding frequency in the swamp was near normal as well.

In general, differences with respect to flooding frequency, flood duration, and maximum flooding depth generally coincided with river discharge. During fall 2005, flood duration was lower at 42 of 54 swamp/marsh subsites and at 41 of 54 during spring 2006 when compared to the previous year when average river discharge was higher. Similarly, the maximum flood depth was less at 35 of 54 subsites in fall 2005 and at 43 of 53 in spring 2006. These general trends add weight to the discussion in Section 3 of this report, which indicated the importance of stream discharge to various attributes of river hydrology, e.g. lag time and wave suppression. Higher water levels in the river translate to higher water levels in the swamp and longer flood duration.

Table 4.2-1. Flooding frequency, duration, depth, and actual water level of marsh/swamp substations during fall 2005. Actual water level is calculated using the maximum depth and marsh/swamp surface elevation relative to NAVD88 datum.

Station Number	Substation Number	Season	Start Date	End Date	# Flood Events	Mean Flood Duration (hr)	Maximum Depth (ft)	Marsh/Swamp Elevation (ft)	Actual water level (ft)
P3	1	Fall 05	12/5/2005	12/19/2005	26/27	5.6	1.8	0.66	1.2
	2	Fall 05	12/5/2005	12/19/2005	26/27	5.2	1.8	0.83	1.0
	3	Fall 05	12/5/2005	12/19/2005	26/27	5.4	1.9	0.52	1.4
	4	Fall 05	12/5/2005	12/19/2005	26/27	5.3	1.8	1.49	0.3
	5	Fall 05	12/5/2005	12/19/2005	20/27	4.7	1.6	0.99	0.6
	6	Fall 05	12/5/2005	12/19/2005	12/27	5.2	3.9	3.31	0.6
P6	1	Fall 05	9/9/2005	9/23/2005	27/27	7.2	3.2	0.76	2.4
	2	Fall 05	9/9/2005	9/23/2005	26/27	5.7	3.2	1.56	1.7
	3	Fall 05	9/9/2005	9/23/2005	27/27	6.6	3.3	0.85	2.5
	4	Fall 05	9/9/2005	9/23/2005	26/27	5.4	3.5	1.13	2.4
	5	Fall 05	9/9/2005	9/23/2005	23/27	5.3	3.5	1.92	1.6
	6	Fall 05	9/9/2005	9/23/2005	20/27	5.1	3.1	1.74	1.4
P7	1	Fall 05	10/12/2005	10/26/2005	22/27	6.7	3.5	1.76	1.7
	2	Fall 05	10/12/2005	10/26/2005	16/27	5.1	3.7	2.23	1.5
	3	Fall 05	10/12/2005	10/14/2005	4/27	4.3	3.3	2.26	1.1
	4	Fall 05	10/12/2005	10/26/2005	13/27	6.4	3.6	2.43	1.2
	5	Fall 05	10/12/2005	10/26/2005	13/27	5.8	3.4	2.31	1.1
	6	Fall 05	10/12/2005	10/26/2005	12/27	6.2	3.5	2.37	1.1
P8	1	Fall 05	10/26/2005	11/9/2005	13/27	5.6	2.6	2.14	0.5
	2	Fall 05	10/26/2005	11/9/2005	23/27	4.6	2.6	1.54	1.1
	3	Fall 05	10/26/2005	11/9/2005	27/27	5.1	2.7	1.46	1.2
	4	Fall 05	10/26/2005	11/9/2005	5/27	3.8	2.5	1.98	0.5
	5	Fall 05	10/26/2005	11/9/2005	7/27	7.3	2.8	2.24	0.6
	6	Fall 05	10/26/2005	11/9/2005	19/27	6.1	2.8	2.38	0.4
P9	1	Fall 05	9/23/2005	10/6/2005	26/27	7.7	3.0	0.58	2.4
	2	Fall 05	9/23/2005	10/6/2005	27/27	5.5	3.0	2.21	0.8
	3	Fall 05	9/23/2005	10/6/2005	19/27	4.5	2.9	1.22	1.7
	4	Fall 05	9/23/2005	10/6/2005	12/27	4.4	2.9	2.06	0.8
	5	Fall 05	9/23/2005	10/6/2005	4/27	6.3	2.9	2.20	0.7
	6	Fall 05	9/23/2005	10/6/2005	15/27	5.6	2.9	1.92	1.0
P11	1	Fall 05	11/9/2005	11/23/2005	19/27	5.5	2.8	1.44	1.4
	2	Fall 05	11/9/2005	11/23/2005	15/27	4.5	2.8	1.82	1.0
	3	Fall 05	11/9/2005	11/23/2005	14/27	4.3	2.8	1.76	1.0

Table 4.2-1. (continued)

	4	Fall 05	11/9/2005	11/18/2005	15/27	4.2	2.5	1.85	0.7
	5	Fall 05	11/9/2005	11/23/2005	16/27	4.5	2.8	1.91	0.9
	6	Fall 05	11/9/2005	11/23/2025	14/27	4.1	3.0	2.04	1.0
P12	1	Fall 05	11/23/2005	12/7/2005	26/27	4.8	2.8	0.90	1.9
	2	Fall 05	11/23/2005	12/7/2005	16/27	4.8	2.6	1.62	1.0
	3	Fall 05	11/23/2005	12/7/2005	11/27	5.7	2.6	2.00	0.6
	4	Fall 05	11/23/2005	12/7/2005	7/27	6.5	2.5	1.90	0.6
	5	Fall 05	11/23/2005	12/7/2005	15/27	6.1	2.6	2.08	0.5
	6	Fall 05	11/23/2005	12/7/2005	16/27	4.0	2.5	2.44	0.1
P13	1	Fall 05	11/14/2005	11/28/2005	10/27	7.0	2.4	1.43	1.0
	2	Fall 05	11/14/2005	11/28/2005	17/27	5.8	2.3	1.08	1.2
	3	Fall 05	11/14/2005	11/28/2005	23/27	4.7	2.4	0.75	1.7
	4	Fall 05	11/14/2005	11/28/2005	22/27	6.0	3.3	1.00	2.3
	5	Fall 05	11/14/2005	11/28/2005	16/27	4.3	2.3	1.21	1.1
	6	Fall 05	11/14/2005	11/28/2005	5/27	5.0	2.0	1.64	0.4
P14	1	Fall 05	10/28/2005	11/11/2005	26/27	7.1	2.1	0.70	1.4
	2	Fall 05	10/28/2005	11/11/2005	26/27	5.6	2.1	0.87	1.2
	3	Fall 05	10/28/2005	11/11/2005	26/27	5.8	1.9	1.08	0.8
	4	Fall 05	10/28/2005	11/11/2005	26/27	5.0	1.8	1.22	0.6
	5	Fall 05	10/28/2005	11/11/2005	21/27	4.8	1.9	1.28	0.6
	6	Fall 05	10/28/2005	11/11/2005	13/27	6.1	2.2	1.49	0.7

Table 4.2-2. Flooding frequency, duration, depth, and actual water level of marsh/swamp substations during spring 2006. Actual water level is calculated using the maximum depth and marsh/swamp surface elevation relative to NAVD88 datum.

Station Number	Substation Number	Season	Start Date	End Date	# Flood Events	Mean Flood Duration (hr)	Maximum Depth (ft)	Marsh/Swamp Elevation (ft)	Actual water level (ft)
P3	1	Spring 06	4/28/2006	5/12/2006	26/27	6.7	2.0	0.66	1.4
	2	Spring 06	4/28/2006	5/12/2006	26/27	5.9	1.8	0.83	1.0
	3	Spring 06	4/28/2006	5/12/2006	26/27	6.7	2.0	0.52	1.5
	4	Spring 06	4/28/2006	5/12/2006	26/27	6.8	2.0	1.49	0.5
	5	Spring 06	4/28/2006	5/12/2006	25/27	5.2	1.8	0.99	0.8
	6	Spring 06	4/28/2006	5/12/2006	21/26	5.0	4.1	3.31	0.8
P6	1	Spring 06	3/13/2006	3/28/2006	27/27	6.1	2.5	0.76	1.7
	2	Spring 06	3/13/2006	3/28/2006	21/26	4.4	2.4	1.56	0.8
	3	Spring 06	3/13/2006	3/28/2006	27/27	5.8	2.4	0.85	1.5
	4	Spring 06	3/13/2006	3/28/2006	23/27	4.6	2.4	1.13	1.3
	5	Spring 06	3/13/2006	3/28/2006	19/27	4.4	2.7	1.92	0.8
	6	Spring 06	3/13/2006	3/28/2006	21/27	5.0	2.4	1.74	0.7
P7	1	Spring 06	3/29/2006	4/12/2006	21/27	4.2	2.8	1.76	1.0
	2	Spring 06	3/29/2006	4/12/2006	3/27	4.1	2.7	2.23	0.5
	3	Spring 06	3/29/2006	4/12/2006	8/27	4.6	2.7	2.26	0.4

Table 4.2-2. (continued)

Station Number	Substation Number	Season	Start Date	End Date	# Flood Events	Mean Flood Duration (hr)	Maximum Depth (ft)	Marsh/Swamp Elevation (ft)	Actual water level (ft)
	4	Spring 06	3/29/2006	4/12/2006	8/27	4.8	2.8	2.43	0.4
	5	Spring 06	3/29/2006	4/12/2006	7/27	5.4	2.7	2.31	0.4
	6	Spring 06	3/29/2006	4/12/2006	7/27	5.6	2.9	2.37	0.5
P8	1	Spring 06	5/1/2006	5/15/2006	23/27	5.0	3.0	2.14	0.8
	2	Spring 06	5/1/2006	5/15/2006	26/27	5.1	2.9	1.54	1.4
	3	Spring 06	5/1/2006	5/15/2006	26/27	5.8	3.0	1.46	1.5
	4	Spring 06	5/1/2006	5/15/2006	24/27	4.7	2.9	1.98	0.9
	5	Spring 06	5/1/2006	5/15/2006	16/27	4.3	2.9	2.24	0.7
	6	Spring 06	5/1/2006	5/15/2006	15/27	4.8	2.9	2.38	0.5
P9	1	Spring 06	4/12/2006	4/26/2006	26/27	6.3	2.8	0.58	2.2
	2	Spring 06	4/12/2006	4/26/2006	17/27	3.9	2.7	2.21	0.5
	3	Spring 06	4/12/2006	4/26/2006	8/27	4.8	2.6	1.22	1.4
	4	Spring 06	4/12/2006	4/26/2006	4/27	5.3	2.6	2.06	0.5
	5	Spring 06	4/12/2006	4/26/2006	5/27	4.6	2.6	2.20	0.4
	6	Spring 06	4/12/2006	4/26/2006	2/27	6.2	2.6	1.92	0.7
P11	1	Spring 06	2/27/2006	3/13/2006	23/27	4.5	3.1	1.44	1.7
	2	Spring 06	2/27/2006	3/13/2006	20/27	4.3	2.7	1.82	0.9
	3	Spring 06	2/27/2006	3/13/2006	21/27	5.0	2.6	1.76	0.8
	4	Spring 06	2/27/2006	3/13/2006	20/27	4.7	2.7	1.85	0.8
	5	Spring 06	2/27/2006	3/13/2006	16/27	4.0	2.7	1.91	0.8
	6	Spring 06	2/27/2006	3/13/2006	21/27	4.0	2.7	2.04	0.7
P12	1	Spring 06	4/10/2006	4/24/2006	23/27	5.4	2.2	0.90	1.3
	2	Spring 06	4/10/2006	4/24/2006	9/27	5.1	2.1	1.62	0.5
	3	Spring 06	4/10/2006	4/24/2006	1/27	4.6	2.1	2.00	0.1
	4	Spring 06	4/10/2006	4/24/2006	1/27	5.8	2.1	1.90	0.2
	5	Spring 06	4/10/2006	4/24/2006	1/27	7.5	2.6	2.08	0.5
	6	Spring 06	4/10/2006	4/24/2006	0/27	0.0	0.0	2.44	0.0
P13	1	Spring 06	3/22/2006	4/5/2006	17/27	5.6	2.1	1.43	0.7
	2	Spring 06	3/22/2006	4/5/2006	22/27	5.3	2.0	1.08	1.0
	3	Spring 06	3/22/2006	4/5/2006	25/27	5.3	2.1	0.75	1.3
	4	Spring 06	3/22/2006	4/5/2006	26/27	5.4	3.0	1.00	2.0
	5	Spring 06	3/22/2006	4/5/2006	22/27	4.5	2.0	1.21	0.8
	6	Spring 06	3/22/2006	4/5/2006	9/27	2.5	1.9	1.64	0.3
P14	1	Spring 06	3/1/2006	3/15/2006	26/27	6.4	2.1	0.70	1.4
	2	Spring 06	3/1/2006	3/15/2006	25/27	4.8	1.9	0.87	1.0
	3	Spring 06	3/1/2006	3/15/2006	23/27	4.2	1.8	1.08	0.7
	4	Spring 06	3/1/2006	3/15/2006	22/27	4.0	2.0	1.22	0.8
	5	Spring 06	3/1/2006	3/15/2006	18/27	4.2	1.9	1.28	0.6
	6	Spring 06	3/1/2006	3/15/2006	11/27	4.4	1.9	1.49	0.4

4.4 Water Salinity in Marshes and Swamps

Intrusion of salt water into the estuary and onto marshes and swamps is generally related to river discharge. The vast majority of subsites were not subject to any saline water (Tables 4.2-3 and 4.2-4) (35/50 in fall 2005 and 32/53 in spring), despite discharge in the Cape Fear River that was below the long term mean discharge (Figure 3.5-1). Mean discharge rates in this reporting year were near rates of discharge for the first year of the study (2000-2001). None of the three most upstream stations in the Cape Fear River (P7, P8, & P9) experienced flooding by any saline water during this reporting year. These stations are all tidal swamps showing no sign of a change in swamp vegetation. Conversely, P12 in the Northeast Cape Fear River is clearly in the process of converting from swamp to oligohaline marsh based on vegetation. Similarly, P13 is also showing some indication of change, but remains a tidal swamp. The process of vegetation change is occurring despite little saline water in floodwaters the past reporting year (Tables 4.2-3 and 4.2-4). Only subsite 1 in fall, and subsites 1-4 at P11, near the river's edge experience any degree of flooding by saline water, but this was relatively high, as high as 9 ppt. Note that sensitive vegetation analyses covered in Section 8 of this report all measure change in vegetation located at or near the river's edge. Only three stations (P 3, P6, & P11) were generally characterized as saline marsh when this study began and they continue to be flooded with saline water (Tables 4.2-3 and 4.2-4).

Table 4.2-3. Summary of salinity data from nine substations collected along the Cape Fear River and its tributaries in fall 2005.

Station Number	Station Name	Substation Number	Fall 2005 Salinity Range (ppt)	Proportion of flood events containing > 1 ppt salinity
P3	Town Creek	1	<1 - 3	3/27
		2	<1 - 2	2/27
		3	<1 - 1	1/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P6	Eagle Island	1	ND	ND
		2	<1 - 22	27/27
		3	<1 - 24	25/27
		4	<1 - 23	18/27
		5	<1 - 15	8/27
		6	<1 - 12	6/27
P7	Indian Creek	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P8	Dollisons Landing	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27

Table 4.2-3. (continued)

Station Number	Station Name	Substation Number	Fall 2005 Salinity Range (ppt)	Proportion of flood events containing > 1 ppt salinity
		5	<1	0/27
		6	<1	0/27
P9	Black River	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	ND	ND
		5	<1	0/27
		6	<1	0/27
P11	Smith Creek	1	<1 - 18	10/27
		2	<1 - 16	9/27
		3	<1 - 15	14/27
		4	<1 - 14	9/27
		5	<1 - 12	8/27
		6	<1 - 10	8/27
P12	Rat Island	1	<1 - 5	2/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P13	Fishing Creek	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	ND	ND
P14	Prince George	1*	<1	0/27
		2**	<1	0/27
		3**	<1	0/27
		4**	<1	0/27
		5**	<1	0/27
		6	ND	ND

ND=No data available

* = Data recorded from 10/28/2005 at 12:00 to 11/11/2005 at 9:36.

**= Data recorded from 11/4/2005 at 11:12 to 11/11/2005 at 9:36.

Table 4.2-4. Summary of salinity data from nine substations collected along the Cape Fear River and its tributaries in spring 2006.

Station Number	Station Name	Substation Number	Spring 2006 Salinity Range (ppt)	Proportion of flood events containing > 1 ppt salinity
P3	Town Creek	1	<1 - 7	16/27
		2	<1 - 5	14/27
		3	<1 - 5	11/27
		4	<1 - 2	4/27
		5	<1 - 2	2/27
		6	<1 - 2	1/27

Table 4.2-4. (continued)

Station Number	Station Name	Substation Number	Spring 2006 Salinity Range (ppt)	Proportion of flood events containing > 1 ppt salinity
P6	Eagle Island	1	<1 - 10	26/27
		2	<1 - 9	20/27
		3	<1 - 9	18/27
		4	<1 - 7	16/27
		5	<1 - 5	11/27
		6	<1 - 2	5/27
P7	Indian Creek	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P8	Dollisons Landing	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P9	Black River	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P11	Smith Creek	1	<1 - 4	6/27
		2	<1 - 5	8/27
		3	<1 - 5	10/27
		4	<1 - 5	6/27
		5	<1 - 2	4/27
		6	ND	ND
P12	Rat Island	1	<1 - 9	14/27
		2	<1 - 6	7/27
		3	<1 - 5	1/27
		4	<1 - 3	1/27
		5	<1	0/27
		6	<1	0/27
P13	Fishing Creek	1*	<1	0/27
		2**	<1	0/27
		3**	<1	0/27
		4**	<1	0/27
		5**	<1	0/27
		6**	<1	0/27
P14	Prince George	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27

Station Number	Station Name	Substation Number	Spring 2006 Salinity Range (ppt)	Proportion of flood events containing > 1 ppt salinity
		5	<1	0/27
		6	<1	0/27

ND=No data available

* = Data recorded from 3/22/2006 at 12:00 to 3/27/2006 at 10:24.

**= Data recorded from 3/22/2006 at 12:00 to 4/5/2006 at 12:24.

4.5 Inter-Annual Variations

Despite the similar levels of flow upstream in the Cape Fear River (Figure 3.5-1), the duration of flooding within marsh/swamp subsites was less that would be expected (Table 4.5-1). This table shows differences in flood duration over an initial data set that included three two week periods, one in spring, one in summer and one in fall. Normal variation should result in 27/54 with longer flood duration and 27/54 with less. Note that tidal wetlands were flooded with lower duration at 30 of 52 subsites in fall 2005 and 32 of 51 in spring (Table 4.5-1). There is also no overall trend of flooding more or less over the reporting period. Reporting periods when there was more water coming into the river, e.g. 2002-2003 and 2003-2004, did result in longer durations of flooding, but the change was not dramatic.

Table 4.5-2 must be interpreted with caution as it represents only one event that contained saline water in excess of the maximum salinity measured during the initial year of study. Nevertheless, it does provide a mechanism of determining if long term trends are apparent. During fall 2005 and spring 2006 only 11 of 50 and 6 of 53 subsites, respectively, recorded higher salinities than in the initial year of collection. This contrasts with data for fall 2001 when 38 of 54 subsites were measured with water higher in salinity than the initial year. Fall 2002 again recorded higher salinities, but other seasons contained just a few subsites where salinity exceeded the baseline year. No trend with respect to saline water moving into swamps and marshes is apparent from data in Table 4.5-2. Note, however, that substations at P11 and P12 on the Northeast Cape Fear River are generally experiencing more saline water through time.

Table 4.5-1. Deviation of flood duration over time.

Station	Subsite	**Initial Avg. Tidal Duration (hrs.) (Spr. 2000-Spr.2001)**	Deviation from Initial Fall 2001	Deviation from Initial Spring 2002	Deviation from Initial Fall 2002	Deviation from Initial Spring 2003	Deviation from Initial Fall 2003	Deviation from Initial Spring 2004	Deviation from initial Fall 2004	Deviation from initial Spring 2005	Deviation from initial Fall 2005	Deviation from Initial Spring 2006
P3	1	**6.3**	(0.6)	0.1	+1.3	+0.8	+1.7	(0.4)	2.2	(0.3)	(0.7)	0.4
	2	**6.0**	(0.7)	(0.7)	+1.2	+0.8	+1.5	(0.5)	2.8	(0.2)	(0.8)	(0.1)
	3	**6.0**	0.2	(0.0)	+1.9	1.3	+1.9	(0.2)	3.1	0.4	(0.6)	0.7
	4	**6.8**	(0.8)	(1.7)	+1.7	+0.5	+1.0	(1.9)	2.2	(0.3)	(1.5)	-
	5	**6.2**	(0.2)	(1.4)	+0.9	+0.4	(0.4)	(0.4)	1.6	(0.5)	(1.5)	(1.0)
	6	**4.7**	+2.8	(0.2)	+1.6	+0.4	+0.9	+1.8	2.0	1.5	0.5	0.3
P6	1	**8.6**	(1.7)	(2.2)	(0.3)	(1.9)	(0.7)	(3.2)	1.7	(2.2)	(1.4)	(2.5)
	2	**5.4**	+1.1	+0.3	+0.8	(0.0)	(0.2)	+0.6	-	0.6	0.3	(1.0)
	3	**6.1**	+0.4	(0.5)	(0.1)	+0.5	+0.3	(1.0)	(0.1)	0.5	0.5	(0.3)
	4	**5.6**	+0.8	(0.1)	+0.1	+0.1	+0.6	(0.7)	0.2	0.1	(0.2)	(1.0)
	5	**5.0**	+0.1	(0.0)	+0.9	+0.2	(0.0)	(0.4)	(0.3)	(0.1)	0.3	(0.6)
	6	**4.5**	(0.1)	(0.1)	+0.5	+0.2	(0.1)	+0.4	(0.9)	0.7	0.6	0.5
P7	1	**5.0**	+1.6	+0.6	+1.3	+2.2	+0.2	+0.1	1.5	1.1	1.7	(0.8)
	2	**2.8**	+3.2	+3.4	+1.2	+3.7	+1.7	+2.9	2.9	2.4	2.3	1.4
	3	**3.2**	+2.9	+2.8	+0.7	+2.9	+0.8	+2.5	2.6	2.9	1.1	1.4
	4	**4.0**	+2.1	+1.5	+0.8	+1.6	+0.2	+0.9	1.7	1.7	2.4	0.8
	5	**2.0**	+4.2	+2.5	+4.1	+3.9	+2.7	+3.4	3.5	4.0	3.8	3.5
	6	**3.9**	+2.1	+1.4	+2.4	+2.1	+1.1	+0.6	1.8	3.3	2.3	1.7
P8	1	**4.8**	(0.3)	+0.4	+0.1	(1.1)	+0.6	(1.2)	1.8	0.7	0.8	0.3
	2	**5.8**	(0.9)	(0.2)	+0.2	(0.7)	(0.0)	(1.4)	(0.7)	0.7	(1.2)	(0.7)
	3	**5.7**	(0.1)	(0.9)	(0.0)	(0.2)	+0.2	(0.7)	0.1	1.2	(0.6)	0.1
	4	**4.8**	(0.6)	+0.5	+0.3	(0.4)	+0.6	+0.2	0.6	0.2	(1.0)	-
	5	**4.2**	(0.2)	+1.2	+0.1	(0.5)	+0.8	+0.8	0.3	0.7	3.1	0.1
	6	**3.5**	(0.1)	+1.5	+0.8	+0.1	+2.1	+1.6	1.4	1.2	2.6	1.3
P9	1	**8.5**	(0.5)	(2.2)	(2.1)	(1.6)	(0.3)	(1.8)	(0.4)	(1.4)	(0.8)	(2.2)
	2	**6.0**	+1.2	(1.7)	(0.6)	(1.2)	(0.1)	(0.9)	0.6	(0.7)	(0.5)	(2.1)
	3	**4.2**	+1.5	+1.7	+0.5	(0.6)	(0.4)	+0.4	1.3	(0.6)	0.3	0.6
	4	**5.8**	+0.3	+0.2	(0.4)	(1.3)	(1.0)	(0.4)	(0.2)	-	(1.4)	(0.5)
	5	**5.7**	+0.2	(1.4)	(0.2)	(1.2)	(1.3)	+0.2	(0.5)	(0.2)	0.6	(1.1)
	6	**5.8**	+0.4	(1.2)	(0.6)	(0.9)	(1.0)	(1.6)	-	1.8	(0.2)	0.4
P11	1	**5.0**	+1.0	+0.1	+1.3	+1.5	+0.9	+0.3	1.1	-	0.5	(0.5)
	2	**3.9**	+1.5	+0.3	+1.0	+1.5	+1.4	+1.0	1.3	0.9	0.6	0.4
	3	**5.2**	+0.9	(0.0)	+0.2	+0.8	+0.3	+0.1	0.2	-	(0.9)	(0.2)
	4	**5.4**	(0.1)	(0.2)	+0.7	+0.2	+0.2	+0.6	-	(0.6)	(1.2)	(0.6)
	5	**5.1**	+0.3	(0.1)	+0.3	+0.7	+0.1	+0.2	0.3	(0.6)	(0.6)	(1.1)
	6	**5.2**	(0.2)	(0.5)	+0.5	(0.3)	0.0	+0.8	0.1	(0.2)	(1.1)	(1.2)
P12	1	**6.3**	+0.7	(0.1)	+0.8	(0.5)	(0.7)	+0.2	(0.5)	(0.5)	(1.5)	(0.9)
	2	**4.9**	+0.3	(0.2)	(0.1)	+1.2	+0.6	+1.2	0.6	(0.5)	(0.1)	0.2
	3	**4.7**	+0.9	(0.2)	+1.7	(0.4)	-	+1.2	1.8	(0.1)	1.0	(0.1)
	4	**4.9**	(0.2)	+0.1	+0.6	+0.8	+2.0	+0.3	1.9	0.8	1.6	0.9
	5	**6.1**	+0.3	(0.6)	+0.2	(0.1)	(0.3)	(1.0)	(0.2)	(0.6)	-	1.5
	6	**5.4**	+2.0	(0.6)	(0.3)	+1.4	+2.2	+1.4	(1.1)	(1.8)	(1.4)	(5.4)
P13	1	**5.6**	+1.9	+1.6	+1.2	0.0	+0.9	+1.8	2.1	0.8	1.4	-
	2	**5.8**	(1.1)	(0.8)	+0.4	+0.6	+0.2	(0.6)	0.1	(0.3)	-	(0.5)
	3	**6.2**	(0.9)	(0.9)	+0.1	+0.5	+0.9	(0.1)	(0.3)	(0.5)	(1.5)	(0.9)
	4	**7.9**	(1.8)	(1.1)	(2.5)	(0.9)	(0.6)	(0.9)	(1.2)	(1.7)	(1.9)	(2.5)
	5	**5.9**	(0.3)	+0.1	(0.9)	(0.3)	(0.1)	(0.1)	0.6	(1.1)	(1.6)	(1.4)
	6	**4.3**	(2.1)	0.0	(0.3)	(0.6)	+0.3	+0.1	2.5	(0.3)	(0.7)	(1.8)
P14	1	**7.9**	(1.4)	(2.7)	+0.2	+0.9	(0.3)	0.8	0.8	(1.3)	(0.8)	(1.5)
	2	**7.4**	(2.7)	(2.3)	(1.2)	+0.6	(0.7)	(1.3)	-	(2.6)	(1.8)	(2.6)
	3	**6.8**	(0.5)	(1.5)	(0.3)	+0.4	(0.2)	+0.1	0.7	(1.3)	(1.0)	(2.6)
	4	**6.5**	(0.6)	(1.7)	+0.4	+0.1	(0.4)	+0.1	1.1	(2.3)	(1.5)	(2.5)
	5	**5.6**	(0.1)	(0.9)	(0.2)	+0.8	+0.1	(0.2)	1.7	(2.5)	(0.8)	(1.4)
	6	**6.0**	+0.9	(0.4)	(0.0)	(0.5)	+0.2	(0.4)	1.4	(0.5)	0.1	(1.6)
		Proportion of subsites flooded less than initial year	**26 of 54**	**34 of 54**	**17 of 54**	**21 of 51**	**21 of 54**	**24 of 54**	**12 of 51**	**28 of 52**	**30 of 52**	**32 of 51**

Table 4.5-2. Deviation of maximum salinities from initial values from 2001-2006.

Station	Subsite	**Initial Avg. Max Salinities (ppt) (Sum. 2000-Spr.2001)**	Deviation from Initial Fall 2001	Deviation from Initial Spring 2002	Deviation from Initial Fall 2002	Deviation from Initial Spring 2003	Deviation from Initial Fall 2003	Deviation from Initial Spring 2004	Deviation from initial Fall 2004	Deviation from initial Spring 2005	Deviation from initial Fall 2005	Deviation from Initial Spring 2006
P3	1	**8.0**	+11.0	-7.0	+13.0	-8.0	0.0	-7.0	-8.0	-2.0	-5.0	-1.0
	2	**8.7**	+10.3	-8.7	+10.3	-8.7	-5.7	-8.7	-8.7	-3.7	-6.7	-3.7
	3	**9.3**	+9.7	-9.3	ND	-9.3	-2.3	-9.3	-9.3	-4.3	-8.3	-4.3
	4	**6.3**	+10.7	-5.3	-0.3	-6.3	-0.3	-5.3	-6.3	-3.3	-6.3	-4.3
	5	**4.5**	+9.5	-2.5	+7.5	-4.5	+1.5	-4.5	-4.5	-2.5	-4.5	-2.5
	6	**4.0**	+10.0	-3.0	+2.0	-4.0	+2.0	-4.0	-4.0	2.0	-4.0	-2.0
P6	1	**9.7**	+5.3	-4.7	-0.7	-9.7	-0.7	-3.7	-9.7	-6.7	ND	0.3
	2	**9.3**	+2.7	-9.3	+3.7	ND	-1.3	-4.3	-9.3	-7.3	12.7	-0.3
	3	**11.0**	+2.0	-7.0	1.0	ND	-4.0	-8.0	-11.0	-9.0	13.0	-0.2
	4	**9.3**	+1.7	-7.3	-4.3	ND	-3.3	-7.3	-9.3	-6.3	13.7	-2.3
	5	**4.0**	+3.0	-4.0	+2.0	-3.0	-2.0	+1.0	-4.0	-3.0	11.0	1.0
	6	**3.5**	+2.5	-1.5	+3.5	-3.5	-1.5	-3.5	-3.5	-2.5	8.5	-1.5
P7	1	**0.0**	+5.0	0.0	+2.0	ND	0.0	0.0	0.0	0.0	0.0	0.0
	2	**0.0**	+1.0	+3.0	+1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	**0.0**	+1.0	0.0	+1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	**0.0**	0.0	0.0	+2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	5	**0.0**	0.0	0.0	+1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	6	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P8	1	**0.3**		-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
	2	**0.0**	0.0	+2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	5	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	6	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P9	1	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	ND	0.0
	5	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	6	**0.0**	0.0	0.0	0.0	0.0	ND	0.0	0.0	0.0	0.0	0.0
P11	1	**6.7**	+7.3	-3.7	+11.3	-6.7	-0.7	-3.7	7.3	-5.7	11.3	-2.7
	2	**7.7**	+4.3	-4.7	+3.3	-7.7	-1.7	-4.7	7.3	-6.7	8.3	-2.7
	3	**7.7**	+7.3	-2.7	+1.3	-7.7	-2.7	-4.7	-3.3	-5.7	7.3	-2.7
	4	**6.3**	+8.7	-3.3	+6.7	-6.3	-1.3	-3.3	6.7	-4.3	7.7	-1.3
	5	**5.7**	+8.3	-2.7	+12.3	-4.7	-1.7	-3.7	6.3	-4.7	6.3	-3.7
	6	**1.5**	+11.5	+1.5	+16.5	+0.5	+3.5	-0.5	10.5	-0.5	8.5	ND
P12	1	**5.0**	+6.0	-3.0	+7.0	-5.0	-2.0	+6.0	8.0	1.0	0.0	4.0
	2	**4.0**	+6.0	-3.0	+8.0	-3.0	-4.0	+3.0	7.0	0.0	-4.0	2.0
	3	**3.0**	+9.0	-2.0	+8.0	-1.0	-3.0	+2.0	7.0	2.0	-3.0	2.0
	4	**2.3**	+8.7	+0.7	+8.7	-1.3	-2.3	+0.7	6.7	0.3	-2.3	0.7
	5	**0.0**	+10.0	+1.0	+11.0	+1.0	0.0	+3.0	8.0	0.0	0.0	0.0
	6	**0.0**	+2.0	+1.0	+7.0	+2.0	+1.0	0.0	0.0	0.0	0.0	0.0
P13	1	**4.3**	+4.7	-4.3	-2.3	-4.3	-4.3	-4.3	0.7	-3.3	-4.3	-4.3
	2	**2.7**	+8.3	-2.7	-0.7	-2.7	-2.7	-2.7	0.3	-1.7	-2.7	-2.7
	3	**2.3**	+6.7	-2.3	-0.3	-1.3	-2.3	-2.3	1.7	-1.3	-2.3	-2.3
	4	**3.7**	+4.3	-3.7	-1.7	-2.7	-3.7	-3.7	-0.7	-2.7	-3.7	-3.7
	5	**3.0**	+4.0	-3.0	-1.0	-3.0	-3.0	-3.0	-1.0	-2.0	-3.0	-3.0
	6	**1.0**	0.0	-1.0	0.0	-1.0	-1.0	-1.0	0.0	-1.0	ND	-1.0
P14	1	**0.0**	+2.0	0.0	+1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	**0.0**	+2.0	+1.0	+1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	**0.0**	+2.0	0.0	+1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	**0.0**	+2.0	0.0	+1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	5	**0.0**	+2.0	0.0	+1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	6	**0.0**	+1.0	0.0	+1.0	0.0	0.0	0.0	0.0	0.0	ND	0.0
		Proportion of subsites greater than initial max	**38 of 54**	**7 of 54**	**30 of 53**	**3 of 53**	**4 of 53**	**6 of 53**	**0 of 44**	**0 of 54**	**11 of 50**	**6 of 53**

5.0 MARSH SWAMP BIOGEOCHEMISTRY

5.1 Summary

Geochemical data were collected at nine stations along the Cape Fear River Estuary beginning in winter of 2000. Data from the winters of 2000-2005 and the summers of 2000-2004 was presented in the previous annual reports for this project (CZR Incorporated 2001; Hackney et al. 2002a, 2002b, 2003, 2005, 2006). Data presented in the current report includes winter 2006 and summer 2005. The microbial modes of organic matter remineralization of the study sites range from sulfate reducing to methanogenic. Analysis of porewater chloride, sulfate, and methane was performed at six substations per station and at 6 sub-depths per substation. Samples were collected during the winter and summer at eight sites and monthly at P6 (Eagle Island). These data were used to classify the geochemical setting of each substation at each station as methanogenic (M), sulfate reducing (SR), methanogenic with evidence of past sulfate reduction (MPSR), and sulfate reducing with a non-seawater source of sulfate (SRNS). Classifications were compared to the previous data for these sites.

Station P6's (Eagle Island) geochemistry was analyzed monthly and displayed a steady decrease in salinity from June of 2002 until June of 2003. Salinity slightly rebounded during the winters of 2004 and 2005, however, it was still lower than previous years. The previous winter (2005) had almost identical conditions as 2004 with the exception of a salinity peak in November (Hackney et al. 2006). This monthly pattern of salinity variation has been observed in previous years where peaks in salinity were observed during November and May (Hackney et al. 2002a, 2002b, 2003). During the current year, a similar pattern was observed with both fall (September and November) and spring (April) peaks in salinity at the substations closet to the riverbanks. Although salinity pulses were of similar magnitude to the previous year, it appears that the consumption of sulfate was more rapid during the current year resulting in conditions unable to support active sulfate reduction.

5.2 Geochemical Theory and Classification

Porewater sampling of the metabolic products of sulfate reducing and methanogenic bacteria help establish the frequency and duration of organic soil inundation by tidal water carrying ocean-derived salt versus inundation by fresh water. Changes in flooding frequency have a more significant impact if salts from seawater enter the pore space of wetland sediments. In the presence of sufficient seawater sulfate, organic matter is remineralized via sulfate reducing bacteria in anaerobic environments generating hydrogen sulfide. In freshwater environments, organic matter is usually remineralized via methanogens that generate methane as a byproduct. In the presence of high levels of sulfate from seawater, methanogens are replaced by sulfate reducing bacteria and methanogenesis is inhibited. Hydrogen sulfide is toxic and limits both plants and animal species that do not have a behavioral or physiological mechanism to tolerate this bacterial metabolite. Thus, a shift in remineralization pathway can lead to different communities of plants and animals.

Chloride concentrations are a direct measure of salinity as it occurs in a constant proportion in seawater and has no substantial sinks or sources in wetland sediments. Therefore, the term salinity used in the biogeochemistry section of this report will refer to salinity based on measured chloride concentrations.

Chloride and sulfate concentrations are in a constant ratio in seawater (approximately 20:1). Unlike sulfate, which can decrease due to sulfate reduction, there are no common removal mechanisms (biotic or abiotic) for chloride from seawater. Therefore, chloride concentrations can be used as an indicator of the amount of sulfate originally supplied to a site by seawater. Changes in the ratio of chloride to sulfate are an indicator of sulfate reduction. In the presence of sulfate reduction, methanogenic bacteria are out competed and methane production is inhibited. Therefore, low concentrations of methane are another indicator of sulfate reduction. When sulfate concentrations decrease sufficiently, sulfate-reducing bacteria are no longer able to function and methane production dominates. Thus, a sulfate reducing threshold concentration can be identified in sulfate concentration versus depth profiles, where sulfate concentrations no longer decrease with increasing depth and methane concentrations increase. Data from all nine marsh/swamp stations of the present study place the level where the shift occurs at approximately 300 µM sulfate. This corresponds to sulfate being supplied by salinities of approximately 0.4 parts per thousand.

Using this sulfate reducing threshold (300 µM sulfate), stations and substations were classified as sulfate reducing or methanogenic. Methanogenic substations that had a chloride to sulfate ratio significantly greater than seawater (>30:1) were classified as methanogenic sites with evidence of past sulfate reduction. Sulfate reducing sites with ratios less than seawater (5:1) were classified as sulfate reducing with a non-seawater source of sulfate. The four main classifications are: 1) sulfate reducing (SR), 2) methanogenic (M), 3) methanogenic with evidence of past sulfate reduction (MPSR) and sulfate reducing with a non-seawater source of sulfate (SRNS). Changes in these classifications will be used to determine changes in biogeochemical setting associated with river dredging, drought, or other factors.

5.3 Geochemical Methodology

Biogeochemical monitoring was established in close proximity to shallow water well/conductivity/temperature substations. Six substations are distributed along the length of each of nine monitoring belt transects with number one near the river or channel and number 6 adjacent to uplands. Substations are roughly perpendicular to the segment of the stream along which they have been established. Sampling devices, peepers, are constructed of thick acrylic with wells (1-cm deep grooves) located at six different depths that sample 1, 6, 11, 16, 21, and 26 cm below the soil surface. Semipermeable membranes allow methane, sulfate, and chlorine to equilibrate with distilled water in wells. Peepers are inserted into the substrate and left for 1 week, which is ample time for equilibration. Peepers have been shown to be reliable collection devices for these types of dissolved substances (Hesslein 1976). The concentrations of all parameters are determined after removing samples from peeper cells with a syringe equipped with a needle. Sulfate and chloride concentrations are stable under oxic conditions and can be stored in serum vials until analysis. Sulfate and chloride concentrations are determined with an ion chromatograph (Hoehler et al. 1994). Salinity is calculated from the chloride concentrations of the equilibrated peeper chamber water based on the constant ratio of chloride to total dissolved salts in seawater. Samples for porewater methane analysis are prepared by extraction of porewater methane into an inert helium headspace within a gas-tight syringe. The headspace gas is then injected into a gas chromatograph equipped with a flame ionization detector (Kelley et al. 1995) for quantitative determination of methane concentration.

Porewater is collected and analyzed at all 54 substations in all nine transect stations during mid-summer and mid-winter, the coldest and warmest parts of the year. This provides data during periods of maximum and minimum bacterial metabolism. In addition, porewater is collected from the Eagle Island station (P6) every month using the same procedures. This station represents a transition between saline and fresh-dominated stations. In addition, the six substations represent the same transition along a different scale, well-flooded to less flooded.

5.4 Eagle Island (P6) Annual Cycles of Sulfate, Chloride, and Methane

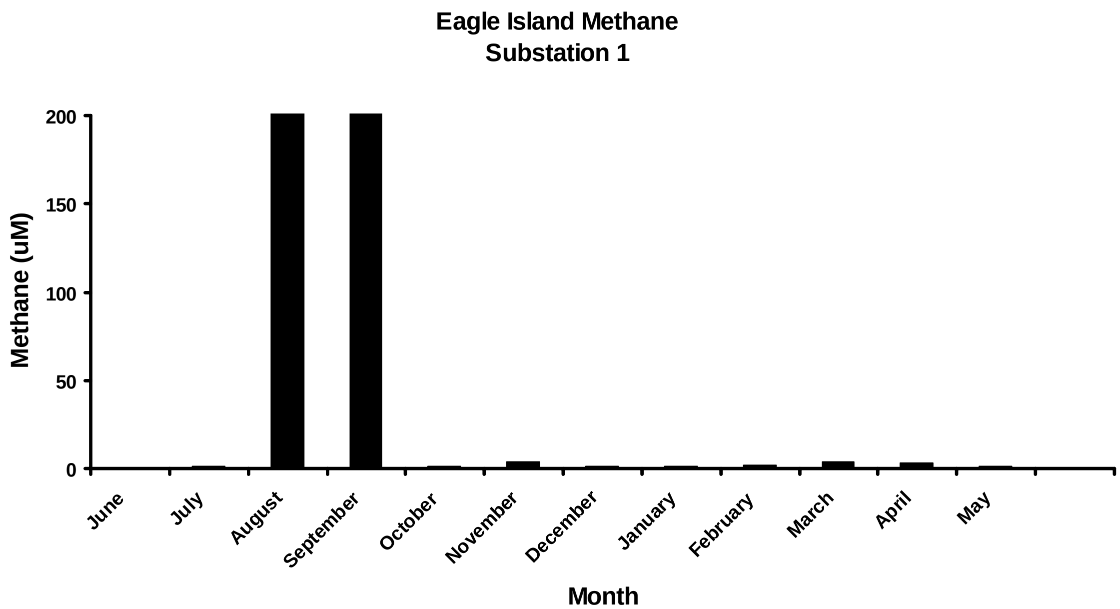
Prior to the spring of 2003, Eagle Island had been classified primarily as SR and MPSR classification because both methanogenesis and sulfate reduction occur at this station (CZR Incorporated 2001; Hackney et al. 2002a; 2002b, 2003). The occurrence of methanogenic geochemical classifications increased during the spring of 2003 and continued through the summer of 2004. Following the pulse of salinity during November 2004, many sites returned to SR classification at the near-shore stations and eventually at all locations by spring 2005 (Hackney et al. 2006). During the current year, both fall (September and November) and spring (April) peaks in salinity were observed at the substations closest to the riverbanks. Although the salinity pulses were of similar magnitude to the previous year, it appears that the consumption of sulfate was more rapid during the current year resulting in conditions unable to support active sulfate reduction. This resulted in a combination of SR and MPSR conditions. Eagle Island's general classifications are based on the following observations: 1) Methane is present at depth in all substations, but is often at very low concentrations at the surface during times of high sulfate input (Figure 5.4-1), 2) Sulfate concentrations range from below the sulfate reducing threshold of 300 µM indicating methane production, to as high as 4000 µM indicating sufficient sulfate to drive sulfate reduction (Figure 5.4-2) and, 3) The ratios of sulfate to chloride range from those found in seawater to ratios indicating a depletion of sulfate due to sulfate reduction (Figure 5.4-3).

Salinity input to Eagle Island varies during the year. Generally the salinity is higher during summer months when the flow rate of the river is lower, however, an input of salt and a corresponding shift in classification was observed during November of 2000, 2001 and 2004 (Figure 5.4-4) and May of 2001 and 2002 (Hackney et al. 2002a, 2002b). These events overshadowed seasonal trends and dominated geochemical conditions during these years (Hackney et al. 2002; 2002a, 2002b). During the winter of 2003 and summer of 2002, the pattern of salinity variations was different (Hackney et al. 2003). Instead of salinity peaks during November and May, the salinity steadily decreased from the summer of 2002 until the spring of 2003. The November pulse of salinity observed during the previous fall (2004) resulted in a shift towards SR classifications leading into the spring of 2005 (Hackney et al. 2006). The salinity variation for the current year is surprisingly different in that the fall and spring pulses of salinity do not appear to affect the biogeochemical setting for an extended period of time due to more rapid consumption of sulfate. The rapid consumption of sulfate during the current year is evidenced by the high ratios of chloride to sulfate observed in the late summer and fall indicating sulfate reduction without replenishment of sulfate from sea salts (Figure 5.4-3).

Salinities at the near-shore station S1 were approximately 10-15 ppt. during the summer of 2002 (Hackney et al. 2003). By November 2002, they had dropped below 0.5 ppt and remained there until the fall of 2003 (Hackney et al. 2005) when there was a slight increase with salinity values approaching 1 ppt. With the exception of low salinity values in February and April, the salinities though the winter of 2004 remained at approximately 1 ppt. At the beginning of the previous report year (June 2004), salinities at S1 were approximately 2 ppt and steadily decreased to approximately 0.1 ppt through October S1 (Hackney et al. 2006). A sharp increase in salinity reaching values greater than 8 ppt was observed in November. Salinities rapidly decreased and varied between approximately 0.1 -2 ppt throughout the rest of the study period. During the current year, salinities were approximately 2 ppt. with the exceptions of the salinity peaks which ranged from about 4 to 9 ppt. Low salinities were observed in June, the winter (December and January) and May. These salinities were less than 0.5 ppt.

At the most inland station S6, the salinities dropped from about 8 ppt. during the summer of 2002 to below 0.5 ppt. by March of 2003 (Hackney et al. 2003). They have remained at approximately 0.1 ppt. through the winter and spring of 2004 and the previous report year (Hackney et al. 2006). Salinities during the current year appear to display the fall and winter peaks in salinity which were approximately 1 ppt. During the rest of the year salinities remained in the 0.5 ppt range (Figure 5.4-4).

Sulfate concentrations at Eagle Island generally paralleled salinity trends (Figure 5.4-2), but were not as high as the previous year due to rapid consumption. Sulfate concentrations at S1 during previous fall peak approached the 8,000 – 10,000 uM values (Hackney et al. 2006) seen during the summer of 2002 prior to the drop in salinity (Hackney et al. 2003). During the current year peaks in sulfate were approximately 4000 uM. Sulfate values at S6 remained low throughout the previous study period staying close to sulfate reducing threshold values (Hackney et al. 2006). During the current year concentrations exceeded threshold concentrations most of the year at this upland site and were as high as 1700 uM during the spring peak (Figure 5.4-2).



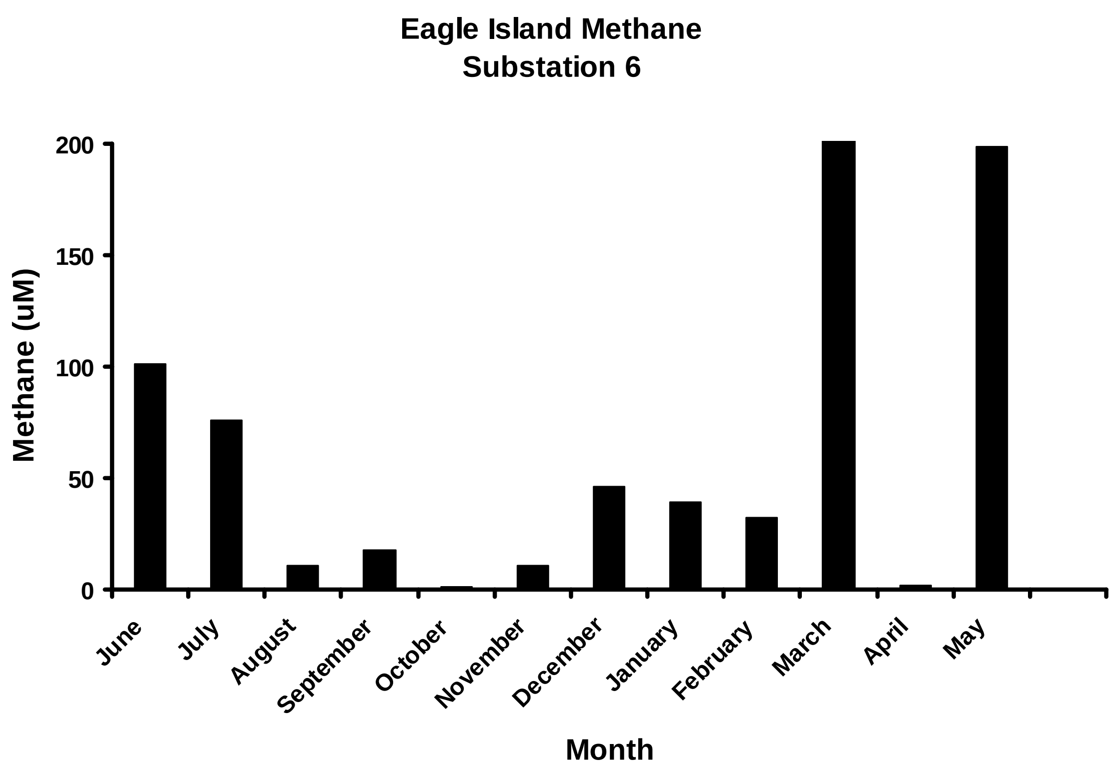
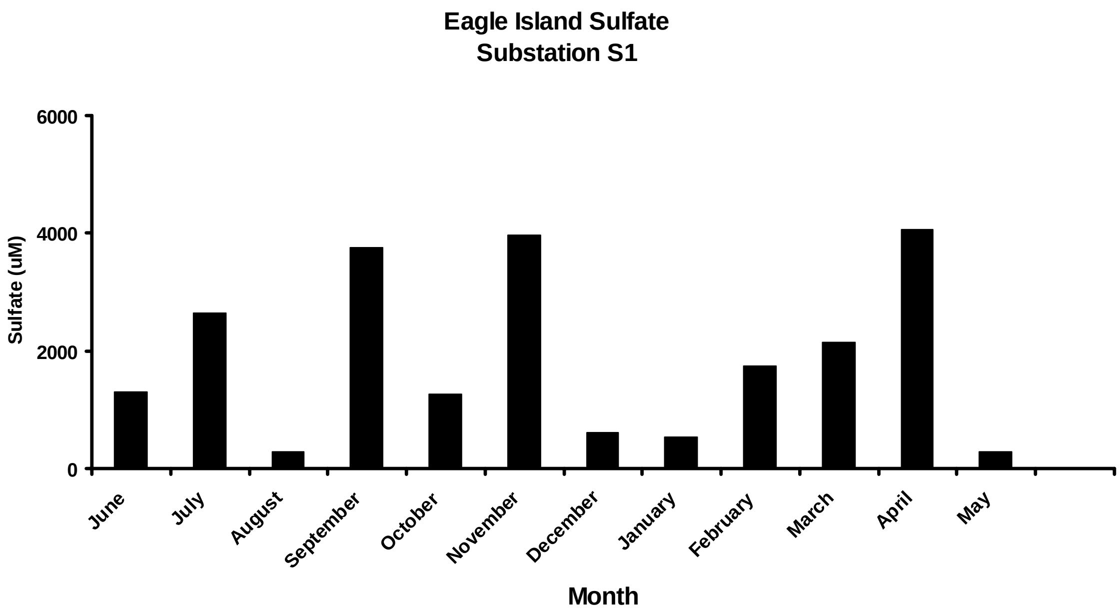


Figure 5.4-1. Methane concentrations of Eagle Island porewaters vs. month. Top shows nearshore site (S1) and bottom shows most upland site (S6).



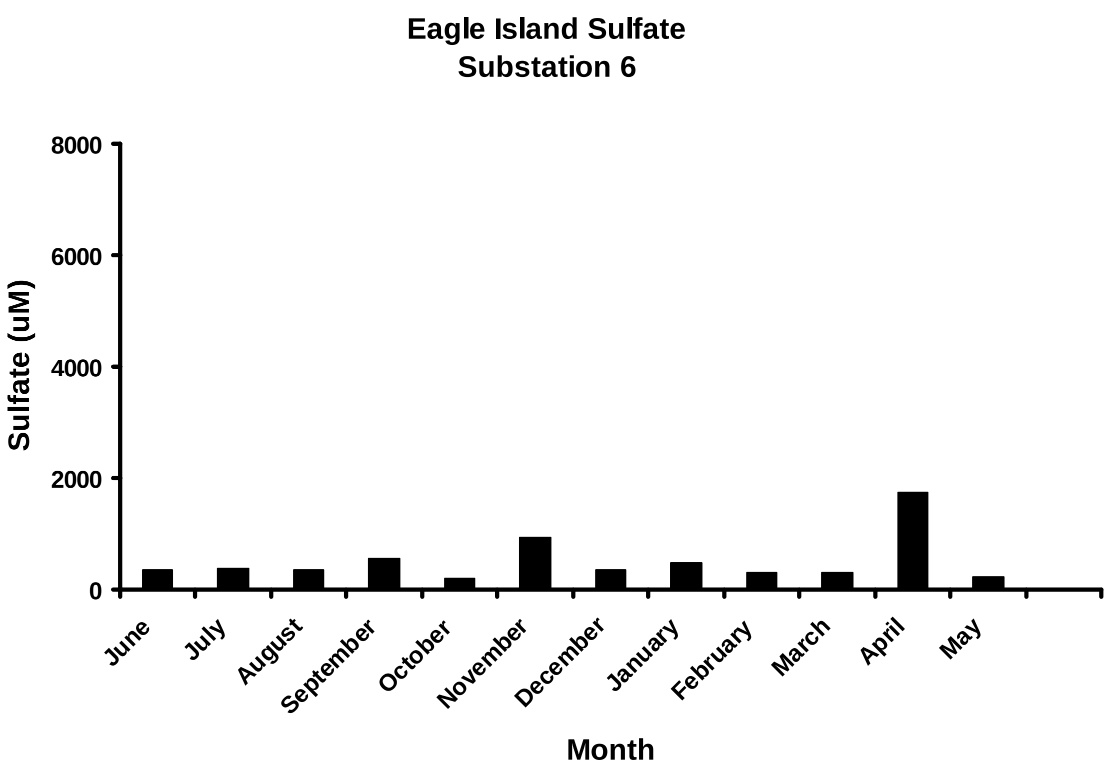
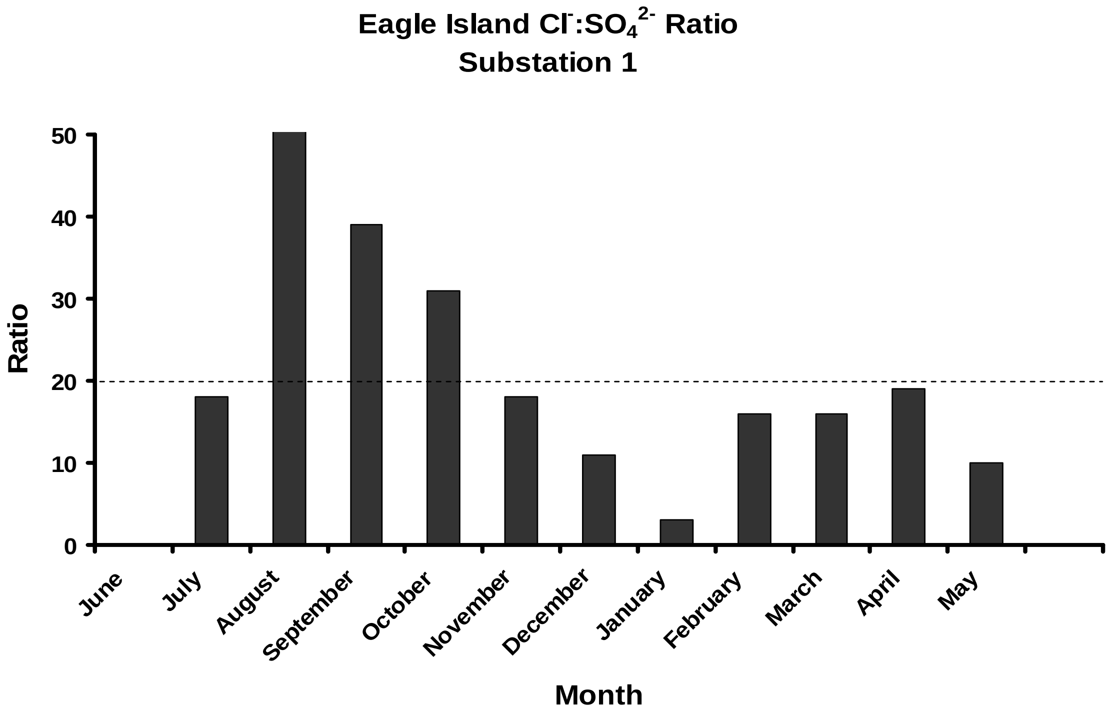


Figure 5.4-2. Sulfate concentrations of Eagle Island porewaters vs. month. Top shows nearshore site (S1) and bottom shows most upland site (S6).



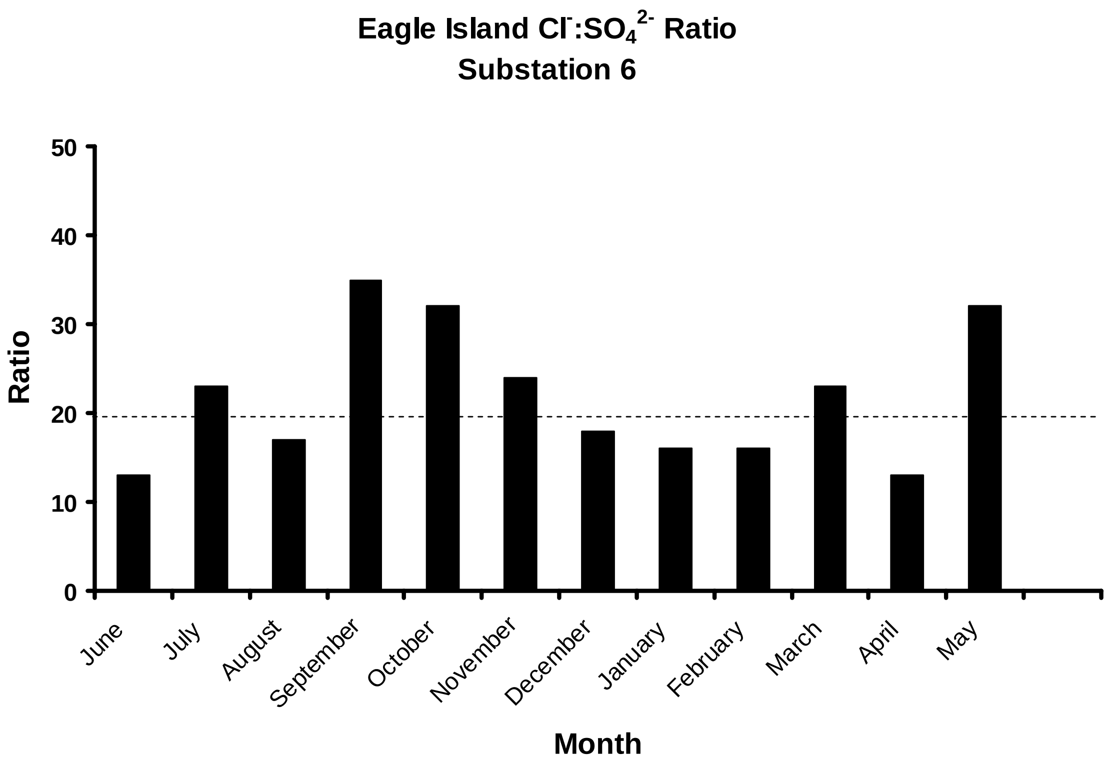
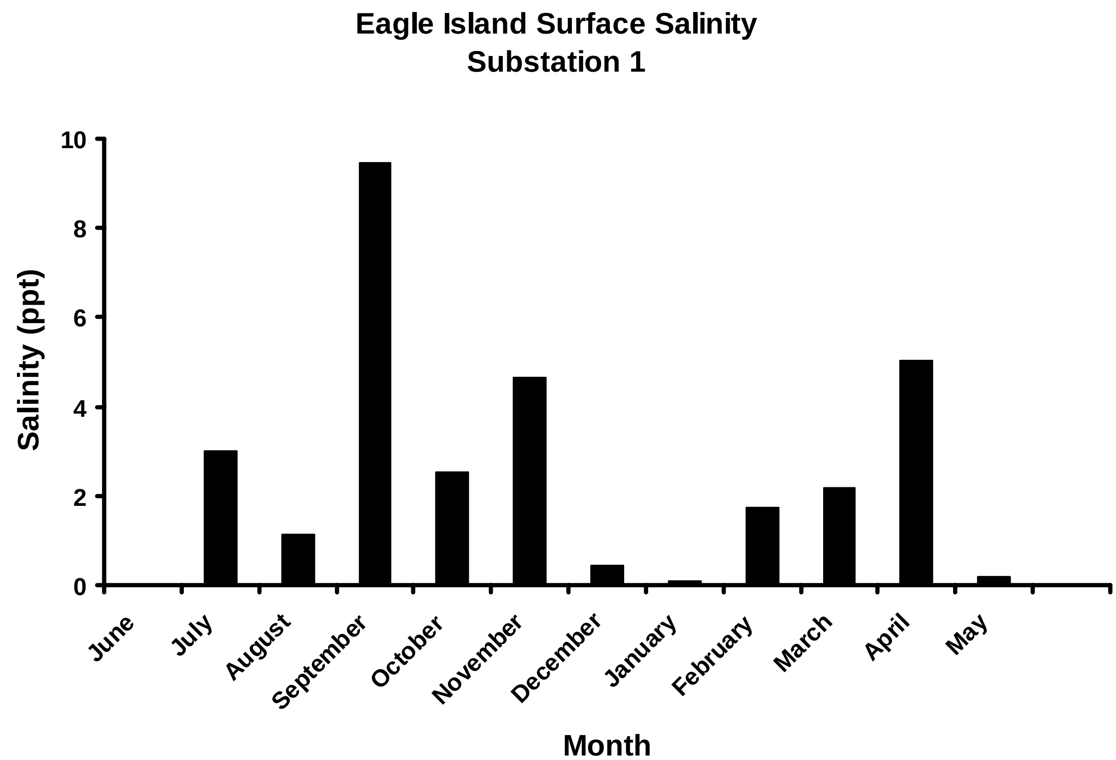


Figure 5.4-3. Chloride to sulfate ratios of Eagle Island porewaters vs. month. Dashed line shows ratio for seawater. Top shows nearshore site (S1) and bottom shows most upland site (S6).



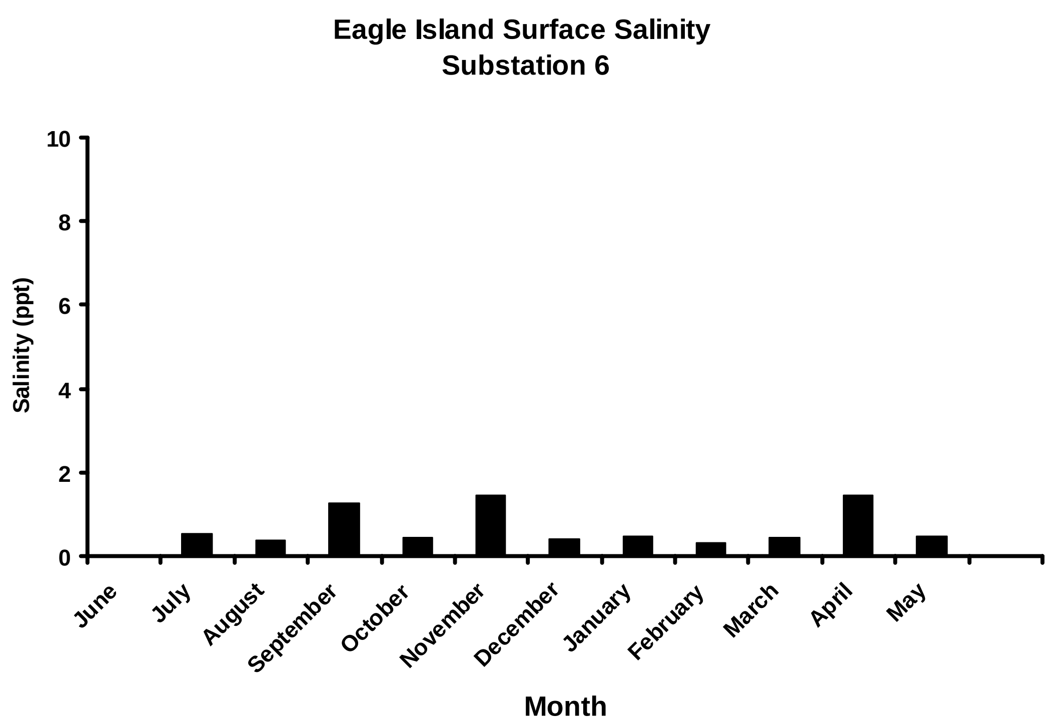


Figure 5.4-4. Salinities of Eagle Island porewaters vs. month. Top shows nearshore site (S1) and bottom shows most upland site (S6).

Prior to the decrease in salinity that began during the fall of 2002, the majority of classifications were SR and MPSR (CZR Incorporated 2001; Hackney et al. 2002a, 2002b, 2003). During the following year (Hackney et al. 2005), the majority of sites were methanogenic due to continued fresh conditions with only a few sub-stations having SR classifications primarily resulting from the slight rebound in salt input which began during the winter of 2004. Geochemical classifications of Eagle Island during the previous report period (Hackney et al. 2006) show the expected trend for a system experiencing an input of salinity during November. Starting with near-shore stations, classifications shifted to SR. By May 2005, all locations had been converted to SR classifications (Hackney et al. 2006). During the current year, Eagle Island classifications were mainly SR and MPSR with a few M classifications (Table 5.4-1). This is similar to the classifications at the onset of the monitoring project. The increase in MPSR classifications this year compared to the previous year likely reflect the high rates of sulfate consumption as described above since it appears that salinity input was similar. This may have been due to higher temperatures or more bioavailable organic matter in this wetland.

The chloride to sulfate ratios ($Cl^{-}:SO_4^{2-}$) reflect the consumption of sulfate observed during the current year (Figure 5.4-3). Generally the ratios were either very close to seawater values, indicating recent supply of sulfate, or elevated above seawater values indicating consumption of sulfate. This was particularly evident during the fall of the current year supporting the idea that resupply was unable to keep pace with consumption of sulfate.

Methane concentrations at Eagle Island were generally lower at the creek bank locations compared to subsites closer to uplands (Figure 5.4-1). Higher salinities at creek bank locations result in inhibition of methanogenesis at these sites, while fresher conditions near uplands are conducive to methanogenesis. Peaks in methane concentrations were observed during the fall at the creek bank location and during the spring at the upland location coinciding with high chloride to sulfate ratios indicating high rates of sulfate consumption likely lowering the amount of sulfate present below threshold concentrations allowing for methanogenesis.

Table 5.4-1. Eagle Island (P6) Geochemical Classifications by month. Site classifications are as follows: Methanogenic I, Sulfate Reducing II, Methanogenic with evidence of past sulfate reduction I*, Sulfate reducing non-seawater source of sulfate II*.

Sites	June 04	July	August	September	October	November	December	January	February	March	April	May
S1-1	II*	II	I	II	II	II	II	II*	II	II	II	I
S1-2	II	II	I	II	I	II	II	II*	II	II	II	I
S1-3	II	II	I	II	I*	II	II	II*	II	II	II	II
S1-4	I*	II	I	II	I*	II	II	II*	II	II	II	II
S1-5	I*	I*	I*	II	I*	I	II	II	II	II	II	II
S1-6	I*	II	I*	II	I	I	I	II	II	II	II	II
S2-1	II	II	II	II	I*	II	I*	II	II*	II	II	II
S2-2	II	II	II	II	I*	II	II	II	II	II	II	I
S2-3	II	II	II	I*	I*	I	I*	II	II	II	II	II
S2-4	I*	II	I*	I*	I*	I	I	I*	II	I	II	II
S2-5	I*	II	I*	I*	I*	I	I	II	I	I	II	II
S2-6	II	I*	I*	I*	I*	I	I	I*	I	I	II	II
S3-1	II	II	II	II	I*	II	II	II	II	II	II	II
S3-2	II	II	I*	II	II	II	II	II	II	II	II	II
S3-3	II	II	II	II	II	II	II	II	II	II	II	II
S3-4	II	II	II	II	II	II	II	II	II	I	II	II
S3-5	I*	II	I	II	II	II	II	II	I	II	II	II
S3-6	I*	II	I	II	II	II	II	II	I	I	I	I
S4-1	II	II	I	II	I*	II	I*	II	I*	II	II	I
S4-2	I*	I*	I	II	I*	II	I*	II	I*	I	I	I
S4-3	I*	I*	I*	II	I*	II	I*	II	I*	I	I	I
S4-4	I*	I*	I*	II	I*	I*	I*	I	I*	I	I	II
S4-5	I*	I*	I*	II	I*	I*	I*	I*	I*	I	I	I
S4-6	I*	I*	I*	I*	I*	I*	I*	I*	I*	I	I	I
S5-1	I	II	I	II	I*	II	I*	II	II	II	II	I
S5-2	I	II	I	II	I*	I*	I*	II	I*	I	I*	I
S5-3	I*	II	I*	II	I*	I*	I*	II	I*	I	I	I
S5-4	II	I*	I*	I*	I*	I*	I*	I*	I*	II	I	I
S5-5	I*	I*	I*	I*	I*	I*	I*	II	I*	II	I	I
S5-6	I*	I*	I*	I	I*	I*	I*	II	I*	I	I	II
S6-1	II	II	II	II	I*	II	II	II	II	I	II	I
S6-2	I	I*	I*	I*	I*	II	I*	II	I*	I	II	I
S6-3	I	I*	I*	II	II	II	I*	II	I*	I	II	II
S6-4	I	I*	I*	I*	II	II	I*	II	I*	I	II	I
S6-5	I	I*	I*	I*	II	I*	I*	II	I*	I	I	I*
S6-6	I	I	I*	I*	II	I*	I*	II	I*	I	I	II

5.5 Marsh/Swamp Transect Stations Geochemistry, Annual Variability

The following section compares the geochemistry of substations from the previous years 2000-2001 (Hackney et al. 2002a), 2001-2002 (Hackney et al. 2002b), 2002-2003 (Hackney et al. 2003), 2003-2004 (Hackney et al. 2005) and 2004-2005 (Hackney et al. 2006) to the current year. The current report includes the winter of 2006 and the summer of 2005.

5.51 Town Creek (P3)

Town Creek is the most downstream station monitored for geochemistry. The average winter porewater salinities increased steadily throughout the first four years of this study [winter 2000 = 0.8 $\pm$ 0.4 ppt; winter 2001 = 1.4 $\pm$ 0.8 ppt (Hackney et al. 2002a); winter 2002 = 3.8 ppt $\pm$ 1.9 (Hackney et al. 2002b); winter 2003 = 7.2 $\pm$ 4.9 ppt. (Hackney et al. 2003)]. Porewater salinities during the winter of 2003 were as high as 17 ppt, roughly twice the highest winter salinities ever observed. (Hackney et al. 2003). During the winters of 2004 and 2005, there was a dramatic shift towards lower salinity conditions (Hackney et al. 2005; Hackney et al. 2006). Salinities ranged from approximately 0.5 ppt to 3.0 ppt, whereas during the previous winter of 2003 the majority of the salinities were greater than 3 ppt (Hackney et al. 2003). Salinities during the current winter (2006) are in the same range (0.5 -3 ppt) as the previous two fresher winters. In the first 4 winters, the majority of geochemical classifications were SR (Hackney et al. 2002a, 2002b, 2003). During the winter of 2004, geochemical classifications reflected the lower salinities with the majority of substations having MPSR conditions indicating a lack of re-supply of sulfate to the porewaters after depletion. Salinities were slightly higher during the winter of 2005 compared to 2004, but were still relatively low (1-3 ppt, Hackney et al. 2006). The slightly higher salinities resulted in some 2004 winter MPSR classifications being converted to SR. During the current winter of 2006, all but one classification was MPSR (Table 5.51-3), indicating fresher conditions or more rapid consumption of sulfate compared to last year. Salinities during the current year ranged from approximately 0.5-2 ppt. compared to 2-5 ppt. during the previous winter.

The average summer salinities showed no obvious changes over the first 3 years of summer data [(summer 2000 = 4.3 $\pm$ 1.7 (Hackney et al. 2002a); summer 2001 = 3.4 $\pm$ 0.8 (Hackney et al. 2002b); summer 2002 = 4.8 $\pm$ 2.2 (Hackney et al. 2003)]. Average porewater salinities are always higher during the summer compared to the winters reflecting the general trend towards higher freshwater river flow in winter. Salinities during the summer of 2003 ranged from approximately 0.4 ppt to 3.0 ppt (Hackney et al. 2005) in contrast to the previous summer 2002, where the majority of salinities were greater than 3.0 ppt (Hackney et al. 2003). Summer 2003 classifications reflected the fresher conditions with the majority of sites having MPSR conditions for the first time (Hackney et al. 2005) (Table 5.51-2). During the summer of 2004, salinities were slightly higher ranging from 2-5 ppt (Hackney et al. 2006) resulting in some MPSR classifications being converted to SR. During the current year this trend has continued with several more MPSR classifications being converted to SR indicating slightly higher sulfate concentrations (Table 5.51-1.).

Methane concentrations were lower during the current summer (2005) (Table 5.51-4) and previous summer (2004) (Hackney et al. 2006) compared to the summer (2003) reflecting a continued increase in salinity since the summer of 2003 and increased inhibition of methanogenesis. During the current winter (2006) methane concentrations were slightly elevated (Table 5.51-4) compared to the previous winter (Hackney et al. 2006) reflecting the slightly fresher conditions described above.

Table 5.51-1. Salinity of Sites. Salinity in parts per thousand calculated from chloride concentrations in porewaters. A --- indicates no data.

