



Fixed-Station Water-Quality Monitoring at Cumberland Island National Seashore

2005 through 2009 Data Summary

Natural Resource Data Series NPS/SECN/NRDS—2015/807



ON THE COVER

Wild ponies on Cumberland Island National Seashore.
Photo courtesy of Brian Gregory, SECN.

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The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Summary and Key Findings

In 2005, the National Park Service (NPS) Southeast Coast Network (SECN) Inventory and Monitoring Program began collecting water-quality data in the estuarine waters near Cumberland Island National Seashore (CUIS) as part of the NPS Vital Signs monitoring program. The Cumberland Island stations collected pH, dissolved oxygen, water temperature, salinity, conductivity, turbidity, and water-level data. Additional water-quality measurements were made by network staff and include monthly measurements of water clarity conditions, nutrients (total dissolved phosphorus [TDP], dissolved inorganic phosphorus [DIP], dissolved inorganic nitrogen [DIN], and total dissolved nitrogen [TDN]), and chlorophyll *a* levels. Methods used are adapted from the water-quality monitoring program established by the National Estuarine Research Reserve Program (Wenner and Geist 2001). The Cumberland Island National Seashore fixed-station water-quality monitoring site is part of the SECN estuarine water and sediment quality monitoring efforts, which routinely collect data in the vicinity of seven coastal parks located along the southeastern U.S. coast (DeVivo et al. 2008, Gregory et al. 2013). Information provided by this monitoring program is designed to help managers understand trends and variability related to water-quality conditions in and around park waters. Summary data are presented in annual data reports published by the Southeast Coast Network. Findings for 2005 through 2009 are as follows:

- Monthly water-quality data at the Old House Creek site indicated:
 - Mostly *good* water clarity conditions (80% of samples), with seven *poor* water clarity ratings spread across the period of record.
 - Dissolved inorganic nitrogen concentrations were mostly *good* (80%) with some *poor* readings (20%), and dissolved inorganic phosphorus concentrations were mostly *fair* (90%), with one *poor* reading in November 2009.
 - Chlorophyll *a* levels rated *fair* for 25 months, *good* for 4 months, and *poor* for 6 months.
 - Dissolved oxygen concentrations were mostly *good* (71.4%) with 28.6% regarded as *fair*. *Fair* dissolved oxygen readings occurred in warmer months, from May to September.
- Continuous water-quality data at the Old House Creek site indicated :
 - Water temperatures across the period of record ranged from a minimum of 6.5°C in February 2009 to a maximum of 34.2°C in August 2007. Monthly means ranged from 12.4°C in January 2009 to 31.3°C in August 2007.
 - Salinity across the period of record ranged from minimum 18.0 parts per thousand in September 2008 to maximum 36.5 parts per thousand in July 2008. Monthly means ranged from 23.8 parts per thousand in April 2009 to 34.9 parts per thousand in December 2008.

- Dissolved oxygen concentrations for the three years ranged from a minimum of 0.3 mg/L in July 2007 to a maximum of 10.22 mg/L in May 2007. Monthly means ranged from 3.8 mg/L in July 2007 to 8.2 mg/L in January 2009.
- Turbidity ranged from a minimum of 0.0 NTU in several months to a maximum of 993 NTU in April 2007. Monthly means ranged from 2.3 NTU in February 2007 to 219 NTU in April 2007. The low pH of 7.0 occurred in August 2008, and the high of 8.4 was in December 2009. Monthly means ranged from 7.2 to 8.1.
- Monthly water-quality data at the Plum Orchard site indicated:
 - Mostly *good* water clarity conditions (97.1% of samples), with only one *poor* water clarity rating in September of 2008.
 - Dissolved inorganic nitrogen concentrations were mostly *good* (80%) with two *fair* readings (20%), and dissolved inorganic phosphorus readings were all *fair* (100%).
 - Chlorophyll *a* levels rated *fair* for 29 months, *good* for four months, and *poor* for two months. Dissolved oxygen concentrations were mostly *good* (74.3%) with 25.7% being regarded as *fair*. *Fair* dissolved oxygen readings occurred in warmer months, from June to September.
- Continuous water-quality data at the Plum Orchard site indicated :
 - Water temperatures across the period of record ranged from a minimum of 8.9°C in February of 2009 to a maximum of 32.1°C in August 2006. Monthly means ranged from 6.6°C in February 2007 to 32.24°C in August 2007.
 - Salinity across the period of record ranged from a minimum of 15.7 ppt in April 2009 to a maximum of 38.0 ppt in May 2007. Monthly means ranged from 22.6 ppt in April 2009 to 36.2 ppt in August 2006.
 - Dissolved oxygen concentrations for the five years ranged from a minimum of 0.0 mg/L in July 2007 to a maximum of 9.74 mg/L in February 2007. Monthly means ranged from 4.0 mg/L in August 2007 to 8.7 mg/L in February 2007.
 - Turbidity ranged from a minimum of 0.0 NTU in several months to a maximum of 998 NTU in September 2005. Monthly means ranged from 1.8 NTU in February 2007 to 102 NTU in March 2008.
 - The low pH of 6.9 occurred in September 2009, and the high of 8.4 was in September 2007. Monthly means ranged from 8.0 to 8.4.

Introduction

In 2005 the Southeast Coast Network (SECN) began collecting continuous water quality and monthly nutrient and chlorophyll *a* data in the waters around Cumberland Island National Seashore (CUIS) in order to provide data to help assess water-quality conditions and determine trends in water quality. This report provides a summary of data collected at two sites (Table 1; Figure 1) during the calendar years of 2005 through 2009, providing a snapshot of conditions to park managers as well as information on short-term variability and seasonal trends of conditions in waters in the vicinity of Cumberland Island National Seashore. The sites monitored on Cumberland Island National Seashore are part of the SECN estuarine water-quality monitoring program, which collects data in the vicinity of seven coastal parks located along the southeastern U.S. coast, described by DeVivo et al. (2008).

To effectively monitor the diverse and dynamic set of estuarine water resources, the Southeast Coast Network has implemented a two-pronged monitoring approach. This approach consists of collecting data from continuously recording fixed stations located in each park and collecting periodic discrete water samples for analysis (Gregory et al. 2013). When combined rather than implemented singularly, these two approaches give a more complete picture of physical processes, diurnal and seasonal variations, and spatial patterns during critical portions of the year.

The Southeast Coast Network has identified four specific monitoring objectives for which data are collected and analyzed (Gregory et al. 2013):

1. Determine daily and seasonal water-quality patterns for five core parameters (dissolved oxygen, salinity, temperature, pH, and turbidity) at fixed monitoring stations using continuous data loggers.
2. Determine monthly and seasonal patterns in nutrients (nitrogen, phosphorus, and chlorophyll *a*) at fixed monitoring stations by collecting discrete water samples.
3. Determine status and spatial variability of water and nutrient chemistry conditions in estuarine waters every five years.
4. Determine status and spatial variability of benthic sediment quality (organic contaminants, carbon, and metal levels) in estuarine waters every ten years.

Cumberland Island National Seashore

Cumberland Island National Seashore is between the mouths of the Satilla and St. Marys Rivers along the coast of Georgia. As Georgia's southernmost barrier island, Cumberland Island is bound on the east by the Atlantic Ocean and the west by the extensive salt marshes and estuaries of the Cumberland River and Cumberland Sound. The seashore is comprised of the majority of Cumberland Island proper and the surrounding marshes and islands (with the exception of Little Cumberland Island, all of which is privately owned, and several private inholdings on the island itself [Figure 1]). The east coast of the island is an almost-continuous strip of beaches that face the ocean, whereas the western side is a network of tidal creeks that flow through salt marshes and eventually open out into coastal water. Aquatic habitats associated with the island include marine areas (offshore water and

associated bottom areas), tidal creeks, saltwater ponds, intertidal areas (beaches, salt marshes, tide pools), and inland ponds (both brackish and fresh water). Although Cumberland Island is considered relatively pristine compared to more highly developed barrier islands, both point and nonpoint sources of pollutants can be found nearby that have the potential to affect the island. In addition to the numerous industrial and municipal waste facilities in the area, the submarine base at Kings Bay is of potential concern due to the effects of channel dredging as well as other activity on the base. There are also a significant number of U.S. Environmental Protection Agency (EPA) listed Superfund sites nearby, most of which are located in the vicinity of Brunswick, Georgia, a port city located approximately 16 miles from Cumberland in Glynn County (Alber et al. 2005).

