

**NE Florida Aquatic Preserves - Data Collection at Kingsley Plantation Site
Water Quality Summary Report**

March 2004 – February 2005



November 2005

Amy Kalmbacher and Eva DiDonato

In fulfillment of cooperative agreement No. H5310030005 between the Department of Interior – National Park Service, Timucuan Ecological and Historic Preserve and the Florida Department of Environmental Protection, Office of Coastal and Aquatic Managed Areas

Principal investigators:

Amy Kalmbacher, Environmental Specialist I
Florida Department of Environmental Protection
CAMA / NE Florida Aquatic Preserves
13802 Pumpkin Hill Road
Jacksonville, FL 32226
904-696-5944
amy.kalmbacher@dep.state.fl.us

Eva DiDonato, Aquatic Ecologist/ Water Quality Specialist
Inventory and Monitoring Program
Southeast Coast Network
Fort Sumter National Monument
1214 Middle Street
Sullivan's Island, SC 29482
843-883-5036
Eva_DiDonato@nps.gov

Executive Summary

The boundaries of the National Park Service (NPS) Timucuan Preserve are nearly identical to the boundaries of Florida Department of Environmental Protection's (DEP) Nassau River - St. Johns River Marshes Aquatic Preserve. Toward the close of 2003, DEP's office of Coastal and Aquatic Managed Areas (CAMA) took initial steps toward developing a statewide water quality monitoring program involving each of their coastal preserves. Since rapid changes due to sedimentation and shifting bathymetry had been occurring in the Ft. George River, and because these changes were of concern to the NPS and CAMA, our very first data collecting site was designated at Kingsley Plantation.

In early 2004, funds were transferred to CAMA from the NPS to purchase two Yellow Springs Instruments (YSI) Model 6600EDS - S data sondes. These submersible instruments record various water quality measurements completely unattended, and are designed to continuously collect data at specific intervals for extended deployment periods. In January 2004, CAMA staff attached a 24 foot PVC tube directly to one of the pilings at the Kingsley Plantation dock to serve as a protective housing for the monitoring device. A data sonde was then suspended within the PVC tube and lowered to approximately one meter from the bottom of the river, with just the collecting probes protruding. From that point on, the instrument has recorded measurements of salinity, conductivity, turbidity, temperature, pH, depth and dissolved oxygen every 30 minutes. CAMA staff retrieve the meter every 10 to 14 days and replace it with a second meter which has been cleaned and calibrated prior to deployment.

The retrieved data sonde is taken back to the CAMA laboratory where data is downloaded from the memory, the unit and the sensors are post-calibrated, cleaned and recharged, then stored until the next deployment. As of February 28, 2005 the data sonde units completed a full year of data collection at the Kingsley Plantation site. Analysis of the data has shown several interesting occurrences.

After the hurricanes of August/September 2004, the salinity levels in the Ft. George River were not only lowered due to large amounts of rainfall, but remained highly variable for several weeks thereafter. This prolonged decrease in salinity implies that the river and marshes surrounding the area do not flush or exchange waters with the ocean as quickly as was previously thought. Because of ever increasing pressure from development within the boundaries of this drainage basin, preventative measures to control contaminants and nutrient enrichment from surface runoff become more important than ever.

High turbidity levels often coincided with busy boating weekends. The increased amount of particulate matter in the water may be the result of increased boating traffic, especially at low tides when propellers are more likely to disturb the substrate and suspend silt and sand into the water column.

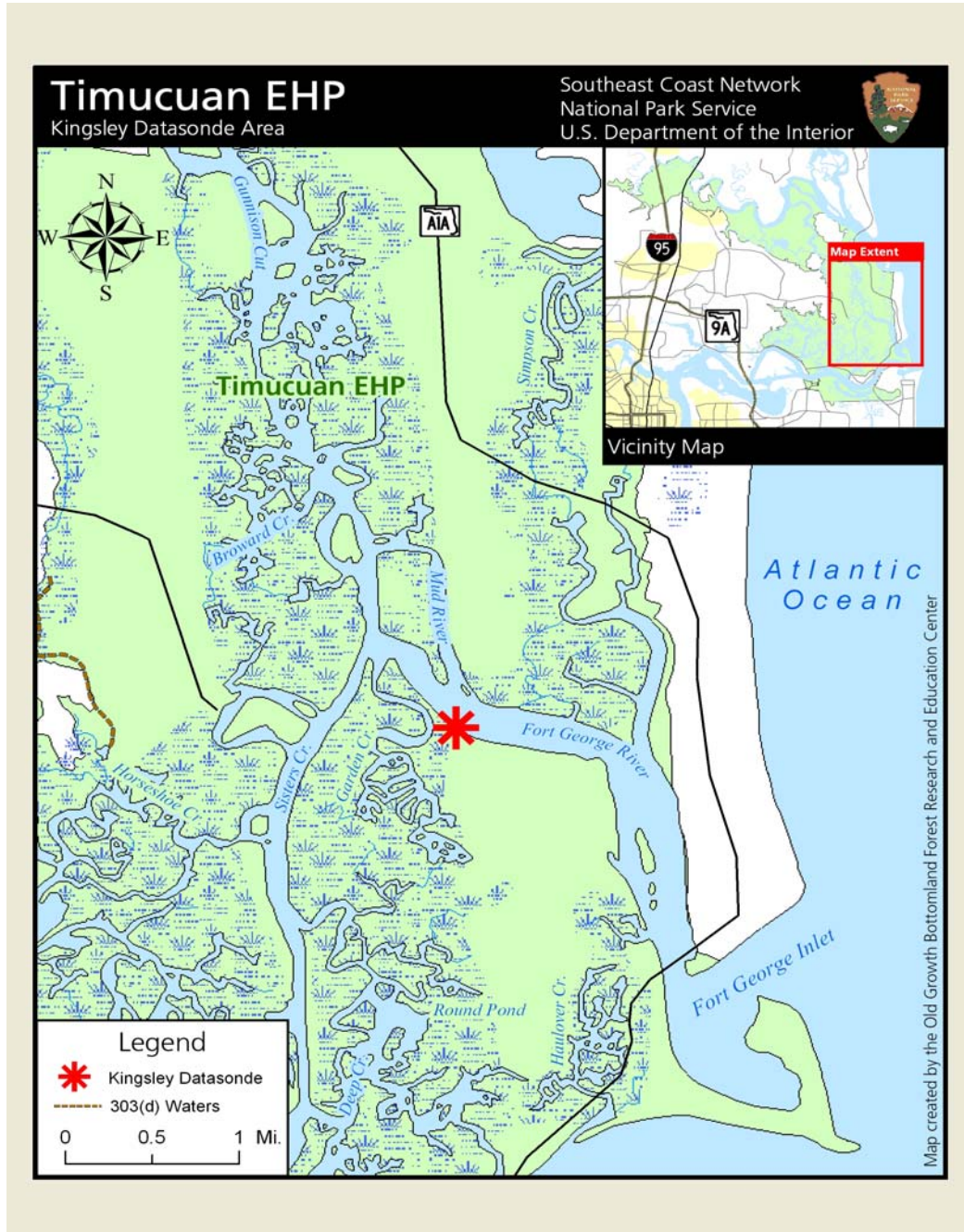
The data also revealed short periods of time when the dissolved oxygen level fell below that of state standards. These low levels do not necessarily indicate a problem within the

system, however. Most of these readings occurred during times of high water temperature, and can be considered normal for seasonal conditions (warm water does not “hold” as much oxygen as cold water). Additionally, these readings were recorded near the bottom of the channel where much less surface to air mixing occurs, and dissolved oxygen readings are normally lower than elsewhere in the water column. In fact, these low oxygen levels may be a natural occurrence that could in some ways be considered beneficial to fish populations. During these times of decreased oxygen saturation, juvenile fish can forage without fear of predation by larger fish that require greater levels of dissolved oxygen and have moved elsewhere to find it. Overall, as long as these periods of hypoxia remain limited, the situation should not be viewed as problematic.

Even though the NPS is no longer funding data collection, CAMA will continue to use the Kingsley Plantation monitoring site and partner with the resource staff to share research and data beneficial to both. Since this first installation at Kingsley, two additional data collectors have been installed at other locations within or immediately adjacent to the Timucuan Preserve. At the eventual “build out” of the project, a total of four sondes will be placed within the immediate vicinity of Timucuan boundaries. As well, two additional sites are planned to the north, one within the Amelia River, and one within the Ft. Clinch State Park Aquatic Preserve. As the project continues, and collected data are analyzed, it is hoped that we will gain additional insight into the varied tidal systems that comprise our preserves, and continue to share information to the benefit of all who enjoy this unique area of Florida.