Station	Substation	Depth (cm)	Salinity	
			Summer 2005	Winter 2006
Town Creek P3	1	1	0.70	0.93
	1	6	1.77	1.38
	1	11	1.88	1.47
	1	16	1.97	2.34
	1	21	1.90	2.55
	1	26	2.07	1.85
	2	1	1.78	0.98
	2	6	0.35	1.21
	2	11	2.98	2.22
	2	16	2.90	2.05
	2	21	3.07	2.45
	2	26	3.26	2.98
	3	1	0.17	0.92
	3	6	0.31	0.91
	3	11	1.05	1.03
	3	16	1.84	1.66
	3	21	2.22	2.69
	3	26	2.59	4.14
	4	1	0.27	0.72
	4	6	0.38	1.12
	4	11	0.48	1.35
	4	16	0.61	1.54
	4	21	0.69	2.24
	4	26	0.91	2.03
	5	1	0.20	0.37
	5	6	0.59	0.31
	5	11	0.81	0.27
	5	16	0.86	0.29
	5	21	0.86	0.42
	5	26	0.87	0.54

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2005	Winter 2006
Town Creek	6	1	0.09	0.33
(continued)	6	6	0.44	0.49
	6	11	0.75	0.55
	6	16	2.02	0.84
	6	21	1.29	1.08
	6	26	1.69	2.17
Eagle Island	1	1	3.00	0.11
P6	1	6	3.03	0.14
	1	11	3.20	0.13
	1	16	3.36	0.18
	1	21	3.01	0.21
	1	26	2.26	0.29
	2	1	2.95	1.33
	2	6	2.92	1.79
	2	11	2.64	2.14
	2	16	2.47	2.25
	2	21	2.19	2.11
	2	26	2.02	2.33
	3	1	1.80	0.51
	3	6	1.99	0.67
	3	11	2.03	0.95
	3	16	2.01	0.67
	3	21	1.91	0.91
	3	26	2.22	0.85
	4	1	1.73	1.11
	4	6	1.84	1.51
	4	11	1.47	1.00
	4	16	1.84	1.63
	4	21	1.81	1.68
	4	26	1.71	1.66
	5	1	1.03	0.56
	5	6	1.03	0.71
	5	11	1.20	0.84
	5	16	1.15	0.90
	5	21	0.88	1.01
	5	26	0.84	1.08
	6	1	0.54	0.49
	6	6	0.94	0.60
	6	11	0.92	0.57
	6	16	0.87	0.61
	6	21	0.47	0.49
	6	26	0.53	0.60
Indian Creek	1	1	0.15	0.08
P7	1	6	0.20	0.09

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2005	Winter 2006
Indian Creek (continued)	1	11	0.26	0.13
	1	16	0.41	0.16
	1	21	0.21	0.18
	1	26	0.19	0.32
	2	1	0.08	0.06
	2	6	0.10	0.06
	2	11	0.13	0.06
	2	16	0.13	0.07
	2	21	0.13	0.08
	2	26	0.11	0.10
	3	1	0.08	0.04
	3	6	0.08	0.04
	3	11	0.08	0.04
	3	16	0.08	0.04
	3	21	0.08	0.04
	3	26	0.09	0.05
	4	1	0.08	0.06
	4	6	0.07	0.04
	4	11	0.07	0.05
	4	16	0.07	0.05
	4	21	0.09	0.05
	4	26	0.08	#DIV/0!
	5	1	0.04	0.00
	5	6	0.05	0.02
	5	11	0.07	0.02
	5	16	0.04	0.02
	5	21	0.05	0.02
	5	26	0.05	0.03
	6	1	0.03	0.02
	6	6	0.02	0.02
	6	11	0.03	0.02
	6	16	0.02	0.02
	6	21	0.02	0.02
	6	26	0.01	0.02
Dollisons Landing P8	1	1	0.01	0.04
	1	6	0.05	0.04
	1	11	0.05	0.04
	1	16	0.03	0.04
	1	21	0.04	0.04
	1	26	0.04	0.05
	2	1	0.02	0.04
	2	6	0.04	0.04
	2	11	0.03	0.04
	2	16	0.04	0.03

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2005	Winter 2006
Dollisons Landing (continued)	2	21	0.05	0.04
	2	26	0.04	0.04
	3	1	0.05	0.05
	3	6	0.05	0.04
	3	11	0.06	0.04
	3	16	0.06	0.05
	3	21	0.07	0.03
	3	26	0.08	0.04
	4	1	0.05	0.04
	4	6	0.04	0.04
	4	11	0.04	0.04
	4	16	0.05	0.03
	4	21	0.04	0.03
	4	26	0.04	0.04
	5	1	0.07	0.14
	5	6	0.09	0.11
	5	11	0.10	0.14
	5	16	0.09	0.14
	5	21	0.11	0.14
	5	26	0.10	0.14
	6	1	0.17	0.13
	6	6	0.17	0.12
	6	11	0.31	0.12
	6	16	0.15	0.23
	6	21	0.16	0.10
	6	26	0.18	0.07
Black River P9	1	1	0.05	0.06
	1	6	0.04	0.05
	1	11	0.05	0.04
	1	16	0.06	0.04
	1	21	0.05	0.05
	1	26	0.05	0.05
	2	1	0.05	0.03
	2	6	0.04	0.04
	2	11	0.05	0.04
	2	16	0.04	0.04
	2	21	0.04	0.04
	2	26	0.05	0.03
	3	1	0.05	0.04
	3	6	0.04	0.03
	3	11	0.06	0.03
	3	16	0.09	0.03
	3	21	0.05	0.03
	3	26	0.04	0.03

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2005	Winter 2006
Black River (continued)	4	1	0.04	0.04
	4	6	0.04	0.03
	4	11	0.03	0.03
	4	16	0.04	0.04
	4	21	0.03	0.03
	4	26	0.06	0.03
	5	1	0.04	0.03
	5	6	0.04	0.03
	5	11	0.04	0.03
	5	16	0.03	0.03
	5	21	0.05	0.03
	5	26	0.04	0.05
	6	1	0.05	0.03
	6	6	0.05	0.03
	6	11	0.08	0.03
	6	16	0.08	0.03
	6	21	0.07	0.03
	6	26	0.06	0.03
Smith Creek P11	1	1	5.76	1.97
	1	6	6.45	2.55
	1	11	5.17	3.04
	1	16	4.55	3.34
	1	21	4.26	3.74
	1	26	4.37	4.28
	2	1	5.03	1.55
	2	6	6.16	1.61
	2	11	6.00	1.98
	2	16	5.85	3.80
	2	21	5.64	3.39
	2	26	5.29	4.30
	3	1	5.36	19.23
	3	6	6.01	2.62
	3	11	6.04	2.68
	3	16	6.20	4.24
	3	21	5.34	3.74
	3	26	5.06	4.22
	4	1	4.73	1.88
	4	6	5.16	2.02
	4	11	4.55	2.75
	4	16	4.43	3.44
	4	21	4.00	4.19
	4	26	4.27	3.68
	5	1	4.32	2.06
	5	6	4.62	2.75

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2005	Winter 2006
Smith Creek (continued)	5	11	4.69	2.94
	5	16	4.37	2.18
	5	21	4.45	3.52
	5	26	4.15	2.83
	6	1	3.91	0.76
	6	6	3.87	0.87
	6	11	3.83	0.83
	6	16	3.56	0.82
	6	21	3.91	0.99
	6	26	3.87	1.28
Rat Island P12	1	1	1.14	0.33
	1	6	2.25	0.37
	1	11	1.13	0.51
	1	16	1.15	0.56
	1	21	1.09	0.72
	1	26	1.14	0.00
	2	1	1.57	0.12
	2	6	1.25	0.19
	2	11	1.29	0.24
	2	16	1.14	0.41
	2	21	0.93	0.67
	2	26	0.78	0.94
	3	1	1.26	1.08
	3	6	0.90	1.07
	3	11	1.01	1.14
	3	16	0.96	1.08
	3	21	0.91	1.13
	3	26	0.87	1.14
	4	1	0.63	0.26
	4	6	0.73	0.29
	4	11	0.87	0.45
	4	16	0.98	0.45
	4	21	0.87	0.46
	4	26	0.81	0.49
	5	1	0.32	0.14
	5	6	0.29	0.16
	5	11	0.34	0.19
	5	16	0.40	0.19
	5	21	0.51	0.18
	5	26	0.53	0.20
	6	1	0.09	0.09
	6	6	0.07	0.06
	6	11	0.08	0.07
	6	16	0.05	0.06

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2005	Winter 2006
Rat Island (continued)	6	21	0.04	0.08
	6	26	0.10	0.09
Fishing Creek P13	1	1	0.07	0.00
	1	6	0.09	0.05
	1	11	0.10	0.03
	1	16	0.17	0.04
	1	21	0.20	0.04
	1	26	0.21	0.05
	2	1	0.07	0.08
	2	6	0.06	0.07
	2	11	0.07	0.06
	2	16	0.06	0.06
	2	21	0.07	0.10
	2	26	0.07	0.10
	3	1	0.13	0.17
	3	6	0.14	0.15
	3	11	0.14	0.19
	3	16	0.16	0.25
	3	21	0.16	0.19
	3	26	0.19	0.20
	4	1	0.07	0.05
	4	6	0.06	0.05
	4	11	0.07	0.04
	4	16	0.07	0.05
	4	21	0.07	0.05
	4	26	0.07	0.05
	5	1	0.05	0.04
	5	6	0.05	0.03
	5	11	0.06	0.04
	5	16	0.05	0.03
	5	21	0.05	0.03
	5	26	0.06	0.03
	6	1	0.02	0.02
	6	6	0.02	0.02
	6	11	0.01	0.02
	6	16	0.02	0.02
	6	21	0.02	0.01
	6	26	0.02	0.02
Prince George P14	1	1	0.04	0.07
	1	6	0.04	0.07
	1	11	0.03	0.07
	1	16	0.04	0.07
	1	21	0.05	0.06
	1	26	0.06	0.10

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2005	Winter 2006
Prince George (continued)	2	1	0.05	0.13
	2	6	0.06	0.08
	2	11	0.06	0.08
	2	16	0.05	0.08
	2	21	0.06	0.08
	2	26	0.07	0.10
	3	1	0.04	0.07
	3	6	0.04	0.07
	3	11	0.05	0.08
	3	16	0.05	0.07
	3	21	0.05	0.07
	3	26	0.05	0.07
	4	1	0.05	0.08
	4	6	0.05	0.08
	4	11	0.06	0.07
	4	16	0.05	0.09
	4	21	0.05	0.07
	4	26	0.05	0.07
	5	1	0.05	0.07
	5	6	0.05	0.06
	5	11	0.05	0.07
	5	16	0.05	0.06
	5	21	0.04	0.06
	5	26	0.05	0.07
	6	1	0.04	0.07
	6	6	0.04	0.06
	6	11	0.04	0.06
	6	16	0.04	0.05
	6	21	0.04	0.06
	6	26	0.03	0.05

Table 5.51-2. Classification of Sites Summer. Site classifications are as follows: Methanogenic I, Sulfate Reducing II, Methanogenic with evidence of past sulfate reduction I*, Sulfate reducing non-seawater source of sulfate II*.

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002	Summer 2003	Summer 2004	Summer 2005
Town Creek	1	1	II	II	II	I*	II	II*
P3	1	6	II	II	II	I*	I*	II*
	1	11	II	II	II	I*	I*	II*
	1	16	II	II	II	I*	I*	II
	1	21	II	II	II	I*	I*	II
	1	26	I*	II	II	I*	I*	II
	2	1	II	II	II	II	II	II
	2	6	II	II	II	II	I	II*
	2	11	II	II	I*	II	I	II
	2	16	II	II	I*	II	I	II
	2	21	II	II	I*	I*	I*	II
	2	26	II	II	I*	II	I	II
	3	1	II	II	II	I*	II	II*
	3	6	II	II	II	I*	II	II*
	3	11	II	II	II	I*	II	II
	3	16	II	II	II	I*	I*	II
	3	21	II	II	II	I*	I*	II
	3	26	II	II	II	I*	I*	II
	4	1	II	II	II	I	II	I*
	4	6	II	II	II	I*	II	II*
	4	11	II	II	II	I*	II	II
	4	16	II	II	II	I*	II	II
	4	21	II	II	II	I*	II	II
	4	26	II	II	II	I*	II	II
	5	1	II	II	I*	I*	I*	I
	5	6	II	II	II	I*	I*	I*
	5	11	II	II	II	I	I*	I*
	5	16	II	II	II	I*	I*	I*
	5	21	II	II	II	I*	I*	I*
	5	26	II	II	II	I*	I*	I*
	6	1	II	II	II	I	II	II*
	6	6	II	II	II	I*	I*	II
	6	11	II	II	II	I*	I*	II
	6	16	II	II	II	I*	I*	II
	6	21	II	II	II	I*	I*	II
	6	26	I*	II	II	I*	I*	II
Eagle Island	1	1	II	II	II	I	II	II
P6	1	6	II	II	II	ns	II	II
	1	11	II	II	II	ns	I*	II
	1	16	II	II	II	I*	I*	II

Table 5.51-2. continued

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002	Summer 2003	Summer 2004	Summer 2005
Rat Island	1	21	II	II	II	I*	I*	I*
(continued)	1	26	II	II	I*	I*	I*	II
	2	1	II	II	II	I	I*	II
	2	6	II	II	II	I	I*	II
	2	11	II	II	II	I	I*	II
	2	16	II	I*	II	I	I*	II
	2	21	II	I*	II	I*	I*	II
	2	26	II	I*	I*	I*	I*	I*
	3	1	I*	II	II	I*	II	II
	3	6	I*	I*	II	I*	I*	II
	3	11	I*	I*	II	I*	I*	II
	3	16	I*	I*	II	I*	I*	II
	3	21	I*	I*	II	I*	I*	II
	3	26	I*	I*	II	I*	I*	II
	4	1	II	II	I*	I*	I*	II
	4	6	II	I*	I*	I*	I*	I*
	4	11	II	I*	I*	I*	I*	I*
	4	16	II	I*	I*	I*	I*	I*
	4	21	II	I*	I*	I*	I*	I*
	4	26	I*	I*	I*	I*	I*	I*
	5	1	II	I*	II	I*	I	II
	5	6	I*	I*	II	I*	I*	II
	5	11	II	I*	I*	I*	I*	II
	5	16	I*	I*	I*	I*	I*	I*
	5	21	I*	I*	I*	I*	I*	I*
	5	26	I*	I*	I*	I*	I*	I*
	6	1	II	I*	II	I	I	II
	6	6	I*	I*	II	I	I	I*
	6	11	---	I*	II	I	I*	I*
	6	16	II	I*	II	I*	I	I*
	6	21	I*	I*	II	I*	I	I*
	6	26	I*	I*	I*	I*	II	I
Indian Creek	1	1	II	II	II	I	II	II
P7	1	6	II	II	II	I*	I	II
	1	11	II	II	II	I*	I	I
	1	16	II	II	II	I*	I*	I*
	1	21	II	II	II	I*	I*	I*
	1	26	I	I*	II	I*	I*	I*
	2	1	I	II	II	I	I	I
	2	6	I	I	II	I*	I	I
	2	11	I	I	II	I	I*	I
	2	16	I	I*	II	I*	I*	I*
	2	21	I	I*	II	I*	I*	I
	2	26	I	I	II	I*	I*	I

Table 5.51-2. continued

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002	Summer 2003	Summer 2004	Summer 2005
Indian Creek	3	1	II	II	I*	I	I	I
(continued)	3	6	II	I	I*	I	I	I
	3	11	I	I*	I*	I	I	II*
	3	16	I	I	I*	I	I*	I
	3	21	II	I	I*	I	I*	I
	3	26	I	II	I*	I*	I*	I
	4	1	I	I	II	I	I	I
	4	6	II	I	II	I	I*	I
	4	11	II	I	II	I	I	I
	4	16	I	I	II	I	I*	I
	4	21	I	I	II	I	I*	I
	4	26	I	I	II	I	I*	I
	5	1	II	I	I*	I	I	I
	5	6	I	I	I*	I	I	I
	5	11	II	I	I*	I	I	I
	5	16	II	---	I*	I	I	I
	5	21	I	I*	I*	I	I	I
	5	26	I	I	I*	I	I	I
	6	1	II	---	I	I	I	I
	6	6	I	---	I	I	I	I
	6	11	I	I	I	I	I	I
	6	16	I	I	I	I	I	I
	6	21	I	---	I	I	I	I
	6	26	II	I	I	I	I	I
Dollisons	1	1	I		II	I	I	I
Landing P8	1	6	II*	II	II	I	I	I
	1	11	II*	II	I	I	I	I
	1	16	II*	II	I	I	I	I
	1	21	II	I	II	I	I*	I
	1	26	II	I	I	I	I*	I
	2	1	II*	II	I	I	I	I
	2	6	II	I	I*	I	I	I
	2	11	I	II	I*	I*	I	I
	2	16	I	I*	I*	I*	I	I
	2	21	I	II	I*	I*	I	I
	2	26	I	I	I*	I*	I	I
	3	1	II	I	I	I	I	I
	3	6	I		I*	I	I	I
	3	11	I	I	I*	I*	I	I
	3	16	I	I	I*	I	I*	I*
	3	21	I	I	I*	I*	I	I*
	3	26	I	II	I*	I	I	I*
	4	1	I	I	II*	I	I	I
	4	6	I	I	I	I	I	I

Table 5.51-2. continued

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002	Summer 2003	Summer 2004	Summer 2005
Dollisons Landing (continued)	4	11	I	II	I*	I	I*	I
	4	16	I	I	ns	I	I	I
	4	21	I	II	I*	I	I	I
	4	26	I	II	I*	I*	I	I
	5	1	I	I	I	I	I	I
	5	6	I	I	I	I	I*	I
	5	11	I	I	I*	I	I*	I
	5	16	I	I*	I*	I	I*	I*
	5	21	I	II	I*	I	I*	I*
	5	26	I	II	I*	I	I*	I*
	6	1	I	I	I	I	I*	I*
	6	6	I	I*	I	I	I*	I*
	6	11	I	I*	I*	I	I*	I*
	6	16	I	I*	I*	I	I*	I*
	6	21	I	I	I*	I	I*	I*
	6	26	I	I	I*	I	I*	I*
Black River P9	1	1	I	---	I*	I	I	I
	1	6	---	---	I*	I	I	I
	1	11	I	---	I	I	I*	I
	1	16	I	---	II*	I	I*	I
	1	21	II	---	I*	I	I	I
	1	26	I	II	I*	I	I*	I
	2	1	I	I*	I*	I	I	I
	2	6	I	I*	I*	I	I	I
	2	11	I	I	I*	I	I	I
	2	16	I	I	II*	I	I	I*
	2	21	I	I	I	I	I	I*
	2	26	I	I*	I*	I	I	I
	3	1	I	II	I*	I	I	I
	3	6	I	II*	I*	I	I	I
	3	11	I	I	I	ns	I	I
	3	16	I	I	II*	I	I	I*
	3	21	I	I	I	I	I*	I*
	3	26	I	I	I	I	I*	I
	4	1	I	II	I*	I	II	I
	4	6	II	II*	I	I	I	I
	4	11	I	II	II*	I	I	I
	4	16	I	I	II*	I	I*	I
	4	21	I	I	II*	I	I	I
	4	26	I	I	II*	ns	I	I
	5	1	II*	II*	I	I	I	I
	5	6	II	II	I	I	I	I
	5	11	I	II	II*	I	I	I
	5	16	I	I	II*	I*	I	I

Table 5.51-2. continued

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002	Summer 2003	Summer 2004	Summer 2005
Black River	5	21	II	I	II*	I	I*	I
(continued)	5	26	II	I	I	I	I*	I
	6	1	II*	---	I	I		I
	6	6	II*	II	II*	I	I	I
	6	11	II*	I	II*	I	I	I*
	6	16	I	I*	II*	I	I	I*
	6	21	I	I	I	I	I	I*
	6	26	I	I	I	I	I	I*
Smith Creek	1	1	II	II	II	II	II	II
P11	1	6	II	I*	II	II	II	II
	1	11	---	II	II	II	II	II
	1	16	II	II	II	II	II	II
	1	21	---	II	II	II	I	II
	1	26	---	II	II	II	I	II
	2	1	II	II	II	II*	II	II
	2	6	---	I*	II	II	II	II
	2	11	II	II	II	II	II	II
	2	16	II	II	II	II	II	II
	2	21	II	II	II	II	II	II
	2	26	II	II	II	II	II	II
	3	1	II	II	II	II	II	II
	3	6	II	II	II	I*	II	II
	3	11	II	II	II	I*	II	II
	3	16	II	II	II	II	I	II
	3	21	II	II	II	I*	I*	II
	3	26	II	II	II	II	I	II
	4	1	II	II	II	II	II	II
	4	6	II	II	II	II	II	II
	4	11	II	II	II	II	II	II
	4	16	II	II	II	II	I	II
	4	21	II	II	II	II		II
	4	26	II	II	II	II	I	II
	5	1	II	I*	II	ns	I	II
	5	6	II	II	II	II	I	II
	5	11	II	II	II	II	I	II
	5	16	II	II	II	II	I	II
	5	21	II	II	II	II	I	II
	5	26	II	II	II	II	I	II
	6	1	II	II	II	I	II	II
	6	6	II	I*	II	I	II	II
	6	11	II	I*	II	I*	II	II
	6	16	II	I*	II	II	I	II
	6	21	II	---	II	II	II	II
	6	26	II	II	II	II	II	II

Table 5.51-2. continued

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002	Summer 2003	Summer 2004	Summer 2005
Rat Island	1	1	II	II	II	I	I*	II
P12	1	6	II	II	II	I	II	II
	1	11	II	II	II	I	I*	I*
	1	16	II	II	II	I	I*	II
	1	21	II	II	II	I*	I*	II
	1	26	I	II	II	I*	I*	I*
	2	1	II	I*	II	I	II	I
	2	6	II	I*	II	II	II	I*
	2	11	II	I*	II	II	I	I*
	2	16	II	II	II	II	I	I*
	2	21	II	II	I*	I*	I*	I*
	2	26	I*	---	II	I*	I*	I*
	3	1	II	II	II	I	I	II
	3	6	II	I	II	I	II	II
	3	11	II	I	II	I	II	II
	3	16	II	I	II	I	II	I
	3	21	II	I*	II	I	II	I
	3	26	II	I*	II	I	II	I
	4	1	II	I*	II	I	II	I
	4	6	I*	II	II	I	II	I
	4	11	I*	I*	II	I	I*	I*
	4	16	II	I*	II	I*	II	I
	4	21	II	I*	I*	I*	II	I
	4	26	I*	I*	I*	I*	II	I
	5	1	II	I	II	I*	I*	I*
	5	6	II	I	II	I*	I*	I*
	5	11	I	I*	II	I*	I*	I*
	5	16	II	I*	II	I*	I*	I*
	5	21	II	I*	II	I*	I*	I*
	5	26	I*	I*	II	I*	I*	I*
	6	1	I	---	II	II	I	II*
	6	6	I	I	II	II	II	I
	6	11	I	I	II	I*	I	I
	6	16	I	I*	II	I*	I	I
	6	21	I	I	II	I*	I	I
	6	26	I	I	II	I*	I*	I
Fishing Creek	1	1	II	---	II	I	I	I
P13	1	6	II	---	II	I	I	I
	1	11	II	I*	II	I	I*	I*
	1	16	II	II	II	I	I*	I*
	1	21	II	I*	II	I	I*	I*
	1	26	I*	II	II	I	I*	I*
	2	1	II	I	II	I	I*	I
	2	6	II	I	II	I	I*	I

Table 5.51-2. continued

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002	Summer 2003	Summer 2004	Summer 2005
Fishing Creek	2	11	II	I	II	I	I*	I
(continued)	2	16	II	II	II	I	I*	I
	2	21	II	II	II	I	I*	I
	2	26	I*	II	II	I	I*	I
	3	1	II	II	II	I	I*	I
	3	6	I	I*	II	I	I*	I
	3	11	II	I*	II	I	I*	I
	3	16	II	I*	II	I	I*	I*
	3	21	II	II	II	I*	I*	I*
	3	26	I	I*	II	I*	I*	I*
	4	1	I	I	II	I	I	I
	4	6	I	II	II	I	I	I
	4	11	I	I	II	I	I*	I
	4	16	I	I	II	I	I*	I
	4	21	I	I	II	I	I*	I
	4	26	I	I	NS	I	I*	I
	5	1	II	I	II	II	I	I
	5	6	II	I	II	I	I	I
	5	11	II	I	II	I	I	I
	5	16	II	I	II	I	I	I
	5	21	II	II	II	I*	I*	I
	5	26	II	I	II	I	I	I
	6	1	I	II	II	I	I	I
	6	6	II*	I	I	II*	I	I
	6	11	I	I	I	I	I	I
	6	16	II	II	I	I	I	I
	6	21	I	I*	I	I	I	I
	6	26	I	I	I	I	I	I
Prince George	1	1	I	I	II	I	I	I
P14	1	6	I	I	II	I	I	I
	1	11	I	I*	II	I	I	II*
	1	16	I	I	II	I	I	I
	1	21	I	I	I*	I	I	II*
	1	26	I	I*	I*	I	I	I
	2	1	I	I	II	I*	I	I
	2	6	I	I	II	I*	I	I
	2	11	I	I	II	I*	I	I
	2	16	I	I	I*	I*	I	I
	2	21	I	I*	I*	I*	I	I
	2	26	I	I*	I*	I*	I	I
	3	1	I	I	II	I	I	I
	3	6	I	II*	II	I	I	I
	3	11	I	I	II	I	I	I
	3	16	I	I*	II	I	I	I

Table 5.51-2. continued

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002	Summer 2003	Summer 2004	Summer 2005
Prince George	3	21	I	I	I*	I	I	I
(continued)	3	26	I	I	I*	I	I	I
	4	1	I	I	II	I	I	I
	4	6	I	I	II	I*	I	I
	4	11	I*	I	II	I*	I	I
	4	16	I	I	II	I*	I	I
	4	21	I	I	I*	I*	I*	I
	4	26	I	I	I*	I*	I*	I
	5	1	I	II	II	I	I	I
	5	6	II	II	II	I	I	II*
	5	11	I	I	II	I	I	I
	5	16	I	I	II	I	I	I
	5	21	I	I	II	I	I	I
	5	26	I	I*	I*	I	I	I
	6	1	I	I	I	I	I	I
	6	6	I	I	II	I	I	I
	6	11	I	I	I*	I	I	I
	6	16	I	I	I*	I	I	I
	6	21	I	I	I*	I	I	I
	6	26	I	II	I*	I	I	I

Table 5.51-3. Classification of Sites Winter. Site classifications are as follows: Methanogenic I, Sulfate Reducing II, Methanogenic with evidence of past sulfate reduction I*, Sulfate reducing non-seawater source of sulfate II*.

Station	Substation	Depth (cm)	Winter 2000	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005	Winter 2006
Town Creek	1	1	---	II	II	II	I	II	I*
P3	1	6	---	II	II	II	I*	II	I*
	1	11	---	II	II	II	I*	II	I*
	1	16	---	I*	II	II	I*	II	I*
	1	21	---	I*	II	I*	I*	II	I*
	1	26	I*	I*	II	I*	I*	II	I*
	2	1	II	II	II	II	I*	II	I*
	2	6	II	II	II	I*	I*	II	I*
	2	11	I*	II	II	I*	I*	I*	I*
	2	16	I	II	II	I*	I*	II	I*
	2	21	I*	II	II	I*	I*	I*	I*
	2	26	I*	II	II	II	I*	I*	I*
	3	1	II	I	II	II	II	II	I*
	3	6	I	II	II	II	I	II	I*
	3	11	I	II	II	II	I*	II	I*
	3	16	I*	I*	II	II	I*	II	I*
	3	21	I*	II	II	II	I*	II	I*
	3	26	I*	II	II	II	I*	II	I*
	4	1	I	II	II	II	II	II	I*
	4	6	I*	I*	II	II	I*	II	I*
	4	11	II	I*	II	II	I*	I*	I*
	4	16	II	I*	II	II	I*	II	I*
	4	21	II	II	II	II	I*	II	I*
	4	26	II	II	II	II	II	II	I*
	5	1	---	II	II	II	I	II	II
	5	6	I	II	II	II	I	II	I*
	5	11	I	II	II	II	I*	II	I*
	5	16	II	II	II	II	I*	II	I*
	5	21	---	II	II	II	I*	II	I*
	5	26	II	II	II	II	II	II	I*
	6	1	II	II	II	II	II	II	I*
	6	6	II	II	II	II	I*	II	I*
	6	11	II	II	II	II	I*	II	I*
	6	16	II	II	II	II	I*	II	I*
	6	21	II	II	II	II	I*	I*	I*
	6	26	II	II	II	II	I*	II	I*
Eagle Island	1	1	---	II	II	II	II	II	II*
P6	1	6	---	II	II	II	II	II	II*
	1	11	---	II	II	II	II	II	II*
	1	16	I	II	II	I	II	II	II*

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Winter 2000	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005	Winter 2006
Eagle Island (continued)	1	21	I	II	II	I	II	II	II
	1	26	I*	II	II	I*	II	II	II
	2	1	I	II	II	II	II	II	II
	2	6	I	II	II	II	II	II	II
	2	11	---	II	II	II	II	II	II
	2	16	---	II	II	II	I*	I*	I*
	2	21	I	II	II	II	I*	I*	II
	2	26	I	II	II	II	I*	I*	I*
	3	1	I	II	II	II	II	II	II
	3	6	---	II	II	II	II	II	II
	3	11	I*	II	II	II	II	II	II
	3	16	I*	I*	II	II	II	II	II
	3	21	I*	II	II	I*	I*	II	II
	3	26	II	II	II	I*	I*	I*	II
	4	1	I	II	II	II	II	II	II
	4	6	I*	II	II	I*	I*	I*	II
	4	11	I*	II	II	I*	I*	I*	II
	4	16	II	I*	II	I*	I*	II	I
	4	21	I*	II*	II	I*	I*	I*	I*
	4	26	I*	II	II	I*	I*	I*	I*
	5	1	I	II	II	II	II	II	II
	5	6	I*	II	I*	I*	II	II	II
	5	11	I	II	I*	I*	II	I	II
	5	16	I*	II	I*	I*	II	I	I*
	5	21	I*	II	II	I*	I	I*	II
	5	26	I*	II	I*	I*	II	I	II
	6	1	I	I*	I*	II	II	II	II
	6	6	I*	I*	I*	I*	II	I	II
	6	11	I	I*	I*	I*	I	I	II
	6	16	I	I*	I*	I*	I	I	II
	6	21	I	I*	I*	I*	I	I	II
	6	26	I	I*	I*	I*	I	I	II
Indian Creek P7	1	1	I	I	I	I	I	I	II*
	1	6	I	I	I	II*	II*	I	II*
	1	11	I	I	I	II	II*		II
	1	16	---	I	I	II	II*	0	I
	1	21	I	I	I	II	I	I	I
	1	26	I	I	I	II	I	I*	I*
	2	1	I	I	I*	I*	I	I	I
	2	6	I	I	I*	I*	I	I	I
	2	11	I	I	I*	I*	I	I	I
	2	16	I	I	I*	I*	I*	I	I
	2	21	I*	I	I*	I*	I*	I	I*

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Winter 2000	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005	Winter 2006
Indian Creek (continued)	2	26	I*	I	I*	I*	I*	I	I*
	3	1	I	I	I	I*	I	I	I
	3	6	I*	I	I	I*	I	I	I
	3	11	I*	I	I*	I*	I*	I	I
	3	16	I	I	I*	I*	I*	I	I
	3	21	I*	I	I*	I*	I	I*	I
	3	26	I	I	I*	I*	I	I	I
	4	1	I	I	I	I	I	I	I
	4	6	I	I	I	I*	I	I	I
	4	11	I	I	I	I*	I*	I	I
	4	16	I*	I	I	I*	I*	I	I
	4	21	I*	I	I	I*	I*	I	I
	4	26	I	I	I	I*	I*	I	I
	5	1	I	I	I	NS	I	I	I
	5	6	I	I	I	I	I	I	I
	5	11	I	I	I	I	I	I	I
	5	16	I*	I	I	I	I	I	I
	5	21	I	I	I	I	I	I	I
	5	26	I*	I	I	I	I	I	I
	6	1	I	I	I	I	I	I	I
	6	6	I	I	I	I	I	I	I
	6	11	I	I	I	I	I	I	I
	6	16	I	I	I	I	I	I	I
	6	21	I	I	I	I	I	I	I
	6	26	II*	I	I	I	I	I	I
Dollisons Landing P8	1	1	---	II*	I	I	I	I	I
	1	6	I	II*	II*	I	II	I	I
	1	11	II	II*	II*	I	II	I	I
	1	16	I	II*	II*	I	I	I	I
	1	21	I*	II	II*	I	I	I	I
	1	26	II*	II*	I	I	I	I	I
	2	1	---	I	I	I	I	I	I
	2	6	---	I	I	I	I	I	I
	2	11	II	I	I	I	I	I	I
	2	16	II	I	I	I	II*	I	I
	2	21	I	I	I	I*	II*	I	I
	2	26	I	I	I	I	I	I	I
	3	1	II	I	I	I	I	I	I
	3	6	I	I	I	I	I	I	I
	3	11	II*	II*	I	I	I	I	I
	3	16	I	II*	I	I	I	I	I
	3	21	II	I	I	I	II*	I	I
	3	26	I	I	I	I	I	I	I

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Winter 2000	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005	Winter 2006
Dollisons Landing (continued)	4	1	II	I	I	I	I	I	I
	4	6	I	I	I	I	I	I	I
	4	11	I*	I	I	I	I	I	I
	4	16	---	I	I	I	I	I	I
	4	21	---	I	I	I	I	I	I
	4	26	I	I	I	I*	I	I	I
	5	1	I	I	I	I	I	I	I
	5	6	II	I	I	I	I	I*	I
	5	11	---	I	I	I	I	I*	I*
	5	16	II	I	I	I	I	I*	I*
	5	21	I	II*	I	I	I	I*	I*
	5	26	II	I	I	I	II*	I	I*
	6	1	I*	I	I	I	I	I	I*
	6	6	I	I	I	I	I	I*	I*
	6	11	II*	I	I*	I	I	I*	I*
	6	16	II	I	I	I*	I	I	II
	6	21	---	I	I	I	I	I	I*
	6	26	I	I	I	I	I	I*	I*
Black River P9	1	1	---	I	I	I*	II	I	I
	1	6	I	I	I	I	II	I	I
	1	11	I	I	I	I	I	I	I*
	1	16	I	I	I	I	I	I	I*
	1	21	I	II	I	I	I	I	I*
	1	26	I*	II	I	I	I	I	I
	2	1	I	II*	I	I	I	I	I
	2	6	I	II*	I	I	I	I	I
	2	11	I	I	I	I	I	I	I
	2	16	I*	I	I	I	I	I	I
	2	21	I	II	I	I	I	I	I
	2	26	I	I	I	I*	I	I	I
	3	1	I	II*	I	I	I	I	I
	3	6	I	II*	I	I	I	I	I
	3	11	I	II*	I	I	I	I	I
	3	16	I	I	I	I	I	I	I
	3	21	I	II	I	I	I	I	I*
	3	26	I	II*	I	I	I	I	I*
	4	1	I	II*	I	I	I	I	I
	4	6	I*	I	I	I	I	I	I
	4	11	I*	II*	I	I	I	I	I
	4	16	I*	II*	I	I	I	I	I*
	4	21	I*	II*	I	I	I	I	I*
	4	26	I*	II*	I	I	I	I	I
	5	1	I*	II*	I	I	I	I	I

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Winter 2000	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005	Winter 2006
Black River (continued)	5	6	I	II*	I	I	I	I	I
	5	11	I	II*	I	I*	I	I	I
	5	16	I*	II*	I	I*	I	I	I
	5	21	I*	II*	I*	I	I	I	I
	5	26	I*	II*	I	I*	I	I	I
	6	1	I	I	I	I	I	I	I
	6	6	I	I	I	I	I	I	I
	6	11	I*	I	I	I	I	I	I
	6	16	I*	I	I	I	I	I	I*
	6	21	I	II*	I	I	I	I	II*
	6	26	I	II*	I	I	I	I	I*
Smith Creek P11	1	1	I	II	II	II	II	II	II
	1	6	I*	I*	II	II	II	II	II
	1	11	---	II	II	II	II	II	II
	1	16	I*	II	II	II	II	II	II
	1	21	I*	II	II	II	II	II	I*
	1	26	---	II	II	II	II	II	I*
	2	1	II	II	---	II	II	II	II
	2	6	I*	II	II	II	II	II	II
	2	11	I*	II	II	II	II	II	II
	2	16	I*	II	II	II	II	II	II
	2	21	I*	II	II	II	II	II	II
	2	26	---	II	II	II	II	II	II
	3	1	---	II	II	II	II	II	II
	3	6	I*	II	II	II	II	II	II
	3	11	I*	II	II	II	II	II	I*
	3	16	I*	II	II	II	II	II	I*
	3	21	I*	II	II	II	II	II	I*
	3	26	I*	II	II	II	II	II	I*
	4	1	I	II	II	II	II	II	II
	4	6	II	I	II	II	II	I*	II
	4	11	II	II	II	II	II	I*	I*
	4	16	II	II	II	II	II	I*	I*
	4	21	II	II	II	II	II	I*	I*
	4	26	II	II	II	II	II	II	I*
	5	1	II	II	II	II	II	II	II
	5	6	II	II	II	II	II	II	I*
	5	11	I*	II	II	II	II	II	I*
	5	16	I*	II	II	II	I*	I*	I*
	5	21	I*	II	II	II	I*	I*	I*
	5	26	---	II	II	II	I*	I*	II
	6	1	---	II	II	II	II	II	II
	6	6	---	II	II	II	II	II	I*

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Winter 2000	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005	Winter 2006
Smith Creek (continued)	6	11	---	II	II	II	II	II	I*
	6	16	---	II	II	II	I*	II	I
	6	21	---	II	II	II	II	II	I*
	6	26	---	II	II	II	II	II	I*
Rat Island P12	1	1	---	II	II	II	II	II	II
	1	6	---	II	II	II	II	II	II
	1	11	I*	II	II	II	II	II	I*
	1	16	I*	II	II	II	II	II	I*
	1	21	I*	II	II	II	I*	II	I
	1	26	I*	II	II	II	II	II	II*
	2	1	I*	II	II	II	II	II	II*
	2	6	I*	I	II	II	II	II	II
	2	11	I*	II	II	II	II	II	II
	2	16	I*	II	II	II	II	II	II
	2	21	I*	II	II	II	II	II	I*
	2	26	I*	II	II	II	II	II	I*
	3	1	II	II	II	II	II	II	II
	3	6	I	II	II	II	II	II	I*
	3	11	I*	II	II	II	II	II	I*
	3	16	I	II	II	II	II	I	I*
	3	21	I	II	II	II	I	II	I
	3	26	I	II	II	II	I*	I	I*
	4	1	I*	II	II	II	II	II	I
	4	6	I*	I*	II	II	II	I	I*
	4	11	I*	I*	II	II	II	I	I*
	4	16	I*	I*	II	I*	I	I*	I*
	4	21	I*	I*	II	I*	I	I*	I*
	4	26	I*	I*	II	II	I	I*	I*
	5	1	I	II	II	II	I*	I*	I
	5	6	I	I*	I	II	I*	I*	I
	5	11	I	I*	II	II	II	II	I
	5	16	I	I*	II	II	I*	II	I
	5	21	I	I*	I*	II	I*	II	I
	5	26	I	I*	I*	II	I*	II	I
	6	1	I	I	---	II	II*	II*	II*
	6	6	I	I	---	II	II*	II*	II*
	6	11	I	I	II	II	II*	II*	II*
	6	16	I	II	II	II	II	II	II*
	6	21	I	I	II	II	I	II	II*
	6	26	I	I	II	II	I	I*	II*
Fishing Creek P13	1	1	II	II	I	I	I	I	I
	1	6	II	II	I	I	I	I	II*
	1	11	I	II	II	II*	I	I*	II*

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Winter 2000	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005	Winter 2006
Fishing Creek (continued)	1	16	I	II	II	II*	II*	I	II*
	1	21	I	II	II	II*	I	I	II*
	1	26	I	II	II	II*	I	I	II*
	2	1	---	II	I	II*	I	I*	I
	2	6	I	II	II	I	I	I*	I
	2	11	I	II	II	I	I	I	I
	2	16	I	I	II	I	I	I*	I
	2	21	I*	I	II	I	I	I*	I
	2	26	I*	I	II	I*	I*	I*	I
	3	1	I	I	II	I*	I*	II	I
	3	6	I	I	II	II	I*	I	I*
	3	11	I*	I	II	I*	I*	I*	I*
	3	16	I	I	II	I*	I*	I*	I*
	3	21	I*	I	II	I*	I*	I*	I*
	3	26	I	II	II	I*	I*	I*	I*
	4	1	II*	II	II	I	I	I	I
	4	6	I	II	II	II	I	I	I
	4	11	I	II	II	II	I	I	I
	4	16	I	II	II	II	I	I	I
	4	21	I	I	II	II	I	I	I
	4	26	I	I	II	II	I	I	I
	5	1	I	I	---	I	I	I	I
	5	6	I	I	II	I	I	I	I
	5	11	I	I	II	I	I	I	I
	5	16	I	I	II	I	I	I	I
	5	21	I	I	I*	I*	I	I	I
	5	26	I	I	---	I*	I	I	I
	6	1	II	I	I	I	I	I	I
	6	6	I*	I	I*	I	I	I	I
	6	11	II	I	I	I	I	I	I
	6	16	---	I	I	I	I	I	I
	6	21	II	I	I	I	I	I	I
	6	26	I	I	I	I	I	I	I
Prince George P14	1	1	I	II*	II*	NS	I	I	I
	1	6	I	I	II*	II*	I	I	I
	1	11	I	I	II	II*	I	I	I*
	1	16	I	I	II	II*	I	I	I
	1	21	I	I	II	II*	I	I	I
	1	26	I	I	II*	II*	I	I	I
	2	1	I	I	II*	I	I	I	I
	2	6	I	I	II*	I	I*	I	I
	2	11	I	I	II*	I	I*	I	I
	2	16	I	II	II*	I	I*	I	I

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Winter 2000	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005	Winter 2006
Prince George (continued)	2	21	I	I*	II*	I	I*	I*	I
	2	26	I*	I	II	I	I*	I	I*
	3	1	II	I	II*	NS	I	I	I*
	3	6	II	I	II*	II*	I	I	I*
	3	11	I	I	II	I	I	I	I
	3	16	I	I	II*	I	I	I	I
	3	21	I	I	II	I	I*	I	I
	3	26	I	I	II	I	I*	I*	I
	4	1	I	I	II*	I	I	I	I
	4	6	I	II*	II*	I	I	I*	I
	4	11	I	I	II	I*	I*	I*	I
	4	16	I	I	II*	I*	I*	I*	I
	4	21	I	I	II	I*	I*	I	I
	4	26	I	I	II	I*	I*	I*	I
	5	1	I	I	II	II*	I	I	I
	5	6	I	I	II*	I	I*	I	I
	5	11	I	I	II	I	I	I	I
	5	16	I	II	II	I	I*	I	I
	5	21	I	I	II	I	I	I*	I
	5	26	I	I	II	I	I	I	I
	6	1	II*	II	II*	II*	I	I	I
	6	6	I	I	II	II*	I	I	I
	6	11	I	I	II	II*	I	I	I
	6	16	I	I	II	II*	I	I*	I
	6	21	I	I	I	II*	I	I	I
	6	26	I	I	I	I	I	I*	I

Table 5.51-4. Methane Concentrations of Sites. Porewater methane concentrations are µM.

Station	Substation	Depth (cm)	Methane	
			Summer 2005	Winter 2006
Town Creek	1	1	31	133
P3	1	6	68	179
	1	11	93	202
	1	16	192	353
	1	21	172	363
	1	26	86	336
	2	1	143	32
	2	6	136	268
	2	11	163	389
	2	16	220	264
	2	21	215	289
	2	26	216	197
	3	1	95	238
	3	6	178	351
	3	11	223	399
	3	16	154	417
	3	21	162	444
	3	26	205	288
	4	1	54	284
	4	6	124	443
	4	11	133	440
	4	16	130	465
	4	21	166	473
	4	26	196	403
	5	1	135	31
	5	6	256	249
	5	11	283	362
	5	16	368	401
	5	21	417	523
	5	26	369	419
	6	1	3	330
	6	6	182	404
	6	11	251	466
	6	16	225	445
	6	21	246	446
	6	26	296	389

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2005	Winter 2006
Eagle Island	1	1	NS	3
P6	1	6	NS	8
	1	11	137	32
	1	16	153	78
	1	21	331	110
	1	26	330	109
	2	1	33	6
	2	6	55	13
	2	11	94	21
	2	16	166	33
	2	21	207	54
	2	26	209	93
	3	1	1	4
	3	6	10	3
	3	11	20	16
	3	16	20	27
	3	21	34	48
	3	26	113	178
	4	1	212	5
	4	6	211	48
	4	11	241	123
	4	16	222	235
	4	21	345	309
	4	26	189	370
	5	1	95	10
	5	6	175	40
	5	11	148	65
	5	16	243	116
	5	21	218	151
	5	26	403	NS
	6	1	12	50
	6	6	68	160
	6	11	127	220
	6	16	147	211
	6	21	143	200
	6	26	243	163

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2005	Winter 2006
Indian Creek	1	1	3	---
P7	1	6	15	---
	1	11	26	2
	1	16	191	2
	1	21	234	3
	1	26	269	---
	2	1	37	55
	2	6	69	71
	2	11	129	100
	2	16	163	149
	2	21	184	122
	2	26	210	99
	3	1	165	101
	3	6	124	90
	3	11	184	101
	3	16	184	131
	3	21	186	120
	3	26	153	117
	4	1	44	6
	4	6	134	42
	4	11	155	42
	4	16	150	46
	4	21	121	74
	4	26	246	38
	5	1	114	29
	5	6	245	39
	5	11	286	55
	5	16	271	51
	5	21	273	35
	5	26	299	29
	6	1	45	13
	6	6	58	12
	6	11	76	16
	6	16	90	24
	6	21	82	23
	6	26	52	---

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2005	Winter 2006
Dollisons	1	1	---	---
Landing P8	1	6	13	27
	1	11	110	149
	1	16	145	181
	1	21	163	181
	1	26	142	---
	2	1	1	4
	2	6	145	47
	2	11	79	58
	2	16	75	46
	2	21	96	61
	2	26	74	47
	3	1	41	77
	3	6	66	101
	3	11	71	63
	3	16	137	51
	3	21	120	33
	3	26	127	34
	4	1	120	16
	4	6	119	62
	4	11	155	86
	4	16	154	91
	4	21	181	96
	4	26	164	---
	5	1	143	9
	5	6	240	29
	5	11	242	74
	5	16	171	123
	5	21	188	143
	5	26	152	91
	6	1	127	24
	6	6	140	34
	6	11	181	41
	6	16	143	43
	6	21	148	79
	6	26	210	65

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2005	Winter 2006
Black River	1	1	66	108
P9	1	6	281	152
	1	11	294	207
	1	16	267	283
	1	21	282	325
	1	26	180	375
	2	1	151	4
	2	6	267	26
	2	11	246	65
	2	16	275	70
	2	21	245	113
	2	26	---	166
	3	1	74	3
	3	6	164	97
	3	11	224	119
	3	16	233	120
	3	21	214	107
	3	26	180	118
	4	1	133	95
	4	6	252	230
	4	11	384	363
	4	16	334	501
	4	21	377	472
	4	26	359	404
	5	1	29	4
	5	6	109	29
	5	11	230	53
	5	16	134	77
	5	21	173	107
	5	26	156	112
	6	1	5	8
	6	6	139	83
	6	11	285	192
	6	16	349	220
	6	21	236	359
	6	26	214	212

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2005	Winter 2006
Smith Creek	1	1	18	2
P11	1	6	62	68
	1	11	207	9
	1	16	336	174
	1	21	329	1015
	1	26	310	248
	2	1	23	#DIV/0!
	2	6	81	207
	2	11	131	198
	2	16	132	106
	2	21	169	14
	2	26	158	#DIV/0!
	3	1	93	4
	3	6	126	299
	3	11	250	204
	3	16	243	450
	3	21	280	485
	3	26	170	349
	4	1	6	20
	4	6	185	260
	4	11	274	547
	4	16	395	406
	4	21	342	472
	4	26	324	506
	5	1	12	91
	5	6	215	365
	5	11	333	406
	5	16	293	540
	5	21	322	617
	5	26	220	660
	6	1	36	59
	6	6	24	397
	6	11	87	381
	6	16	110	268
	6	21	221	160
	6	26	---	216

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2005	Winter 2006
Rat Island	1	1	169	2
P12	1	6	191	100
	1	11	164	192
	1	16	95	218
	1	21	191	77
	1	26	---	---
	2	1	88	2
	2	6	123	29
	2	11	175	47
	2	16	206	95
	2	21	215	165
	2	26	180	263
	3	1	87	517
	3	6	103	627
	3	11	199	527
	3	16	129	494
	3	21	106	603
	3	26	181	575
	4	1	234	52
	4	6	243	332
	4	11	229	506
	4	16	262	449
	4	21	207	526
	4	26	243	575
	5	1	159	56
	5	6	251	68
	5	11	281	132
	5	16	299	187
	5	21	77	95
	5	26	---	125
	6	1	23	10
	6	6	96	7
	6	11	105	9
	6	16	199	21
	6	21	143	62
	6	26	155	159

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2005	Winter 2006
Fishing Creek	1	1	10	---
P13	1	6	100	1
	1	11	206	---
	1	16	327	2
	1	21	327	14
	1	26	302	7
	2	1	112	7
	2	6	191	115
	2	11	225	152
	2	16	332	156
	2	21	337	228
	2	26	291	201
	3	1	150	167
	3	6	162	236
	3	11	162	268
	3	16	194	240
	3	21	250	363
	3	26	297	207
	4	1	7	51
	4	6	50	68
	4	11	79	83
	4	16	80	121
	4	21	98	107
	4	26	126	91
	5	1	1	5
	5	6	9	29
	5	11	50	47
	5	16	78	61
	5	21	82	56
	5	26	76	80
	6	1	36	1
	6	6	31	---
	6	11	46	---
	6	16	61	---
	6	21	102	---
	6	26	126	---

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2005	Winter 2006
Prince George	1	1	---	1
P14	1	6	110	2
	1	11	205	2
	1	16	189	9
	1	21	---	23
	1	26	96	10
	2	1	277	23
	2	6	330	117
	2	11	344	161
	2	16	380	165
	2	21	380	216
	2	26	221	272
	3	1	3	2
	3	6	151	3
	3	11	288	15
	3	16	251	64
	3	21	214	111
	3	26	226	153
	4	1	163	146
	4	6	93	174
	4	11	202	201
	4	16	158	305
	4	21	199	256
	4	26	172	152
	5	1	6	17
	5	6	---	122
	5	11	58	299
	5	16	109	331
	5	21	126	445
	5	26	163	426
	6	1	128	43
	6	6	223	252
	6	11	267	636
	6	16	339	482
	6	21	384	453
	6	26	329	365

5.52 Indian Creek (P7)

Porewaters of Indian Creek were essentially fresh during the winters of 2000, 2001, and 2002, with highest salinities never exceeding 0.2 ppt. (Hackney et al. 2002a, 2002b). Winter porewater salinities increased substantially at this station during the winter of 2003 with salinities as high as 1.3 ppt at the near shore substation S1 and averaged 0.4 ± 0.3 ppt at substations 1, 2, 3, and 4 combined (Hackney et al. 2003). The substations closer to uplands, 5 and 6, were still fresh and likely not influenced as much by tidal flood waters. During the winter of 2004, salinities returned to low values with only 2 substations reaching values above 0.2 ppt (Hackney et al. 2005). Classifications were generally MP and MPSR, similar to the winters of 2000, 2002, and 2003, but not as fresh as the winter of 2001 where all classifications were M (Table 5.51-3). Only substation S1 had sulfate concentrations sufficient to sustain sulfate reduction (Table 5.52-1). Last winter (2005) and the current winter (2006) were very fresh and similar to the winter of 2001. Salinities were generally less than 0.05 ppt. (Table 5.51-1) and all classifications were M except for three MPSR and a few sulfate reducing classifications at the surface of the creek bank locations (Table 5.51-3).

An increase in salinity was observed during the summer of 2002 (Hackney et al. 2003). During the previous 2 summers, the majority of the substations had values below 0.5 ppt. (Hackney et al. 2002a, 2002b). During the summer of 2002 most values at the non-upland substations had salinities in the 2.0 ppt range clearly showing an increase in salinity. The following summer of 2003 had all but 3 substations sub-depths with salinities below 0.2 ppt indicating very low salinity conditions for this site. For the first time, this site had all methanogenic summer classifications with the majority being M and only a few MPSR (Hackney et al. 2005). Salinities during last summer (2004) were slightly higher ranging from 0.05 -0.13 ppt. Classifications reflected the slightly higher salinities with some M classifications converted to MPSR (Hackney et al. 2006). Salinities during the current summer were slightly fresher and similar to the summer of 2003 with most salinities below 0.05 ppt. (Table 5.51-1). Several MPSR classifications were converted back to M (Table 5.51-2). It should be noted that a non-seasalt source of sulfate was observed at the most upland site during the current summer for the first time. The source of this sulfate remains unknown at this time, but is like anthropogenic.

Table 5.52-1. Sulfate Concentrations of Sites. Porewater sulfate concentrations are µM. A --- indicates no data.

Station	Substation	Depth (cm)	Sulfate	
			Summer 2005	Winter 2006
Town Creek	1	1	2415	40
P3	1	6	1845	83
	1	11	1511	97
	1	16	1027	80
	1	21	1526	146
	1	26	1608	249
	2	1	1571	187

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2005	Winter 2006
Town Creek (continued)	2	6	1429	85
	2	11	1131	-
	2	16	1266	41
	2	21	1136	30
	2	26	1246	-
	3	1	1849	170
	3	6	2069	84
	3	11	1438	75
	3	16	1256	-
	3	21	1171	120
	3	26	1449	278
	4	1	24	160
	4	6	1433	133
	4	11	1420	85
	4	16	1135	84
	4	21	1019	200
	4	26	1281	297
	5	1	221	372
	5	6	249	107
	5	11	168	111
	5	16	130	69
	5	21	216	134
	5	26	125	88
	6	1	2139	89
	6	6	1254	113
	6	11	1055	105
	6	16	1254	26
	6	21	929	48
	6	26	736	75
Eagle Island P6	1	1	2641	538
	1	6	2610	587
	1	11	2074	587
	1	16	723	586
	1	21	185	618
	1	26	461	732
	2	1	1398	538
	2	6	987	447
	2	11	797	343
	2	16	460	278
	2	21	318	408
	2	26	247	277
	3	1	1271	633
	3	6	1103	640
	3	11	970	573

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2005	Winter 2006
Eagle Island (continued)	3	16	834	519
	3	21	696	579
	3	26	389	631
	4	1	797	320
	4	6	278	311
	4	11	178	364
	4	16	198	287
	4	21	121	265
	4	26	156	280
	5	1	626	603
	5	6	519	422
	5	11	392	336
	5	16	256	276
	5	21	157	330
	5	26	170	408
	6	1	368	473
	6	6	293	391
	6	11	179	313
	6	16	145	386
	6	21	166	352
	6	26	151	377
Indian Creek P7	1	1	408	342
	1	6	386	348
	1	11	296	367
	1	16	120	297
	1	21	69	178
	1	26	51	154
	2	1	228	89
	2	6	138	56
	2	11	121	47
	2	16	58	48
	2	21	90	35
	2	26	64	49
	3	1	115	46
	3	6	68	51
	3	11	405	41
	3	16	52	32
	3	21	85	36
	3	26	82	39
	4	1	200	109
	4	6	123	63
	4	11	76	49
	4	16	73	47
	4	21	84	39

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2005	Winter 2006
Indian Creek (continued)	4	26	83	---
	5	1	58	20
	5	6	46	54
	5	11	46	43
	5	16	33	40
	5	21	43	37
	5	26	31	39
	6	1	72	44
	6	6	92	55
	6	11	99	55
	6	16	120	46
	6	21	104	49
	6	26	124	117
Dollisons Landing P8	1	1	23	243
	1	6	112	126
	1	11	48	118
	1	16	50	57
	1	21	31	66
	1	26	49	101
	2	1	31	45
	2	6	25	27
	2	11	33	20
	2	16	39	27
	2	21	42	33
	2	26	37	48
	3	1	71	54
	3	6	50	30
	3	11	40	33
	3	16	29	42
	3	21	32	30
	3	26	37	29
	4	1	68	43
	4	6	34	29
	4	11	24	19
	4	16	30	21
	4	21	23	19
	4	26	26	63
	5	1	54	112
	5	6	65	90
	5	11	51	45
	5	16	47	37
	5	21	48	31
	5	26	39	36
	6	1	79	50

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2005	Winter 2006
Dollisons Landing (continued)	6	6	85	44
	6	11	98	50
	6	16	30	479
	6	21	26	41
	6	26	55	33
Black River P9	1	1	67	141
	1	6	31	33
	1	11	28	16
	1	16	37	12
	1	21	33	15
	1	26	30	765
	2	1	127	149
	2	6	30	167
	2	11	25	106
	2	16	16	205
	2	21	17	161
	2	26	47	89
	3	1	90	154
	3	6	44	48
	3	11	34	37
	3	16	32	17
	3	21	20	15
	3	26	25	9
	4	1	125	74
	4	6	43	18
	4	11	34	20
	4	16	32	17
	4	21	19	13
	4	26	38	17
	5	1	129	144
	5	6	59	117
	5	11	32	75
	5	16	38	46
	5	21	28	25
	5	26	28	69
	6	1	180	97
	6	6	46	47
	6	11	25	19
	6	16	30	7
	6	21	25	412
	6	26	24	11
Smith Creek P11	1	1	4814	1890
	1	6	4830	2268
	1	11	2625	1393

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2005	Winter 2006
Smith Creek	1	16	969	518
(continued)	1	21	819	72
	1	26	909	91
	2	1	935	1447
	2	6	670	1427
	2	11	650	1259
	2	16	657	937
	2	21	490	462
	2	26	529	1112
	3	1	1891	18085
	3	6	1216	967
	3	11	1185	157
	3	16	902	1
	3	21	954	1
	3	26	1104	8
	4	1	3761	1075
	4	6	1609	559
	4	11	1013	49
	4	16	955	2
	4	21	745	13
	4	26	1555	32
	5	1	3417	594
	5	6	2298	222
	5	11	1320	8
	5	16	1072	41
	5	21	1176	1
	5	26	1237	327
	6	1	1911	342
	6	6	1982	19
	6	11	1255	24
	6	16	1078	36
	6	21	747	29
	6	26	1195	74
Rat Island	1	1	485	495
P12	1	6	369	357
	1	11	255	140
	1	16	341	27
	1	21	308	77
	1	26	266	831
	2	1	226	433
	2	6	135	556
	2	11	77	394
	2	16	106	363
	2	21	105	250

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2005	Winter 2006
Rat Island (continued)	2	26	122	117
	3	1	768	386
	3	6	493	166
	3	11	416	61
	3	16	231	67
	3	21	218	45
	3	26	253	73
	4	1	242	200
	4	6	160	85
	4	11	195	76
	4	16	216	32
	4	21	173	21
	4	26	143	46
	5	1	152	138
	5	6	49	108
	5	11	109	155
	5	16	137	85
	5	21	111	86
	5	26	125	96
	6	1	310	810
	6	6	189	868
	6	11	216	1188
	6	16	155	692
	6	21	124	703
	6	26	145	508
Fishing Creek P13	1	1	90	24
	1	6	86	783
	1	11	52	672
	1	16	38	508
	1	21	34	392
	1	26	31	398
	2	1	106	152
	2	6	82	80
	2	11	72	58
	2	16	46	59
	2	21	54	73
	2	26	48	60
	3	1	107	75
	3	6	108	59
	3	11	107	39
	3	16	68	44
	3	21	52	24
	3	26	57	37
	4	1	93	68

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2005	Winter 2006
Fishing Creek (continued)	4	6	78	58
	4	11	90	65
	4	16	73	59
	4	21	61	63
	4	26	82	64
	5	1	95	148
	5	6	98	99
	5	11	79	122
	5	16	50	64
	5	21	60	76
	5	26	54	37
	6	1	149	154
	6	6	95	110
	6	11	86	110
	6	16	86	119
	6	21	67	147
	6	26	98	110
Prince George P14	1	1	239	296
	1	6	61	191
	1	11	351	303
	1	16	217	263
	1	21	457	172
	1	26	165	172
	2	1	52	165
	2	6	58	58
	2	11	52	83
	2	16	48	71
	2	21	55	258
	2	26	51	36
	3	1	87	495
	3	6	70	1
	3	11	55	192
	3	16	49	130
	3	21	53	158
	3	26	45	48
	4	1	69	78
	4	6	199	47
	4	11	63	55
	4	16	48	51
	4	21	51	69
	4	26	47	76
	5	1	96	178
	5	6	194	114
	5	11	57	94

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2005	Winter 2006
Prince George (continued)	5	16	55	128
	5	21	44	115
	5	26	52	56
	6	1	67	164
	6	6	41	104
	6	11	63	78
	6	16	43	84
	6	21	45	86
	6	26	46	27

5.53 Dollisons Landing (P8)

Winter porewaters at Dollisons Landing have been essentially fresh with only a few substation sub-depths with sulfate concentrations able to support sulfate reduction, mainly during the winter of 2000 (Hackney et al. 2002a). Since the winter of 2000 the site has remained relatively fresh. During the winters of 2000 and 2001, the site had porewater salinities in the 0.1 to 0.3 ppt range (Hackney et al. 2002a). During the winters of 2002, 2003, and 2004, salinities were below 0.1 ppt. (Hackney et al. 2002b, Hackney et al. 2003, Hackney et al. 2005), continuing the low salinity conditions. Salinities during the past winter (2005) were saltier near the uplands (Hackney et al. 2006) making that year the saltiest since 2000; several M classifications shifted to MPSR. Conditions during the current winter are essentially the same as the previous one with only minor differences namely slightly saltier conditions in the upland sites with a few more M classifications converted to MPSR (Table 5.51-3). The higher salinities were approximately 0.15 ppt (Table 5.51-1) compared to 0.1 ppt during the previous winter of 2005 (Hackney et al. 2006).

Salinities during the summer (2003) (Hackney et al. 2005) were all at or below 0.05 ppt. resulting in the lowest salinities observed at this site since the project's inception. For the first time all substations had methanogenic conditions (Hackney et al. 2005). The majority of substations had M classifications and only a few had MPSR classifications. During the summer of 2004, conditions were slightly saltier in the uplands resulting in several M classifications converted to MPSR (Hackney et al. 2006) Conditions were slightly fresher nearer to the river with a few SR classifications converted to M. Classifications during the current summer are very similar to the previous one with only a few minor exceptions (Table 5.51-2).

5.54 Black River (P9)

Winter porewaters of the Black River station continued to display fresh conditions from the winter of 2002 to last winter (2005). All substations were methanogenic during the winter of 2004 except for the two surface sub-depths at substation S1 (Hackney et al. 2005). During the previous two winters (2002, 2003) a few of the substations were MPSR classifications, however none were MPSR classifications during the winter 2004 suggesting slightly fresher conditions. Salinities remained low with the majority of values below 0.04 ppt (Hackney et al. 2005). During the previous winter of 2005, salinities remained in the same range (0.02-0.06 ppt., Hackney et al. 2006). All classifications were M reflecting these low salinity conditions. During the current winter, classifications indicated slightly saltier conditions with a few MPSR classifications (Table 5.51-2). Salinities however were similar to the previous winter and averaged approximately 0.05 ppt. (Table 5.51-1)

Summer 2004 salinities were similar to the winter 2005 values and ranged from approximately 0.01- 0.04 ppt (Table 5.51-1). On the basis of classifications and salinities, the summer of 2003 was the freshest summer since monitoring began for this site with all M classifications and only one MPSR. All locations were methanogenic during the previous summer of 2005, with mostly M classifications and a few MPSR (Table 5.51-2). The higher instances of MPSR in that summer indicate slightly more saline conditions. Conditions during the current summer were essentially the same as the previous one with a few MPSR classifications converting to M and visa versa. Salinities were essentially the same averaging approximately 0.05 ppt. (Table 5.51-1).

5.55 Smith Creek (P11)

Porewater salinities during the winter at Smith Creek showed a steady increase from 2000 (Hackney et al. 2002a) to 2002 (Hackney et al. 2002b). However, salinities during the winter of 2003 [av. = 4.4 $\pm$ 1.1 ppt; (Hackney et al. 2003)] and 2004 [av. = 3.3 $\pm$ 1.1 ppt; (Hackney et al. 2005)] were lower than the winter of 2002 [(av. = 7.2 $\pm$ 2.1 ppt; (Hackney et al. 2002b)]. The slightly fresher conditions during winter of 2004 were reflected in classifications, which for the first time since the winter of 2000 show a few substations with methanogenic (MPSR) conditions (Hackney et al. 2005). The winter of 2005 was similar to the winter of 2004 with the exception of a few more MPSR classifications (Table 5.51-3) indicating slightly fresher conditions. The slight freshening continued during the current winter with a few more SR classifications converted to MPSR. This was reflected in the higher range of salinities that were approximately 4 ppt. (Table 5.51-1) compared to 5 ppt. the previous winter (Hackney et al. 2006).

The previous summer 2004 salinities ranged from 5-8 ppt. (Hackney et al. 2006) (Table 5.51-1) with the exception of S5 which displayed very fresh conditions (0.01-0.02 ppt.). These salinities are higher than those observed during the summer of 2003 (0.1-4 ppt., Hackney et al. 2005), but are not as high as previous years, which have reached, as high as 14 ppt. During the current summer, all classifications were SR indicating saltier conditions particularly in the upland station (Table 5.51-2).

5.56 Rat Island (P12)

Vegetation along this transect is strongly transitional, from saline tolerant species near the river to salt intolerant species toward the upland boundary. Porewater salinity reflects the gradient with higher salinity at substations near the river and fresher conditions toward the uplands. Winter salinities steadily increased from 2000-2002 (Hackney et al. 2002a, 2002b), with the winter of 2003 showing a dramatic salinity increase in sites adjacent to uplands for the first time (Hackney et al. 2003). Average substation S6 salinities had never exceeded 0.2 ppt, but were 2.7 $\pm$ 0.2 ppt during the winter of 2003, representing more than a ten fold increase. The salinities during the winter of 2004 returned to lower values similar to those observed during winters of 2001-2002 with the majority of salinities near the upland edge below 0.3 ppt (Hackney et al. 2005). Winter classifications reflected lower salinities with several upland sites returning to methanogenic conditions (Table 5.51-3). Last winter (2005) was similar to the previous one (2004), but conditions were slightly saltier in the uplands with some M classifications converted to MPSR and some MPSR classifications converted to SR (Table 5.51-3). Fresher condition prevailed during the current year with several SR classifications converting to MPSR or M classifications. This winter, 2006, is comparable to the freshest winter so far for this monitoring project, which occurred during the first year, 2000.

During the summer of 2002, average salinities at near-shore station S1 were always below 2 ppt (Hackney et al. 2002a, 2002b), however, during the summer of 2002 the average value at substation S1 was 6.3 $\pm$ 0.7 ppt (Hackney et al. 2003). Salinities at upland substation 6 increased as well during the summer of 2002. Average salinities at this site (1.9 $\pm$ 0.2 ppt, Hackney et al. 2003) increased almost tenfold from previous average salinities (0.2 + 0.1 ppt, Hackney et al. 2002a, 2002b). Salinities during the summer of 2003 were lower than that of the summer of 2002 with the majority of salinities below 0.4 ppt. (Hackney et al. 2005). On the basis of classifications, the summer of 2003 was the freshest observed during this project at the time. All but 5 substations were methanogenic (Hackney et al. 2005), whereas during the second freshest summer (2001), 10 substations had sulfate reducing conditions (Hackney at al., 2002). Conditions during the summer (2004) were slightly saltier than 2003 in most stations except S6 which was slightly fresher (Table 5.51-1). Several classifications shifted from M and MPSR to SR as a result of increased salinity while a few MPSR classifications converted to M near the uplands. With the exception of the creek bank location, this site was generally fresher than the previous year. Several SR classifications were converted to MPSR and M classifications.

5.57 Fishing Creek (P13)

The winter porewater salinities at Fishing Creek displayed a peak during the winter of 2002 (Hackney et al. 2002b) and returned to values similar to the winters of 2000 and 2001 (Hackney et al. 2002a) during the winter of 2003 (Hackney et al. 2003). Salinities of approximately 1 ppt. were observed during the winter of 2002 (Hackney et al. 2002b). During the winter of 2003 salinities were all less than 0.5 ppt (Hackney et al.

2003). Winter 2004 salinities displayed a freshening trend with all salinities below 0.1 ppt except for substation 3 (Hackney et al. 2005). On the basis of classifications, the winter of 2004 and 2005 were the freshest on record with only one site having sulfate concentrations high enough to maintain sulfate reduction (Hackney et al. 2005). The lowest salinity winter (winter 2000) prior to this winter had 6 sub-depths with sulfate reducing conditions. The current winter (2006) was slightly fresher with several MPSR converted to M classifications at substation S2 (Table 5.51-3). It should be noted that there was a non-sea salt source of sulfate present at the creek bank location during this winter.

Porewater salinities measured during the summer of 2002 were the highest ever obtained for Fishing Creek since the beginning of the project in 2000 with values of approximately 5-7 ppt. at the near-bank substation, 3 ppt at the mid substations, and essentially fresh conditions at stations near the upland (Hackney et al. 2003). Porewater salinities during the summer of 2003 were the lowest observed during the project for Fishing Creek with values less than 0.1 ppt at the near-bank substation, less than 0.5 ppt at the mid substations (Hackney et al. 2005). Summer 2003 classifications reflected the fresher conditions with all but 2 sub-depths with methanogenic conditions. In previous summers at least 1/3 of the sub-depths were sulfate reducing (Table 5.51-2). Salinities during last summer (2004) were still relatively fresh but slightly saltier than the previous fresh summer of 2003. Several M classifications were converted to MPSR (Table 5.51-2) indicating that the spring was saltier than the previous spring of 2003. However, there were no SR classifications such as those observed during the saltier summers of 2000-2002. During the current, fresher conditions were observed which were similar to the winter of 2003.

5.58 Prince George Creek (P14)

Winter salinities peaked during the winter (2002) and decreased during the winters of 2003-2005. Salinities during the winter (2003) ranged from 0.05 to 0.26 ppt (Hackney et al. 2003), while salinities for the winter of 2004 and 2005 were all below 0.1 ppt. (Hackney et al. 2005; 2006). For the first time all substation sub-depths were methanogenic (Hackney et al. 2005). Conditions during the current winter of 2006 were slightly saltier at the creek bank locations and slightly fresher at the mid and upland locations. No sites had sulfate concentrations able to support sulfate reduction due to lower chloride (Table 5.58-1) and salinities levels (Table 5.51-1).

Summer salinities peaked during 2002 and returned to lower salinity during the summer of (2003). Summer 2002 salinity values were approximately 1 ppt (Hackney et al. 2003), roughly twice previous values (Hackney et al. 2002a, 2002b). The majority of summer (2003) values were below 0.04 ppt. (Hackney et al. 2005). Salinities during the summer 2004 were slightly lower than the previous summer of 2003. Prior to the summer of 2002, summer geochemical classifications were essentially all (M). Due to the increase in salinity at this site during the summer 2002, the majority of substations were converted to (SR) (Table 5.51-2). None of the classifications from the flowing summers (2003, 2004) were sulfate reducing and were similar to the previous summers of

2000 and 2001. Conditions during the current summer are similar with the exception of a few sites displaying a non-sea salt source of sulfate.

Table 5.58-1. Chloride Concentrations of Sites. Chloride concentrations of porewaters in µM.

Station	Substation	Depth (cm)	Chloride	
			Summer 2005	Winter 2006
Town Creek	1	1	10918	14478
P3	1	6	27690	21509
	1	11	29418	22959
	1	16	30798	36559
	1	21	29610	39769
	1	26	32382	28876
	2	1	27769	15254
	2	6	5445	18955
	2	11	46502	34636
	2	16	45255	32055
	2	21	47892	38305
	2	26	50887	46555
	3	1	2600	14401
	3	6	4840	14219
	3	11	16398	16025
	3	16	28687	25988
	3	21	34685	41972
	3	26	40537	64720
	4	1	4152	11328
	4	6	5940	17542
	4	11	7539	21158
	4	16	9540	23988
	4	21	10738	34958
	4	26	14294	31669
	5	1	3074	5856
	5	6	9274	4874
	5	11	12726	4220
	5	16	13435	4583
	5	21	13425	6564
	5	26	13655	8470
	6	1	1445	5148
	6	6	6875	7604
	6	11	11690	8643
	6	16	31576	13049
	6	21	20194	16946
	6	26	26423	33968

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2005	Winter 2006
Eagle Island	1	1	46893	1703
P6	1	6	47315	2134
	1	11	49957	2065
	1	16	52524	2758
	1	21	47042	3284
	1	26	35335	4520
	2	1	46022	20718
	2	6	45562	27940
	2	11	41229	33487
	2	16	38554	35196
	2	21	34171	33028
	2	26	31620	36450
	3	1	28066	8040
	3	6	31161	10492
	3	11	31710	14851
	3	16	31446	10433
	3	21	29853	14294
	3	26	34744	13226
	4	1	27026	17313
	4	6	28777	23543
	4	11	22982	15611
	4	16	28762	25416
	4	21	28353	26254
	4	26	26694	25903
	5	1	16139	8778
	5	6	16031	11171
	5	11	18756	13141
	5	16	18008	14066
	5	21	13750	15825
	5	26	13173	16849
	6	1	8467	7679
	6	6	14623	9385
	6	11	14376	8841
	6	16	13599	9461
	6	21	7374	7653
	6	26	8320	9445

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2005	Winter 2006
Indian Creek	1	1	2297	1304
P7	1	6	3120	1476
	1	11	4098	1958
	1	16	6433	2525
	1	21	3324	2881
	1	26	2980	4942
	2	1	1238	1004
	2	6	1589	916
	2	11	1997	991
	2	16	2070	1141
	2	21	2020	1272
	2	26	1766	1620
	3	1	1227	645
	3	6	1205	663
	3	11	1252	619
	3	16	1190	617
	3	21	1179	643
	3	26	1357	733
	4	1	1293	945
	4	6	1126	692
	4	11	1080	714
	4	16	1022	773
	4	21	1380	705
	4	26	1195	---
	5	1	594	57
	5	6	771	376
	5	11	1135	361
	5	16	675	362
	5	21	789	275
	5	26	704	402
	6	1	437	284
	6	6	299	300
	6	11	438	276
	6	16	300	288
	6	21	364	283
	6	26	210	360

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2005	Winter 2006
Dollisons Landing P8	1	1	78	655
	1	6	713	564
	1	11	843	691
	1	16	503	566
	1	21	595	624
	1	26	679	845
	2	1	357	597
	2	6	560	668
	2	11	529	557
	2	16	577	527
	2	21	710	577
	2	26	633	601
	3	1	801	839
	3	6	813	683
	3	11	887	620
	3	16	979	744
	3	21	1061	545
	3	26	1285	563
	4	1	705	622
	4	6	641	557
	4	11	651	552
	4	16	715	536
	4	21	676	511
	4	26	576	598
	5	1	1131	2146
	5	6	1383	1696
	5	11	1526	2138
	5	16	1445	2253
	5	21	1662	2187
	5	26	1594	2183
	6	1	2693	2005
	6	6	2724	1864
	6	11	4830	1874
	6	16	2294	3654
	6	21	2551	1579
	6	26	2836	1165

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2005	Winter 2006
Black River	1	1	848	970
P9	1	6	665	784
	1	11	710	657
	1	16	867	696
	1	21	833	754
	1	26	840	780
	2	1	777	520
	2	6	686	681
	2	11	731	601
	2	16	618	674
	2	21	603	670
	2	26	802	463
	3	1	837	588
	3	6	679	501
	3	11	859	504
	3	16	1401	463
	3	21	749	513
	3	26	664	538
	4	1	624	569
	4	6	597	501
	4	11	514	444
	4	16	560	610
	4	21	513	456
	4	26	914	466
	5	1	628	511
	5	6	611	498
	5	11	549	490
	5	16	521	483
	5	21	740	516
	5	26	675	816
	6	1	748	448
	6	6	775	460
	6	11	1215	449
	6	16	1187	478
	6	21	1119	432
	6	26	996	465

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2005	Winter 2006
Smith Creek	1	1	89994	30788
P11	1	6	100791	39847
	1	11	80837	47543
	1	16	71082	52240
	1	21	66535	58495
	1	26	68251	66824
	2	1	78647	24150
	2	6	96177	25168
	2	11	93699	30940
	2	16	91345	59313
	2	21	88062	53013
	2	26	82604	67193
	3	1	83720	300530
	3	6	93959	40862
	3	11	94362	41803
	3	16	96940	66208
	3	21	83450	58433
	3	26	79017	65996
	4	1	73927	29441
	4	6	80649	31576
	4	11	71100	43019
	4	16	69288	53688
	4	21	62439	65509
	4	26	66721	57578
	5	1	67547	32178
	5	6	72265	43037
	5	11	73301	45965
	5	16	68327	34103
	5	21	69576	54984
	5	26	64917	44186
	6	1	61056	11844
	6	6	60425	13581
	6	11	59890	12992
	6	16	55594	12827
	6	21	61155	15507
	6	26	60540	20069

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2005	Winter 2006
Rat Island	1	1	17848	5210
P12	1	6	35183	5778
	1	11	17707	7925
	1	16	17966	8815
	1	21	17099	11212
	1	26	17781	70
	2	1	24470	1953
	2	6	19593	2941
	2	11	20083	3732
	2	16	17835	6477
	2	21	14590	10413
	2	26	12182	14660
	3	1	19658	16935
	3	6	14132	16756
	3	11	15825	17734
	3	16	15011	16938
	3	21	14143	17690
	3	26	13608	17840
	4	1	9908	4060
	4	6	11434	4602
	4	11	13539	7020
	4	16	15274	7067
	4	21	13646	7238
	4	26	12595	7702
	5	1	4972	2131
	5	6	4599	2510
	5	11	5387	2963
	5	16	6292	3046
	5	21	8035	2888
	5	26	8356	3060
	6	1	1416	1386
	6	6	1036	916
	6	11	1300	1077
	6	16	822	893
	6	21	667	1223
	6	26	1491	1340

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2005	Winter 2006
Fishing Creek	1	1	1143	54
P13	1	6	1341	709
	1	11	1576	534
	1	16	2624	583
	1	21	3113	648
	1	26	3348	772
	2	1	1019	1288
	2	6	984	1036
	2	11	1081	1015
	2	16	977	990
	2	21	1077	1513
	2	26	1170	1609
	3	1	1977	2677
	3	6	2157	2298
	3	11	2165	2895
	3	16	2489	3909
	3	21	2567	2973
	3	26	2978	3065
	4	1	1023	732
	4	6	1000	728
	4	11	1019	694
	4	16	1071	707
	4	21	1016	778
	4	26	1033	727
	5	1	832	610
	5	6	787	471
	5	11	873	581
	5	16	737	439
	5	21	799	469
	5	26	865	449
	6	1	357	307
	6	6	247	269
	6	11	222	261
	6	16	293	286
	6	21	390	197
	6	26	352	274

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2005	Winter 2006
Prince George	1	1	689	1153
P14	1	6	636	1111
	1	11	537	1133
	1	16	672	1071
	1	21	722	1014
	1	26	922	1579
	2	1	785	1956
	2	6	876	1256
	2	11	973	1249
	2	16	837	1290
	2	21	886	1283
	2	26	1030	1591
	3	1	570	1168
	3	6	692	1023
	3	11	729	1324
	3	16	738	1125
	3	21	716	1101
	3	26	744	1126
	4	1	765	1228
	4	6	803	1241
	4	11	861	1118
	4	16	809	1411
	4	21	773	1069
	4	26	839	1132
	5	1	729	1112
	5	6	743	987
	5	11	783	1045
	5	16	821	868
	5	21	675	944
	5	26	718	1022
	6	1	586	1017
	6	6	612	930
	6	11	606	890
	6	16	596	817
	6	21	597	981
	6	26	517	787

5.6 Long Term Trends and Change

The patterns of variations for the current year and previous years follow.