Relatively little information on water quality was reported from in or around Cumberland Island before 2000; however, several studies have shed light on the characteristics in and around the island in the past 10 years. In 2001, the Coastal Resources Division (CRD) of the Georgia Department of Natural Resources (GADNR) began monitoring 20 stations located in and around Cumberland Sound. These sites have been sampled on a monthly basis since the summer of 2001 for numerous parameters including concentrations of dissolved nutrients (nitrogen, phosphorus, silica), fecal coliform, and dissolved oxygen. As of 2005, data from this assessment indicated that 56% of the dissolved inorganic nitrogen observations in Cumberland Sound were *good* and 44% were *fair* (none were *poor*). In terms of PO₄, 85% of the observations were considered *fair*, 11% were *good*, and 5% were *poor*. Frequent observations of low dissolved oxygen concentrations in surface waters in and around Cumberland Sound were reported. Low concentrations (less than or equal to 4 mg/L) occurred 16% of the time (182 out of 1,136 observations taken between March 2000 and December 2004). Values ≤ 4 mg/L were most common during summer months, with 83% of the low observations occurring between May and September (Alber et al. 2005).

In July 2007, the Southeast Coast Network and the University of Georgia conducted an assessment of water and sediment quality around Cumberland Island National Seashore as a part of the network Vital Signs Monitoring program (Gregory et al. 2010). This study sampled 30 sites around Cumberland Island during the late summer and indicated overall conditions as *fair* in waters around the seashore, with sediment conditions rating from *good* to *fair* across the seashore. Arsenic was the only metal found at levels above background and was only slightly elevated (*fair* in terms of potential biological effects) at 7 of 30 sites. Organic contaminants that have guidance values associated with them (Long et al. 1995) were detected at only one site; however polycyclic aromatic hydrocarbons (PAHs) were detected at two sites and polychlorinated biphenyls (PCBs) were detected at seven sites. The widespread occurrence of elevated dissolved phosphorus levels was noted as an issue of potential concern by this study (Gregory et al. 2010).



Figure 1. Location of continuous water-quality monitoring stations at Cumberland Island National Seashore from 2005 to 2009. Map shows estuarine and marine water resources in the vicinity of Cumberland Island National Seashore in Georgia. Indicated are areas of salt marsh (USFWS 2013), urbanized area (USCB 2013), 303(d) listed water bodies (EPA 2013), and areas designated as having special uses or restrictions such as oyster harvest areas (GADNR 2013) or inclusion on National Rivers Inventory (NPS 2013).

Methods

Data collection at the Cumberland fixed stations is modeled after an ongoing coastal water-quality monitoring program using methods established by the National Estuarine Research Reserve Program (Wenner and Geist 2001). Detailed field and lab standard operating procedures and methods have been reported for the continuously collected data in Gregory et al. (2013) and are briefly summarized in the following sections.

Sampling Locations

The Cumberland Island fixed-station site for Plum Orchard (CUIS01) is located in the Brickhill River on the dock for the Plum Orchard Historic District, 375 meters south-southwest of the mansion. The station is located on an outside piling of the northern floating dock wing. The dock is used by the seashore concessioner-operated ferry for Plum Orchard tours, as well as for general seashore operations and by island residents.

The Cumberland Island fixed-station site for Old House Creek (CUIS02) is located on a floating dock on the Old House Creek— a smaller tidal creek that drains a large area of salt marsh. Tidal fluctuations are large although tidal currents are not as strong as those in the larger tidal rivers in the vicinity. This station typically receives very little recreational traffic and is primarily used by island residents to dock small water craft.

Table 1. Location of continuous water-quality monitoring sites at Cumberland Island National Seashore during 2005 through 2009.

Name	Location Description	Location (lat /long)	Period of Record
CUIS 01	Plum Orchard Dock	30.854866/ -81.467229	1/6/07 to 9/1/10
CUIS 02	Old House Creek Dock	30.798004/-81.47027	8/3/05 to 9/1/10



Figure 2. Photo of continuous data collection station at Plum Orchard Dock (CUIS 01) on Cumberland Island (discontinued September 2010). Photo by SECN staff.

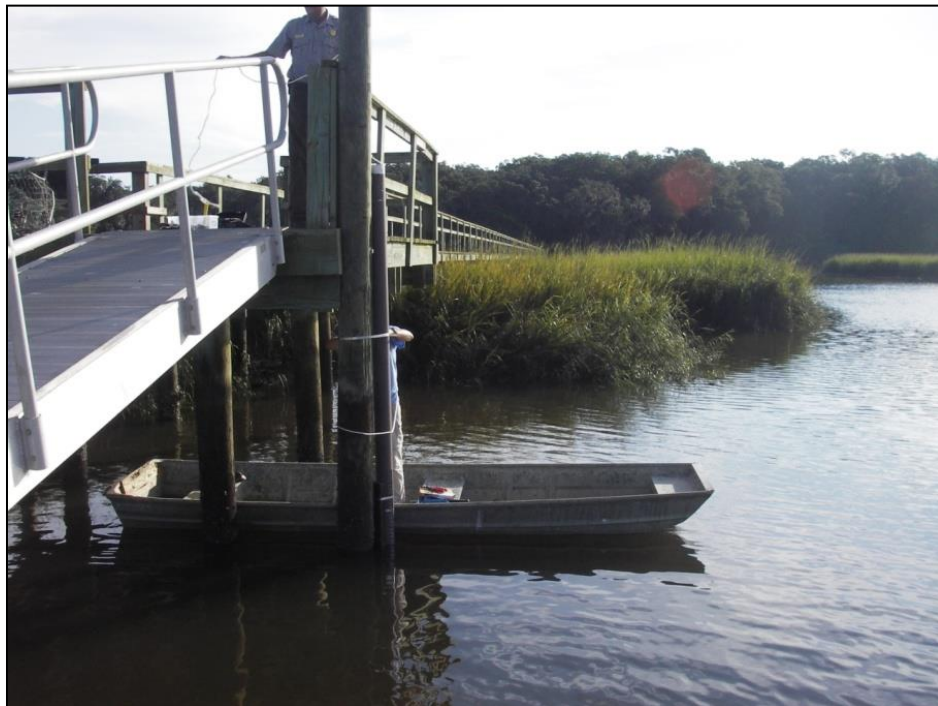


Figure 3. Photo of continuous data collection platform at dock on Old House Creek (CUIS 02) on Cumberland Island (discontinued September 2010). Photo by SECN staff.

Continuous Data

Continuously collected data include dissolved oxygen, pH, specific conductance (to compute salinity), temperature, depth, and turbidity. Readings for these parameters are collected at 15-minute intervals using YSI data sondes (Model 6600) which are deployed in three- to five-week intervals depending on routine instrument maintenance schedules. The data collection platform consists of a six-inch diameter PVC pipe attached vertically to a piling at the Sea Camp Dock with the sonde suspended within and approximately 1 meter from the bottom. Prior to January 2013, there was not a cap, nor lock at the top of the pipe. Water is allowed to freely circulate via openings cut into the PVC housing. A carriage bolt is inserted through the housing at the submerged end to prevent instrument loss should the attachment hardware fail. Anti-fouling paint is used on the PVC tube to extend deployment intervals, which are sometimes shortened due to excessive biofouling. The sonde guard is covered with plastic mesh to prevent fish, crabs, and detritus from entering, which could skew measurements or damage the instrument's probes. Figures 2 and 3 show a photo of the station and additional details on site selection and installation procedures are reported by Gregory et al. (2013).