2) Research Objectives:

The Ft. George River, in Northeast Florida's Nassau River basin, connects the Intracoastal Waterway with the Atlantic Ocean at Ft. George River Inlet. Ongoing sedimentation and reduced tidal volume due to hydrological changes in this inlet have led to questions concerning potential water quality changes. For this reason Kingsley Plantation (NPS Timucuan Ecological and Historic Preserve), situated on the south bank of the Ft. George River, was chosen as a monitoring site for a YSI 6600 EDS-S data sonde.



Historic data does exist for this system, but it is somewhat sporadic and mostly derived from grab samples taken at widely spaced intervals. To date nothing has been available that is equivalent to the type of data collected by the YSI 6600 EDS-S data sonde. The instrument collects continuous readings on a half hour cycle during deployments averaging 11 days in length. At the conclusion of the deployment the sonde is retrieved and exchanged for a clean, newly calibrated unit. In this way there is a constant, unbroken recording of data, and therefore a much higher rate of consistency in the resultant tables and graphs.

The objectives of this project are as follows :

- 1) to create a point in time baseline of water quality measurements against which to detect and measure future alterations to the system
- 2) to detect any deviations from expected water quality measurements
- 3) to detect any variation from state water quality standards
- 4) to relate observed variations in water quality measurements with concurrently collected meteorological data

3) Research Methods:

A YSI 6600 EDS-S data sonde has been continuously operating (collecting data every 30 minutes) at the Kingsley Plantation dock site since January 20, 2004. Since operating this type of extended deployment instrumentation was new to staff, the month of February essentially served as a “break in” period for data sonde operation and rotation. Though data was collected during February, it is not included in this report, and for all intents and purposes March 1, 2004 is considered the official start of data collection.



Data sonde housing attached to piling at NE corner of Kingsley Plantation dock.

The sonde is housed within a vertical 4 inch diameter PVC pipe that is directly attached to one of the support pilings at the NE corner of the Kingsley Plantation dock. The sonde is lowered on an attached rope within the PVC tube until its probes are just barely exposed beyond the lower edge of the pipe. At this point it is suspended approximately one meter above the substrate. A sheet of plastic mesh (1/4 inch opening) surrounds the protective guard on the data sonde to prevent fish and crabs from entering the guard and damaging any of the probes. A locking cap on the dock end of the PVC tube prevents any unwanted tampering, and a 4 inch stainless steel carriage bolt below the submerged edge prevents accidental slippage out of the other end should the rope or attachment hardware fail. Exchange of the data sondes (replacing an operating unit for a clean, calibrated unit at the end of a deployment period) usually takes about 5 - 10 minutes. Retrieval and replacement of the sondes never occurs within 5 minutes of a scheduled data recording in order to assure continuous collection of information. Field notes are also recorded during the exchange regarding weather conditions, tidal stage, condition of the retrieved sonde, and any unusual occurrences at the site.



Richard Bryant, Chief of Resources Stewardships for the NPS Timucuan Preserve, with a YSI 6600EDS-S data sonde.

After retrieval from the sampling site, data sondes are returned to the laboratory where post deployment readings and reconditioning take place in accordance with methods outlined in the YSI Operating and Service Manual. The sonde is rinsed with tap water then sequentially submersed in each of the various standards in order to obtain post deployment readings. Standards consist of pH (Fisher Scientific 7.00 buffer solution), conductivity (Exaxol 50.00 mS/cm standard) and 0.0 NTU turbidity (distilled water). The dissolved oxygen membrane, if requiring replacement, can also be exchanged at this point, as a period of at least 24 hours is required for it to equilibrate before its next deployment. These post deployment readings are then used to evaluate the validity of the data collected for that deployment period.

4) Site location and character:

Ft. George River Inlet is approximately 6 miles south of Nassau Sound and immediately north of the mouth of the St. Johns River in Northeast Florida's Duval County. The inlet is bordered by Little Talbot Island to the north, and Ward's bank to the south, and is one of the few inlets left in the state that is not hardened with fortification structures. Much of the land surrounding this system has remained relatively undeveloped due to its ownership by various governmental entities and its intended use for conservation and low impact public recreation.

Ft. George River connects to Simpson Creek a little more than a mile and a half from its mouth, and then another mile and a half to the west, it joins the Intracoastal waterway which in turn flows north to the mainstem of the Nassau River. The surface area drained by this sub – basin of the Nassau River constitutes an area of approximately 6,285 acres (Adamus et.al., 1997). As a conveyance of surface water runoff, this is not one of the largest freshwater contributors to the nearly 55 mile long Nassau River. The Ft. George River drainage basin is a sizable system, however, and any major changes to it could exert a noticeable impact on the Nassau River as well.

The climate for the Ft. George Island area can be categorized as humid and sub-tropical with long summers of abundant rainfall, followed by comparatively dry winters and occasional frost. The average annual rainfall is approximately 53 inches, at least 50% of which occurs during the months of June through September. Data from weather stations in Jacksonville and Jacksonville Beach give the average yearly temperature for this area as 69 degrees, with 55.9 degrees as the lowest mean monthly temperature in January, and 82.6 as the highest mean monthly temperature in July. Prevailing winds in this coastal area tend to be out of the east and southeast throughout the summer months, and predominantly out of the northeast during the winter.



View from Kingsley Plantation dock looking west along Ft. George River

Station description: The Kingsley Dock (KD) site is located at the Kingsley Plantation boat dock (N 30° 44' 11.6" / W 81° 43' 9.08") within the NPS Timucuan Ecological and Historic Preserve on Ft. George Island. Surrounding land use is predominantly natural with very limited residential development on Ft. George Island and the neighboring Talbot Islands. This site and surrounding surface waters carry the dual designation of Class II Shellfish Harvesting Waters and Outstanding Florida Waters. The average depth at this site is 4.0m with a tidal range of 1.54 m; the substrate type is muddy sand, with emergent oyster beds lining the immediate shoreline.

5) Entry verification:

Data are collected with a YSI Model 6600EDS-S data sonde and uploaded to a laptop PC in the water quality lab at the NE FL Aquatic Preserve office. Version 3.15 of Eco Watch software is used to plot the data and generate graphs. Graphs for each deployment are studied immediately for trends and anomalies. Any unusual variations are then noted as pertaining to individual probes, and the need for their reconditioning or replacement.

Each data file is exported as a comma delimited file (.cdf) using EcoWatch software. Two copies of this .cdf file are saved in the .csv format. One is used to archive the raw data, and one is edited to adjust all records of Eastern Standard Time to read exactly on the hour or half hour. This second file is also used to delete data at the beginning and end of each deployment period when the instrument was out of the water. These unwanted data can be identified, and consequently deleted, due to field notes that document the start and end times for each deployment, and from conductivity and depth readings near zero.

Monthly data files are then created from the edited .csv files and processed by various macros distributed by the Centralized Data Management Organization (CDMO) which handles all data sonde data collected by the National Estuarine Research Reserves (NERR). The macros check files for missing data points, fill all cells that do not contain data with periods, and convert the data columns to CDMO approved formats for time, date and numeric values. They also find all data that are out of acceptable range for the sensors, save the files as Excel worksheets, and generate single parameter monthly graphs.

Questionable data are evaluated to determine if they can be deemed valid, or must be deleted. Data that have fallen either outside of the expected range for the given site or outside of the range of measurements established for the data sonde sensors are flagged (see Table 1). Anomalous data are investigated for validity based on field observations, weather data, quality control checks, and instrument diagnostics. If anomalies are attributed to sensor malfunction, they are deleted. These deletions can be the direct result of a physical defect in one of the data sonde probes, such as a DO membrane puncture or a ruptured pH sensor “bulb”. If the voltage reading of the probe is outside of the range established for the sensor, or if the sensor will not calibrate, data will also be deleted.