Year 1 (winter 2000, 2001, summer 2000):

During the first year of the study general geochemical classifications were established for the sites in order to compare with future conditions. In the first report, which included the winters of 2000, 2001, and the summer of 2000 (Hackney et al. 2002), three of these stations were primarily sulfate reducing year-round (P3 - Town Creek, P12 - Rat Island, and P11- Smith Creek) two were primarily methanogenic year round (P8 - Dollisons Landing, and P14 - Prince George) and four exhibited mixed conditions with sulfate reduction typically dominating the geochemistry during the summer and methanogenesis dominating during the winter (P7- Indian Creek , P9 - Black River, P12 - Rat Island, P13 - Fishing Creek) (Hackney et al. 2002).

Year 2 (winter 2002, summer 2001):

In the second report, which included the summer of 2001 and the winter of 2002 (Hackney et al. 2002ab), two Northeast Cape Fear River sites, Prince George (P14) and Fishing Creek (P13), displayed a dramatic change in winter classification from methanogenic in the winters of 2000 and 2001 to sulfate reducing in the Winter of 2002 resulting from an increase in salinity. The other two sites on the Northeast Cape Fear River, Rat Island (P12) and Smith Creek (P11), also showed signs of increased salinity although their general classification did not change. Rat Island (P12) had several methanogenic classifications converted to sulfate reducing. Smith Creek (P11), which was already a sulfate reducing system, recorded higher salinities in porewaters.

The summer geochemical classifications on the Cape Fear River showed the opposite trend with evidence of a slight freshening of the porewaters. Changes in classifications of the Cape Fear River sites were not as dramatic as those observed on the Northeast Cape Fear River. The general trend for Cape Fear River sites was a slight freshening of the porewaters in winter 2002 and saltier conditions in summer 2001 compared to the data contained in the previous report. Town Creek (P3), which is located below the confluence of the Northeast Cape Fear River and the Cape Fear River, displayed a similar trend as that of the Cape Fear River sites with slightly saltier conditions during the summer and slightly fresher conditions during the winter.

Year 3 (winter 2003, summer 2002):

The increases in porewater salinities observed during previous summers continued through the summer of 2002 in the Northeast Cape Fear River (Fishing Creek, Prince George, Rat Island, Smith Creek). Due to the continued increase in summer salinities, all four sites were classified as sulfate reducing geochemical classifications for the first time. With the exception of Smith Creek, which already had a sulfate reducing geochemical classification, this was the first time the upper Northeast Cape Fear sites have had a summertime sulfate reducing geochemical classifications. A similar increase in summertime porewater salinity was noted in the Cape Fear River sites immediately above the City of Wilmington (Indian Creek, Eagle Island) while the sites further upstream on the Cape Fear River (Black River, Dollisons Landing) had peak salinities occurring during the previous summer (2001). The salinities of Town Creek, the only site below the City of Wilmington monitored for geochemical classification, showed no obvious change in summer porewater salinity.

With the exception of Town Creek, which is below the city of Wilmington, and the Cape Fear River sites immediately above the City of Wilmington (Indian Creek, Eagle Island) all sites had lower winter porewater salinities than previous winters. For the upper Cape Fear River stations (Black River, Dollisons Landing), winter conditions showed a steady decrease in salinity since 2000. Fresher conditions did not cause a shift in geochemical classification for these sites since they were already methanogenic. In the Northeast Cape Fear River (Fishing Creek, Prince George, Rat Island, Smith Creek), winter (2003) porewater salinities returned to lower values after peaking during the previous winter (2002). The decrease in salinities for the more seaward stations (Rat Island and Smith Creek) was not enough to convert these systems from sulfate reducing geochemical classification. For upstream stations (Fishing Creek, Price George), several substations that previously converted to sulfate reducing during returned to a methanogenic geochemical classification during the winter (2003). Porewater salinities of Town Creek, Indian Creek, and Eagle Island increased during the winter (2003). The changes in geochemical classifications were relatively small for these sites with only slight changes towards higher salinity classifications.

Year 4: (winter 2004, summer 2003)

Low salinity conditions characterize year four, summer 2003 and winter 2004. In general, all sites experienced conditions that would be considered low salinity on the basis of previous winters and summers. Several sites had conditions that were the lowest in salinity since the study began in 2000. For the most seaward station, Town Creek, both the winter and summer were the freshest on record. The Cape Fear River sites (Indian Creek, Dollisons Landing, and Black River) had a relatively low salinity winter and a summer that was the freshest observed during this study. While all Northeast Cape Fear River sites had relatively fresher conditions during the current year, there was more variability in the extent to which they experienced low salinities. Fishing Creek had the freshest winter and summer on record, Prince George had the freshest winter on record, and Rat Island had the freshest summer on record. Smith Creek had fresh conditions during both the summer and winter, but not the freshest on record.

Year 5: (winter 2005, summer 2004)

Low salinity conditions characterize year five of the study, summer 2004 and winter 2005. In general, all sites experienced conditions that would be considered low salinity on the basis of previous winters and summers. However, conditions were not as fresh as the previous year. Five stations experienced slightly saltier conditions during the current summer (2004) compared to last summer (Town Creek, Indian Creek, Black River, Smith Creek, and Fishing Creek), while Prince George experienced slightly fresher conditions. The remainder of sites either had no change or a mix of fresher and saltier conditions within the site. Two stations experienced slightly saltier conditions during the current winter (2005) compared to last winter (Town Creek and rat Island), while Indian Creek experienced slightly fresher conditions. Five sites were essentially the same as the previous winter (Eagle Island, Black River, Smith Creek, Fishing Creek and Prince *George) and Dollisons Landing had both saltier and fresher conditions with the site.*

Year 6: (winter 2006, summer 2005)

In general fresher conditions continued though year six of this monitoring study, although slight differences were noted between the current year and the previous one. During the current winter, these slight changes in salinity and mode of organic matter remineralization varied systematically with river location. NECF river sites (Prince George, Fishing Creek, Rat Island and Smith Creek) displayed a slight freshening, while all but one (Indian Creek) main stream CFR sites showed slightly saltier conditions (Eagle Island, Black River, Dollisons Landing). Town Creek, which is the most seasward location monitored for geochemistry was noticeable fresher.

During the summer there were no consistent patterns with some sites showing slightly saltier conditions (Rat Island creek bank, Smith Creek, Eagle Island, Town Creek) and some showing slightly fresher conditions (Fishing Creek, Rat Island upland, Indian Creek, Black River).

6.0 BENTHIC INFAUNA COMMUNITIES

6.1 Summary

This chapter summarizes infaunal community patterns at 9 sites distributed among the Cape Fear River, Northeast Cape Fear River and Town Creek from 1999-2005. This period covered three major potential system-level impacts: a developing drought in 2001-2002, a period of recovery and relatively higher freshwater input late in 2003 and in 2004, as well as the initiation of channel widening construction in 2001-2002. Diversity was generally lowest in 2000 and species richness and diversity were generally highest in 2004 (six out of nine sites for both parameters). However, there were no consistent patterns for either diversity or richness among the remaining years. Richness and diversity for 2005 was intermediate and not significantly different from either 2003 or 2004 (with one exception of a difference between 2004 and 2005 at P3b). Analysis of Similarity and Multidimensional Scaling Analysis indicated that 1999-2001 samples did not have significantly dissimilar faunal assemblages. However, subsequent years did have distinct infaunal assemblages, both from the 1999-2001 grouping as well as from each other. The overall separation of 2002-2005 from 1999-2001 was greater than differences among the 2002-2005 grouping as indicated by Analysis of Similarity. As part of the 2004 report, we had identified a shift in species dominance related primarily to increasing drought impacts (many sites initially dominated by tidal freshwater and oligohaline species shifted toward dominance by oligohaline-mesohaline polychaetes in 2002) and subsequent recovery in 2003. Summer 2004 showed the highest mean abundances or second highest mean abundance among major taxonomic groupings and functional groups for all but a few sites. Dominance patterns varied among sites, but in general oligochaetes and insect taxa were the most abundant taxa at most sites in 2004. Patterns for 2005 for both major taxa and functional guilds continued this trend, with increases in oligochaetes at 3 sites (reflected in deep burrowers as well), insects at 3 sites (reflected in surface mobile fauna), and amphipods at 2 sites.

6.2 Background

As part of the U.S. Army Corps of Engineers project to deepen the Cape Fear River shipping channel from the mouth of the river to Wilmington Harbor, benthic infaunal communities have been monitored at stations predicted to have the greatest potential impacts. The focus of this sampling effort is on the fringing wetlands that border the river and represent critical habitat and nursery areas for a number of commercially and ecologically important taxa. Changes in the composition and abundance of organisms living within or directly on the sediments of the fringing marsh (infauna) may result from changes in salinity, flow and tidal currents. Benthic infaunal community patterns integrate environmental changes at a specific site over time. Most infauna have limited post-larval mobility or dispersal, with abundances at a site reflecting a combination of recruitment patterns and site-specific processes. Infauna may be relatively long-lived, with lifespans of months to years for some taxa, and they occupy intermediate trophic positions, consuming detrital or planktonic food sources and being prey for larger fish and decapods. As a result, the infaunal community present in an area represents cumulative impacts of varying environmental factors over a several month period. Changes in the composition of the infaunal community in response to changing environmental conditions may occur more slowly than for more motile organisms that can migrate to optimal locations. However, changes in this group may also have fundamental importance for local ecosystem functioning because of their key position in nearshore estuarine food webs.

While many benthic species are resilient to short-term disturbances, long-term change associated with fluctuations in water quality, changes in tidal inundation or amplitude, changes in current flow or local hydrology, or changes in salinity regime and other physical factors may alter species composition and abundance. These physical changes may impact the infaunal community through direct mortality, reduced dispersal, food web alteration, and impacts related to increased stress (e.g. reduced feeding, competition). The monitoring effort reported here is designed to detect changes in the infaunal communities at selected sites that may be coincident with the timing of deepening of the Cape Fear River shipping channel. We hope to be able to distinguish potential long-term changes related to these anthropogenic impacts from year-to-year variability related to climatic fluctuations. Current working hypotheses are: 1) Changes in salinity and/or tidal amplitude and/or inundation period will lead to changes in intertidal and shallow subtidal benthic community composition. 2) If alterations of the Cape Fear River shipping channel significantly change estuarine flow characteristics, a change in community composition and function reflecting altered recruitment patterns may follow.

Polychaetes, oligochaetes, amphipods, and insect larvae are the dominant taxonomic groups of the Cape Fear estuary. Polychaetes and amphipods tend to dominate mesohaline sites in the river, while oligochaetes and insects dominate the oligohaline sites, although this pattern may shift among years and site-specific responses may vary with taxonomic composition. The relative importance of specific species that dominate a site changes along the estuarine gradient from polyhaline to oligohaline and tidal freshwater conditions. As noted in previous evaluations of the Cape Fear River estuary, both bivalves and gastropods have conspicuously low abundances in estuarine portions of the river both in the intertidal and subtidal habitats (Mallin et al. 1999 and 2001). Infaunal groups demonstrate a variety of reproductive, dispersal, and functional strategies that can directly relate to timing and magnitude of their response to shifting environmental conditions. Polychaetes (segmented worms bearing specialized appendages) are common throughout the estuary and are generally the numerically dominant taxa in euhaline to mesohaline environments. Polychaetes have a variety of living modes including free-living, burrowing, and sedentary forms. Burrowing and tube-dwelling species dominate in most of the intertidal and shallow subtidal areas and are common prey for fish, shrimp and crabs. Oligochaetes are another group of segmented worms that generally lack specialized appendages, have a burrowing habit and exhibit direct development. Direct development in this group can result in locally dense patches and the ability to respond quickly to local environmental changes. Their deeper burrowing habit often makes them less available as a prey resource for fish and decapods than tube-dwelling polychaetes or amphipods. Amphipods are a diverse group of brooding crustaceans. This group can exhibit explosive population growth under optimal conditions, and serves as a critical food resource in fringing wetlands during at least certain time periods. Although many are free-living or pelagic, a large proportion of estuarine amphipods are tube builders that can be highly mobile over small spatial scales and may quickly colonize disturbed habitats. Insect larvae are among the most numerous and diverse groups that inhabit the oligohaline and tidal freshwater regions of the estuary, but are generally absent from lower mesohaline and more saline areas. Insect larvae exploit virtually every habitat type in the upper estuary and are distinct from other groups in having aerial dispersal. However, many insects are very sensitive to salt intrusions and are indicators of changing salinity conditions. Like other infaunal groups, this group includes of a number of living strategies including surface tube-dwelling and free-living species that would be susceptible to predation especially by juvenile fish that recruit into the system heavily in the spring and to a lesser extent in the fall of each year.

6.3 Methodology

Infaunal core samples were collected at nine stations along the Cape Fear River estuarine gradient. Three benthic stations are located in Town Creek (P2 at the mouth of Town Creek, P3A and P3B inner Town Creek), three stations in the main stem Cape Fear above the city of Wilmington (P6- Eagle Island, P7- Indian Creek, and P8- Dollisons Landing), and three stations in the Northeast Cape Fear River (P11- Smith Creek, P12- Rat Island, and P13- Fishing Creek). These stations are the same as those being monitored for epifauna patterns (Section 7.0) and represent a subset of those stations being monitored for changes in physical factors that may be causal for possible biotic changes (including tidal elevation, inundation, and biogeochemical composition among other variables).

Infaunal core samples (10 cm diameter X 15 cm deep) were collected at two upper intertidal subsites and two lower intertidal subsites at each station. These subsites are fixed stations that were originally marked (and positions recorded using GPS) in 1999. Three replicate core samples were collected within a one-meter area around these points. Core samples are collected at all stations in June of each year. All samples are fixed in a 10% formalin solution (~4% formaldehyde), with rose Bengal dye added, later sieved through a 500 micron screen to remove excess sediment, and preserved in 50% isopropanol. All organisms are separated from the remaining sediment by sorting under a dissecting microscope and identified to lowest reasonable taxon, in most cases this is genus or species.

The major deepening efforts for the Cape Fear River channel began in winter 2001 and were ongoing at various areas within the Cape Fear system into 2005. Since the current report summarizes data from infaunal samples taken through June 2005, the data represents background conditions (pre-dredging; 1999-2001) and possible initial impacts related to the actual sediment removal activities (2002-2005) and any developing hydrologic impacts of channel alterations. Full effects of the deepening project cannot be assessed until 2-3 years of post-dredging data are available to compare to pre-dredging conditions and patterns occurring while dredging was ongoing. However, interim community patterns at each site over the 6 years of sampling were assessed by examining patterns of species diversity, species richness, taxonomic and guild dominance, and community similarity. Per site diversity was calculated using the Shannon-Weiner Diversity Index and was compared along with per sample taxonomic richness among years by site. For comparison of taxonomic richness, taxa were combined where there was uncertainty among years. Abundances of major taxanomic groups (polychaetes, oligochaetes, amphipods and insects) and major functional guilds (sedentary/tube dwellers, surface/mobile taxa, deep burrowing taxa, and surface burrowing taxa) were compared among years separately for each site using analysis of variance. Abundances were log-transformed before analyses to meet assumptions of homogeneity of variances. Community similarity was compared among site / year combinations using the ANOSIM and multidimensional scaling data analysis procedures of the PRIMER statistical package (Clarke and Gorley 2001). These procedures examine community similarity based on a Bray-Curtis Similarity matrix. All species were included in this analysis and abundances were square root transformed to reduce dominating effects on analyses by common taxa.

6.4 Faunal Patterns

While four locations (two high intertidal and two low intertidal substations) where sampled at each station, mean total abundances for all infaunal species present at a given station are given by tidal position. In order to more easily compare the relative abundance and shifts in composition between tidal positions and among years, abundance data is presented in three year blocks by tidal position and only for taxa that were present at that site/substation combination. Tables 6.4-1a and 6.4-1b represent the mouth of Town creek (P2) located in the mesohaline region of the Cape Fear River, while Tables 6.4-2a and 6.4-2b and Tables 6.4-3a and 6.4-3b represent the two inner Town Creek sites, P3A and P3B, respectively. Shifts in species composition and relative abundance are evident in the main stem Cape Fear sites; Eagle Island (P6) (Tables 6.4-4a and 6.4-4b), Indian Creek (P7) (Tables 6.4-5a and 6.4-5b), and Dollisons Landing (P8) (Tables 6.4-6a and 6.4-6b). Most of these individual species shifts follow major taxonomic changes (see below), though there was considerable species replacement among years within a guild or higher taxonomic grouping. Mean abundances for the three Northeast Cape Fear River stations, Smith Creek (P11) (Tables 6.4-7a and 6.4-7b), Rat Island (P12) (Tables 6.5-8a and 6.5-8b), and Fishing Creek (P13) (Tables 6.4-9a and 6.4-9b) also show a high degree of variability among years, generally following the shifts in major guild or taxonomic groups.

Table 6.4-1a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected on the Town Creek mouth site (P2) during June 1999, 2000, 2001, 2002, 2003, 2004, and 2005. The means presented here represent the combination of two sub-sites for high intertidal areas.

High Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
amphipod sp.	0.17(0.17)	0.5(0.23)	0(0)	0(0)	0(0)	0(0)	0(0)
Bezzia/*palpomia*	0.5(0.5)	0(0)	0(0)	2.0(2.0)	2.5(0.86)	3.5(2.06)	0(0)
juv. Bivalve	1.0(0.37)	0.5(0.29)	0(0)	0(0)	0.25(0.25)	1(0.58)	0.25(0.25)
Boccardia sp. A	0(0)						1.75(1.75)
Boccardiella sp.	0(0)	26.5(18.62)	0(0)	0.25(0.25)	0.75(0.48)	18.75(6.97)	6.25(4.73)
Capitellidae sp.	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	
Cassidinidea lunifrons	0.17(0.17)	0.5(0.5)	0(0)	0(0)	0.5(0.5)	2(1.35)	2.25(0.63)
Caulleriella killariensis	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Chironomid larvae	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Coleoptera sp.							0.25(0.25)
Corophium acherusicum	0(0)	0(0)	12.5(8.72)	0(0)	0(0)	0(0)	0(0)
Corophium acutum	0(0)	0(0)	7.75(7.75)	0(0)	0(0)	0(0)	0(0)
Corophium lacustre	0(0)	4.25(0.85)	0(0)	0(0)	0.5(0.29)	28.25(9.28)	75.25(40.79)
Corophium sp.	0.17(0.17)	0(0)	11.75(7.81)	0(0)	0(0)	2(2)	0(0)
Crangonyx psudogracilis	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)
Curculionidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	1.5(1.19)	0(0)
Cyathura polita	0(0)	0.75(0.75)	0(0)	0(0)	0(0)	4.5(3.84)	0.25(0.25)
Dicrotendipes lobus	0(0)	0(0)	0(0)	0(0)	0(0)	22.0(17.64)	0(0)
Dicrotendipes nervosus	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Dicrotendipes sp.	2.0(0.93)	1.0(1.0)	0.25(0.25)	0(0)	7.5(6.85)	1.5(1.5)	0.25(0.25)
Dipolyudora ligni	0(0)	0(0)	0(0)	0(0)	0(0)	2.0(1.08)	0(0)
Dolichopodidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Eteone heteropoda	0(0)	1.0(0.41)	0(0)	0(0)	0(0)	0(0)	0(0)
Eteone sp.	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Fabriciola sp.	0(0)	0(0)	0(0)	37.0(37.0)	0(0)	0(0)	0(0)
Fabriciola trilobata	0(0)	0(0)	0(0)	5.75(5.42)	0(0)	0.25(0.25)	0.50(0.50)
Flabelligeridae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Gammarus sp.	0(0)	0.75(0.48)	0(0)	0.25(0.25)	0(0)	0.25(0.25)	0(0)
Gammarus tigrinus	0(0)	2.25(2.25)	0(0)	0(0)	0(0)	0(0)	0(0)
juv. Gastropod	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Hageria rapax	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	5.0(4.67)	24.50(12.58)
Hobsonia florida	3.67(2.01)	3.0(2.68)	0.5(0.5)	0(0)	0.5(0.5)	11.25(4.27)	0(0)
insect pupae	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
insect sp.	0.17(0.17)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Laeonereis culveri	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	1.25(0.75)
Marenzellaria virdis	1.67(1.67)	0(0)	0(0)	0(0)	0(0)	0.5(0.29)	0(0)
Megalops	0(0)	0(0)	0(0)	0(0)	0(0)	1.5(0.65)	0.25(0.25)
Melita nitida	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.75(0.48)
Mite	0(0)	0(0)	0(0)	0(0)	0(0)	1.0(0.71)	0(0)
Nereidae sp.	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Nereis falsa	0(0)	1.25(1.25)	0(0)	0(0)	0(0)	0(0)	1.00(1.00)
Nereis riisei	0.67(0.49)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Neanthes succinea	0(0)	0.25(0.25)	1.5(0.96)	0(0)	0(0)	0(0)	1.75(0.63)
Notophilia sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Oligochaete	36.5(11.55)	8.75(6.79)	2.25(1.31)	0(0)	0(0)	0(0)	0(0)
Orchestia uhleri	0(0)	0(0)	0(0)	0.75(0.75)	0(0)	0.25(0.25)	0.25(0.25)
Owenia sp.	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Palaemonetes pugio	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.50(0.50)
Parandalia sp.	1.0(0.63)	0(0)	0.5(0.29)	2.75(1.11)	0(0)	4.75(2.93)	1.25(0.95)

Table 6.4-1a. (continued)

High Intertidal	June 99	June 00	June 01	June 02	June 03	June 04	June 05
Polydora caulleryi							0.25(0.25)
Polydora ligni	12.17(10.83)	0.25(0.25)	0.25(0.25)	0.75(0.48)	0(0)	0(0)	2.00(1.68)
Polydora socialis	5.5(4.11)	0(0)	3.25(3.25)	0.25(0.25)	0(0)	0(0)	3.25(2.93)
Polypedilum sp.	1.5(0.72)	0.3(0.3)	0(0)	0(0)	13.5(11.51)	0.5(0.29)	0(0)
Streblospio benedicti	0.83(0.31)	0.75(0.25)	0.25(0.25)	8.25(4.77)	0(0)	0(0)	1.75(1.44)
Tanais sp.	0.33(0.33)	0(0)	16.75(9.46)	0(0)	0(0)	0(0)	0(0)
Tanytarus sp.	0(0)	0(0)	0(0)	0(0)	0.75(0.75)	0(0)	0(0)
Tipulidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	2.25(1.93)	2.75(1.55)	52.5(27.52)	31.00(17.61)
Tubificoides heterochaetus	0(0)	0(0)	0(0)	0.5(0.5)	0(0)	0(0)	6.25(5.92)
Uca minax	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0.25(0.25)	0(0)
Uca sp.	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)

Table 6.4-1b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected on the Town Creek mouth site (P2) during June 1999, 2000, 2001, 2002, 2003, and 2004. The means presented here represent the combination of two sub-sites for low intertidal areas.

Low Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
amphipod sp.	0.17(0.17)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Belanus improvisus	0(0)	0(0)	4.8(4.8)	0(0)	0(0)	1.0(0.71)	0(0)
juv. Bivalve	0(0)	0.25(0.25)	0(0)	0.29(0.18)	0(0)	0.5(0.29)	0.20(0.20)
Boccardiella sp.	0(0)	16.5(5.17)	0(0)	0(0)	0(0)	0(0)	0(0)
Capitella capitata	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)	0(0)
Chironomus sp.	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)	0(0)
Collembola sp.	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0.60(0.24)
Corophium sp.	0(0)	0.25(0.25)	0.2(0.2)	0(0)	0(0)	0.25(0.25)	0(0)
Corophium lacustre	0(0)	2.5(1.19)	0(0)	0(0)	0(0)	0(0)	0.20(0.20)
Cyclaspis varians	0(0)	0(0)	0(0)	0.14(0.14)	0(0)	0(0)	0(0)
Dicrotendipes sp.	0(0)	0.5(0.5)	0(0)	0(0)	0(0)	0(0)	0(0)
Edotea (*montosa*)	0.17(0.17	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Edotea sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.20(0.20)
Edotea triloba	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Eteone heteropoda	0(0)	0(0)	0(0)	0.71(0.42)	0(0)	0(0)	0(0)
Gammarus sp.	0(0)	0.25(0.25)	0.2(0.2)	0.14(0.14)	0(0)	0(0)	0(0)
Gammarus tigrinus	0.33(0.33)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)	0(0)
Haustoridae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Hobsonia florida	0.83(0.83)	4.0(2.74)	0(0)	0(0)	0.25(0.25)	0.25(0.25)	0(0)
Laeonereis culveri	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Mediomastus ambiseta	1.17(0.83)	0(0)	0(0)	2.86(2.54)	0(0)	0(0)	3.40(1.47)
Mediomastus sp.	1.67(0.99)	0(0)	0(0)	4.29(2.3)	0.25(0.25)	0.25(0.25)	4.20(1.68)
Melita nitida	0(0)	0.5(0.5)	0.2(0.2)				0(0)
Mucrogammarus mucronata	0(0)	0(0)	0(0)	0.14(0.14)	0(0)	0(0)	0(0)
Nemertea sp.	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0.40(0.24)
Nereis acuminata	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Neanthes succinea	0(0)	1.25(0.95	0.2(0.2)	0.14(0.14)	0(0)	1.25(0.95)	0(0)
Oligochaete	4.83(2.21)	2.5(1.19)	0.2(0.2)	0(0)	0(0)	0(0)	0(0)
Orthoptera sp.							0.20(0.20)
Parandalia sp.	2.5(0.85)	1.0(0.71)	0.8(0.37)	2.43(1.49)	0(0)	0.75(0.25)	0.20(0.20)
Paraprionospio pinnata	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Polydora ligni	0.83(0.83	1.5(1.5)	0(0)	0.43(0.43)	0(0)	0(0)	0(0)
Porcladius sp.	0(0)	0(0)	0(0)	0(0)	0.75(0.25)	0(0)	0(0)
Spisula solidessima	0(0)	0(0)	0(0)	0.29(0.18)	0(0)	0(0)	0(0)
Streblospio benedicti	3.0(1.69	0(0)	1.6(1.03)	54.29(11.27)	0(0)	0(0)	0.40(0.40)
Syllidae sp.	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Tanais sp.	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Tubificoides heterochaetus	0(0)	0(0)	0.2(0.2)	0.86(0.7)	0(0)	3.25(1.31)	12.80(3.43)
Tubificidae sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0.25(0.25)	0.20(0.20)

Table 6.4-2a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P3A upper Town Creek sites during June 1999, 2000, 2001, 2002, 2003, 2004 and 2005. The means presented here represent the combination of two sub-sites for high intertidal areas.

High Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
Acarina	0(0)	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)
Apedilum sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)
Bezzia/*palpomyia*	0(0)	0(0)	0.4(0.24)	0.17(0.17)	0.75(0.47)	0.25(0.25)	2.00(0.91)
juv. Bivalve	0.17(0.17)	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0.50(0.29)
Cassidinidea lunifrons	0(0)	0(0)	1.0(0.32)	0(0)	1.25(0.63)	4.0(0.91)	1.00(0)
Collembola sp.	0.33(0.21)	0(0)	0(0)	8.67(7.09)	0(0)	1.25(0.48)	0(0)
Corophium volutator	0(0)	0(0)	0(0)	0(0)	0(0)	0.75(0.48)	1.00(0.41)
Chironomidae sp	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Cryptochironomous sp	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)	0(0)
Cyathura (madelinae)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Cyathura polita	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	1.5(1.19)	2.75(1.11)
Dicrotendipes sp.	0(0)	0(0)	0(0)	0.17(0.41)	0(0)	0(0)	0(0)
Dicrotendipes (lobus)	0(0)	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)
Dolichopodidae larvae	0(0)	3.75(1.38)	0.6(0.4)	0(0)	0.25(0.25)	0(0)	0.25(0.25)
Elasmopus sp.	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Enchytraeidae sp	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Eukiefferiella sp.	0(0)	0(0)	1.8(1.56)	0(0)	0(0)	0(0)	0(0)
Gammarus tigrinus	0.33(0.33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Hemipodus roseus	0(0)	0.5(0.5)	0.4(0.24)	0(0)	0(0)	0(0)	0(0)
Hobsonia florida	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.50(0.50)
insect pupae	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
insect sp.	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
insect sp.b	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
insect sp. g	0.33(0.33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
juv. Nereid	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Laeonereis culveri	0.67(0.67)	0.5(0.5)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Lumbriculidae sp	0(0)	0(0)	0.2(0.2)	0(0)	0.75(0.75)	0.75(0.75)	0(0)
Megalops	0(0)	0(0)	0(0)	0.17(0.17)	0.25(0.25)	0.25(0.25)	0(0)
Mite	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Nais sp	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Oligochaete	36.67(24.02)	42.0(12.81)	9.6(3.98)	0(0)	0(0)	0(0)	0(0)
Olivella sp.	0(0)	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)
Orchestia sp.	0(0)	0(0)	0.8(0.58)	0(0)	0(0)	0.5(0.29)	0(0)
Orchestia uhleri	0(0)	0(0)	0.4(0.4)	0.17(0.17)	0(0)	0(0)	0(0)
Parametriocnemus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	4.0(1.58)	0(0)
Polypedilum sp.	0(0)	0.25(0.25)	0(0)	0(0)	3.5(2.36)	0(0)	0(0)
Procladius sp.	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Solenopsis sp	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)	0(0)
Spionidae sp.	0(0)	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)
Streblospio benedicti	0(0)	0(0)	0(0)	0.17(0.17	0(0)	0(0)	0(0)
Tabanus sp	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0.25(0.25)	0(0)
Tubificidae sp.	0(0)	0(0)	2.4(2.4)	0(0)	0(0)	0(0)	21.00(5.02)
Tubificoides heterochaetus	0(0)	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	6.67(3.26)	6.0(0.25)	26.25(5.76)	0(0)
Uca minax	0(0)	0(0)	0(0)	0(0)	0(0)	0.5(0.29)	0(0)
Uca pugilator	0.5(0.34)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Uca pugnax	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Uca sp.	0(0)	0.25(0.25)	0(0)	0.33(0.21)	0.25(0.25)	0(0)	1.00(0.41)

Table 6.4-2b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P3A upper Town Creek sites during June 1999, 2000, 2001, 2002, 2003, 2004 and 2005. The means presented here represent the combination of two sub-sites for low intertidal areas.

Low Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
Ampharetidae sp.	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Amphipoda sp.	0.67(0.33)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Anurida maritima	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	5.00(5.00)
Bezzia/palpomyia	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)	0.25(0.25)
juv. Bivalve	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Boccardiella sp.	0(0)	0(0)	0(0)	0.33(0.21)	0(0)	0(0)	0(0)
Cassidinidea lunifrons	0.17(0.17)	0(0)	0.2(0.2)	0(0)	0.5(0.29)	0.25(0.25)	0.25(0.25)
Chironomidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Collembola sp.	0(0)	0(0)	0(0)	0.33(0.21)	0(0)	21.0(7.15)	
Corophium lacustre	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Corophium volutator	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0.5(0.5)	1.75(1.44)
Cryptochironomous sp	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Cyathura (madelinae)	0(0)	0(0)	0(0)	0(0)	0.5(0.29)	0(0)	0(0)
Cyathura polita	0(0)	0(0)	0.4(0.4)	0(0)	0(0)	0(0)	0.25(0.25)
Dolichopodidae larvae	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	4.25(1.11)	2.00(1.08)
Eukiefferiella sp.	0(0)	0(0)	0.4(0.4)	0(0)	0(0)	0(0)	0(0)
Gammarus plumosa	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Gammarus tigrinus	2.67(2.12)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
gastropod juv.	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Georthocladius sp.				0(0)	0(0)	0.5(0.5)	0(0)
Hobsonia florida	3.17(1.33)	0(0)	0.6(0.4)	0(0)	0.5(0.29)	0(0)	0(0)
Hydrophilidae larvae	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
insect larva b	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	?	0(0)
Insect pupae	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Laeonereis culveri	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	5.25(2.87)
Lumbriculidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	13.5(13.5)	0(0)
Marenzellaria virdis	0.33(0.33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Mediomastus ambiseta	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Mediomastus califoriensis	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Megalops	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Melita nitida	0(0)	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)
Mite	0(0)	0(0)	0(0)	0(0)	0(0)	4.75(1.25)	0(0)
Monopylephorus irroratus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	60.25(60.25)
Monopylephorus sp.	0(0)	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)
Munna sp.	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Neanthes succinea	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Oligochaete	5.0(3.85)	83.0(35.67)	12.4(3.91)	0(0)	0(0)	0(0)	0.25(0.25)
Orchestia sp	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)	0(0)
Polydora ligni	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Polydora sp.	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Polypedilum sp.	1.0(0.37)	0(0)	0(0)	0(0)	1.5(1.19)	0(0)	0(0)
Procladius sp	2.5(0.34)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Streblospio benedicti	0.17(0.17)	0(0)	0.2(0.2)	1.67(1.12)	0(0)	0(0)	0(0)
Tanytarsus sp.	0.5(0.34)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	4.5(1.34)	2.0(1.08)	44.5(15.44)	43.25(21.26)
Tubificoides heterochaetus	0(0)	0(0)	0(0)	0.67(0.33)	0(0)	0(0)	0(0)
Uca pugilator	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Uca sp.	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)

Table 6.4-3a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P3B upper Town Creek sites during June 1999, 2000, 2001, 2002, 2003, 2004 and 2005. The means presented here represent the combination of two sub-sites for high intertidal areas.

High Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
Ablabesmyia sp.	0(0)	0(0)	0(0)	0(0)	2(2)	0(0)	0(0)
Apedilum sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)
Axarus sp.	0(0)	0(0)	0(0)	0(0)	2.5(2.5)	0(0)	0(0)
Bezzia/palpomyia	0(0)	0(0)	0(0)	0.8(0.58)	0.25(0.25)	1.5(0.65)	0.50(0.29)
juv. Bivalve	0.4(0.24)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Boccardiella sp A	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Cassidinidea lunifrons	0(0)	0(0)	0.6(0.24)	0(0)	0.5(0.5)	0.75(0.25)	1.50(0.64)
Chrysops sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)
Collembola sp.	0.4(0.24)	0(0)	0(0)	0.2(0.2)	0.25(0.25)	1.0(0.58)	0(0)
Corophium lacustre	0(0)	0(0)	0(0)	0(0)	1.25(0.95)	0(0)	0(0)
Corophium volutator	0(0)	0(0)	0.4(0.2)	0(0)	1.25(0.95)	0.25(0.25)	0(0)
Cryptochironomous sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Cyathura (madelinae)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Cyathura polita	0(0)	0(0)	0(0)	0(0)	0(0)	1.0(0.5)	0.50(0.50)
Dero sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Dicrotendipes sp.	0(0)	0(0)	0(0)	0(0)	2.5(2.5)	0(0)	0(0)
Diptera sp.	0(0)	0(0)	0(0)	0.2(0.2)	0.25(0.25)	0(0)	0(0)
Dolichopodid larvae	0(0)	0.5(0.5)	0.4(0.24)	0(0)	0(0)	0.5(0.5)	0(0)
Dolichopus sp	0.4(0.4)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)	0(0)
Enchytraeidae sp.	0(0)	0(0)	0(0)	3.0(3.0)	0(0)	0(0)	0(0)
Ephydridae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	2.0(1.41)	0(0)
Erioptera sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Eukiefferiella sp.	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)	0(0)
juv. Gastropod	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
*Hobsonia flori*da	0(0)	0(0)	0.8(0.8)	0.2(0.2)	0(0)	0.25(0.25)	0(0)
Hydrothassa sp.	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)
insect larva c	0.4(0.24)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Laeonereis culveri	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Marenzellaria virdis	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Megalops	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0.25(0.25)
Munna sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Nereidae sp.	0(0)	0.75(0.75)	0(0)	0(0)	0(0)	0(0)	0(0)
juv. Nereidae	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Oligochaete	16.4(6.24)	27.3(6.8)	3(1.84)	0(0)	0(0)	0(0)	0(0)
Orchestia sp.	0.2(0.2)	0.25(0.25)	4.2(3.95)	0(0)	0(0)	0(0)	0(0)
Orchestia uhleri	0(0)	0.75(0.48)	0.2(0.2)	0(0)	0(0)	0(0)	0(0)
Parametriocnemus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	1.25(0.48)	0(0)
Paratendipes sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.75(0.48)	0(0)
Platyhelminthes sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Polypedilum sp.	0(0)	0.25(0.25)	0(0)	0(0)	2.5(2.18)	0.25(0.25)	0.25(0.25)
Procladius sp.	0(0)	0(0)	0(0)	0(0)	1(1)	0(0)	0(0)
Streblospio benedicti	0(0)	0(0)	0.2(0.2)	0.4(0.4)	0(0)	0(0)	0(0)
Tabanus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	1.25(1.25	0(0)
Tanytarsus sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25	0(0)	0(0)
Tubificidae sp.	0(0)	0(0)	1.0(1.0)	0.8(0.58)	8(4.74)	16.5(1.71)	9.50(2.99)
Uca mixax	0(0)	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)
Uca sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)

Table 6.4-3b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P3B upper Town Creek sites during June 1999, 2000, 2001, 2002, 2003, 2004 and 2005. The means presented here represent the combination of two sub-sites for low intertidal areas.

Low Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
Amphipoda sp.	0.33(0.21)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Apedilum sp.				0(0)	0(0)	0.25(0.25)	0(0)
Cassidisca lunifrons	0.17(0.17)	0(0)	0(0)	0.2(0.2)	0(0)	2.0(2.0)	0(0)
Chironomidae sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Collembola sp.	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	13.5(6.54)	0(0)
Coelotanypus sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Corophium acutum	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Corophium lacustre	0(0)	0(0)	0.5(0.5)	0(0)	0(0)	0(0)	0.25(0.25)
Corophium volutator	0(0)	0(0)	0(0)	0(0)	0(0)	9.0(5.70)	0(0)
Cryptochironomous sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Cyathura polita	0(0)	0.5(0.29)	0(0)	0.8(0.8)	0(0)	1.5(0.87)	0.50(0.29)
Dicrotendipes sp.	0.17(0.17)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	
Dolichopodidae larvae	0(0)	0.25(0.25)	0.25(0.25)	0(0)	0(0)	1.25(1.25)	0.25(0.25)
Enchytraeidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	1.0(1.0)	0(0)
Gammarus lawrencianus	0.83(0.83)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Gammarus tigrinus	1.83(1.83)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Gammarus sp.	0.17(0.17)	0(0)	0(0)	0.4(0.4)	0(0)	0(0)	0(0)
Gastropoda sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Goeldichironomus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Heteromastus filiformis	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Hobsonia florida	2.5(0.89)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
insect sp. a	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
insect pupae	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Laeonereis culveri	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	4.25(3.33)	0.75(0.48)
Limnodrilus hoffmeisteri	0(0)	0(0)	0(0)	0(0)	1.75(1.75)	0(0)	0(0)
Lumbriculidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Marenzellaria virdis	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Marinogammarus sp.	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Melita dentata	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)
Mite	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	4.75(2.43)	0(0)
Monopylephorus irroratus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Munna sp.	0.5(0.34)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Namalycastis sp.	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Nimbocera sp	0.5(0.5)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Oligochaete	4.83(2.36)	39.3(13.9)	10.5(3.23)	0(0)	0(0)	0(0)	0(0)
Orthoptera sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Polydora ligni	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Polydora socialis	0(0)	0(0)	0(0)	0.4(0.4)	0(0)	0(0)	0(0)
Polydora sp.	0.33(0.33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Polypedilum sp.	0.67(0.49)	0(0)	0(0)	0(0)	1.5(0.96)	0(0)	0.75(0.48)
Procladius sp.	0.5(0.34)	0(0)	0(0)	0(0)	4.5(2.6)	0(0)	0(0)
Rhithropanapeus harisii	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)
Strictochironomus sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Streblospio benedicti	0(0)	0(0)	0(0)	3.6(1.03)	0(0)	0(0)	0(0)
Tharyx sp.	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	6.6(2.01)	1.75(0.63)	50.25(29.71)	17.50(7.64)
Tubificoides heterochaetus	0(0)	0(0)	0(0)	0.8(0.58)	0.5(0.5)	0(0)	0(0)
Uca minax	0(0)	0(0)	0(0)	0(0)	0(0)	0.75(0.48)	0(0)

Table 6.4-4a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at the lowest main-stem Cape Fear site P6 during June 1999, 2000, 2001, 2002, 2003, 2004 and 2005. The means presented here represent the combination of two sub-sites for high intertidal areas.

High Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
Bezzia/*palpomyia*	0.6(0.24)	0.25 (0.25)	0(0)	0.5(0.29)	6.75(4.01)	4.0(0.91)	3.50(1.55)
juv. Bivalve	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Cassidinidea lunifrons	1(1)	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)
Chrysops sp.	0(0)	0(0)	0(0)	0.25(0.25)	1(1)	0(0)	0(0)
Collembola sp.	1.6(0.75)	0(0)	0(0)	1(0.41)	1.75(0.63)	0.75(0.25)	0.50(0.50)
Curculionidae sp.	0.4(0.4)	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0.25(0.25)
Cyathura (*madelinae*)	0.4(0.4)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Cyathura polita	0.8(0.58)	0(0)	0(0)	0(0)	0(0)	1.0(0.58)	0(0)
Delphacidae sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Dero sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Diptera sp.	0(0)	0(0)	0(0)	0(0)	0.75(0.48)	0(0)	0.25(0.25)
Dolichopodidae larvae	0(0)	0(0)	1(0.41)	0.25(02.5)	1(0.58)	1.0(0.41)	0.25(0.25)
Dolichopus sp.	0.8(0.8)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Enchytraeidae sp.	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)
Endochironomus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Ephydridae sp	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Eukiefferiella (*claripennis*)	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
juv. Gastropod	0.2(0.2)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Hemipodus roseus	0.8(0.8)	0(0)	1.75(0.85)	0(0)	0(0)	0(0)	0(0)
insect larva c	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
insect sp h	1(1)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
insect sp I	0.4(0.4)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Laeonereis culveri	3.2(2.03)	2.5(1.66)	0(0)	1(0.58)	0(0)	0(0)	1.75(1.03)
Lumbriculidae sp.	0(0)	0(0)	0(0)	2.25(2.25)	0(0)	0(0)	0.25(0.25)
Marrenzellaria virdis	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Mesovelia sp.							0.25(0.25)
Microvelia sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Mite	0(0)	0(0)	0(0)	0(0)	0(0)	0.5(0.29)	0(0)
Monopylephorus irroratus	0(0)	0(0)	0(0)	0(0)	4(3.67)	0(0)	6.25(5.01)
Namalycastis abiuma	0(0)	1(0.41)	0(0)	0(0)	0(0)	0(0)	0(0)
Nereidae sp.	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)	0(0)
Oligochaete	9.6(4.84)	9.5(2.9)	6(4.06)	0(0)	0(0)	0(0)	0(0)
Orchestia uhleri	1(0.55)	0(0)	0(0)	0.25(02.5)	0(0)	0(0)	0(0)
Orthocladinae sp.	1.2(0.97)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Parametriocnemus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	1.0(1.0)	0(0)
Paratendipes sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Polypedilum sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Procladius sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Sabellaria vulgaris beauforteasis	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Sciomyzidae sp.							0.25(0.25)
Sthenelais sp. A	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Syphidae	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	1.5(0.29)	19.75(6.34)	14.25(3.86)	13.25(5.51)
Tubificoides heterochaetus	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	1.0(1.0)	0(0)
Uca minax	0(0)	0(0)	0.25(0.25)	0.25(0.25)	0(0)	0(0)	0.50(0.50)
Uca pugilator	0.4(0.4)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Uca pugnax	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Uca sp.	0.2(0.2)	0(0)	0(0)	1(0.41)	0(0)	0(0)	0(0)

Table 6.4-4b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at the lowest main-stem Cape Fear site P6 during June 1999, 2000, 2001, 2002, 2003, 2004 and 2005. The means presented here represent the combination of two sub-sites for low intertidal areas.

Low Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
Americhelidium americanum	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
amphipod sp.	0.8(0.58)	0(0)	0.4(0.4)	0(0)	0(0)	0(0)	0(0)
Anurida maritima							89.00(49.14)
Bezzia/palpomyia	0.6(0.4)	0(0)	0.2(0.2)	0(0)	0.25(0.25)	0.5(0.29)	0.25(0.25)
juv. Bivalve	0.6(0.4)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Capitellidae sp.	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)
Cassidisca lunifrons	1(0.77)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Coelotanypus sp.	0(0)	0(0)	0(0)	0(0)	0.75(0.75)	0(0)	0(0)
Collembola sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	2.0(2.0)	3.75(2.39)
Cyathura polita	5.0(5.0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Dipolyudora sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Dolichopus sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Dolichopodidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	1.00(0.58)
Eukiefferiella (*claripennis*)	0.4(0.4)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Gammarus daiberi	0.2(0.2)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)	0(0)
Gammarus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
juv. Gastropod	0.4(0.24)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Hargeria rapax	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Hobsonia florida	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
insect pupae	1.8(1.11)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
insect sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Laeonereis culveri	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.50(0.50)
Lumbriculidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1,50(0.87)
Maranzellaria virdis	0(0)	2(0.91)	3.8(1.16)	0(0)	0(0)	4.75(2.63)	0(0)
Melita sp.	1.0(1.0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Mite	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Munna sp.	1.0(1.0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Nemertean	0(0)	0(0)	0(0)	0.4(0.4)	0(0)	0(0)	0(0)
Oligochaete	49.6(18.89)	3.5(1.94)	1(0.55)	0(0)	0(0)	0(0)	0(0)
Parametriocnemus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Parandalia sp.	0(0)	0(0)	0(0)	0.4(0.24)	0.25(0.25)	0(0)	0(0)
Pectinaria gouldii	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)
Polydora socialis	2.6(2.6)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Polydora sp.	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)
Polypedilum sp.	0.4(0.4)	0(0)	0(0)	0(0)	0.5(0.29)	1.5(1.5)	0(0)
Procladius sp.	0.6(0.6)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Pyrrhalta sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Streblospio benedicti	0(0)	0(0)	0(0)	0.4(0.4)	0(0)	0(0)	0(0)
Spirosperma sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Tabanus sp.							0.25(0.25)
Tubificidae sp.	0(0)	0(0)	0(0)	0(0)	1.75(0.25)	10.0(5.29)	9.50(4.42)
Tubificoides heterochaetus	0(0)	0(0)	0(0)	3.8(2.33)	0(0)	0.5(0.29)	0(0)
Uca sp.	0.4(0.4)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)

Table 6.4-5a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P7 on the main-stem Cape Fear during June 1999, 2000, 2001, 2002, 2003, 2004 and 2005. The means presented here represent the combination of two sub-sites for high intertidal areas.

High Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
Asellus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	17.50(8.66)
Bezzia/palpomyia	0.2(0.2)	0(0)	0.17(0.17)	0(0)	2.25(1.03)	0(0)	1.25(0.95)
juv. Bivalve	0(0)	0.2(0.2)	0.17(0.17)	0(0)	2(0.82)	0.25(0.25)	0.25(0.25)
*Cassidisca luni*frons	0(0)	0(0)	1(0.52)	0(0)	0.25(0.25)	0.75(0.75)	0(0)
Celina sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Chironomidae spp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Chironomus sp.	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)	0(0)
Chrysops sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Collembola sp.	0.4(0.24)	1.2(0.8)	0(0)	0.17(0.17)	0(0)	0.5(0.29)	1.00(0.71)
Corophium acherusicum	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)	0(0)
Corophium sp.	0(0)	0(0)	0.5(0.5)	0(0)	0(0)	0(0)	0(0)
Corophium volutator	0(0)	0(0)	0.67(0.67)	0(0)	0(0)	0(0)	0.25(0.25)
Cryptochironomus sp.	0.2(0.2)	0(0)	0(0)	0(0)	1(0.58)	0(0)	0(0)
Cyathura (*madelinae*)	0.4(0.4)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
*Cyathura poli*ta	0(0)	0.2(0.2)	3.67(1.02)	0(0)	0(0)	0(0)	0.25(0.25)
Diptera sp.							0.25(0.25)
Dolichopodidae larvae	0(0)	1.6(0.24)	0.5(0.5)	0(0)	0(0)	0(0)	0.25(0.25)
Dolichopus sp.	1.6(0.51)	0(0)	0.5(0.5)	0(0)	0(0)	0(0)	0(0)
Enchytraeidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Erioptera sp.	0(0)	0(0)	0(0)	0(0)	0(0)	3.75(1.75)	0(0)
*Gammarus diabe*ri	0(0)	0(0)	4(4)	0(0)	0(0)	0(0)	0(0)
Gammarus sp.	0(0)	0(0)	0.67(0.67)	0(0)	0(0)	0(0)	0(0)
juv. Gastropod	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Georthocladius sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Hargeria rapax	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Hobsonia florida	0(0)	0(0)	0.17(0.17)	0.17(0.17)	0(0)	0(0)	0(0)
insect larvae	0(0)	0.4(0.4)	0(0)	0(0)	0(0)	0(0)	0(0)
insect pupae	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
insect sp.	0(0)	0(0)	0.67(0.49)	0(0)	0(0)	0(0)	0(0)
Isopod sp.	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)	0(0)
Laeonereis culveri							*1.25(0.95)*
Limnodrilus hoffmeisteri	0(0)	0(0)	0(0)	0(0)	11.5(3.75)	0(0)	0(0)
Lirceus sp.	1.4(1.2)	0(0)	0.67(0.67)	0(0)	0(0)	0(0)	0(0)
Lumbriculidae sp.	7.4(3.33)	0(0)	0.33(0.21)	0.17(0.17)	0(0)	17.25(6.7)	4.50(2.06)
Megalops	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Micropsectra sp.	0.8(0.37)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Microtendipes (rydalensis group)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Mite	0(0)	0.2(0.2)	0(0)	0(0)	0(0)	1.0(0.71)	0(0)
Nemertea	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)	0(0)
Noteridae sp.							0.25(0.25)
Oligochaete	52.2(15.47)	64.2(23.7)	20.17(10.29)	0(0)	0.5(0.5)	0(0)	0(0)
Omisus sp.	0(0)	0(0)	1.83(1.83)	0(0)	0(0)	0(0)	0(0)
Orchestia (plantesis)	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Orchestia uhleri	0.6(0.6)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0.25(0.25)
Orchestia sp.	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)	0(0)
Orthocladinae sp.							0.25(0.25)
Parametriocnemus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)
Paratendipes sp.	0(0)	0(0)	1.83(1.64)	0(0)	0(0)	0(0)	13.50(10.44)
Peloscolex sp.	0(0)	0(0)	0(0)	0(0)	0(0)	5.50(3.57)	31.00(15.73)
Polypedilum sp.	0(0)	0(0)	0.17(0.17)	0(0)	6.75(2.84)	0.25(0.25)	0(0)
Pristinella sp.	0.4(0.4)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)

Table 6.4-5a. (continued)

High Intertidal	June 99	June 00	June 01	June 02	June 03	June 04	June 05
Sirosperma sp.	0(0)	0(0)	0(0)	0(0)	1(0.58)	0(0)	0(0)
Spionidae sp.	0(0)	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)
Spirosperma carolinensis	0(0)	0(0)	0.83(0.83)	0(0)	0(0)	0(0)	0(0)
Staphylinidae	0(0)	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)
Stictochironomus sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Tabanus sp.	0.2(0.2)	0(0)	0(0)	0(0)	0.3(0.3)	0(0)	0(0)
Tanytarsus sp.				0(0)	0(0)	0.5(0.5)	0(0)
Tubificidae sp.	0(0)	0(0)	3.17(2.01)	24.5(5.36)	104(30.6)	13.75(3.57)	33.75(18.08)
Tubificoides heterochaetus	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Uca pugilator	0.4(0.4)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Uca sp.	0(0)	0(0)	0.33(0.33)	0(0)	104(30.6)	0(0)	0.50(0.29)

Table 6.4-5b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P7 on the main-stem Cape Fear during June 1999, 2000, 2001, 2002, 2003, 2004 and 2005. The means presented here represent the combination of two sub-sites for low intertidal areas.

Low Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
Arcteonais lomondi	0(0)	0(0)	0(0)	0(0)	0.4(0.24)	0(0)	0(0)
Aulodrilus pluriseta	0(0)	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)
Batea cathariensis	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)	0(0)
juv. Bivalve	0.6(0.4)	0.25(0.25)	0(0)	0.17(0.17)	0.4(0.4)	0.25(0.25)	0(0)
Bezzia/Palpomyia	0.2(0.2)	0(0)	0(0)	0.17(0.17)	3.8(2.58)	1.75(0.48)	0.50(0.50)
Cassidisca lunifrons	0.6(0.24)	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)
Chironomidae sp.	0(0)	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)
Chironomus sp.	0.2(0.2)	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)
Chrysops sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Cladotanytarsus sp.	0(0)	0(0)	0(0)	0(0)	0.4(0.4)	0(0)	0(0)
Coelotanypus sp.	0(0)	0(0)	0(0)	0.17(0.17)	2(1.05)	0(0)	0(0)
Collembola	0(0)	0(0)	0(0)	0(0)	0(0)	0.5(0.29)	0(0)
Corophium volutator	0(0)	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0.25(0.25)
Cryptochironomous sp.	0.6(0.6)	0(0)	0(0)	0(0)	2(0.89)	0.75(0.25)	0(0)
Cryptotendipes sp.	0(0)	0(0)	0(0)	0(0)	0.4(0.4)	0(0)	0(0)
Cyathura polita	0(0)	0.5(0.29)	0.67(0.49)	0(0)	0(0)	0.25(0.25)	1.50(0.87)
Cyathura (*madelinae*)	0.4(0.24)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Dispio unicata	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Dolichopodidae larvae	0(0)	0.25(0.25)	0.67(0.67)	0(0)	0(0)	0(0)	0.75(0.48)
Dolichopus sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Gammarus daiberi	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Gammarus tigrinus	0.6(0.4)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Dero sp.	0(0)	0(0)	0(0)	0(0)	0.8(0.8)	0(0)	0(0)
juv. Gastropod	1.0(0.45)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
insect larvae	0(0)	0(0)	0.33(0.33)	0(0)	0(0)	0(0)	0(0)
insect pupae	0.4(0.24)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
insect species	0(0)	0(0)	0.33(0.21)	0(0)	0(0)	0(0)	0(0)
insect sp. a	0.4(0.24)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Isochaetides sp.	0(0)	0(0)	0.5(0.5)	0(0)	0(0)	0(0)	0(0)
Isopoda (unknown)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Laeonereis culveri	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	1.25(0.95)
Limnodrilus hoffmeisteri	0(0)	0(0)	0.5(0.5)	0(0)	2.8(1.16)	0(0)	0(0)
Lumbriculidae sp.	0(0)	0(0)	0.83(0.54)	0(0)	0(0)	0(0)	4.00(1.22)
Megalops	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Mite	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Nereidae sp.							0.25(0.25)
Oligochaete	17.8(4.55)	64(19.63)	46.83(25.24)	0(0)	0(0)	0(0)	0(0)
Orchestia sp.	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)	0(0)
Parametriocnemus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Paratendipes sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	1.0(1.0)	2.00(1.08)
Peloscolex sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	1.50(0.96)
Polypedilum sp.	1.0(1.0)	1.25(0.48)	0.33(0.33)	0(0)	2(0.84)	0.75(0.75)	1.00(0.71)
Procladius sp.	0.2(0.2)	0(0)	0(0)	0(0)	1.6(0.4)	0(0)	0(0)
Saetheria sp.	0(0)	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)
Spionidae sp.	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Spirosperma carolinensis	0(0)	0(0)	0.33(0.33)	0(0)	0(0)	0(0)	0(0)
Tanytarsus sp.	0(0)	0(0)	0(0)	0(0)	0.4(0.24)	0(0)	0(0)
Tubificidae sp.	0(0)	0(0)	8.5(5.38)	11.0(3.34)	48.2(6.85)	24.5(3.23)	38.00(12.86)

Table 6.4-6a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P8 on the main-stem Cape Fear during June 1999, 2000, 2001, 2002, 2003, 2004 and 2005. The means presented here represent the combination of two sub-sites for high intertidal areas.

High Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
Aulodrilus paucichaeta	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.20(0.20)
Bezzia/palpomyia	0.33(0.33)	0.75 (0.25)	0.33(0.21)	0(0)	0(0)	1.0(0)	0(0)
juv. Bivalve	11.17(4.32)	23.5(8.51)	5.17(1.82)	0.6(0.4)	2(1.15)	18.5(1.16)	0.20(0.20)
Branchiura sowerbyi	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Cassidisca lunifrons	0(0)	0(0)	0(0)	0.4(0.24)	0(0)	0(0)	0(0)
Coelotanypus sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Coleoptera larvae	0.33(0.33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Collembola sp.	1.5(0.43)	6.5(2.53)	0.33(0.21)	0(0)	0(0)	0.75(0.75)	0(0)
Cryptochironomus sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Curculionidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.20(0.20)
Cyathura polita	0(0)	0(0)	0(0)	0.6(0.4)	0(0)	0(0)	0(0)
Dero sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Dolichopodidae larvae	0(0)	6.5(2.33)	0.67(0.49)	0.4(0.4)	0.5(0.5)	0(0)	0.40(0.40)
Dolichopus sp.	2.17(.75)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Enchytraeidae sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0.75(0.75)	0(0)
Erioptera sp.	0(0)	0(0)	0(0)	0(0)	0(0)	1.5(1.19)	0(0)
Fabriciola trilobata	0(0)	0(0)	0(0)	0(0)	0(0)	0.75(0.75)	0(0)
Gammarus tigrinus	1.33(1.33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
gastropod juv.	0.5(0.34)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Hargeria rappax	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)	0(0)
Hydaticus larvae	0.33(0.21)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Hydrobia sp.	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)	0(0)
Hydrophilidae larvae	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Insect larvae	0(0)	0(0)	1.33(0.88)	0(0)	0(0)	0(0)	0(0)
insect pupae	0(0)	0(0)	0.83(0.31)	0(0)	0(0)	0(0)	0(0)
insect sp. a	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
insect sp. b	0(0)	0(0)	0.5(0.5)	0(0)	0(0)	0(0)	0(0)
insect sp. C	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)	0(0)
insect sp. D	0(0)	0(0)	0.33(0.33)	0(0)	0(0)	0(0)	0(0)
insecta sp.	0.17(0.17)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)	0.20(0.20)
Limnodrilus hoffmeisteri	0(0)	0(0)	0(0)	0(0)	1.0(0.71)	0(0)	0(0)
Lumbriculidae sp.	5(2.89)	2(2)	0(0)	1.4(0.75)	0.25(0.25)	4.0(2.83)	4.00(1.70)
Micropsectra sp.	3.17(3.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Mite	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Neanthes succinea	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Nemertea	0(0)	0(0)	0.33(0.21)	0(0)	0.25(0.25)	0(0)	0(0)
Oligochaete	73.5(14.07)	180.25(37.14)	44.17(11.32)	0(0)	0(0)	0(0)	0(0)
Omisus sp.	0(0)	0(0)	0(0)	0.6(0.6)	0(0)	0(0)	0(0)
Orchestia sp.	0(0)	0(0)	5.5(1.57)	0.2(0.2)	0(0)	0(0)	0(0)
Orchestia uhleri	3.5(1.48)	2.5(1.5)	0(0)	1 (1)	0(0)	0.59(0.5)	2.60(1.03)
Oribatei sp.	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)
Parametriocnemus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Paratendipes sp.	0(0)	5.75(2.69)	0(0)	0.2(0.2)	1.5(1.19)	0.75(0.48)	0(0)
Peloscolex sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.75(0.48)	6.00(3.88)
Pericoma sp.	0(0)	0(0)	0(0)	0(0)	0(0)	3.0(1.22)	0(0)
Polypedilum sp.	0.17(0.17)	2.75(2.43)	0.17(0.17)	0.2(0.2)	3(1.41)	0(0)	0(0)
Rheotanytarsus sp.	0.33(0.33)	0.5(0.5)	0(0)	0(0)	0(0)	0(0)	0(0)
Sirosperma sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Stratiomya sp.	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Tabanus sp.	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)	0(0)
Tanytarsus sp.	1(1)	7.5(2.99)	0.17(0.17)	0(0)	0(0)	1.75(1.03)	0(0)
Telmatoscopus sp.							4.20(3.29)

Table 6.4-6a. (continued)

High Intertidal	June 99	June 00	June 01	June 02	June 03	June 04	June 05
Tipula sp.	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0.5(0.5)	0(0)
Tipulidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.75(0.48)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	19.4(9.14)	128(39.51)	63.25(16.14)	75.20(18.92)
Tubificoides heterochaetus	0.17(0.17)	0(0)	0(0)	1(1)	0.25(0.25)	0(0)	0.40(0.40)
Uca pugilator	0.17(0.17)	0.5(0.5)	0(0)	0(0)	0(0)	0(0)	0(0)
Uca pugnax	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)	0(0)

Table 6.4-6b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P8 on the main-stem Cape Fear during June 1999, 2000, 2001, 2002, 2003, 2004 and 2005. The means presented here represent the combination of two sub-sites for low intertidal areas.

Low Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
Anurida maritima	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.40(0.24)
Apedilum sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.75(0.75)	0(0)
Armadillidium quadrifrons	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)
Bezzia/*palpomyia*	0.33(0.33)	0(0)	0.33(0.21)	0.75(0.48)	1(0.58)	0.25(0.25)	0.20(0.20)
juv. Bivalve	1.67(0.56)	5.75(4.46)	1.83(0.31)	0.25(0.25)	1(0.71)	0.25(0.25)	1.20(0.37)
Branchiura sowerbyi	0(0)	0(0)	0(0)	0(0)	1(0.71)	0(0)	0(0)
Cassidisca lunifrons	0.83(0.83)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Chironomus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Coelotanypus sp.	0(0)	0(0)	0(0)	0.25(0.25)	0.75(0.48)	0(0)	0(0)
Collembola sp.	0.17(0.17)	0.25(0.25)	1(1)	0(0)	0(0)	3.75(3.09)	0(0)
Corophium lacustre	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.20(0.20)
Corophium acherusicum	0(0)	0(0)	3.33(0.99)	0(0)	0(0)	0(0)	0(0)
Corophium sp.	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)	0(0)
Corophium volutator	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	5.00(2.88)
Cryptochironomous sp.	0.33(0.33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Cyathura polita	0(0)	0(0)	1.5(0.56)	0.25(0.25)	0(0)	0(0)	0(0)
Cyathura (*madelinae*)	0.67(0.67)	0.75(0.75)	0(0)	0(0)	0(0)	0(0)	0(0)
Dolichopodidae larvae	0(0)	0.75(0.25)	0.67(0.33)	0(0)	0(0)	0(0)	0.80(0.20)
Dolichopus sp.	1(0.82)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Gammarus tigrinus	1.5(1.15)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
juv. Gastropod	0.17(0.17)	0.5(0.5)	1(0.68)	0.5(0.5)	0(0)	0.25(0.25)	0(0)
Goeldichironomus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)
insect pupae	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
insect sp.	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)	0(0)
insect sp.b	0.17(0.17)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)	0(0)
Isopoda (unknown)	0(0)	0(0)	0.83(0.65)	0(0)	0(0)	0(0)	0(0)
Limnodrilus hoffmeisteri	0(0)	0(0)	0(0)	0(0)	6.25(5.92)	0(0)	0(0)
Lumbriculidae sp.	3(1.61)	1.5(1.19)	0(0)	0(0)	0(0)	5.0(2.61)	3.80(1.46)
Megalops	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Micropsectra sp.	0.17(0.17)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)
Namalycastis sp.	0(0)	0(0)	0.8(1)	0(0)	0(0)	0(0)	0(0)
Oligochaete	122.83(31.34)	103(16.91)	63(67.6)	0(0)	0(0)	0.25(0.25)	0(0)
Orchestia sp.	0(0)	0(0)	57(21.7)	0(0)	0(0)	0(0)	0(0)
Orchestia uhleri	0(0)	0.75(0.48)	0(0)	0(0)	0(0)	0(0)	0.40(0.24)
Orthocladinae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.75(0.75)	0(0)
Parametriocnemus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Paratendipes sp.	0.17(0.17)	1(0.58)	0(0)	0(0)	0(0)	0.5(0.5)	0.60(0.60)
Peloscolex sp.							0.20(0.20)
Polypedilum haterale group	2.33(2.33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Polypedilum sp.	1.33(0.56)	3(1.58)	2.5(2.4)	0(0)	0(0)	0(0)	0(0)
Pristinella sp.	0.67(0.67)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Procladius sp.	0(0)	0(0)	0.3(0.5)	0(0)	1(0.71)	0(0)	0(0)
Rheotanytarsus sp.	0.17(0.17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Sirosperma sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Tanytarsus sp.	0.33(0.33)	1(1)	0(0)	0(0)	0(0)	0(0)	0(0)
Tipulidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.75(0.75)	0(0)
Tribelos sp.	0.33(0.33)	0(0	0(0)	0(0)	0(0)	0(0)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	129.5(47.23)	70.60(17.64)
Tubificoides sp.	0(0)	0(0)	0(0)	6.5(2.06)	57.25(32.77)	0(0)	0(0)

Table 6.4-6b. (continued)

Low Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
Uca minax	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Uca pugilator	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.20(0.20)
(Xestochironomus sp.)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.20(0.20)

Table 6.4-7a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P11 on the NE Cape Fear River during June 1999, 2000, 2001, 2002, 2003, 2004, and 2005. The means presented here represent the combination of two sub-sites for high intertidal areas.

High Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
amphipod sp.	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Apedilum sp.	0(0)	0(0)	0(0)	0(0)	0(0)	1.4(0.87)	0(0)
Bezzia/palpomia	0(0)	0(0)	0.5(0.5)	0.5(0.29)	0.25(0.25)	4.8(2.37)	0.75(0.48)
juv. Bivalve	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0.2(0.2)	0(0)
Boccardiella sp.	0(0)	1.25(1.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Cassidisca lunifrons	1(0.71)	0.25(0.25)	1.25(0.48)	0(0)	0(0)	0(0)	0(0)
Chironomus sp.	0.5(0.5)	0(0)	0(0)	0(0)	0(0)	3.2(2.06)	0(0)
Collembola	0(0)	0(0)	0(0)	0(0)	0(0)	0.6(0.24)	0(0)
Corophium volutator	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Cladotanytarsus sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Cricotopus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.2(0.2)	0(0)
Cryptochironomus sp.	0(0)	0(0)	0(0)	0(0)	1.75(1.44)	0.6(0.6)	0(0)
Curculionidae sp.	0.75(0.75)	0(0)	0(0)	0(0)	0(0)	0(0)	4.50(3.57)
Cyathura madelina	0(0)	0.25(0.25)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)
Cyathura polita	0(0)	0(0)	0(0)	0(0)	0(0)	0.8(0.58)	0(0)
Dicrotendipes lobus	1(1)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Dicrotendipes nirvosus	0.5(0.5)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Dicrotendipes sp.	0(0)	1(0.71)	0.5(0.29)	0.25(0.25)	0(0)	0(0)	0.25(0.25)
Dolichopodidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.4(0.24)	0(0)
Edotea triloba	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Gammarus diaberi	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Gammarus tigrinus	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Gammarus mucronatus	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Gammarus sp.	0(0)	0(0)	0(0)	1.5(1.5)	0(0)	0(0)	0(0)
Goeldichironomus holoprasinus	0(0)	0(0)	0(0)	0(0)	0(0)	1.6(1.6)	0(0)
Hobsonia florida	7.5(4.33)	0(0)	3.25(1.11)	0(0)	0(0)	0(0)	2.75(2.75)
Insect larvae (Elimidae)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0.6(0.6)	0(0)
insect pupae	1(1)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Insect sp.	1.25(1.25)	0(0)	0(0)	0.5(0.5)	0(0)	0(0)	0(0)
Laeonereis culveri	0(0)	0(0)	0(0)	0.5(0.5)	0(0)	0.6(0.6)	0(0)
Megalops	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)
Megalopae (Uca)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Neanthes succinea	0(0)	0(0)	0(0)	0(0)	0(0)	0.6(0.6)	0(0)
Nematoda	0(0)	0(0)	0(0)	0(0)	0(0)	3.4(1.12)	0(0)
Nemertea	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)
Nereidae sp.	0(0)	0(0)	1(0.71)	0(0)	0(0)	0(0)	0(0)
Oligochaete	10.5(3.69)	14.25(7.7)	1.75(0.85)	0(0)	0(0)	0(0)	0(0)
Orchestia uhleri	0(0)	0(0)	0(0)	0(0)	0(0)	0.2(0.2)	0(0)
Paratendipes sp.	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Polydora ligni	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Polydora socialis	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Polydora sp.	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Polypedilium sp.	0.5(.5)	0.25(0.25)	0.5(0.5)	0(0)	3.75(1.49)	2.0(1.26)	0(0)
Stictochironomus sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Streblospio benedicti	0(0)	0(0)	0(0)	0.75(0.49)	0(0)	0(0)	0.25(0.25)
Tanytarsus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.2(0.2)	0(0)
Tipulidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.6(0.4)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	9.75(8.76)	4.75(2.59)	13.4(5.55)	47.25(19.55)

Table 6.4-7a. (continued)

High Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
Tubificidae heterochaetus	0(0)	0(0)	0(0)	1(0.71)	0.75(0.48)	0(0)	0(0)
Tubificoides heterochaetus	0(0)	0(0)	0(0)	0(0)	0(0)	2.0(2.0)	0(0)
Uca sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)

Table 6.4-7b. Mean (no. per 0.01 m^2) and (standard deviation) for all taxa collected at P11 on the NE Cape Fear River during June 1999, 2000, 2001, 2002, 2003, 2004 and 2005 The means presented here represent the combination of two sub-sites for low intertidal areas.

Low Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
amphipod sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Armadillidium vulgare	0(0)	0(0)	0(0)	0(0)	0.33(0.33)	0(0)	0(0)
Axarus sp.	0(0)	0(0)	0(0)	0(0)	3.67(1.52)	0(0)	0(0)
Bivalve sp.	0(0)	0(0)	0(0)	0.2(0.2)	1.17(0.4)	0(0)	0(0)
Juv. Bivalve	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Boccardiella sp.	0(0)	0(0)	0.17(0.17)	0(0)	0(0)	0(0)	0(0)
Cladotanytarsus sp	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)	0(0)
Collembola sp.	0(0)	0(0)	0(0)	0(0)	0.17(0.17)	0(0)	1.25(0.63)
Corophium acherusicum	0(0)	0(0)	0.33(0.33)	0(0)	0(0)	0(0)	0(0)
Corophium lacustre							0.25(0.25)
Corophium sp.	0(0)	0(0)	0.33(0.33)	0(0)	0(0)	0(0)	0.25(0.25)
Cryptochironomous (*fulvens*)	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Cryptochironomous sp.	0(0)	0(0)	0(0)	0(0)	2(0.58)	0(0)	0(0)
Cyathura (madelinae)	0(0)	0(0)	0(0)	0(0)	0.17(0.17)	0(0)	0(0)
Cyathura polita	0(0)	0(0)	0(0)	0(0)	0.17(0.17)	0.25(0.25)	0(0)
Diplopoda (millipede)	0(0)	0(0)	0(0)	0(0)	0.17(0.17)	0(0)	0(0)
Eteone heteropoda	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)
Gammarus tigrinus	0.6(0.4)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Hobsonia florida	0.6(0.24)	0(0)	0.33(0.21)	0(0)	0(0)	0(0)	0(0)
Laeonereis culveri	0(0)	0(0)	5(4.43)	0.2(0.2)	0(0)	0(0)	0.75(0.25)
Marenzellaria virdis	1(0.77)	3.75(1.93)	22.83(5.72)	0(0)	12.17(3.51)	51.5(6.85)	0.50(0.50)
Megalopae	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Nemertea	0.2(0.2)	0(0)	0.5(0.22)	0.2(0.2)	0(0)	0(0)	0.25(0.25)
Nereidae	0(0)	0(0)	7(2.5)	0(0)	0(0)	0(0)	0(0)
Oligochaete	3.6(1.86)	0.25(0.25)	7.5(4.63)	0(0)	0(0)	0(0)	0(0)
Parandalia sp A	0(0)	0(0)	0(0)	0.2(0.2)	0.17(0.17)	0(0)	0(0)
Paratanytarsus sp.	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)	0(0)
Paratendipes sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Pentatomidae	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)
Polypedilum sp.	0.4(0.4)	0.5(0.5)	1.67(0.61)	0(0)	3(0.93)	1.75(1.11)	0.50(0.50)
Procladius sp.	0(0)	0(0)	0(0)	0(0)	1.33(1.33)	0(0)	0(0)
Streblospio benedicti	0(0)	0(0)	0(0)	2.0(1.38)	0(0)	0(0)	0(0)
Tanytarsus sp.	0(0)	0(0)	0(0)	0(0)	0.17(0.17)	0(0)	0(0)
Tubificidae spp.	0(0)	0(0)	0(0)	0.4(0.4)	1.17(1.17)	0(0)	0.75(0.48)
Tubificoides heterochaetus	6.2(6.2)	0(0)	1.5(1.31)	30.4(18.98)	6.5(2.86)	3.5(1.71)	20.75(4.33)

Table 6.4-8a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P12 on the NE Cape Fear River during June 1999, 2000, 2001, 2002, 2003, 2004 and 2005. The means presented here represent the combination of two sub-sites for high intertidal areas.

High Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
Bezzia/palpomyia	1.8(0.37)	0(0)	0.25(0.25)	1.4(0.93)	0.6(0.24)	0.5(0.29)	4.25(2.02)
Cassidisea lunifrons	0.2(0.2)	0.25(0.25)	0.25(0.25)	0.4(0.4)	0(0)	0.25(0.25)	0(0)
Coleoptera sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Collembola sp.	0.2(0.2)	1(0.41)	0(0)	0(0)	0(0)	0.75(0.48)	0.25(0.25)
Corophium (*lacustre*)	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Corophium volutator	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Cricotopus sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Cyathura polita	0(0)	0(0)	0(0)	0(0)	0(0)	0.75(0.25)	0(0)
Delphacidae sp.	0(0)	0(0)	0(0)	0(0)	0.2(0.2)	0.5(0.5)	0(0)
Dicrotendipes sp.	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Diptera sp.	0(0)	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)
Dispio unicata	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Dolichopodidae larvae	0(0)	0.25(0.25)	0.75(0.75)	0(0)	0(0)	0(0)	0(0)
Dolichopodidae sp.	0(0)	0(0)	0(0)	0.2(0.2)	0.4(0.24)	1.0(0.41)	0.25(0.25)
Dolichopus sp.	0.6(0.4)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Donacia sp.	0.2(0.2)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)
Donaciinae sp.	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)
Endochironomus sp.	0(0)	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)
Ephydra sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)
Ephydridae	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Gammarus sp.	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)
juv. Gastropod	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0.25(0.25	0(0)
Hemiptera sp.	0(0)	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)
Heterothissocladius sp.	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Hydrobia sp.	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Insect sp.	0(0)	0(0)	0.75(0.48)	0(0)	0(0)	0(0)	0(0)
insect sp. g	0.4(0.4)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
insect sp. h	1.2(1.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
insect sp. f	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Laeonereis culveri	1.4(0.51	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Lumbriculid sp.	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Mesomelia mulsanti	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0.5(0.5)	0(0)
Mite	0(0)	0(0)	0.25(0.25)				0(0)
Monopylephorus irroratus	1(1)	0(0)	0(0)	0(0)	0.4(0.4)	0.25(0.25)	0(0)
Namalycastis sp.	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Neanthes succinea	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Nereidae sp.	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Ocypode quadrata	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Oligochaete	47.8(15.93)	30(9.61)	13.25(7.11)	0(0)	0(0)	0(0)	0(0)
Orchestia uhleri	0.2(0.2)	0.5(0.29)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Orthocladinae sp.	0(0)	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)
Parametriocnemus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	3.75(1.49)	0(0)
Paratandipes sp.	0(0)	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)
Polypedilium sp.	0(0)	0(0)	0.5(0.5)	0(0)	1.8(1.11)	0.5(0.29)	0(0)
Pristinella sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Spiophanes bombyx	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Streblospio benedicti	0(0)	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)
Tubificidae spp.	0(0)	0(0)	0(0)	3.2(1.16)	17.6(4.15)	55.25(10.0	25.50(15.94)
Uca minax	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0.5(0.29)	0(0)
Uca pugilator	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Uca sp.	0(0)	0(0)	0(0)	0.4(0.4)	0(0)	0(0)	0.75(0.75)

Table 6.4-8b. Mean (no. per 0.01 m^2) and (standard deviation) for all taxa collected at P12 on the NE Cape Fear River during June 1999, 2000, 2001, 2002, 2003, 2004, and 2005. The means presented here represent the combination of two sub-sites for low intertidal areas.

Low Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
Ablabesmyia sp.	0(0)	0(0)	0(0)	0(0)	0.2(0.71)	0(0)	0(0)
amphipod sp. B	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Apedilum sp.	0(0)	0(0)	0(0)	0(0)	0(0)	2.75(2.75)	0(0)
Axarus sp.	0(0)	0(0)	0(0)	0(0)	0.75(0.75)	0(0)	0(0)
Bezzia/palpomyia	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0.50(0.29)
Boccardiella sp.	0(0)	0(0)	12.5(12.5)	7.6(4.43)	0.75(0.48)	0(0)	0(0)
Cassidinidea lunifrons	0(0)	0(0)	0(0)	0(0)	0.75(0.48)	0(0)	0(0)
Chironomidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Chironomus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	1.0(1.0)	0(0)
Chyrsops sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Collembola sp.	0(0)	0(0)	0.5(0.5)	0(0)	0(0)	0.75(0.49)	0.75(0.75)
Corophium acherusicum	0(0)	0(0)	1.0(1.0)	0(0)	0(0)	0(0)	0(0)
Corophium sp.							0.25(0.25)
Crangonyx sp.	0(0)	0(0)	0(0)	0.4(0.4)	0(0)	0(0)	0(0)
Cricotopus sp.	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)	0(0)
Cryptochironomus sp.	0(0)	0(0)	0(0)	0(0)	0.75(0.75)	0(0)	0(0)
Dicrotendipes lucifer	0(0)	0(0)	0(0)	0(0)	0.25(0.25	0(0)	0(0)
Dicrotendipes sp.	0(0)	0(0)	0(0)	0(0)	1.75(1.75)	0(0)	0(0)
Diptera sp.							0.75(0.75)
Dolichopodidae sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0.50(0.50)
Edotea juv sp.	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0.25(0.25)	0(0)
Enchytraeidae sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Gammarus tigrinus	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Gammarus sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
juv. Gastropod	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Goeldichironomus holoprasinus	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Goeldichironomus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	3.25(2.36)	0(0)
Hobsonia florida	0(0)	0(0)	0(0)	0.4(0.4)	0.25(0.25)	0(0)	0(0)
Insect sp.	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
insect larvae	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Laeonereis culveri	0(0)	0(0)	0(0)	0.4(0.4)	0(0)	0(0)	0.50(0.50)
Lumbriculidae sp.	0(0)	1.75(1.44)	0(0)	0(0)	0(0)	0(0)	0.75(0.75)
Marenzellaria viridis	0(0)	0(0)	0(0)	0(0)	0(0)	0.75(0.48)	0(0)
Mediomastus sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Megalops	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0.50(0.29)
Naididae sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Namalycastis sp.	0(0)	0(0)	0.5(0.5)	0(0)	0(0)	0(0)	0(0)
Nereis lamellosa	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)
Oligochaete	1.6(0.51)	7.25(4.4)	2.75(1.49)	0(0)	0(0)	0(0)	0(0)
Paracladopelma sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Paratendipes sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Paratendipes (subaequalis)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.50(0.50)
Polydora ligni	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Polydora socialis	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)
Polydora sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Polypedilum sp.	0.2(0.2)	0(0)	0(0)	0(0)	3.75(1.11)	0(0)	0(0)
Procladius sp.	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)
Rhithropanopeus harrisii	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)
Spiophanes bombyx	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)

Table 6.4.8b. (continued)

Low Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
Streblospio benedicti	0(0)	0(0)	0(0)	0.8(0.58)	0(0)	0(0)	0.25(0.25)
Tanypodinae sp.	0(0)	0(0)	0(0)	0(0)	1.25(1.25)	0(0)	0(0)
Tubificidae spp.	0(0)	0(0)	0(0)	1.8(1.36)	0.5(0.29)	0.25(0.25)	18.00(15.02)
Tubificoides heterochaetus	0(0)	0(0)	0(0)	0.4(0.4)	6.75(3.90)	0.75(0.75)	0(0)

Table 6.4-9a. Mean (no. per 0.01 m^2) and (standard deviation) for all taxa collected at P13 on the NE Cape Fear River during June 1999, 2000, 2001, 2002, 2003, 2004, and 2005. The means presented here represent the combination of two sub-site for high intertidal areas at each station.

High Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
Anurida maritima	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Aricidea suecica	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)
Bezzia/palpomyia	0(0)	0(0)	0.2(0.2)	0.75(0.75)	1(0.71)	3.75(1.18)	3.75(1.11)
juv. Bivalve	0(0)	0.75(0.48)	0(0)	0(0)	0(0)	0(0)	0(0)
Cassidinidea lunifrons	0(0)	0(0)	0(0)	0(0)	0(0)	0.75(0.48)	0.75(0.25)
Chironomus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Collembola sp.	0.2(0.2)	0(0)	0.8(0.8)	0(0)	0.5(0.5)	1.50(0.96)	0.50(0.50)
Corophium lacustre	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Corophium sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Corophium volutator	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Cyathura polita	0.2(0.2)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)	1.00(0.71)
Cryptochironomus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Dicrotendipes sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Dolichopodidae sp.	0(0)	0.5(0.5)	0.2(0.2)	0.25(0.25)	0(0)	0.5(0.29)	0.25(0.25)
Dolichopus sp.	0.4(0.24)	0.75(0.75)	0(0)	0(0)	0(0)	0(0)	0(0)
Goeldichironomus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)	0(0)
Halipldae sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Helophorus linearis	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)	0(0)
Hydrobia sp.	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Insect sp.	0(0)	0(0)	0.4(0.4)	0.25(0.25)	0(0)	0(0)	0(0)
Insect pupae	0.2(0.2)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)	0(0)
Laeonereis culveri	0.4(0.24)	2(1.08)	0(0)	0.25(0.25)	0(0)	0.75(0.75)	0.50(0.50)
Lumbriculidae sp.	1.4(1.4)	0.5(0.29)	18.4(18.4)	1(0.58)	0(0)	0.25(0.25)	0.75(0.75)
Mediomastus sp.	0.2(0.2)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Megalopae (Uca)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0.25(0.25)	0(0)
Megalops sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
amalycastis sp.	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)	0(0)
Nereidae sp.	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)
Oligochaete	29.4(6.9)	11(3.72)	37.2(14.04)	0(0)	0(0)	0(0)	0(0)
Oribatei sp.	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)
Orchestia sp.	0(0)	0(0)	0.4(0.24)	0(0)	0(0)	0(0)	0(0)
Orchestia uhleri	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)	0.25(0.25)
Parachaetocladius sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Paratendipes sp.	0(0)	0.5(0.5)	0.6(0.4)	0(0)	1(0.71)	3.75(0.85)	26.00(14.72)
Polichopodidae sp.	0(0)	0(0)	0.2(0.2)	0(0)	0(0)	0(0)	0(0)
Polypedilium sp.	0.6(0.4)	0(0)	0.4(0.24)	0(0)	5(1.22)	0.25(0.25)	0(0)
Tabanus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Tubificidae sp	0(0)	0(0)	0(0)	2.75(2.43)	6.25(1.97)	60(11.37)	95.75(22.76)
Tubificoides heterochaetus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)

Table 6.4-9b. Mean (no. per 0.01 m^2) and (standard deviation) for all taxa collected at P13 on the NE Cape Fear River during June 1999, 2000, 2001, 2002, 2003, 2004, and 2005. The means presented here represent the combination of two sub-site for low intertidal areas at each station.

Low Intertidal	**June 99**	**June 00**	**June 01**	**June 02**	**June 03**	**June 04**	**June 05**
Amphididae sp.	0(0)	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)
Bezzia/palpomyia	0(0)	0(0)	0.25(0.25)	0.75(0.48)	0(0)	1.5(0.5)	2.00(1.08)
Cassidimidea lunifrons	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)
Chirodotea caeca	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Collembola sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Corophium sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Cryptochironomous (*fulvens*)	0.5(0.5)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Cryptochironomous sp.	0(0)	0(0)	0(0)	0(0)	0.8(0.37)	1.0(1.0)	0.50(0.29)
Cyathura polita	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.25)
Diptera sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.5(0.5)	0(0)
Dolichopodid larvae	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Hobsonia florida	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
insect pupae	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
insect sp.d	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Insect sp e	0.5(0.5)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Laeonereis culveri	0(0)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)
larval fish	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Limnodrilus hoofmeisteri	0(0)	0(0)	0(0)	0(0)	0.6(0.24)	0(0)	0(0)
Megalopa (Uca)	0(0)	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)
Namalycastis sp.	0(0)	0.25(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)
Oligochaete	34.25(11.13)	29.3(15.37)	8.25(4.97)	0(0)	0(0)	0(0)	0(0)
Paratendipes sp.	0(0)	0(0)	0(0)	0(0)	0(0)	1.0(1.0)	0.25(0.25)
Polypedilum sp.	0.25(0.25)	1(0.71)	1.25(0.95)	0(0)	0.8(0.2)	1.0(1.0)	0.25(0.25)
Procladius sp.	0.75(0.48)	0(0)	0(0)	0(0)	0.2(0.2)	0(0)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	4.0(3.08)	5.0(2.65)	17.5(0.5)	20.00(2.48)
Tubificoides heterochaetus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1.25(1.25)

ANOVA comparisons of among-year abundances for major taxonomic groups and functional guilds show generally greater abundances of insect larvae in most sites (7 of 9) in 2003-2005 compared to at least certain earlier years (Table 6.4.12) – a period coincident with the lessoning of the drought as well as ongoing channel widening. Insect larvae as a group are generally less common with increasing salinity in the estuary. Oligochaetes showed significant patterns less often, but were also more abundant in 2003-2005 at 5 of 8 sites when significant among year trends were detected. This group also tends to be more abundant in lower salinities, though high numbers are characteristic of certain mesohaline to euhaline inner marsh locations. Polychaetes showed mixed pattern, with no detectable among year differences at 6 sites, greater abundance in drought years at P2 and P11, and greater abundance in 2005 at P7, an oligohaline/tidal freshwater site. Functional guild changes paralleled these patterns, with among year variations in surface /mobile fauna reflecting their dominance by insect larvae and certain amphipods in sites where significant among year variations in this functional group occurred, deep burrowers reflecting the patterns for oligochaetes at most sites, and sedentary/tube builders reflecting mixed effects of polychaetes (especially *Streblospio* and *Maranzellaria*) and certain tube-dwelling amphipods (Table 6.4.12). In general, 2005 patterns were most similar to 2003-2004. 2005 patterns for both major taxa and functional guilds continued a trend of relatively higher oligochaete and insect abundances for several sites, with increases in oligochaetes at 3 sites compared to prior years (reflected in deep burrowers as well), increases in insects at 3 sites (reflected in surface mobile fauna), and increases in amphipods at 2 sites.

Table 6.4-10. Among year comparison of species richness for the infaunal community.

SITE	F	SNK of F significant (high to low)
Smith Creek (P11)	3.28 (0.008)	03a 04a 01ab 99ab 05ab 02ab 00b
Rat Island (P12)	2.00 NS	
Fishing Creek (P13)	3.44 (0.006)	04a 05ab 99b 03b 00b 01b 02b
Town Creek mouth (P2)	3.72 (0.0034)	04a 05ab 00ab 99b 02b 01b 03b
Inner Town Creek (P3a)	7.05 (0.0001)	04a 05b 03bc 02bc 01bc 00c
Inner Town Creek (P3b)	5.21 (0.0003)	04a 03b 99b 01b 02b 05b 00b
Eagle Island (P6)	4.12 (0.0018)	99a 04ab 03abc 05abc 02abc 01bc 00c
Indian Creek (P7)	14.23 (0.0001)	04a 03a 05a 99a 01b 00bc 02c
Dolison Landing (P8)	4.63 (0.0006)	04a 99ab 00ab 01ab 03abc 05abc 02c

Table 6.4-11 Among year comparison of species diversity for the infaunal community.

SITE	F	SNK of F significant (high to low)
Smith Creek (P11)	3.29 (0.0076)	03a 01a 04ab 99ab 02ab 05ab 00b
Rat Island (P12)	2.02 NS	
Fishing Creek (P13)	5.60 (0.0002)	04a 03a 02a 00a 05ab 99ab 01b
Town Creek mouth (P2)	6.94 (0.0001)	04a 00a 99ab 05abc 03bc 01bc 02c
Inner Town Creek (P3a)	8.96 (0.0001)	04a 03ab 02abc 05bc 01c 00d
Inner Town Creek (P3b)	5.31 (0.0002)	04a 03ab 99ab 02bc 01bc 05bc 00c
Eagle Island (P6)	2.41 (0.039)	04a 99a 03ab 02ab 05ab 01ab 00b
Indian Creek (P7)	10.21 (0.0001)	04a 05a 99a 03a 01a 02b 00b
Dolison Landing (P8)	2.01 NS	

Table 6.4-12. Guild and major taxa patterns by site among years.

Site	Taxa/guild	F	SNK (high to low)
Smith Creek (P11)			
	INS	5.66(0.0001)	03a 04ab 05abc 99bc 01bc 00c 02c
	OLI	2.73 (0.021)	05a 02b 99b 04b 03b 01b 00b
	POL	3.54 (0.005)	01a 04ab 03ab 99b 00b 02b 05b
	AMP	0.97 NS	
	DEC	0.44 NS	
	ISO	0.81 NS	
	BIV	3.81 (0.003)	03a 04b 02b 99b 01b 05b 00b
	GAS	…	
	ST	2.62 (0.026)	01a 04a 03a 99a 00a 05a 02a
	SM	6.35 (0.0001)	03a 04ab 01bc 05bc 00bc 99bc 02c
	DB	2.73 (0.021)	05a 02b 99b 04b 03b 01b 00b
	SB	11.40 (0.0001)	01a 02b 05b 04b 03b 00b 99b
Rat Island (P12)			
	INS	4.74 (0.0006)	04a 03a 05ab 99ab 01b 00b 02b
	OLI	1.61 NS	
	POL	1.24 NS	
	AMP	0.54 NS	
	DEC	1.74 NS	
	ISO	1.39 NS	
	BIV	…	
	GAS	0.54 NS	
	ST	1.98 NS	
	SM	9.82 (0.0001)	04a 03a 01b 00b 05b 99b 02b
	DB	1.62 NS	
	SB	1.28 NS	
Fishing Creek (P13)			
	INS	5.65 (0.0002)	04a 05a 03ab 01b 99b 00b 02b
	OLI	8.65 (0.0001)	05a 04a 99a 01a 00ab 03bc 02c
	POL	1.38 NS	
	AMP	3.39 (0.007)	05a 01ab 03b 00b 02b 04b 99b
	DEC	1.16 NS	
	ISO	1.25 NS	
	BIV	2.24 NS	
	GAS	1.02 NS	
	ST	2.01 NS	
	SM	4.50 (0.0010)	05a 04a 03a 01ab 00ab 9ab 02b
	DB	8.65 (0.0001)	05a 04a 99a 01a 00ab 03bc 02c
	SB	0.95 NS	
Town Creek mouth (P2)			
	INS	2.22 NS	
	OLI	7.15 (0.0001)	05a 04a 99a 00ab 03b 02b 01b
	POL	9.00 (0.0001)	02a 00a 99ab 05ab 04ab 01bc 03c

Table 6.4-12. (continued)

Site	Taxa/guild	F	SNK (high to low)
	AMP	4.01 (0.0002)	05a 04a 00a 01a 02b 99b 03b
	DEC	2.00 (NS)	
	ISO	4.17 (0.0015)	05a 04ab 00b 03b 99b 01b 02b
	BIV	1.48 NS	
	GAS	1.21 NS	
	ST	2.39 (0.039)	00a 02a 04ab 05ab 99ab 01ab 03b
	SM	3.15 (0.0096)	03a 04ab 99ab 00ab 05ab 01b 02b
	DB	6.42 (0.0001)	05a 04ab 99ab 00bc 02c 03c 01c
	SB	2.30 (0.0461)	02a 99a 04a 05a 01a 00a 03a
Inner Town Creek (P3A)			
	INS	4.75 (0.0013)	04a 03b 05b 00b 02b 01b
	OLI	10.48 (0.0001)	04a 00a 05a 01ab 02bc 03c
	POL	1.55 NS	
	AMP	2.81 (0.026)	05a 04ab 01ab 00ab 02b 03b
	DEC	1.27 NS	
	ISO	8.51 (0.0001)	04a 03a 01ab 02b 00b 05b
	BIV	1.66 NS	
	GAS	0.68 NS	
	ST	3.03 (0.0185)	04a 05a 02ab 03ab 01ab 00b
	SM	4.30 (0.0026)	04a 03b 05b 00b 02b 01b
	DB	10.82 (0.0001)	04a 00a 05a 01ab 02bc 03c
	SB	2.93 (0.022)	05a 01ab 00ab 04b 02b 03b
Inner Town Creek (P3B)			
	INS	8.03 (0.0001)	04a 03a 99b 05b 02b 01b 00b
	OLI	5.90 (0.0001)	00a 04a 05ab 99b 01b 03b 02b
	POL	1.44 NS	
	AMP	1.65 NS	
	DEC	3.71 (0.0036)	04a 05b 02b 99b 03b 01b 00b
	ISO	2.74 (0.021)	04a 99b 01b 02b 03b 00b 05b
	BIV	1.68 NS	
	GAS	0.97 NS	
	ST	4.53 (0.0061)	04a 02ab 99ab 01ab 03 05b 00b
	SM	6.22 (0.0001)	04a 03a 99b 05b 00b 02b 01b
	DB	6.81 (0.0001)	00a 04a 05ab 99b 01b 03b 02b
	SB	1.14 NS	
Eagle Island (P6)			
	INS	7.48 (0.0001)	05a 04b 99b 03bc 02bc 01bc 00c
	OLI	3.03 (0.013)	99a 04ab 05ab 03ab 00ab 02b 01b
	POL	1.29 NS	
	AMP	5.34 (0.0002)	99a 03b 01b 04b 02b 05b 00b
	DEC	1.80 NS	
	ISO	3.01 (0.013)	99a 04ab 05b 03b 00b 01b 02b
	BIV	2.36 (0.043)	99a 04b 01b 03b 00b 05b 02b
	GAS	2.25 NS	
	ST	2.80 (0.0193)	04a 01a 00a 99a 02a 03a 05a

Table 6.4-12. (continued)

Site	Taxa/guild	F	SNK (high to low)
	SM	3.05 (0.012)	05a 99ab 04ab 03ab 01b 02b 00b
	DB	3.05 (0.012)	99a 04ab 05ab 03ab 00ab 02b 01b
	SB	1.22 NS	
Indian Creek (P7)			
	INS	10.28 (0.0001)	03a 05ab 04abc 99bc 00c 01c 02d
	OLI	4.74 (0.0005)	03a 00a 05a 99ab 01ab 04b 02b
	POL	3.50 (0.0049)	05a 00b 02b 01b 04b 03b 99b
	AMP	4.18 (0.0014)	01a 99ab 05b 04b 03b 00b 02b
	DEC	1.12 NS	
	ISO	4.97 (0.0003)	01a 99ab 04b 00b 03b 05b 02b
	BIV	1.88 NS	
	GAS	3.61 (0.004)	99a 05b 04b 03b 00b 01b 02b
	ST	1.21 NS	
	SM	5.67 (0.0001)	03a 05ab 01ab 00ab 04ab 99b 02c
	DB	4.63 (0.0006)	03a 00a 05a 99ab 01ab 04ab 02b
	SB	4.73 (0.0005)	05a 01b 00b 02b 04b 03b 99b
Dolison Landing (P8)			
	INS	6.19 (0.0001)	00a 04ab 99abc 01bc 03cd 05cd 02d
	OLI	12.09 (0.0001)	00a 99ab 04ab 05ab 03ab 01b 02c
	POL	1.34 (NS)	
	AMP	7.64 (0.0001)	01a 05ab 99abc 00bcd 02cd 04cd 03d
	DEC	0.48 NS	
	ISO	1.99 NS	
	BIV	4.39 (0.001)	00a 04ab 99ab 01ab 03b 05b 02b
	GAS	0.904 NS	
	ST	3.63 (0.004)	00a 04ab 01ab 99abc 05abc 03bc 02c
	SM	7.35 (0.0001)	00a 04b 99bc 03bc 01bc 02c 05c
	DB	12.06 (0.0001)	00a 99ab 04ab 05ab 03ab 01b 02c
	SB	9.89 (0.0001)	01a 02b 00b 03b 04b 05b 99b

More pronounced than variations in abundance of taxonomic groups was their relative composition. For example, insect larvae and certain amphipods were among the dominant taxa at several sites during both 1999 and 2003 (Tables 6.4-1 through 6.4-9). However, in 1999 the dominant insect larvae were *Bezzia/Palpomyia* at one site, *Polypedilium* at one site, and *Procladius* at another site. The dominant amphipods were *Gammarus* spp. In 2003 the dominant insect larvae were *Polypedilium* at 6 sites, *Dicrotendipes* at 3 sites and *Cryptochironomus* and *Paratindipes* at 1 site each. Where amphipods dominated, *Corophium* was usually the most common genera in 2003 samples. Within a site, dominant species within a taxonomic grouping also varied among years, as is particularly evident for insect larvae in 1999-2001 versus 2003-2005. As noted in last year's progress report, 2002 was distinguished by greater dominance of several polychaete species, consistent with a drought signature, and decline of insects at most sites. Oligochaetes were generally more abundant in 2005 relative to previous years and there were 15 new species recorded in 2005 not recorded in previous years (mostly insect larvae). Variations in abundances of less common taxa are also apparent among years for most sites (Tables 6.4-1 through 6.4-9).

This variation in exact species composition is reflected in Analysis of Community Similarity and Multidimensional Scaling Analysis. These analyses indicated that 1999-2001 samples did not have significantly dissimilar faunal assemblages (Figure 6.4-1). However, subsequent years did have distinct infaunal assemblages, both from the 1999-2001 grouping as well as from each other (statistically distinct groupings: 1999-2001; 2002, 2003, 2004 and 2005; ANOSIM, $R=0.671$, $p<0.001$). However, the overall separation of 2002-2005 from 1999-2001 was greater than differences among the 2002-2005 groupings as indicated by Analysis of Similarity. This roughly corresponds to pre-dredging periods differing from those after channel deepening began; and variable patterns among years during this deepening activity. Strong effects of a drought in 2002 also mean this pattern corresponds with pre-drought/developing drought conditions (1999-2001) and post-drought conditions (2003-2005).

Species richness and diversity exhibited significant variation among years and sites with 2004 representing distinct pattern for both measures compared to previous years (ANOVA; $p<0.0001$; Tables 6.4-10 and 6.4-11). Among year comparison for each site shows highest diversity occurred in 2004 for 6 out of the 7 sites exhibiting significant interannual variations in diversity (Table 6.4-11). Patterns for other years were not as consistent. However, diversity was generally lowest in 2000-2001 (6 of 7 sites showing significant differences). 2005 diversity patterns were generally intermediate relative to other years. Species richness was highest in 2004 for 6 of the 8 sites showing significant differences (and second highest for the remaining 2 sites) (Table 6.4-10). Lowest richness generally occurred in 2000 or 2002 (7 of 8 sites exhibiting significant differences). 2005 richness was intermediate relative to other years for all sites.

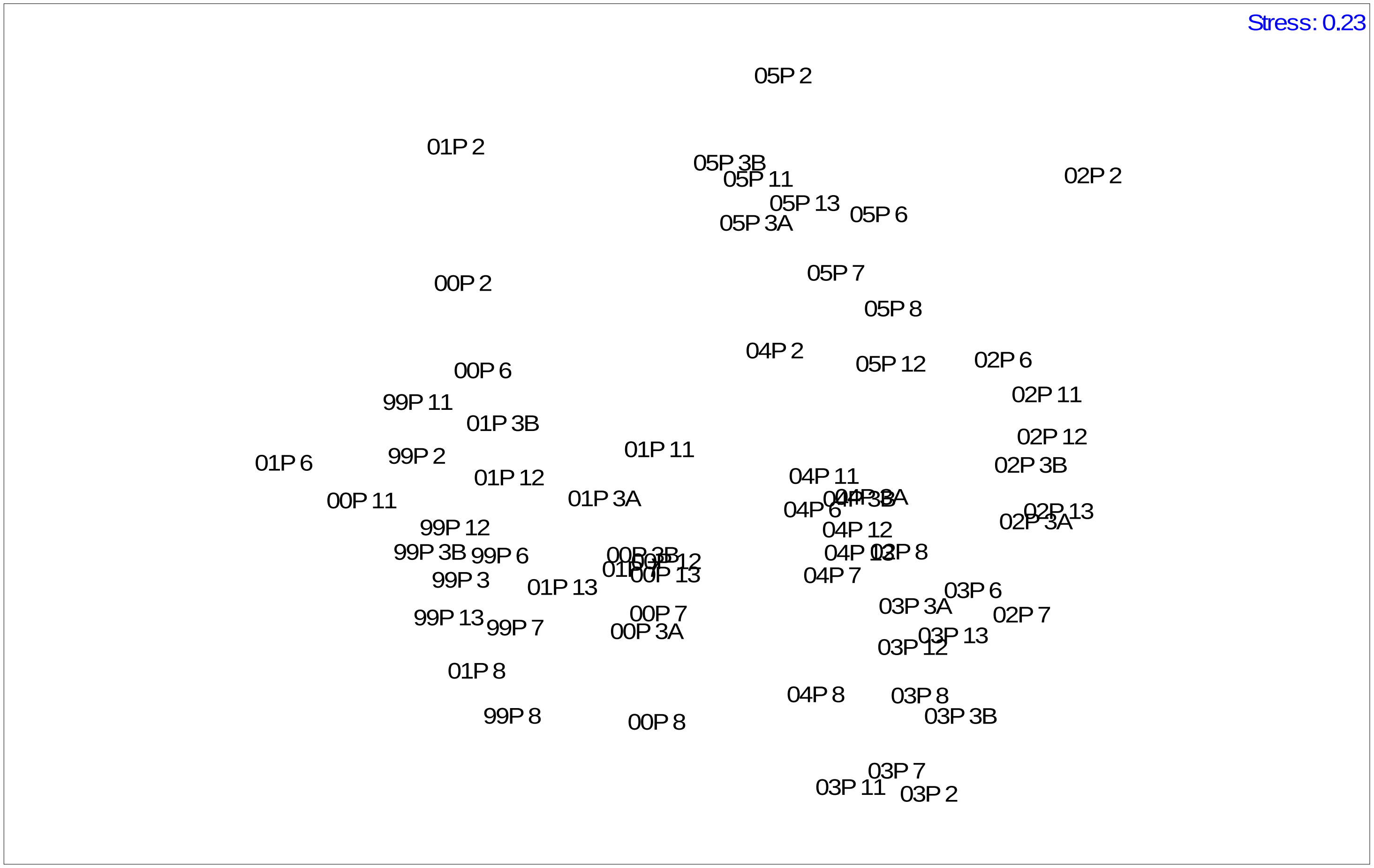


Figure 6.4-1: MDS plot of community similarity among sites and years. Each year site community set is indicated by the year (99, 00, 01, 02, 03, 04, 05) and site (P2, P3a, P3b, P6, P7, P8, P11, P12, P12). Five statistically distinct sample groupings are present based on community similarity (ANOSIM, p<0.01), including the complex formed by 1999-1001 samples, and then each of the subsequent years also representing a distinct community grouping (2002, 2003, 2004, and 2005). Greatest differences were between 1999 - 2001 and the 4 subsequent years.

7.0 EPIBENTHIC STUDIES: DECAPODS AND EPIBENTHIC FISH

7.1 Summary

The epibenthic communities (those organisms that live on or just above the substrate) are strongly influenced by shifts in the physical environment and changes in prey availability. While most of these organisms are highly motile, leading to quick local population responses to changing conditions, evaluation of long-term trends is needed to describe the community's trajectory and response to large scale events. Long term trends must be evaluated against natural population variability. Since 1999 the UNCW Benthic Ecology Lab has conducted a series of seasonal studies focusing on shifts in community level factors such as composition, diversity, species richness, and abundance of the organisms (primarily juvenile fish and crustaceans) that utilize the shallow tidal marshes, swamps, and wetlands along the Cape Fear River estuary. The distribution and abundance of this group of organisms is affected by the distribution and species composition of the benthic infauna, discussed in Chapter 6 that are their primary food source. Many of the epibenthic organisms that have been the target of this study are the juveniles of commercially important species, e.g. *Leiostomus xanthurus* (spot) and *Paralichthys* spp. (flounder), or are critical prey items for fishery species.

This study was initiated in 1999 prior to the deepening of the Cape Fear River. The deepening project included widening only a small portion of the river channel and straightening the shipping lane on the offshore approach to the mouth of the river. Actual dredging activities started late in 2001, with a major portion of the activities taking place in the 2002-2003 time period, but continuing into 2006. Two methods were employed to sample epibenthos, Breder traps (a passive sampling device) and drop traps (an active density based sampling method). Previous findings indicated changes in species patterns consistent with developing drought conditions in 2001 and 2002, though this period was also coincident with initial construction activity. Annual and seasonal differences exist for most sites Evaluation of species richness by season show that 2004, 2005, and 2006 spring sampling periods tended to have significantly higher species richness measures but fall sampling seems to be inconsistent. Analysis of total abundance shows a high degree of variation among years for each of the three tributaries. Spring 2006 tended to show the highest total abundances among all years sampled but this pattern was not observed for fall samples.

7.2 Background

The key to survival for many estuarine dependent species is the balance between refuge and prey availability. Shift in salinity could have an upward cascade effect if it limits prey density, while increased inundation period could lead to shifts in dominant vegetation type, directly altering the habitat quality or having indirect impacts through increased predator forage time and/or efficiency. Tidal fringing marsh and swamps provide essential habitat for juvenile fishes and crustaceans across the estuarine gradient. The maintenance of these habitats supports the commercial shrimp fishery (both *Farfantepanaeus azrecus* and *Litopanaeus setiferus)* in the lower Cape Fear River and provides essential refuge for juvenile blue crabs *Callinectes sapidus*, several species of scianids, and a large number of prey fishes. These are critical fisheries for the Cape Fear region. Changes in the epibenthic organisms (either composition or abundance) could cause significant impacts on these critical groups, either through the direct impacts in the juvenile stages or through the shift in available forage species. Epibenthos are sensitive to changes associated with shifts in salinity and/or tidal inundation. The ingress of juvenile stages of many of the fishery species is closely dependent on the recruitment of prey species. In general, benthic fauna such as annelids tend towards highest abundances in early spring, (following a winter relatively free of predator influence and abundance benthic production) and juvenile fish and crustaceans that depend on the benthic resource start invading the estuary by mid February with full recruitment of multi-species assemblages by early March. There is also a slightly smaller recruitment of benthos in the fall of each year and this too is closely followed by benthic feeding fishes and crustaceans. These annual cycles of recruitment were the basis for our focus on spring and fall sampling events

As part of the long-term project to monitor potential changes in the communities that depend on these habitats we are examining the epibenthic community (primarily fish and decapods) found along the marsh and swamp boundary. Aside from resident fish and decapods, epibenthos include juveniles of transient fish, crabs and shrimp as well as larger snails, amphipods, and isopods. These organisms tend to be highly motile, are often able to utilize a variety of habitats, and may respond rapidly to environmental cues. Many species have larval stages that leave the upper estuary, making recruitment, and subsequent impacts on population levels, potentially responsive to changes in river hydrology. Examples of epibenthos in the Cape Fear system include important fisheries species such as the blue crab, *Callinectes sapidus*, the spot, *Leiostomus xanthurus*, flounder *Paralichthys dentatus*, and commercial shrimp, *Farfantepanaeus* sp. and *Litopanaeus* sp. Many epibenthos occupy critical intermediate trophic roles, being predators on benthos or plankton and prey for larger fish (e.g. grass shrimp, *Palaemonetes* spp., killifish, *Fundulus* spp., and bay anchovy, *Anchoa* sp.). Evaluation of epibenthos provides direct information on possible year class strength of target fishery and indicator species as well as indications of resource and ecosystem responses. Epibenthos may respond quickly to changing conditions because of their ability to move away from unfavorable conditions as well as their dependence on annual recruitment events.

Epibenthic taxa may represent indicators of ecosystem level changes for three reasons: 1) their motile lifestyles allows them to quickly respond to physical changes in the environment, 2) many of the species are juveniles that represent a critical “bottleneck” in year class strength that is sensitive to hydrodynamic factors affecting larval ingress, and 3) the intermediate trophic role of many epibenthos may lead to greater responsiveness to both changes in primary consumer abundances (e.g. benthos) and higher predator abundances. Changes in tidal amplitude or salinity regimes may be first detected as a change in the distribution of certain epifaunal organisms, including shifts in dominance at a site or along the upstream/ downstream gradient. Epifauna are sensitive to changes in many physical conditions and may show behavioral avoidance depending on the factor (i.e. rapid shift in dissolved oxygen, temperature or salinity). Conversely, they may show consistency on the longer temporal scale (i.e. timing of ingress/egress into the estuary and dominance patterns). For many epifauna, especially the juveniles of transient fish, a critical factor may be resource limitation. The presence of a consistent and abundant food resource (including benthic fauna) and refuge (structural habitat within the marsh system) are important for determining population levels and survivorship.

The objective of this section of the monitoring project is to evaluate long-term trends in abundance, species composition and habitat utilization of epibenthos and to detect shifts (if any) in these patterns concordant with river deepening activities and any associated physical changes. The primary objective of the first 2 years of sampling (fall 1999-spring 2001) was to establish a baseline for species composition and abundance patterns. The third and fourth year of monitoring represents a construction phase of the project and potential impact to hydrology may start to become apparent at this time, likewise potential impact to the faunal communities may also begin to be detected. Any potential long-term impacts of the river deepening project would be detected by comparison of patterns in multiple years after channel deepening has been completed to pre-construction and construction patterns. As with the benthic infaunal sampling, some of the potential impacts to these communities are similar to those predicted for rapid sea level rise and so may indicate long-term community changes expected in other systems over the next several decades.

In previous reports there have been three working hypotheses, focusing only on main effects of channel deepening however a fourth hypothesis dealing with indirect effects of site development is also appropriate to mention;

1) Shifts in salinity, tidal inundation, or tidal amplitude may cause shifts in the epibenthic community composition and /or abundance.

2) Changes in the benthic community resulting from the deepening and widening of the river channel may cause a trophic cascading effect that will change the dominance patterns and distribution of some epibenthic species.

3) Hydrologic alterations may affect annual recruitment patterns into the estuary, especially for transient species.

4) Alteration of salinity regime, tidal inundation and/or tidal amplitude may lead to shifts in dominant marsh vegetation and alter epibenthic assemblages.

The fourth hypothesis deals with several sites that seem to be in a state of “development” in terms of dominant vegetation, noted in Chapter 8.

7.3 Methodology

Marshes and boundary wetlands in the Cape Fear River estuary provide a variety of habitats, especially in the tidally influenced areas that have both intertidal and shallow subtidal edge habitats. We use two sampling methods, Breder traps and drop traps, to target fauna with different utilization patterns. Breder trap sampling targets bottom oriented organisms that utilize the intertidal marsh or swamp habitat during the period of inundation. Breder traps are a passive form of sampling that average use patterns over a several hour period. This method has the advantage of being reliably deployed among a variety of structures. Drop trap sampling targets those organisms that utilize the shallow subtidal or “edge” habitat. It is an instantaneous method that provides reliable estimates for both bottom oriented and pelagic species, with the advantage of allowing high replication, but it is difficult to deploy within heavy structure.

Breder traps are constructed of clear acrylic (31 cm length X 16 cm height X 15 cm width). When submerged these traps are transparent and catch epibenthic fish and crustaceans passively, as they move into the tidal wetlands. At each station traps are placed at three tidal heights; lower intertidal (near mean low water), mid intertidal (submerged ~1m depth at mean high water), and upper intertidal (submerged ~ 0.5m at mean high water). Two sets of five traps are set at each tidal height with the opening oriented toward the channel or downstream. The orientation of the traps is based on preliminary data that indicates this positioning is optimal for obtaining highest catches. Each trap is secured to the substrate to ensure it maintains proper orientation. All traps are set on the rising tide and traps are allowed to "fish" for two hours. This time period is based on previous work and represents a compromise between obtaining higher catches and reducing possible loss due to escape or to predation or cannibalism among organisms within the traps. All organisms caught are identified to lowest possible taxon and representative specimens are preserved for verification. All organisms caught are measured for total length. Breder trap sampling is conducted at 9 sites: P11 (Smith Creek), P12 (Rat Island) and P13 (Fishing Creek) in the mainstem Cape Fear River, P6 (Eagle Island), P7 (Indian Creek), and P8 (Dollisons Landing) in the Northeast Cape Fear, and P2 (at the mouth of Town Creek) and 2 sites at P3 in Town Creek.

Drop traps sample those epibenthos utilizing the lower marsh edge or shallow subtidal regions adjacent to the marsh. The drop trap is an aluminum square that is 1m on a side and 1m high with mesh netting and floats attached to the top edge to prevent organisms from escaping. The trap is deployed from a boat using a large boom that suspends the trap 6-8 feet above the water surface. When the trap is released its weight drives it into the substrate and seals the bottom to prevent organisms from escaping beneath the trap (each drop is checked for an adequate bottom seal upon deployment to ensure that organisms cannot escape). Eighteen replicate drops are made in the shallow subtidal areas at each station. Replicate samples are taken at least 10m apart and at least 20 minutes is allowed between each sample. Once the trap is secured the contents are removed using a steel frame sweep net with a 2mm mesh. The trap is considered empty when five consecutive sweeps of the entire trap yield no organisms. All organisms caught are identified, enumerated, and measured (total length). Representatives of each species caught are preserved for verification. Drop sampling is conducted at the same sites as Breder trap sampling, except that the two P3 subsites are sampled as one site because of edge area limitations.

Drop trap and Breder trap sampling was conducted during the same time window for all stations. At least 24 hours separated the use of each method at a site. While Breder traps were deployed on a single day per site, drop trap samples were collected over a 3+ day period for each site. The collection of drop trap data over a multi-day sampling period gives a more accurate evaluation of the use of the subtidal areas adjacent to each site.

For this report, we present mean abundance of epibenthos for each station by year and season (reflecting seasonal variation in faunal abundances) (Tables 7.4-1-7.4-17). To evaluate potential trends and community level responses, analyses for this report focuses on differences in diversity, species richness, and total fauna by season across years. Breder trap and drop trap data was analyzed separately. Because of interactions between seasons and among sites the data was analyzed using a 1-way Analysis of Variance among years. The Shannon-Weiner diversity index was used to describe diversity patterns and was compared among sites using Analysis of Variance. Where significant year affects were found, an SNK test was used to distinguish among years. Overall community comparisons, including all species present, were analyzed using an Analysis of Similarity with Primer - a multivariate statistical package. Fall and spring data were analyzed separately, results are presented in a multidimensional scaling plot.

7.4 Community Evaluation

Multivariate Analysis

Multivariate analysis of the epibenthic catches from marsh edge (drop trap), show weak annual groupings for spring (Figure 7.4-1) These data show 2002 and 2003 grouping together weakly, while 2001 and 2000 appear as closely related groups and 2004-2006 cluster together. Analyses for fall (Figure 7.4-2) show that 2002 and 2000 form groups but that most other site/year combinations cluster together. These close groupings most likely reflect the overlap in dominant species and an overall similarity of rare species.

Dominance patterns

Cumulative species curves indicate that the accumulation of new species reached its peak in 2002-2004. In the 2005-2006 sampling period only three new species were collected using Breder traps and 2 additional species for drop traps, bringing the total species listing by the two methods to 52 and 87 respectively (Appendix B). The mean abundance and standard errors for each taxa by site/season/year is presented for marsh samples (Breder traps) in Tables 7.4-1 through 7.4-9, while marsh edge (drop trap) data is presented in Tables 7.4-10 through 7.4-17. Several species were consistently present among the numerically dominant (comprising >5% of the total number of individuals collected) taxa among years and across habitats. *Leiostomus xanthurus* (spot) and *Lagodon rhomboids* (pinfish) were among the most common taxa collected in both habitats during spring, other dominate taxa include *Ctenogobius shufeldi* (freshwater goby), *Palaemonetes pugio* (grass shrimp), *Gambusia* sp., and *Fundulus heteroclitus* that were present in both seasons. Several species of flounder (*Paralichthyes* spp.) and *Trinectes maculates* (hogchoker) were prominent in both fall and spring catches. Two species of fiddler crab (*Uca Minax*, and *Uca Pugilator*) were common across most sites and seasons in the marsh sampling. One distinct difference between the marsh and marsh edge habitats, that becomes evident when evaluating the 2000-2005 data is the presence of nekton such as *Anchoa mitchilli* (anchovies), and *Menidia beryllina* (silverside), in the fall and juvenile clupeids in the spring. These species are rarely collected within the marsh and are not generally considered epibenthic; however the consistent presence of these species among years indicates their utilization of the shallow subtidal areas along the marsh edge. During spring 2005 juvenile clupeids accounted for nearly 30% of the total catch while anchovies and silversides comprised ~18% of total catches and during fall 2005. The pattern changes during spring 2006 sampling because spot (*Leiostomus xanthurus*) comprise greater than 80% of all catches with mosquito fish as a co-dominant although that species only comprised ~6% of total catches.

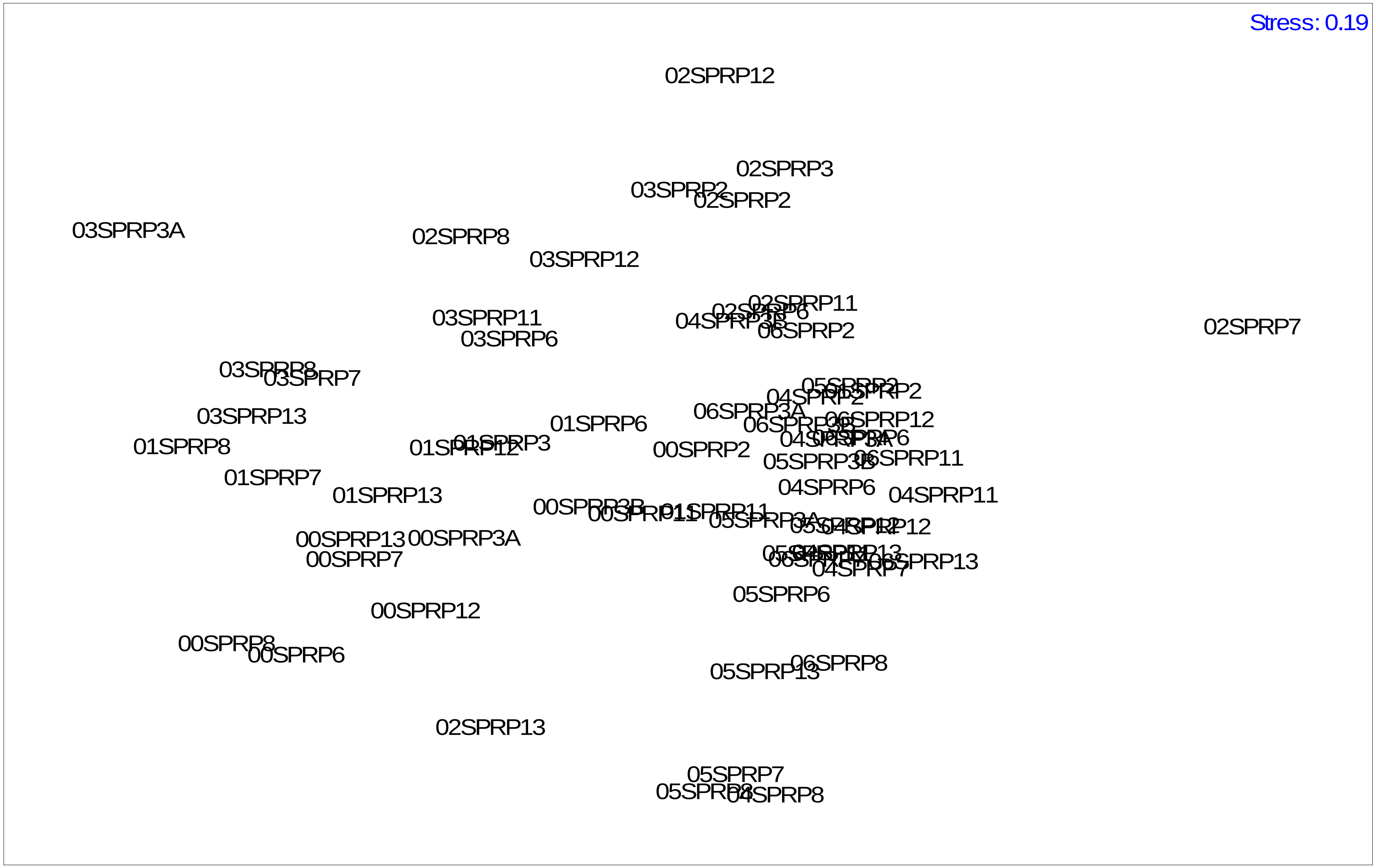


Figure 7.4-1. Multidimensional Scaling plot of Spring drop trap samples. Samples are designated by year/season/site.

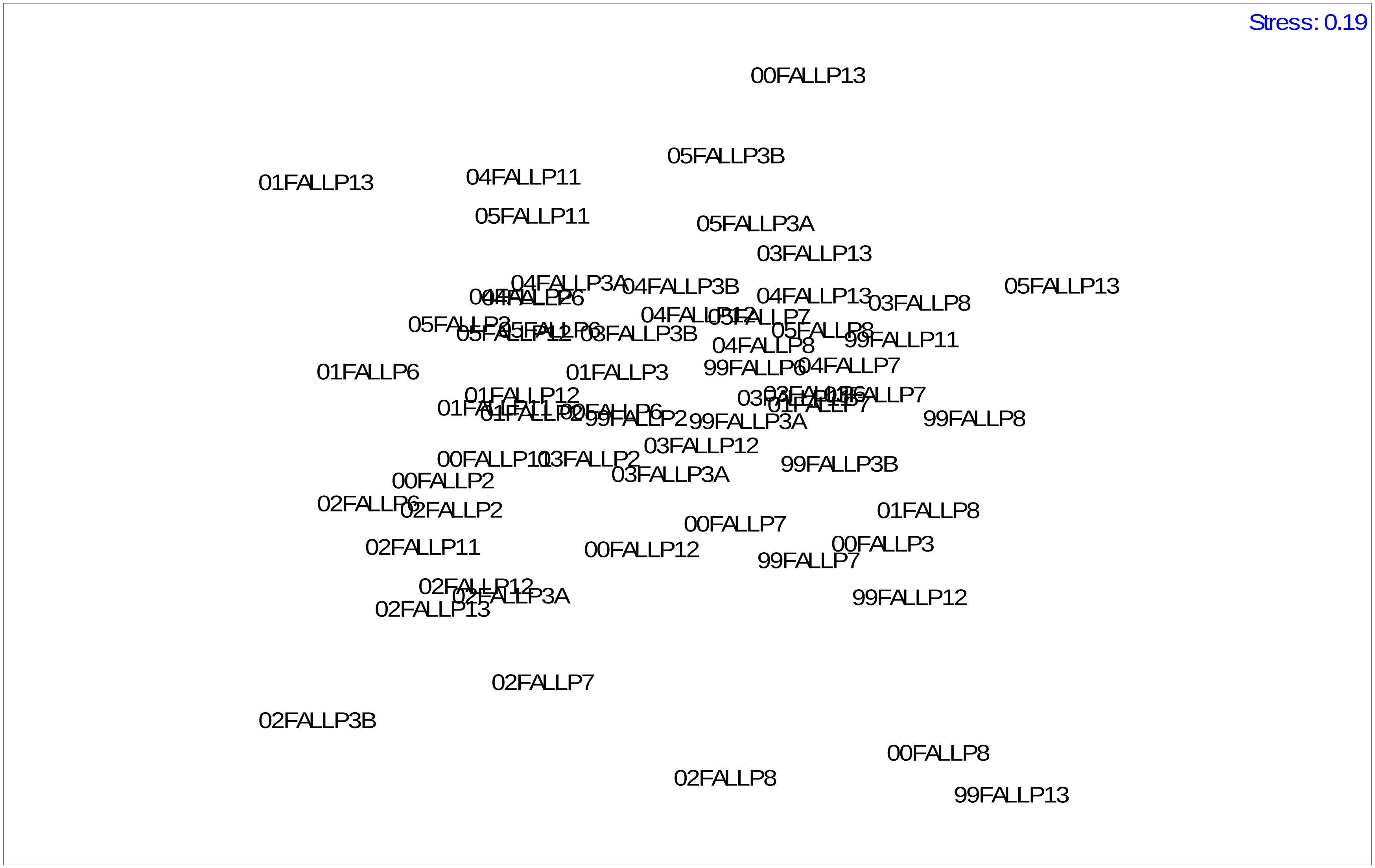


Figure 7.4-2. Multidimensional Scaling plot of Fall drop trap samples. Samples are designated by year/season/site.

Table 7.4-1a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2005) Breder trap samples at station P2 (Mouth of Town Creek).

	Fall 1999			Fall 2000			Fall 2001			Fall 2002			Fall 2003			Fall 2004			Fall 2005		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.20 (0.20)	0 (0)	0.30 (0.15)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0(0)	0(0)	0(0)
Ctenogobius boleosoma	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.30 (0.21)	0.30 (0.15)	0.30 (0.21)
Ctenogobius shufeldti	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	010 (0.10)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0(0)	0(0)	0(0)
Dormitator maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0(0)	0(0)	0(0)
Eucinostomus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10 (0.10)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0.70 (0.33)	0.90 (0.28)	0.60 (0.27)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	3.50 (0.82)	4.50 (1.18)	3.70 (1.68)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0(0)	0(0)	0(0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0(0)	0(0)	0(0)
Gambusia affinis	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)		0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0(0)	0(0)	0(0)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0(0)	0(0)	0(0)
Litopenaeus setiferus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.30 (0.15)	0 (0)	0.20 (0.13)	0.70 (0.26)	0.50 (0.22)	0.50 (0.17)
Menidia beryllina	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0(0)	0(0)	0(0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.20 (0.13)	0.10 (0.10)	0.20 (0.13)
Palaemonetes pugio	0 (0)	0.30 (0.15)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.30 (0.21)	0.40 (0.22)	0.60 (0.31)	0.80 (0.42)	0.30 (0.15)	0 (0)	0 (0)	0 (0)	0.40 (0.31)	0.60 (0.27)	0.50 (0.22)	0(0)	0(0)	0.70 (0.39)
Palaemonetes vulgaris	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10 (0.10)	0.10 (0.10)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0(0)	0(0)	0(0)
Rhithropanopeus harrisii	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10 (0.10)	0(0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0(0)	0(0)	0(0)
Syngnathidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0(0)	0(0)	0(0)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0(0)	0(0)	0(0)
U/I insect	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0(0)	0(0)	0(0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0(0)	0(0)	0(0)
Uca pugilator	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.5 (1.19)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0(0)	0(0)	0(0)
Uca pugnax	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0(0)	0(0)	0(0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.80 (0.80)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0(0)	0(0)	0(0)

Table 7.4-1b. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2006) Breder trap samples at station P2 (Mouth of Town Creek).

	Spring 2000			**Spring 2001**			**Spring 2002**			**Spring 2003**			**Spring 2004**			**Spring 2005**			**Spring 2006**		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.70 (0.33)	0.20 (0.13)	0.30 (0.15)	0 (0)	0 (0)	0 (0)
Clupidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.40 (0.30)	0.20 (0.13)	0 (0)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.50 (0.22)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0.10 (0.10)	0.20 (0.13)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.40 (0.27)	0.30 (0.30)	0.10 (0.10)	0.40 (0.22)	0.40 (0.22)	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0.10 (0.10)	0.10 (0.10)	0 (0)	0.20 (0.13)	0.20 (0.13)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.30 (0.15)	0.20 (0.13)	1.00 (0.33)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.30 (0.21)
Fudulus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.30 (0.15)	0.20 (0.20)	0 (0)	0 (0)	0 (0)
Hirudinea	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0.40 (0.16)	0.30 (0.21)	0 (0)
Leiostomas xanthurus	9.90 (2.66)	5.00 (1.62)	5.30 (2.33)	0 (0)	0 (0)	0.50 (0.22)	1.00 (0.54)	0.50 (0.27)	0.30 (0.21)	0 (0)	0 (0)	0 (0)	2.60 (1.64)	2.20 (0.44)	1.40 (0.40)	2.10 (0.48)	3.30 (0.67)	2.90 (0.74)	20.6 (7.56)	20.7 (5.78)	17.2 (5.67)
Micropogonias undulates	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Palaemonetes pugio	1.50 (0.43)	1.40 (0.52)	2.30 (1.04)	2.00 (0.82)	1.10 (0.53)	1.30 (0.68)	1.00 (0.45)	1.00 (0.47)	0.10 (0.10)	0.80 (0.44)	0.80 (0.51)	1.70 (0.96)	1.60 (0.67)	1.80 (0.36)	1.30 (0.50)	1.90 (0.41)	3.80 (0.57)	1.50 (0.43)	1.00 (0.30)	1.00 (0.49)	1.00 (0.52)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.30 (0.15)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.80 (0.59)	0.10 (0.10)	0.30 (0.30)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-2a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2005) Breder trap samples at station P3A (Town Creek).

	Fall 1999			**Fall 2000**			**Fall 2001**			**Fall 2002**			**Fall 2003**			**Fall 2004**			**Fall 2005**		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0.80 (0.47)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.30 (0.21)	0.10 (0.10)	0.40 (0.22)	0.30 (0.15)	0.30 (0.21)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.33 (0.33)	0.20 (0.13)	0.70 (0.50)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0.20 (.20)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.20 (0.13)	0.40 (0.16)	0.22 (0.15)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.70 (0.40)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0.50 (0.31)	1.10 (0.41)	0.50 (0.31)	0.11 (0.11)	0.20 (0.20)	0.20 (0.20)	0.60 (0.50)	1.60 (0.85)	1.20 (0.57)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.70 (0.60)	1.40 (0.60)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0.10 (0.10)	0.10 (0.10)	0.20 (0.20)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.70 (0.52)	0.40 (0.31)	0.50 (0.31)	0.30 (0.15)	0.40 (0.22)	0 (0)	0.33 (0.24)	0.80 (0.61)	0.90 (0.69)	0.20 (0.133)	0.40 (0.16)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.33 (0.17)	0.50 (0.31)	0.50 (0.40)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0.10 (0.10)	0.10 (0.10)
Uca pugnax	0.20 (0.20)	0.40 (0.22)	0.80 (0.25)	0 (0)	0.20 (0.20)	0.30 (0.21)	0.20 (0.20)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-2b. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2006) Breder trap samples at station P3A (Town Creek).

	Spring 2000			**Spring 2001**			**Spring 2002**			**Spring 2003**			**Spring 2004**			**Spring 2005**			**Spring 2006**		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0.10 (0.10)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.90 (0.35)	0.80 (0.33)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0.10 (0.10)	1.00 (0.54)	1.00 (0.89)	1.50 (0.82)	0.10 (0.10)	0.30 (0.15)	0.80 (0.51)	0.20 (0.20)	0.50 (0.27)	0.89 (0.35)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)
Fundulus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Gambusia affinis	0.10 (0.10)	0.50 (0.27)	0.50 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)	0.30 (0.21)	0.60 (0.43)	0.90 (0.69)	0.10 (0.10)	0.60 (0.34)	0 (0)	1.70 (0.86)	0.80 (0.29)	0 (0)	0.70 (0.52)	2.40 (1.48)	1.80 (0.92)	0 (0)	0 (0)	20.3 (9.73)
Heterandria formosa	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.30 (0.60)	1.50 (0.52)	2.70 (1.75)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.70 (0.60)	0.70 (0.60	0 (0)	0.50 (0.40)	0.30 (0.21)	0 (0)	5.60 (3.08)	0.70 (0.21)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0.30 (0.15)	0 (0)	0 (0)	0.20 (0.13)	0.90 (0.55)	0 (0)	0.50 (0.22)	0.30 (0.21)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.60 (0.31)	0.80 (0.29)	1.11 (0.31)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0 (0)	0 (0)
Uca pugnax	1.50 (0.62)	2.10 (0.57)	2.00 (0.67)	0.10 (0.10)	1.40 (0.56)	1.80 (0.53)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugilator	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	1.00 (0.30)	1.10 (0.48)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-3a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2005) Breder trap samples at station P3B (Town Creek).

	Fall 1999			**Fall 2000**			**Fall 2001**			**Fall 2002**			**Fall 2003**			**Fall 2004**			**Fall 2005**		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Cambaridae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.50 (0.22)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.50 (0.50)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.40 (0.22)	0.40 (0.27)	0.80 (0.51)	0.10 (0.10)	0.15 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus confluentus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.40 (0.40)
Fundulus majalis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia affinis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	1.00 (0.56)	0.20 (0.13)	1.00 (0.49)	0 (0)	0.30 (0.15)	0 (0)	0.50 (0.40)	0 (0)	0.10 (0.10)	0 (0)	0.20 (0.16)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	1.60 (0.40)	1.50 (0.76)	1.20 (0.59)	0.20 (0.13)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.80 (0.49)	0.90 (0.41)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.20 (0.49)	1.80 (0.61)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	1.10 (0.90)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.50 (0.22)	0.20 (0.13)	0.40 (0.16)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-3b. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2006) Breder trap samples at station P3B (Town Creek).

	Spring 2000			Spring 2001			Spring 2002			Spring 2003			Spring 2004			Spring 2005			Spring 2006		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.30 (0.15)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.60 (0.27)	0 (0)	0.30 (0.21)	0.30 (0.21)	0 (0)	0.30 (0.15)	0 (0)	0 (0)
Dormitator maculatus	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Esox niger	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0.30 (0.30)	0.60 (0.31)
Gambusia affinis	0.10 (0.10)	0.20 (0.13)	0.30 (0.15)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0.40 (0.31)	1.10 (0.67)	0.60 (0.40)	2.30 (0.83)	2.30 (1.04)	0.60 (0.34)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0.30 (0.21)	0 (0)	0.20 (0.13)	0.90 (0.35)	0.20 (0.20)	0.10 (0.10)	0 (0)	0.10 (0.10)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	030 (0.15)	1.80 (0.92)	0.10 (0.10)	0.30 (0.21)	0.40 (0.22)	0.30 (0.21)	1.20 (0.71)	1.60 (0.76)	0.20 (0.13)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0.10 (0.10)	0.10 (0.10)	1.20 (0.53)	0.30 (0.15)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.20 (0.13)	0.10 (0.10)	0.30 (0.15)	0.80 (0.39)	0.20 (0.13)	0.80 (0.25)	1.00 (0.42)	2.30 (1.32)
Paralichthys albigutta	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.30 (0.21)	0.10 (0.10)	0 (0)	0.20 (0.13)	0.10 (0.10)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.80 (0.47)	1.40 (0.60)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.70 (0.26)	1.20 (0.49)	0.60 (0.34)	0.20 (0.13)	0.60 (0.40)	0.90 (0.50)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugilator	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.40 (0.22)	0.30 (0.15)	2.60 (0.73)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-4a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2005) Breder trap samples at station P6 (Eagle Island).

	Fall 1999			**Fall 2000**			**Fall 2001**			**Fall 2002**			**Fall 2003**			**Fall 2004**			**Fall 2005**		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.10 90.10)	0.10 (0.10)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.50 (0.50)	0.90 (0.55)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Dormitator maculates	0 (0)	0.10 (0.10)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.40 (0.31)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0.90 (0.23)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.60 (0.50)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)
Fundulus majalis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia affinis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leptocephalus larvae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulates	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0.10 (0.10)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	1.00 (0.60)	0.80 (0.44)	0.20 (0.13)	1.90 (1.49)	1.40 (0.45)	2.89 (1.74)	0.50 (0.22)	0.50 (0.31)	4.22 (4.10)	0 (0)	0 (0)	0 (0)	0.40 (0.22)	0.50 (0.22)	0.20 (0.13)	1.80 (0.70)	1.50 (0.62)	0.80 (0.59)
Paralichthys albigutta	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sygnathidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.50 (0.22)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
U/I fish	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-4b. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2006) Breder trap samples at station P6 (Eagle Island).

	Spring 2000			Spring 2001			Spring 2002			Spring 2003			Spring 2004			Spring 2005			Spring 2006		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0.10 (0.10)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0.10 (0.10)	0.10 (0.10)	0.20 (0.13)	0.30 (0.21)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0.30 (0.15)	0.50 (0.22)	0.10 (0.10)	0.50 (0.27)	0.90 (0.69)	0 (0)	0 (0)	0 (0)	0 (0)
Diving beetle	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.90 (0.59)	1.00 (0.89)	0.50 (0.27)	0.10 (0.10)	0.20 (0.13)	0 (0)	0.10 (0.10)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.70 (0.33)	0.20 (0.13)
Fundulus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.70 (0.21)	0.40 (0.27)	0.50 (0.27)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0.10 (0.10)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	15.5 (3.14)	30.9 (10.1)	33.5 (9.06)
Leiostomus xanthurus	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.20 (0.20)	0 (0)	0 (0)	0 (0)	8.70 (2.87)	14.30 (4.37)	32.90 (12.60)	5.30 (2.82)	11.4 (3.53)	9.3 (3.00)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.60 (0.31)	0.70 (0.40)	2.30 (1.08)	0 (0)	0 (0)	0 (0)	0.80 (0.51)	0.70 (0.42)	0.10 (0.10)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0.30 (0.30)	0.10 (0.10)	0.20 (0.20)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	1.40 (0.58)	1.00 (0.30)	4.30 (1.57)
Paralichthys dentatus	0.30 (0.30)	0.40 (0.22)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2.30 (0.67)	1.80 (0.63)	0.80 (0.59)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0.20 (0.20)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugilator	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0 (0)	0 (0)	0 (0)	0.30 (0.21)	0 (0)	0.60 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-5a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2005) Breder trap samples at station P7 (Indian Creek).

	Fall 1999			**Fall 2000**			**Fall 2001**			**Fall 2002**			**Fall 2003**			**Fall 2004**			**Fall 2005**		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0.50 (0.22)	0.10 (0.10)	0.40 (0.22)	0 (0)	0.10 (0.10)	0.20 (0.13)	0 (0)	0 (0)	0 (0)
Dormitator maculatus	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus argenteus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.40 (0.31)	0 (0)	0 (0)	0 (0)
Evorthodus lyricus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropterus salmoides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	1.56 (0.56)	0.56 (0.34)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0.40 (0.31)	0 (0)	0.10 (0.10)	0.10 (0.10)
Uca pugnax	0.60 (0.34)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)		0 (0)	0 (0)	0 (0)

Table 7.4-5b. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2005) Breder trap samples at station P7 (Indian Creek).

	Spring 2000			Spring 2001			Spring 2002			Spring 2003			Spring 2004			Spring 2005			Spring 2006		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Clupidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)			
Ctenogobius shufeldti	0.40 (0.16)	1.10 (0.28)	4.33 (3.85)	0.40 (0.22)	0.60 (0.22)	0.30 (0.21)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.70 (0.42)	0.70 (0.30)	0 (0)	1.00 (0.49)	0.70 (0.40)	0 (0)	0.90 (0.35)	0.90 (0.41)	0.10 (0.10)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.50 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0.10 (0.10)	0 (0)			0.10 (0.10)
Fundulus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0.10 (0.10)	3.00 (1.30)			
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4.20 (2.09)			
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	6.60 (2.35)	8.20 (3.57)	2.80 (0.66)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.60 (0.78)	0.90 (0.31)	1.10 (0.35)	0.40 (0.22)	1.10 (0.46)	0.50 (0.22)	0.40 (0.16)	0.60 (0.40)	0.30 (0.15)
Lepomis macrochirus	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0.40 (0.22)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0.40 (0.16)	0.30 (0.21)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Paralichthys lethostigma	0 (0)	0.30 (0.15)	0.67 (0.44)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.20 (0.33)	0.70 (0.37)	0.50 (0.17)	0.10 (0.10)	0 (0)	0 (0)			
Rhithropanopeus herbstii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.33 (0.17)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			

Table 7.4-6a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2005) Breder trap samples at station P8 (Dollisons Landing).

	Fall 1999			**Fall 2000**			**Fall 2001**			**Fall 2002**			**Fall 2003**			**Fall 2004**			**Fall 2005**		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)			
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Cambarus robustus	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Ctenogobius shufeldti	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.10 (0.60)	0.50 (0.27)	0.20 (0.13)	0 (0)	0 (0)	0 (0)			
Dormitator maculatus	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Fundulus confluentus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Fundulus diaphanus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.50 (0.27)	1.60 (0.64)	2.20 (1.17)			
Fundulus heteroclitus																				0.10 (0.10)	
Gambusia affinis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0 (0)	0 (0)			
Gambusia holbrooki																			0.40 (0.22)	0.10 (0.10)	0.50 (0.34)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	1.0 (1.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.78 (0.66)	0.30 (0.21)	1.10 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)		
Paralichthys sp.	0.20 (0.13)	0.20 (0.20)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.20 (0.20)	0.10 (0.10)	0 (0)	0 (0)	0 (0)			
Uca minax																				0.40 (0.30)	0.10 (0.10)

Table 7.4-6b. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2006) Breder trap samples at station P8 (Dollisons Landing).

	Spring 2000			**Spring 2001**			**Spring 2002**			**Spring 2003**			**Spring 2004**			**Spring 2005**			**Spring 2006**		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Amphipoda	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0.60 (0.31)	0.30 (0.15)	0.30 (0.21)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.30 (0.21)	0.30 (0.15)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0.40 (0.22)	2.50 (1.27)	1.20 (0.85)
Fundulus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.60 (0.40)	0.50 (0.31)			
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)			
Menidia beryllina	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.20 (0.13)	1.00 (0.80)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.11 (0.11)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.20 (0.61)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)			

Table 7.4-7a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2005) Breder trap samples at station P11 (Smith Creek).

	Fall 1999			**Fall 2000**			**Fall 2001**			**Fall 2002**			**Fall 2003**			**Fall 2004**			**Fall 2005**		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)			
Ctenogobius boleosoma																			0.40 (0.30)	0.40 (0.22)	
Ctenogobius shufeldti	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	2.10 (0.85)	0.70 (0.40)	0.30 (0.21)	0.10 (0.10)	0 (0)	0.10 (0.10)	0.20 (0.20)		
Dormitator maculatus	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Eucinostomus sp.																				0.10 (0.10)	0.20 (0.13)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.60 (0.27)	0.50 (0.22)	0.20 (0.13)	1.20 (0.70)	1.80 (0.61)	1.20 (0.36)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Fundulus heteroclitus	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Fundulus majalis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0.30 (0.21)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Lepomis macrochirus	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Litopenaeus setiferus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.10 (0.10)	0.40 (0.16)			
Lutjanus griseus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Menidia beryllina	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)			
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.80 (0.80)	0 (0)	0.40 (0.31)	0.40 (0.22)	0.40 (0.16)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)			
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Symphorus plagiusa	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Trinectes maculatus	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
U/I larval fish	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.40 (0.40)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Uca pugnax	0.10 (0.10)	0.20 (0.13)	8.50 (4.17)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			

Table 7.4-7b. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2006) Breder trap samples at station P11 (Smith Creek).

	Spring 2000			Spring 2001			Spring 2002			Spring 2003			Spring 2004			Spring 2005			Spring 2006		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.30 (0.15)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)		0.10 (0.10)	
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0.60 (0.31)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)			
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)		
Lagodon rhomboides	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.50 (0.67)	1.10 (0.46)	0.60 (0.31)			
Leiostomus xanthurus	1.30 (0.76)	0.30 (0.21)	1.0 (0.39)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	6.80 (2.08)	9.70 (3.85)	25.90 (11.83)	15.30 (5.11)	26.60 (8.71)	19.20 (4.62)	21.8 (2.93)	45.2 (6.12)	22.7 (5.51)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.80 (0.61)	0.50 (0.22)	1.10 (0.60)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)			0.10 (0.10)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.20 (0.20)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)		0.80 (0.59)	1.00 (0.42)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.40 (0.16)	0.40 (0.31)	1.20 (0.63)	0.33 (0.17)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)			0.10 (0.10)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.89 (0.56)	0.10 (0.10)	0.30 (0.21)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.40 (0.22)		0.10 (0.10)

Table 7.4-8a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2004) Breder trap samples at station P12 (Rat Island).

	Fall 1999			**Fall 2000**			**Fall 2001**			**Fall 2002**			**Fall 2003**			**Fall 2004**			**Fall 2005**		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0.60 (0.43)	0.60 (0.40)	0.60 (0.31)	0.30 (0.15)	0.70 (0.26)	0 (0)			
Dormitator maculatus	0.60 (0.34)	0 (0)	0.40 (0.22)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Eucinostomus sp																			0.30 (0.15)		
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)	0.30 (0.21)	0.30 (0.15)	0.89 (0.26)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Gambusia affinis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Lepomis macrochirus	0 (0)	0.20 (0.13)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Litopenaeus setiferus																			0.60 (0.27)	0.60 (0.16)	0.60 (0.22)
Menidia beryllina	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Palaemonetes pugio	0.10 (0.10)	0 (0)	0 (0)	0.40 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.44 (0.24)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.70 (0.26)	0.40 (0.22)	0.10 (0.10)
Paralychthys albigutta																				0.10 (0.10)	
Syngnathidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)			0.10 (0.10)
Uca pugnax	0 (0)	0.20 (0.13)	0.10 (0.10)	0.10 (0.10)	0 (0)	1.70 (0.53)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			

Table 7.4-8b. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2006) Breder trap samples at station P12 (Rat Island).

	Spring 2000			**Spring 2001**			**Spring 2002**			**Spring 2003**			**Spring 2004**			**Spring 2005**			**Spring 2006**		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.30 (0.15)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)			
Ctenogobius shufeldti	0.60 (0.31)	0.60 (0.31)	0.10 (0.10)	0 (0)	0.20 (0.20)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.60 (0.22)	0.60 (0.22)	0.10 (0.10)	0.10 (0.10)		
Fundulus heteroclitus	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.20 (0.20)	0.80 (0.49)	0 (0)	0 (0)	0.30 (0.21)	0 (0)	0 (0)	0 (0)	0.90 (0.41)	0.55 (0.25)	0.90 (0.50)	0 (0)	0 (0)	0 (0)	0.50 (0.22)	0.60 (0.30)	0.90 (0.41)
Fundulus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)			
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	6.20 (1.54)	3.30 (1.15)	2.90 (0.62)			
Leiostomas xanthurus	0.20 (0.20)	0.20 (0.13)	0.10 (0.10)	0.50 (0.31)	0.60 (0.27)	0.80 (0.49)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	13.20 (3.03)	15.40 (5.68)	11.40 (8.63)	31.9 (7.54)	26.6 (7.74)	
Lepomis macrochirus	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)		
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.20 (0.20)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 90.10)	
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0.30 (0.21)	0.50 (0.22)	0 (0)	1.00 (0.39)	0.50 (0.27)	0.67 (0.55)	1.60 (0.93)	3.50 (3.06)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0.30 (0.21)	1.10 (0.58)	
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.15)	1.40 (1.09)	0.40 (0.22)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Paralichthys lethostigma	0 (0)	0.30 (0.21)	0.30 (0.15)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)			
Rhithropanopeus herbstii	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)		0.10 (0.10)	2.30 (1.24)
Uca pugnax	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.81 (0.55)	1.50 (0.43)			

Table 7.4-9a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2005) Breder trap samples at station P13 (Fishing Creek).