Prior to deployment, the data sonde is calibrated according to YSI recommendations for pH (two-point calibration), dissolved oxygen, specific conductivity, depth and turbidity (two-point calibration) (YSI Incorporated 2011), with additional instructions provided by Gregory et al. (2013). After instrument retrieval, data sondes are returned to the laboratory where post-deployment readings are made using calibration standards to evaluate the accuracy and validity of the data collected for that deployment period. All pre-deployment and post-retrieval calibration information is recorded on calibration data sheets that are archived at SECN office locations. After post-retrieval processing is complete, the sonde is cleaned, reconditioned, and readied for re-deployment with methods outlined by YSI (2011). Performance specifications of the YSI 6600 are shown in Table 2.

Data generated during the deployment period are reviewed and certified by SECN staff prior to being made available to park staff. During the data review process data may be flagged (marked as suspect) for a variety of reasons including: the presence of heavy fouling on equipment, lack of post-calibration data, readings outside of equipment specifications, calibration errors, and extended deployment times. All flagged data remain in the data set but, depending on the cause, may be excluded from analyses and reports (tables, charts, and graphs). Missing periods of data may result from probe failures or other problems that cause complete loss of data.

Table 2. Performance specifications of YSI 6600 EDS data loggers deployed at continuous monitoring site (YSI 2011).

Parameter	Range	Resolution	Accuracy
Dissolved Oxygen (% saturation)	0–500%	0.1%	0 to 200%: +/- 2% of reading or 2% air saturation, whichever is greater.
Dissolved Oxygen (mg/L)	0–50 mg/L	0.01 mg/L	0 to 20 mg/L: +/- 2% of reading or 0.2 mg/L whichever is greater.
Conductivity	0–100 mS/cm	0.001 to 0.1 mS/cm; range dependent	+/- 0.5% of reading + 0.001 mS/cm
Temperature	-5–50°C	0.01 °C	+/- 0.15 °C
pH	0 to 14 units	0.01 units	+/- 0.2 unit
Depth	0–9 m (0–30 ft)	0.001m (0.001ft)	+/- 0.018m (+/- 0.06 ft.)
Salinity	0–70 ppt	0.01 ppt	+/- 1% of reading or 0.1 ppt, whichever is greater.
Turbidity	0–1000 NTU	0.1 NTU	+/- 2% of reading or 0.3 NTU, whichever is greater.

Discrete Data

Water sample collection for this project is conducted by Southeast Coast Network staff, usually at the time of routine station maintenance. Secchi depth is measured using an eight inch diameter black-and-white disk. Water samples are collected as grabs in clean, acid-washed, field-rinsed containers. Samples are filtered using a 0.45-micron filter prior to preservation. Samples and chlorophyll *a* filters are shipped to water-quality analysis labs on wet ice. Quality assurance and quality control of field sampling includes both field blanks and duplicates collected on random dates throughout the year. Original chain-of-custody paperwork accompanies all samples to the laboratory. Data collection standard operating procedures are further documented in Gregory et al. (2013). Samples were analyzed by Chesapeake Biological Laboratory in Solomons, Maryland.

Water clarity conditions were derived from estimated light attenuation coefficients (*k*) using the equation: $k = a / Z_{\text{Secchi}}$, where *Z* is Secchi depth in meters and *a* is assigned to one of three values depending on the water bodies' naturally occurring clarity conditions (e.g., *a* = 1.0 for naturally turbid conditions, *a* = 1.4 for moderately turbid conditions, or *a* = 1.7 for clear water estuaries). These constants were estimated for each water clarity class based on values for Cumberland Island National Seashore reported in the literature (Smith et al. 2006). This method of estimating water clarity condition is generally used when information on light transmission in the water column is missing; the Southeast Coast Network is reporting derived values for data consistency among other network parks and recently collected datasets where water column light transmission information was not collected.

Assessment Criteria

Water quality was assessed for each of the parameters following the East/Gulf Coast site criteria in the EPA National Coastal Assessment IV Report (Table 3) using data from the monthly samples (EPA 2012). The categorical assessments (i.e., *good*, *fair*, and *poor*) use measurements of chlorophyll *a*, nutrients, dissolved oxygen, and water clarity and are intended to highlight a range of

conditions including acutely degraded water-quality conditions. Light attenuation coefficients (k) were used to assess water clarity conditions using criteria categories in Smith et al. (2006) which are equivalent to the EPA criteria for the assessed water bodies.

Table 3. EPA (2012) coastal water-quality monitoring condition criteria for water-quality parameters collected by the Southeast Coast Network.

Rating	Water Clarity ¹ (k)	Chlorophyll a ($\mu\text{g/L}$)	Dissolved Inorganic Nitrogen (DIN) (mg/L)	Dissolved Inorganic Phosphorus (DIP) (mg/L)	Dissolved Oxygen (mg/L)
Good	<2.3	<5	<0.1	<0.01	>5
Fair	2.30–2.99	5–20	0.1–0.5	0.01–0.05	2–5
Poor	>2.99	>20	>0.5	>0.05	<2

¹ Light attenuation coefficients (k) were used to assess water clarity conditions using criteria categories in Smith et al. (2006) which are comparable to the EPA (2012) criteria for the assessed water bodies.

Results

Continuous Data

Old House Creek

Water temperatures across the period of record ranged from a minimum of 6.5°C in February 2009 to a maximum of 34.2°C in August 2007. Monthly means ranged from 12.4°C in January 2009 to 31.3°C in August 2007. Salinity across the period of record ranged from a minimum of 18.0 ppt in September 2008 to a maximum of 36.5 ppt in July 2008. Monthly means ranged from 23.8 ppt in April 2009 to 34.9 ppt in December 2008. Dissolved oxygen concentrations for the three years ranged from a minimum of 0.3 mg/L in July 2007 to a maximum of 10.2 mg/L in May 2007. Monthly means ranged from 3.8 mg/L in July 2007 to 8.2 mg/L in January 2009. Turbidity ranged from a minimum of 0.0 NTU in several months to a maximum of 993 NTU in April 2007. Monthly means ranged from 2.3 NTU in February 2007 to 219 NTU in April 2007. The low pH of 7.0 occurred in August 2008, and the high of 8.4 was in December 2009. Monthly means ranged from 7.2 to 8.1.

Plum Orchard

Water temperatures across the period of record ranged from a minimum of 8.9°C in February 2009 to a maximum of 32.1°C in August 2006. Monthly means ranged from 6.6°C in February 2007 to 32.2°C in August 2007. Salinity across the period of record ranged from a minimum of 15.7 ppt in April 2009 to a maximum of 38.0 ppt in May 2007. Monthly means ranged from 22.6 ppt in April 2009 to 36.2 ppt in August 2006. Dissolved oxygen concentrations for the five years ranged from a minimum of 0.0 mg/L in July 2007 to a maximum of 9.7 mg/L in February 2007. Monthly means ranged from 4.0 mg/L in August 2007 to 8.7 mg/L in February 2007. Turbidity ranged from a minimum of 0.0 NTU in several months to a maximum of 998 NTU in September 2005. Monthly means ranged from 1.8 NTU in February 2007 to 102 NTU in March 2008. The low pH of 6.9 occurred in September 2009, and the high of 8.4 was in September 2007. Monthly means ranged from 8.0 to 8.4.

Figures 4 through 15 depict the daily averages by parameter for 2005 through 2009. Relative water depth collected by SECN staff at the site is included in this section as an aid for data interpretation because it includes information that relates daily tidal fluctuations to parameter values. Salinity values are calculated from specific conductance values.

Minimum and maximum values with the mean and standard deviation for each month are shown in Tables 4 and 5. The “percentage of values” field indicates the level of completeness of the monthly data sets used for calculating mean, maximum, and minimum statistics, and equals the number of data points collected (i.e., not missing or flagged) divided by the total number of expected points for a complete month of data. For those months where all of the data were either missing and/or flagged, the percentage of values is 0% and no statistics (mean, maximum or minimum) are presented. When the percentage of values is low, the statistics (mean, maximum and minimum) may be less informative than for those months where all or nearly all of the data were used in the calculation of summary statistics.