6) Data collection period:

Though the data sonde protective housing was installed at the Kingsley Plantation dock in mid January of 2004, and the first data sonde unit was placed in the housing by the end of that month, data for this study was not collected until March 1, 2004. The month of February was used as a “break in period” in terms of familiarization with sonde calibration, deployment, data handling, and any possible trouble shooting for problems that might arise in the initial phase of the project. Since March 1, 2004, however, the station has remained in continuous service. Individual data sonde deployment and retrieval times for the full year of study from 03/01/04 – 02/28/05 are as follows:

BEGAN		ENDED	
02/26/04	16:00	03/11/04	15:00
03/11/04	15:30	03/30/04	14:00
03/30/04	14:30	04/08/04	13:00
04/08/04	12:30	04/22/04	13:30
04/22/04	14:00	05/06/04	12:00
05/06/04	12:30	05/21/04	14:00
05/21/04	14:30	06/04/04	11:30
06/04/04	12:00	06/11/04	12:00
06/11/04	13:00	06/22/04	09:00
06/22/04	09:30	07/01/04	12:30
07/01/04	13:00	07/09/04	10:00
07/09/04	10:30	07/16/04	14:30
07/16/04	15:00	07/26/04	09:30
07/26/04	10:00	07/28/04	10:30

07/28/04	11:00	08/04/04	09:30
08/04/04	10:00	08/16/04	11:00
08/16/04	11:30	08/24/04	10:30
08/24/04	11:00	08/31/04	12:00
08/31/04	12:30	09/08/04	13:00
09/08/04	13:30	09/21/04	11:00
09/21/04	10:30	09/29/04	11:30
09/29/04	11:00	10/06/04	12:00
10/06/04	12:00	10/13/04	11:30
10/13/04	12:00	10/25/04	11:30
10/25/04	12:00	11/05/04	11:00
11/05/04	11:30	11/15/04	10:30
11/15/04	11:30	11/30/04	12:30
11/30/04	13:00	12/14/04	10:30
12/14/04	11:00	12/30/04	12:30
12/30/04	12:00	01/13/05	11:30
01/13/05	12:00	01/28/05	16:00
01/28/05	16:30	02/22/05	11:30
02/22/05	12:00	03/09/05	11:00

7) Distribution

Since the establishment of the initial monitoring site at Kingsley Plantation the NE Florida Aquatic Preserves office has expanded its program to include two other stations within the Nassau/ St. Johns River drainage basins that also collect continuous data. After being downloaded, checked and graphed, the data are stored (for the time being) within the NE FL Aquatic Preserve office. Until available in a more broadly accessible format, data from all three sites are available upon request to other agencies, universities, non-profit environmental organizations, independent researchers and the general public.

In response to such requests for data from the Kingsley Plantation site for the first year of collection, the NPS Timucuan Ecological and Historic Preserve and DEP/CAMA Northeast Florida Aquatic Preserves retain the right to be fully credited for having collected and processed the data. The user is also to contact and fully acknowledge both NPS and DEP/CAMA in any subsequent publications in which any part of the data is used.

8) Associated researchers and projects:

CAMA's' Northeast Florida Aquatic Preserves office, aside from coordinating with other sections within the Department of Environmental Protection, works cooperatively with other resource protection agencies and organizations in the Nassau and St. Johns Rivers watershed. Some of these include the: 1) National Park Service (NPS), 2) St. Johns River Water Management District (SJRWMD), 3) US Army Corp. of Engineers (USACE), 5) City of Jacksonville (COJ), 6) The Nature Conservancy (TNC), 7) DEP

Division of Parks and Recreation (FPS), 8) Florida Fish and Wildlife Conservation Commission (FWCC), and 9) US Fish and Wildlife Service (USFWS).

Although occurring just slightly behind schedule to coincide with the most recent phase, the current monitoring program is producing data that may be of assistance for the next cycle of DEP's Total Maximum Daily Load program for the Nassau River. The existing sampling sites are located within segments of the river that do not have abundant background or historic information, and additional sites are planned for the near future. This type of continuous data may help give staff a clearer picture of conditions within certain stretches of the Nassau River and therefore assist in regulatory determinations.

The City of Jacksonville's Ambient Water Quality Section monitors the Ft. George River bi-monthly in its 12 site monitoring program within the Timucuan Preserve. Though not sampling all of the same parameters as the COJ, the aquatic preserve's program can offer continuous data from sites within the same region. In so doing, the city's long running program may be bolstered with information of prevailing conditions surrounding the collection of their "grab" samples that require laboratory analysis.

In cooperation with Richard Bryant, Chief of Resources Stewardships for the NPS Timucuan Preserve, approximately a dozen photo points have been established around Ft. George Inlet in attempts to document rudimentary changes in flow and channel morphology. In lieu of aerial photos that would be preferable (albeit economically unfeasible), the photos help record physical conditions at the time of the sonde's water quality data collection. Taken quarterly, usually at the lowest possible tide stage during a given season, it is hoped that these photos coupled with the collected data will give a better overall view of what has been occurring, hydrologically, in the Ft. George River Inlet.

9) Variable Sequence, Range of measurements, Units, Resolution, and Accuracy

Variable	Range of Measurements	Resolution	Accuracy
Date	1-12, 1-31, 00-99 (Mo,Day,Yr)	1mo, 1 day, 1 yr	NA
Time	0-24, 0-60, 0-60 (Hr, Min, Sec)	1 hr, 1 min, 1 sec	NA
Temp	-5 to 45 (c)	0.01 C	+/- 0.15C
Sp Cond	0-100 (mS/cm)	0.01 mS/cm	+/- 5% of reading+0.001mS/Cm
Salinity	0-70 Parts per thousand (ppt)	0.01ppt	+/-1% of reading or 0.1ppt *
DO	0-200(% air saturation)	0.1% @ air sat	+/-2% @ air saturation
DO	200-500 (% air saturation)	0.1% @ air sat	+/-6% @ air saturation
DO	0-20 (mg/l)	0.01 mg/l	+/-0.2 mg/l
DO	20-50	0.01 mg/l	+/- 0.6 mg/l
Depth	0-9.1 (m)	0.00m	+/-0.018m
PH	2-14 units	0.01 units	+/- 0.2 units
Turbidity	0-1000 NTU	0.1 NTU	+/- 5% of reading or 2 NTU *

Whichever is greater *

FOR COMPLETE SETS OF TABULAR AND GRAPHED DATA - SEE APPENDICES A AND B

10) Coded variable indicator and variable code definitions:

Within the data sets (appendices A and B) the following definitions apply:

File definitions: YSI deployment site/month/year (e.g. KDWQ0404 = monthly data from the Kingsley Plantation dock site for April of 2004).

Site code: KD = Kingsley Dock

11) Anomalous data (Contained within appendices A and B):

Note 1: When data sonde units are exchanged in the field, sometimes there are slight shifts produced in the data that are observable in the monthly graphs. These shifts are most notable in pH, specific conductivity, DO% and DO concentration and may be related to sensor drift (due to fouling) and /or calibration/performance difference between sondes.

Note 2: Turbidity “outliers” (i.e., those values that are negative or greater than 1000 NTU) are listed separately in Table 1 and have not been deleted from the monthly records. Negative turbidity values have occurred throughout the sampling year, but have been within the accuracy range of the sensor (± 2.0 NTU) and therefore have not been removed from the dataset.

March 1- 31, 2004

a) 03/28/04 –03/29/04 Accelerated winds from the north to northeast during these days may have affected depth, salinity, conductivity, and dissolved oxygen readings.

b) 03/30/04, 14:30 Shift in DO, conductivity, salinity, and depth attributed to data sonde exchange.

April 1 – 30, 2004

a) 04/08/04, 12:30 Shift in salinity and specific conductivity due to exchange of data sonde.

b) 04/13/04 & 04/14/04 Salinity and specific conductivity shift coincide with rainfall data for Kingsley area on those days ($> .5$ inch).

c) 04/30/04, 14:00, 1430, 19:30 Sudden occurrence turbidity spike to 1621 NTU-possible obstruction (fish or crab inside protective “cage”) or beginning of growth on probe toward end of deployment.

May 1 – 31, 2004

a) 05/01/04 – 05/04/04 Salinity, specific conductivity, pH and DO affected by nearly 2 inches of rainfall during the first four days of the month.

b) 05/03/04 – 05/05/04 High turbidity readings most likely due to end of deployment fouling.

c) 05/31/04 Moderately high turbidity readings could possibly be due to holiday (Memorial Day) boat traffic, though very high turbidity spikes are most likely attributed to heavy fouling at the end of deployment – filamentous growth had to be removed from probe at post calibration.

June 1 – 30 , 2004

a) 06/01/04 – 06/03/04 Turbidity values high due to heavy fouling at end of deployment (see above).

b) 06/11/04, 13:00 Shift in salinity and specific conductivity appear related to data sonde exchange

c) 06/12/04 – 06/15/04 Salinity and specific conductivity readings reflect the approximate 2 inches of rainfall that occurred during this time.

d) 06/29/04, 12:30, 20:00 High turbidity spikes probably due to obstruction (fish or crab within mesh guard).