	Fall 1999			**Fall 2000**			**Fall 2001**			**Fall 2002**			**Fall 2003**			**Fall 2004**			**Fall 2005**		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)			
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0.60 (0.34)	0.20 (0.13)	0.20 (0.13)			0.10 (0.10)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)		
Dormitator maculatus	0.10 (0.10)	0.20 (0.20)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Eucinostomus sp.																			0.80 (0.51)	0.30 (0.30)	0.30 (0.21)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Fundulus sp.																			0.10 (0.10)		
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Lepomis macrochirus	0.60 (0.60)	0.30 (0.30)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)		
Lutjanus griseus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)			
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)			
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.30 (0.30)	0 (0)	0.40 (0.40)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)			0.30 (0.15)
Uca pugnax	0 (0)	0.40 (0.31)	0.40 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)			

Table 7.4-9b. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2006) Breder trap samples at station P13 (Fishing Creek).

	Spring 2000			Spring 2001			Spring 2002			Spring 2003			Spring 2004			Spring 2005			Spring 2006		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.30 (0.21)	0.70 (0.33)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.50 (0.50)		0.20 (0.13)	0.20 (0.13)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.80 (0.42)	0.40 (0.22)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.30 (0.47)	1.00 (0.49)	1.50 (0.70)	0 (0)	0 (0)	0 (0)			0.20 (0.13)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.60 (0.34)	0.20 (0.13)	0 (0)			
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.30 (1.10)	0.60 (0.34)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	2.00 (1.31)	2.20 (1.04)	5.50 (2.87)	0.10 (0.10)	0.40 (0.31)	0.10 (0.10)		1.70 (0.47)	0.90 (0.46)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.30 (0.21)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.30 (0.30)	0.20 (0.20)	0.40 (0.22)	0 (0)	0 (0)	0.10 (0.10)			
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.40 (0.16)	0.90 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			0.80 (0.39)
Uca pugnax	0 (0)	0 (0)	0.10 (0.10)	0.20 (0.13)	0.60 (0.43)	0.80 (0.33)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			

Table 7.4-10a. Mean abundance (SE) for epibenthic fauna collected in Fall drop trap sampling at station P2 (Mouth of Town Creek).

	1999	2000	2001	2002	2003	2004	2005
Alpheus heterochelis	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Anchoa mitchelli	0.44 (0.44)	0 (0)	1.39 (1.33)	0.28 (0.23)	0 (0)	5.22 (5.11)	0.89 (0.46)
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Anthinnae	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Bivalve	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Brevoortia tyrannus	0 (0)	0 (0)	0.17 (0.17)	0 (0)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0.33 (0.14)	0.67 (0.23)	0.78 (0.42)	0.11 (0.11)	0 (0)	0.67 (0.40)	1.89 (0.47)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)
Ctenogobius shufeldti	0.44 (0.20)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0.11 (0.08)	0 (0)
Eucinostomus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0 (0)
Farfantepenaeus aztecus	0 (0)	0.17 (0.09)	0.17 (0.12)	3.50 (1.35)	0.44 (0.23)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Gerreidae	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.13)	0 (0)	0 (0)
Gobiesox punctulatus	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Larimus fasciatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (0.05)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Litopenaeus setiferus	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	1.00 (0.48)	2.11 (0.74)
Lutjanus griseus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0.39 (0.24)	0 (0)	0 (0)	0.22 (0.22)	0.17 (0.17)
Menidia menidia	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0.33 (0.24)	0 (0)	0 (0)
Menticirrhus saxatilis	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0.44 (0.27)	0 (0)	0 (0)	0.06 (0.06)	0.83 (0.28)
Mugil cephalus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes intermedius	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.27 (0.27)	0 (0)
Palaemonetes pugio	1.39 (0.88)	0.78 (0.61)	2.11 (0.81)	0.06 (0.06)	3.06 (0.73)	2.56 (1.25)	2.39 (1.05)
Palaemonetes vulgaris	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.72 (0.45)
Panopeus herbstii	0.06 (0.06)	0.50 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (0.05)
Paralichthys dentatus	0 (0)	0.06 (0.06)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Penaeid	0 (0)	0.17 (0.12)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rangia cuneata	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0.06 (0.06)	0 (0)	0.06 (0.06)	0.06 (0.06)	0 (0)	0.22 (0.10)	0 (0)
Sciaenidae sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Sesarma reticulatum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Smphurus plagiusa	0 (0)	0 (0)	0 (0)	1.00 (0.44)	0.11 (0.11)	0 (0)	1.33 (0.48)
Syngnathid sp.	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Trachinotus falcatus	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0.05 (0.05)
U/I larval fish sp A	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.06 (0.06)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)

Table 7.4-10b. Mean abundance (SE) for epibenthic fauna collected in Spring drop trap sampling at station P2 (Mouth of Town Creek).

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Alpheus heterochelis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Anchoa mitchelli	0 (0)	0 (0)	2.00 (1.94)	0 (0)	0 (0)	0.11 (0.11)	0 (0)
Anguilla rostrata	0 (0)	0.06 (0.06)	0.28 (0.14)	0 (0)	0 (0)	0 (0)	0 (0)
Anthinnae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Bivalve	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Brevoortia tyrannus	0 (0)	0 (0)	21.67 (20.80)	0 (0)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0.06 (0.06)	0.06 (0.06)	0.50 (0.15)	0.17 (0.09)	0.17 (0.09)	1.17 (0.40)	1.05 (0.23)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.22)	0 (0)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.09)
Ctenogobius shufeldti	0.17 (0.09)	0.06 (0.06)	0.11 (0.08)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	3.06 (2.37)	0 (0)	1.22 (0.75)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Gerreidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiesox punctulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0.44 (0.23)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.13)	0 (0)
Leiostomus xanthurus	7.0 (2.41)	62.89 (40.60)	0.22 (0.17)	0 (0)	4.61 (1.39)	7.94 (2.11)	2.55 (0.79)
Litopenaeus setiferus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	5.61 (3.20)	1.28 (0.75)	1.39 (1.13)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	4.56 (4.38)	0.89 (0.35)	0 (0)	0 (0)
Menticirrhus saxatilis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	9.06 (1.89)	16.56 (4.12)	0 (0)	0.06 (0.06)	0.11 (0.11)
Mugil cephalus	0 (0)	1.39 (0.78)	0.89 (0.35)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes intermedius	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Palaemonetes pugio	5.56 (1.35)	20.22 (10.05)	37.94 (16.39)	1.33 (0.55)	1.33 (0.53)	16.22 (6.10)	3.78 (1.75)
Panopeus herbstii	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0.11 (0.08)	0 (0)	0.11 (0.08)	0.17 (0.12)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	1.61 (0.57)	0.06 (0.06)	0.11 (0.08)	0 (0)
Penaeid	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rangia cuneata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0.22 (0.10)	0 (0)	0 (0)	0.11 (0.11)	0.05 (0.05)
Sciaenidae sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sesarma reticulatum	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Syngnathid sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trachinotus falcatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish sp A	0 (0)	0 (0)	0 (0)	0.17 (0.09)	0 (0)	0 (0)	0 (0)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-11a. Mean abundance (SE) for epibenthic fauna collected in Fall drop trap sampling at station P3 (Town Creek).

	1999	2000	2001	2002	2003	2004	2005
Anchoa mitchelli	1.36 (0.63)	0 (0)	0 (0)	0 (0)	0.11 (0.08)	14.33 (11.63)	0 (0)
Anguilla rostrata	0.06 (0.04)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (0.05)
Brevoortia tyrannus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0.11 (0.10)	0 (0)	0.11 (0.08)	0 (0)	0.39 (0.18)	0.22 (0.10)	0.11 (0.08)
Cambarus robustus	(0.03) (0.03)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0.53 (0.34)	0.33 (0.16)	0.17 (0.09)	0 (0)	1.22 (0.45)	2.89 (0.59)	0.22 (0.17)
Eucinostomus argenteus	0 (0)	0 (0)	0.11 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2.11 (1.02)	0.05 (0.05)
Evorthodus lyricus	0 (0)	0 (0)	0 (0)	0 (0)	2.44 (0.89)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	2.33 (0.67)	3.56 (2.05)	0 (0)	0 (0)
Fundulus heteroclitus	0.12 (.08)	0 (0)	0 (0)	0.17 (0.12)	0 (0)	0.06 (0.06)	0 (0)
Fundulus majalis	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0.81 (0.72)	1.83 (0.62)	3.39 (1.72)	0.11 (0.08)	1.00 (0.58)	1.50 (0.78)	1.05 (0.57)
Gobionellus oceanicus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.56 (0.22)	0.28 (0.16)
Gobiosoma bosc	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0.28 (0.14)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0.09 (0.07)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0 (0)
Menidia beryllina	0.06 (0.04)	0 (0)	0.06 (0.06)	0 (0)	2.89 (2.38)	0.22 (0.17)	0.17 (0.17)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0.11 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0.78 (0.34)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Notropis petersoni	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	1.39 (0.83)	0.56 (0.30)	0.17 (0.12)	2.11 (1.03)	0 (0)
Panopeus herbstii	0.06 (0.06)	0.17 (0.12)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys albigutta	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (0.05)
Paralichthys dentatus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 .06 (0.06)	0.06 (0.06)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.12)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0.06 (0.06)	0.56 (0.50)	0.17 (0.09)
Sesarma cinereum	0 (0)	0.28 (0.11)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Sesarma reticulatum	0 (0)	0 (0)	0 (0)	0.17 (0.09)	0 (0)	0 (0)	0 (0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sygnathidae	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Trinectes maculatus	2.14 (1.05)	0.06 (0.06)	0 (0)	0 (0)	0.06 (0.06)	0.06 (0.06)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0.17 (0.09)	0 (0)	0.67 (0.61)	0 (0)
Uca pugnax	0.92 (0.47)	5.06 (0.96)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-11b. Mean abundance (SE) for epibenthic fauna collected in Spring drop trap sampling at station P3 (Town Creek).

	2000	2001	2002	2003	2004	2005	2006
Anchoa mitchelli	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Anguilla rostrata	0.09 (0.07)	0.28 (0.16)	0 (0)	0 (0)	0.06 (0.06)	0.06 (0.06)	0 (0)
Brevoortia tyrannus	0 (0)	0 (0)	4.00 (2.50)	0 (0)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0.20 (0.11)	0.28 (0.16)	0.56 (0.27)	0 (0)	0.56 (0.22)	0.22 (0.13)	0.28 (0.13)
Cambarus robustus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.39 (0.33)	0 (0)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.39 (0.23)	0 (0)
Ctenogobius shufeldti	0.28 (0.12)	0.73 (0.39)	0.22 (0.17)	0 (0)	5.78 (1.79)	0.17 (0.12)	0.28 (0.13)
Eucinostomus argenteus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Evorthodus lyricus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	1.39 (1.16)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0.11 (0.11)	0 (0)	0 (0)
Fundulus majalis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	2.00 (1.28)	0.06 (0.06)	0.22 (0.13)	0 (0)	1.11 (0.54)	0 (0)	7.94 (4.82)
Lagodon rhomboides	0.34 (0.19)	0 (0)	0.22 (0.10)	0 (0)	0.11 (0.11)	1.39 (0.89)	0 (0)
Leiostomus xanthurus	0 (0)	0.28 (0.17)	0 (0)	0 (0)	36.39 (13.62)	31.22 (12.62)	13.8 (6.83)
Lepomis macrochirus	1.59 (1.70)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0.06 (0.06)	0 (0)	4.33 (2.22)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	50.44 (21.43)	0 (0)	0 (0)	0 (0)	0.05 (0.05)
Mugil cephalus	0 (0)	0 (0)	2.89 (1.19)	0 (0)	0.06 (0.06)	0 (0)	0.50 (0.40)
Notropis petersoni	0 (0)	0.22 (0.22)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0.17 (0.09)	7.17 (3.23)	0 (0)	10.39 (5.52)	3.94 (3.08)	10.9 (8.27)
Panopeus herbstii	0.06 (0.04)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0.45 (0.16)	1.17 (0.59)	0 (0)	0.11 (0.08)	0 (0)	0 (0)	0.05 (0.05)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.44 (0.35)	0.22 (0.13)	0.94 (0.34)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0.05 (0.05)
Sesarma cinereum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sesarma reticulatum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Sygnathidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0.31 (0.17)	0.39 (0.22)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0.50 (0.22)	0 (0)	2.28 (2.22)	0 (0)
Uca pugnax	0.03 (0.03)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0.78 (0.46)	0 (0)	0.39 (0.39)	0 (0)	0 (0)

Table 7.4-12a. Mean abundance (SE) for epibenthic fauna collected in Fall drop trap sampling at station P6 (Eagle Island).

	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Anchoa mitchelli	0 (0)	1.00 (0.37)	0 (0)	0 (0)	0 (0)	9.72 (6.05)	3.39 (2.99)
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0.22 (0.10)	0.06 (0.06)	0 (0)	0.06 (0.06)	0.39 (0.16)	0.33 (0.16)	0.39 (0.12)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Corbicula fluminea	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.10)
Ctenogobius shufeldti	0.06 (0.06)	0.22 (0.15)	0 (0)	0 (0)	1.61 (0.51)	0.33 (0.11)	0.17 (0.12)
Eucinostomus harengulus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Eucinostomus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0.83 (0.35)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gerres cinereus	0 (0)	0.28 (0.16)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0.22 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Litopenaeus setiferus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.09)	0.28 (0.16)
Menidia beryllina	0.11 (0.08)	0 (0)	0.17 (0.09)	0.72 (0.42)	0 (0)	0.28 (0.18)	0.05 (0.05)
Menidia menidia	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	5.44 (3.28)	1.00 (1.00)	0 (0)	0 (0)	14.72 (8.95)	3.39 (2.06)
Panopeus herbstii	0 (0)	0.11 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0.05 (0.05)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.17)	0.05 (0.05)
Sesarma cinereum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Sesarma reticulatum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0.44 (0.20)	0.11 (0.08)	0 (0)	0 (0)	0.50 (0.25)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)
U/I larval fish	0 (0)	0 (0)	0 (0)	2.44 (1.72)	0 (0)	0 (0)	0 (0)

Table 7.4-12b. Mean abundance (SE) for epibenthic fauna collected in Spring drop trap sampling at station P6 (Eagle Island).

	2000	2001	2002	2003	2004	2005	2006
Anchoa mitchelli	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.55 (0.38)
Anguilla rostrata	0 (0)	0.11 (0.08)	0.05 (0.05)	0.50 (0.25)	0.11 (0.08)	0 (0)	0 (0)
Callinectes sapidus	0 (0)	0.06 (0.06)	0.53 (0.18)	0.22 (0.10)	0.61 (0.18)	0.56 (0.25)	0.25 (0.10)
Clupeidae	0 (0)	0 (0)	0.21 (0.21)	0 (0)	0 (0)	37.78 (14.75)	0.85 (0.70)
Corbicula fluminea	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0.05 (0.05)
Ctenogobius shufeldti	0.11 (0.11)	0.11 (0.08)	0 (0)	0 (0)	1.78 (0.33)	0.67 (0.21)	0.10 (0.07)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0.32 (0.27)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Fundulus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Gerres cinereus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0.11 (0.08)	0.39 (0.24)	0 (0)
Leiostomus xanthurus	0 (0)	1.72 (0.72)	1.00 (0.52)	0 (0)	25.61 (9.85)	2.50 (1.02)	17.9 (3.76)
Lepomis sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Menidia beryllina	0 (0)	20.83 (10.04)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	0.28 (0.28)	0 (0)	0 (0)	0 (0)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0.32 (0.32)	0 (0)	3.44 (2.55)	0 (0)	1.10 (0.56)
Mugil cephalus	0 (0)	0.22 (0.17)	0.16 (0.16)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	1.78 (0.60)	8.21 (2.52)	0.22 (0.13)	0.22 (0.13)	2.11 (0.82)	14.0 (7.36)
Panopeus herbstii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0.17 (0.12)	1.17 (0.56)	0.11 (0.11)	0.44 (0.23)	0 (0)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0.26 (0.13)	10.83 (3.68)	11.00 (3.82)	1.06 (0.36)	0.20 (0.09)
Rhithropanopeus harrisii	0 (0)	0 (0)	0.05 (0.05)	0 (0)	0.06 (0.06)	0.17 (0.17)	0.05 (0.05)
Sesarma reticulatum	0 (0)	0 (0)	0.05 (0.05)	0 (0)	0 (0)	0 (0)	0 (0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0.06 (0.06)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-13a. Mean abundance (SE) for epibenthic fauna collected in Fall drop trap sampling at station P7 (Indian Creek).

	1999	2000	2001	2002	2003	2004	2005	2006
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0.33 (0.14)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0.06 (0.06)	0 (0)	0.17 (0.09)	0 (0)	0.11 (0.07)	0.06 (0.06)	0.17 (0.09)	0.05 (0.05)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.17)	0 (0)	0 (0)	0.83 (0.78)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.12)	0 (0)
Ctenogobius shufeldti	0.06 (0.06)	0.28 (0.18)	0.22 (0.10)	0 (0)	2.11 (0.38)	1.17 (0.35)	0.17 (0.09)	0.11 (0.11)
Dorosoma cepedianum	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Dorosoma pretense	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Esox lucius	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus argenteus	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)
Evorthodus lyricus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (0.05)	0 (0)
Fundulus heteroclitus	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0.06 (0.06)	0.17 (0.17)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (0.05)	0 (0)
Gerres cinereus	0 (0)	0.22 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobionellus oceanicus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	11.6 (6.07)
Menidia beryllina	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (0.05)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0.28 (0.23)	0 (0)	0.33 (0.28)	0 (0)	0 (0)	0 (0)	0.05 (0.05)
Paralichthys albigutta	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.28 (0.19)	0 (0)	0.55 (0.22)
Rangia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0.06 (0.06)	0.44 (0.15)	0 (0)	2.06 (0.60)	0.06 (0.06)	0.05 (0.05)	0 (0)
U/I juvenile fish	0 (0)	0.39 (0.33)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.06 (0.06)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)

Table 7.4-13b. Mean abundance (SE) for epibenthic fauna collected in Spring drop trap sampling at station P7 (Indian Creek).

	2000	2001	2002	2003	2004	2005
Anguilla rostrata	0.71 (0.34)	0.11 (0.11)	0 (0)	0.39 (0.28)	1.06 (0.41)	0 (0)
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.22)
Ctenogobius shufeldti	0.29 (0.14)	0 (0)	0 (0)	0 (0)	1.72 (0.53)	0.22 (0.13)
Dorosoma cepedianum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Dorosoma pretense	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Esox lucius	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus argenteus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gerres cinereus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0.35 (0.35)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	38.78 (21.08)	0 (0)
Menidia beryllina	0 (0)	0.28 (0.18)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Menidia sp.	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0.28 (0.23)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0.28 (0.28)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0.47 (0.29)	1.56 (0.56)	0 (0)	1.50 (0.48)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0.11 (0.08)	0 (0)	9.50 (2.14)	1.72 (0.40)
Rangia sp.	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0.61 (0.22)	0 (0)	0 (0)
U/I juvenile fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.8-14a. Mean abundance (SE) for epibenthic fauna collected in Fall drop trap sampling at station P8 (Dollisons Landing).

	1999	2000	2001	2002	2003	2004	2005
Alosa pseudoharengus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.17)	0 (0)
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0.11 (0.11)	0 (0)
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0.11 (0.08)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0.11 (0.08)	0 (0)	0.06 (0.06)	0 (0)	2.56 (0.67)	1.00 (0.27)	0.33 (0.16)
Cyprinidae	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)
Dorosoma petenense	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Esox niger	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus harengulus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.10)	0 (0)
Eucinostomus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2.89 (2.14)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0.22 (0.22)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.22)
Gambusia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0.17 (0.12)	0 (0)	0 (0)	0 (0)
Lepomis gibbensis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0.06 (0.06)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Notropis chalybaeus	2.94 (1.98)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Notropis petersoni	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0.06 (0.06)	0.11 (0.08)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Penaeid	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithorpanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0.06 (0.06)	0 (0)
Sesarma cinereum	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0.17 (0.12)	0 (0)	0.11 (0.11)	0.06 (0.06)	4.00 (1.40)	0.28 (0.14)	0.33 (0.14)
U/I larval fish sp A	0 (0)	0 (0)	0 (0)	1.17 (0.74)	0 (0)	0 (0)	0 (0)
U/I larval fish sp B	0 (0)	0 (0)	0 (0)	0.17 (0.09)	0 (0)	0 (0)	0 (0)
Uca pugnax	0 (0)	0.17 (0.12)	0.17 (0.09)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.8-14b. Mean abundance (SE) for epibenthic fauna collected in Spring drop trap sampling at station P8 (Dollisons Landing).

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Anguilla rostrata	0 (0)	0.33 (0.18)	0.39 (0.14)	0.06 (0.06)	0.11 (0.08)	0 (0)	0 (0)
Callinectes sapidus	0 (0)	0 (0)	0.22 (0.10)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	69.78 (45.05)	7.94 (5.06)	1.61 (0.98)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0 (0)	2.17 (0.62)	0.33 (0.11)	0.05 (0.05)
Cyprinidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Esox niger	0 (0)	0 (0)	0 (0)	0.12 (0.08)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Gambusia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.33 (0.23)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.83 (0.49)
Lepomis gibbensis	0 (0)	0 (0)	0 (0)	1.76 (1.76)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0.61 (0.39)	0 (0)	0 (0)	0.12 (0.12)	0 (0)	0.11 (0.08)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Notropis chalybaeus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Notropis petersoni	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0.11 (0.11)	0.06 (0.06)	0 (0)	1.35 (0.34)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	1.72 (0.40)	0.50 (0.25)	1.50 (0.78)
Penaeid	0 (0)	0 (0)	0.22 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithorpanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sesarma cinereum	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0 (0)	0.06 (0.06)	0.18 (0.13)	0 (0)	0 (0)	0 (0)
U/I larval fish sp A	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish sp B	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-15a. Mean abundance (SE) for epibenthic fauna collected in Fall drop trap sampling at station P11 (Smith Creek).

	1999	2000	2001	2002	2003	2004	2005
Anchoa mitchelli	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	1.94 (1.83)	0.11 (0.11)
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0 (0)	0.06 (0.06)	0.50 (0.25)	0.17 (0.09)	0.22 (0.10)	0 (0)	0.17 (0.12)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (0.05)
Ctenogobius shufeldti	0.22 (0.13)	0 (0)	0.06 (0.06)	0 (0)	0.28 (0.16)	0.06 (0.06)	0 (0)
Eucinostomus argenteus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0.17 (0.12)
Gambusia holbrooki	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Gobionellus oceanicus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (0.05)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ictalurus furcatus	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0.11 (0.08)	0 (0)	0 (0)	0 (0)	0.05 (0.05)
Litopenaeus setiferus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.78 (0.39)	0.50 (0.18)
Logodon rhomboides	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	1.89 (0.64)	0.83 (0.61)	0 (0)	0 (0)	0.22 (0.13)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	0 (0)	1.50 (1.44)	0 (0)	0 (0)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0.28 (0.28)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	1.56 (0.41)	0.17 (0.17)	0.17 (0.17)	0 (0)	0 (0)	0.05 (0.05)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0 (0)	0.05 (0.05)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0.83 (0.49)	6.28 (4.30)	3.56 (1.16)	0 (0)	0 (0)	0 (0)
Penaeus setiferus	0 (0)	1.89 (0.85)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rangia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0.06 (0.06)	0.06 (0.06)	0.17 (0.12)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Sesarma cinereum	0 (0)	0.72 (0.38)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0.22 (0.13)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0.22 (0.17)	0.06 (0.06)	0 (0)	0 (0)	0.33 (0.14)	0 (0)	0 (0)
U/I larval fish sp A	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-15b. Mean abundance (SE) for epibenthic fauna collected in Spring drop trap sampling at station P11 (Smith Creek).

	2000	2001	2002	2003	2004	2005	2006
Anchoa mitchelli	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0.39 (0.33)	0 (0)	0 (0)
Anguilla rostrata	0.33 (0.16)	0 (0)	0.06 (0.06)	0.11 (0.08)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0.11 (0.08)	0 (0)	1.17 (0.56)	0.28 (0.11)	0.72 (0.33)	0.26 (0.10)	0.28 (0.13)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.42 (0.69)	0.11 (0.08)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.16 (0.09)	0 (0)
Ctenogobius shufeldti	0.17 (0.12)	0 (0)	0 (0)	0 (0)	0.72 (0.23)	0.05 (0.05)	0 (0)
Eucinostomus argenteus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0.28 (0.18)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0.33 (0.20)	0 (0)	0 (0)	0 (0)	0 (0)
Ictalurus furcatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0.72 (0.50)	0 (0)	0.11 (0.08)	0 (0)	0 (0)	0.26 (0.13)	0 (0)
Leiostomus xanthurus	14.83 (9.79)	9.56 (2.30)	1.94 (0.60)	0.39 (0.23)	64.11 (14.63)	16.89 (4.91)	50.5 (15.9)
Litopenaeus setiferus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Logodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0.22 (0.17)	1.0 (0.76)	0.06 (0.06)	0 (0)	0 (0)	0.05 (0.05)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	2.67 (1.11)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	1.89 (0.87)	0 (0)	1.22 (0.51)
Mugil cephalus	0 (0)	0.94 (0.79)	0.17 (0.12)	0 (0)	0 (0)	0 (0)	0.05 (0.05)
Palaemonetes pugio	0.06 (0.06)	0.17 (0.09)	5.20 (2.38)	0.22 (0.13)	0.06 (0.06)	0.05 (0.05)	0.39 (0.24)
Paralichthys dentatus	1.17 (0.44)	0.06 (0.06)	0 (0)	16.11 (3.31)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0.28 (0.14)	0 (0)	14.78 (3.73)	1.53 (0.40)	0.22 (0.10)
Rangia sp.	0.17 (0.12)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Sesarma cinereum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (0.05)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.15)
U/I larval fish sp A	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-16a. Mean abundance (SE) for epibenthic fauna collected in Fall drop trap sampling at station P12 (Rat Island).

	1999	2000	2001	2002	2003	2004	2005
Alosa aestivalis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Anchoa mitchilli	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.50 (0.36)
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Brevoortia tyrannus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0 (0)	0.11 (0.08)	0.56 (0.27)	0.06 (0.06)	0.11 (0.08)	0.22 (0.17)	0.28 (0.13)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (0.05)
Ctenogobius shufeldti	0.11 (0.08)	0.06 (0.06)	0.06 (0.06)	0 (0)	0.72 (0.40)	0.39 (0.16)	0.11 (0.08)
Gobionellus oceanicus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0.28 (0.23)	0 (0)	0 (0)	0 (0)	0.55 (0.28)
Lepomis macrochirus	0.11 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Litopenaeus setiferus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2.39 (0.78)
Lutjanus griseus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0.05 (0.05)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0.33 (0.23)	0 (0)	0 (0)	0.28 (0.19)	0.89 (0.49)
Palaemonetes pugio	0 (0)	1.22 (0.66)	1.56 (0.89)	0.33 (0.16)	0.11 (0.11)	0 (0)	0.55 (0.03)
Paralichthys albigutta	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0.06 (0.06)	0.22 (0.10)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (0.05)
Sesarma cinereum	0 (0)	0.17 (0.09)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (0.05)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0.22 (0.22)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.06 (0.06)	1.11 (0.54)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)

Table 7.4-16b. Mean abundance (SE) for epibenthic fauna collected in Spring drop trap sampling at station P12 (Rat Island).

	2000	2001	2002	2003	2004	2005	2006
Alosa aestivalis	0 (0)	0 (0)	0 (0)	0 (0)	2.56 (2.44)	0 (0)	0 (0)
Anchoa mitchilli	0 (0)	0 (0)	0 (0)	0 (0)	1.67 (1.05)	0 (0)	0.05 (0.05)
Anguilla rostrata	0 (0)	0.33 (0.28)	0 (0)	0 (0)	0.17 (0.12)	0 (0)	0 (0)
Brevoortia tyrannus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0 (0)	0 (0)	0.78 (0.26)	0 (0)	0.17 (0.09)	0.11 (0.08)	0.28 (0.11)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4.39 (2.94)	1.05 (0.89)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.28 (0.14)	0.28 (0.18)
Ctenogobius shufeldti	0.06 (0.06)	0.56 (0.23)	0 (0)	0 (0)	1.83 (0.69)	0.17 (0.12)	0.50 (0.24)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.10)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.17)
Gobiosoma sp.	0 (0)	0 (0)	0.22 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	1.22 (0.55)	0 (0)
Leiostomus xanthurus	0.11 (0.08)	0 (0)	17.56 (15.35)	0 (0)	16.94 (8.08)	33.11 (9.33)	71.6 (13.9)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	8.22 (4.56)	0 (0)	4.61 (1.86)
Menidia beryllina	0.17 (0.12)	0.39 (0.39)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0.22 (0.17)
Palaemonetes pugio	0.06 (0.06)	1.61 (0.93)	1.50 (0.41)	5.94 (2.60)	0 (0)	0.94 (0.61)	13.1 (3.71)
Paralichthys albigutta	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Paralichthys dentatus	0.17 (0.12)	0.33 (0.16)	0 (0)	11.44 (3.57)	0 (0)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	1.17 (0.68)	2.22 (1.19)	1.06 (0.30)	0.33 (0.18)
Rhithropanopeus harrisii	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0.11 (0.08)	0 (0)
Sesarma cinereum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0 (0)	0.11 (0.08)	0.06 (0.06)	0 (0)	0 (0)	0.17 (0.17)
U/I larval fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)

Table 7.4-17a. Mean abundance (SE) for epibenthic fauna collected in Fall drop trap sampling at station P13 (Fishing Creek).

	1999	2000	2001	2002	2003	2004	2005
Alosa aestivalis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Anchoa mitchelli	0 (0)	0 (0)	0 (0)	0.28 (0.28)	0 (0)	0 (0)	0 (0)
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Cambarus robustus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0 (0)	1.39 (0.74)	0.33 (0.18)	0 (0)
Dorosoma petenense	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Esox americanus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0.33 (0.16)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0.33 (0.18)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobionellus oceanicus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.17)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0.39 (0.27)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0.72 (0.46)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	4.28 (2.51)	0 (0)	0 (0)	0 (0)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.44 (0.29)	0 (0)	0 (0)	0 (0)
Panopeus herbstii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Panopeus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Procambarus robustus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0.22 (0.10)	0 (0)	0 (0)	0.11 (0.11)	0.06 (0.06)	0 (0)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.12)	0.17 (0.12)
U/I larval fish	0 (0)	0 (0)	0 (0)	0.89 (0.89)	0.11 (0.11)	0 (0)	0 (0)
Uca pugnax	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-17b. Mean abundance (SE) for epibenthic fauna collected in Spring drop trap sampling at station P13 (Fishing Creek).

	2000	2001	2002	2003	2004	2005	2006
Alosa aestivalis	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Anchoa mitchelli	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Anguilla rostrata	0.17 (0.17)	0.28 (0.14)	0 (0)	0.06 (0.06)	0.11 (0.08)	0.05 (0.05)	0 (0)
Callinectes sapidus	0 (0)	0.17 (0.12)	0.06 (0.06)	0 (0)	0.11 (0.08)	0.05 (0.05)	0 (0)
Cambarus robustus	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	7.05 (5.99)	2.39 (1.60)
Ctenogobius shufeldti	0.22 (0.15)	0.17 (0.09)	0.11 (0.08)	0 (0)	1.17 (0.40)	0.16 (0.09)	0 (0)
Dorosoma petenense	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Esox americanus	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.09)	7.32 (6.07)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0.11 (0.11)	0 (0)	27.22 (5.68)	1.26 (0.57)	8.44 (3.65)
Lepomis macrochirus	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	1.39 (0.97)	0.22 (0.22)	6.89 (6.54)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	7.28 (3.11)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.39 (0.39)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)
Panopeus herbstii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Panopeus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0.33 (0.16)	0.56 (0.23)	0 (0)	1.29 (0.50)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.56 (0.20)	1.47 (0.54)	0.17 (0.12)
Procambarus robostus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0.24 (0.14)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0.33 (0.20)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Community Measures

Analysis of species richness data detected significant differences for both marsh (Breder trap) and marsh edge (drop trap) utilization, across both sampling seasons at most sites. Species richness for the marsh sampling, was greatest in fall of 2005 for 3 of 8 significant comparisons (Table 7.4-18 and Figure 7.4-2), while spring of 2006 was intermediate for all comparisons (Table 7.4-19 and Figure 7.4-1). Marsh edge showed similar patterns, although 2004 had the greatest species richness for 5 out of 8 significant comparisons in spring (Figures 7.4-1 and 7.4-2; Tables 7.4-23 and 7.4-24).

Diversity and total abundance tracked the species richness data very closely. The marsh sampling showed a high degree of interannual variation among sites for both fall and spring sampling although there was some evidence of tributary influence (Tables 7.4-20 and 7.4-21) while the marsh edge showed clear evidence of greater diversity in spring for 2004 for the mainstem Cape Fear River sites (P6, P7, and P8) (Tables 7.4-25 and 7.4-26). It seems from this data that spring and fall sampling periods showed marked differences in the community level indicators. The community utilizing the marsh surface in the fall tends to have greater species richness than those in spring; however total abundances tend to be greater in the spring than in the fall. No clear year differences were evident for fall, all though 2005 tended to be an intermediate year (Tables 7.4-22 and 7.4-29). However 2006 clearly showed higher total abundances for 5 out of 8 significant comparisons, driven entirely by a large recruitment of spot.

Table 7.4-18. Comparison of species richness at each location collected using Breder traps during fall sampling period among years.

Site	**F**	**SNK of F Significance**
Smith Creek (P11)	4.27(0.012)	02a 99ab 01ab 04ab 03ab 05ab 00b
Rat Island (P12)	3.70(0.020)	05a 00ab 99ab 02ab 04ab 03b 01b
Fishing Creek (P13)	5.30(0.005)	04a 05ab 99ab 02ab 03b 00b 01b
Town Creek Mouth (P2)	7.43(0.001)	05a 02a 01ab 04ab 99bc 00bc 03c
Inner Town Creek (P3A)	3.32(0.030)	02a 03ab 01ab 00ab 99ab 05ab 04b
Inner Town Creek (P3B)	5.11(0.006)	02a 00ab 03b 99b 01b 05b 04b
Eagle Island (P6)	5.00(0.006)	05a 03a 00ab 04ab 01ab 02ab 99b
Indian Creek (P7)	1.47 NS	
Dollisons Landing (P8)	6.50(0.002)	03a 05ab 02abc 99abc 04bc 00bc 01c

Table 7.4-19. Comparison of species richness at each location collected using Breder traps during spring sampling period among years.

Site	F	SNK of F Significance
Smith Creek (P11)	1.18 NS	
Rat Island (P12)	3.26(0.032)	01a 05a 06a 00a 02a 03a 04a
Fishing Creek (P13)	3.96(0.024)	04a 05ab 01ab 06ab 03ab 00b
Town Creek Mouth (P2)	3.61(0.022)	05a 04ab 06ab 00ab 03b 01b 02b
Inner Town Creek (P3A)	1.21 NS	
Inner Town Creek (P3B)	10.7(0.0001)	05a 06b 04b 01b 02b 00b 03c
Eagle Island (P6)	1.97 NS	
Indian Creek (P7)	4.04(0.015)	05a 04ab 01ab 06ab 00ab 03b 02b
Dollisons Landing (P8)	10.0(0.0002)	04a 01a 06a 03a 00a 05a 02b

Table 7.4-20. Comparison of diversity at each location collected using Breder traps during fall sampling period among years.

Site	F	SNK of F Significance
Smith Creek (P11)	2.58 NS	
Rat Island (P12)	2.67 NS	
Fishing Creek (P13)	3.51(0.025)	04a 99ab 05ab 02ab 03ab 00b 01b
Town Creek Mouth (P2)	7.60(0.009)	05a 01a 04a 02a 99ab 00b 03b
Inner Town Creek (P3A)	5.32(0.005)	02a 03ab 00ab 01ab 99b 05b 04b
Inner Town Creek (P3B)	3.06(0.040)	02a 00a 03a 99a 01a 04a 05a
Eagle Island (P6)	5.43(0.004)	03a 05a 04a 00ab 02ab 01ab 99b
Indian Creek (P7)	1.51 NS	
Dollisons Landing (P8)	4.59(0.009)	03a 05ab 99ab 02ab 00b 04b 01b

Table 7.4-21. Comparison of diversity at each location collected using Breder traps during spring sampling period among years.

Site	F	SNK of F Significance
Smith Creek (P11)	2.28 NS	
Rat Island (P12)	3.35(0.029)	01a 00a 05a 02a 03a 04a 06a
Fishing Creek (P13)	3.85(0.026)	04a 05a 01ab 06ab 03ab 00b
Town Creek Mouth (P2)	6.58(0.002)	05a 04a 02ab 03b 01b 00b 06b
Inner Town Creek (P3A)	1.77 NS	
Inner Town Creek (P3B)	19.4(0.0001)	05a 04b 01bc 06bc 02c 00c 03d
Eagle Island (P6)	2.36 NS	
Indian Creek (P7)	3.41(0.028)	05a 04a 06a 01a 00a 02a 03a
Dollisons Landing (P8)	8.45(0.005)	04a 01a 00b 03b 02b 05b 06b

Table 7.4-22. Comparison of total abundance at each location collected using Breder traps during fall sampling period among years.

Site	F	SNK of F Significance
Smith Creek (P11)	6.22(0.0001)	02a 99ab 03bc 01bc 04bc 05bc 00c
Rat Island (P12)	4.45(0.0003)	00a 05ab 02bc 99bc 03bc 04bc 01c
Fishing Creek (P13)	4.06(0.0007)	04a 05ab 99ab 02abc 00bc 03bc 01c
Town Creek Mouth (P2)	35.8(0.0001)	02a 05b 04c 00cd 01cde 99de 03e
Inner Town Creek (P3A)	3.87(0.001)	03a 02ab 01ab 00abc 05bc 99bc 04c
Inner Town Creek (P3B)	20.4(0.0001)	02a 00a 99b 03b 01b 04b 05b
Eagle Island (P6)	4.47(0.0001)	05a 01a 03a 02a 00ab 04ab 99b
Indian Creek (P7)	3.03(0.007)	02a 04ab 03ab 99ab 05ab 01b 00b
Dollisons Landing (P8)	5.46(0.0001)	04a 03ab 02abc 05abcd 99bcd 00cd 01d

Table 7.4-23. Comparison of total abundance at each location collected using Breder traps during spring sampling period among years.

Site	F	SNK of F Significance
Smith Creek (P11)	74.3(0.0001)	06a 05b 04c 02d 00d 03d 01d
Rat Island (P12)	33.7(0.0001)	06a 05a 03b 01b 04b 00b 02b
Fishing Creek (P13)	20.3(0.0001)	04a 06b 01b 03bc 05bc 00c
Town Creek Mouth (P2)	33.2(0.0001)	06a 05b 00b 04b 01c 02c 03c
Inner Town Creek (P3A)	1.67 NS	
Inner Town Creek (P3B)	6.41(0.0001)	02a 06a 05ab 01bc 04bc 00bc 03c
Eagle Island (P6)	51.6(0.0001)	06a 04b 05b 03c 02c 01c 00c
Indian Creek (P7)	16.6(0.0001)	01a 04b 05b 00bc 06bc 03cd 02d
Dollisons Landing (P8)	4.82(0.0001)	06a 01a 04ab 05abc 00bc 03c 02c

Table 7.4-24. Comparison of species richness from drop traps sampling at each location during fall sampling period among years.

Site	F	SNK of F Significance
Smith Creek (P11)	4.62(0.0003)	00a 01b 03b 02b 05b 04b 99b
Rat Island (P12)	34.96(0.0001)	05a 01b 00b 02b 03b 04b 99b
Fishing Creek (P13)	2.40(0.03)	02a 03ab 04ab 00ab 01ab 05ab 99b
Town Creek Mouth (P2)	5.30(0.0001)	05a 03ab 04bc 02bc 01bc 00bc 99c
Inner Town Creek (P3)	7.61(0.0001)	04a 03b 00b 99bc 01bc 02bc 05c
Eagle Island (P6)	5.38(0.0001)	04a 05ab 00abc 03abc 02bcd 99cd 01d
Indian Creek (P7)	5.37(0.0001)	03a 04b 01b 00b 05b 02b 99b
Dollisons Landing (P8)	9.53(0.0001)	03a 04a 05b 02b 99b 01b 00b

Table 7.4-25. Comparison of species richness from droptrap sampling at each location during spring sampling period among years.

Site	F	SNK of F Significance
Smith Creek (P11)	6.22(0.0001)	04a 02ab 05ab 06bc 03bc 00bc 01c
Rat Island (P12)	11.06(0.0001)	06a 05ab 04bc 02bc 03cd 01cd 00d
Fishing Creek (P13)	13.59(0.0001)	04a 05b 06bc 01bc 00c 03c 02c
Town Creek Mouth (P2)	2.88(0.011)	02a 05ab 03ab 00ab 01b 04b 06b
Inner Town Creek (P3)	12.43(0.0001)	02a 04ab 06bc 05bc 01c 00c 03d
Eagle Island (P6)	13.64(0.0001)	04a 05ab 06abc 01bc 02bc 03c 00d
Indian Creek (P7)	19.49(0.0001)	04a 06b 03b 05bc 00bc 01bc 02c
Dollisons Landing (P8)	9.26(0.0001)	04a 06b03bc 05bc 02bc 01c 00c

Table 7.4-26. Comparison of diversity at each location from droptrap sampling during fall sampling period among years.

Site	F	SNK of F Significance
Smith Creek (P11)	6.30(0.0001)	00a 01b 05b 02b 03b 04b 99b
Rat Island (P12)	7.57(0.0001)	05a 01b 00b 02b 03b 04b 99b
Fishing Creek (P13)	0.93 NS	03a 04a 02a 00a 05a 01a 99a
Town Creek Mouth (P2)	4.64(0.0003)	05a 03ab 02bc 01bc 04bc 00bc 99c
Inner Town Creek (P3)	5.89(0.0001)	04a 03ab 00ab 02bc 99bc 01bc 05c
Eagle Island (P6)	2.62(0.0203)	04a 00ab 05ab 03ab 02ab 99ab 01b
Indian Creek (P7)	4.13(0.0008)	03a 00b 04b 01b 05b 99b 02b
Dollisons Landing (P8)	6.04(0.0001)	03a 04a 02b 05b 99b 00b 01b

Table 7.4-27. Comparison of diversity at each location from droptrap sampling during spring sampling period among years.

Site	F	SNK of F Significance
Smith Creek (P11)	5.02(0.0001)	02a 04ab 05abc 00bc 06bc 03c
Rat Island (P12)	3.95(0.0012)	06a 02ab 05ab 04abc 03abc 01bc 00c
Fishing Creek (P13)	7.43(0.0001)	04a 05a 01b 00b 06b 03b 02b
Town Creek Mouth (P2)	0.52 NS	05a 02a 06a 00a 01a 03a 04a
Inner Town Creek (P3)	5.64(0.0001)	02a 04a 01a 06a 05a 00a 03b
Eagle Island (P6)	5.45(0.0001)	04a 05a 06a 01a 02a 03a 00b
Indian Creek (P7)	8.66(0.0001)	04a 03b 00b 06b 05b 01b 02b
Dollisons Landing (P8)	4.32(0.0006)	04a 06ab 02ab 05b 03b 01b 00b

Table 7.4-28. Comparison of total abundance at each location from droptrap sampling during fall sampling period among years.

Site	F	SNK of F Significance
Smith Creek (P11)	4.75(0.0002)	00a 01ab 02ab 03b 04b 05b 99b
Rat Island (P12)	3.69(0.0021)	05a 01ab 00ab 04b 03b 02b 99b
Fishing Creek (P13)	3.52(0.0030)	02a 03ab 01b 04b 00b 05b 99b
Town Creek Mouth (P2)	4.55(0.0003)	05a 03ab 04b 02b 01b 00b 99b
Inner Town Creek (P3)	5.70(0.0001)	04a 03ab 00ab 99bc 02bc 01bc 05c
Eagle Island (P6)	6.02(0.0001)	04a 00ab 05ab 03bc 02bc 99c 01c
Indian Creek (P7)	8.72(0.0001)	03a 04b 00b 01b 05b 02b 99b
Dollisons Landing (P8)	7.41(0.0001)	03a 04b 05bc 99bcd 02bcd 01cd 00d

Table 7.4-29. Comparison of total abundance at each location from droptrap sampling during spring sampling period among years.

Site	F	SNK of F Significance
Smith Creek (P11)	11.71(0.0001)	04a 06b 05bc 03bc 01bcd 02cd 00d
Rat Island (P12)	20.81(0.0001)	06a 05b 03bc 04cd 02cd 01ed 00e
Fishing Creek (P13)	18.06(0.0001)	04a 06b 05b 01c 00c 03c 02c
Town Creek Mouth (P2)	4.97(0.0001)	02a 01ab 03abc 05abc 00bc 04bc 06c
Inner Town Creek (P3)	17.85(0.0001)	02a 04ab 05ab 06b 01c 00c 03d
Eagle Island (P6)	15.26(0.0001)	04a 06ab 05abc 01bc 02c 03c 00d
Indian Creek (P7)	27.39(0.0001)	04a 06b 03c 05cd 01cd 00cd 02d
Dollisons Landing (P8)	10.91(0.0001)	04a 06b 05bc 03bc 02bc 00bc 01c

8.0 SENSITIVE HERBACEOUS VEGETATION SAMPLING

8.1 Summary

It seems clear that these tidal wetland systems are controlled largely by salinity incursions in the upper estuary/lower river and changes in vegetation largely reflect past events. The area of *Zizaniopsis miliacea* at the Inner Town Creek site (P3), has expanded from 710 ft^2, measured in 2000, to 3,619 ft^2 measured this year, but had undergone both expansion and contraction in the interim. There has been more than a two-fold increase in polygon size between last year (1,518 ft^2) and the current year. At stations above salinity incursions, e.g. Indian Creek, sensitive herbaceous vegetation was largely unaffected by arrival of ocean-derived salts. Above the area of saltwater intrusion change may still occur after extended periods of river flooding. Noteworthy changes in the cover and species content of the sensitive herbaceous polygon at Dollisons Landing station include a substantial increase in the dominant species, *Saururus cernuus*, and losses of three species, *Hymenocallis floridana*, *Proserpinaca palustris*, and *Alternanthera philoxeroides*. Two species, *Polygonum punctatum*, and *Pontederia cordata*, have reappeared in the sample area. At the Black River site, the sensitive herbaceous polygon established in 2000 and used through the 2004 growing season to track salinity events had to be replaced. Problems with the old plots have been discussed in previous reports for this site. The greatest problem seen upon investigation in the 2005 growing season was that all the main species of interest, *Ludwigia palustris*, no longer occurred in the area. Sensitivities of this species to deep river flooding and oxygen deprivation have been possibilities discussed as responsible for fragmentation and removal by flooding waters. Changes in the sensitive herbaceous polygon at Rat Island since last year have been remarkable. *Schoenoplectus americanus* has recovered to the extent that it is again comparable to coverage in 2000, the first year of sampling. It is doubtful that this sudden growth can be attributed to recruitment of additional plants. Rather it is likely due to re-emergence of above-ground stems from rhizomes that were able to survive below the surface of the substrate until lower salinities occurred again. The sensitive herbaceous vegetation polygon for the Fishing Creek station has decreased in size this year by 233.5 ft^2, mostly due to slight narrowing in some areas, but has remained considerably larger than the polygon measured in 2000. *Pontederia cordata*, the main sensitive herbaceous species used to define the polygon, has continued to rebound following the extremes of 2001-2003. At Prince George Creek *Saururus cernuus* and *Polygonum hydropiperoides* were the two most abundant sensitive herbaceous species within the polygon at Prince George Creek. These two species have dominated the polygon each year except in 2002 when *Polygonum hydropiperoides* was not visible. Both have generally rebounded from the high salinity, but this year *Saururus cernuus* has diminished in cover compared to 2002. Reasons for this decrease in cover are uncertain. With this cover decrease there has been a strong increase in abundance by the annual, *Polygonum arifolium*. This year the latter species actually constituted approximately 20 percent of the overall cover within the polygon, but it is not considered a sensitive herbaceous species.

It is possible that vascular herbaceous species composition and cover in tidal brackish marsh systems is not only a mutable, but a reversible phenomenon, as well. Oligohaline and mesohaline subsystems are changed or rebound relative to water salinity both accompanying and following an event. It seems clear that when these systems are driven largely by salinity regime. Salinity regime in middle estuarine reaches, at least, is under the influence of weather and climate. It follows that in tidal marsh systems in an estuarine environment vegetation patterning is then linked to weather and climate making plant cover and dominance an extension of a naturally chaotic system.

8.2 Introduction and Background

As a part of sensitive herbaceous vegetation monitoring for Wilmington Harbor in the Cape Fear River Estuary, seven stations are examined annually to assess plant species content and percent cover (Table 8.2-1). Current data apply to the sixth year of data collection. Each of the stations is subject to the astronomical tides experienced within the lower Cape Fear River estuarine system. Six of the seven stations, during six years of the sampling, have experienced exposure to ocean-derived salt as well as freshwater tidal flooding. Ocean-derived salts have not been sampled at Black River, at the uppermost Cape Fear River station. Generalized vegetation zones along 50-meter wide transects extending from tidal shore line to upland at each station were defined and described as a part of an earlier report (CZR Incorporated 2001). Methods and results of past years' sensitive herbaceous species sampling and observations at the seven stations are covered in earlier reports (CZR Incorporated 2001, CZR Incorporated 2002, Hackney 2002a, Hackney 2002b, Hackney 2003, Hackney 2004, and Hackney 2005).

Table 8.2-1. Locations, names and numbers of sensitive herbaceous vegetation monitoring stations in the Wilmington Harbor monitoring project, Cape Fear River Estuary, North Carolina

Station Name	Stream Name	Station Number
Inner Town Creek	Town Creek	P3
Indian Creek	Cape Fear River	P7
Dollisons Landing	Cape Fear River	P8
Black River	Cape Fear River (near Black River)	P9
Rat Island	Northeast Cape Fear River	P12
Fishing Creek	Northeast Cape Fear River	P13
Prince George Creek	Northeast Cape Fear River	P14

8.3 Methodology

Data collection methods remain largely the same as those used during previous years of sensitive herbaceous vegetation sampling (CZR Incorporated 2002, Hackney et al. 2002a, Hackney et al. 2002b, Hackney et al. 2003, Hackney et al. 2005, and Hackney et al. 2006). As with previous iterations, this year's data for plant species presence and percent cover were gathered from five variable plots and two fixed plots. Percent cover data from the previous year are not consulted prior to assessment of conditions for the current year. Assessments are made in the field independent of pre-existing data.

Variable polygons were sampled at Inner Town Creek (P3), Black River (P9), Rat Island (P12), Fishing Creek (P13), and Prince George Creek (P14) and are used below to demonstrate yearly size, shape, and plant species cover variations. These variable-size plots have boundaries created by on-site delineations of recognizable assemblages dominated by sensitive herbaceous species. Polygons at two stations with fixed, four-sided plots were originally chosen because they best represented larger, more widespread sensitive herbaceous vegetation assemblages. These two plots occur only at Indian Creek (P7) and Dollisons Landing (P8) (CZR Incorporated 2001).

Sampling stations were visited during the second week of August 2005, when wetland herbaceous vegetation usually reaches optimum seasonal development. Polyvinyl chloride (PVC) stakes were added, moved, or removed in order to remark polygons for this iteration of sampling. Each stake was renumbered and flagged as necessary. At each station, plant species seen in each polygon were listed and their contributed cover percentages were recorded. Position data of the PVC stakes were recorded using GPS (Global Positioning System) instruments during the third week of January 2006 at the five stations (Appendix C). Details of the GPS data gathering process are covered in earlier reports (Hackney et al. 2002a, Hackney et al. 2002b).

Field personnel responsible for gathering sensitive herbaceous vegetation data and GPS data have not changed since the inception of the project. The same personnel are responsible for analysis and reporting.

8.4 Hydrologic Events and Sensitive Vegetation

The sampling period for sensitive herbaceous vegetation for the current year followed earlier growing seasons during which unusual hydrologic events pulsed through the project area. Record-breaking regional drought was accompanied by profound salinity intrusions into usually freshwater portions of the Cape Fear River estuary. Flood events followed drought with abundant rainfall from the three contributing watersheds. The effects of these hydrological events on habitats, growth and distribution of sensitive herbaceous plant species are still being observed and assessed in tidal marsh and swamp forest communities. Most remarkable at some stations have been the recoveries demonstrated by expansion of rhizomatous (perennial) species.

Data covering sensitive herbaceous vegetation are presented below for each of the sampling stations (Tables 8.41-1through 8.47-1) (Appendix D). Polygon configurations are presented for the baseline year (2000), last year (2004), and the current year (2005) (Figures 8.41-1 through 8.47-1). Discussions may include allusions to interim data. Presentation of GPS data from interim years of sensitive herbaceous vegetation sampling are covered in previous reports (CZR Incorporated 2001, CZR Incorporated 2002, Hackney et al. 2002a, Hackney et al. 2002b, Hackney et al. 2003, Hackney et al. 2005, Hackney 2006) and will be referenced as needed in the current text. Data comparing areas and percentage cover by species within polygons through all years are also presented as single tables in appropriate sections.

Additional variables considered important during collection and presentation of the data are discussed for each station. Some of these variables include (1) changes of sensitive herbaceous species, (2) shifts in dominance of sensitive herbaceous species, (3) changes in cover contributions of sensitive herbaceous species within delineated polygons, (4) variations in shapes and sizes of polygons, (5) habitat-related hydrological factors up to the sampling time in August, and (6) plant characteristics of special importance in vegetation change within the plots.

8.41 Inner Town Creek

The area of *Zizaniopsis miliacea*, the dominant sensitive herbaceous species being monitored at the Inner Town Creek site (P3), has expanded from 710 ft^2, measured in 2000, to 3619 ft^2 measured this year (Figure 8.41-1 and Table 8.41-1). There has been more than a two-fold increase in polygon size between last year (1,518 ft^2) and the current year (Table 8.41-1). Three polygons were established at this site last year A, B and C. The larger polygon of this year has expanded to include last year's polygon B. Polygon C, an outlier last year and this year, is now encompassed by a much larger outlier that spreads north and west.

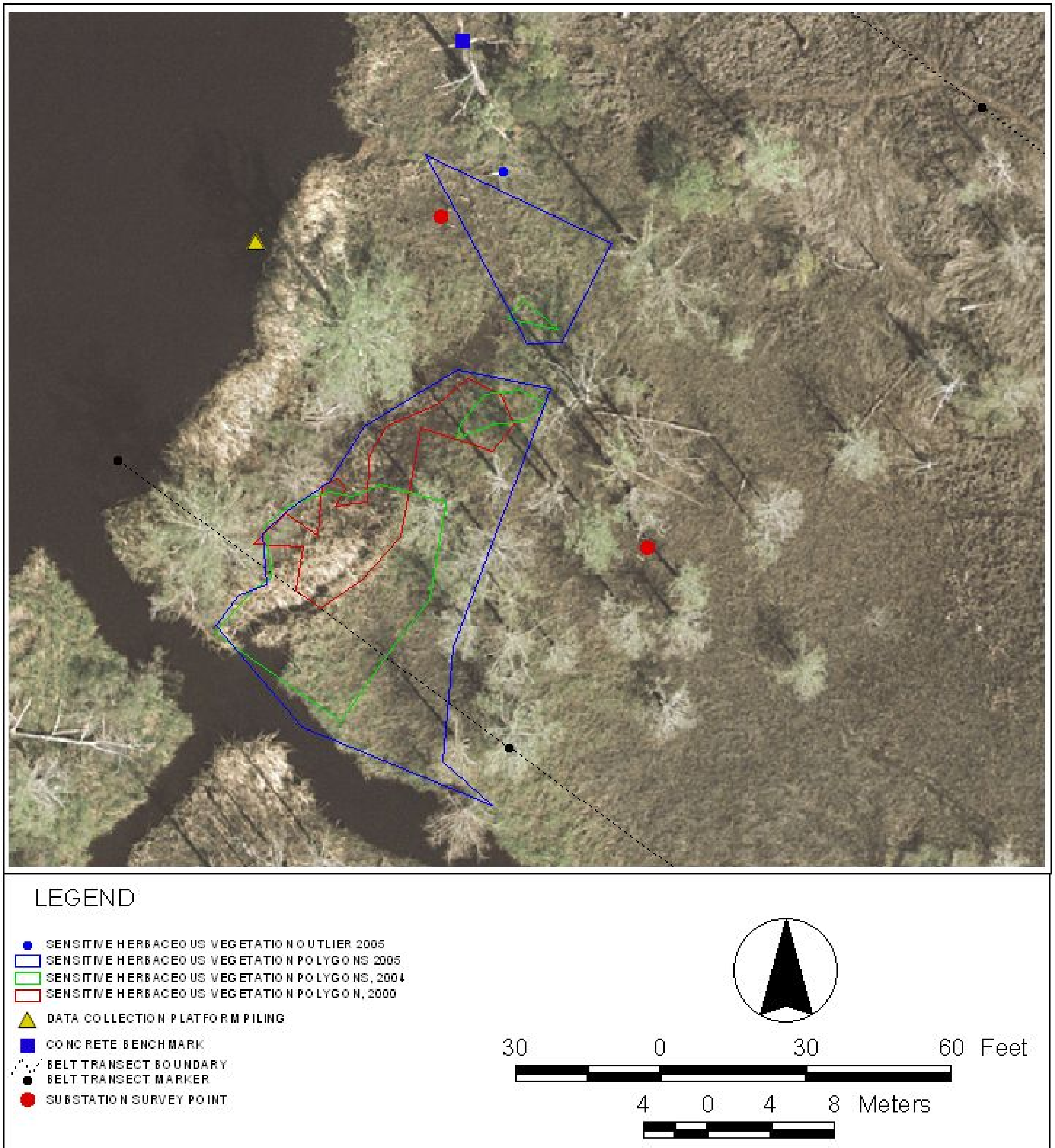
Table 8.41-1. Comparisons of areas (ft^2) of sensitive herbaceous vegetation polygons for years 2000-2005 at sensitive herbaceous vegetation monitoring stations, Wilmington Harbor monitoring project, Town Creek, North Carolina.

Station	**Year**					
	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Inner Town Creek	710.0	1552.5	1311.0	1326.0	1518.1	3619.2[a]
Indian Creek	129.8	129.8	281.9[b]	281.9	281.9	281.9
Dollisons Landing	404.5	404.5	286.1[b]	286.1	286.1	286.1
Black River	431.0	1120.0	913.0	567.8	69.5	251.8[c]
Rat Island	532.9	532.9	532.9	532.9	532.9	532.9
Fishing Creek	1522.2	1646.1	971.9	682.1	2506.3	2272.8
Prince George Creek	3931.2	36631.3	5190.2	5265.4	5227.2	5245.9

[a]Combined areas of large and small polygons (see Figure 8.41-1).
[b]Changes in area are an artifact of shift to winter GPS data collection (Hackney 2003).
[c]Polygon moved to new location.

Along the northwest margin of the large polygon there is a dike of soil material (possibly once associated with rice culture) that parallels the creek. This dike constitutes an elevation barrier between the original polygon and the Town Creek shoreline. The dike has previously retarded growth of *Zizaniopsis miliacea* to the west. Next year, if expansion continues, the dike no longer will separate the *Zizaniopsis miliacea* in the polygon from the stand of *Zizaniopsis miliacea* now dominating the adjacent stream bank. The entire stand appears to be expanding in a northerly direction.

Rhizomes of *Zizaniopsis miliacea* seem now to be invading both sides of the above dike. Stems of *Spartina cynosuroides*, not a sensitive herbaceous species, are becoming more abundant west of the dike and, this year, were found east of the dike and invading the polygon. It is uncertain if *Spartina cynosuroides* rhizomes have actually penetrated the dike material or grown around it.



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COMPARISON OF SENSITIVE HERBACEOUS VEGETATION POLYGONS FROM YEARS 2000, 2004 AND 2005 AT STATION P3 (INNER TOWN CREEK), WILMINGTON HARBOR MONITORING PROJECT, TOWN CREEK, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

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DRAWN BY: DMD	DATE: 30 MARCH 2006	FIGURE 8.41-1

Several species used originally as sensitive herbaceous species continue to persist in the polygon. The cover values contributed by *Zizaniopsis miliacea* have remained similar for the last three growing seasons (Table 8.41.2). A similar situation is true for *Sagittaria lancifolia* and *Peltandra virginica*.

Schoenoplectus americanus and *Carex hyalinolepis* may be in the process of disappearing, at least as subaerial stems, from the polygon.

Typha latifolia may never have existed in the polygon within the life of the current project and has been removed from the table (Table 8.41-2). The entity originally identified as *Typha latifolia* in the polygon was probably *Typha* x *glauca*, a recognized hybrid of *T. latifolia* and *T. angustifolia*. *Typha angustifolia* and *Typha* x *glauca* are not considered sensitive herbaceous species because of their apparent tolerance to relatively high mesohaline conditions. *T. angustifolia*, at least, is present in both the large and small polygons for the current year.

Table 8.41-2. Comparisons of percent cover contributions by sensitive herbaceous species in major (and outlier) polygons at the Inner Town Creek Station (P3) for years 2000-2005, Wilmington Harbor monitoring project, Town Creek, North Carolina.

Species	**Year**					
	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Zizaniopsis miliacea	70	60	20	50	60 (20)	55 (5)
Sagittaria lancifolia	5	20	5	10	10	10 (30)
Peltandra virginica	3	<1	<1	10	<1 (--)	<5 (<1)
Carex hyalinolepis	1	10	10	40	1	<5
Schoenoplectus americanus	--	--	10	10	10	>1 (<1)
Zizania aquatica	--	--	--	--	--	-- (<1)

A species new to the sensitive herbaceous polygon at the Inner Town Creek sampling station is wild rice, *Zizania aquatica*. This perennial species takes advantage of brackish-to-freshwater regime shifts for recruitment in open or partially shaded tidal habitats. It is characteristically an oligohaline species and its presence as a subaerial form through time will depend on persistence of low salinity levels and lack of rhizome-damaging salinity events.

Apparent shifts in fresher species dominance are influenced by dominant freshwater flows from upstream at the Inner Town Creek station. Such a regime is suggested by the data presented for the 2004-2005 sampling year (Hackney et al. 2006). Colonies of *Zizaniopsis miliacea* are expanding and *Zizania aquatica*, also a colonial species, is, at least apparently, newly established. *Carex hyalinolepis* has not rebounded from higher salinity conditions and *Schoenoplectus americanus* is notably reduced in coverage this year. Substrate inclusions of these species are, of course, unknown.

Curiously, another species new to the polygon this year is *Schoenoplectus robustus* (previously called *Scirpus robustus*), which is tolerant of persistent high mesohaline conditions. It is not considered a sensitive herbaceous species. It can often be found on higher salinity mesohaline flats interior of stream banks dominated by *Spartina cynosuroides*.

From maximum monthly salinities a mean of 10.34 ppt (calculated by averaging mean maximum monthly summaries for DCP data from Hackney et al. 2006 along with similar data for June and July 2005) for the year preceding the current period of sampling places the site in the lower mesohaline range of brackish marsh salinity (Mitsch and Gosselink 1993). This value may represent an optimum balance for the dominant species presently occurring within the Inner Town Creek polygon.

Both mesohaline and oligohaline species (*Schoenoplectus robustus* and *Zizania aquatica*, respectively) have recently established within the Inner Town Creek polygon. This station seems to be demonstrating divergent trends in response to varying salinity regimes. However, these trends may better demonstrate a random opportunism that characterizes plant recruitment within these variable brackish marsh habitats. It seems possible that opportunism and the capacity to take advantage of habitats providing low competitive interaction can be parts of successful recruitment strategy. It is not known if these new species were introduced as seed or as vegetative units. Vegetative propagula, such as stem or rhizome segments, may be favored longer distance dispersal devices during recruitment in these systems.

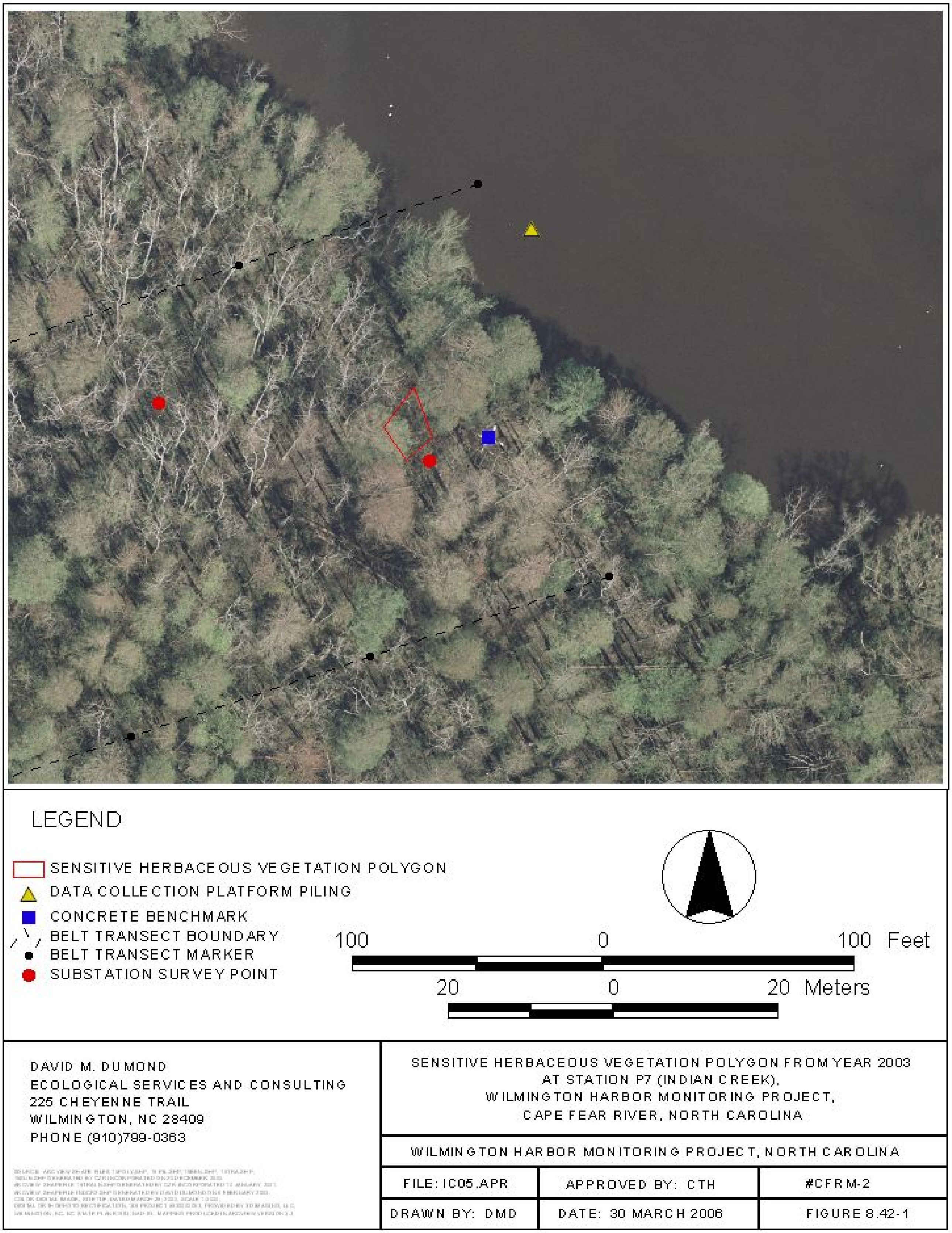
8.42 Indian Creek

The salinity regime at the Indian Creek station has been near fresh for the year preceding current sampling at the sensitive herbaceous vegetation plot. Only for one month was there a mean maximum salinity in excess of .02 ppt. That mean monthly maximum was 1.8 ppt for August 2004 (Hackney et al. 2006). This means that sensitive herbaceous vegetation at the site was largely unaffected by arrival of ocean-derived salts.

As in previous years the sensitive herbaceous vegetation polygon at Indian Creek is a simple four-sided figure marked by flagged trees located at each corner (Figure 8.42-1). No actual polygon size changes have occurred since 2000 (Table 8.42-1). The apparent change in area is an artifact of GPS data collection under two differing conditions. These changes have been explained in an earlier report (Hackney et al. 2002b).

Continued deepening of a new channel through the approximate middle of the sensitive herbaceous vegetation polygon is apparent. In addition, the channel is widening. Erosion resulting from the formation of the channel and its trend toward widening may be partially responsible for loss of species diversity and continued decrease in percent cover within the plot. At least initially in 2002 salt damage at the site was considerable. The erosion may be related to pedestrian traffic.

The sensitive herbaceous polygon at Indian Creek is now sparsely covered. A notable change within the polygon is the decrease in cover contributed by *Saururus cernuus*. Cover by this species was at a high last year when it was the dominant species. Rhizome material, possibly weakened in 2002 by the higher salinities, has now been eroded from the site. *Campsis*


LEGEND
SENSITIVE HERBACEOUS VEGETATION POLYGON
DATA COLLECTION PLATFORM PILING
CONCRETE BENCHMARK
BELT TRANSECT BOUNDARY
BELT TRANSECT MARKER
SUBSTATION SURVEY POINT
100 0 100 Feet
20 0 20 Meters
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SENSITIVE HERBACEOUS VEGETATION POLYGON FROM YEAR 2003
AT STATION P7 (INDIAN CREEK),
WILMINGTON HARBOR MONITORING PROJECT,
CAPE FEAR RIVER, NORTH CAROLINA
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA
FILE: IC05.APR
APPROVED BY: CTH
#CFRM-2
DRAWN BY: DMD
DATE: 30 MARCH 2006
FIGURE 8.42-1

Table 8.42-1. Comparisons of percent cover contributions by sensitive herbaceous species in the sampling polygon at the Indian Creek Station (P7) for years 2000-2005, Wilmington Harbor monitoring project, Cape Fear River, North Carolina.

Species	**Year**					
	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Saururus cernuus	2		--	2	20	1
Cicuta maculata	5	2	<1	2	1	1
Polygonum punctatum	<1	<1	--	--	<1	<1
Commelina virginica	<1	2	1	<1	--	<1
Carex crinita var. *brevicrinus*	<1	<1	10	--	--	<1
Carex hyalinolepis	<1	2	--	1	<1	<1
Symphyotrichum elliottii	<1	--	--	--	--	<1
Triadenum walteri	<1	<1	--	--	--	--
Lycopus virginicus	<1	--	--	--	--	--
Galium sp.	<1	--	--	--	--	--
Phanopyrum gymnocarpum	--	<1	2	1	1	1
Peltandra virginica	--	--	<1	--	--	--
Boehmeria cylindrica	--	<1	--	--	--	<1
Polygonum virginianum	--	--	--	1	--	<1
Chasmanthium latifolium	--	--	--	1[a]	--	<1
Hymenocallis floridana	--	--	--	--	<1	<1
Cinna arundinacea	--	--	--	--	<1	<1

[a]Possible misidentification. Species may have been *Cinna arundinacea*.

radicans, a woody non-sensitive herbaceous species, was common within the polygon. *Impatiens capensis*, an annual and therefore not considered a sensitive herbaceous species, was dominant in the polygon and constituted roughly 10 percent cover.

Two potential symptoms of poor health were noted at the time of the sampling at Indian Creek. Specimens of *Chasmanthium latifoium* and *Carex crinita* var. *brevicrinus* were yellowing for an unknown reason. Several specimens of *Cicuta maculata* hosted large moth caterpillars which were consuming primary stem leaves. No flowering stems had developed on *Cicuta maculata* plants in the polygon this year.

There are three possible causes for the changes seen in the Indian Creek sensitive herbaceous vegetation polygon in the last three years. Weakness initially caused by the salinity incursions in 2001and 2002 may have been working in concert with topographic changes initiated by human-caused modifications. Workers may have created the new channel in association with their walk-way between interior sampling stations.

A third possibility may be due to movement of fresh (though likely polluted) water from adjacent upland locations to the west at the upper end of the sampling transect. Plans several years ago were for this upland area to be converted to a spray field for disposal of the contents from portable toilets owned or serviced by a local waste management company. Confirmation of such land has not been made.

8.43 Dollisons Landing

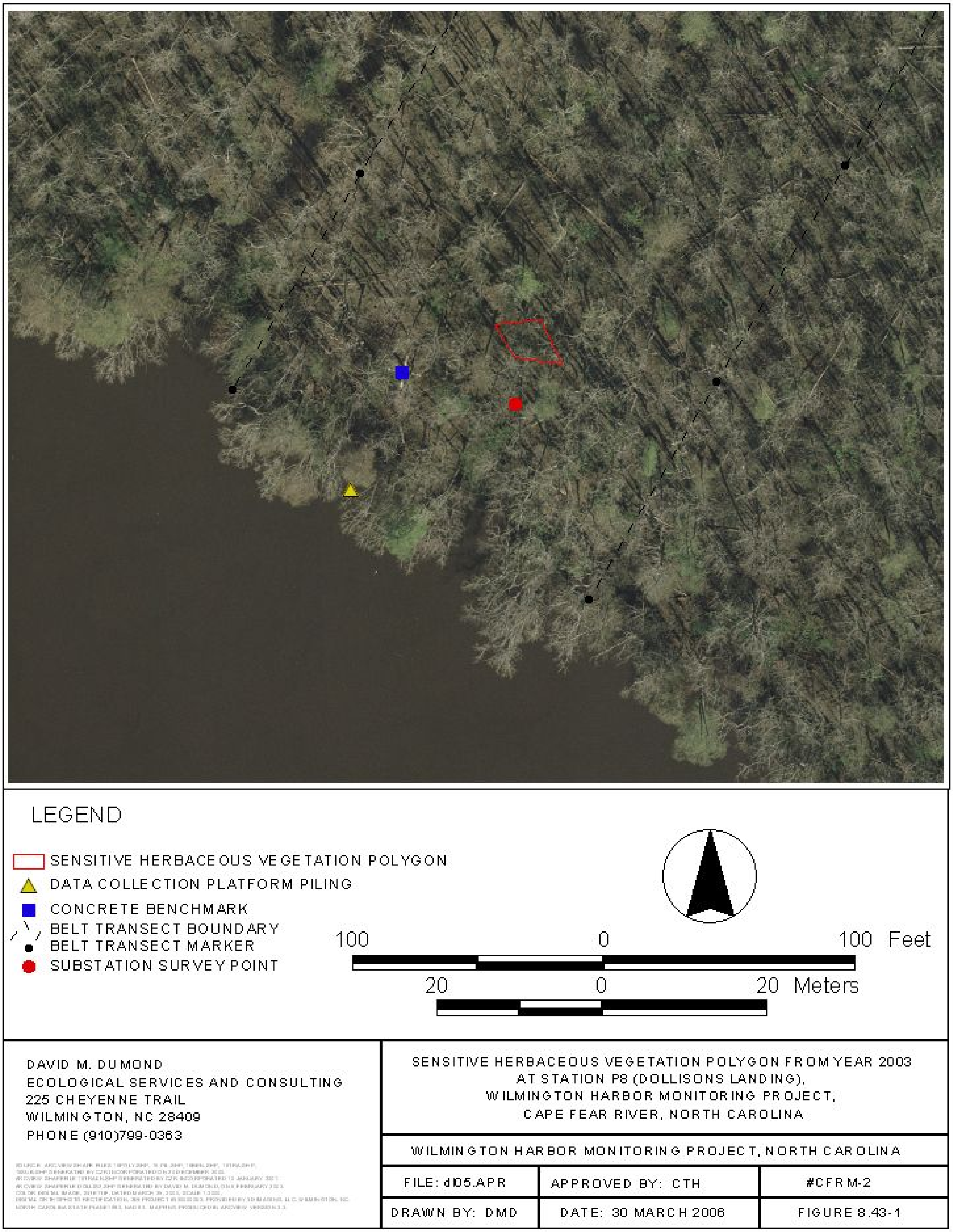
The polygon at Dollisons Landing is also a fixed, four-sided figure marked by flagged trees at the corners with essentially no changes in shape on the ground since the beginning of the project (Figure 8.43-1). Data for current GPS locations of the corners were recollected during the winter of 2002 during leafless canopy conditions. The position of this polygon is shown in Figure 8.43.1. Cover data from all years for the sensitive herbaceous vegetation polygon are presented below (Table 8.43.1).