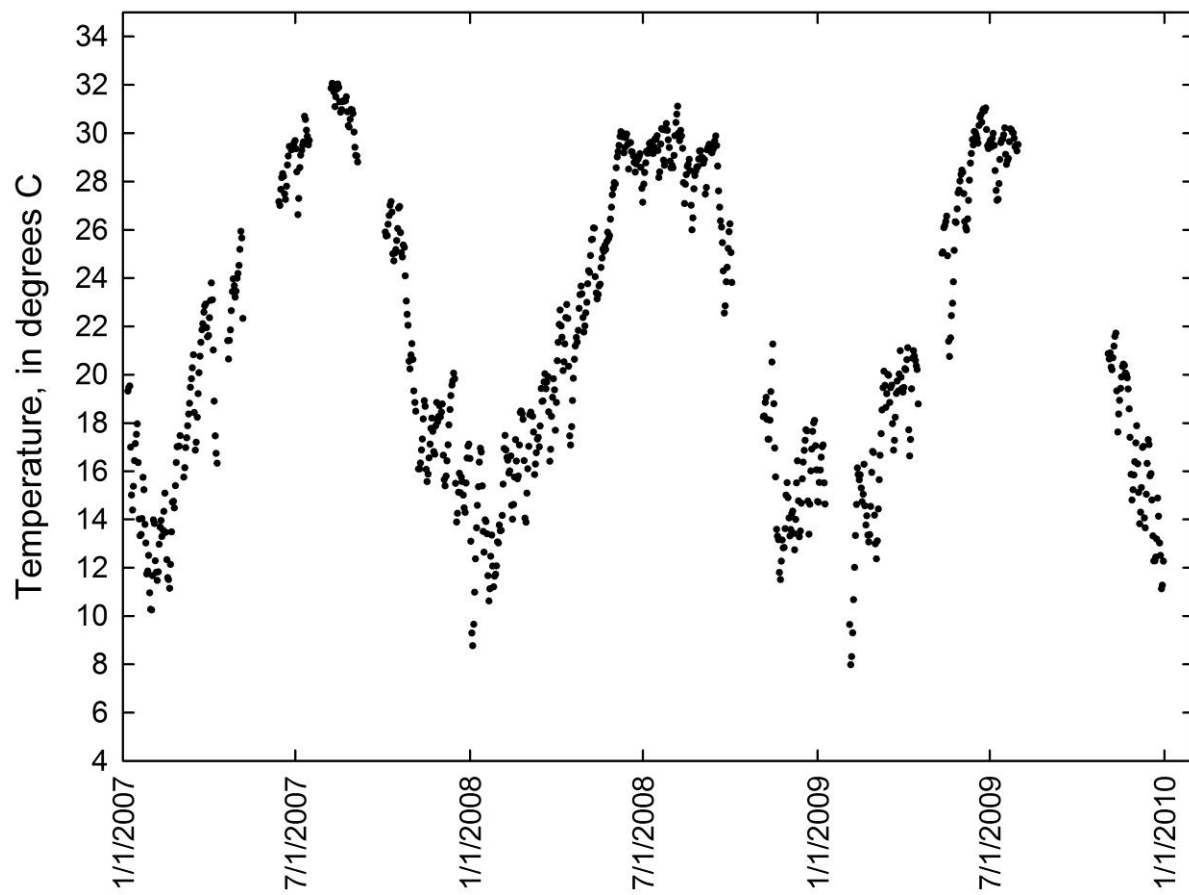


Figure 4. Mean daily water temperature at Old House Creek at Cumberland Island National Seashore from 2007 to 2009. Breaks in data record indicate missing and/or flagged data.

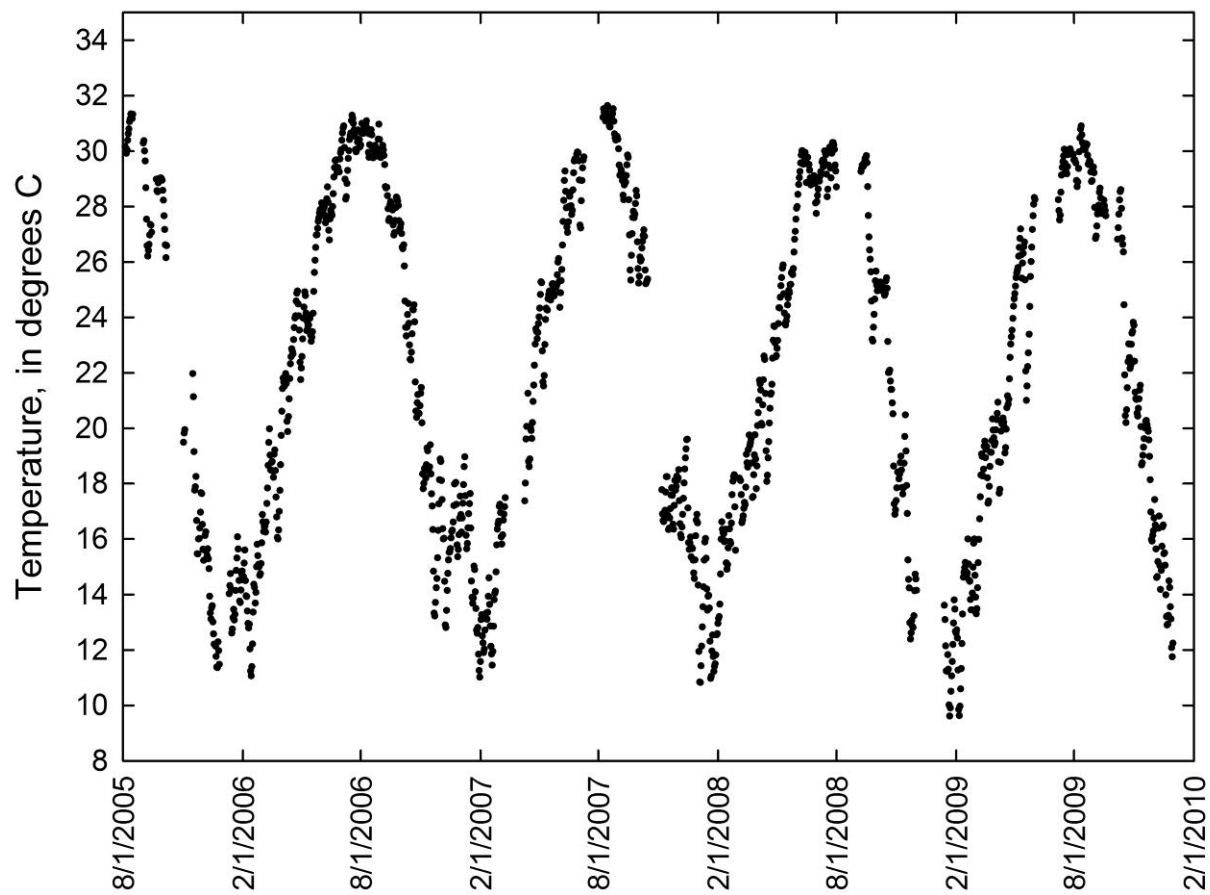


Figure 5. Mean daily water temperature at Plum Orchard at Cumberland Island National from 2005 to 2009. Breaks in data record indicate missing and/or flagged data.