July 1 – 31, 2004

a) 07/01/04 Turbidity spike to near 70NTU appears to be related to end of deployment fouling.

b) 07/12/04 – 07/20/04 Downward shift in salinity and specific conductivity reflective of rainfall (approximately 2 1/3 inches).

c) 07/20/04 – 07/26/04 DO readings suspect – O-ring from probe found on bottom of protective “cage” upon retrieval.

August 1 – 31, 2004

a) 08/14/04 – 08/25/04 Decrease in salinity / specific conductivity readings correspond with rainfall data for this period.

September 1 – 30, 2004

a) 09/05/04, 09/29/04 Turbidity spikes to 100NTU and over, and general exaggeration of values during the month, appear to be legitimate and associated with hurricane activity

b) 09/08/04 – 09/20/04 Salinity and specific conductivity decrease in response to hurricane related rainfall (nearly 5 inches on 09/05, 3 inches on 09/14 and 09/15, and 3 ½ inches on 09/27)

c) 09/20/04 Beginning of a depth shift most likely associated with strong NE winds from hurricane Ivan.

October 1 – 31, 2004

10/27/04, 5:00 Isolated turbidity spike to 862 NTU – probably due to obstruction.

November 1 – 30, 2004

a) 11/13/04 – 11/15/04 Elevated turbidity readings and spike to over 50 NTU attributed to fouling at end of deployment.

b) 11/09/04 Beginning of a period of strong winds out of the E/NE causing a “stacking up” effect reflected in depth, salinity and specific conductivity readings.

December 1 – 31, 2004

a) 12/26/04 Slightly elevated turbidity associated with over 1 ½ inch of rainfall in vicinity.

b) 12/20/04 Temperature drop and isolated downward spike in salinity and specific conductivity (?) – can not attribute to rainfall, but strong W/NW winds on the evening of the 19th and early morning hours of the 20th may have influenced readings.

January 1 – 31, 2005

a) 01/12/05, 01/15/05, 01/16/05, 01/28/05 – 01/30/05 Slightly elevated turbidity readings - all seem legitimate, and those occurring at mid- month associated with rainfall.

b) 01/13/05, 12:00 and 01/28/05, 16:30 Sharp drops in DO readings attributed to data sonde exchanges and calibration differences between units.

c) 01/15/05 – 01/18/05 Depth, salinity, and specific conductivity increases and temperature decreases correspond with strong N/NE winds.

February 1 – 28, 2005

a) 02/16/05 – 02/22/05 Salinity, specific conductivity, depth, and pH readings exhibit downward trend corresponding to prevailing westerly winds during the first few days of this period.

12) Deleted Data:

Values were recorded for the following periods by the data sondes, but removed from the final data set for the reasons stated.

- 03/11/04, 15:30 – 03/13/04, 7:00 – data sonde hung up in tube, not deployed to full sampling depth

- 06/03/04, 12:00 – 06/04/04, 10:30 Retrieval of data sonde was attempted on 06/03 but it became wedged in tube well above sampling level. Unit could not be removed from the tube until the following day at noon – all subsequent readings were recorded at an elevated depth.

-08/04/04, 10:00 – 08/05/04, 4:00 Data sonde hung up in tube – not deployed to proper sampling depth

-11/15/04, 11:30 – 11/16/04, 13:00 Very high tide waters prevented data sonde from settling to its proper depth

13) Missing Data:

Data are missing due to equipment or associated specific probes not being deployed, equipment / battery failure or time set errors at calibration.

- 05/07/04, 2:30 No value was recorded for specific conductivity (?) – no explanation for this missed reading.

- 06/04/04 11:00, 11:30 No values recorded – time set problem during data sonde exchange.

- 06/22/04 9:30, 10:00 No values recorded – Time set problem during data sonde exchange.

- 07/03/04, 8:00 – 07/09/04, 10:00 No data recorded – flooded battery chamber.
- 07/16/04, 14:00 and 14:30 No values recorded – time set error, not set to EST
- 07/26/04 , 10:00 No values recorded – time set error at deployment
- 08/16/04, 11:30 No values recorded – time set error at time of data sonde exchange
- 10/06/04, 11:30 No values recorded time set error at deployment

Table 1. Turbidity outliers

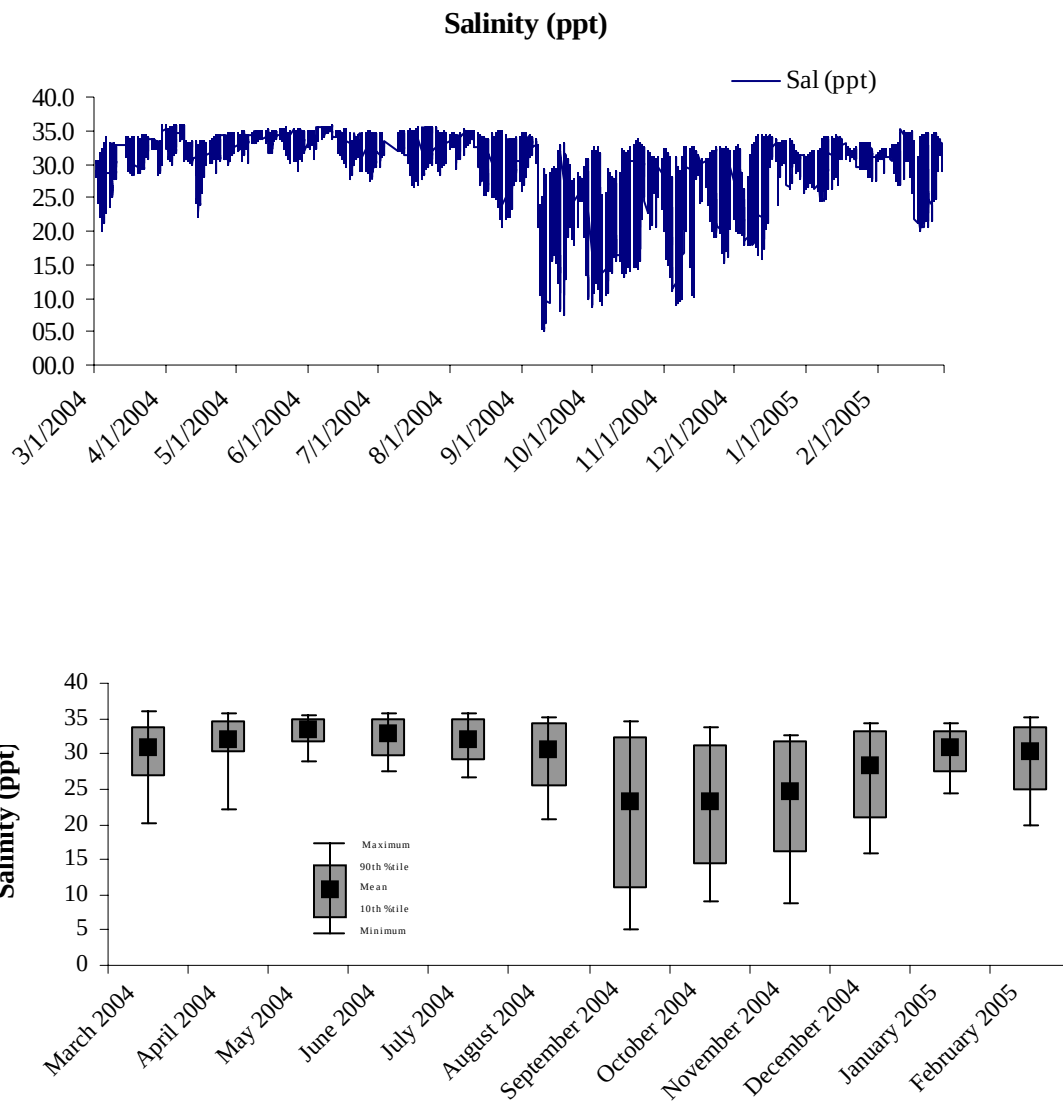
Date	Time	Value
04/30/04	14:00:00	1620
04/30/04	14:30:00	1616
05/03/04	18:30:00	1609
05/04/04	00:30:00	1610
05/04/04	02:30:00	1606
05/04/04	20:00:00	1598
05/04/04	20:30:00	1191
05/04/04	21:00:00	1597
05/04/04	21:30:00	1597
05/04/04	23:00:00	1600
05/04/04	24:00:00	1600
05/05/05	00:30:00	1598
05/05/05	02:00:00	1597
05/05/05	04:30:00	1595
05/05/05	20:00:00	1609
05/31/05	06:30:00	1816
05/31/05	09:00:00	1840
05/31/05	10:30:00	1779
05/31/05	13:00:00	1850
05/31/05	15:30:00	1860
05/31/05	17:00:00	1520
05/31/05	19:30:00	1812
05/31/05	22:00:00	1846
05/31/05	22:30:00	1111
05/31/05	24:00:00	1847
06/01/05	00:30:00	1039
06/01/05	02:30:00	1746
06/01/05	03:00:00	1054
06/01/05	05:00:00	1025
06/01/05	05:30:00	1344
06/01/05	08:30:00	1356