Noteworthy changes in the cover and species content of the sensitive herbaceous polygon at Dollisons Landing station include a substantial increase in the cover of the dominant species, *Saururus cernuus*, and losses of three species, *Hymenocallis floridana*, *Proserpinaca palustris*, and *Alternanthera philoxeroides*. Two species, *Polygonum punctatum*, and *Pontederia cordata*, have reappeared in the sample area. The three species which have disappeared from the plot are potentially transient species. *Hymenocallis floridana*, found only as a trace in the three past years, may have disappeared altogether or may be obscured within the substrate, only to appear again later. *Proserpinaca palustris* and *Alternanthera philoxeroides* are highly mobile plant species. Fragments of these two species appear and disappear through time as plant fragments are delivered or removed by flooding.

Polygonum arifolium, an annual and therefore not a sensitive herbaceous species (removed from sensitive herbaceous species tables), and *Polygonum punctatum* have reappeared after one year. The latter species, which is strongly rhizomatous, may not have been absent, but only obscured or possibly adjacent to the plot. *Pontederia cordata* has been absent from the plot for three years only to reappear this year. This species has never been as important as *Polygonum arifolium* and *Polygonum punctatum* once were.

The continued rebound of *Saururus cernuus* in the plot is consistent with what has been seen in other areas following alternating periods of high and low salinity. Habitats for this and the other species in the plot continue to be near fresh. The mean monthly maximum of salinity values for tidal waters regularly inundating the area during the growing season prior to the current sample period is 0.1 ppt (Hackney 2005).

No additional changes in the health of woody or herbaceous species at the Dollisons Landing station were noted. The top of a *Taxodium ascendens* was broken out of a tree, perhaps by wind, and lays near the north end of the plot.


LEGEND
SENSITIVE HERBACEOUS VEGETATION POLYGON
DATA COLLECTION PLATFORM PILING
CONCRETE BENCHMARK
BELT TRANSECT BOUNDARY
BELT TRANSECT MARKER
SUBSTATION SURVEY POINT
100 0 100 Feet
20 0 20 Meters
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SENSITIVE HERBACEOUS VEGETATION POLYGON FROM YEAR 2003
AT STATION P8 (DOLLISONS LANDING),
WILMINGTON HARBOR MONITORING PROJECT,
CAPE FEAR RIVER, NORTH CAROLINA
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA
FILE: d05.APR
APPROVED BY: CTH
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DRAWN BY: DMD
DATE: 30 MARCH 2006
FIGURE 8.43-1

Table 8.43-1. Comparisons of percent cover contributions by sensitive herbaceous species in the sampling polygon at the Dollisons Landing Station (P8) for Years 2000-2005, Wilmington Harbor monitoring project, Cape Fear River, North Carolina.

Species	**Year**					
	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Saururus cernuus	30	20	35	35	40	50
Boehmeria cylinidrica	<1	--	<1	<1	1	<1
Rumex verticillatus	<1	--	2	2	<1	<1
Cicuta maculata	2	--	2	2	<1	<1
Carex sp.	1	--	--	--	--	--
Polygonum punctatum	1	1	3	3	--	<1
Peltandra virginica	2	1	3	3	<1	1
Carex crinita	<1	2	--	--	--	--
Dulichium arundinaceum	<1	--	--	--	--	--
Triadenum walteri	<1	--	--	--	--	--
Eryngium aquaticum	--	3	1	1	--	--
Pontederia cordata	--	<1	--	--	--	<1
Hymenocallis floridana[a]	--	--	<1	<1	<1	--
Alternanthera philoxeroides	--	--	<1	<1	--	--
Proserpinaca palustris	--	--	--	--	<1	--
Ipomoea sp. (?)	--	--	--	--	<1	--

[a]Name change from 2004 does not represent a species change.

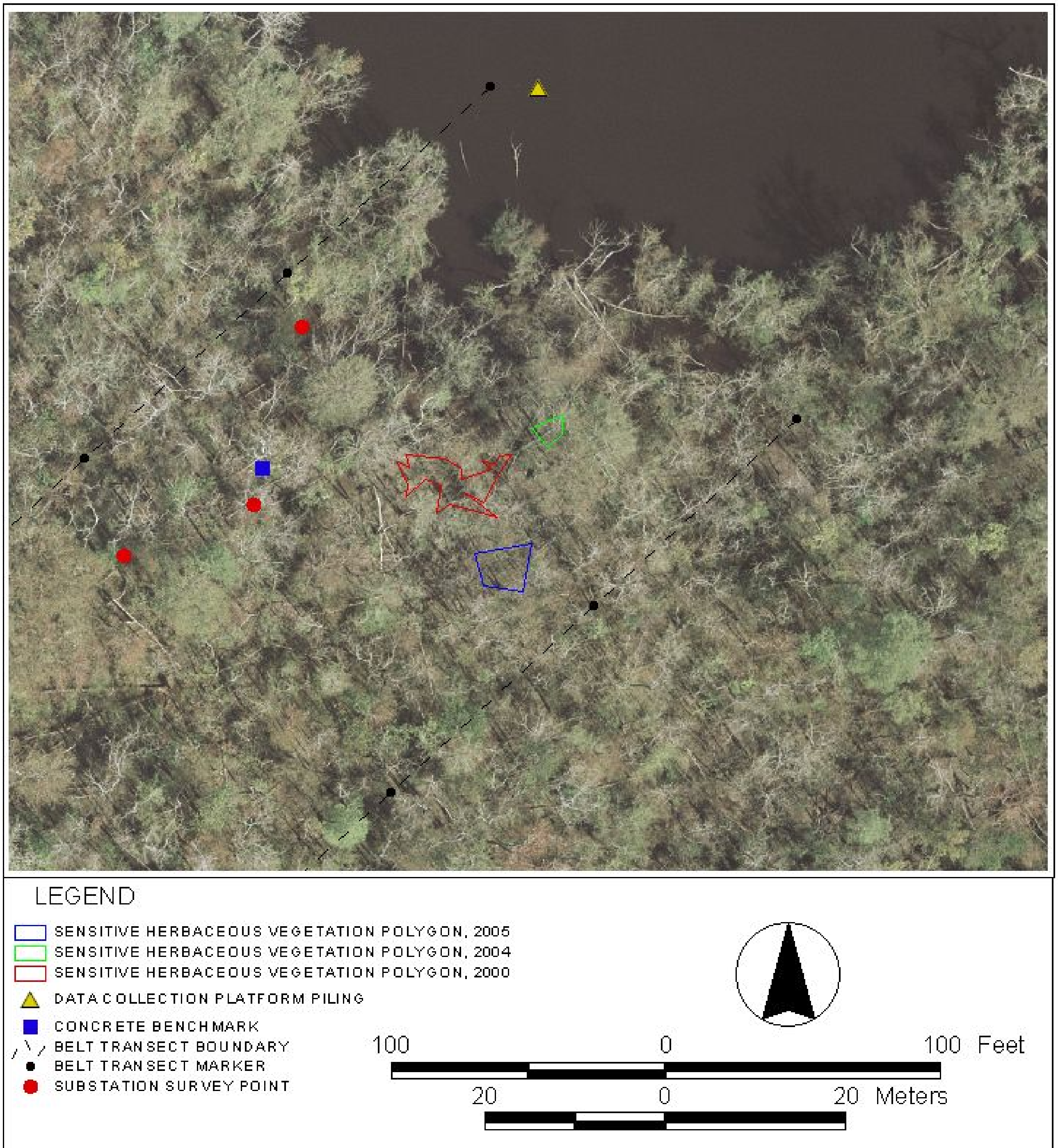
8.44 Black River

The sensitive herbaceous polygon established in 2000 and used through the 2004 growing season to track salinity events at the Black River station has been replaced. Problems with the old plots have been discussed in previous reports for this site (Hackney et al. 2003 and Hackney et al. 2005). The greatest problem seen upon investigation in the 2005 growing season was that all the main species of interest, *Ludwigia palustris,* no longer occurred in the area. Sensitivities of this species to flooding and oxygen deprivation have been possibilities discussed as responsible for fragmentation and removal by flooding waters. Data from sample years 2000-2004 (Table 8.44-1) are still presented for reference only. Data for sample year 2005 (in red) represent the contents of the new polygon (Figure 8.44-1).

Table 8.44-1. Comparisons of percent cover contributions by sensitive herbaceous species in old polygons from years 2000-2004 and new sensitive herbaceous polygon for 2005 at the Black River (P9), Wilmington Harbor monitoring project, Cape Fear River, North Carolina.

Species	**Year**					
	2000	**2001**	**2002**	**2003**	**2004**	**2005**[a]
Ludwigia palustris	50	20	20	1	5	--
Polygonum[a] *punctatum*	--	15	1	--	1	<1
Symphyotrichum elliottii	--	2	<1	1	<1	<1
Scutellaria lateriflora	--	--	<1	--	--	--
Boehmeria cylindrica	--	--	<1	--	<1	--
Saururus cernuus	--	--	--	--	--	10
Physostegia leptophylla	--	--	--	--	--	<1
Peltandra virginica	--	--	--	--	--	<1

[a] Location of plot has changed. Plants and values from the current year are in red.



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COMPARISON OF SENSITIVE HERBACEOUS VEGETATION POLYGONS FROM YEARS 2000, 2004 AND 2005 AT STATION P9 (BLACK RIVER), WILMINGTON HARBOR MONITORING PROJECT, NORTHEAST CAPE FEAR RIVER, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE: BR05.APR	APPROVED BY: CTH	#CFRM-2
DRAWN BY: DMD	DATE: 30 MARCH 2006	FIGURE 8.44-1

Tidal influence in the vicinity of the plot was determined by examining the lower stems of dominant plants for a silt line. Presence of the silt was used as an indicator of the height of regular tidal influence. The dominant plants in the plot show silt deposits higher on the stems than those above the plot. Below the plot, the dominant species, *Saururus cernuus*, disappears. An attempt was made to select an area largely free of hummocks and stumps. These topographic variations provide elevations above direct contact with regular tidal water and hence could not be used for assessment of sensitive herbaceous vegetation.

Data presented in the table above simply compare the species present in the old plot with those present in the new plot. Between the two plots cover percents mean little. Since there have been no recorded salinity events at this station, the old data can be used to reflect that. Use of the new plot, particularly with the presence of *Saururus cernuus* should prove more satisfactory than the old plot with the highly mobile *Ludwigia palustris*. *Saururus cernuus* is sensitive to even low salinities.

8.45 Rat Island

Changes in the sensitive herbaceous polygon at Rat Island since last year have been remarkable. *Schoenoplectus americanus* has recovered to the extent that it is again comparable to coverage in 2000, the first year of sampling. It is doubtful that this sudden growth can be attributed to recruitment of additional plants. Rather it is likely due to re-emergence of above-ground stems from rhizomes that were able to survive below the surface of the substrate (Table 8.45-1, Figure 8.45-1).

Carex hyalinolepis and *Sagittaria lancifolia* show a definite decline since last year. Growth of the *Schoenoplectus americanus* may be attributable to continuation of relatively fresh water conditions in this, now, middle to low mesohaline environment. The mean monthly maximum salinity at this site is essentially equal to that at the Inner Town Creek station at 10.31 ppt (Inner Town Creek was 10.34 ppt).

Table 8.45-1. Comparisons of percent cover contributions by sensitive herbaceous species in the polygon for years 2000-2005 at the Rat Island (P12), Wilmington Harbor monitoring project, Northeast Cape Fear River, North Carolina.

Species	**Year**					
	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Schoenoplectus americanus	100	20	30	50	25	90
Carex hyalinolepis	20	8	10	<1	2	<1
Sagittaria lancifolia	10	30	--	5	10	<1
Alternanthera philoxeroides	<1	--	<1	--	--	--
Boltonia asteroides	<1	<1	--	--	--	--
Symphyotrichum subulatum	<1	<1	<1	<1	--	--
Peltandra virginica	--	1	--	--	--	--
Rumex verticillatus	--	1	--	--	--	--
Hymenocallis floridana	--	<1	--	1	<1	<1
Polygonum punctatum	--	--	--	--	<1	--
Symphyotrichum tenuifolium	--	--	--	--	<1	1

LEGEND

- SENSITIVE HERBACEOUS VEGETATION POLYGON, 2001
- SENSITIVE HERBACEOUS VEGETATION POLYGON, 2000
- DATA COLLECTION PLATFORM PILING
- CONCRETE BENCHMARK
- BELT TRANSECT BOUNARY
- BELT TRANSECT MARKER
- SUBSTATION SURVEY POINT

100 0 100 Feet

20 0 20 Meters

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COMPARISON OF SENSITIVE HERBACEOUS VEGETATION POLYGONS FROM YEARS 2001 AND 2000 AT STATION P12 (RAT ISLAND), WILMINGTON HARBOR MONITORING PROJECT, NORTHEAST CAPE FEAR RIVER, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE: ri05.APR	APPROVED BY: CTH	#CFRM-2
DRAWN BY: DMD	DATE: 30 MARCH 2006	FIGURE 8.45-1

Even more remarkable are finds of scattered oligohaline and low mesohaline species outside the polygon. *Zizaniopsis miliacea*, which has never been seen at this site, was found outside the plot. Other species seen outside the polygon were *Alternanthera philoxeroides*, *Peltandra virginica*, *Rumex verticillatus*, and *Pluchea odorata*. All but *Pluchea* were part of the plot in previous years. The above finds likely indicate random dispersal in association with a year of fresher water.

Last year *Spartina cynosuroides*, not considered a sensitive herbaceous species and therefore not considered in the overall cover within the polygons, had a total cover within the polygon of about 50 percent. This year its total cover is only 10 percent. The loss in cover of *Spartina cynosuroides* and gain in cover by *Schoenoplectus americanus* within a period of one year has been almost reciprocal. The only apparent reason for this change is an increase in fresh water.

8.46 Fishing Creek

The sensitive herbaceous vegetation polygon for the Fishing Creek station has decreased in size this year by 233.5 ft^2, mostly due to slight narrowing in some areas, but has remained considerably larger than the polygon measured in 2000 (Table 8.41.1, Figure 8.46-1). *Pontederia cordata*, the main sensitive herbaceous species used to define the polygon, has continued to rebound following the extremes of 2001-2003. The polygon terminates at the northern transect boundary, roughly following a low, natural levee that parallels the river. The polygon has not increased significantly southward.

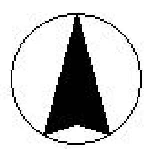
Simple species diversity within the sensitive herbaceous vegetation polygon is the same as last year. Twenty sensitive herbaceous species were noted at the site both years. Twelve species were noted during the first year while only 9 species were counted in 2002 (Table 8.46-1). It is interesting to note that cover of *Pontederia cordata* was highest during the year of highest salinity. The same is true for *Sium suave* (apparently absent this year), while *Zizania aquatica*, *Peltandra virginica* and *Zizaniopsis miliacea* had their highest cover percents in the following years. *Saururus cernuus* may be decreasing in response to increasing competition from *Pontederia cordata* as well as past salinity events.

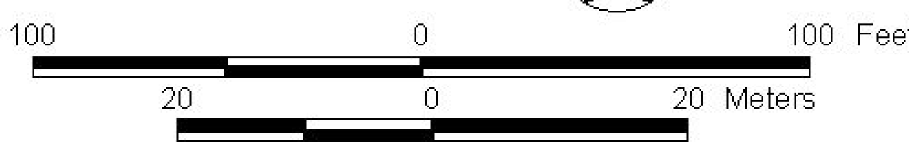
Five additional sensitive herbaceous species have become visible this year; *Lycopus virginicus*, *Cyperus* sp., *Elymus virginicus*, *Lobelia cardinalis* and *Carex crus-corvi*. These species are characteristically found in freshwater wetland habitats and are an indication of the continued oligohaline regime influencing this site. A simple average of mean monthly river salinities at this station for the year offers a value of 2.7 ppt (Hackney et al. 2006).

The absence of *Sium suave*, often an important species in low mesohaline marshes, is significant this year. This absence is a possible indication that *Sium suave* either does not persist long above ground in oligohaline conditions, that it succumbs to competition by those species that do or possibly both. *Polygonum arifolium*, an annual, was significantly diminished this year. Possibly with continued low to medium oligohaline conditions that favor the growth of other species and a reduced seed source this species may disappear from the site by next year. Annuals are subject to rapid changes relative to open habitat.

LEGEND

- SENSITIVE HERBACEOUS VEGETATION POLYGON, 2005
- SENSITIVE HERBACEOUS VEGETATION POLYGON, 2004
- SENSITIVE HERBACEOUS VEGETATION POLYGON, 2000
- DATA COLLECTION PLATFORM PILING
- CONCRETE BENCHMARK
- BELT TRANSECT BOUNDARY
- BELT TRANSECT MARKER
- SUBSTATION SURVEY POINT





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COMPARISON OF SENSITIVE HERBACEOUS VEGETATION POLYGONS FOR YEARS 2000, 2004 AND 2005 AT STATION P13 (FISHING CREEK), WILMINGTON HARBOR MONITORING PROJECT, NORTHEAST CAPE FEAR RIVER, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE: fc05.APR	APPROVED BY: CTH	#CFRM-2
DRAWN BY: DMD	DATE: 30 MARCH 2006	FIGURE 8.46-1

Table 8.46-1. Comparisons of percent cover contributions by sensitive herbaceous species in polygons from years 2000-2005 at the Fishing Creek Station (P13), Wilmington Harbor monitoring project, Northeast Cape Fear River, North Carolina.

Species	**Year**					
	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Pontederia cordata	20	40	50	30	30	35
Symphyotrichum elliottii	<1	--	--	--	--	1
Polygonum hydropiperoides[a]	2	1	--	<1	10	2
Sium suave	<1	2	5	1	1	--
Zizaniopsis miliacea	2	<1	<1	5	5	<1
Saururus cernuus	2	2	--	1	5	1
Cicuta maculata	<1	2	--	--	1	1
Sagittaria lancifolia	2	20	5	20	5	1
Orontium aquaticum	<1	--	--	--	--	--
Peltandra virginica	<1	1	5	30	12	5
Rhynchospora corniculata	<1	<1	--	--	<1	--
Carex sp.	<1	--	--	--	--	--
Alternanthera philoxeroides	--	5	<1	<1	--	1
Zizania aquatica	--	2	<1	50	<1	<1
Boltonia asteroides	--	1	--	--	<1	<1
Rumex verticillatus	--	<1	2	1	--	<1
Cinna arundinacea	--	<1	--	<1	<1	--
Eryngium aquaticum	--	<1	5	2	2	5
Schoenoplectus americanus	--	--	<1	--	--	--
Carex hyalinolepis	--	--	--	1	--	--
Apios americana	--	--	--	<1	<1	<1
Hymenocallis floridana	--	--	--	2	--	--
Ludwigia palustris	--	--	--	<1	<1	--
Hypericum mutilum	--	--	--	--	<1	--
Boehmeria cylindrica	--	--	--	--	<1	<1
Lycopus virginicus	--	--	--	--	--	<1
Cyperus sp.	--	--	--	--	--	<1
Elymus virginicus	--	--	--	--	--	<1
Lobelia cardinalis	--	--	--	--	--	<1
Carex crus-corvi	--	--	--	--	--	<1

[a] Previously identified as *Polygonum punctatum*.

Two other species warrant additional comments. *Alternanthera philoxeroides* is a highly mobile species, carried from place to place by moving water, often in large floating rafts. It is likely to appear and disappear unpredictably from sensitive herbaceous vegetation polygons.

Impatiens capensis, an annual and not here considered a sensitive herbaceous species, was abundant in the polygon this year. It actually constituted about 50 percent of the total cover within the plot. Last year this species composed only 5 percent of the cover. A heavy seed year last year at Fishing Creek as well as other areas was likely responsible for the sudden increase in cover. Such rapid increases in abundance are often characteristic of annuals and can be misleading in assessing the effects of salinity changes. The species is highly sensitive to salinity events and would likely be wiped out by salinities above 10 ppt. However, following such events it is quite capable of taking advantage of the habitat changes and reduced competition. It is generally rather shallowly rooted.

This station has accumulated the highest simple diversity of sensitive herbaceous species of any of all sampling stations. The combinations of water events that have taken place are largely responsible. Significant salinity events followed by freshwater flooding and a return to an oligohaline regime all count toward increases in plant diversity in oligohaline and low-mesohaline tidal systems, particularly marshes.

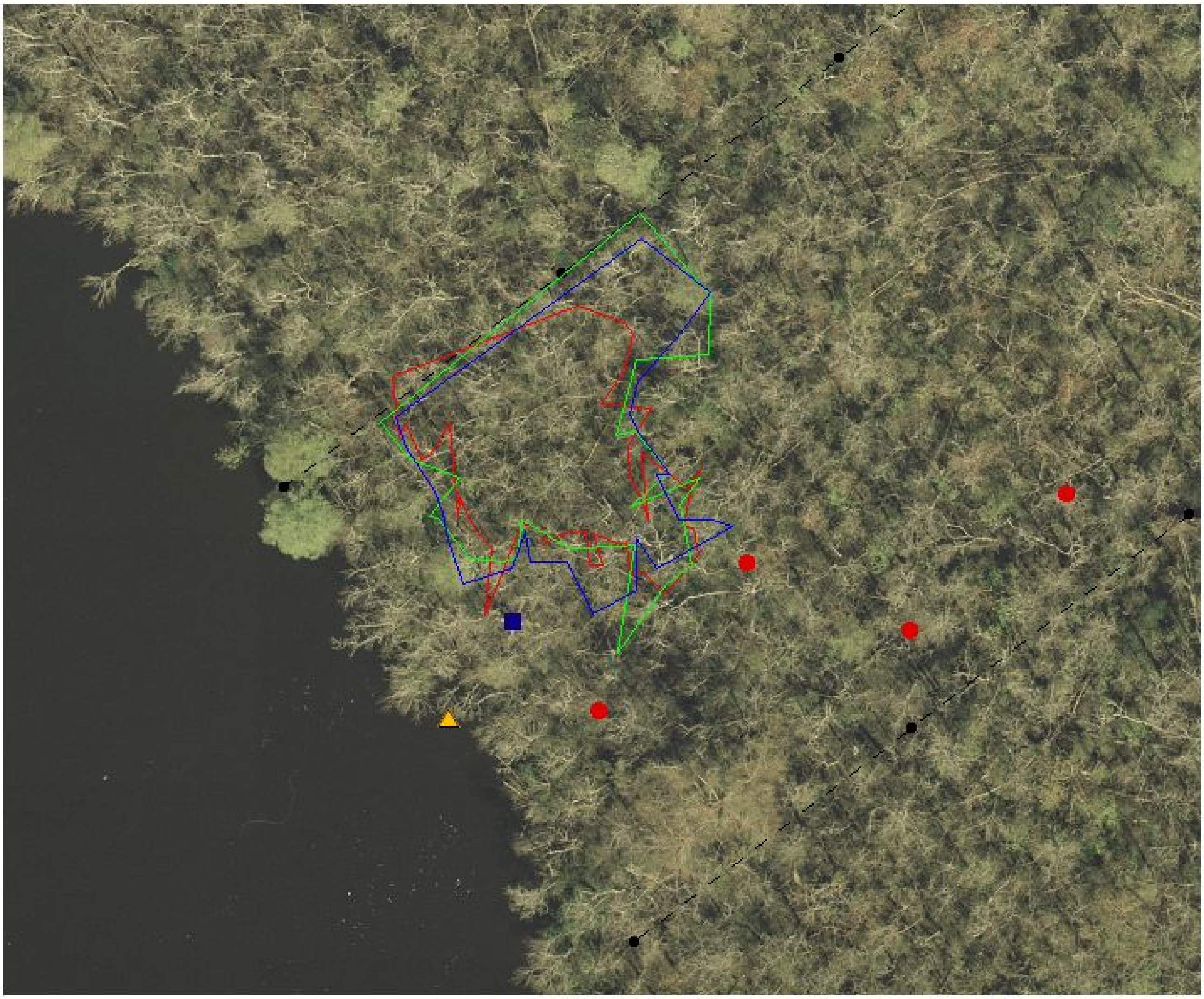
In this sense it is possible to speak of stenohaline (narrow variations in salt regimes) and euryhaline (wide variations in salinity regimes) changes with respect to diversity of plant species assemblages within these systems. Euryhaline changes followed by a return to oligohaline conditions seem responsible for an increase in species diversity at Fishing Creek.

8.47 Prince George Creek

Saururus cernuus and *Polygonum hydropiperoides* were the two most abundant sensitive herbaceous species within the polygon at Prince George Creek (Table 8.47-1). These two species have dominated the polygon each year except in 2002 when *Polygonum hydropiperoides* was not visible. Both have generally rebounded from the high salinity, but this year *Saururus cernuus* has diminished in cover compared to 2002. Reasons for this decrease in cover are uncertain. With this cover decrease there has been a strong increase in abundance by the annual, *Polygonum arifolium*. This year the latter species actually constituted approximately 20 percent of the overall cover within the polygon, but it is not considered a sensitive herbaceous species and therefore is not listed in the table below.

The sensitive herbaceous vegetation polygon has remained roughly the same size for the last four years and remained roughly the same shape as last year's polygon (Table 8.41-1, Figure 8.47-1). Variations in GPS (Global Positioning System) data remain the largest cause of variation in shape, although minor changes occur annually due to the slight changes in the extent of *Saururus cernuus*. Traverses twice yearly of the polygon perimeter may limit further significant changes in its size since pedestrian movement in these habitats can be disrupting to both substrate and its plant rhizome contents.

There have been no significant species losses this year. Two sensitive herbaceous species have appeared. *Boehmeria cylindrica* has reappeared after two years absence and *Lobelia cardinalis* has appeared for the first time. Two annuals have appeared for the first time. *Packera glabella*, a common swamp forest annual, was seen in the polygon. *Pilea pumila*, also an annual, was noted on edges of hummocks, branches and stumps in clusters where seeds have been deposited in mass at a past high-water mark. *Pontederia cordata*, absent from the polygon this year, occurs nearby. *Amaranthus cannabinus* and *Sium suave* were also noted outside the polygon. *Zizaniopsis miliacea* has been present in the polygon for the last three years. It first appeared following the salinity events of 2001 and 2002.



LEGEND

SENSITIVE HERBACEOUS VEGETATION POLYGON, 2005
SENSITIVE HERBACEOUS VEGETATION POLYGON, 2004
SENSITIVE HERBACEOUS VEGETATION POLYGON, 2000
DATA COLLECTION PLATFORM PILING
CONCRETE BENCHMARK
BELT TRANSECT BOUNDARY
BELT TRANSECT MARKER
SUBSTATION SURVEY POINT

100 0 100 Feet

20 0 20 Meters

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COMPARISON OF SENSITIVE HERBACEOUS VEGETATION POLYGONS FOR YEARS 2000, 2004 AND 2005 AT STATION P14 (PRINCE GEORGE CREEK), WILMINGTON HARBOR MONITORING PROJECT, NORTHEAST CAPE FEAR RIVER, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE: pgc05.APR	APPROVED BY: CTH	#CFRM-2
DRAWN BY: DMD	DATE: 30 MARCH 2006	FIGURE 8.47-1

Table 8.47-1. Comparisons of percent cover contributions by sensitive herbaceous species in polygons from years 2000-2005 at the Prince George Creek Station (P14), Wilmington Harbor monitoring project, Northeast Cape Fear River, North Carolina.

Species	**Year**					
	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Saururus cernuus	35	60	20	40	40	20
Polygonum hydropiperoides[a]	20	15	--	<1	20	30
Peltandra virginica	10	8	1	5	10	5
Pontederia cordata	--	5	--	--	<1	--
Cicuta maculata	--	<1	<1	<1	--	--
Zizania aquatica	--	<1	--	--	--	--
Cinna arundinacea	--	<1	--	--	<1	<1
Boehmeria cylindrica	--	<1	<1	--	--	1
Carex lupulina	--	<1	<1	--	--	--
Alternanthera philoxeroides	--	--	<1	--	--	--
Decodon verticillatus	--	--	<1	<1	<1	<1
Hymenocallis floridana	--	--	<1	<1	1	1
Zizaniopsis miliacea	--	--	--	<1	<1	<1
Triadenum walteri	--	--	--	<1	--	--
Hydrocotyle sp.	--	--	--	--	<1	--
Lobelia cardinalis	--	--	--	--	--	<1

[a] Previously identified as *Polygonum hydropiper*.

8.5 Sensitive Herbaceous Vegetation Monitoring in 2005: Closing thoughts

It is possible that vascular herbaceous species composition and cover in tidal brackish marsh systems is not only a mutable, but a reversible phenomenon, as well. Oligohaline and mesohaline subsystems are changed or rebound relative to water salinity both accompanying and following an event. It seems clear that when these systems are driven largely by salinity regime. Salinity regime in middle estuarine reaches, at least, is under the influence of weather and climate. It follows that in tidal marsh systems in an estuarine environment vegetation patterning is then linked to weather and climate making plant cover and dominance an extension of a naturally chaotic system.

The success of *Zizaniopsis miliacea* at the Inner Town Creek station will be an indication that the mesohaline marsh system along the creek is carrying a salinity balance that favors its vegetative expansion. Should the water regime freshen by precipitation runoff, other species can be expected to appear and possibly persist. One such species, *Zizania aquatica*, has already appeared and is new for the station, at least during the life of the current project. It may have persisted from rhizome material that remained present from earlier.

The polygon at inner Town Creek, based on the expansion of *Zizaniopsis miliacea*, is larger than it has ever been, and may, next year, be considerably larger. However, the clear establishment of *Spartina cynosuroides* along the somewhat better aerated inter-tidal creek bank is an artifact of a higher salinity regime than was extant over the past year. Presence of this species more nearly parallels the salinity regime of another new species at the site, *Schoenoplectus robustus*. All these species are not only sensitive to salinity within some range, but they are opportunistic and disperse widely by seed, rhizome or subaerial stem segments with tidal and riverine flows.

Opportunism in situ may also govern the success of species in brackish systems. By this is meant that some species have an inherent ability within rhizomes to sustain long durations with minimal subaerial stem growth. Subaerial stems function in photosynthesis, sexual reproduction and as source of organic matter for recycling nutrients. However, during failure of these functions the rhizomes have the ability to carry the plant in situ and are able to provide a means of dispersal as well. When the correct conditions occur they are fully capable of producing subaerial stems.

A specific example of opportunism in situ occurred in 2003 as *Zizania aquatica* extended subaerial stems and flowered heavily, only to return to a minimal presence last year and this year at Fishing Creek. It has not, in all likelihood, disappeared from the site. If a substantial salinity event were again to move up the Northeast Cape Fear River past Fishing Creek, its effects could compromise the competitive edge now held by *Pontederia cordata* at that site and favor *Zizania aquatica*, particularly if the event were again followed by fresh water flooding.

Several species at a time able to take advantage of these competitive openings can at least temporarily increase the simple species diversity of a site. Again, such an increase may have been the case at the Fishing Creek station. Such openings also create open habitats where recruitment of widely dispersed annuals, like *Impatiens capensis* and *Polygonum arifolium*, can temporarily increase diversity.

Conditions at the Rat Island are surprising. At least along the inter-tidal shoreline where the sample plot has been established there are signs that a reversal of an altogether different type may be underway. Both appear to be undergoing changes in response these regimes. At Rat Island, *Schoenoplectus americanus*, originally had a cover of 100 percent in 2000. The cover of this species was reduced to 20 percent during 2000. Along with this change there was an increase (unfortunately, undocumented) in cover by *Spartina cynosuroides*. This year, with an increase in freshwater in effect for more than two years, the opposite is happening. *Schoenoplectus americanus* is increasing and *Spartina cynosuroides* is decreasing, at least in subaerial extent. Additionally, other, fresher, species are appearing nearby.

A slightly different situation has occurred at Inner Town Creek where a dominant species, *Zizaniopsis miliacea*, was reduced in importance in 2002 by a salinity event and now has recovered. *Spartina cynosuroides* invaded and has continued to expand. In addition, now other species are appearing that could play a part in future changes in dominance. The parts that could be played would be within quite different habitats. *Zizania aquatica* could be important in an oligohaline habitat, while *Schoenoplectus robustus* could be important in a stronger mesohaline environment.

It is unfortunate that a plot was not originally established at Eagles Island. A permanent plot at that site would have allowed assessment of yet one more variation of vegetation changes with decreased salt concentrations. The profound dominance of *Spartina cynosuroides* at this site, at least near the shoreline of the river, may have long ago eliminated other important species capable of in situ opportunism. However, it might be worth a reevaluation.

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APPENDIX A

LIST OF TIDAL RANGE DATA FOR ALL 14 STATIONS USED TO GENERATE FIGURES AND TABLES IN SECTION 3.0

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1	4.14	4.30	2.65	4.35	4.22	4.22	3.48	3.28	4.16	3.67	3.09	2.19
2	4.61	4.69	2.80	4.72	4.59	4.14	3.76	3.52	4.51	3.98	3.34	2.35
3	4.98	4.88	2.88	4.85	4.72	4.26	3.85	3.61	4.62	4.06	3.42	2.41
4	4.48	4.42	2.44	4.40	4.25	3.79	3.40	3.15	4.16	3.64	2.96	1.93
5	3.98	4.18	2.39	4.22	4.06	3.65	3.31	3.08	4.02	3.55	2.91	1.95
6	4.61	4.69	2.74	4.72	4.52	4.09	3.70	3.47	4.45	3.90	3.26	2.19
7	4.85	4.94	2.85	4.97	4.77	4.31	3.88	3.64	4.67	4.09	3.39	2.26
8	4.53	4.63	2.64	4.67	4.49	4.04	3.61	3.35	4.41	3.87	3.20	2.09
9	3.92	4.11	2.43	4.20	4.05	3.64	3.29	3.07	3.97	3.50	2.91	1.91
10	4.57	4.51	2.73	4.62	4.29	4.03	3.67	xxx	4.33	3.86	3.27	2.30
11	5.13	4.99	2.94	5.05	4.85	4.41	3.99	3.75	4.75	4.19	3.53	2.46
12	4.71	4.60	2.45	4.54	4.35	3.84	3.38	3.07	4.25	3.67	2.98	1.81
13	3.95	3.99	2.23	4.01	3.88	3.43	3.04	2.78	3.77	3.30	2.70	1.67
14	4.26	4.29	2.56	4.43	4.30	3.84	3.48	3.24	4.16	3.68	3.06	2.02
15	5.18	5.13	2.89	5.14	4.94	4.42	4.01	3.72	4.82	4.22	3.50	2.31
16	4.82	4.83	2.47	4.79	4.60	4.04	3.53	3.16	4.52	3.90	3.15	1.90
17	3.64	3.84	2.12	3.93	3.83	3.36	2.94	2.63	3.73	3.24	2.62	1.58
18	3.96	4.14	2.43	4.19	4.09	3.70	3.37	3.11	3.98	3.39	3.02	2.16
19	5.06	5.04	2.81	5.02	4.84	4.37	3.97	3.68	4.73	4.37	3.51	2.45
20	4.78	4.81	2.49	4.83	4.65	4.09	3.62	3.26	4.52	3.92	3.21	2.02
21	3.62	3.88	2.09	3.93	3.83	3.34	2.94	2.63	3.69	3.22	2.64	1.65
22	3.87	4.13	2.40	4.14	4.07	3.73	3.40	3.09	3.93	3.54	3.02	2.19
23	4.95	4.98	2.76	4.96	4.82	4.40	4.00	3.75	4.67	4.17	3.52	2.51
24	4.78	4.81	2.56	4.85	4.69	4.17	3.72	3.40	4.55	3.97	3.26	2.10
25	3.58	3.83	2.12	3.94	3.83	3.38	2.96	2.69	3.72	3.24	2.67	1.69
26	3.69	4.01	2.47	4.02	3.95	3.63	3.33	3.13	3.85	3.46	3.00	2.24
27	4.77	4.85	2.81	4.79	4.66	4.27	3.94	3.73	4.55	4.05	3.48	2.55
28	4.59	4.69	2.64	4.74	4.59	4.11	3.71	3.43	4.47	3.89	3.24	2.16
29	3.43	3.72	2.21	3.83	3.74	3.32	2.95	2.74	3.64	3.16	2.64	1.75
30	3.33	3.67	2.46	3.77	3.69	3.39	3.12	2.93	3.60	3.23	2.82	2.17
31	4.45	4.63	2.84	4.68	4.53	4.18	3.87	3.69	4.42	3.95	3.41	2.56
32	4.30	4.52	2.69	4.58	4.42	3.99	3.57	3.32	4.33	3.78	3.17	2.17
33	3.12	3.59	2.29	3.76	3.68	3.31	2.95	2.77	3.59	3.16	2.68	1.85
34	3.27	3.70	2.48	3.82	3.77	3.44	3.14	2.98	3.67	3.29	2.86	2.12
35	4.17	4.45	2.79	4.45	4.36	4.01	3.70	3.49	4.24	3.78	3.26	2.40
36	4.10	4.38	2.66	4.44	4.31	3.87	3.52	3.24	4.19	3.68	3.10	2.13
37	3.05	3.49	2.26	3.62	3.56	3.16	2.85	2.62	3.45	3.01	2.53	1.73
38	3.05	3.57	2.53	3.69	3.64	3.35	3.13	2.99	3.54	3.19	2.80	2.18
39	4.00	4.29	2.83	4.38	4.26	3.94	3.68	3.51	4.15	3.74	3.25	2.48

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
40	3.76	4.09	2.63	4.15	4.04	3.69	3.39	3.19	3.94	3.50	2.98	2.17
41	2.87	3.37	2.28	3.50	3.43	3.11	2.83	2.66	3.35	2.96	2.52	1.83
42	2.98	3.42	2.42	3.54	3.51	3.25	3.02	2.87	3.43	3.09	2.71	2.11
43	3.89	4.26	2.78	4.26	4.21	3.90	3.65	3.51	4.10	3.70	3.22	2.46
44	3.78	4.11	2.60	4.13	4.06	3.68	3.35	3.12	3.94	3.50	2.97	2.14
45	3.02	3.45	2.31	3.58	3.57	3.26	2.97	2.80	3.46	3.07	2.63	1.89
46	2.96	3.40	2.40	3.52	3.52	3.25	3.00	2.82	3.43	3.07	2.69	1.99
47	3.49	3.86	2.60	3.89	3.84	3.55	3.28	3.08	3.76	3.37	2.93	2.20
48	3.55	3.90	2.59	3.95	3.87	3.56	3.28	3.06	3.77	3.37	2.91	2.17
49	3.06	3.55	2.43	3.72	3.63	3.33	3.07	2.87	3.52	3.16	2.74	2.02
50	2.76	3.27	2.24	3.38	3.33	3.09	2.87	2.71	3.26	2.91	2.51	1.83
51	3.18	3.58	2.42	3.61	3.57	3.31	3.07	2.89	3.50	3.14	2.72	2.02
52	3.53	3.92	2.62	4.00	3.93	3.62	3.35	3.15	3.85	3.42	2.94	2.14
53	3.15	3.63	2.45	3.76	3.67	3.36	3.09	2.92	3.59	3.18	2.73	1.97
54	2.89	3.56	2.32	3.46	3.40	3.15	2.93	2.80	3.32	2.97	2.58	1.90
55	2.93	3.55	2.33	3.45	3.38	3.12	2.91	2.78	3.30	2.96	2.57	1.91
56	3.33	3.77	2.71	3.98	3.84	3.57	3.36	3.24	3.75	3.38	2.99	2.32
57	3.50	3.97	2.76	4.17	4.02	3.75	3.51	3.40	3.94	3.02	3.11	2.36
58	3.10	3.52	2.40	3.62	3.54	3.27	3.02	2.89	3.51	3.11	2.67	1.92
59	2.84	3.19	2.27	3.29	3.22	2.96	2.72	2.59	3.19	2.83	2.43	1.78
60	3.27	3.71	2.72	3.90	3.79	3.56	3.34	3.20	3.71	3.21	2.99	2.37
61	3.87	4.24	2.93	4.36	4.23	3.97	3.72	3.55	4.14	3.91	3.28	2.54
62	3.33	3.73	2.48	3.80	3.70	3.39	3.14	2.99	3.65	3.22	2.75	2.02
63	2.98	3.32	2.32	3.45	3.36	3.05	2.81	2.68	3.31	2.94	2.52	1.88
64	3.18	3.58	2.58	3.76	3.63	3.38	3.17	3.08	3.58	3.23	2.86	2.25
65	4.18	4.47	2.97	4.55	4.39	4.11	3.84	3.69	4.34	3.89	3.42	2.61
66	3.88	4.11	2.49	4.12	4.02	3.62	3.26	3.03	3.97	3.46	2.89	1.91
67	3.25	3.55	2.29	3.62	3.57	3.19	2.87	2.69	3.52	3.09	2.60	1.74
68	3.63	3.98	2.69	4.11	3.99	3.68	3.43	3.30	3.94	3.52	3.05	2.26
69	4.49	4.62	2.93	4.68	4.49	4.14	3.81	3.60	4.44	3.93	3.36	2.44
70	4.65	4.63	2.80	4.66	4.51	4.06	3.67	3.41	4.45	3.88	3.22	2.20
71	3.66	3.82	2.44	3.88	3.81	3.39	3.03	2.84	3.76	3.28	2.72	1.88
72	4.17	4.55	3.00	4.48	4.24	4.08	3.78	3.65	4.36	3.90	3.42	2.66
73	5.61	5.56	3.39	5.42	5.09	4.84	4.48	4.26	5.20	4.60	3.98	2.98
74	5.16	4.91	2.95	4.92	4.74	4.26	3.86	3.59	4.68	4.09	3.44	2.34
75	3.67	3.85	2.50	3.90	3.77	3.38	3.04	2.85	3.72	3.27	2.78	1.91
76	4.35	4.48	3.09	4.58	4.12	4.10	3.81	3.68	4.38	3.95	3.50	2.72
77	6.02	5.76	3.62	5.81	5.26	5.09	4.72	4.49	5.50	4.90	4.26	3.19
78	5.49	5.22	3.02	5.17	4.99	4.39	3.92	3.60	4.90	4.25	3.52	2.32

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
79	3.85	3.98	2.56	4.06	3.98	3.54	3.17	2.94	3.90	3.43	2.88	1.96
80	4.66	4.62	3.13	4.75	4.25	4.21	3.87	3.63	4.51	4.05	3.51	2.64
81	6.21	5.91	3.63	5.95	5.34	5.12	4.69	4.40	5.58	4.96	4.24	3.08
82	5.94	5.52	3.16	5.53	5.28	4.59	4.09	3.73	5.16	4.47	3.66	2.34
83	4.28	4.22	2.62	4.28	4.14	3.64	3.22	2.96	4.05	3.52	2.90	1.89
84	4.79	4.75	3.22	4.77	4.24	4.22	3.98	3.78	4.57	4.11	3.60	2.75
85	6.21	5.85	3.67	5.85	5.22	5.03	4.70	4.43	5.53	4.92	4.24	3.12
86	6.19	5.71	3.41	5.78	5.20	4.86	4.36	4.02	5.41	4.71	3.90	2.62
87	4.55	4.30	2.82	4.48	4.00	3.82	3.38	3.12	4.22	3.69	3.05	2.05
88	4.81	4.74	3.39	4.98	4.17	4.03	4.11	3.86	4.74	4.31	3.79	2.93
89	6.49	6.15	3.91	6.18	5.27	4.97	4.98	4.70	5.82	5.22	4.53	3.40
90	5.97	5.63	3.38	5.62	5.12	4.76	4.29	3.96	5.27	4.62	3.84	2.65
91	4.64	4.50	2.97	4.66	4.25	4.05	3.65	3.40	4.41	3.91	3.28	2.29
92	4.65	4.75	3.29	4.87	4.37	4.25	4.02	3.82	4.66	4.21	3.70	2.82
93	5.94	5.77	3.69	5.79	5.22	4.95	4.66	4.41	5.49	4.91	4.25	3.18
94	5.66	5.51	3.28	5.43	5.07	4.63	4.18	3.88	5.09	4.49	3.74	2.59
95	4.64	4.64	2.98	4.62	4.32	4.02	3.63	3.40	4.37	3.88	3.26	2.30
96	4.60	4.58	3.05	4.58	4.29	4.06	3.71	3.52	4.40	3.93	3.39	2.51
97	5.57	5.40	3.37	5.34	5.01	4.67	4.27	4.03	5.08	4.53	3.88	2.84
98	5.72	5.41	3.22	5.38	5.02	4.58	4.13	xxx	5.05	4.44	3.68	2.51
99	4.68	4.67	2.94	4.75	4.43	4.09	3.70	xxx	4.50	3.97	3.31	2.27
100	4.52	4.58	3.07	4.70	4.43	4.19	3.83	xxx	4.49	4.01	3.46	2.55
101	4.95	4.91	3.17	4.99	4.70	4.43	4.03	xxx	4.75	4.22	3.62	2.64
102	5.38	5.19	3.31	5.33	4.79	4.62	4.20	xxx	5.01	4.43	3.76	2.72
103	4.71	4.67	3.09	4.91	4.39	4.27	3.87	xxx	4.55	4.09	3.49	2.52
104	4.25	4.35	3.02	4.55	4.30	4.10	3.75	xxx	4.29	3.90	3.40	2.55
105	4.46	4.50	3.07	4.62	4.37	4.16	3.81	xxx	4.43	3.97	3.44	2.59
106	4.80	4.75	3.21	4.87	4.44	4.32	3.95	xxx	4.64	4.15	3.58	2.67
107	4.80	4.81	3.23	4.99	4.55	4.42	4.05	xxx	4.74	4.23	3.65	2.72
108	4.22	4.33	2.92	4.46	4.34	3.97	3.59	xxx	4.27	3.79	3.26	2.39
109	4.12	4.23	2.93	4.32	4.21	3.88	3.54	xxx	4.15	3.71	3.21	2.40
110	4.50	4.49	2.97	4.63	4.33	4.09	3.75	xxx	4.38	3.92	3.36	2.48
111	4.59	4.61	3.07	4.76	4.49	4.25	3.92	xxx	4.54	4.08	3.51	2.63
112	4.10	4.31	2.84	4.39	4.27	3.91	3.55	xxx	4.20	3.73	3.16	2.22
113	3.62	3.86	2.60	3.96	3.87	3.49	3.15	xxx	3.79	3.35	2.83	1.98
114	4.08	4.37	3.01	4.50	4.15	4.00	3.69	xxx	4.29	3.87	3.36	2.53
115	4.74	5.03	3.29	5.13	4.72	4.58	4.23	xxx	4.88	4.68	3.78	2.80
116	4.06	4.31	2.63	4.42	4.25	3.89	3.49	xxx	4.22	3.71	2.80	2.12
117	3.33	3.65	2.35	3.78	3.65	3.30	2.94	xxx	3.62	3.20	2.39	1.88

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
118	3.85	4.07	2.83	4.19	4.06	3.76	3.45	xxx	3.99	xxx	3.14	2.35
119	4.75	4.85	3.16	4.93	4.75	4.42	4.05	xxx	4.58	xxx	3.63	2.67
120	4.30	4.38	2.70	4.43	4.30	3.88	3.47	xxx	4.24	3.70	3.07	2.05
121	3.38	3.48	2.32	3.57	3.49	3.09	2.73	xxx	3.45	3.02	2.50	1.69
122	3.95	4.02	2.83	4.20	3.96	3.71	3.38	xxx	4.01	3.33	3.10	2.30
123	4.87	4.94	3.22	5.04	4.77	4.49	4.12	xxx	4.80	4.82	3.68	2.69
124	4.45	4.50	2.82	4.56	4.41	3.98	3.59	xxx	4.35	3.78	3.16	2.10
125	3.53	3.60	2.42	3.73	3.62	3.21	2.85	xxx	3.56	3.10	2.59	1.71
126	3.66	3.94	2.83	4.12	3.80	3.68	3.39	xxx	3.92	3.54	3.10	2.35
127	4.79	4.89	3.23	4.98	4.76	4.44	4.11	xxx	4.72	4.22	3.66	2.72
128	4.37	4.47	2.82	4.52	4.36	3.93	3.56	xxx	4.30	3.74	3.13	2.11
129	3.36	3.62	2.47	3.77	3.65	3.27	2.95	xxx	3.61	3.16	2.65	1.80
130	3.69	3.98	2.83	4.14	4.01	3.69	3.39	xxx	3.94	3.54	3.07	2.28
131	4.68	4.85	3.19	4.90	4.74	4.38	4.02	xxx	4.65	4.15	3.57	2.62
132	4.44	4.52	2.82	4.54	4.40	3.98	3.56	xxx	4.33	3.77	3.12	2.06
133	3.37	3.66	2.46	3.77	3.70	3.30	2.93	xxx	3.64	3.18	2.64	1.73
134	3.62	3.83	2.67	3.89	3.85	3.54	3.25	xxx	3.75	xxx	2.92	2.15
135	4.73	4.78	3.12	4.78	4.66	4.31	3.95	xxx	4.54	xxx	3.49	2.55
136	4.38	4.57	2.76	4.56	4.41	3.98	3.58	xxx	4.32	3.77	3.12	2.03
137	3.21	3.61	2.34	3.61	3.52	3.15	2.84	xxx	3.47	xxx	2.52	1.65
138	3.57	3.83	2.60	3.87	3.81	3.51	3.23	3.07	3.75	xxx	2.89	2.12
139	4.50	4.58	2.95	4.64	4.51	4.17	3.82	3.62	4.42	xxx	3.37	2.42
140	4.34	4.56	2.82	4.63	4.48	4.08	xxx	3.47	4.38	3.84	3.23	2.20
141	3.36	3.75	2.46	3.97	3.79	3.42	xxx	2.90	3.71	3.42	2.72	1.83
142	3.37	3.67	2.52	3.76	3.62	3.37	xxx	2.92	3.58	3.19	2.76	2.08
143	4.53	4.76	3.00	4.70	4.59	4.26	xxx	3.72	4.53	4.01	3.46	2.55
144	4.27	4.29	2.48	4.25	4.13	3.69	xxx	3.05	4.06	3.52	2.90	1.83
145	2.76	2.95	1.89	2.93	2.92	2.57	xxx	2.10	2.86	2.50	2.06	1.26
146	3.50	3.77	2.75	3.92	3.77	3.59	xxx	3.22	3.77	3.45	3.08	2.40
147	4.43	4.47	3.00	4.59	4.35	4.14	xxx	3.68	4.35	3.92	3.42	2.59
148	4.18	4.45	2.97	4.52	4.34	4.07	xxx	3.55	4.34	3.89	3.37	2.49
149	3.40	3.75	2.60	3.86	3.75	3.48	xxx	3.01	3.74	3.35	2.90	2.10
150	3.45	3.68	2.70	3.82	3.75	3.48	xxx	3.06	3.71	3.37	2.98	2.32
151	4.22	4.35	3.02	4.45	4.32	4.05	xxx	3.60	4.29	3.88	3.42	2.65
152	3.93	4.26	2.92	4.38	4.23	3.89	xxx	3.42	4.19	3.75	3.28	2.47
153	3.24	3.65	2.62	3.83	3.73	3.41	xxx	3.03	3.68	3.30	2.90	2.18
154	3.21	3.61	2.63	3.73	3.65	3.36	xxx	3.01	3.62	3.26	2.90	2.25
155	3.78	4.13	2.92	4.21	4.09	3.81	xxx	3.41	4.06	3.67	3.26	2.55
156	3.87	4.20	2.89	4.32	4.19	3.86	xxx	3.38	4.14	xxx	3.23	2.45

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
157	3.20	3.65	2.60	3.81	3.73	3.39	xxx	2.97	3.67	xxx	2.86	2.16
158	3.12	3.55	2.61	3.71	3.66	3.38	3.13	3.02	3.61	3.27	2.90	2.28
159	3.64	3.99	2.83	4.09	3.98	3.71	3.44	3.32	3.95	3.58	3.16	2.47
160	3.72	4.06	2.83	4.14	4.01	3.73	3.47	3.34	3.99	3.61	3.18	2.44
161	3.37	3.81	2.72	3.93	3.83	3.55	3.29	3.18	3.78	3.44	3.05	2.34
162	3.24	3.47	2.49	3.58	3.53	3.27	3.01	2.90	3.52	3.16	2.78	2.12
163	3.42	3.63	2.59	3.73	3.68	3.41	3.15	3.03	3.65	3.29	2.90	2.23
164	3.64	4.15	2.86	4.16	4.07	3.75	3.48	3.33	4.01	3.61	3.18	2.47
165	3.63	4.21	2.92	4.21	4.27	3.93	3.63	3.54	4.13	3.79	3.25	2.48
166	3.10	3.54	xxx	3.62	3.66	3.34	3.11	2.83	3.61	3.21	2.78	2.03
167	3.30	3.66	xxx	3.75	3.67	3.34	3.08	2.93	3.65	3.27	2.84	2.14
168	3.70	3.93	2.61	4.12	3.97	3.61	3.32	3.14	3.92	3.50	3.04	2.27
169	3.87	4.02	2.66	4.16	4.05	3.71	3.42	3.26	4.00	3.58	3.13	2.36
170	3.26	3.56	2.27	3.58	3.53	3.24	2.97	2.81	3.50	3.11	2.67	1.93
171	3.12	3.41	2.20	3.37	3.38	3.05	2.74	2.59	3.32	2.93	2.48	1.75
172	3.90	4.17	2.69	4.19	4.18	3.82	3.49	3.34	4.10	3.69	3.24	2.51
173	4.12	4.44	2.84	4.44	4.42	4.09	3.78	3.62	4.38	3.93	3.45	2.64
174	3.69	3.98	2.38	3.95	3.95	3.59	3.23	3.03	3.93	3.47	2.95	2.11
175	2.87	3.24	2.10	3.40	3.32	2.96	2.63	2.46	3.28	2.90	2.47	1.80
176	3.49	3.91	2.66	4.11	xxx	3.70	3.44	3.34	3.93	3.60	3.22	2.61
177	4.34	4.68	2.95	4.78	xxx	4.32	4.02	3.89	4.59	xxx	3.67	2.88
178	3.98	4.24	2.57	4.29	4.18	3.82	3.47	3.27	4.16	3.68	3.16	2.32
179	3.02	3.41	2.18	3.47	3.41	3.07	2.75	2.57	3.40	3.00	2.59	1.92
180	3.62	4.04	2.81	4.18	3.70	3.72	3.52	3.40	4.03	3.66	3.29	2.63
181	4.94	5.16	3.28	5.30	4.75	4.72	4.44	4.27	5.05	xxx	4.05	3.16
182	4.31	4.53	2.69	4.56	4.40	3.97	3.57	3.32	4.35	xxx	3.24	2.31
183	3.08	3.43	2.21	3.51	3.43	3.03	2.70	2.49	3.39	2.99	2.54	1.83
184	3.83	4.14	2.96	4.30	3.80	3.80	3.61	3.47	4.15	3.78	3.37	2.71
185	5.31	5.42	3.45	5.53	4.91	4.84	4.54	4.35	5.25	4.74	4.16	3.23
186	4.97	5.01	2.98	5.10	4.86	4.37	3.88	3.58	4.82	4.23	3.54	2.44
187	3.48	3.73	2.44	3.89	3.76	3.34	2.96	2.73	3.72	3.29	2.77	1.95
188	4.36	4.46	3.16	4.65	3.90	3.84	3.84	3.66	4.44	xxx	3.58	2.79
189	5.94	5.80	3.67	5.87	5.03	4.89	4.78	4.53	5.56	xxx	4.36	3.28
190	5.60	5.42	3.26	5.47	4.98	4.67	4.14	3.82	5.16	4.53	3.81	2.64
191	4.19	4.23	2.76	4.39	3.98	3.75	3.28	3.04	4.17	3.67	3.09	2.15
192	4.70	4.72	3.29	4.91	4.06	3.97	4.00	3.79	4.51	4.05	3.74	2.88
193	6.38	6.06	3.85	6.14	5.19	4.98	4.93	4.65	5.62	5.19	4.53	3.40
194	6.04	5.53	3.24	5.60	5.06	4.72	4.17	3.81	5.25	4.59	3.83	2.59
195	4.62	4.37	2.81	4.56	4.11	3.89	3.43	3.15	4.32	3.80	3.20	2.22

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
196	4.95	4.84	xxx	4.98	4.22	4.15	4.01	3.79	4.76	3.92	3.73	2.81
197	6.65	6.34	xxx	6.25	5.36	5.14	4.90	4.60	5.89	5.25	4.51	3.30
198	6.09	5.75	3.05	5.70	xxx	4.72	4.11	3.71	5.31	4.62	3.81	2.51
199	4.89	4.69	2.72	4.83	xxx	4.09	3.57	3.27	4.56	4.00	3.33	2.24
200	5.19	4.94	3.02	5.05	4.53	4.38	3.93	3.70	4.79	4.22	3.62	2.59
201	6.53	6.00	3.41	6.01	5.40	5.11	4.59	4.27	5.64	4.97	4.20	2.98
202	6.32	5.71	2.86	5.75	5.33	4.67	4.06	3.62	5.32	4.60	3.73	2.33
203	5.46	4.92	2.62	5.01	4.66	4.13	3.58	3.21	4.67	4.07	3.32	2.09
204	5.39	5.13	2.80	5.25	4.70	4.47	3.97	3.65	4.91	4.31	3.63	2.48
205	6.13	5.80	3.10	5.86	5.26	4.94	4.37	3.99	5.45	4.78	3.99	2.70
206	6.04	5.61	2.74	5.65	5.23	4.66	4.06	3.62	5.25	4.55	3.69	2.27
207	5.37	5.04	2.54	5.13	4.75	4.27	3.75	3.37	4.80	4.18	3.41	2.12
208	5.03	4.96	2.61	5.02	4.74	4.29	3.80	3.47	4.72	4.15	3.46	2.32
209	5.65	5.50	2.80	5.52	5.22	4.69	4.13	3.77	5.17	4.53	3.74	2.48
210	5.87	5.51	2.72	5.51	5.22	4.55	3.95	3.53	5.16	4.47	3.62	2.26
211	5.07	4.91	2.50	4.98	4.73	4.16	3.63	3.26	4.69	xxx	3.33	2.09
212	4.89	4.72	2.59	4.78	4.63	4.14	3.68	3.39	4.54	xxx	3.32	2.22
213	4.99	4.80	2.60	4.86	4.68	4.18	3.71	3.39	4.60	4.03	3.34	2.23
214	5.15	5.10	2.83	5.22	4.79	4.45	3.97	3.64	4.89	4.28	3.57	2.40
215	5.02	5.05	2.77	5.16	4.73	4.39	3.90	3.58	4.83	xxx	3.51	2.34
216	4.46	4.58	2.63	4.63	4.47	4.03	3.59	3.32	4.38	xxx	3.20	2.18
217	4.23	4.31	2.52	4.40	4.25	3.83	3.43	3.18	4.16	xxx	3.07	2.12
218	4.58	4.67	2.85	4.83	4.50	4.17	3.79	3.52	4.51	xxx	3.38	2.36
219	4.84	4.99	2.93	5.08	4.76	4.41	3.98	3.72	4.77	xxx	3.55	2.47
220	4.20	4.40	2.59	4.41	4.29	3.87	3.45	3.18	4.22	xxx	3.05	2.04
221	3.69	3.91	2.38	3.97	3.87	3.47	3.10	2.86	3.80	xxx	2.77	1.87
222	4.01	4.31	2.80	4.43	4.29	3.92	3.60	3.39	4.19	xxx	3.22	2.37
223	4.46	4.64	2.89	4.75	4.58	4.20	3.84	3.62	xxx	xxx	3.41	2.45
224	4.08	4.20	2.58	4.29	4.16	3.76	3.40	3.17	4.10	xxx	3.03	2.12
225	3.21	3.55	2.29	3.60	3.50	3.10	2.79	2.60	3.45	3.05	2.57	1.83
226	3.66	3.95	2.68	4.02	3.91	3.56	3.28	3.12	3.84	3.46	3.00	2.28
227	4.62	4.74	3.03	4.83	4.71	4.36	4.04	3.87	4.62	4.13	3.56	2.64
228	4.06	4.28	2.48	4.28	4.18	3.74	3.32	3.05	4.13	3.62	3.03	2.09
229	3.03	3.37	2.15	3.42	3.38	2.98	2.64	2.44	3.32	2.91	2.42	1.67
230	3.38	3.75	2.55	3.84	3.78	3.42	3.11	2.91	3.72	3.37	2.98	2.32
231	4.13	4.38	2.84	4.43	4.37	4.04	3.73	3.50	4.29	3.88	3.41	2.61
232	4.02	4.33	2.55	4.24	4.21	3.76	3.32	2.99	4.14	3.66	3.14	2.27
233	2.82	3.37	2.11	3.28	3.37	2.93	2.54	2.25	3.27	2.88	2.43	1.70
234	3.23	3.74	2.54	3.83	3.73	3.54	3.23	3.02	3.76	3.47	3.07	2.45

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
235	4.22	4.55	2.96	4.65	4.44	4.24	3.90	3.66	4.49	4.10	3.65	2.93
236	3.77	4.11	2.50	4.20	4.14	3.70	3.31	2.97	4.06	3.62	3.15	2.38
237	3.08	3.52	2.23	3.64	3.60	3.18	2.82	2.50	3.53	3.08	2.72	2.03
238	3.27	3.72	2.42	3.88	3.84	3.47	3.14	2.86	3.76	3.36	3.04	2.39
239	4.35	4.66	2.84	4.75	4.68	4.27	3.88	3.57	4.58	4.15	3.67	2.85
240	3.90	4.24	2.34	4.25	4.17	3.66	3.19	2.76	4.09	3.60	3.05	2.12
241	3.01	3.50	2.07	3.61	3.55	3.08	2.67	2.26	3.47	3.08	2.63	1.87
242	3.27	3.78	2.32	3.92	3.84	3.42	3.02	2.65	3.75	3.37	2.93	2.23
243	4.47	4.77	2.72	4.79	4.69	4.20	3.73	3.35	4.58	4.09	3.53	2.63
244	4.13	4.33	2.28	4.33	4.26	3.68	3.12	2.65	4.15	3.62	2.98	1.94
245	3.07	3.49	1.94	3.55	3.52	2.99	2.48	2.02	3.41	3.00	2.49	1.66
246	3.51	3.95	2.40	4.09	4.04	3.57	3.14	2.77	3.85	3.37	3.00	2.23
247	4.42	4.71	2.69	4.80	4.69	4.17	3.69	3.31	4.53	4.10	3.45	2.51
248	4.28	4.57	2.54	4.58	4.48	3.96	3.43	3.02	4.37	3.81	3.17	2.13
249	3.18	3.67	2.15	3.75	3.68	3.22	2.75	2.38	3.58	xxx	2.62	1.77
250	3.64	4.07	2.61	4.19	4.07	3.71	3.35	3.06	xxx	xxx	3.09	2.30
251	4.62	4.87	2.90	4.92	4.74	4.33	3.90	3.58	4.64	xxx	3.56	2.61
252	4.26	4.55	2.65	4.55	4.45	4.00	3.52	3.18	4.34	3.80	3.17	2.15
253	3.38	3.83	2.34	3.86	3.81	3.40	2.96	2.67	3.73	3.26	2.74	1.86
254	3.50	4.00	2.66	4.08	3.99	3.65	3.32	3.06	3.91	3.47	3.03	2.26
255	4.45	4.72	2.93	4.79	4.65	4.23	3.85	3.60	4.55	4.04	3.47	2.54
256	4.37	4.53	2.72	4.55	4.46	3.99	3.57	3.27	4.36	3.81	3.17	2.16
257	3.53	3.86	2.43	3.93	3.89	3.46	3.06	2.81	3.82	3.34	2.78	1.90
258	3.62	4.00	2.68	4.09	4.01	3.67	3.33	3.15	3.94	3.50	3.01	2.22
259	4.44	4.63	2.91	4.67	4.53	4.15	3.76	3.53	4.43	3.93	3.37	2.45
260	4.27	4.39	2.71	4.45	4.33	3.90	3.50	3.26	4.24	3.70	3.11	2.16
261	3.57	3.83	2.49	3.92	3.84	3.44	3.10	2.89	3.76	3.30	2.79	1.97
262	3.68	4.00	2.70	4.11	4.03	3.63	3.36	3.18	3.93	3.48	3.00	2.20
263	4.16	4.37	2.86	4.49	4.37	3.94	3.63	3.43	4.28	3.77	3.23	2.35
264	4.07	4.26	2.74	4.38	4.26	3.85	3.52	3.29	4.18	3.67	3.10	2.18
265	3.81	4.13	2.65	4.20	4.12	3.72	3.38	3.17	4.03	3.56	3.02	2.15
266	3.88	4.18	2.66	4.23	4.19	3.79	3.44	3.23	4.08	3.60	3.04	2.12
267	3.94	4.16	2.68	4.25	4.17	3.77	3.44	3.23	4.08	3.59	3.03	2.10
268	4.01	4.29	2.80	4.39	4.28	3.90	3.59	xxx	4.19	3.72	3.18	2.30
269	3.90	4.22	2.97	4.35	4.30	3.91	3.60	3.02	4.16	3.71	3.17	2.28
270	3.67	4.03	2.32	4.13	4.07	3.70	3.37	3.16	3.95	3.51	3.00	2.13
271	3.66	4.11	2.33	4.10	4.00	3.66	3.34	3.15	3.93	3.48	2.98	2.12
272	3.81	4.22	2.40	4.22	4.11	3.77	3.46	3.29	4.03	3.60	3.11	2.31
273	3.88	4.21	2.41	4.29	4.18	3.85	3.54	3.37	4.09	3.66	3.15	2.32

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
274	3.45	3.77	2.07	3.88	3.79	3.45	3.13	2.95	3.72	3.29	2.79	1.96
275	3.23	3.56	2.03	3.69	3.61	3.27	2.99	2.83	3.54	3.14	2.67	1.92
276	3.59	3.94	2.27	4.07	3.98	3.63	3.35	3.17	3.89	3.47	3.00	2.25
277	3.92	4.27	2.39	4.38	4.27	3.94	3.63	3.45	4.17	xxx	3.20	2.35
278	3.42	3.70	1.98	3.73	3.63	3.30	3.00	2.79	3.57	3.16	2.64	1.80
279	2.98	3.32	1.80	3.37	3.31	2.97	2.68	2.49	3.25	2.88	2.40	1.66
280	3.53	3.94	2.28	4.08	4.01	3.66	3.38	3.19	3.91	3.51	3.05	2.29
281	3.89	4.25	2.47	4.39	4.28	3.94	3.64	3.47	4.16	xxx	3.25	2.40
282	3.59	3.99	2.33	4.06	3.95	3.58	3.24	3.03	3.90	xxx	2.93	2.10
283	2.81	3.29	1.97	3.40	3.33	2.97	2.67	2.46	3.28	2.88	2.44	1.74
284	3.12	3.63	2.50	3.84	3.72	3.44	3.21	3.07	3.65	3.34	2.99	2.38
285	4.13	4.48	2.82	4.60	4.46	4.17	3.82	3.74	4.37	4.26	3.52	2.73
286	3.69	4.01	2.45	4.07	3.99	3.63	3.19	3.02	3.94	3.47	2.94	2.10
287	2.70	3.18	2.09	3.31	3.28	2.94	2.56	2.39	3.23	2.85	2.42	1.77
288	3.23	3.73	2.64	3.94	3.84	3.55	3.24	3.14	3.76	xxx	3.04	2.41
289	4.36	4.79	3.04	4.82	4.67	4.33	3.97	3.84	4.62	xxx	3.66	2.83
290	4.00	4.38	2.56	4.34	4.25	3.82	3.35	3.14	4.21	3.67	3.07	2.13
291	2.77	3.22	2.10	3.37	3.32	2.92	2.56	2.33	3.25	2.85	2.38	1.67
292	3.59	3.99	2.83	4.23	3.81	3.79	3.53	3.37	4.02	xxx	3.26	2.58
293	4.83	5.10	3.25	5.25	4.76	4.70	4.37	4.17	4.98	xxx	3.94	3.00
294	4.44	4.67	2.84	4.74	4.59	4.14	3.70	3.43	4.53	xxx	3.36	2.38
295	3.27	3.64	2.40	3.80	3.71	3.30	2.90	2.67	3.65	xxx	2.72	1.93
296	3.81	4.21	3.01	4.42	3.89	3.92	3.71	3.54	4.24	1.77	3.45	2.68
297	5.39	5.55	3.54	5.66	5.03	4.96	4.65	4.40	5.37	4.84	4.24	3.21
298	4.85	4.95	2.92	4.97	4.79	4.25	3.77	3.44	4.72	4.12	3.43	2.34
299	3.73	3.99	2.56	4.09	3.98	3.52	3.13	2.87	3.91	3.45	2.91	2.03
300	4.33	4.54	3.07	4.75	4.21	4.20	3.87	3.67	4.52	4.07	3.55	2.67
301	5.88	5.74	3.57	5.86	5.22	5.08	4.63	4.33	5.53	4.92	4.23	3.09
302	5.36	5.17	2.93	5.22	4.98	4.36	3.83	3.47	4.89	4.25	3.48	2.25
303	4.56	4.52	2.68	4.59	4.44	3.89	3.44	3.14	4.35	3.81	3.14	2.07
304	4.89	4.90	3.01	4.99	4.68	4.34	3.90	3.62	4.73	4.19	3.55	2.48
305	6.11	5.89	3.41	5.92	5.48	5.02	4.45	4.09	5.53	4.86	4.07	2.79
306	6.10	5.64	2.99	5.66	5.34	4.62	3.97	3.54	5.24	4.53	3.64	2.22
307	5.10	4.83	2.69	4.91	4.71	4.09	3.55	3.19	4.60	4.01	3.25	2.01
308	5.54	5.23	3.06	5.30	4.85	4.52	4.02	3.70	4.98	4.40	3.68	2.51
309	6.46	5.99	3.35	6.02	5.45	5.03	4.43	4.05	5.59	4.90	4.06	2.72
310	6.15	5.68	2.99	5.70	5.37	4.65	3.97	3.52	5.27	4.56	3.67	2.22
311	5.28	4.97	2.74	5.05	4.83	4.21	3.62	3.24	4.72	4.11	3.33	2.05
312	5.63	5.33	3.02	5.34	4.90	4.53	3.98	3.64	5.00	4.38	3.64	2.43

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
313	6.45	6.00	3.25	5.93	5.41	4.95	4.34	3.96	5.50	4.79	3.94	2.58
314	6.33	5.84	3.03	5.72	5.40	4.63	3.94	3.48	5.31	4.60	3.69	2.26
315	5.74	5.39	2.88	5.33	5.07	4.38	3.75	3.32	4.98	4.34	3.51	2.17
316	5.57	5.25	2.94	5.31	5.06	4.46	3.87	3.46	4.96	4.35	3.56	2.27
317	5.89	5.52	3.05	5.56	5.27	4.62	4.00	3.58	5.18	4.52	3.69	2.35
318	5.94	5.55	3.01	5.59	5.27	4.60	3.97	3.54	5.22	4.52	3.66	2.26
319	5.78	5.43	2.93	5.47	5.19	4.52	3.89	3.47	5.11	4.45	3.60	2.21
320	5.46	5.19	2.83	5.23	5.02	4.37	3.79	3.40	4.82	4.28	3.46	2.17
321	5.33	5.07	2.83	5.14	4.92	4.30	3.74	3.36	4.76	4.22	3.43	2.18
322	5.51	5.17	2.86	5.23	5.01	4.39	3.80	3.43	4.92	4.27	3.45	2.14
323	5.38	5.03	2.82	5.09	4.88	4.31	3.49	3.38	4.79	4.18	3.39	2.14
324	4.88	4.62	2.40	4.62	4.35	3.60	3.06	2.68	4.25	3.63	2.82	1.68
325	xxx	4.46	2.37	4.42	4.23	3.50	2.99	2.64	4.14	3.54	2.76	1.66
326	xxx	4.97	2.67	4.69	4.78	4.23	3.77	3.42	4.67	4.10	3.39	2.18
327	5.11	5.09	2.74	4.80	4.84	4.27	3.79	3.42	4.71	4.12	3.39	2.17
328	4.44	4.51	2.31	4.53	4.39	3.90	3.49	3.19	4.28	3.75	3.09	2.05
329	4.02	4.11	2.21	4.18	4.04	3.57	3.20	2.94	3.95	3.46	2.85	1.89
330	4.10	4.23	2.17	4.36	4.22	3.78	3.40	3.15	4.13	3.63	3.02	2.06
331	4.63	4.61	2.40	4.67	4.53	4.08	3.66	3.38	4.43	3.90	3.24	2.19
332	4.07	4.10	1.91	4.12	3.99	3.56	3.20	2.95	3.92	3.44	2.81	1.80
333	3.46	3.70	1.79	3.79	3.66	3.24	2.92	2.69	3.61	3.18	2.60	1.68
334	3.69	3.90	1.90	4.01	3.87	3.47	3.18	2.98	3.81	3.38	2.82	1.94
335	4.37	4.51	2.15	4.54	4.37	3.93	3.57	3.32	4.30	3.79	3.16	2.13
336	3.70	3.90	1.75	3.92	3.76	3.34	2.99	2.76	3.73	3.25	2.66	1.68
337	2.86	3.22	1.50	3.32	3.20	2.84	2.56	2.38	3.19	2.81	2.30	1.48
338	3.25	3.52	1.73	3.55	3.43	3.08	2.81	2.69	3.41	3.02	2.49	1.73
339	3.77	3.94	1.87	3.92	3.79	3.43	3.10	2.95	3.76	3.33	2.75	1.89
340	3.50	3.92	1.88	3.77	3.67	3.30	2.99	2.80	3.64	3.20	2.64	1.71
341	2.50	3.10	1.49	3.02	2.95	2.58	2.33	2.20	2.92	2.56	2.11	1.36
342	3.01	3.42	2.00	3.55	3.48	3.18	2.95	2.85	3.44	3.10	2.67	1.98
343	3.89	4.14	2.26	4.21	4.09	3.80	3.52	3.37	4.06	3.64	3.11	2.26
344	3.36	3.62	1.97	3.66	3.56	3.23	2.94	2.79	3.53	3.13	2.62	1.75
345	2.70	3.11	1.70	3.19	3.12	2.79	2.53	2.39	3.09	2.74	2.29	1.52
346	2.84	3.29	1.96	3.38	3.31	3.04	2.81	2.69	3.27	2.94	2.50	1.83
347	3.78	4.13	2.30	4.14	4.03	3.70	3.42	3.26	3.98	3.56	3.01	2.16
348	3.49	3.84	1.99	3.75	3.64	3.29	2.95	2.74	3.63	3.17	2.61	1.62
349	2.66	3.12	1.71	3.15	3.07	2.78	2.50	2.34	3.07	2.69	2.25	1.43
350	2.91	3.23	1.91	3.31	3.24	2.96	2.69	2.54	3.20	2.83	2.39	1.62
351	3.77	4.03	2.25	4.07	3.98	3.61	3.27	3.07	3.91	3.45	2.89	1.94