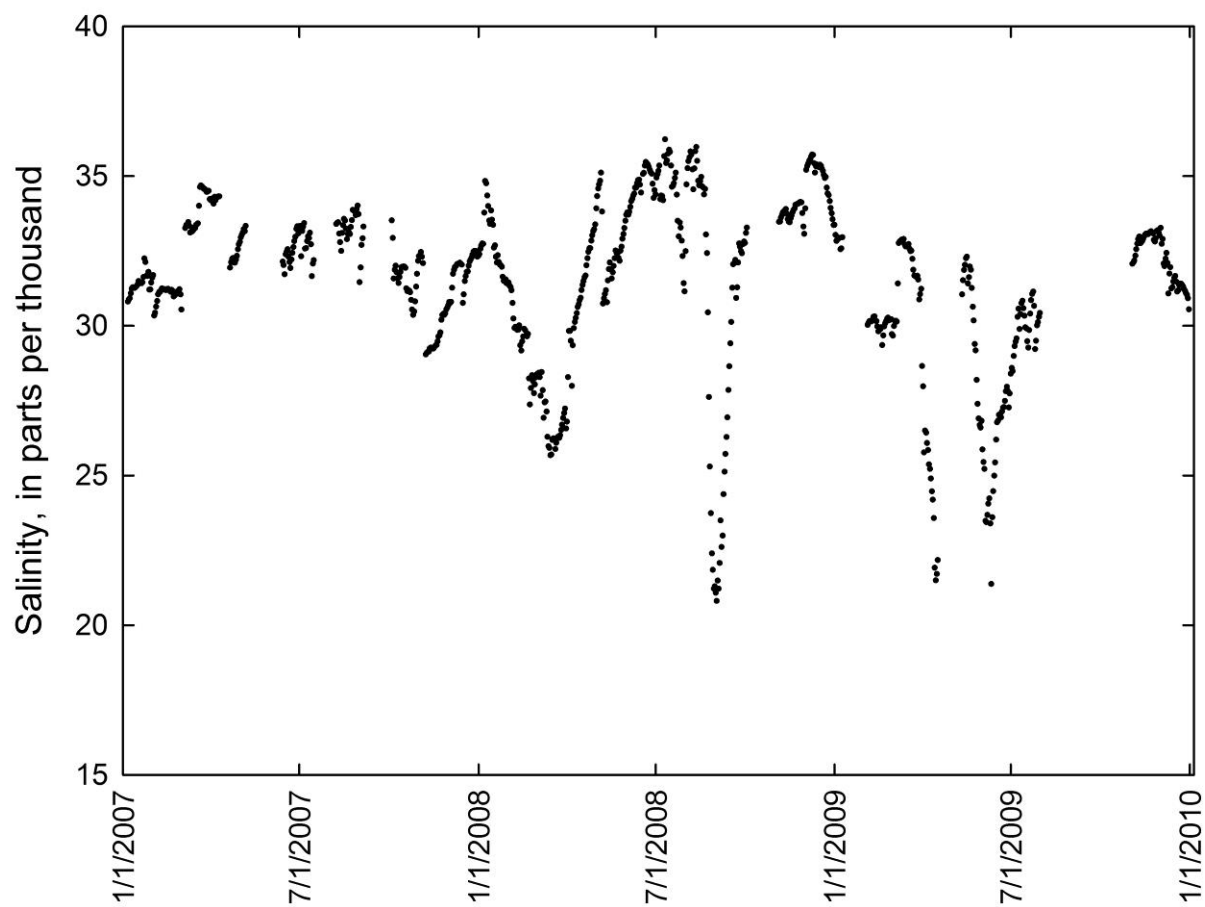


Figure 6. Mean daily salinity at Old House Creek at Cumberland Island National Seashore from 2007 to 2009. Breaks in data record indicate missing and/or flagged data.

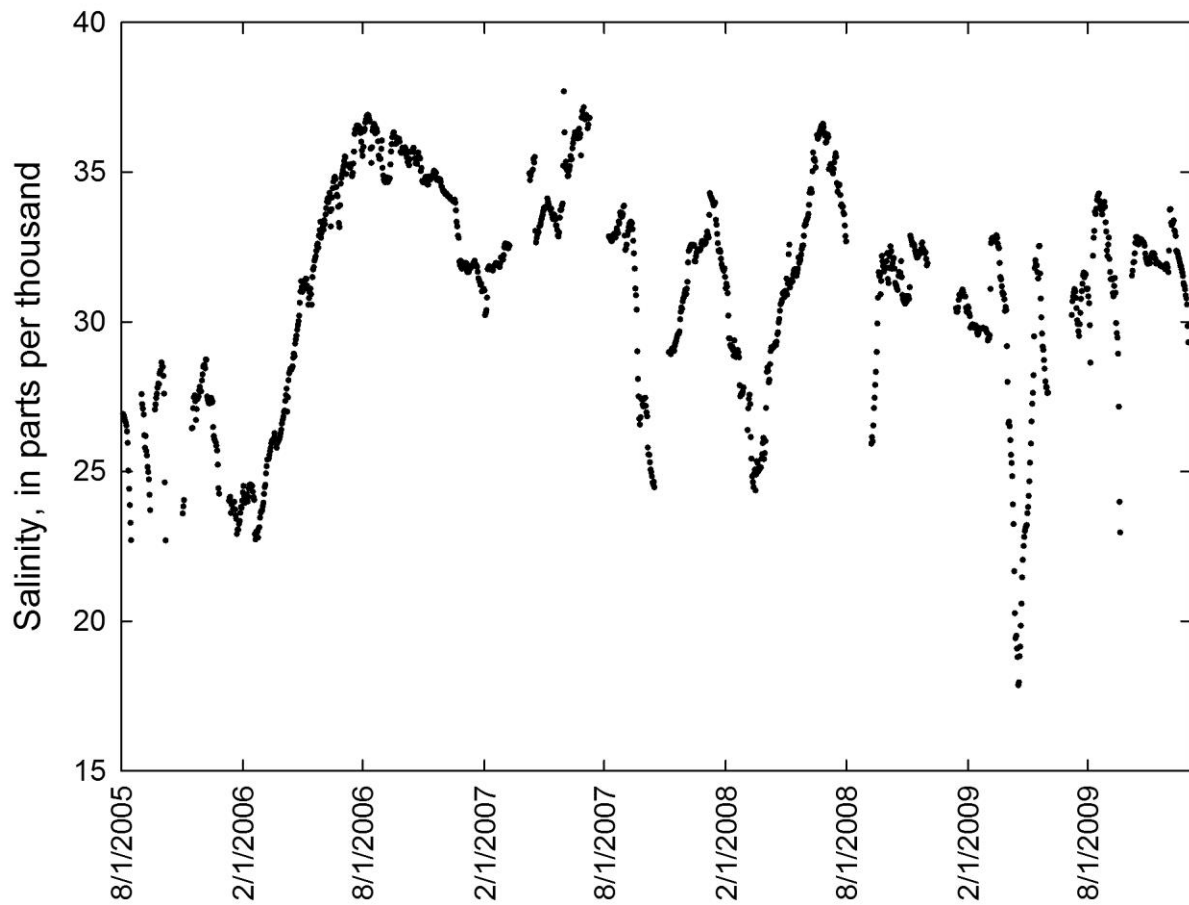


Figure 7. Mean daily salinity at Plum Orchard at Cumberland Island National from 2005 to 2009. Breaks in data record indicate missing and/or flagged data.