06/01/05	09:00:00	1663
06/01/05	11:00:00	1700
06/01/05	11:30:00	1103
06/01/05	14:00:00	1818
06/01/05	16:00:00	1474
06/01/05	16:30:00	1211
06/01/05	19:00:00	1091
06/01/05	19:30:00	1806
06/01/05	22:30:00	1831
06/02/05	02:30:00	1534
06/02/05	05:00:00	1338
06/02/05	05:30:00	1558
06/02/05	09:00:00	1761
06/02/05	09:30:00	1037
06/02/05	12:00:00	1841
06/02/05	15:00:00	1851
06/02/05	18:30:00	1802
06/02/05	22:00:00	1802
06/03/05	08:30:00	1799
06/03/05	12:00:00	1822
06/03/05	12:30:00	1077

14) Kingsley Data Summary:

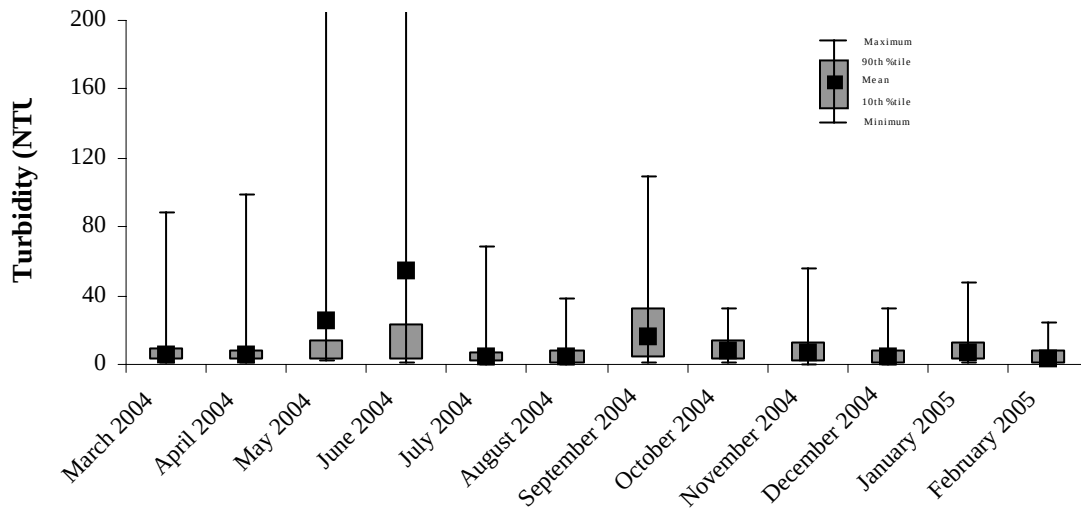
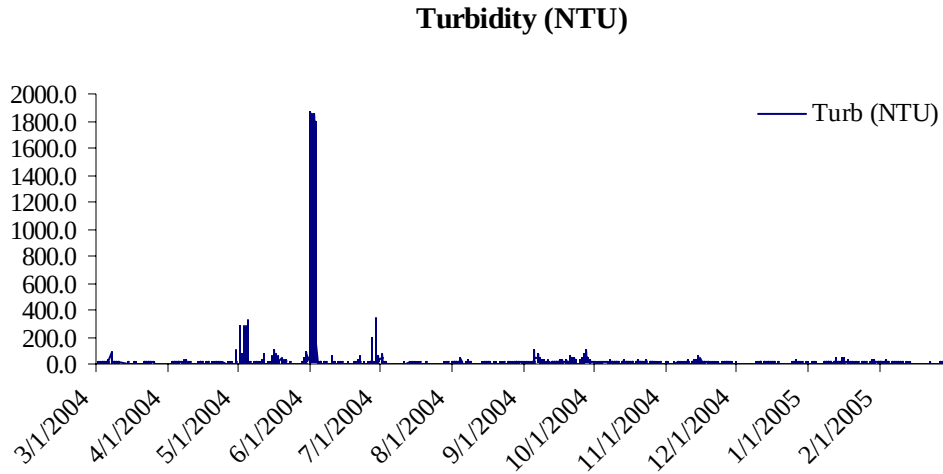
Salinity:

- Mean Daily Salinity = 29.4 ppt
- Mean Salinity Range = 7.75 ppt
- Lowest Salinity during this year occurred in September immediately after Hurricane Francis (5.2 ppt).
- Highest Salinity during this year occurred in March (35.9 ppt).



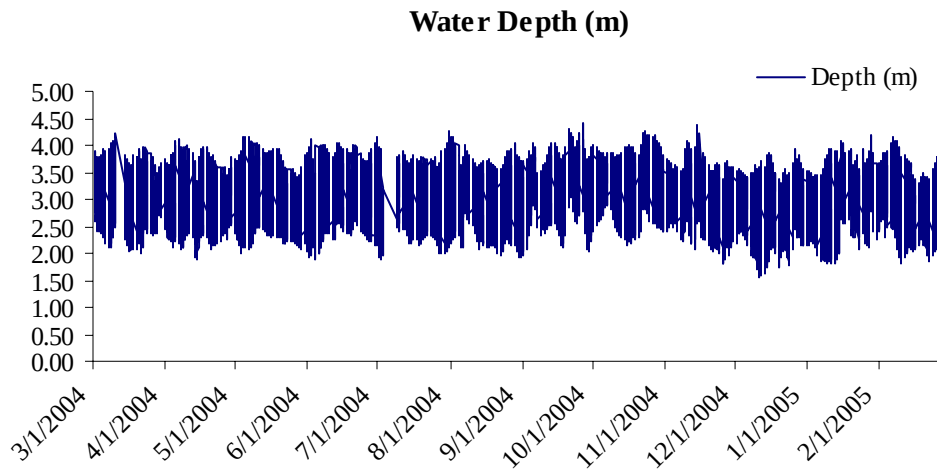
Turbidity:

- Greater than 25 NTU was experienced around 3% of the time.
- Large spike in turbidity over Memorial Day weekend.
- Minimum and maximum turbidities were 0.1 NTU and 1,860.2 NTU respectively.

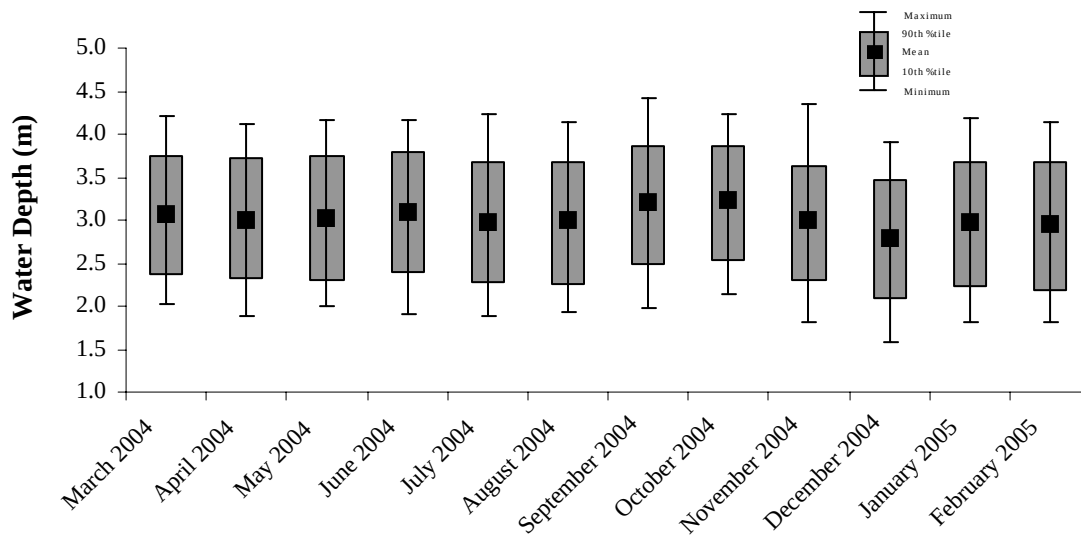


* Depth:

- Mean daily depth range = 1.54m.
- Mean depth = 4.0m.
- Minimum recorded depth was 1.6m (December), and maximum was 4.4m (November).