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
352	3.80	3.91	2.06	3.94	3.85	3.40	3.00	2.74	3.76	3.25	2.65	1.54
353	2.70	2.94	1.61	3.01	2.96	2.62	2.28	2.09	2.90	2.51	2.07	1.17
354	3.40	3.68	2.32	3.75	3.66	3.41	xxx	3.02	3.61	3.25	2.84	2.06
355	4.13	4.27	2.53	4.29	4.16	3.85	xxx	3.37	4.06	3.64	3.11	2.19
356	4.10	4.38	1.84	4.40	4.30	3.92	3.54	2.53	4.23	3.73	3.13	2.18
357	3.12	3.41	2.13	3.49	3.43	3.08	2.74	2.57	3.37	2.96	2.47	1.70
358	3.29	3.63	2.56	3.79	3.69	3.43	3.31	3.05	3.63	3.30	2.91	2.26
359	4.35	4.59	2.90	4.67	4.52	4.21	3.90	3.74	4.45	4.01	3.49	2.64
360	4.10	4.33	2.62	4.34	4.25	3.84	3.48	3.26	4.19	3.68	3.10	2.17
361	3.44	3.74	2.37	3.79	3.76	3.40	3.07	2.87	3.70	3.26	2.76	1.94
362	3.80	4.06	2.70	4.14	4.05	3.74	3.43	3.26	3.99	3.57	3.09	2.31
363	4.34	4.51	2.86	4.57	4.43	4.09	3.74	3.55	4.37	3.89	3.35	2.47
364	4.29	4.47	2.81	4.48	4.40	4.02	3.65	3.44	4.34	3.84	3.27	2.34
365	3.58	3.80	2.53	3.86	3.81	3.46	3.13	2.95	3.75	3.32	2.84	2.05
366	3.86	4.08	2.84	4.23	4.05	3.78	3.47	3.31	4.04	3.63	3.17	2.46
367	4.42	4.63	3.04	4.74	4.52	4.22	3.87	3.69	4.51	4.04	3.50	2.66
368	4.17	4.38	2.87	4.47	4.35	3.98	3.63	3.44	4.30	3.83	3.29	2.41
369	4.04	4.14	2.79	4.23	4.12	3.78	3.45	3.27	4.07	3.63	3.13	2.32
370	3.88	4.09	2.76	4.24	4.10	3.78	3.46	3.27	4.05	3.62	3.14	2.35
371	4.31	4.44	2.90	4.58	4.43	4.06	3.72	3.51	4.37	3.90	3.36	2.49
372	4.25	4.38	2.81	4.46	4.35	3.98	3.64	3.44	4.29	3.82	3.27	2.37
373	4.21	4.23	2.78	4.29	4.19	3.85	3.52	3.33	4.14	3.69	3.17	2.32
374	4.06	4.14	2.69	4.28	4.15	3.80	3.47	3.27	4.09	3.64	3.11	2.28
375	4.16	4.19	2.72	4.35	4.20	3.86	3.54	3.34	4.15	3.71	3.18	2.34
376	4.11	4.19	2.71	4.30	4.16	3.83	3.51	3.31	4.12	3.66	3.13	2.26
377	4.30	4.36	2.80	4.41	4.29	3.94	3.62	3.42	4.23	3.76	3.22	2.33
378	4.32	4.28	2.67	4.34	4.21	3.82	3.46	3.25	4.13	3.65	3.08	2.16
379	3.94	3.96	2.54	4.06	3.94	3.58	3.24	3.04	3.87	3.43	2.90	2.06
380	3.81	3.80	2.47	3.88	3.79	3.51	3.23	3.06	3.74	3.33	2.84	2.06
381	4.28	4.25	2.66	4.27	4.16	3.86	3.56	3.38	4.11	3.65	3.12	2.24
382	4.24	4.20	2.52	4.18	4.09	3.71	3.36	3.12	4.02	3.52	2.95	1.96
383	3.74	3.96	2.39	3.87	3.81	3.46	3.15	2.93	3.75	3.30	2.78	1.89
384	3.88	4.08	2.53	4.05	3.95	3.64	3.35	3.17	3.90	3.45	2.94	2.08
385	4.37	4.42	2.72	4.51	4.36	4.01	3.66	3.45	4.30	3.79	3.21	2.23
386	3.96	3.96	2.32	4.01	3.89	3.53	3.16	2.92	3.82	3.33	2.76	1.75
387	3.35	3.47	2.16	3.57	3.49	3.20	2.89	2.68	3.43	3.01	2.53	1.66
388	3.66	3.83	2.45	3.92	3.84	3.55	3.27	3.09	3.78	3.34	2.82	1.97
389	4.14	4.13	2.55	4.17	4.09	3.76	3.44	3.24	4.01	3.53	2.95	2.02
390	3.87	3.95	2.42	3.97	3.91	3.60	3.27	3.06	3.83	3.37	2.83	1.94

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
391	3.11	3.22	2.08	3.27	3.23	2.96	2.66	2.48	3.16	2.78	2.33	1.59
392	3.33	3.51	2.45	3.63	3.57	3.39	3.17	3.07	3.52	3.20	2.84	2.25
393	4.22	4.10	2.68	4.12	4.01	3.79	3.55	3.43	3.95	3.57	3.12	2.39
394	3.94	3.87	2.49	3.91	3.80	3.57	3.30	3.16	3.74	3.35	2.91	2.16
395	2.83	3.06	2.12	3.20	3.12	2.92	2.68	2.56	3.08	2.75	2.40	1.80
396	3.15	3.34	2.45	3.51	3.43	3.26	3.08	2.98	3.39	3.13	2.82	2.26
397	4.23	4.16	2.80	4.23	4.12	3.92	3.70	3.57	4.07	3.72	3.32	2.60
398	3.91	3.83	2.46	3.85	3.76	3.53	3.27	3.10	3.72	3.34	2.91	2.15
399	2.98	3.17	2.19	3.29	3.23	3.04	2.81	2.66	3.19	2.89	2.55	1.91
400	3.47	3.62	2.59	3.80	3.73	3.53	3.31	3.18	3.67	3.35	3.01	2.41
401	4.91	4.50	2.96	4.54	4.42	4.16	3.91	3.75	4.36	3.95	3.49	2.73
402	3.83	3.47	2.06	3.43	3.36	3.09	2.85	2.65	3.32	2.95	2.49	1.63
403	2.96	3.11	1.98	3.15	3.15	2.94	2.72	2.55	3.10	2.80	2.42	1.65
404	3.41	3.60	2.22	3.68	3.64	3.41	3.14	2.95	3.57	3.18	2.73	1.97
405	4.86	4.54	2.77	4.57	4.45	4.11	3.79	3.55	4.39	3.88	3.31	2.39
406	4.35	3.93	1.94	3.93	3.82	3.42	2.99	2.67	3.75	3.21	2.58	1.42
407	3.11	2.50	1.45	2.47	2.47	2.15	1.78	1.54	2.40	2.03	1.64	xxx
408	4.74	4.90	1.41	5.16	xxx	xxx	xxx	xxx	xxx	xxx	3.85	xxx
409	4.82	5.60	2.45	5.79	xxx	xxx	xxx	xxx	xxx	5.02	4.38	xxx
410	5.33	4.51	0.09	4.62	xxx	3.91	3.45	3.16	4.24	3.67	2.94	1.64
411	4.36	4.14	xxx	4.43	4.28	3.85	3.44	3.21	4.14	3.66	3.02	1.77
412	4.49	xxx	xxx	4.75	4.41	4.15	3.71	3.45	4.46	3.94	3.24	1.92
413	5.90	xxx	xxx	5.77	5.30	4.98	4.47	4.13	5.38	4.71	3.85	2.25
414	5.20	4.91	xxx	4.90	4.63	4.06	3.46	3.04	4.57	3.90	3.04	1.56
415	4.89	4.73	xxx	4.78	4.57	4.01	3.44	xxx	4.49	3.86	3.04	1.59
416	5.11	5.03	xxx	5.07	4.83	4.24	xxx	xxx	4.69	4.05	3.20	1.72
417	5.90	5.68	xxx	5.68	5.40	4.68	3.98	3.48	5.20	4.44	3.49	1.87
418	5.86	5.44	xxx	5.43	5.13	4.32	3.61	3.09	4.97	4.19	3.21	1.60
419	5.27	5.00	xxx	5.01	4.77	4.02	3.38	2.92	4.62	3.93	3.03	1.51
420	5.59	5.27	xxx	5.29	4.99	4.29	3.66	3.22	4.82	4.13	3.24	1.66
421	6.19	5.70	xxx	5.72	5.34	4.55	3.84	3.34	5.16	4.38	3.41	1.78
422	6.09	5.52	xxx	5.53	5.20	4.39	3.65	3.13	5.04	4.25	3.27	1.63
423	5.56	5.12	xxx	5.13	4.87	4.13	3.45	2.97	4.72	4.01	3.09	1.54
424	5.77	5.28	xxx	5.25	5.01	4.34	3.70	3.27	4.84	4.15	3.25	1.73
425	5.79	5.29	xxx	5.26	4.99	4.30	3.65	3.23	4.83	4.12	3.21	1.68
426	5.79	5.45	xxx	5.47	5.22	4.48	3.86	3.44	5.05	4.32	3.42	1.85
427	5.84	5.42	xxx	5.43	5.18	4.44	3.81	3.41	xxx	4.28	3.38	1.76
428	5.90	5.45	xxx	5.47	5.21	4.51	3.88	3.49	xxx	4.33	3.41	1.82
429	5.52	5.18	xxx	5.22	4.98	4.30	3.71	3.32	4.82	4.12	3.24	1.76

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
430	5.31	5.19	xxx	5.24	5.04	4.42	3.88	3.53	4.86	4.20	3.39	1.98
431	5.66	5.44	xxx	5.50	5.26	4.60	4.01	3.64	5.09	4.38	3.52	2.04
432	5.53	5.30	xxx	5.30	5.07	4.40	3.81	3.43	4.90	4.20	3.34	1.87
433	4.88	4.78	xxx	4.79	4.62	4.02	3.50	3.15	4.45	3.83	3.06	1.70
434	5.14	5.08	1.99	5.11	4.90	4.38	3.90	3.59	4.78	4.17	3.43	2.12
435	5.52	5.33	1.98	5.37	5.10	4.54	4.03	3.70	4.97	4.32	3.52	2.15
436	4.96	4.92	2.01	4.98	4.76	4.16	3.66	3.33	4.61	3.99	3.22	1.93
437	4.13	4.27	1.67	4.36	4.21	3.70	3.28	3.01	4.08	3.54	2.87	1.72
438	4.27	4.45	2.23	4.56	4.42	3.96	3.59	3.37	4.30	3.81	3.19	2.15
439	5.10	5.17	2.40	5.18	5.01	4.45	4.01	3.75	4.86	4.26	3.54	2.33
440	4.43	4.60	2.11	4.51	4.35	3.79	3.30	3.01	4.23	3.65	2.96	1.75
441	3.47	3.79	1.78	3.82	3.70	3.27	2.88	2.64	3.60	3.15	2.57	1.55
442	3.86	4.13	2.27	4.22	4.11	3.71	3.36	3.15	4.01	3.55	2.99	1.99
443	4.46	4.65	2.43	4.68	4.56	4.11	3.69	3.44	4.43	3.91	3.26	2.08
444	3.81	4.11	2.19	4.11	4.02	3.58	3.19	2.95	3.90	3.42	2.80	1.65
445	2.97	3.38	1.84	3.43	3.37	2.97	2.64	2.44	3.29	2.88	2.36	1.37
446	3.37	3.77	2.32	3.90	3.80	3.46	3.20	3.04	3.71	3.32	2.83	1.92
447	4.10	4.38	2.54	4.48	4.35	3.98	3.65	3.45	4.24	3.77	3.20	2.09
448	3.46	3.82	2.18	3.89	3.78	3.39	3.05	2.83	3.70	3.24	2.68	1.59
449	2.57	2.97	1.79	3.08	3.01	2.64	2.36	2.20	2.93	2.58	2.11	1.25
450	2.70	3.05	2.11	3.22	3.14	2.85	2.64	2.58	3.06	2.78	2.40	1.67
451	3.80	4.06	2.53	4.13	4.02	3.71	3.43	3.31	3.93	3.54	3.06	2.03
452	3.02	3.26	1.81	3.26	3.20	2.88	2.56	2.38	3.15	2.77	2.27	1.24
453	2.33	2.75	1.61	2.82	2.77	2.48	2.22	2.07	2.74	2.44	2.01	1.13
454	2.86	3.28	1.97	3.35	3.25	2.96	2.70	2.57	3.20	2.84	2.38	1.46
455	3.32	3.70	2.38	3.77	3.64	3.34	3.03	2.87	3.60	3.19	2.65	1.59
456	3.28	3.54	2.09	3.63	3.51	3.20	2.88	2.69	3.48	3.07	2.52	1.42
457	2.46	2.74	1.70	2.84	2.76	2.48	2.22	2.08	2.73	2.41	1.98	1.11
458	2.87	3.27	2.21	3.39	3.33	3.05	2.84	2.72	3.26	2.94	2.55	1.67
459	3.48	3.72	2.40	3.83	3.76	3.47	3.22	3.07	3.66	3.29	2.82	xxx
460	3.07	3.35	2.10	3.45	3.38	3.10	2.82	2.67	3.31	2.96	2.47	xxx
461	2.83	3.11	1.98	3.21	3.14	2.86	2.59	2.45	3.09	2.75	2.30	xxx
462	2.95	3.31	2.21	3.44	3.34	3.06	2.84	2.72	3.28	2.93	2.52	xxx
463	3.50	3.78	2.42	3.88	3.75	3.46	3.21	3.08	3.69	3.29	2.82	xxx
464	3.41	3.65	2.22	3.72	3.62	3.30	3.00	2.81	3.58	3.17	2.66	xxx
465	2.97	3.38	2.10	3.49	3.40	3.09	2.81	2.63	3.36	2.99	2.51	xxx
466	3.39	3.71	2.34	3.80	3.73	3.40	3.10	2.91	3.67	3.25	2.73	xxx
467	3.89	4.13	2.53	4.19	4.09	3.73	3.40	3.19	4.03	3.55	2.98	xxx
468	3.86	4.09	2.42	4.17	4.07	3.62	3.26	3.02	3.99	3.48	2.88	xxx

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
469	3.40	3.50	2.16	3.58	3.53	3.12	2.81	2.59	3.44	3.01	2.50	xxx
470	3.50	3.72	2.42	3.83	3.73	3.43	3.18	3.02	3.66	3.28	2.83	xxx
471	4.24	4.36	2.66	4.43	4.27	3.90	3.58	3.38	4.21	3.73	3.16	xxx
472	3.80	3.93	2.29	3.96	3.85	3.47	3.14	2.92	3.79	3.33	2.78	xxx
473	3.84	3.96	2.33	4.00	3.89	3.51	3.19	2.97	3.83	3.37	2.84	xxx
474	4.09	4.20	2.39	4.28	4.12	3.66	3.28	3.03	4.04	3.52	2.92	xxx
475	4.04	4.16	2.42	4.26	4.10	3.66	3.29	3.05	4.02	3.51	2.92	xxx
476	4.09	4.17	2.43	4.23	4.09	3.66	3.29	3.05	4.02	3.52	2.91	xxx
477	3.80	3.92	2.31	3.98	3.87	3.46	3.10	2.88	3.80	3.33	2.76	xxx
478	4.29	4.35	2.62	4.42	4.27	3.86	3.51	3.29	4.19	3.70	3.12	xxx
479	4.19	4.35	2.56	4.39	4.22	3.82	3.46	3.23	4.14	3.66	3.05	xxx
480	4.13	4.31	2.61	4.35	4.20	3.83	3.48	3.28	4.14	3.67	3.10	xxx
481	4.44	4.47	2.69	4.51	4.37	3.96	3.60	3.38	4.30	3.71	3.20	xxx
482	4.33	4.41	2.60	4.46	4.32	3.88	3.50	3.25	4.24	xxx	3.10	xxx
483	4.12	4.27	2.55	4.38	4.23	3.81	3.44	3.21	4.16	3.66	3.06	xxx
484	4.27	4.38	2.70	4.49	4.35	3.94	3.59	3.38	4.28	3.78	3.20	xxx
485	4.48	4.49	2.74	4.56	4.42	3.99	3.63	3.41	4.33	3.82	3.22	xxx
486	4.54	4.48	2.67	4.55	4.40	3.94	3.54	3.29	4.29	3.77	3.14	xxx
487	4.15	4.21	2.54	4.30	4.17	3.73	3.35	3.12	4.07	3.58	2.98	xxx
488	4.03	4.12	2.58	4.20	4.09	3.72	3.40	3.20	4.01	3.55	3.01	xxx
489	4.81	4.76	2.88	4.76	4.61	4.17	3.82	3.59	4.50	3.98	3.39	xxx
490	xxx	4.37	2.37	4.25	4.08	3.62	3.24	2.97	3.98	3.45	2.83	xxx
491	xxx	3.96	2.24	3.85	3.81	3.39	3.03	2.79	3.71	3.21	2.65	xxx
492	3.85	4.02	2.28	4.06	3.95	3.47	3.10	2.86	3.86	3.36	2.78	xxx
493	4.82	4.69	2.63	4.76	4.54	4.01	3.60	3.32	4.45	3.89	3.21	xxx
494	4.73	4.55	2.00	4.37	4.23	3.55	3.01	2.61	4.09	3.48	2.74	xxx
495	3.85	3.98	1.87	3.90	3.80	3.23	2.77	2.44	3.68	3.16	2.54	xxx
496	xxx	3.96	1.46	3.93	3.72	3.15	2.64	2.27	3.65	3.11	2.43	xxx
497	xxx	4.93	2.45	4.86	4.69	4.04	xxx	xxx	4.59	3.96	3.19	xxx
498	4.63	4.24	0.57	4.15	3.90	3.01	2.31	xxx	3.75	3.06	2.14	xxx
499	3.47	3.36	xxx	3.42	3.26	2.51	1.96	xxx	3.11	2.63	1.99	xxx
500	xxx	3.42	xxx	3.40	3.16	2.26	1.62	xxx	2.88	2.25	1.46	xxx
501	xxx	4.05	xxx	3.93	3.71	2.76	2.09	xxx	3.48	2.85	2.04	xxx
502	4.34	4.10	xxx	4.09	3.85	2.80	1.94	xxx	3.56	2.74	1.72	xxx
503	3.01	2.97	xxx	2.97	2.68	1.80	1.15	xxx	2.45	1.79	1.01	xxx
504	3.26	3.55	xxx	3.60	3.34	2.53	1.81	xxx	3.15	2.47	1.65	xxx
505	4.31	4.42	xxx	4.44	4.19	3.26	2.36	xxx	3.94	3.12	2.13	xxx
506	3.85	4.07	xxx	4.15	3.92	3.02	2.25	xxx	3.71	2.96	2.09	xxx
507	2.83	3.09	xxx	3.17	2.92	2.09	1.43	xxx	2.74	2.07	1.25	xxx

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
508	3.01	3.50	xxx	3.55	3.38	2.72	2.15	1.65	3.23	2.68	1.94	xxx
509	4.32	4.44	xxx	4.42	4.23	3.45	2.75	2.08	4.02	3.33	2.46	xxx
510	3.73	3.75	xxx	3.75	3.61	2.95	2.36	1.80	3.40	2.85	2.11	xxx
511	2.77	3.03	xxx	3.10	2.97	2.36	1.79	1.27	2.83	2.33	1.61	xxx
512	3.16	3.61	xxx	3.75	3.58	3.03	2.51	2.07	3.40	2.91	2.19	xxx
513	4.22	4.44	xxx	4.52	4.27	3.61	3.02	2.52	4.08	3.44	2.64	xxx
514	4.04	4.20	xxx	4.31	4.05	3.35	2.76	2.26	3.87	3.20	2.41	xxx
515	3.17	3.48	xxx	3.64	3.44	2.82	2.28	1.82	3.27	2.72	2.00	xxx
516	3.61	3.82	xxx	3.98	3.84	3.30	2.83	2.42	3.66	3.10	2.35	xxx
517	4.68	4.62	xxx	4.72	4.49	3.84	3.29	2.82	4.32	3.62	2.79	xxx
518	4.52	4.66	xxx	4.55	4.33	3.59	2.97	2.48	4.14	3.37	2.51	xxx
519	3.87	4.18	xxx	4.11	3.93	3.24	2.69	2.25	3.75	3.08	2.29	xxx
520	3.81	3.97	xxx	4.04	3.88	3.31	2.85	2.46	3.70	3.10	2.36	xxx
521	4.85	4.87	xxx	4.88	4.65	3.97	3.36	2.88	4.47	3.72	2.85	xxx
522	5.10	4.89	xxx	4.89	4.58	3.73	3.04	2.48	4.37	3.50	2.52	xxx
523	4.62	4.52	xxx	4.56	4.28	3.47	2.84	2.31	4.08	3.28	2.38	xxx
524	4.52	4.56	xxx	4.66	4.38	3.66	3.05	2.56	4.18	3.39	2.50	xxx
525	5.05	4.96	xxx	5.04	4.72	3.92	3.25	2.71	4.51	3.66	2.71	1.12
526	5.18	4.91	xxx	4.91	4.60	3.73	3.05	2.51	4.38	3.50	2.52	0.98
527	5.03	4.84	xxx	4.85	4.56	3.70	3.02	2.50	4.34	3.47	2.52	1.00
528	4.99	4.81	xxx	4.87	4.55	3.71	3.03	2.50	4.32	3.45	2.50	0.99
529	5.49	5.20	xxx	5.25	4.86	3.95	3.20	2.63	4.64	3.71	2.67	1.10
530	5.59	5.20	xxx	5.20	4.82	3.86	3.07	2.49	4.58	3.63	2.56	1.02
531	5.24	4.84	xxx	4.86	4.51	3.63	2.90	2.35	4.28	3.40	2.41	0.91
532	5.36	5.03	xxx	5.11	4.73	3.90	3.18	2.65	4.52	3.63	2.64	1.08
533	5.29	5.01	xxx	5.09	4.71	3.85	3.13	2.59	4.50	3.59	2.57	0.98
534	5.69	5.33	xxx	5.37	5.03	4.14	3.42	2.88	4.82	3.89	2.84	1.21
535	5.66	5.27	xxx	5.28	4.96	4.08	3.36	xxx	4.74	3.81	2.75	1.09
536	5.69	5.30	xxx	5.34	5.00	4.15	3.44	2.92	4.78	3.89	2.88	1.26
537	5.09	4.86	xxx	4.93	4.62	3.82	3.16	2.70	4.40	3.57	2.60	1.02
538	5.39	5.22	xxx	5.24	5.01	4.28	3.67	3.26	4.81	4.02	3.06	1.48
539	5.61	5.38	2.12	5.38	5.13	4.37	3.74	3.29	4.91	4.07	3.05	1.35
540	5.83	5.48	2.29	5.50	5.20	4.44	3.80	3.35	4.99	4.16	3.20	1.56
541	4.78	4.62	1.87	4.70	4.45	3.80	3.24	2.87	4.25	3.54	2.68	1.16
542	4.97	4.98	2.48	5.07	xxx	4.34	3.88	3.61	4.72	4.10	3.33	1.95
543	5.63	5.47	2.58	5.49	xxx	4.65	4.13	3.80	5.09	4.37	3.47	1.88
544	5.47	5.31	2.56	5.34	5.11	4.45	3.92	3.58	4.93	4.25	3.41	1.92
545	4.29	4.42	2.16	4.53	4.34	3.77	3.32	3.04	4.18	3.59	2.88	xxx
546	4.45	4.69	2.70	4.83	xxx	4.23	3.87	3.67	4.56	4.07	3.48	xxx

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
547	5.30	5.31	2.88	5.39	xxx	4.69	4.25	4.00	5.05	4.45	3.73	xxx
548	4.87	4.92	2.72	5.02	4.82	4.29	3.82	3.55	4.67	4.08	3.37	xxx
549	3.71	3.98	2.32	4.17	4.01	3.54	3.15	2.92	3.88	3.39	2.79	xxx
550	3.83	4.15	2.75	4.34	xxx	3.86	3.55	3.40	4.12	3.73	3.26	xxx
551	4.84	4.93	3.03	5.03	xxx	4.48	4.11	3.92	4.76	4.27	3.70	xxx
552	4.24	4.37	2.58	4.39	4.29	3.82	3.41	3.16	4.16	3.65	3.05	xxx
553	3.35	3.78	2.29	3.78	3.71	3.31	2.97	2.77	3.60	3.18	2.66	xxx
554	3.16	3.51	2.34	3.56	3.49	3.18	2.94	2.83	3.40	3.06	2.65	xxx
555	4.17	4.25	2.68	4.35	4.23	3.85	3.53	3.38	4.12	3.68	3.16	xxx
556	3.76	3.90	2.30	3.94	3.84	3.45	3.07	2.87	3.73	3.28	2.72	xxx
557	2.40	2.59	1.67	2.61	2.57	2.25	1.98	1.82	2.50	2.19	1.78	xxx
558	3.16	3.50	2.60	3.59	3.55	3.28	3.08	2.97	3.50	3.24	2.92	xxx
559	4.31	4.47	3.02	4.62	4.51	4.20	3.93	3.80	4.41	4.04	3.60	xxx
560	3.37	3.63	2.33	3.80	3.63	3.29	3.01	2.85	3.53	3.16	2.70	xxx
561	2.65	3.05	2.06	3.21	3.08	2.79	2.53	2.39	3.03	2.71	2.31	xxx
562	xxx	2.78	1.83	2.90	2.82	2.58	2.34	2.24	2.77	2.50	2.15	xxx
563	xxx	3.69	2.31	3.69	3.60	3.34	3.08	2.95	3.53	3.21	2.78	xxx
564	xxx	4.12	2.53	4.17	4.04	3.65	3.33	3.17	3.95	3.52	3.02	xxx
565	xxx	2.94	1.98	3.10	3.01	2.65	2.37	2.22	2.95	2.61	2.20	xxx
566	2.71	2.92	2.11	2.75	2.99	2.72	2.94	2.38	2.95	2.69	2.34	xxx
567	3.36	3.72	2.47	3.53	3.74	3.47	3.22	3.11	3.67	3.36	2.95	xxx
568	3.40	3.81	2.46	3.80	3.75	3.48	3.22	3.08	3.70	3.35	2.89	xxx
569	2.15	2.68	1.89	2.78	2.75	2.49	2.25	2.14	2.71	2.45	2.07	xxx
570	2.55	3.06	2.28	2.75	3.24	2.98	2.74	2.64	3.17	2.94	2.60	xxx
571	3.63	3.98	2.74	3.56	4.03	3.77	3.52	3.40	3.96	3.64	3.25	xxx
572	3.10	3.50	2.30	3.54	3.51	3.23	2.95	2.83	3.46	3.10	2.67	xxx
573	2.87	3.20	2.18	3.27	3.25	2.98	2.71	2.60	3.19	2.88	2.48	xxx
574	2.69	3.03	2.10	3.16	3.07	2.85	2.65	2.58	3.00	2.74	2.41	xxx
575	3.23	3.56	2.34	3.64	3.55	3.31	3.08	2.98	3.48	3.16	2.77	xxx
576	xxx	3.96	2.50	4.03	3.94	3.61	3.31	3.13	3.87	3.46	2.95	xxx
577	xxx	3.32	2.19	3.42	3.37	3.04	2.75	2.59	3.30	2.95	2.49	xxx
578	2.88	3.21	2.25	3.32	3.28	3.05	2.82	2.73	3.19	2.94	2.58	xxx
579	3.12	3.43	2.37	3.54	3.47	3.27	3.05	2.97	3.36	3.12	2.76	xxx
580	3.67	3.83	2.59	3.93	3.85	3.55	3.25	3.11	3.75	3.40	2.94	xxx
581	3.75	3.99	2.63	4.09	3.98	3.64	3.32	3.16	3.90	3.51	3.02	xxx
582	3.57	3.90	2.60	4.00	3.92	3.60	3.30	3.15	3.83	3.46	3.00	xxx
583	3.54	3.94	2.62	4.07	3.98	3.68	3.38	3.22	3.90	3.53	3.06	xxx
584	3.84	4.13	2.75	4.22	4.12	3.78	3.45	3.27	4.04	3.64	3.13	xxx
585	4.02	4.26	2.79	4.30	4.22	3.86	3.51	3.33	4.14	3.71	3.19	xxx

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
586	4.03	4.29	2.76	4.38	4.23	3.87	3.52	3.33	4.15	3.72	3.19	xxx
587	3.81	4.16	2.70	4.85	4.14	3.77	3.44	3.24	4.06	3.63	3.11	xxx
588	3.96	4.39	2.85	4.89	4.24	3.92	3.57	3.39	4.15	3.75	3.24	xxx
589	4.43	4.72	3.00	4.63	4.52	4.20	3.81	3.62	4.43	4.00	3.46	xxx
590	4.62	4.64	2.91	4.72	4.54	4.13	3.70	3.46	4.43	3.93	3.34	xxx
591	4.20	4.29	2.75	4.40	4.24	3.84	3.45	3.22	4.13	3.67	3.11	2.16
592	4.13	4.31	2.87	4.40	4.30	3.96	3.61	3.42	4.18	3.79	3.27	2.41
593	4.77	4.81	3.10	4.86	4.74	4.36	3.96	3.75	4.61	4.15	3.58	2.60
594	4.75	4.73	2.90	4.81	4.61	4.16	3.71	3.45	4.50	3.96	3.33	2.25
595	4.17	4.25	2.69	4.37	4.19	3.77	3.36	3.12	4.09	3.62	3.04	2.06
596	4.48	4.43	2.92	4.54	4.38	4.03	3.66	3.45	4.30	3.88	3.34	2.45
597	5.35	5.01	3.15	5.02	4.81	4.42	4.00	3.76	4.72	4.22	3.62	2.62
598	5.02	4.82	2.92	4.86	4.65	4.18	xxx	3.24	4.55	4.01	3.37	2.29
599	3.91	4.08	2.62	4.23	4.08	3.66	3.28	3.05	3.99	3.54	2.98	2.03
600	4.09	4.27	2.93	4.39	4.25	3.96	3.64	3.47	4.18	3.82	3.34	2.53
601	5.17	5.13	3.28	5.15	4.98	4.62	4.22	4.00	4.89	4.42	3.83	2.84
602	5.24	5.00	3.00	5.03	4.69	4.35	3.84	3.55	4.73	4.14	3.46	2.32
603	4.01	4.04	2.60	4.19	4.05	3.61	3.19	2.95	3.94	3.48	2.91	1.97
604	4.08	4.34	3.02	4.47	4.18	4.05	3.73	3.57	4.27	3.91	3.44	2.65
605	5.26	5.25	3.40	5.31	4.98	4.78	4.36	4.15	5.05	4.56	3.98	2.98
606	5.08	4.90	2.99	4.97	4.80	4.30	3.80	3.53	4.68	4.10	3.43	2.31
607	3.69	3.80	2.51	3.95	3.84	3.41	3.00	2.79	3.74	3.29	2.76	1.88
608	4.02	4.25	3.02	4.39	xxx	3.96	3.66	3.50	4.21	3.86	3.40	2.68
609	5.06	5.07	3.35	5.14	xxx	4.61	4.24	4.04	4.88	4.44	3.88	2.97
610	4.83	4.80	3.06	4.82	4.70	4.26	3.81	3.59	4.59	4.07	3.47	2.47
611	3.65	3.86	2.58	3.88	3.83	3.43	3.06	2.86	3.75	3.32	2.82	2.01
612	3.76	4.10	2.97	4.17	xxx	3.83	3.54	3.40	4.04	3.72	3.33	2.68
613	4.94	5.03	3.43	5.11	xxx	4.64	4.29	4.12	4.88	4.46	3.96	3.11
614	4.53	4.54	2.93	4.61	4.47	4.04	3.64	3.42	4.38	3.88	3.32	2.38
615	3.39	3.64	2.53	3.75	3.68	3.32	2.98	2.80	3.61	3.22	2.77	2.02
616	3.68	4.01	2.93	4.19	xxx	xxx	3.53	3.39	4.02	3.70	3.32	2.66
617	4.60	4.73	3.26	4.86	xxx	xxx	4.04	3.87	4.61	4.21	3.75	2.93
618	4.22	4.39	2.94	4.47	4.35	3.99	3.61	3.42	4.27	3.83	3.33	2.50
619	3.33	3.66	2.59	3.84	3.74	3.40	3.07	2.90	3.67	3.30	2.86	2.17
620	xxx	3.76	2.77	3.95	3.86	3.57	3.30	3.16	3.80	3.50	3.12	2.49
621	xxx	4.69	3.21	4.77	4.66	4.34	4.02	3.85	4.60	4.20	3.73	2.93
622	4.13	4.36	2.82	4.40	4.30	3.91	3.54	3.33	4.24	3.76	3.23	2.36
623	3.40	3.72	2.55	3.81	3.76	3.40	3.08	2.90	3.68	3.29	2.85	2.11
624	3.65	3.94	2.75	4.09	3.98	3.67	3.36	3.20	3.90	3.53	3.13	2.41

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
625	4.22	4.48	3.01	4.61	4.47	4.14	3.79	3.61	4.40	3.96	3.49	2.66
626	4.35	4.49	2.96	4.53	4.42	4.05	3.69	3.49	4.33	3.88	3.36	2.48
627	3.97	4.16	2.81	4.24	4.14	3.78	3.43	3.24	4.10	3.62	3.14	2.33
628	3.88	4.13	2.84	4.26	4.17	3.87	3.77	3.38	4.09	3.69	3.27	2.49
629	3.88	3.91	2.71	3.98	3.86	3.57	3.26	3.10	3.80	3.43	3.04	2.31
630	4.64	4.52	3.26	4.75	xxx	4.15	3.95	3.78	4.56	4.15	3.70	2.90
631	4.84	4.66	3.28	4.91	xxx	4.29	4.04	3.84	4.71	4.27	3.77	2.89
632	4.01	4.12	2.88	4.26	4.14	3.84	3.51	3.34	4.07	3.69	3.27	2.53
633	4.38	4.60	3.12	4.73	4.58	4.26	3.93	3.75	4.52	4.09	3.62	2.81
634	4.87	4.78	3.11	4.84	4.69	4.28	3.87	3.63	4.63	4.12	3.54	2.58
635	4.93	4.78	3.13	4.83	4.69	4.29	3.89	3.65	4.62	4.13	3.56	2.61
636	4.79	4.76	3.07	4.81	4.68	4.26	3.88	3.64	4.59	4.11	3.54	2.59
637	4.41	4.45	2.94	4.53	4.41	4.03	3.67	3.44	4.34	3.89	3.36	2.47
638	4.93	4.73	3.23	4.93	xxx	4.40	4.00	3.76	4.70	4.23	3.68	2.77
639	5.29	4.98	3.33	5.15	xxx	4.57	4.14	3.90	4.89	4.38	3.79	2.83
640	5.12	5.03	3.28	5.09	xxx	4.49	4.09	3.86	4.82	4.31	3.73	2.79
641	4.63	4.65	3.09	4.74	xxx	4.20	3.81	3.59	4.51	4.05	3.50	2.61
642	4.95	xxx	3.35	5.01	xxx	4.37	4.08	3.86	4.79	4.33	3.80	2.90
643	5.48	xxx	3.55	5.40	xxx	4.70	4.40	4.16	5.15	4.63	4.06	3.09
644	5.34	5.16	3.38	5.26	xxx	4.63	4.19	3.95	4.97	4.44	3.84	2.87
645	4.60	4.54	3.09	4.73	xxx	4.16	3.74	3.51	4.46	4.00	3.46	2.57
646	4.88	4.59	3.32	4.91	4.22	4.23	4.00	3.78	4.67	4.24	3.75	2.90
647	5.80	5.33	3.65	5.56	4.85	4.80	4.54	4.30	5.29	4.77	4.22	3.24
648	5.64	5.29	3.38	5.36	xxx	4.67	4.20	3.93	5.05	4.48	3.84	2.77
649	4.58	4.44	xxx	4.60	xxx	4.01	3.57	3.33	4.34	3.87	3.31	2.41
650	4.48	4.46	xxx	4.68	xxx	xxx	3.84	3.66	4.48	4.07	3.62	2.85
651	5.55	5.39	3.61	5.51	xxx	xxx	4.50	4.28	5.24	4.73	4.18	3.22
652	5.55	5.22	3.26	5.18	xxx	4.53	4.04	3.75	4.89	4.34	3.69	2.65
653	4.11	4.05	2.75	4.16	xxx	3.68	3.25	3.01	3.98	3.53	3.01	2.19
654	4.50	xxx	3.41	4.97	4.00	xxx	4.19	3.99	4.79	4.42	3.99	3.17
655	5.29	xxx	3.51	5.17	4.13	xxx	4.23	4.00	4.93	4.50	4.01	3.11
656	4.95	xxx	3.42	4.88	xxx	xxx	4.00	3.79	4.69	4.26	3.82	3.03
657	3.83	xxx	2.90	4.15	xxx	xxx	3.42	3.22	4.05	3.68	3.29	2.59
658	3.94	xxx	3.11	4.35	xxx	xxx	3.70	3.53	4.26	3.95	3.57	2.90
659	5.39	xxx	3.73	5.37	xxx	xxx	4.53	4.34	5.14	4.75	4.30	3.48
660	4.70	4.56	3.18	4.66	4.31	4.15	3.80	3.59	4.46	4.03	3.59	2.78
661	3.61	3.78	2.79	3.92	3.68	3.57	3.25	3.07	3.83	3.49	3.12	2.47
662	3.56	3.81	2.87	3.95	xxx	3.66	3.37	3.23	3.86	3.57	3.23	2.66
663	4.67	4.77	3.39	4.83	xxx	4.46	4.15	3.99	4.68	4.31	3.89	3.16

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
664	4.56	4.58	3.10	4.62	4.49	4.16	3.81	3.61	4.47	4.04	3.54	2.70
665	3.24	3.47	2.52	3.57	3.52	3.25	2.96	2.80	3.50	3.19	2.82	2.19
666	3.49	3.72	2.83	3.87	xxx	3.60	3.37	3.25	3.77	3.51	3.23	2.69
667	4.22	4.38	3.20	4.52	xxx	4.15	3.88	3.73	4.37	4.04	3.68	2.99
668	3.92	4.10	2.95	4.21	4.11	3.87	3.57	3.39	4.10	3.76	3.37	2.68
669	xxx	3.34	2.51	3.50	3.44	3.25	3.02	2.88	3.42	3.18	2.88	2.34
670	xxx	3.17	2.20	3.29	3.28	3.03	2.80	2.68	3.19	3.01	2.69	2.11
671	xxx	5.12	3.25	5.04	5.04	xxx	4.26	4.06	4.92	4.52	3.99	xxx
672	xxx	xxx	1.32	4.24	4.17	xxx	xxx	2.93	4.03	xxx	2.89	xxx
673	xxx	xxx	1.05	3.28	3.19	xxx	xxx	xxx	xxx	xxx	2.35	xxx
674	xxx	4.10	2.37	4.27	4.16	xxx	xxx	xxx	xxx	3.75	3.34	xxx
675	xxx	3.77	2.20	3.85	3.80	3.51	3.08	2.99	3.67	3.34	2.91	2.10
676	xxx	3.94	2.24	4.02	xxx	3.65	3.30	3.13	3.87	3.54	3.13	2.40
677	xxx	2.98	1.57	3.13	xxx	2.79	2.55	2.43	2.96	2.70	2.39	1.86
678	2.18	2.63	1.56	2.76	2.76	2.59	2.45	2.40	2.66	2.51	2.31	2.01
679	3.49	3.92	2.43	4.01	3.97	3.77	3.54	3.47	3.90	3.65	3.30	2.73
680	2.74	3.10	1.74	3.17	3.11	2.88	2.61	2.51	3.09	2.80	2.43	1.83
681	2.48	3.12	1.78	3.22	3.16	2.95	2.70	2.60	3.23	2.87	2.52	1.95
682	2.87	3.37	1.90	3.47	3.34	3.10	xxx	2.70	3.31	3.01	2.61	1.92
683	2.92	3.32	1.86	3.41	3.31	3.06	xxx	2.69	3.32	2.98	2.60	1.94
684	3.39	3.91	2.38	4.04	3.97	3.68	3.41	3.27	3.89	3.56	3.14	2.40
685	2.73	2.96	1.66	3.06	3.00	2.70	2.42	2.25	2.93	2.63	2.26	1.62
686	2.82	3.21	2.18	3.39	xxx	3.13	2.92	2.81	3.31	3.10	2.81	2.33
687	3.30	3.66	2.49	3.86	xxx	3.57	3.35	3.24	3.75	3.51	3.17	2.59
688	3.22	3.60	2.61	3.75	3.67	3.44	3.20	3.07	3.66	3.38	3.04	2.47
689	3.28	3.68	2.59	3.85	3.73	3.52	3.27	3.15	3.72	3.45	3.11	2.55
690	2.97	3.58	2.53	3.64	3.53	3.24	2.98	2.85	3.44	3.20	2.85	2.29
691	2.83	3.54	2.44	3.61	3.54	3.24	2.98	2.85	3.44	3.20	2.85	2.30
692	3.21	3.70	2.72	3.87	xxx	3.52	3.24	3.10	3.73	3.45	3.08	2.47
693	3.70	4.07	2.90	4.20	xxx	3.83	3.54	3.41	4.04	3.73	3.35	2.69
694	3.36	3.73	2.61	3.85	3.75	3.45	3.14	2.98	3.70	3.36	2.94	2.24
695	3.14	3.57	2.52	3.70	3.64	3.32	3.00	2.85	3.58	3.25	2.83	2.18
696	3.39	3.78	2.73	3.92	3.83	3.55	3.24	3.13	3.75	3.45	3.03	2.40
697	4.15	4.55	3.08	4.59	4.44	4.16	3.82	3.67	4.38	4.02	3.52	2.73
698	3.96	4.24	2.73	4.19	4.10	3.72	3.34	3.13	4.04	3.60	3.05	2.14
699	3.39	3.80	2.57	3.86	3.82	3.46	3.12	2.95	3.74	3.36	2.88	2.07
700	3.60	3.90	2.68	3.98	3.87	3.56	3.22	3.06	3.78	3.44	2.97	2.15
701	4.83	4.89	3.13	4.91	4.76	4.36	3.94	3.71	4.65	4.18	3.60	2.57
702	4.62	4.60	2.60	4.62	4.49	3.93	3.39	3.05	4.35	3.76	3.05	1.82

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
703	3.43	3.60	2.27	3.75	3.63	xxx	2.78	2.53	3.53	3.08	2.54	1.57
704	4.22	4.45	2.97	4.66	4.32	xxx	3.72	3.51	4.36	3.95	3.43	2.45
705	5.03	5.01	3.13	5.09	4.75	4.47	xxx	3.75	4.77	4.26	3.62	2.50
706	5.07	4.97	3.05	5.06	4.74	4.37	xxx	3.56	4.74	4.21	3.57	2.45
707	3.95	4.10	2.65	4.27	3.98	3.66	xxx	2.94	4.00	3.54	2.98	2.02
708	4.17	xxx	3.10	4.58	xxx	4.05	3.72	3.50	4.42	4.03	3.56	2.76
709	5.66	xxx	3.52	5.51	xxx	4.86	4.49	4.24	5.25	4.74	4.16	3.13
710	5.21	4.91	2.96	4.92	4.77	4.20	3.67	3.33	4.62	4.09	3.43	2.34
711	4.26	4.34	2.76	4.46	4.35	3.86	3.40	3.07	4.22	3.77	3.17	2.21
712	4.76	xxx	3.16	4.92	xxx	4.32	3.86	3.53	4.70	4.25	3.65	2.68
713	5.68	xxx	3.40	5.49	xxx	4.79	4.26	3.90	5.22	4.67	3.98	2.86
714	5.41	5.24	3.11	5.28	4.98	4.47	3.87	3.45	4.98	4.39	3.68	2.49
715	3.95	4.17	2.64	4.29	4.04	3.63	3.12	2.75	4.06	3.60	3.02	2.04
716	4.34	xxx	3.15	4.69	xxx	4.15	3.78	3.49	4.54	4.13	3.63	2.79
717	5.73	xxx	3.58	5.65	xxx	4.98	4.52	4.19	5.42	4.89	4.27	3.22
718	5.36	5.20	3.13	5.27	4.95	4.46	3.89	3.49	4.95	4.37	3.67	2.48
719	4.13	4.30	2.78	4.46	4.21	3.79	3.29	2.92	4.23	3.76	3.17	2.17
720	4.42	4.50	3.09	4.66	xxx	4.15	3.72	3.45	4.44	4.02	3.48	2.61
721	5.40	5.24	3.40	5.40	xxx	4.75	4.26	3.96	5.14	4.62	3.98	2.93
722	5.43	5.17	3.23	5.27	4.90	4.54	4.01	3.67	4.99	4.42	3.72	2.56
723	3.71	3.78	2.50	3.88	3.57	3.29	2.84	2.55	3.68	3.25	2.72	1.83
724	3.98	xxx	3.18	4.59	xxx	xxx	3.88	3.70	4.44	4.11	3.71	2.99
725	5.45	xxx	3.72	5.65	xxx	xxx	4.68	4.46	5.37	4.93	4.39	3.43
726	4.83	4.82	3.14	4.92	xxx	4.22	3.80	3.54	4.63	4.14	3.55	2.60
727	xxx	4.52	3.00	4.50	xxx	3.90	3.51	3.27	4.29	3.84	3.30	2.46
728	xxx	xxx	3.50	5.46	xxx	xxx	4.26	3.97	5.12	4.67	4.05	2.97
729	xxx	xxx	3.54	5.60	xxx	xxx	4.37	4.09	5.23	4.76	4.12	3.00
730	4.45	4.53	3.15	4.61	xxx	4.10	3.74	3.53	4.44	4.04	3.56	2.75
731	3.98	4.41	3.02	4.47	xxx	3.97	3.64	3.45	4.28	3.90	3.43	2.64
732	3.96	4.39	3.03	4.43	xxx	3.88	3.51	3.27	4.23	3.85	3.38	2.62
733	4.58	4.75	3.27	4.82	xxx	4.34	3.96	3.67	4.63	4.22	3.73	2.90
734	4.78	4.88	3.24	4.89	xxx	4.29	3.75	3.35	4.70	4.24	3.67	2.71
735	4.16	4.34	2.98	4.39	xxx	3.86	3.37	2.99	4.23	3.83	3.30	2.45
736	4.14	4.36	3.07	4.52	xxx	3.93	xxx	3.08	4.33	3.94	3.44	2.64
737	4.53	4.44	3.11	4.56	xxx	4.00	xxx	3.14	4.39	3.98	3.48	2.66
738	4.25	4.17	2.93	4.30	4.16	3.78	3.33	2.96	4.13	3.75	3.30	2.52
739	5.02	5.34	3.48	5.48	5.26	4.77	4.24	3.83	5.23	4.72	4.13	3.12
740	xxx	5.47	3.33	5.64	5.31	4.74	4.06	3.52	5.33	4.75	4.02	2.71
741	xxx	4.10	2.74	4.33	4.03	3.57	2.98	2.50	4.10	3.68	3.09	2.07

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
742	4.62	xxx	3.25	4.80	xxx	4.12	3.72	3.36	4.60	4.20	3.70	2.86
743	4.91	xxx	3.34	5.03	xxx	4.32	3.90	3.54	4.78	4.34	3.84	2.95
744	3.85	4.18	2.94	4.39	4.20	3.83	3.43	3.14	4.12	3.74	3.28	2.53
745	3.98	4.36	3.01	4.56	4.37	3.99	3.58	3.28	4.29	3.90	3.41	2.63
746	4.28	4.40	2.96	4.54	4.37	3.96	3.49	3.15	4.30	3.86	3.31	2.43
747	4.60	4.70	3.13	4.83	4.66	4.21	3.73	3.37	4.58	4.11	3.54	2.60
748	4.85	4.91	3.22	4.99	xxx	4.37	xxx	3.48	4.76	4.26	3.67	2.67
749	4.06	4.22	2.87	4.35	xxx	3.81	xxx	2.98	4.17	3.72	3.19	2.32
750	4.41	xxx	3.28	4.82	xxx	4.18	3.84	3.53	4.62	4.19	3.70	2.83
751	5.24	xxx	3.58	5.44	xxx	4.71	4.33	3.99	5.19	4.70	4.14	3.11
752	4.58	4.72	3.11	4.83	4.62	4.21	3.72	3.37	4.58	4.11	3.53	2.55
753	4.08	4.36	2.97	4.50	4.31	3.93	3.47	3.13	4.27	3.85	3.32	2.44
754	4.73	4.70	3.32	5.06	xxx	4.40	3.94	3.58	4.80	4.34	3.78	2.83
755	5.41	5.09	3.49	5.38	xxx	4.66	4.17	3.79	5.09	4.58	3.98	2.95
756	4.67	4.76	3.11	4.90	4.61	4.23	3.76	3.41	4.62	4.13	3.57	2.59
757	4.01	4.23	2.86	4.46	4.19	3.83	3.38	3.05	4.19	3.75	3.23	2.34
758	4.24	4.48	3.13	4.66	xxx	4.12	3.72	3.42	4.44	4.02	3.54	2.69
759	5.41	5.33	3.50	5.39	xxx	4.76	4.31	3.96	5.15	4.64	4.07	3.06
760	5.18	5.01	3.13	5.04	4.91	4.32	3.81	3.42	4.77	4.23	3.59	2.54
761	4.17	4.26	2.81	4.39	4.27	3.75	3.29	2.96	4.16	3.70	3.14	2.23
762	4.20	4.34	2.97	4.49	4.27	3.93	3.53	3.24	4.30	3.86	3.35	2.51
763	5.60	5.48	3.51	5.49	5.25	4.81	4.32	3.96	5.26	4.71	4.07	3.03
764	4.80	4.34	2.21	4.23	4.05	3.46	2.92	2.53	3.94	3.37	2.68	xxx
765	3.69	3.66	2.01	3.65	3.53	3.01	2.54	2.19	3.44	2.99	2.42	xxx
766	4.66	4.81	3.02	4.92	4.73	4.30	3.85	3.43	4.70	4.24	3.65	2.62
767	5.14	5.09	3.09	5.16	4.92	4.46	3.93	3.55	4.88	4.34	3.67	2.58
768	5.04	4.91	2.88	4.99	4.83	4.23	3.66	3.25	4.69	4.13	3.43	2.35
769	3.79	3.95	2.48	4.12	4.03	3.51	3.02	2.65	3.90	3.44	2.86	1.95
770	4.07	4.35	2.99	4.51	xxx	4.01	3.57	3.24	4.36	3.97	3.49	2.71
771	4.81	4.83	3.17	4.93	xxx	4.41	3.95	3.60	4.72	4.28	3.76	2.88
772	4.74	4.82	3.10	4.96	xxx	4.18	3.59	3.10	4.69	4.21	3.63	2.68
773	4.02	4.20	2.80	4.36	xxx	3.64	3.10	2.62	4.15	3.69	3.16	2.35
774	3.92	4.16	2.64	4.32	xxx	3.53	2.93	2.39	4.13	3.70	3.20	2.42
775	4.88	4.90	3.07	5.05	xxx	4.20	3.55	2.98	4.78	4.34	3.79	2.91
776	4.39	4.35	2.58	4.47	4.31	3.55	2.84	2.17	4.19	3.70	3.10	2.09
777	3.42	3.67	2.35	3.84	3.68	2.96	2.31	1.73	3.62	3.21	2.72	1.89
778	3.53	3.77	2.43	3.95	3.79	3.10	2.46	1.91	3.74	3.36	2.90	2.10
779	4.31	4.51	2.80	4.67	4.52	3.78	3.08	2.44	4.43	3.97	3.41	2.45
780	4.18	4.35	2.39	4.46	4.30	3.49	2.69	1.97	4.19	3.68	3.04	1.97

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
781	3.02	3.53	2.01	3.68	3.54	2.80	2.08	1.48	3.47	3.05	2.50	1.58
782	3.12	3.78	2.38	3.96	3.87	3.17	2.52	1.97	3.83	3.49	3.05	2.30
783	3.93	4.33	2.63	4.49	4.37	3.61	2.90	2.24	4.30	3.88	3.36	2.51
784	3.78	4.17	2.40	4.29	4.16	3.42	2.68	2.02	4.07	3.61	3.05	2.14
785	2.85	3.39	1.99	3.52	3.40	2.73	2.07	1.53	3.34	2.98	2.53	1.79
786	3.02	3.58	2.36	3.76	3.66	3.02	2.45	1.97	3.62	3.29	2.88	2.22
787	3.71	4.13	2.63	4.32	4.19	3.49	xxx	2.27	4.13	3.72	3.24	2.47
788	3.43	3.92	2.53	4.04	3.92	3.30	xxx	2.15	3.85	3.46	3.00	2.24
789	2.78	3.37	2.22	3.54	3.43	2.82	xxx	1.75	3.37	3.04	2.63	1.95
790	2.60	3.21	2.32	3.42	3.32	2.81	xxx	1.95	3.26	2.98	2.63	2.06
791	3.16	3.67	2.49	3.84	3.75	3.23	xxx	2.28	3.68	3.35	2.95	2.30
792	3.21	3.67	2.52	3.82	3.72	3.23	xxx	2.27	3.64	3.28	2.85	2.16
793	2.73	3.35	2.30	3.50	3.41	2.90	xxx	1.95	3.34	3.01	2.62	1.98
794	2.78	3.39	2.43	3.56	3.50	3.03	xxx	2.17	3.40	3.09	2.69	2.04
795	2.71	3.39	2.41	3.58	3.52	3.08	xxx	2.24	3.43	3.12	2.70	2.06
796	2.81	3.51	2.61	3.70	3.61	3.24	xxx	2.51	3.55	3.26	2.91	2.33
797	3.17	3.79	2.69	3.90	3.81	3.43	xxx	2.70	3.74	3.42	3.05	2.40
798	3.10	3.73	2.60	3.88	3.75	3.37	xxx	2.64	3.67	3.30	2.86	2.11
799	2.56	3.23	2.35	3.45	3.33	2.96	xxx	2.23	3.27	2.96	2.57	1.94
800	xxx	3.58	2.72	3.78	3.67	3.42	xxx	2.86	3.64	3.37	3.04	2.49
801	xxx	4.34	3.10	4.48	4.35	4.06	xxx	3.49	4.29	3.94	3.52	2.81
802	xxx	3.35	2.19	3.41	xxx	3.04	xxx	2.51	3.23	2.90	2.48	1.75
803	xxx	3.30	2.21	3.36	xxx	3.01	xxx	2.45	3.23	2.92	2.51	1.75
804	xxx	4.36	2.90	4.51	4.32	4.02	xxx	3.28	4.32	3.90	3.36	2.41
805	4.04	4.47	3.00	4.65	4.42	4.12	xxx	3.36	4.41	3.97	3.44	2.52
806	3.85	4.33	2.86	4.52	4.38	3.97	xxx	3.23	4.23	3.81	3.31	2.34
807	2.63	3.15	2.22	3.37	3.28	2.89	xxx	2.24	3.18	2.85	2.44	1.58
808	3.42	xxx	2.88	4.20	xxx	xxx	xxx	3.22	4.10	3.79	3.39	2.65
809	4.47	xxx	3.36	5.05	xxx	xxx	xxx	3.96	4.84	4.45	3.97	3.15
810	3.73	4.10	2.77	4.30	4.11	3.76	xxx	3.12	4.08	3.66	3.16	2.33
811	3.12	3.66	2.55	3.88	3.73	3.41	xxx	2.78	3.71	3.34	2.88	2.13
812	3.54	xxx	2.89	4.29	xxx	3.85	xxx	3.26	4.14	3.76	3.31	2.58
813	4.88	xxx	3.39	5.27	xxx	4.71	xxx	4.02	5.06	4.56	4.00	3.07
814	4.38	4.62	2.87	4.64	4.53	4.02	xxx	3.20	4.39	3.88	3.26	2.28
815	3.57	3.95	2.62	4.06	3.98	3.53	xxx	2.78	3.85	3.43	2.90	2.05
816	3.93	4.12	2.62	4.29	4.13	xxx	xxx	2.99	4.06	3.59	3.06	2.17
817	5.05	5.11	3.16	5.20	5.02	xxx	xxx	3.71	4.93	4.40	3.77	2.71
818	5.00	5.00	2.83	5.09	4.90	4.25	xxx	3.16	4.73	4.12	3.34	2.02
819	3.73	3.96	2.34	4.17	3.99	3.41	xxx	2.44	3.86	3.35	2.70	1.56

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
820	4.41	xxx	3.05	5.01	xxx	4.22	xxx	3.53	4.77	4.29	3.71	2.67
821	6.04	xxx	3.53	6.06	xxx	5.11	xxx	4.26	5.73	5.08	4.32	3.05
822	5.30	5.15	2.78	5.18	4.96	4.30	xxx	3.21	4.81	4.19	3.41	2.13
823	4.41	4.50	2.55	4.61	4.43	3.86	xxx	2.87	4.28	3.76	3.09	1.94
824	4.86	4.94	2.90	5.10	xxx	4.36	xxx	3.39	4.79	4.24	3.56	2.42
825	6.11	5.95	3.35	6.05	xxx	5.10	xxx	3.96	5.66	4.97	4.15	2.79
826	6.00	5.57	2.79	5.59	5.31	4.50	xxx	3.17	5.16	4.41	3.51	2.00
827	4.49	4.47	2.29	4.48	4.30	3.62	xxx	2.47	4.15	3.58	2.85	1.62
828	5.06	xxx	3.01	5.30	xxx	4.51	xxx	3.58	5.00	4.47	3.80	2.66
829	6.36	xxx	3.34	6.08	xxx	5.12	xxx	4.07	5.71	5.03	4.23	2.89
830	5.98	5.57	2.95	5.62	xxx	4.62	xxx	3.41	5.21	4.51	3.68	2.27
831	4.85	4.74	2.63	4.90	xxx	4.05	xxx	2.96	4.55	3.97	3.24	2.01
832	4.94	4.87	2.94	5.12	xxx	4.39	xxx	3.50	4.81	4.28	3.62	2.54
833	6.34	6.00	3.39	6.16	xxx	5.18	xxx	4.11	5.74	5.06	4.25	2.91
834	5.87	5.45	2.69	5.54	5.20	4.36	xxx	3.06	5.04	4.29	3.38	1.87
835	xxx	4.69	2.46	4.85	4.63	3.91	xxx	2.74	4.48	3.87	3.09	1.78
836	5.12	4.90	2.66	5.03	4.86	4.23	xxx	3.18	4.71	4.11	3.37	2.09
837	5.69	5.36	2.85	5.43	5.18	4.49	xxx	3.39	5.05	4.37	3.57	2.19
838	5.84	5.47	2.67	5.55	5.18	4.45	xxx	3.22	5.12	4.40	3.52	2.02
839	4.96	4.77	2.43	4.90	4.60	3.96	xxx	2.82	4.53	3.92	3.14	1.82
840	4.41	4.60	2.45	4.73	4.59	4.02	xxx	3.08	4.46	3.94	3.27	2.12
841	5.51	5.50	2.79	5.55	5.33	4.64	xxx	3.60	5.19	4.53	3.73	2.36
842	5.12	5.04	2.30	5.08	4.83	4.09	3.44	2.93	4.68	4.01	3.19	1.80
843	4.78	4.83	2.31	4.93	4.72	4.02	3.39	2.90	4.57	3.95	3.17	1.84
844	4.54	4.60	2.11	4.69	4.50	3.81	3.21	2.74	4.34	3.73	2.96	1.66
845	4.74	4.79	2.21	4.88	4.68	3.97	3.34	2.85	4.51	3.88	3.09	1.75
846	4.57	4.68	2.08	4.77	4.55	3.85	3.19	2.69	4.39	3.75	2.94	1.59
847	4.58	4.61	2.07	4.65	4.44	3.74	3.10	2.60	4.28	3.66	2.87	1.57
848	4.63	4.75	2.19	4.86	4.68	3.96	3.35	2.85	4.51	3.88	3.10	1.75
849	4.32	4.32	1.99	4.43	4.27	3.62	3.05	2.58	4.13	3.56	2.85	1.57
850	4.22	4.25	2.12	4.25	4.13	3.61	3.10	2.70	4.00	3.49	2.86	1.72
851	4.58	4.65	2.24	4.66	4.52	3.93	3.38	2.95	4.38	3.79	3.08	1.83
852	4.26	4.38	2.06	4.41	4.25	3.61	3.08	2.62	4.11	3.52	2.81	1.58
853	3.44	3.80	1.83	3.91	3.79	3.22	2.74	2.31	3.66	3.17	2.53	1.43
854	4.35	4.62	2.46	4.70	4.59	4.01	3.48	3.05	4.45	3.91	3.23	2.03
855	4.42	4.65	2.44	4.73	4.61	4.04	3.51	3.08	4.46	3.89	3.20	1.99
856	4.21	4.44	2.43	4.77	4.42	3.88	3.38	2.96	4.27	3.74	3.08	1.96
857	3.29	3.85	2.11	4.23	3.91	3.41	2.95	2.56	3.78	3.31	2.71	1.68
858	3.93	4.41	2.73	4.55	4.33	4.02	3.60	3.27	4.35	3.91	3.36	2.40

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
859	4.49	4.78	2.84	4.85	4.61	4.27	3.82	3.48	4.61	4.11	3.50	2.47
860	4.21	4.52	2.82	4.51	4.45	3.98	3.54	3.21	4.30	3.85	3.25	2.27
861	2.93	3.46	2.21	3.54	3.47	3.06	2.68	2.37	3.35	2.99	2.51	1.73
862	3.88	xxx	3.06	4.58	xxx	3.77	3.70	3.43	4.37	3.99	3.52	2.74
863	4.81	xxx	3.29	5.16	xxx	4.27	4.16	3.89	4.88	4.43	3.87	2.95
864	4.10	4.44	3.07	4.63	xxx	4.05	3.69	3.44	4.38	3.95	3.43	2.62
865	3.42	3.95	2.66	4.08	xxx	3.57	3.23	2.98	3.90	3.48	3.02	2.27
866	3.79	4.07	3.04	4.46	xxx	3.79	3.65	3.42	4.28	3.87	3.44	2.69
867	4.76	4.82	3.49	5.24	xxx	4.47	4.29	4.06	4.99	4.53	4.01	3.11
868	4.05	4.39	2.96	4.47	4.39	3.98	3.58	3.34	4.26	3.84	3.31	xxx
869	3.50	3.98	2.78	4.15	4.07	3.67	3.28	3.05	3.97	3.56	3.07	xxx
870	3.93	4.37	3.10	4.62	xxx	4.05	3.67	3.42	4.38	3.94	3.43	xxx
871	4.69	4.96	3.40	5.12	xxx	4.53	4.14	3.86	4.89	4.40	3.84	xxx
872	4.48	4.68	3.07	4.76	4.61	4.14	3.72	3.43	4.52	4.01	3.44	xxx
873	3.59	3.95	2.70	4.12	3.99	3.55	3.15	2.88	3.91	3.46	2.95	xxx
874	3.83	4.23	3.08	4.51	xxx	4.00	3.66	3.43	4.32	3.91	3.45	xxx
875	4.88	5.08	3.48	5.23	xxx	4.67	xxx	4.04	5.01	4.53	3.98	xxx
876	4.49	4.69	3.01	4.75	4.63	4.13	xxx	3.37	4.50	3.98	3.37	xxx
877	xxx	4.29	2.85	4.42	4.30	3.86	xxx	3.15	4.18	3.72	3.17	xxx
878	xxx	3.68	2.41	3.65	3.74	3.38	xxx	2.75	xxx	3.21	2.74	xxx
879	xxx	4.55	2.78	4.41	4.48	4.00	xxx	3.22	xxx	3.85	3.23	xxx
880	5.21	5.08	2.98	5.11	5.01	4.38	xxx	3.37	4.87	4.28	3.52	xxx
881	3.24	3.33	2.14	3.46	3.34	2.83	xxx	1.99	3.25	2.82	2.27	xxx
882	3.78	xxx	3.09	4.34	xxx	xxx	xxx	3.37	4.16	3.87	3.50	xxx
883	5.02	xxx	3.61	5.33	xxx	xxx	xxx	4.31	5.14	4.74	4.25	xxx
884	4.49	4.60	2.98	4.62	4.49	4.02	xxx	3.26	4.39	3.90	3.30	xxx
885	3.75	4.12	2.81	4.28	4.17	3.74	xxx	3.03	4.07	3.65	3.12	xxx
886	3.31	3.74	2.68	3.92	3.85	3.54	xxx	3.02	3.75	3.42	3.00	xxx
887	4.84	5.00	3.25	5.06	4.95	4.53	xxx	3.83	4.83	4.36	3.79	xxx
888	4.52	4.51	2.61	4.52	4.37	3.80	xxx	2.87	4.27	3.68	3.00	xxx
889	3.56	3.82	2.37	3.90	3.81	3.32	xxx	2.51	3.71	3.24	2.67	xxx
890	4.15	4.36	2.80	4.50	4.40	3.93	xxx	3.11	4.28	3.80	3.21	xxx
891	4.64	4.63	2.92	4.74	4.61	4.12	xxx	3.27	4.49	3.95	3.34	xxx
892	4.37	4.37	2.65	4.37	4.24	3.71	xxx	2.87	4.10	3.56	2.93	xxx
893	4.05	4.38	2.71	4.53	4.46	3.92	xxx	3.07	4.28	3.77	3.14	xxx
894	xxx	3.77	2.33	3.77	xxx	3.39	xxx	2.66	3.63	3.22	2.69	xxx
895	xxx	3.44	2.09	3.33	xxx	2.90	xxx	2.19	3.19	2.81	2.28	xxx
896	xxx	4.98	1.03	5.06	xxx	4.45	xxx	3.59	xxx	4.33	3.65	xxx
897	xxx	3.69	2.43	3.83	xxx	3.31	xxx	2.56	3.66	3.21	2.68	xxx

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
898	3.53	3.73	2.94	4.13	xxx	3.52	xxx	3.28	4.03	3.68	3.30	xxx
899	3.90	4.04	3.04	4.43	xxx	3.78	xxx	3.53	4.29	3.88	3.44	2.67
900	3.70	4.04	3.04	4.28	xxx	3.77	xxx	3.38	4.15	3.76	3.36	2.70
901	3.71	4.05	3.03	4.27	xxx	3.78	xxx	3.39	4.15	3.78	3.39	2.71
902	3.34	3.80	2.83	3.96	xxx	3.64	xxx	3.18	3.84	3.50	3.13	2.51
903	3.37	3.90	2.89	4.00	xxx	3.70	xxx	3.24	3.91	3.56	3.18	2.55
904	3.35	3.88	2.85	3.99	xxx	3.66	xxx	3.19	3.89	3.53	3.13	2.50
905	3.32	3.79	2.81	3.99	xxx	3.63	xxx	3.16	3.87	3.52	3.12	2.50
906	3.13	3.64	2.73	3.85	3.80	3.50	xxx	3.09	3.72	3.43	3.02	2.45
907	2.80	3.40	2.53	3.63	3.61	3.32	xxx	2.91	3.83	3.24	2.82	2.26
908	2.94	3.54	2.72	3.75	xxx	3.48	xxx	3.11	3.65	3.36	3.04	2.54
909	3.28	3.79	2.89	3.96	xxx	3.64	xxx	3.26	3.83	3.53	3.21	2.66
910	3.08	3.79	2.85	4.03	xxx	3.66	xxx	3.24	3.88	3.56	3.20	2.59
911	2.82	3.27	2.49	3.45	xxx	3.18	xxx	2.77	3.33	3.08	2.79	2.32
912	2.46	2.90	2.29	3.01	3.03	2.87	xxx	2.61	2.94	2.76	2.55	2.23
913	3.56	4.10	3.07	4.21	4.14	3.93	xxx	3.61	4.07	3.81	3.46	2.88
914	3.46	3.82	2.68	3.94	3.85	3.50	xxx	3.02	3.79	3.41	2.95	2.20
915	2.46	3.11	2.25	3.21	3.25	2.93	xxx	2.50	3.28	2.87	2.50	1.92
916	3.09	3.69	2.74	3.78	3.82	3.58	xxx	3.22	3.71	3.49	3.15	2.59
917	3.74	4.21	3.17	4.37	4.27	4.02	3.80	3.65	4.20	3.91	3.54	2.93
918	3.29	3.84	2.74	3.98	3.87	3.50	3.21	2.98	3.78	3.40	2.96	2.26
919	2.81	3.30	2.37	3.44	3.41	3.06	2.78	2.56	3.30	2.96	2.55	1.93
920	3.00	3.48	2.60	3.56	3.55	3.32	3.09	2.93	3.44	3.20	2.89	2.36
921	3.87	4.37	3.07	4.32	4.24	3.99	3.72	3.55	4.16	3.85	3.46	2.79
922	3.97	4.49	3.06	4.50	4.40	4.05	xxx	3.42	4.31	3.93	3.45	2.58
923	2.66	3.19	2.27	3.33	3.28	2.96	xxx	2.39	3.18	2.88	2.50	1.82
924	3.67	xxx	3.08	4.32	xxx	xxx	3.64	3.40	4.17	3.88	3.48	2.83
925	4.85	xxx	3.72	5.33	xxx	xxx	4.54	4.30	5.15	4.76	4.26	3.43
926	4.20	4.48	3.20	4.72	xxx	4.20	3.80	3.51	4.55	4.10	3.56	2.64
927	3.35	3.67	2.71	3.92	xxx	3.53	3.17	2.89	3.80	3.44	3.00	2.26
928	3.90	3.90	3.01	4.30	xxx	xxx	3.65	3.40	4.19	3.85	3.43	2.74
929	5.40	5.12	3.69	5.44	xxx	xxx	4.57	4.29	5.23	4.78	4.24	3.33
930	4.71	4.74	3.15	4.80	4.67	4.18	3.76	3.42	4.53	4.04	3.45	2.47
931	3.72	4.17	2.91	4.32	4.23	3.77	3.38	3.07	4.10	3.68	3.15	2.28
932	4.58	4.54	3.35	4.88	xxx	4.24	3.94	3.64	4.70	4.24	3.68	2.74
933	5.92	5.58	3.82	5.82	xxx	5.04	4.66	4.31	5.59	5.00	4.32	3.17
934	5.61	5.37	3.31	5.38	5.16	4.56	3.97	3.54	5.06	4.42	3.67	2.42
935	4.68	4.65	3.03	4.76	4.56	4.03	3.51	3.12	4.47	3.93	3.28	2.19
936	4.96	4.86	3.38	5.16	xxx	4.48	4.02	3.66	4.89	4.35	3.72	2.67

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
937	6.30	5.94	3.85	6.15	xxx	5.28	4.70	4.28	5.80	5.12	4.36	3.08
938	6.18	5.60	3.24	5.63	5.37	4.59	3.91	3.42	5.20	4.47	3.61	2.15
939	5.19	4.81	2.96	4.94	4.74	4.06	3.47	3.02	4.59	3.99	3.24	1.97
940	5.32	5.10	3.27	5.30	xxx	4.53	4.01	3.62	4.96	4.39	3.67	2.47
941	6.59	6.06	3.61	6.11	xxx	5.11	xxx	4.03	5.67	4.96	4.10	2.71
942	6.13	5.62	3.14	5.64	5.35	4.58	xxx	3.39	5.20	4.47	3.57	2.12
943	5.50	5.15	3.02	5.21	5.00	4.30	xxx	3.21	4.85	4.21	3.39	2.04
944	xxx	5.54	3.22	5.58	5.25	4.73	xxx	3.64	5.20	4.59	3.78	2.32
945	xxx	5.45	3.18	5.34	xxx	4.59	xxx	3.51	5.03	4.44	3.66	2.30
946	xxx	5.55	3.31	5.61	xxx	4.79	4.17	3.71	5.31	4.62	3.78	2.41
947	5.64	5.24	3.11	5.45	xxx	4.57	3.97	3.55	5.09	4.42	3.51	2.23
948	5.45	5.24	3.27	5.38	xxx	4.66	4.12	3.75	5.09	4.51	3.70	2.62
949	6.25	5.83	3.54	5.93	xxx	5.08	4.47	4.06	5.58	4.90	4.10	2.78
950	5.95	5.55	3.16	5.51	xxx	4.58	3.93	3.49	5.14	4.44	3.61	2.26
951	5.71	5.43	3.17	5.42	xxx	4.54	3.91	3.48	5.07	4.41	3.60	2.29
952	5.31	5.21	3.02	5.22	xxx	4.39	3.81	3.39	4.89	4.26	3.47	2.18
953	5.45	5.34	3.07	5.35	xxx	4.49	3.89	3.45	5.01	4.36	3.56	2.23
954	5.24	5.09	2.83	5.10	xxx	4.21	3.61	3.19	4.74	4.08	3.28	1.97
955	5.55	5.37	3.06	5.44	xxx	4.51	3.87	3.42	5.09	4.40	3.55	2.19
956	5.33	5.00	2.63	5.04	xxx	4.06	3.40	2.90	4.68	3.98	3.11	1.69
957	4.27	4.26	2.30	4.27	xxx	3.47	2.91	2.48	3.97	3.41	2.68	1.45
958	4.79	4.81	2.84	4.91	xxx	4.18	3.66	3.28	4.60	4.05	3.33	2.11
959	5.41	5.18	2.99	5.27	xxx	4.45	3.89	3.48	4.91	4.29	3.50	2.18
960	xxx	4.49	2.52	4.48	xxx	3.75	3.27	2.89	4.15	3.60	2.90	1.70
961	xxx	4.33	2.43	4.35	xxx	3.66	3.19	2.83	4.08	3.54	2.86	1.68
962	xxx	4.57	2.68	4.66	xxx	3.97	xxx	3.18	4.39	3.83	3.16	2.00
963	xxx	xxx	2.45	4.10	xxx	3.49	xxx	2.78	3.83	3.35	2.75	1.74
964	4.09	xxx	2.75	4.27	xxx	3.83	xxx	3.25	4.06	3.66	3.14	2.22
965	2.90	3.29	2.20	3.43	xxx	2.96	xxx	2.43	3.23	2.87	2.40	1.60
966	3.56	4.03	2.95	4.18	xxx	3.71	xxx	3.32	4.07	3.71	3.26	2.60
967	4.24	4.52	3.13	4.64	xxx	4.14	xxx	3.72	4.47	4.05	3.56	2.79
968	3.81	4.22	2.99	4.34	xxx	3.88	xxx	3.33	4.16	3.74	3.25	2.52
969	3.08	3.66	2.58	3.77	xxx	3.39	xxx	2.88	3.68	3.28	2.84	2.17
970	3.44	3.99	2.97	4.18	xxx	3.67	xxx	3.35	4.08	3.71	3.31	2.68
971	4.31	4.58	3.37	4.74	xxx	4.21	xxx	3.88	4.58	4.19	3.75	3.04
972	3.55	4.00	2.87	4.16	xxx	3.72	xxx	3.24	3.98	3.59	3.15	2.43
973	2.79	3.24	2.35	3.39	xxx	3.00	xxx	2.56	3.28	2.90	2.53	1.97
974	3.11	3.54	2.66	3.62	xxx	3.37	xxx	3.03	3.57	3.24	2.92	2.46
975	4.09	4.50	3.27	4.59	xxx	4.23	xxx	3.81	4.44	4.08	3.64	2.95