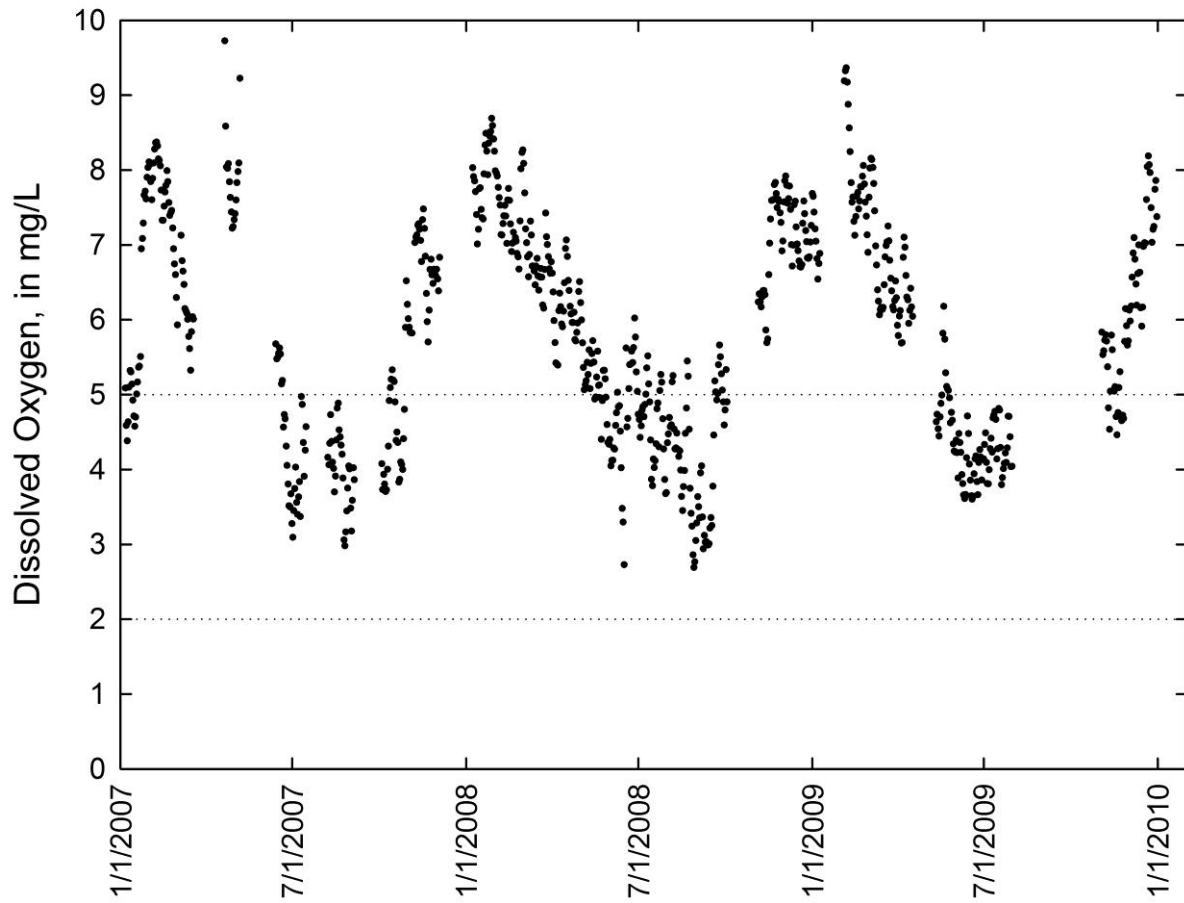


Figure 8. Mean daily dissolved oxygen at Old House Creek at Cumberland Island National Seashore National Seashore from 2007 to 2009. Concentrations above 5 mg/L are considered “good” and concentrations below 2 mg/L are considered “bad” based on EPA National Coastal Assessment Criteria (EPA 2012). Breaks in data record indicate missing and/or flagged data.

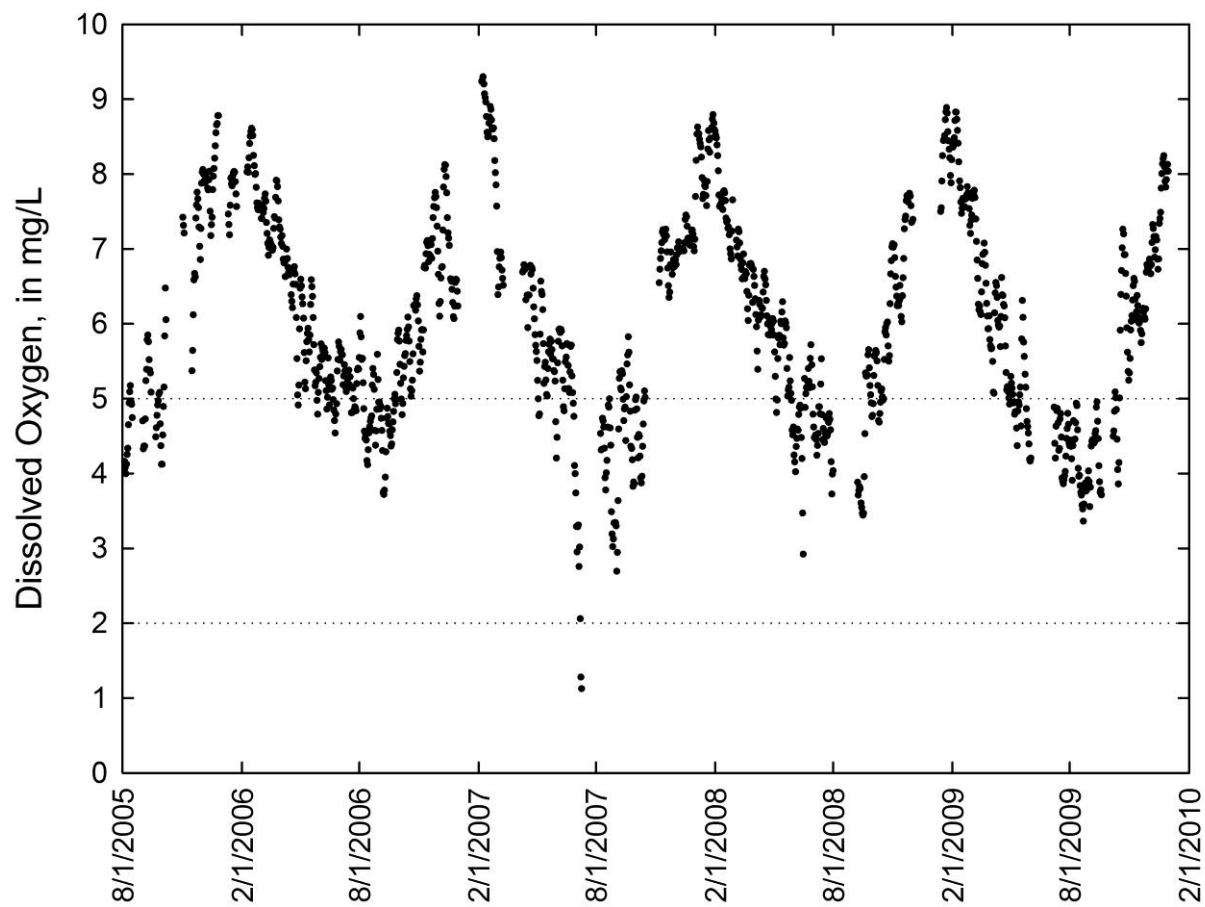


Figure 9. Mean daily dissolved oxygen at Plum Orchard at Cumberland Island National Seashore National Seashore from 2005 to 2009. Concentrations above 5 mg/L are considered “good” and concentrations below 2 mg/L are considered “bad” based on EPA National Coastal Assessment Criteria (EPA 2012). Breaks in data record indicate missing and/or flagged data.