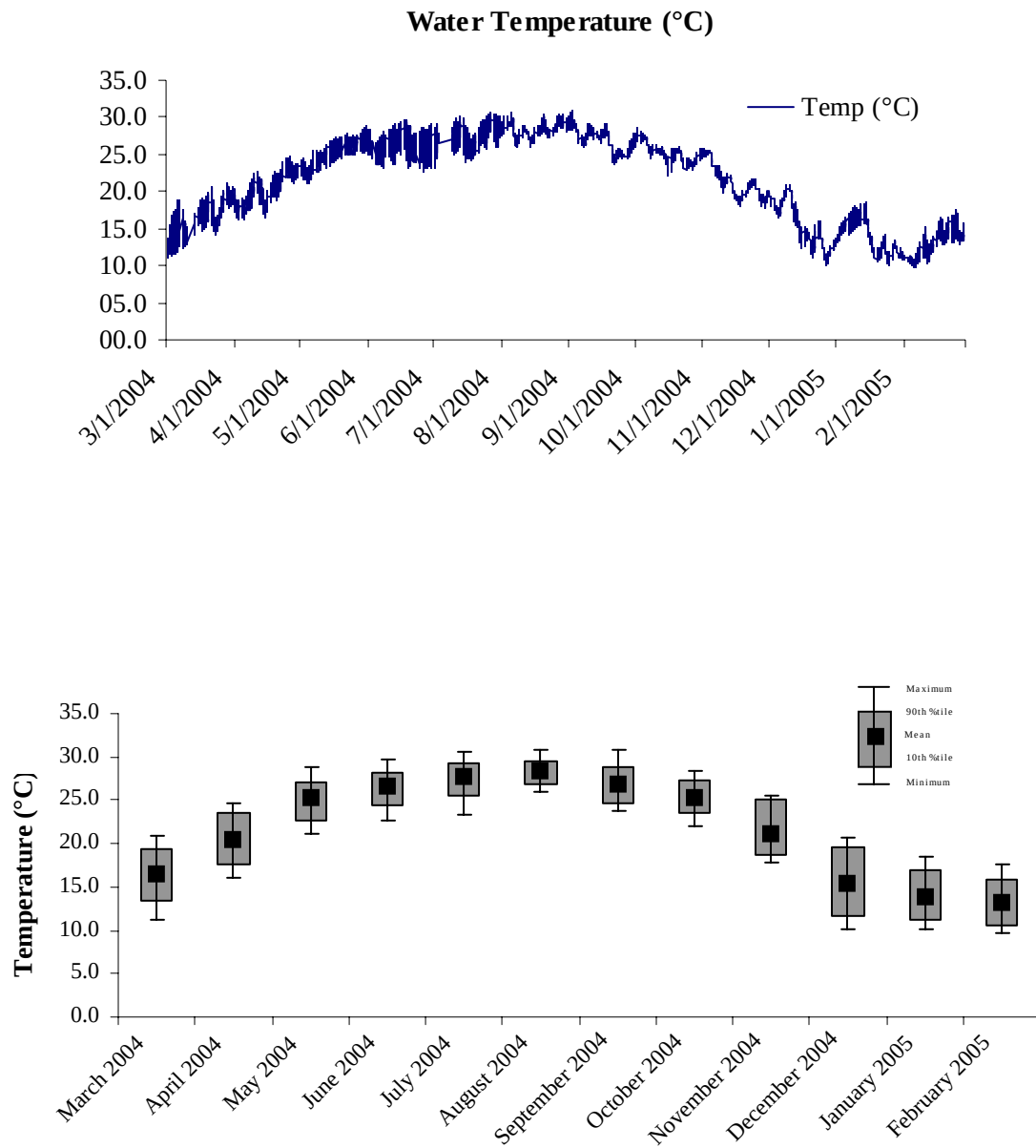


*All depth values represent the data sonde's depth in the water column, not the actual depth of the river. River depth at the time of collection of any of these values would be that number plus one meter.



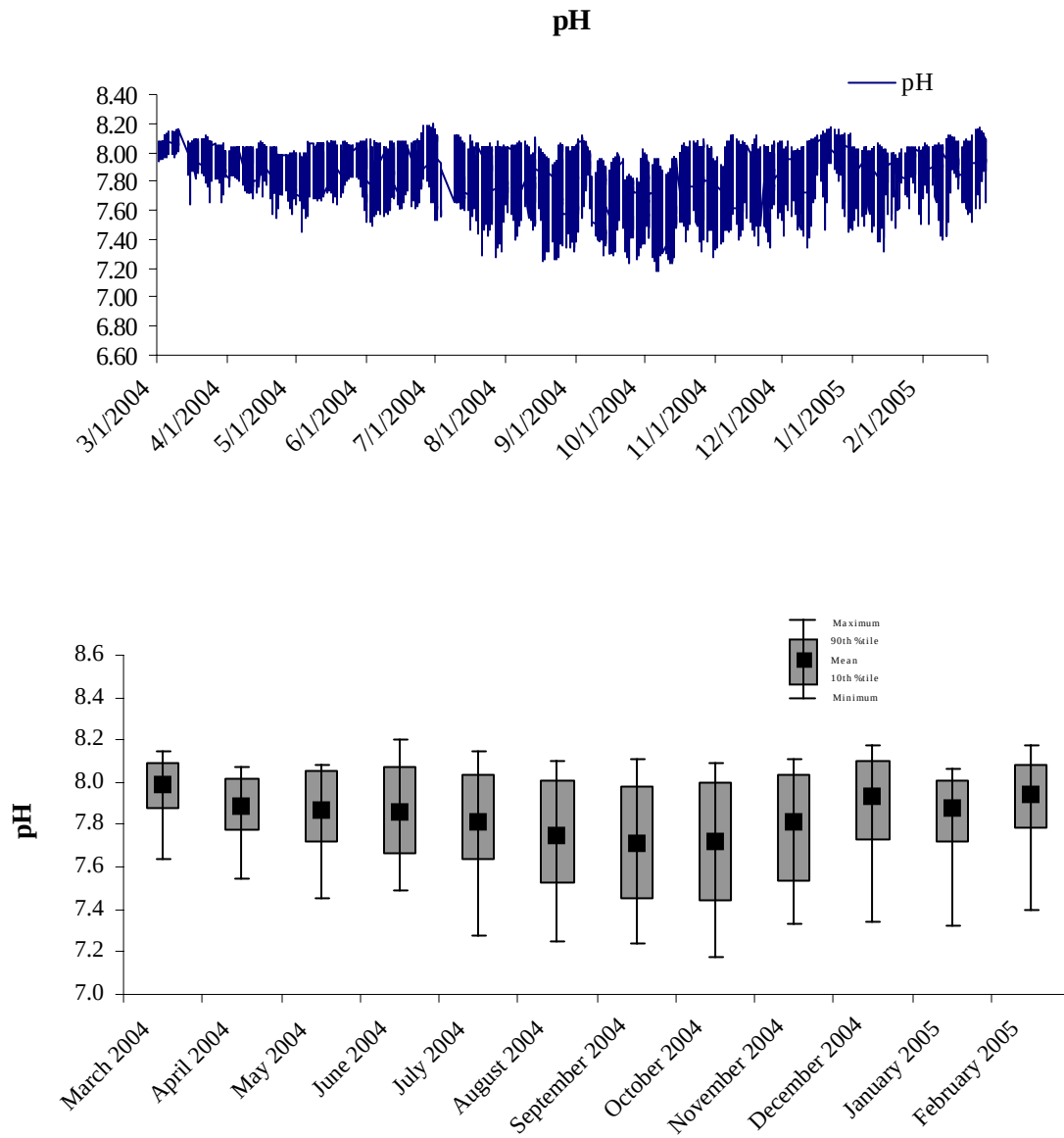
Water temperature:

- Water temperatures ranged from 9.7 C to 30.9 C.
- Temperatures exceeded 25 C in 40% of the measurements.