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
976	3.70	4.14	2.92	4.25	xxx	3.80	xxx	3.31	4.05	3.67	3.21	2.48
977	2.70	3.40	2.48	3.56	xxx	3.19	xxx	2.72	3.43	3.09	2.70	2.08
978	3.37	3.96	2.95	4.14	xxx	3.72	xxx	3.33	4.02	3.67	3.28	2.60
979	4.25	4.60	3.36	4.73	xxx	4.24	xxx	3.86	4.56	4.18	3.74	2.98
980	3.87	4.19	3.01	4.37	xxx	3.90	xxx	3.43	4.17	3.80	3.35	2.62
981	3.02	3.47	2.51	3.64	xxx	3.28	xxx	2.85	3.52	3.20	2.81	2.17
982	3.36	3.79	2.80	3.89	xxx	3.59	xxx	3.18	3.82	3.50	3.11	2.49
983	4.48	4.75	3.39	4.84	xxx	4.44	xxx	3.95	4.69	4.29	3.81	3.04
984	3.88	4.15	2.84	4.16	xxx	3.72	xxx	3.17	3.99	3.58	3.10	2.33
985	3.29	3.72	2.64	3.75	xxx	3.38	xxx	2.84	3.64	3.27	2.83	2.15
986	3.73	4.10	2.93	4.25	xxx	3.82	xxx	3.28	4.10	3.70	3.22	2.47
987	4.46	4.58	3.23	4.70	xxx	4.21	xxx	3.67	4.50	4.08	3.58	2.75
988	3.90	4.02	2.66	4.09	xxx	3.58	xxx	3.01	3.90	3.45	2.91	2.03
989	3.40	3.84	2.55	4.00	xxx	3.43	xxx	2.79	3.78	3.33	2.78	1.94
990	4.39	4.56	3.09	4.69	xxx	4.18	xxx	3.54	4.49	4.03	3.46	2.58
991	4.50	4.42	3.01	4.51	xxx	4.01	xxx	3.41	4.33	3.89	3.33	2.48
992	4.43	4.64	3.23	4.83	xxx	4.20	xxx	3.71	4.58	4.16	3.63	2.76
993	3.88	4.16	2.90	4.37	xxx	3.79	xxx	3.26	4.14	3.74	3.23	2.38
994	4.06	xxx	xxx	4.52	xxx	3.81	xxx	3.59	4.37	4.01	3.55	2.82
995	4.71	xxx	xxx	4.98	xxx	4.23	xxx	4.05	4.83	4.41	3.92	3.11
996	4.36	4.57	xxx	4.63	xxx	4.12	xxx	3.57	4.45	3.99	3.48	2.62
997	4.12	4.40	3.12	4.55	xxx	4.05	xxx	3.47	4.35	3.92	3.41	2.58
998	3.98	4.24	3.04	4.37	xxx	3.93	xxx	3.40	4.21	3.81	3.31	2.62
999	4.04	4.37	3.14	4.45	xxx	4.05	xxx	3.56	4.33	3.93	3.43	2.74
1000	4.29	4.47	3.14	4.53	xxx	4.06	xxx	3.51	4.35	3.93	3.40	2.59
1001	3.95	4.19	2.95	4.29	xxx	3.79	xxx	3.23	4.09	3.68	3.18	2.40
1002	4.12	4.43	3.23	4.63	xxx	xxx	xxx	3.62	4.46	4.06	3.57	2.77
1003	4.05	4.30	3.15	4.48	xxx	xxx	xxx	3.74	4.35	3.95	3.47	2.68
1004	4.04	4.31	3.18	4.42	xxx	xxx	3.68	3.52	xxx	3.89	3.44	2.73
1005	4.13	4.35	3.17	4.49	xxx	xxx	3.67	3.51	4.31	3.91	3.44	2.68
1006	3.89	4.29	3.16	4.42	xxx	xxx	3.70	3.53	4.29	3.92	3.48	2.75
1007	3.87	4.27	3.17	4.41	xxx	xxx	3.72	3.56	4.28	3.92	3.50	2.77
1008	4.31	4.38	3.26	4.63	xxx	xxx	3.82	3.63	4.47	4.05	3.59	2.78
1009	4.11	4.27	3.18	4.51	xxx	xxx	3.73	3.54	4.36	3.95	3.49	2.73
1010	3.79	4.19	3.11	4.36	xxx	3.83	3.67	3.51	4.20	3.84	3.41	2.71
1011	3.76	4.20	3.10	4.39	xxx	3.83	3.65	3.47	4.23	3.86	3.41	2.68
1012	3.89	4.23	3.15	4.39	xxx	3.83	xxx	3.52	4.26	3.89	3.46	2.74
1013	3.91	4.15	3.09	4.26	xxx	3.74	3.61	3.45	4.14	3.79	3.40	2.71
1014	3.90	xxx	3.11	4.50	xxx	xxx	3.74	3.58	4.29	3.92	3.50	2.76

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1015	4.15	xxx	3.16	4.57	xxx	xxx	3.73	3.55	4.35	3.95	3.49	2.69
1016	3.83	4.11	3.07	4.26	xxx	3.77	3.62	3.47	4.14	3.80	3.42	2.72
1017	3.78	3.98	3.00	4.14	xxx	3.65	3.52	3.39	4.02	3.70	3.35	2.72
1018	3.32	3.57	2.71	3.79	xxx	3.48	3.24	3.14	3.68	3.39	3.06	2.55
1019	3.13	3.51	2.63	3.71	xxx	3.42	3.19	3.07	3.62	3.36	3.01	2.46
1020	3.19	3.30	2.64	3.65	xxx	3.33	3.09	2.96	3.58	3.29	2.92	2.33
1021	3.63	3.75	3.02	4.13	xxx	3.81	3.58	3.47	4.02	3.73	3.36	2.77
1022	3.59	3.89	2.81	4.05	xxx	3.64	3.37	3.23	3.92	3.56	3.12	2.44
1023	2.92	3.30	2.41	3.49	xxx	3.13	2.84	2.68	3.42	3.07	2.66	2.04
1024	2.94	3.41	2.62	3.57	xxx	3.33	3.10	2.99	3.50	3.24	2.92	2.44
1025	3.50	4.00	3.03	4.13	xxx	3.83	3.62	3.53	4.01	3.73	3.38	2.83
1026	3.66	4.05	2.96	4.18	xxx	3.80	3.52	3.39	4.06	3.71	3.28	2.60
1027	2.41	2.87	2.06	3.00	xxx	2.69	2.43	2.32	2.92	2.63	2.28	1.78
1028	2.54	3.08	2.42	3.19	xxx	xxx	2.87	2.82	3.12	2.93	2.71	2.37
1029	3.95	4.34	3.31	4.45	xxx	xxx	3.97	3.89	4.32	4.04	3.71	3.14
1030	3.31	3.70	2.67	3.78	xxx	3.41	3.11	2.98	3.68	3.33	2.93	2.31
1031	2.31	2.88	2.16	2.99	xxx	2.72	2.36	2.35	2.95	2.67	2.38	1.93
1032	2.85	3.41	2.61	3.60	xxx	3.34	3.15	3.05	3.49	3.25	2.98	2.48
1033	4.26	4.51	3.35	4.64	xxx	4.30	4.07	3.96	4.48	4.17	3.78	3.09
1034	xxx	3.98	2.62	4.05	xxx	3.68	3.35	3.18	3.97	3.57	3.11	2.35
1035	xxx	3.14	2.17	3.21	xxx	2.91	2.61	2.43	3.19	2.85	2.47	1.85
1036	3.37	3.75	2.78	3.83	xxx	3.58	3.36	3.26	3.77	3.52	3.20	2.65
1037	4.60	4.83	3.34	4.91	xxx	4.52	4.26	4.17	4.74	4.37	3.93	3.20
1038	4.40	4.69	2.98	4.76	xxx	4.19	xxx	3.61	4.55	4.07	3.53	2.66
1039	3.27	3.76	2.58	3.86	xxx	3.44	xxx	2.92	3.75	3.37	2.92	2.23
1040	3.98	xxx	3.01	4.35	xxx	xxx	3.64	3.46	4.22	3.87	3.42	2.70
1041	5.23	xxx	3.51	5.38	xxx	xxx	4.52	4.34	5.17	4.71	4.17	3.26
1042	5.00	4.96	3.00	4.91	xxx	4.25	3.79	3.51	4.64	4.10	3.47	2.44
1043	4.14	4.24	2.74	4.27	xxx	3.71	3.29	3.04	4.05	3.60	3.06	2.21
1044	xxx	xxx	2.98	4.85	xxx	xxx	3.85	3.60	4.60	4.15	3.58	2.65
1045	xxx	xxx	3.30	5.33	xxx	xxx	4.21	3.94	5.03	4.51	3.87	2.88
1046	xxx	4.97	2.92	5.12	xxx	4.42	3.92	3.60	4.82	4.28	3.59	2.49
1047	5.17	5.12	3.00	5.34	xxx	4.66	4.17	3.83	5.05	4.50	3.80	2.63
1048	5.38	4.79	2.90	5.24	xxx	4.49	3.96	3.58	4.95	4.35	3.61	2.41
1049	6.11	5.37	3.15	5.74	xxx	4.91	4.32	3.90	5.43	4.77	3.96	2.65
1050	6.04	5.32	2.66	5.37	xxx	4.48	3.86	3.36	5.00	4.34	3.50	2.12
1051	5.62	5.05	2.60	5.17	xxx	4.32	3.70	3.25	4.82	4.20	3.40	2.08
1052	6.07	5.46	2.75	5.58	xxx	4.73	4.08	3.62	5.26	4.59	3.73	2.35
1053	5.82	5.28	2.71	5.40	xxx	4.59	3.96	3.51	5.10	4.44	3.61	2.29

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1054	xxx	5.31	2.74	5.50	xxx	4.67	4.15	xxx	5.16	4.50	3.69	2.35
1055	xxx	5.41	2.75	5.60	xxx	4.71	4.08	xxx	5.22	4.55	3.72	2.35
1056	5.97	5.40	2.86	5.63	xxx	4.76	4.17	xxx	5.25	4.61	3.80	2.50
1057	5.85	5.31	2.80	5.53	xxx	4.67	4.09	xxx	5.16	4.52	3.72	2.44
1058	xxx	xxx	2.86	5.55	xxx	4.67	4.22	xxx	5.18	4.53	3.72	2.43
1059	xxx	xxx	2.93	5.76	xxx	4.82	4.21	xxx	5.37	4.68	3.85	2.51
1060	5.97	5.49	2.92	5.61	xxx	4.71	4.10	xxx	5.23	4.55	3.74	2.41
1061	5.81	5.42	2.88	5.59	xxx	4.70	4.10	xxx	5.21	4.54	3.73	2.41
1062	5.69	5.23	2.80	5.28	xxx	4.43	xxx	xxx	4.93	4.28	3.50	2.23
1063	5.63	5.11	2.74	5.12	xxx	4.30	xxx	xxx	4.78	4.17	3.42	2.19
1064	5.55	xxx	3.00	5.41	xxx	4.61	xxx	xxx	5.08	4.47	3.73	2.53
1065	5.53	xxx	2.89	5.23	xxx	4.42	xxx	xxx	4.89	4.28	3.55	2.36
1066	5.05	4.81	2.81	4.90	xxx	4.18	xxx	xxx	4.59	4.03	3.37	2.30
1067	5.32	5.21	2.96	5.17	xxx	4.41	xxx	xxx	4.85	4.25	3.57	2.46
1068	5.28	xxx	3.04	5.27	xxx	4.51	xxx	xxx	4.97	4.35	3.66	2.51
1069	4.37	xxx	2.72	4.66	xxx	3.98	xxx	xxx	4.40	3.87	3.24	2.20
1070	4.42	4.19	2.92	4.64	xxx	4.06	xxx	xxx	4.39	3.92	3.35	2.45
1071	4.88	4.61	3.07	5.01	xxx	4.40	xxx	xxx	4.74	4.23	3.62	2.63
1072	4.83	4.71	3.06	5.00	xxx	4.34	xxx	xxx	4.73	4.19	3.55	2.50
1073	3.93	3.99	2.71	4.34	xxx	3.73	xxx	xxx	4.11	3.63	3.06	2.15
1074	3.62	3.84	2.76	4.06	xxx	3.65	xxx	xxx	3.90	3.53	3.07	2.37
1075	4.25	4.37	2.99	4.53	xxx	4.12	xxx	xxx	4.36	3.95	3.45	2.63
1076	4.15	4.32	2.85	4.45	xxx	3.95	xxx	xxx	4.24	3.78	3.23	2.35
1077	xxx	3.39	2.32	3.56	xxx	3.13	xxx	xxx	3.43	3.04	2.52	1.82
1078	xxx	3.43	2.57	3.63	xxx	3.39	xxx	xxx	3.61	3.29	2.87	2.33
1079	4.13	4.18	2.96	4.34	xxx	3.99	xxx	xxx	4.22	3.84	3.38	2.66
1080	3.52	3.85	2.82	3.94	xxx	3.62	xxx	xxx	3.74	3.48	3.17	2.60
1081	2.90	3.13	2.28	3.21	xxx	2.91	xxx	xxx	3.04	2.81	2.54	2.07
1082	3.10	3.25	2.44	3.34	xxx	2.99	xxx	xxx	3.21	2.92	2.58	2.05
1083	3.92	4.24	3.00	4.32	xxx	4.00	xxx	xxx	4.18	3.87	3.46	2.81
1084	3.55	3.86	2.48	3.99	xxx	3.47	xxx	xxx	3.80	3.38	2.84	2.02
1085	2.47	3.10	2.15	3.31	xxx	2.89	2.59	xxx	3.19	2.85	2.41	1.71
1086	2.93	3.48	2.53	3.61	xxx	3.37	3.11	xxx	3.54	3.25	2.87	2.26
1087	3.88	4.11	2.80	4.17	xxx	3.81	3.53	xxx	4.04	3.66	3.19	2.46
1088	3.57	3.75	2.52	3.69	xxx	3.31	xxx	xxx	3.55	3.20	2.79	2.12
1089	2.77	3.23	2.27	3.23	xxx	2.92	xxx	xxx	3.18	2.84	2.51	1.95
1090	3.07	3.52	2.42	3.36	xxx	3.08	2.86	xxx	3.29	2.98	2.63	2.08
1091	3.73	4.00	2.66	3.86	xxx	3.54	3.30	xxx	3.79	3.38	2.98	2.32
1092	3.92	3.95	2.71	3.94	xxx	3.61	xxx	xxx	3.73	3.41	2.99	2.25

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1093	2.98	3.25	2.29	3.21	xxx	2.91	xxx	xxx	3.10	2.78	2.42	1.82
1094	3.51	3.95	2.84	4.02	xxx	3.68	xxx	xxx	3.90	3.58	3.16	2.49
1095	3.96	4.18	2.99	4.23	xxx	3.87	xxx	xxx	4.11	3.75	3.30	2.57
1096	3.95	4.20	3.02	4.26	xxx	3.93	xxx	xxx	4.14	3.80	3.35	2.65
1097	3.51	3.86	2.79	3.98	xxx	3.65	xxx	xxx	3.87	3.54	3.10	2.42
1098	3.57	4.01	2.93	4.12	xxx	3.76	xxx	xxx	4.02	3.68	3.26	2.59
1099	4.31	4.60	3.26	4.65	xxx	4.24	xxx	xxx	4.50	4.12	3.65	2.89
1100	4.12	4.32	3.02	4.35	xxx	3.92	xxx	xxx	4.17	3.78	3.30	2.53
1101	3.72	4.06	2.91	4.15	xxx	3.74	xxx	xxx	3.99	3.62	3.19	2.48
1102	3.86	4.20	3.02	4.36	xxx	3.92	xxx	xxx	4.20	3.81	3.34	2.60
1103	4.29	4.56	3.16	4.61	xxx	4.16	xxx	xxx	4.46	4.02	3.50	2.71
1104	4.21	4.37	2.98	4.32	xxx	3.88	xxx	xxx	4.16	3.73	3.24	2.46
1105	4.24	4.42	3.05	4.47	xxx	4.01	xxx	xxx	4.29	3.86	3.37	2.57
1106	4.22	4.40	2.98	4.48	xxx	3.99	xxx	xxx	4.27	3.83	3.30	2.42
1107	4.28	4.49	3.05	4.56	xxx	4.07	xxx	xxx	4.48	3.91	3.38	2.50
1108	4.39	4.43	2.93	4.55	xxx	4.06	xxx	xxx	4.35	3.89	3.36	2.45
1109	3.89	3.75	2.57	3.83	xxx	3.36	xxx	xxx	3.68	3.25	2.77	1.99
1110	4.67	xxx	3.33	4.76	xxx	xxx	xxx	xxx	4.62	4.20	3.70	2.91
1111	4.49	xxx	3.16	4.57	xxx	xxx	xxx	xxx	4.45	4.00	3.48	2.70
1112	3.85	4.12	3.00	4.18	xxx	xxx	xxx	xxx	4.05	3.66	3.25	2.60
1113	4.55	4.77	3.38	4.91	xxx	xxx	xxx	xxx	4.70	4.30	3.84	3.04
1114	4.37	4.54	3.13	4.66	xxx	4.13	xxx	xxx	4.45	4.00	3.47	2.64
1115	4.17	4.47	3.11	4.53	xxx	4.04	xxx	xxx	4.35	3.92	3.42	2.62
1116	4.05	4.30	2.95	4.36	xxx	3.87	xxx	xxx	4.17	3.75	3.26	2.47
1117	4.54	4.65	3.17	4.75	xxx	4.23	xxx	xxx	4.53	4.08	3.55	2.71
1118	4.44	4.50	2.97	4.57	xxx	4.04	xxx	xxx	4.39	3.89	3.32	2.40
1119	3.92	4.05	2.77	4.13	xxx	3.65	xxx	xxx	3.99	3.55	3.04	2.21
1120	3.99	4.15	2.90	4.32	xxx	3.88	xxx	3.42	4.15	3.75	3.28	2.52
1121	4.56	4.51	3.07	4.64	xxx	4.18	3.85	3.66	4.45	4.00	3.49	2.67
1122	4.23	4.32	2.87	4.38	xxx	3.95	3.59	3.40	4.26	3.78	3.25	2.39
1123	3.68	3.85	2.68	3.96	xxx	3.56	3.25	3.07	3.86	3.45	2.97	2.19
1124	3.73	3.78	2.67	3.89	xxx	3.51	3.23	3.09	3.75	3.39	2.95	2.26
1125	4.19	4.28	2.90	4.37	xxx	3.95	3.63	3.47	4.20	3.78	3.29	2.51
1126	4.42	4.66	3.13	4.82	xxx	4.30	3.96	3.78	4.61	4.13	3.58	2.70
1127	3.80	4.01	2.77	4.20	xxx	3.71	3.38	3.22	4.02	3.60	3.10	2.29
1128	3.53	3.63	2.63	3.71	xxx	3.39	3.12	2.98	3.63	3.29	2.89	2.25
1129	4.08	4.24	2.96	4.27	xxx	3.94	3.65	3.52	4.17	3.78	3.35	2.65
1130	4.06	4.32	2.93	4.43	xxx	3.98	3.65	3.48	4.28	3.83	3.31	2.47
1131	3.04	3.32	2.38	3.52	xxx	3.11	2.83	2.68	3.41	3.04	2.61	1.94

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1132	3.28	3.62	2.71	3.75	xxx	3.43	3.22	3.12	3.65	3.34	3.01	2.46
1133	4.32	4.43	3.14	4.44	xxx	4.09	3.83	3.73	4.31	3.94	3.53	2.86
1134	3.74	3.93	2.73	3.94	xxx	3.61	3.35	3.26	3.82	3.48	3.07	2.41
1135	xxx	3.48	2.53	3.61	xxx	3.23	2.98	2.87	3.47	3.16	2.77	2.16
1136	xxx	3.79	2.73	3.93	xxx	3.48	3.19	3.05	3.81	3.43	3.00	2.35
1137	xxx	4.34	2.99	4.32	xxx	3.97	3.70	3.57	4.24	3.84	3.40	2.68
1138	3.98	4.19	2.87	4.36	xxx	3.95	3.64	3.47	4.23	3.80	3.31	2.49
1139	2.74	3.03	2.18	3.30	xxx	2.91	2.63	2.45	3.22	2.86	2.44	1.76
1140	2.78	xxx	2.38	3.10	xxx	2.92	2.76	2.68	3.07	2.86	2.63	2.25
1141	3.97	xxx	2.94	4.09	xxx	3.84	3.63	3.56	3.98	3.69	3.37	2.80
1142	3.96	4.02	2.97	4.31	xxx	3.90	3.61	3.47	4.16	3.82	3.40	2.67
1143	2.92	3.20	2.46	3.51	xxx	3.21	2.94	2.79	3.45	3.16	2.80	2.17
1144	xxx	3.20	2.49	3.31	xxx	3.12	2.93	2.83	3.29	3.07	2.81	2.36
1145	xxx	4.06	3.03	4.13	xxx	3.83	3.63	3.55	4.00	3.73	3.40	2.86
1146	3.82	3.88	2.70	4.01	xxx	3.63	3.33	3.17	3.91	3.56	3.15	2.41
1147	3.12	3.27	2.42	3.39	xxx	3.11	2.89	2.74	3.36	3.07	2.75	2.16
1148	3.49	3.49	2.71	3.73	xxx	3.43	3.21	3.08	3.63	3.35	3.02	2.45
1149	4.41	4.56	3.21	4.74	xxx	4.33	4.03	3.88	4.57	4.18	3.71	2.93
1150	4.42	4.53	2.97	4.66	xxx	4.07	3.66	3.42	4.45	3.97	3.43	2.49
1151	3.66	3.82	2.69	4.05	xxx	3.55	3.17	2.96	3.89	3.48	3.03	2.23
1152	4.37	4.01	3.20	4.67	xxx	4.16	3.88	3.70	4.50	4.10	3.63	2.84
1153	5.34	4.73	3.48	5.34	xxx	4.70	4.37	4.15	5.10	4.60	4.02	3.08
1154	4.79	4.60	3.07	4.89	xxx	4.24	4.00	3.57	4.65	4.14	3.55	2.57
1155	4.34	4.29	2.97	4.60	xxx	4.02	3.63	3.41	4.39	3.94	3.42	2.51
1156	5.09	4.37	3.33	5.10	xxx	4.48	4.10	3.87	4.88	4.37	3.79	2.81
1157	5.61	4.76	3.45	5.44	xxx	4.75	4.32	4.05	5.19	4.62	3.97	2.91
1158	5.62	4.76	3.29	5.36	xxx	4.59	xxx	3.82	5.04	4.46	3.77	2.67
1159	5.48	4.73	3.30	5.38	5.15	4.62	xxx	3.86	5.07	4.50	3.82	2.72
1160	5.65	5.31	3.36	5.42	5.22	4.72	4.20	3.91	5.14	4.54	3.85	2.72
1161	5.80	5.34	3.37	5.43	5.24	4.72	4.20	3.90	5.14	4.53	3.84	2.70
1162	6.01	5.34	3.42	5.47	5.27	4.72	4.65	3.89	5.14	4.53	3.82	2.66
1163	6.06	5.46	3.47	5.60	5.36	4.80	4.26	3.94	5.23	4.62	3.89	2.72
1164	6.06	5.45	3.54	5.77	5.57	xxx	4.42	4.11	5.44	4.80	4.05	2.83
1165	5.67	5.03	3.35	5.36	5.20	xxx	xxx	3.79	5.07	4.46	3.76	2.62
1166	5.67	4.60	3.46	5.43	5.24	xxx	xxx	3.95	5.12	4.55	3.91	2.84
1167	6.34	5.19	3.70	5.96	5.73	xxx	4.56	4.31	5.61	4.98	4.25	3.07
1168	6.24	5.09	3.53	5.78	5.56	4.92	4.31	4.04	5.44	4.78	4.00	2.79
1169	5.70	4.67	3.37	5.40	5.21	4.62	4.04	3.80	5.10	4.49	3.78	2.64
1170	5.61	4.73	3.40	5.38	5.20	4.65	4.07	3.88	5.08	4.50	3.82	2.73

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1171	6.34	5.31	3.65	5.93	5.70	5.08	4.45	4.22	5.58	4.93	4.17	2.97
1172	6.10	5.18	3.38	5.67	5.44	4.81	4.16	3.86	5.33	4.66	3.86	2.61
1173	5.19	4.45	3.10	5.01	4.85	4.30	3.72	3.48	4.76	4.17	3.48	2.38
1174	5.40	xxx	3.30	5.15	5.00	4.50	3.97	3.79	4.90	4.34	3.70	2.67
1175	6.15	xxx	3.38	5.73	5.50	4.96	4.38	4.13	5.41	5.36	3.83	2.90
1176	5.86	5.42	3.08	5.42	5.17	4.61	3.99	3.72	5.11	4.61	3.48	2.49
1177	4.55	4.49	2.87	4.64	4.49	3.99	3.47	3.25	4.42	3.99	3.24	2.20
1178	4.73	4.59	3.11	4.74	4.62	4.20	3.76	3.60	4.53	4.20	3.47	2.54
1179	5.41	5.05	3.29	5.10	4.93	4.48	3.99	3.80	4.84	4.48	3.66	2.66
1180	5.08	5.01	3.22	5.07	4.94	4.45	3.97	3.78	4.85	4.45	3.64	2.65
1181	3.98	3.93	2.67	4.05	4.00	3.55	3.12	2.98	3.91	3.55	2.93	2.10
1182	3.92	3.54	2.98	4.20	4.14	3.78	3.48	3.40	4.06	3.78	3.32	2.62
1183	5.14	4.71	3.56	5.28	5.13	4.72	4.36	4.24	5.06	4.72	4.06	3.16
1184	4.41	4.46	2.89	4.52	4.35	3.94	3.48	3.32	4.30	3.94	3.20	2.30
1185	3.37	3.74	2.59	3.86	3.75	3.37	2.96	2.83	3.71	3.37	2.80	2.05
1186	3.46	3.73	2.50	3.77	3.77	3.44	xxx	2.97	3.70	3.44	2.88	2.15
1187	xxx	4.02	2.62	3.95	3.98	3.65	xxx	3.14	3.93	3.65	3.01	2.26
1188	xxx	4.26	3.14	4.80	4.71	4.33	xxx	3.80	4.62	4.33	3.65	2.79
1189	3.46	3.26	2.52	3.84	3.79	3.42	xxx	2.95	3.71	3.42	2.88	2.16
1190	3.05	3.21	2.49	3.35	3.43	3.22	xxx	2.92	3.40	3.22	2.81	2.33
1191	3.72	3.87	2.91	4.07	4.05	3.86	xxx	3.52	4.03	3.86	3.37	2.74
1192	3.81	3.92	3.02	4.27	4.11	3.89	xxx	3.48	4.15	3.89	3.39	2.69
1193	3.09	3.31	2.58	3.65	3.53	3.30	xxx	2.92	3.57	3.30	2.88	2.28
1194	2.80	3.27	2.50	3.34	3.34	3.12	xxx	2.84	3.32	3.12	2.77	2.31
1195	3.45	3.82	2.80	3.82	3.79	3.58	xxx	3.28	3.77	3.58	3.17	2.62
1196	3.37	3.80	2.71	3.88	3.77	3.53	xxx	3.16	3.77	3.53	3.11	2.49
1197	2.85	3.35	2.48	3.56	3.50	3.28	xxx	2.94	3.48	3.28	2.88	2.31
1198	2.71	3.36	2.48	3.39	3.38	3.19	xxx	2.91	3.37	3.19	2.83	2.34
1199	3.31	3.85	2.78	3.84	3.78	3.55	xxx	3.24	3.78	3.55	3.15	2.59
1200	3.40	3.63	2.68	3.69	3.58	3.39	xxx	xxx	3.58	3.39	2.98	2.41
1201	2.79	3.31	2.50	3.45	3.38	3.22	xxx	2.92	3.38	3.22	2.85	2.33
1202	2.84	3.29	2.46	3.42	3.40	3.16	xxx	2.83	3.38	3.16	2.75	2.21
1203	3.25	3.56	2.64	3.66	3.61	3.37	xxx	3.03	3.74	3.37	2.92	2.37
1204	3.56	3.81	2.80	3.83	3.74	3.50	xxx	3.14	3.69	3.50	3.02	2.39
1205	3.14	3.39	2.53	3.35	3.33	3.09	xxx	2.75	3.34	3.09	2.67	2.09
1206	xxx	3.62	2.71	3.81	3.85	3.58	xxx	3.25	3.80	3.58	3.16	2.61
1207	xxx	xxx	2.17	3.03	3.06	2.81	xxx	2.55	3.00	2.81	2.49	2.10
1208	xxx	xxx	2.51	3.35	3.36	xxx	xxx	2.94	3.31	2.96	2.82	2.38
1209	3.93	4.21	3.15	4.41	4.34	xxx	xxx	3.74	4.33	3.91	3.60	2.91

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1210	3.55	3.83	2.82	3.91	3.86	3.61	xxx	3.22	3.89	3.61	3.16	2.50
1211	3.93	4.17	3.06	4.26	4.21	3.94	xxx	3.55	4.20	3.94	3.44	2.75
1212	3.95	4.19	2.98	4.31	4.20	3.90	xxx	3.45	4.17	3.90	3.35	2.59
1213	3.96	4.24	3.02	4.39	4.27	3.98	3.71	3.54	4.23	3.98	3.43	2.68
1214	3.90	4.19	2.91	4.27	4.19	3.87	3.56	3.40	4.15	3.87	3.28	2.49
1215	3.79	4.07	2.88	4.12	4.08	3.75	3.45	3.30	4.04	3.75	3.20	2.44
1216	4.28	4.38	3.12	4.53	4.40	4.05	3.75	3.59	4.34	4.05	3.44	2.68
1217	4.35	4.44	3.12	4.62	4.46	4.11	3.80	3.62	4.40	4.11	3.47	2.69
1218	4.26	4.44	3.12	4.56	4.45	4.11	3.79	3.62	4.39	4.11	3.48	2.69
1219	3.82	4.12	2.94	4.22	4.15	3.81	3.51	3.36	4.11	3.81	3.25	2.51
1220	4.34	4.51	3.29	4.65	4.56	xxx	3.91	3.75	4.50	3.96	3.62	2.84
1221	4.49	4.60	3.34	4.79	4.65	xxx	3.99	3.82	4.59	4.06	3.69	2.87
1222	4.39	4.57	3.34	4.70	4.60	xxx	3.96	3.79	4.55	4.06	3.68	2.87
1223	3.94	4.19	3.04	4.28	4.25	xxx	3.59	3.42	4.22	3.70	3.36	2.59
1224	4.34	3.81	3.10	4.28	4.23	xxx	3.61	3.46	4.18	3.71	3.40	2.71
1225	5.03	4.42	3.50	4.94	4.79	xxx	4.16	4.00	4.73	4.28	3.87	3.10
1226	4.71	4.29	3.34	4.86	4.72	4.27	3.98	3.79	4.66	4.27	3.68	2.82
1227	3.93	3.74	2.97	4.26	4.24	3.77	3.51	3.31	4.21	3.77	3.27	2.50
1228	4.08	3.87	3.14	4.36	4.31	xxx	xxx	3.53	4.26	3.78	3.45	2.74
1229	5.12	4.68	3.60	5.22	5.06	xxx	xxx	4.20	5.02	4.50	4.05	3.19
1230	4.80	4.41	3.17	4.67	4.59	4.21	xxx	3.62	4.53	4.21	3.52	2.63
1231	3.61	3.42	2.66	3.67	3.65	3.33	xxx	2.86	3.64	3.33	2.84	2.18
1232	3.79	3.64	2.97	4.12	4.03	3.61	xxx	3.32	3.99	3.61	3.27	2.64
1233	4.95	4.61	3.51	5.07	4.90	4.45	xxx	4.08	4.85	4.45	3.92	3.10
1234	4.55	4.39	3.21	4.78	4.61	4.26	xxx	3.69	4.57	4.26	3.58	2.71
1235	3.66	3.58	2.80	4.00	3.91	3.57	xxx	3.07	3.86	3.57	3.04	2.30
1236	3.40	3.55	2.72	3.71	3.65	3.41	xxx	2.85	3.61	3.41	2.96	2.40
1237	4.78	4.79	3.36	4.87	4.73	4.44	xxx	3.99	4.69	4.44	3.80	3.04
1238	4.66	4.62	3.02	4.68	4.56	4.12	xxx	3.48	4.51	4.12	3.39	2.42
1239	3.20	3.42	2.46	3.57	3.53	3.15	xxx	2.62	3.48	3.15	2.64	1.92
1240	3.42	3.63	2.65	3.77	3.57	3.49	xxx	xxx	3.83	3.49	2.99	2.38
1241	4.53	4.24	2.86	4.28	4.29	3.95	xxx	3.46	4.22	3.95	3.32	2.61
1242	4.10	3.96	2.74	4.14	3.98	3.66	xxx	3.18	3.95	3.66	3.10	2.35
1243	3.41	3.54	2.54	3.78	3.67	3.35	xxx	2.93	3.65	3.35	2.88	2.20
1244	3.39	3.54	2.61	3.69	3.66	3.39	xxx	3.03	3.60	3.39	2.91	2.30
1245	4.20	4.34	2.99	4.42	4.34	4.07	xxx	3.65	4.29	4.07	3.45	2.69
1246	4.18	4.39	2.92	4.52	4.36	3.99	xxx	3.49	4.33	3.99	3.35	2.49
1247	3.00	3.51	2.44	3.70	3.59	3.24	xxx	2.76	3.59	3.24	2.74	2.02
1248	3.20	3.72	2.74	3.81	3.77	3.52	3.25	3.13	3.74	3.52	3.07	2.46

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1249	4.12	4.31	3.05	4.37	4.29	4.04	3.79	3.65	4.25	4.04	3.48	2.77
1250	4.21	4.40	3.02	4.54	4.40	4.06	3.76	3.57	4.37	4.06	3.44	2.61
1251	3.10	3.58	2.56	3.80	3.74	3.39	3.08	2.92	3.70	3.39	2.88	2.16
1252	xxx	3.52	2.69	3.62	3.66	3.43	3.19	3.09	3.61	3.43	3.00	2.46
1253	xxx	4.37	3.08	4.35	4.29	4.04	3.79	3.65	4.26	4.04	3.49	2.81
1254	4.16	4.48	3.05	4.39	4.36	4.03	3.72	3.53	4.37	4.03	3.45	2.67
1255	3.03	3.55	2.57	3.62	3.67	3.38	2.76	2.94	xxx	3.38	2.94	2.28
1256	3.30	3.73	2.84	3.88	3.86	3.63	3.38	3.26	3.83	3.63	3.20	2.60
1257	4.27	4.56	3.31	4.65	4.58	4.34	4.06	3.91	4.55	4.34	3.75	3.01
1258	4.38	4.42	3.08	4.37	4.26	3.97	3.65	3.46	4.22	3.97	3.35	2.58
1259	3.75	3.80	2.75	3.73	3.69	3.40	3.07	2.92	3.64	3.40	2.90	2.25
1260	3.69	4.00	3.02	4.08	4.04	3.79	3.54	3.42	4.02	3.79	3.38	2.74
1261	4.49	4.63	3.34	4.72	4.57	4.29	4.04	3.90	4.56	4.29	3.75	2.99
1262	4.73	4.73	3.29	4.89	4.71	4.29	3.89	3.67	4.66	4.29	3.69	2.82
1263	4.46	4.64	3.26	4.82	4.68	4.28	3.91	3.73	4.58	4.28	3.68	2.84
1264	4.30	4.47	3.16	4.60	4.46	4.11	3.75	3.57	4.42	4.11	3.50	2.69
1265	4.66	4.73	3.29	4.81	4.65	4.30	3.93	3.74	4.62	4.30	3.66	2.83
1266	5.05	4.94	3.34	5.09	4.89	4.43	4.02	3.76	4.84	4.43	3.72	2.75
1267	5.11	5.02	3.40	5.20	4.98	4.52	4.12	3.85	4.94	4.52	3.81	2.83
1268	4.86	4.80	3.20	4.91	4.70	4.28	3.85	3.59	4.67	4.28	3.55	2.58
1269	5.08	4.93	3.26	5.02	4.82	4.38	3.93	3.67	4.78	4.38	3.62	2.63
1270	5.46	5.10	3.33	5.25	5.01	4.49	4.25	3.69	4.94	4.49	3.71	2.63
1271	5.88	5.51	3.50	5.61	5.38	4.82	4.31	4.00	5.29	4.82	3.97	2.82
1272	5.35	5.14	3.18	5.18	4.98	4.40	3.86	3.51	4.93	4.40	3.59	2.43
1273	4.90	4.65	3.00	4.71	4.53	3.99	3.51	3.19	4.47	3.99	3.28	2.23
1274	5.44	4.95	3.35	5.31	5.12	4.53	4.06	3.73	5.03	4.53	3.78	2.71
1275	6.41	5.73	3.72	6.01	5.79	5.13	4.58	4.18	5.68	5.13	4.23	3.00
1276	5.42	5.00	2.93	5.01	4.80	4.17	3.66	3.27	4.73	4.17	3.38	2.20
1277	5.03	4.69	2.81	4.73	4.56	3.95	3.47	3.12	4.49	3.95	3.23	2.15
1278	xxx	4.96	3.05	5.22	5.21	4.55	3.99	3.61	5.08	4.55	3.67	2.45
1279	xxx	5.33	3.22	5.78	5.47	4.78	4.20	3.79	5.36	4.78	3.86	2.55
1280	5.64	5.13	2.86	5.66	4.97	4.28	3.70	3.27	4.89	4.28	3.45	2.14
1281	4.41	4.24	2.55	4.64	4.28	3.71	3.23	2.87	4.19	3.71	3.01	1.92
1282	4.97	4.75	2.89	4.87	4.69	4.12	3.62	3.22	4.58	4.12	3.39	2.33
1283	6.05	5.67	3.23	5.70	5.46	4.84	4.26	3.80	5.35	4.84	3.88	2.60
1284	6.16	5.36	3.12	5.73	5.47	4.61	3.83	3.20	5.38	4.61	3.79	2.38
1285	4.64	4.01	2.59	4.51	4.35	3.59	2.93	2.36	4.22	3.59	3.00	1.89
1286	4.55	4.02	2.89	4.59	4.46	3.79	3.18	2.64	4.33	3.79	3.38	2.52
1287	6.05	5.17	3.30	5.61	5.46	4.71	4.07	3.49	5.31	4.71	4.02	2.90

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1288	5.42	4.98	2.89	5.09	4.90	4.02	3.26	2.57	4.80	4.02	3.44	2.26
1289	4.12	4.04	2.52	4.25	4.10	3.27	2.52	1.86	3.99	3.27	2.91	1.96
1290	4.35	4.12	2.79	4.46	4.37	3.54	2.81	2.14	4.23	3.54	3.20	2.26
1291	5.40	5.02	2.92	5.28	5.09	4.29	3.56	2.85	5.03	3.53	3.50	2.63
1292	4.93	4.82	2.50	4.86	4.62	3.79	2.98	2.21	4.59	3.97	2.98	2.05
1293	3.86	4.08	2.44	4.23	4.09	3.22	2.42	1.68	3.99	3.47	2.84	1.80
1294	4.01	4.16	2.67	4.36	4.22	3.42	2.69	2.01	4.11	3.63	3.05	2.11
1295	4.96	4.88	2.98	5.00	4.82	4.00	3.26	2.55	4.73	4.17	3.49	2.38
1296	4.49	4.55	2.61	4.60	4.43	3.61	2.90	2.20	4.34	3.78	3.07	1.92
1297	3.45	3.89	2.33	3.84	3.88	3.08	2.35	1.67	3.78	3.31	2.70	1.70
1298	3.28	3.58	2.23	3.50	3.62	3.05	2.49	1.98	3.49	3.07	2.54	1.65
1299	4.04	4.24	2.55	4.27	4.16	3.55	2.98	2.47	4.07	3.58	2.97	1.94
1300	4.16	4.41	2.53	4.48	4.33	3.69	3.13	xxx	4.23	3.69	2.98	1.82
1301	3.01	3.27	2.01	3.40	3.28	2.68	3.02	xxx	3.19	2.78	2.21	1.30
1302	2.73	3.26	2.26	3.37	3.32	3.01	2.70	2.44	3.21	2.91	2.52	1.91
1303	3.77	4.15	2.62	4.18	4.09	3.73	3.38	3.10	3.99	3.56	3.05	2.23
1304	3.46	3.83	2.30	3.92	3.79	3.38	3.02	2.74	3.71	3.24	2.66	1.77
1305	2.68	3.30	2.08	3.41	3.33	2.94	2.61	2.37	3.27	2.87	2.37	1.60
1306	2.77	3.31	2.14	3.36	3.37	3.06	2.79	2.61	3.30	2.90	2.44	1.69
1307	3.34	3.69	2.34	3.76	3.70	3.38	3.08	2.87	3.64	3.21	2.70	1.87
1308	3.35	3.65	2.23	3.74	3.63	3.31	3.04	2.83	3.56	3.15	2.63	1.79
1309	2.79	3.26	2.09	3.39	3.30	2.98	2.73	2.56	3.23	2.87	2.39	1.62
1310	2.75	3.22	2.08	3.30	3.24	2.93	2.69	2.55	3.19	2.83	2.34	1.58
1311	3.31	3.54	2.16	3.49	3.45	3.13	2.86	2.68	3.40	3.00	2.48	1.67
1312	3.59	3.87	2.42	3.88	3.83	3.52	3.26	3.05	3.75	3.34	2.83	2.01
1313	3.02	3.49	2.27	3.59	3.52	3.23	2.99	2.82	3.44	3.06	2.58	1.81
1314	2.94	3.49	2.34	3.56	3.48	3.19	2.96	2.83	3.44	3.08	2.62	1.92
1315	2.83	3.32	2.26	3.42	3.34	3.05	2.84	2.71	3.29	2.95	2.51	1.85
1316	3.08	3.59	2.53	3.73	3.63	3.39	3.19	3.07	3.58	3.27	2.86	2.25
1317	3.23	3.63	2.52	3.77	3.65	3.42	3.22	3.11	3.61	3.30	2.88	2.22
1318	xxx	3.02	2.05	3.17	3.04	2.81	2.61	2.50	3.01	2.72	2.33	1.62
1319	xxx	2.80	1.97	2.90	2.82	2.60	2.42	2.31	2.77	2.50	2.16	1.57
1320	3.21	3.57	2.54	3.66	3.61	3.33	3.10	2.93	3.53	3.21	2.82	2.19
1321	3.70	4.04	2.72	4.11	4.04	3.77	3.53	3.34	3.97	3.59	3.11	2.35
1322	3.46	3.78	2.50	3.86	3.76	3.40	3.09	2.82	3.74	3.32	2.81	1.99
1323	3.38	3.74	2.53	3.87	3.79	3.45	3.15	2.88	3.74	3.33	2.85	2.05
1324	3.37	3.74	2.49	3.87	3.76	3.38	3.04	2.73	3.71	3.30	2.81	1.99
1325	4.08	4.34	2.76	4.43	4.27	3.86	3.49	3.15	4.23	3.78	3.20	2.26
1326	3.89	4.11	2.42	4.12	3.99	3.49	3.02	2.61	3.95	3.45	2.80	1.72

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1327	3.32	3.65	2.25	3.71	3.66	3.18	2.74	2.34	3.60	3.15	2.59	1.62
1328	3.78	3.89	2.47	3.97	3.90	3.43	3.01	2.64	3.79	3.33	2.78	1.85
1329	4.41	4.50	2.73	4.57	4.40	3.89	3.42	3.03	4.30	3.77	3.13	2.07
1330	4.39	4.48	2.55	4.56	4.35	3.74	3.19	2.72	4.25	3.68	2.94	1.70
1331	3.57	3.80	2.31	3.95	3.79	3.23	2.73	2.30	3.69	3.22	2.61	1.55
1332	3.65	3.79	2.42	3.82	3.71	3.29	2.87	2.53	3.59	3.17	2.63	1.70
1333	4.60	4.61	2.75	4.58	4.42	3.91	3.41	3.02	4.31	3.75	xxx	1.95
1334	4.93	4.98	2.84	5.06	4.86	4.22	3.57	3.06	4.76	4.09	xxx	1.92
1335	3.90	4.08	2.43	4.18	4.07	3.51	2.94	2.48	3.97	3.42	2.73	1.57
1336	3.73	3.87	2.47	3.90	3.81	3.40	3.05	2.70	3.69	3.27	2.71	1.78
1337	4.74	4.74	2.84	4.75	4.54	4.03	3.57	3.20	4.44	3.89	3.21	2.09
1338	4.85	5.05	2.81	4.96	4.79	4.15	3.55	3.12	4.69	4.03	3.22	1.91
1339	3.71	4.06	2.39	3.99	3.93	3.38	2.86	2.50	3.83	3.30	2.64	1.54
1340	3.79	3.99	2.65	4.09	4.00	3.63	3.26	3.01	3.90	3.47	2.94	2.06
1341	5.01	5.03	3.07	5.08	4.89	4.40	3.93	3.61	4.77	4.20	3.51	2.40
1342	4.86	4.87	2.79	4.92	4.71	4.09	3.54	3.13	4.59	3.94	3.18	1.91
1343	3.50	3.81	2.36	3.92	3.80	3.29	2.85	2.52	3.71	3.20	2.60	1.55
1344	3.74	3.93	2.61	3.92	3.87	3.49	3.18	2.95	3.77	3.36	2.83	1.94
1345	5.04	4.99	3.03	4.94	4.79	4.29	3.85	3.54	4.68	4.12	3.42	2.28
1346	xxx	5.06	2.92	5.14	4.91	4.31	3.74	3.34	4.81	4.17	3.38	2.05
1347	xxx	3.94	2.45	4.07	3.93	3.45	3.00	2.70	3.84	3.35	2.73	1.65
1348	3.80	3.88	2.63	3.88	3.81	3.45	3.15	2.96	3.71	3.31	2.83	2.05
1349	4.95	4.66	2.95	4.60	4.45	4.01	3.64	3.37	4.33	3.84	3.24	2.29
1350	5.02	4.97	3.04	5.03	4.84	4.28	3.83	3.48	4.73	4.15	3.44	2.26
1351	3.83	4.01	2.59	4.11	4.01	3.53	3.12	2.85	3.90	3.41	2.81	1.83
1352	3.42	3.69	2.63	3.79	3.73	3.43	3.15	3.00	3.64	3.29	2.87	2.21
1353	4.74	4.79	3.10	4.82	4.68	4.26	3.94	3.71	4.58	4.10	3.54	2.63
1354	4.64	4.75	2.83	4.77	4.61	4.00	3.54	3.18	4.51	3.91	3.20	2.05
1355	3.34	3.77	2.44	3.86	3.76	3.28	2.89	2.60	3.69	3.22	2.65	1.73
1356	3.46	3.72	2.57	3.80	3.73	3.39	3.10	2.91	3.65	3.26	2.78	2.03
1357	4.63	4.66	2.98	4.68	4.56	4.13	3.76	3.50	4.46	3.96	3.35	2.39
1358	4.79	4.92	2.96	4.93	4.76	4.18	3.82	3.35	4.65	4.04	3.32	2.16
1359	3.56	4.02	2.55	4.14	4.02	3.50	xxx	2.79	3.92	3.40	2.80	1.81
1360	3.42	3.59	2.49	3.67	3.63	3.30	xxx	2.85	3.54	3.16	2.70	1.93
1361	4.38	4.18	2.77	4.17	4.10	3.74	xxx	3.22	4.00	3.57	3.05	2.17
1362	4.87	4.99	3.19	5.07	4.91	4.40	xxx	3.70	4.79	4.25	3.61	2.51
1363	4.06	4.33	2.83	4.46	4.29	3.80	xxx	3.17	4.21	3.70	3.11	2.12
1364	3.66	3.86	2.70	3.95	3.90	3.56	xxx	3.10	3.83	3.42	2.95	2.23
1365	4.36	4.46	2.96	4.51	4.44	4.07	xxx	3.52	4.35	3.89	3.35	2.50

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1366	4.75	4.93	3.16	4.98	4.80	4.34	xxx	3.65	4.70	4.18	3.55	2.51
1367	4.34	4.66	3.03	4.76	4.61	4.16	xxx	3.50	4.52	4.00	3.40	2.41
1368	4.10	4.29	2.79	4.33	4.24	3.78	xxx	3.17	4.14	3.64	3.07	2.14
1369	xxx	4.36	2.85	4.33	4.24	3.80	xxx	3.19	4.15	3.67	3.10	2.18
1370	4.52	4.72	3.12	4.81	4.66	4.22	xxx	3.60	4.56	4.06	3.48	2.51
1371	4.50	4.76	3.13	4.85	4.69	4.22	xxx	3.60	4.57	4.06	3.47	2.48
1372	4.04	4.43	2.92	4.43	4.33	3.89	xxx	3.37	4.22	3.75	3.22	2.36
1373	4.14	4.39	2.90	4.40	4.28	3.85	xxx	3.33	4.17	3.71	3.18	2.32
1374	4.57	4.74	3.16	4.84	4.67	4.24	xxx	3.65	4.57	4.08	3.51	2.59
1375	4.99	5.10	3.30	5.20	5.02	4.57	xxx	3.89	4.92	4.38	3.75	2.74
1376	4.45	4.58	2.87	4.65	4.50	4.03	xxx	3.34	4.43	3.88	3.25	2.25
1377	4.12	4.31	2.79	4.38	4.25	3.80	xxx	3.17	4.18	3.68	3.10	2.18
1378	4.90	5.09	3.22	5.05	4.94	4.41	xxx	3.74	4.74	4.27	3.63	2.59
1379	5.48	5.57	3.41	5.49	5.36	4.78	xxx	4.02	5.24	4.62	3.90	2.75
1380	5.08	4.99	3.06	4.99	4.83	4.29	xxx	3.52	4.74	4.16	3.44	2.33
1381	4.46	4.49	2.86	4.52	4.38	3.88	xxx	3.21	4.31	3.78	3.15	2.15
1382	4.82	4.93	3.20	4.96	4.79	4.32	xxx	3.68	4.70	4.17	3.56	2.58
1383	5.50	5.53	3.42	5.53	5.30	4.77	xxx	4.02	5.21	4.60	3.89	2.78
1384	5.30	5.20	3.14	5.22	4.99	4.41	xxx	3.61	4.91	4.29	3.54	2.38
1385	4.39	4.51	2.83	4.52	4.35	3.85	xxx	3.19	4.28	3.76	3.13	2.12
1386	4.84	4.87	3.17	4.81	4.65	4.21	xxx	3.60	4.57	4.06	3.48	2.52
1387	5.87	5.67	3.54	5.67	5.44	4.91	xxx	4.13	5.35	4.73	4.02	2.86
1388	5.67	5.30	3.13	5.33	5.06	4.46	xxx	3.58	4.99	4.33	3.55	2.30
1389	4.38	4.24	2.69	4.32	4.15	3.65	xxx	2.94	4.08	3.56	2.93	1.91
1390	xxx	4.72	3.17	4.71	4.61	4.18	xxx	3.57	4.51	4.03	3.47	2.57
1391	xxx	5.66	3.57	5.58	5.41	4.92	xxx	4.17	5.17	4.74	4.04	2.99
1392	xxx	5.06	3.03	5.11	4.89	4.33	xxx	3.46	4.80	4.19	3.40	2.19
1393	xxx	3.87	2.53	3.99	3.83	3.33	xxx	2.66	3.76	3.26	2.65	1.68
1394	xxx	4.51	3.19	4.70	4.58	4.09	xxx	3.68	4.49	4.06	3.56	2.75
1395	xxx	5.71	3.65	5.79	5.60	5.01	xxx	4.40	5.48	4.90	4.21	3.12
1396	xxx	5.32	3.26	5.36	5.14	4.56	xxx	3.75	5.06	4.43	3.69	2.54
1397	xxx	4.13	2.76	4.26	4.12	3.63	xxx	2.96	4.06	3.56	2.97	2.05
1398	xxx	4.40	3.13	4.57	4.43	4.03	xxx	3.57	4.36	3.96	3.46	2.68
1399	xxx	5.42	3.55	5.51	5.28	4.82	xxx	4.24	5.22	4.70	4.07	3.09
1400	xxx	5.11	3.22	5.14	4.94	4.44	xxx	3.72	4.88	4.29	3.61	2.57
1401	xxx	4.09	2.80	4.20	4.08	3.62	xxx	3.04	4.00	3.54	3.01	2.16
1402	xxx	4.12	2.86	4.16	4.03	3.67	xxx	3.22	3.97	3.58	3.13	2.42
1403	xxx	5.18	3.33	5.10	4.92	4.53	xxx	3.95	4.90	4.38	3.79	2.89
1404	xxx	4.92	3.07	4.91	4.75	4.27	xxx	3.59	4.73	4.14	3.47	2.43

Tide	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1405	xxx	3.72	2.54	3.85	3.74	3.32	xxx	2.79	3.70	3.26	2.74	1.94
1406	xxx	3.96	2.88	4.13	4.02	3.72	xxx	3.29	3.96	3.60	3.17	2.50
1407	4.64	4.77	3.23	4.85	4.69	4.36	xxx	3.84	4.64	4.18	3.65	2.81
1408	4.63	4.78	3.12	4.72	4.59	4.20	xxx	3.64	4.55	4.06	3.48	2.60
1409	3.31	3.70	2.57	3.77	3.71	3.35	xxx	2.87	3.65	3.28	2.82	2.09
1410	3.31	3.75	2.82	3.89	3.85	3.59	xxx	3.22	3.79	3.46	3.10	2.48
1411	4.03	4.38	3.15	4.43	4.33	4.08	xxx	3.65	4.29	3.90	3.47	2.77

APPENDIX B

LIST OF COMMON NAMES AND AUTHORITIES FOR PLANTS SEEN IN OR NEAR POLYGONS AT SAMPLING STATIONS IN THE CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

List of Plant Species

A list of plant species used in text and tables with accompanying authorities and common names follows. Both common and scientific names for vascular plants follow Kartesz and Meacham 1999. Species considered sensitive herbaceous species are marked with an asterisk (*). The list is cumulative for the project.

Acer rubrum L. Red Maple
**Alternanthera philoxeroides* (Mart.) Griseb. Alligator-Weed
Amaranthus cannabinus (L.) Sauer Tidal-Marsh Amaranth
Apios americana Medik. Groundnut
**Aster* sp. Probably *Symphyotrichum* sp.
Bidens laevis (L.) B.S.P. Smooth Beggarticks
Bidens sp. Beggarticks
**Boehmeria cylindrica* (L.) Sw. Small-Spike False Nettle
**Boltonia asteroides* (L.) L'Hér. White Doll's-Daisy
Campsis radicans (L.) Seem. Ex Bureau Trumpet-Creeper
**Carex* L. Sedge
**Carex crinita* Lam. Fringed Sedge
**Carex crinita* var. *brevicrinis* Fern. Fringed Sedge
Carex crus-corvi Shuttlw. Ex Kunze Raven-Foot Sedge
**Carex hyalinolepis* Steud. Shoreline Sedge
**Carex lupulina* Muhl. Ex Willd. Hop Sedge
Chasmanthium latifolium (Michx.) Yates Indian Wood-Oats
**Cicuta maculata* L. Spotted Water-Hemlock
**Cinna arundinacea* L. Sweet Wood-Reed
**Commelina virginica* L. Virginia Dayflower
**Cyperus* L. Umbrella Sedge
**Decodon verticillatus* (L.) Ell. Swamp-Loosestrife
**Dulichium arundinaceum* (L.) Britt. Three-Way Sedge
**Elymus virginicus* L. Virginia Wild Rye
**Eryngium aquaticum* L. Rattlesnake-Master
**Galium* L. Bedstraw
Hydrocotyle L. Marsh-Pennywort
**Hymenocallis floridana* (Raf.) Morton Florida Spider-Lily
Hypericum mutilum L. Dwarf St. John's-Wort
Impatiens capensis Meerb. Spotted Touch-Me-Not
Ipomoea L. Morning-Glory
Lilaeopsis chinensis (L.) Kuntze Eastern Grasswort
**Lobelia cardinalis* L. Cardinal-Flower
**Ludwigia grandiflora* (M. Micheli) Greuter & Burdet Large-Flower Primrose-Willow
**Ludwigia palustris* (L.) Ell. Marsh Primrose-Willow
**Lycopus virginicus* L. Virginia Water-Horehound
Mikania scandens (L.) Willd. Climbing Hempvine
**Murdannia keisak* (Hassk.) Hand.-Maz. Wart-Removing-Herb
Nyssa aquatica L. Water Tupelo
**Orontium aquaticum* L. Goldenclub
Osmunda regalis L. Gray Royal Fern
Packera glabella (Poir.) C. Jeffrey Cress-Leaf Groundsel
**Peltandra virginica* (L.) Schott Green Arrow-Arum
Phanopyrum gymnocarpon (Ell.) Nash Savannah-Panic Grass
Physostegia leptophylla Small Slender-Leaf False Dragonhead
Pilea pumila (L.) Gray Canadian Clearweed
Pluchea odorata (L.) Cass. Sweetscent
Polygonum arifolium L. Halberd-Leaf Tearthumb
**Polygonum hydropiper* L. Mild Water-Pepper
**Polygonum hydropiperoides* Michx. Swamp Smartweed

**Polygonum punctatum* Ell. Dotted Smartweed
Polygonum virginianum L. Jumpseed
**Pontederia cordata* L. Pickerelweed
Porella pinnata L Leafy Liverwort
Proserpinaca palustris L. Marsh Mermaidweed
**Rhynchospora corniculata* (Lam.) Gray Short-Bristle Horned Beak Sedge
**Rhynchospora inundata* (Oakes) Fern. Narrow-Fruit Horned Beak Sedge
Rosa palustris Marsh. Swamp Rose
**Rumex verticillatus* L. Swamp Dock
**Sagittaria lancifolia* L. Bull-Tongue Arrowhead
**Saururus cernuus* L. Lizard's-Tail
**Scutellaria lateriflora* L. Mad Dog Skullcap
**Schoenoplectus americanus* (Pers.) Volk. Ex Schinz & R. Keller Chairmaker's Club-Rush
Schoenoplectus robustus (Pursh) M.T. Strong Seaside Club-Rush
**Sium suave* Walt. Hemlock Water-Parsnip
Smilax rotundifolia L. Horsebrier
Solidago sempervirens var. *mexicana* (L.) Fern. Seaside Goldenrod
Spartina cynosuroides (L.) Roth Big Cord Grass
**Symphyotrichum elliottii* (Torr. & Gray) Nesom Marsh American-Aster
Symphyotrichum subulatum (Michx.) Nesom Seaside American-Aster
Symphyotrichum tenuifolium (L.) Nesom Perennial Saltmarsh American-Aster
Taxodium ascendens Brongn. Pond-Cypress
Toxicodendron radicans (L.) Kuntze Eastern Poison-Ivy
**Triadenum walteri* (J.G. Gmel.) Gleason Greater Marsh-St. John's-Wort
**Typha latifolia* L. Broad-Leaf Cat-Tail
Typha angustifolia L. Narrow-Leaf Cat-Tail
Typha ×glauca Godr. (pro sp.)
**Zizania aquatica* L. Indian Wild Rice
**Zizaniopsis miliacea* (Michx.) Doell & Aschers. Marsh-Millet

Kartesz, J.T., and C.A. Meacham. 1999. Synthesis of the North American Flora, Version 1.0. North Carolina Botanical Garden, Chapel Hill, NC.

APPENDIX C

METADATA COVERING GIS/GPS FILES USED IN TEXT FIGURES IN SENSITIVE HERBACEOUS VEGETATION POLYGONS: 2004 ASSESSMENTS AT SEVEN STATIONS ESTABLISHED FOR THE WILMINGTON HARBOR MONITORING PROJECT IN THE CAPE FEAR RIVER ESTUARY, NORTH CAROLINA

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P3, INNER TOWN CREEK

FIGURE 8.41-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	13ben.shp	13ben.dbf	13ben.shx
DESCRIPTION OF LAYER:	Point depicting concrete benchmark		
SOURCE:	Trimble PRO XRS GPS Unit		
DATA TYPE:	Point		
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2		
DATUM:	North American Datum (NAD) 1983		
COORDINATE SYSTEM:	U.S. State Plane 1983		
REGION:	North Carolina 3200		
UNITS OF MEASURE:	Feet		
DATA COLLECTION:	20 December 2000		
SOURCE:	CZR Incorporated		
SOURCE CONTACT:	Samuel Cooper		
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403		
SOURCE PHONE:	910/392-9253		
SOURCE FAX:	910/392-9139		

FILE NAMES:	13pil.shp	13pil.dbf	13pil.shx
DESCRIPTION OF LAYER:	Point depicting data collect platform piling		
SOURCE:	Trimble PRO XRS GPS Unit		
DATA TYPE:	Point		
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2		
DATUM:	North American Datum (NAD) 1983		
COORDINATE SYSTEM:	U.S. State Plane 1983		
REGION:	North Carolina 3200		
UNITS OF MEASURE:	Feet		
DATA COLLECTION:	20 December 2000		
SOURCE:	CZR Incorporated		
SOURCE CONTACT:	Samuel Cooper		
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403		
SOURCE PHONE:	910/392-9253		
SOURCE FAX:	910/392-9139		

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P3, INNER TOWN CREEK

FIGURE 8.41-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	13poly.shp	13poly.dbf	13poly.shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2000 (13poly.ssf GPS file from CZR Incorporated)		
SOURCE:	Trimble PRO XRS GPS Unit		
DATA TYPE:	Polygon		
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2		
DATUM:	North American Datum (NAD) 1983		
COORDINATE SYSTEM:	U.S. State Plane 1983		
REGION:	North Carolina 3200		
UNITS OF MEASURE:	Feet		
DATA COLLECTION:	20 December 2000		
SOURCE:	CZR Incorporated		
SOURCE CONTACT:	Samuel Cooper		
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403		
SOURCE PHONE:	910/392-9253		
SOURCE FAX:	910/392-9139		

FILE NAMES:	13sub.shp	13sub.dbf	13sub.shx
DESCRIPTION OF LAYER:	Points depicting substation survey points		
SOURCE:	Trimble PRO XRS GPS Unit		
DATA TYPE:	Points		
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2		
DATUM:	North American Datum (NAD) 1983		
COORDINATE SYSTEM:	U.S. State Plane 1983		
REGION:	North Carolina 3200		
UNITS OF MEASURE:	Feet		
DATA COLLECTION:	20 December 2000		
SOURCE:	CZR Incorporated		
SOURCE CONTACT:	Samuel Cooper		
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403		
SOURCE PHONE:	910/392-9253		
SOURCE FAX:	910/392-9139		

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P3, INNER TOWN CREEK

FIGURE 8.41-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	site9.tif
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1" = 250' Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272' based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P3, TOWN CREEK

FIGURE 8.41-1

**CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA**

FILE NAMES:	13tra.shp 13tra.dbf 13tra.shx
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	Area-gen. shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2004
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9 and Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	21 Jan 2005
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P3, TOWN CREEK

FIGURE 8.41-1

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, *NORTH CAROLINA*

FILE NAMES:	Point-ge .shp, .dbf, .shx
DESCRIPTION OF LAYER:	Points depicting sensitive herbaceous plants, 2004
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9 and Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	21 January 2006
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

FILE NAMES:	itcpol05 .shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2005
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9 and Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	10 Jan 2005
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P3, TOWN CREEK

FIGURE 8.41-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	itcpt05 .shp, .dbf, .shx
DESCRIPTION OF LAYER:	Point depicting sensitive herbaceous plants, 2005
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9 and Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	10 Jan 2006
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P7, INDIAN CREEK

FIGURE 8.42-1

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	15ben.shp 15ben.dbf 15ben.shx
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	15pil.shp 15pil.dbf 15pil.shx
DESCRIPTION OF LAYER:	Point depicting data collect platform piling
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P7, INDIAN CREEK

FIGURE 8.42-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	Indcr2.shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2003
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.8 and Arcview 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	6 January 2003
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

FILE NAMES:	15sub.shp 15sub.dbf 15sub.shx
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P7, INDIAN CREEK

FIGURE 8.42-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	site8.tif
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1” = 250’ Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272’ based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P7, INDIAN CREEK

FIGURE 8.42-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	15tra.shp	15tra.dbf	15tra.shx
DESCRIPTION OF LAYER:	Points depicting belt transect markers		
SOURCE:	Trimble PRO XRS GPS Unit		
DATA TYPE:	Points		
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2		
DATUM:	North American Datum (NAD) 1983		
COORDINATE SYSTEM:	U.S. State Plane 1983		
REGION:	North Carolina 3200		
UNITS OF MEASURE:	Feet		
DATA COLLECTION:	20 December 2000		
SOURCE:	CZR Incorporated		
SOURCE CONTACT:	Samuel Cooper		
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403		
SOURCE PHONE:	910/392-9253		
SOURCE FAX:	910/392-9139		

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P8, DOLLISONS LANDING

FIGURE 8.43-1

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	16ben.shp 16ben.dbf 16ben.shx
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	16pil.shp 16pil.dbf 16pil.shx
DESCRIPTION OF LAYER:	Point depicting data collect platform piling
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P8, DOLLISONS LANDING

FIGURE 8.43-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	Area-gen.shp, .dbf .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2002
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	6 January 2003
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

FILE NAMES:	16sub.shp 16sub.dbf 16sub.shx
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P8, DOLLISONS LANDING

FIGURE 8.43-1

**CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA**

FILE NAMES:	site3.tif
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1" = 250' Resolution: 1100 DPI (23.1 microns):
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272' based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P8, DOLLISONS LANDING

FIGURE 8.43-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	16tra.shp 16tra.dbf 16tra.shx
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P9, BLACK RIVER

FIGURE 8.44-1

**CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA**

FILE NAMES:	17ben.shp	17ben.dbf	17ben.shx

DESCRIPTION OF LAYER: Point depicting concrete benchmark

SOURCE: Trimble PRO XRS GPS Unit

DATA TYPE: Point

SOFTWARE: Pathfinder Office 2.1 and Arcview version 3.2
DATUM: North American Datum (NAD) 1983
COORDINATE SYSTEM: U.S. State Plane 1983
REGION: North Carolina 3200
UNITS OF MEASURE: Feet
DATA COLLECTION: 20 December 2000

SOURCE: CZR Incorporated
SOURCE CONTACT: Samuel Cooper
SOURCE ADDRESS: 4709 College Acres, Suite 2
Wilmington, NC 28403
SOURCE PHONE: 910/392-9253
SOURCE FAX: 910/392-9139

FILE NAMES:	17pil.shp	17pil.dbf	17pil.shx

DESCRIPTION OF LAYER: Point depicting data collect platform piling

SOURCE: Trimble PRO XRS GPS Unit

DATA TYPE: Point

SOFTWARE: Pathfinder Office 2.1 and Arcview version 3.2
DATUM: North American Datum (NAD) 1983
COORDINATE SYSTEM: U.S. State Plane 1983
REGION: North Carolina 3200
UNITS OF MEASURE: Feet
DATA COLLECTION: 20 December 2000

SOURCE: CZR Incorporated
SOURCE CONTACT: Samuel Cooper
SOURCE ADDRESS: 4709 College Acres, Suite 2
Wilmington, NC 28403
SOURCE PHONE: 910/392-9253
SOURCE FAX: 910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P9, BLACK RIVER

FIGURE 8.44-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	17poly.shp 17poly.dbf 17poly.shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2000 (17poly.ssf GPS file from CZR Incorporated)
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	17sub.shp 17sub.dbf 17sub.shx
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P9, BLACK RIVER

FIGURE 8.44-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	site4.tif
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1" = 250' Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272' based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

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METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P9, BLACK RIVER

FIGURE 8.44-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	17tra.shp, .dbf, .shx
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	Area-gen.shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2004
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.9, Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	21 January, 2005
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P9, BLACK RIVER

FIGURE 8.44-1

**CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA**

FILE NAMES:	briv.shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2005
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.9, ArcView 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	21 January, 2006
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P12, RAT ISLAND

FIGURE 8.45-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	Cam2.shp Came2.dbf Cam2.shx
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	Ratpil2.shp, .dbf, .shx
DESCRIPTION OF LAYER:	Point depicting new location of piling, 2002
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.8 and Arcview 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	5 August 2002
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P12, RAT ISLAND

FIGURE 8.45-1

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	19poly.shp 19poly.dbf 19poly.shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2000 (19poly.ssf GPS file from CZR Incorporated)
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	19sub.shp 19sub.dbf 19sub.shx
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P12, RAT ISLAND

FIGURE 8.45-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	site5.tif
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1" = 250' Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272' based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P12, RAT ISLAND

FIGURE 8.45-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	19tra.shp 19tra.dbf 19tra.shx
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	RATISL.shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2001
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.8, Arcview 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	23 August, 2001
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P13, FISHING CREEK

FIGURE 8.46-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	20ben.shp 20ben.dbf 20ben.shx
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	20pil.shp 20pil.dbf 20pil.shx
DESCRIPTION OF LAYER:	Point depicting data collect platform piling
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P13, FISHING CREEK

FIGURE 8.46-1

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	20poly.shp 20poly.dbf 20poly.shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2000 (20poly.ssf GPS file from CZR Incorporated)
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	20sub.shp 20sub.dbf 20sub.shx
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P13, FISHING CREEK

FIGURE 8.46-1

**CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA**

FILE NAMES:	site2b.tif
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1" = 250' Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272' based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P13, FISHING CREEK

FIGURE 8.46-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	20tra.shp 20tra.dbf 20tra.shx
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	Area-gen, .shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2004
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9, Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	22 January, 2005
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P13, FISHING CREEK

FIGURE 8.46-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	Area-gen, .shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2004
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9, Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	22 January, 2005
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

FILE NAMES:	fcreek05, .shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2005
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9, Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	12 January, 2006
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409:
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P14, PRINCE GEORGE CREEK

FIGURE 8.47-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	21ben.shp	21ben.dbf	21ben.shx
DESCRIPTION OF LAYER:	Point depicting concrete benchmark		
SOURCE:	Trimble PRO XRS GPS Unit		
DATA TYPE:	Point		
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2		
DATUM:	North American Datum (NAD) 1983		
COORDINATE SYSTEM:	U.S. State Plane 1983		
REGION:	North Carolina 3200		
UNITS OF MEASURE:	Feet		
DATA COLLECTION:	20 December 2000		
SOURCE:	CZR Incorporated		
SOURCE CONTACT:	Samuel Cooper		
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403		
SOURCE PHONE:	910/392-9253		
SOURCE FAX:	910/392-9139		

FILE NAMES:	21pil.shp	21pil.dbf	21pil.shx
DESCRIPTION OF LAYER:	Point depicting data collect platform piling		
SOURCE:	Trimble PRO XRS GPS Unit		
DATA TYPE:	Point		
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2		
DATUM:	North American Datum (NAD) 1983		
COORDINATE SYSTEM:	U.S. State Plane 1983		
REGION:	North Carolina 3200		
UNITS OF MEASURE:	Feet		
DATA COLLECTION:	20 December 2000		
SOURCE:	CZR Incorporated		
SOURCE CONTACT:	Samuel Cooper		
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403		
SOURCE PHONE:	910/392-9253		
SOURCE FAX:	910/392-9139		

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P14, PRINCE GEORGE CREEK

FIGURE 8.47-1

**CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA**

FILE NAMES:	21poly.shp 21poly.dbf 21poly.shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2000 (21poly.ssf GPS file from CZR Incorporated)
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	21sub.shp 21sub.dbf 21sub.shx
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P14, PRINCE GEORGE CREEK

FIGURE 8.47-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	site1.tif
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1" = 250' Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272' based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P14, PRINCE GEORGE CREEK

FIGURE 8.47-1

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	21tra.shp 21tra.dbf 21tra.shx
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	Area-gen.shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2004
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9, Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	22 January, 2005
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P14, PRINCE GEORGE CREEK

FIGURE 8.47-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	pgc05.shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2005
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9, Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	12 January, 2006
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

APPENDIX D

AREAS AND LOCATIONS OF NEW YEAR 2005 SENSITIVE HERBACEOUS SPECIES POLYGONS AT SAMPLING STATIONS IN THE CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

Table D1. Areas and locations of year 2005 sensitive herbaceous species polygons at sampling stations in the Cape Fear River Estuary, Wilmington Harbor Monitoring Project, North Carolina

Station Name/Number	Polygon Area (ft^2)	Point Number	Northing* (ft)	Easting* (ft)
Town Creek/ P3-A	3023.37	1A	140277.038	2304218.997
		2A	140266.789	2304201.285
		3A	140254.743	2304194.880
		4A	140249.465	2304187.035
		5A	140244.039	2304180.329
		6A	140234.363	2304181.958
		7A	140232.131	2304178.519
		8A	140225.210	2304171.268
		9A	140203.468	2304188.287
		10A	140186.799	2304228.337
		11A	140194.738	2304218.580
		12A	140218.972	2304217.875
		13A	140274.607	2304238.752
P3-C	595.8	1C	140281.656	2304236.782
		2C	140283.505	2304242.246
		3C	140302.289	2304251.935
		4C	140323.203	2304213.641
OL-1 Point		1	140318.617	2304230.244
Black River/ P9	251.78	A	216619.718	2286268.383
		B	216630.997	2286265.635
		C	216635.128	2286286.067
		D	216617.557	2286282.889
Fishing Creek P13	2272.78	1	215481.037	2303578.807
		2	215463.671	2303577.963
		3	215459.700	2303580.149
		4	215456.641	2303587.758
		5	215447.511	2303596.497
		6	215434.479	2303603.164
		7	215435.434	2303591.283
		8	215438.878	2303578.019
		9	215446.697	2303572.919
		10	215463.555	2303564.140
		11	215470.546	2303563.012
		12	215481.873	2303557.663
		13	215493.287	2303564.334
		14	215510.781	2303559.331
		15	215510.906	2303542.784
		16	215541.262	2303518.889
		17	215549.340	2303536.916
		18	215536.494	2303556.425
		19	215523.861	2303559.320
		20	215507.870	2303569.683
		21	215505.760	2303579.500
		22	215495.508	2303580.691
		23	215491.336	2303578.749
		24	215492.962	2303573.951
		25	215483.517	2303568.020

Station Name/Number	Polygon Area (ft^2)	Point Number	Northing* (ft)	Easting* (ft)
Prince George Creek./P14	5245.89	1	227257.195	232012.695
		2	227248.844	2320215.889
		3	227236.032	2320223.989
		4	227229.928	2320226.411
		5	227222.056	2320227.619
		6	227209.550	2320231.835
		7	227214.239	2320246.059
		8	227216.016	2320251.211
		9	227224.590	2320249.697
		10	227216.111	2320261.913
		11	227201.201	2320269.257
		12	227222.832	2320281.613
		13	227208.038	2320281.386
		14	227214.048	2320287.134
		15	227226.322	2320309.048
		16	227228.114	2320302.919
		17	227228.151	2320293.418
		18	227240.874	2320287.268
		19	227241.016	2320290.872
		20	227252.492	2320282.290
		21	227259.466	2320279.765
		22	227267.490	2320281.887
		23	227282.262	2320295.025
		24	227293.048	2320302.395
		25	227308.263	2320282.929

*North Carolina State Coordinate System, Region 3200, North American Datum, 1983.