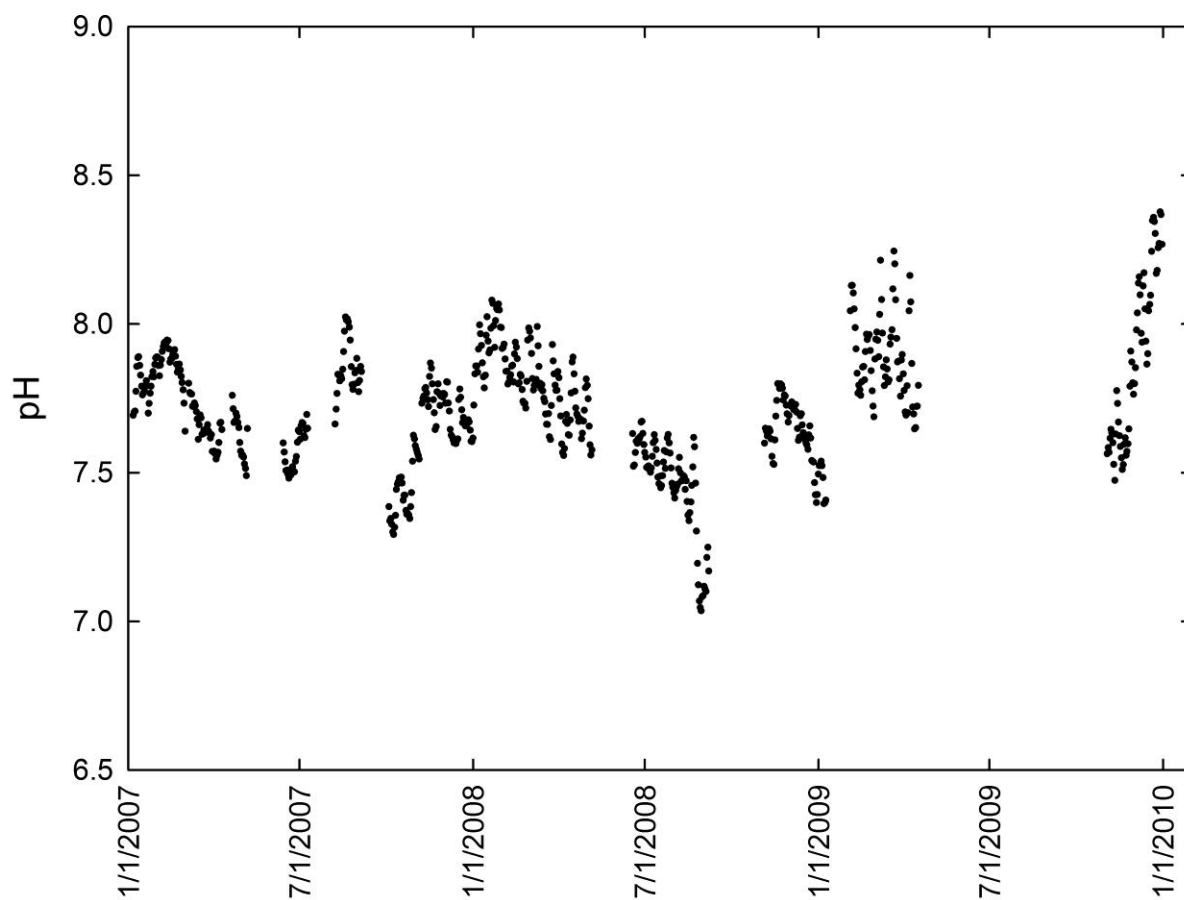


Figure 10. Mean daily pH at Old House Creek at Cumberland Island National Seashore from 2007 to 2009. Breaks in data record indicate missing and/or flagged data.

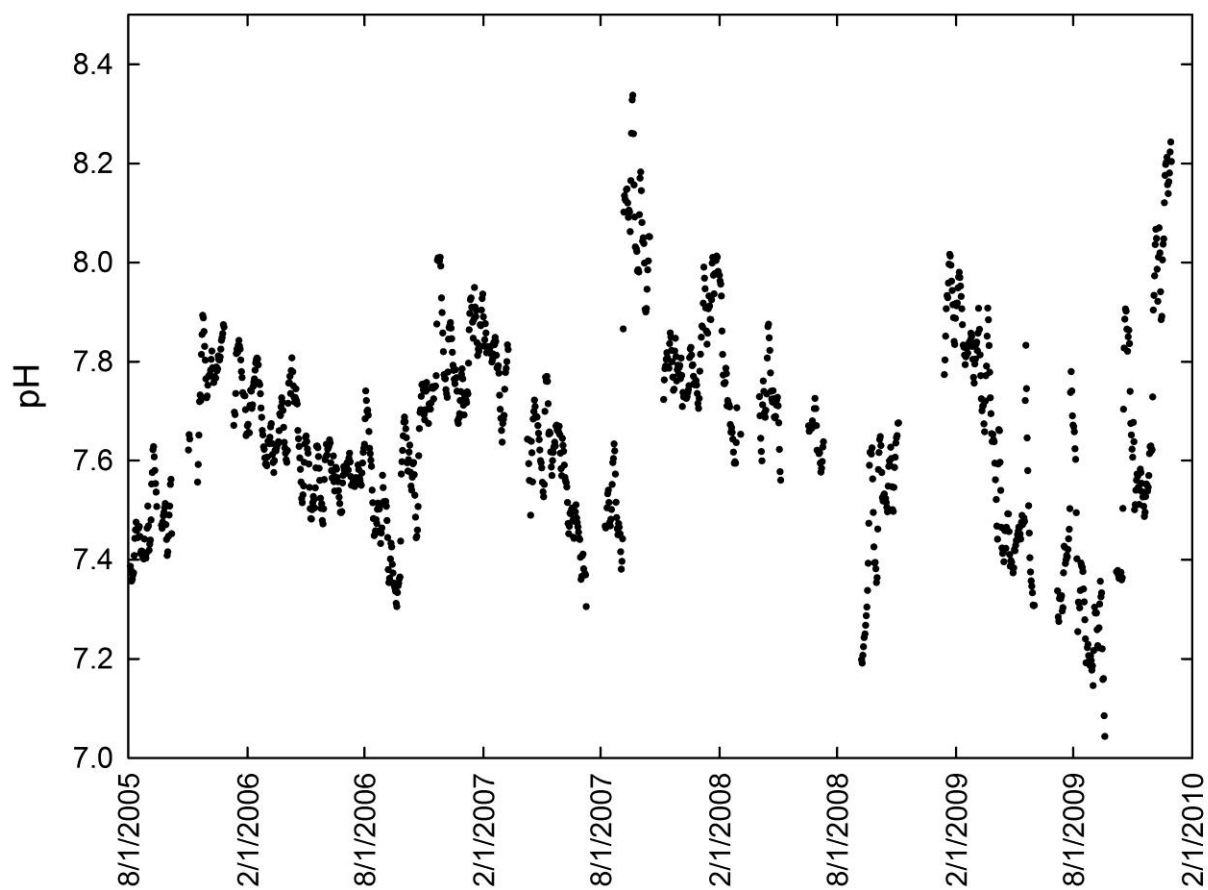


Figure 11. Mean daily pH at Plum Orchard at Cumberland Island National Seashore from 2005 to 2009. Breaks in data record indicate missing and/or flagged data.

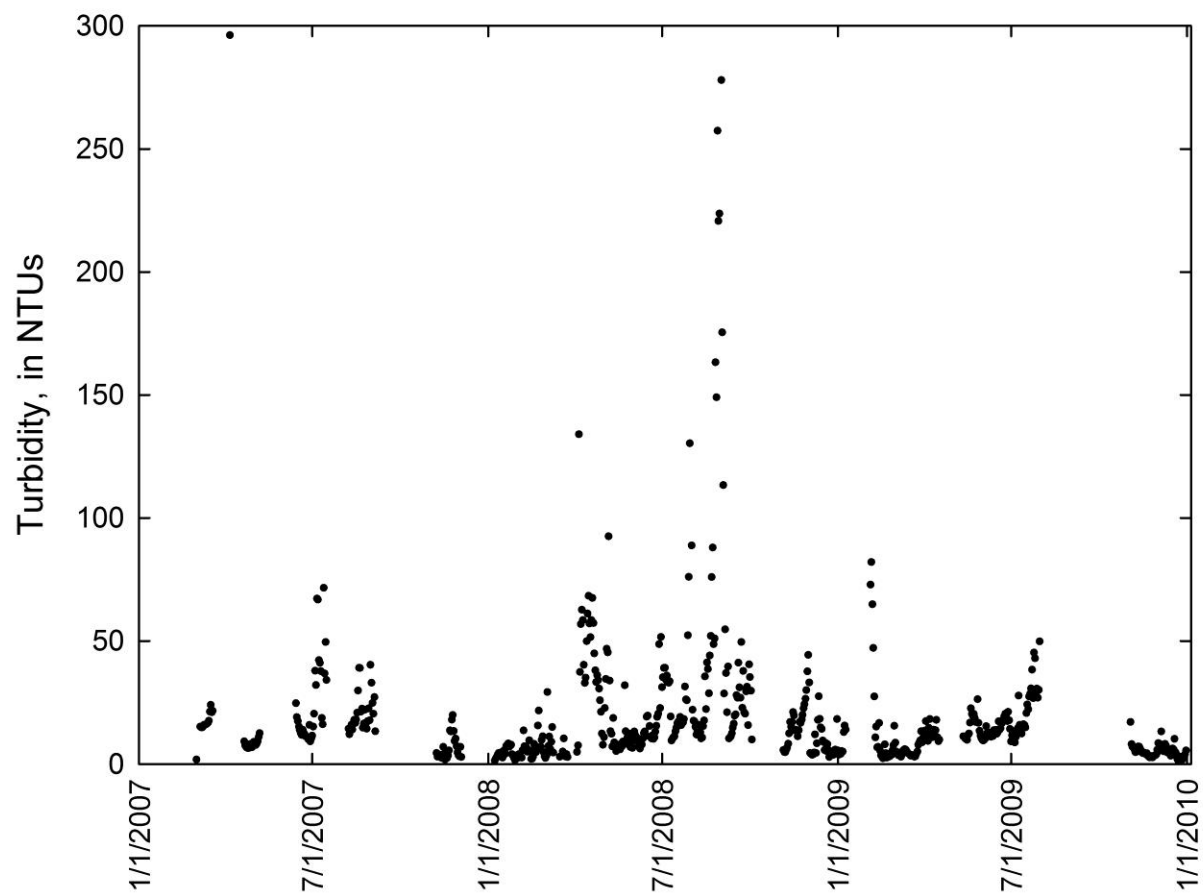


Figure 12. Mean daily turbidity at Old House Creek at Cumberland Island National Seashore from 2007 to 2009. Breaks in data record indicate missing and/or flagged data.