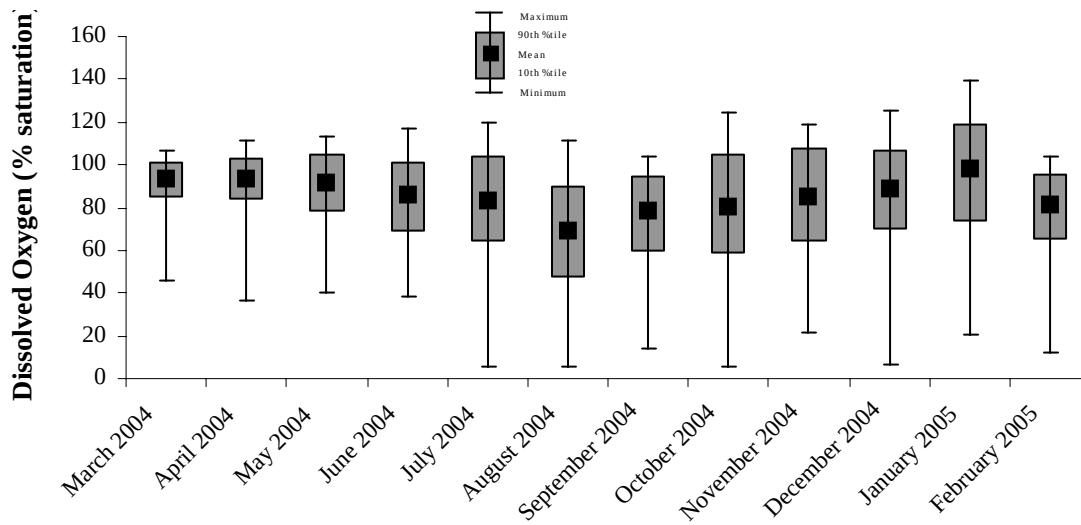
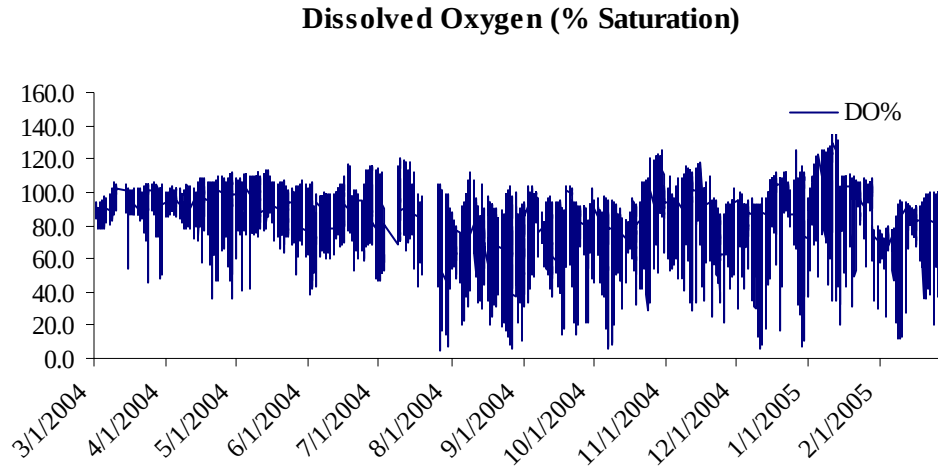
pH:

- Values greater than 8.0 occurred 21% of the time
- Values ranged from 7.2 – 8.2.



DO %:

- Minimum percent DO saturation observed was 5.4% (July).
- Highest percent DO saturation observed was 139.3% (January).



Graphs based on data collected from the first 48 hours of each deployment

Class II Surface Water Quality Standards:

The Florida Department of Environmental Protection has designated present and future most beneficial uses of all waters of the State by means of a classification system set forth in Chapter 62-302 of the Florida Administrative Code. Outlined in this chapter are surface water quality standards that have been established by the Department as a means for the protection and propagation of fish, shellfish, and wildlife, as well as for recreation in and on the water. According to Chapter 62- 302, all waters from Ft. George Inlet north to Nassau Sound, including all of Ft. George River and Simpson Creek, are categorized as Class II waters (shellfish propagation or harvesting waters). In terms of standards for Class II waters, only three parameters collected for this survey could be considered applicable: pH, dissolved oxygen, and turbidity. Florida state standards for each of these parameters are as follows: a) pH: Shall not vary more than one unit above or below natural background of coastal waters or more than two-tenths unit above or below natural background of open waters provided that the pH is not lowered to less than 6.5 units or raised above 8.5 units. (Full definition contained in Section 62-302.502 (3) F.A.C.) . b) Dissolved Oxygen: The average for a 24 hour period shall not fall below 5 mg/l, shall never be less than 4 mg/l, and normal daily and seasonal fluctuations above these levels shall be maintained. c) Turbidity: Levels must not exceed 29 NTU over natural background conditions.

a) pH: Recorded pH values for the entire year fell within the expected range considering historic data for this region, and within bounds of state standards 100% of the time. Values collected at this site ranged from a minimum of 7.2 to a maximum of 8.2.

b) Dissolved oxygen: State standards are difficult to apply in this situation as it is very common in tidal creeks of this region for dissolved oxygen levels to dip below standard values during the summer months. It does not necessarily signal a problem, however, when such levels are encountered at the Kingsley site and several factors should be kept in mind when trying to apply the standards. In general, warm water cannot attain the oxygen saturation level that the same volume of colder water can. In essence, cold water “holds” more oxygen than warm water does. Thus during the extreme temperatures experienced in northeast Florida during summer months, an occasional low dissolved oxygen condition is almost to be expected. Additionally, dissolved oxygen values for this report were recorded at approximately one meter above the substrate where there is little surface to air mixing. Presumably values would increase if readings were taken elsewhere in the water column – readings near the bottom often represent “worst case scenario” for dissolved oxygen levels. Lastly, and in terms of immediate effect upon resident species, large fish that are most acutely affected by these lowered levels compensate by moving off to more oxygen saturated waters. In some respects, this can benefit populations of smaller species and juveniles in that predation may markedly decrease during periods of high temperature and low dissolved oxygen. Rather than create elevated concern over “fitness” of habitat, deviation from state standards may simply indicate the need for continued monitoring and perhaps invite investigation into the applicability of the standard itself in these types of estuarine environments.

Using an earlier model of the YSI 6600, the National Estuarine Research Reserves (NERR) showed an increase of hypoxia (conditions where dissolved oxygen values fall

below 28% saturation) with increasing deployment duration (Wenner et al. 2004). To compensate for this finding and minimize bias due to drift it was recommended that analysis of dissolved oxygen data be based only on the first 48 hours of deployment. Currently a newer model of the YSI is being used (YSI 6600EDS-S). The YSI 6600EDS-S model is equipped with a sweeping brush that clears the surface of the probes every five minutes in order to address the biofouling issue. To our knowledge a new recommendation for deployment duration with regards to the YSI 6600EDS-S and dissolved oxygen data has not been made. Until the time either the NERR program or NPS have sufficient data to determine the new deployment duration for reliable DO data, it has been decided to continue to use data only from the first 48 hours of deployment for DO analyses. In doing this we are guaranteed an unbiased estimate of DO in the system. However, for the purpose of this report the full set of data is being made available. Graphic depictions of the data have been identified as to which graph was created with which set of data (the complete set or the “48 hour” set). Gaps appear in the monthly data graphs (Appendix B) where there was suspect or missing data.

Throughout the sampling year, the minimum percent DO saturation observed was 5.4% (July) and the highest was 139.3% (January). As for actual percentages in terms of “failure” to meet state standards for dissolved oxygen levels throughout the duration of the year, readings fell below the 4mg/l level 9.4% of the time when only the first 48 hours of data was used, and 7.0% of the time when all of the data was used. When calculating for the less than 5mg/l average in a 24 hour period, using just the data from the first 48 hours of each deployment, the result was 7.2% of the time. The value for this average using all available data was 9.7%. [The preceding graph depicts dissolved oxygen data for the entire year by percent saturation. This is a measurement that compensates for temperature variation. State standards for dissolved oxygen do not incorporate this type of compensation and are expressed in mg/l as opposed to percent saturation.] Not surprisingly, July and August were months with the lowest values - there were periods when the average did not rise above 5mg/l for several days (as can be seen on the monthly graphs in Appendix B).

c) Turbidity: This standard was created under the assumption that there is the presence of some type of effluent or spill coming from a distinct source. Under these circumstances, it is possible for one sample to be taken in the affected area, and a second “control” or background sample to be taken upstream and away from the effluent. In this particular situation, where turbidity is just being measured against conditions over time, the standard is not as easily applied.

Minimum and maximum turbidities during the sampling year were 0.1 NTU and 1860.2 NTU respectively. In order to answer the question of how often Class II turbidity standards were exceeded, (after acknowledging that the standards do not truly apply in the same manner as written) calculations were made to approximate “background” conditions. First, an average of all turbidity values falling between the 10th and 90th percentile for the entire year was determined (7.96 NTU), then increased by 29 NTU (36.96 NTU). At this point, monthly tables for turbidity values were checked for the number of times readings exceeded this amount. After the final calculations, it appears that the “29 NTU above background” standard was only exceeded 1.9% of the time. Instances of high readings or turbidity “spikes” appear mostly isolated and are more often attributed to end of deployment biofouling of the probe than anything else. Occasions of

generally elevated turbidity readings were noted during some weekends, perhaps linked to increased boat traffic around the dock. This may have been the case during the Memorial Day holiday. However, this time also coincided with the end of a sonde deployment cycle so direct cause is not clear.

15) Post deployment information:

Table 2. Post deployment readings for all data sondes deployed at the Kingsley Plantation site from March 2004 – Feb . 2005

Date	pH	Temp.(C)	SC(mS/cm)	DO%	Turbidity (NTU)	Depth(m)
03/11/04	7.04	19.31	36.77	102.5	0.0	0.108
03/30/04	7.06	22.29	38.52	98.3	0.2	-0.111
04/08/04	*	24.98	34.90	96.4	0.0	-0.122
04/22/04	7.04	22.78	50.17	102.9	0.1	0.100
05/06/04	6.94	22.26	49.56	104.7	4.1	0.016
05/21/04	6.95	23.09	45.06	99.3	0.4	0.008
06/04/04	7.03	23.10	48.86	99.9	0.0	-0.055
06/11/04	6.99	24.03	50.34	95.7	0.4	- 0.062
06/22/04	7.03	24.29	49.73	101.1	-0.2	0.011
07/01/04	7.05	24.67	49.75	99.5	0.1	0.059
07/09/04	7.01	23.55	50.17	99.0	0.0	-0.006
07/16/04	7.00	23.50	49.18	103.5	0.2	-0.088
07/26/04	7.03	24.39	50.59	96.8	0.0	0.075
07/28/04	6.98	24.12	49.83	100.1	0.0	-0.034
08/04/04	6.97	24.78	50.04	72.5	- 0.5	-0.031
08/16/04	7.04	23.65	50.12	102.9	0.8	0.104
08/24/04	6.89	23.92	50.49	95.0	0.1	-0.049

09/08/04	7.03	24.08	50.36	104.2	0.4	-0.317
09/21/04	6.97	23.97	50.34	101.4	0.0	0.082
09/29/04	6.90	23.99	49.96	89.8	-0.2	-0.066
10/06/04	6.96	23.28	50.75	99.4	0.5	0.139
10/13/04	7.11	23.46	50.12	93.8	-0.5	-0.177
10/25/04	7.05	22.64	50.20	99.1	-0.1	0.084
11/05/04	7.01	21.12	49.74	107.5	0.1	-0.016
11/15/04	7.06	21.38	49.74	107.6	0.0	0.041
11/30/04	7.03	21.22	47.98	107.6	0.0	-0.142
12/14/04	7.05	19.67	49.87	104.3	0.2	0.115
12/30/04	7.07	19.80	49.59	104.3	0.1	0.038
01/13/05	7.03	22.83	50.48	102.1	3.9	- 0.151
01/28/05	7.03	20.96	50.27	102.1	0.0	0.321
02/22/05	7.08	21.77	50.40	105.5	0.0	-0.097
03/09/05	7.06	19.63	50.31	100.6	-0.8	-0.062

* pH probe was broken in lab just prior to post calibration

16) Other remarks/notes:

- a) Calibration of DO for all sondes was performed on the day of deployment.
- b) Daily, Monthly, and Annual Precipitation Totals as recorded from rain gauge at Kingsley Plantation:

<u>Date</u>	<u>Daily Precipitation Totals (inches)</u>
03/06/04	0.15
03/16/04	1.62
03/27/04	.01

Monthly total - March	1.78
04/08/04	0.10
04/09/04	0.14
04/13/04	0.47
04/14/04	0.01
04/24/04	0.02
Monthly total – April	0.74
05/01/04	0.54
05/02/04	0.11
05/03/04	1.13
05/04/04	0.15
05/16/04	0.04
Monthly total - May	1.97
06/02/04	0.67
06/03/04	2.37
06/04/04	0.74
06/05/04	0.37
06/06/04	0.48
06/12/04	0.11
06/14/04	1.61
06/15/04	0.09
06/20/04	0.10
06/21/04	0.10
06/22/04	0.46
06/23/04	1.44
06/24/04	0.21
06/25/04	0.12
06/26/04	0.94
06/27/04	0.04
Monthly total – June	9.85
07/01/04	0.20
07/02/04	0.08
07/03/04	0.07
07/04/04	0.97
07/05/04	0.88
07/07/04	0.16
07/08/04	0.16
07/09/04	0.44
07/12/04	0.19
07/13/04	0.25
07/14/04	0.03
07/16/04	0.70

07/17/04	1.05
07/18/04	0.09
07/20/04	0.06
07/31/04	0.10
Monthly total - July	5.43

08/02/04	0.27
08/03/04	0.10
08/04/04	1.87
08/05/04	0.15
08/06/04	0.02
08/14/04	2.34
08/15/04	0.32
08/16/04	2.39
08/18/04	1.60
08/19/04	0.34
08/23/04	0.15
08/24/04	0.18
08/25/04	0.35
08/30/04	0.35
08/31/04	0.25
Monthly total – August	10.68

*09/05/04	4.70
09/14/04	2.46
09/15/04	1.42
09/18/04	0.34
09/19/04	0.01
09/21/04	0.31
09/25/04	0.09
09/27/04	3.69

* Hurricane Frances - 4.70 inches was actually the total over several days between 09/05/04 5 and 09/07/04

Monthly total – September	13.02
---------------------------	-------

10/02/04	0.87
10/12/04	0.60
10/15/04	0.71
10/20/04	0.23
10/22/04	0.09
Monthly total – October	2.50

11/04/04	0.33
11/26/04	0.25
11/28/04	1.68
Monthly total – November	2.26

12/04/04	0.06
12/10/04	0.88
12/11/04	0.10
12/24/04	0.53
12/26/04	1.23
12/27/04	0.04
Monthly total – December	2.84

01/14/05	0.59
01/16/05	0.37
01/23/05	0.02
01/30/05	0.76
Monthly total – January	1.74

02/02/05	0.03
02/03/05	0.21
02/04/05	0.16
02/24/05	0.16
02/25/05	0.46
02/26/05	0.71
02/27/05	2.43
Monthly total – February	4.16

Total for sampling year March 2004 – February 2005 56.97 inches

- c) Wind speed and direction can have an appreciable effect on conditions at the Kingsley Plantation site when rainfall does not appear to be a major factor. Wind data reported at the Jacksonville International Airport, recorded by The Weather Underground, Inc. (www.wunderground.com) was used for this report.
- d) Calculation of percentage of missing and deleted data versus total possible recordings for the entire sampling year revealed a 97.1% accuracy rate for the data sondes. (This does not include deletion of merely “suspect” data - such as isolated high turbidity values).

References:

Adamus, C., D. Clapp, S. Brown. 1997. Surface Water Drainage Basin Boundaries: A Reference Guide. Technical Publication SJ97-1. Palatka, Florida: St. Johns River Water Management District.

Wenner, E., D. Sanger, M. Arendt, A.F. Holland, and Y. Chen. 2004. Variability in Dissolved Oxygen and Other Water Quality Variables Within the National Estuarine Research Reserve System. *Journal of Coastal Research*. 45: 17-38.

Acknowledgements:

Many thanks to the following people for their patience, dedication to detail, and hours spent helping to start this initial monitoring station in the program:

- Mac Kendrick and Jim Flanagan - CAMA - installation of housing for monitoring equipment at Kingsley Plantation dock.

-Pamela Chancey, Laurie Clarke, and Kelly Morgan - CAMA/ NE FL Aquatic Preserves- field assistance and equipment maintenance.

-Dr. Rick Gleeson and Jon Brucker –Guana/Tolomato/Matanzas National Estuarine Research Reserve - data interpretation and technical assistance

-Dr.Fred Holland and Dr. Guy DiDonato – NOAA/ Hollings Marine Laboratory – data interpretation and technical assistance.