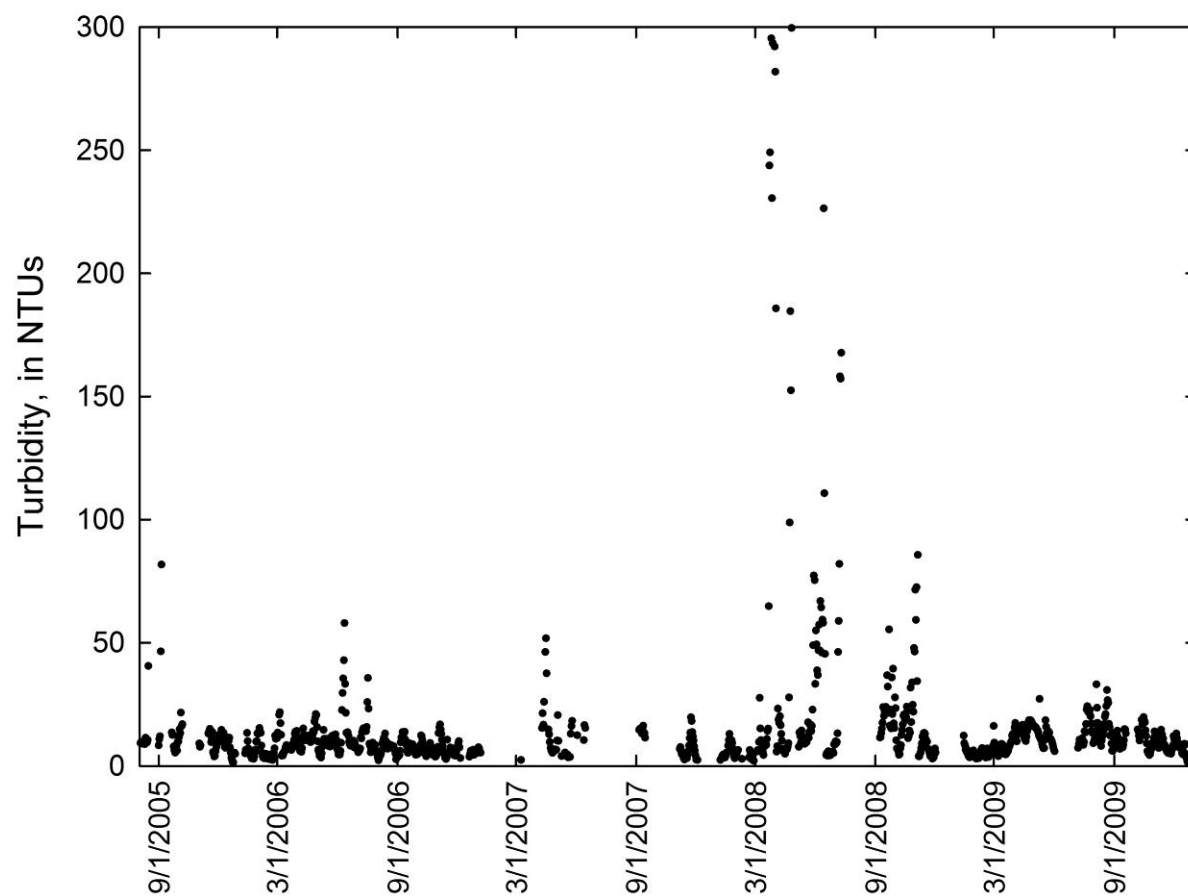


Figure 13. Mean daily turbidity at Plum Orchard at Cumberland Island National Seashore from 2005 to 2009. Breaks in data record indicate missing and/or flagged data.

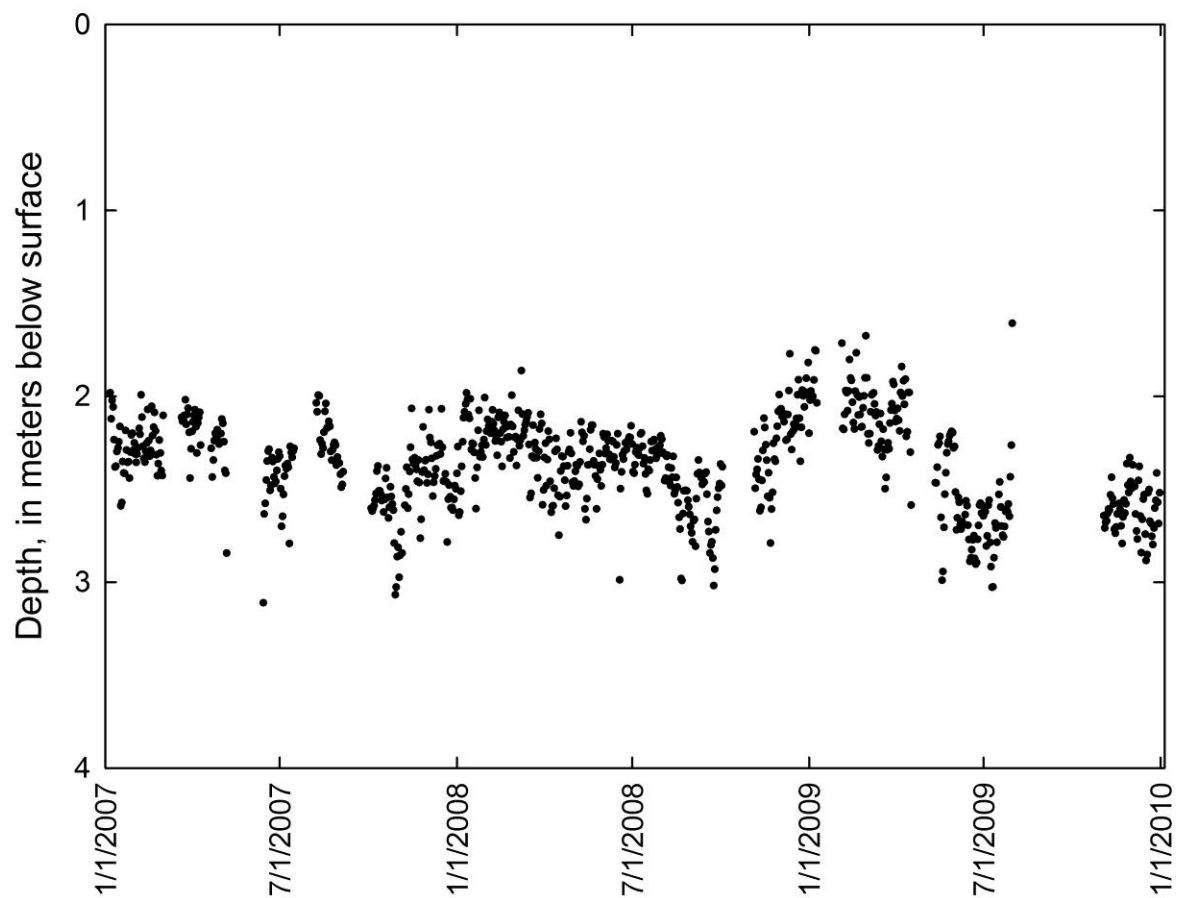


Figure 14. Mean daily depth at Old House Creek at Cumberland Island National Seashore from 2007 to 2009. Breaks in data record indicate missing and/or flagged data.

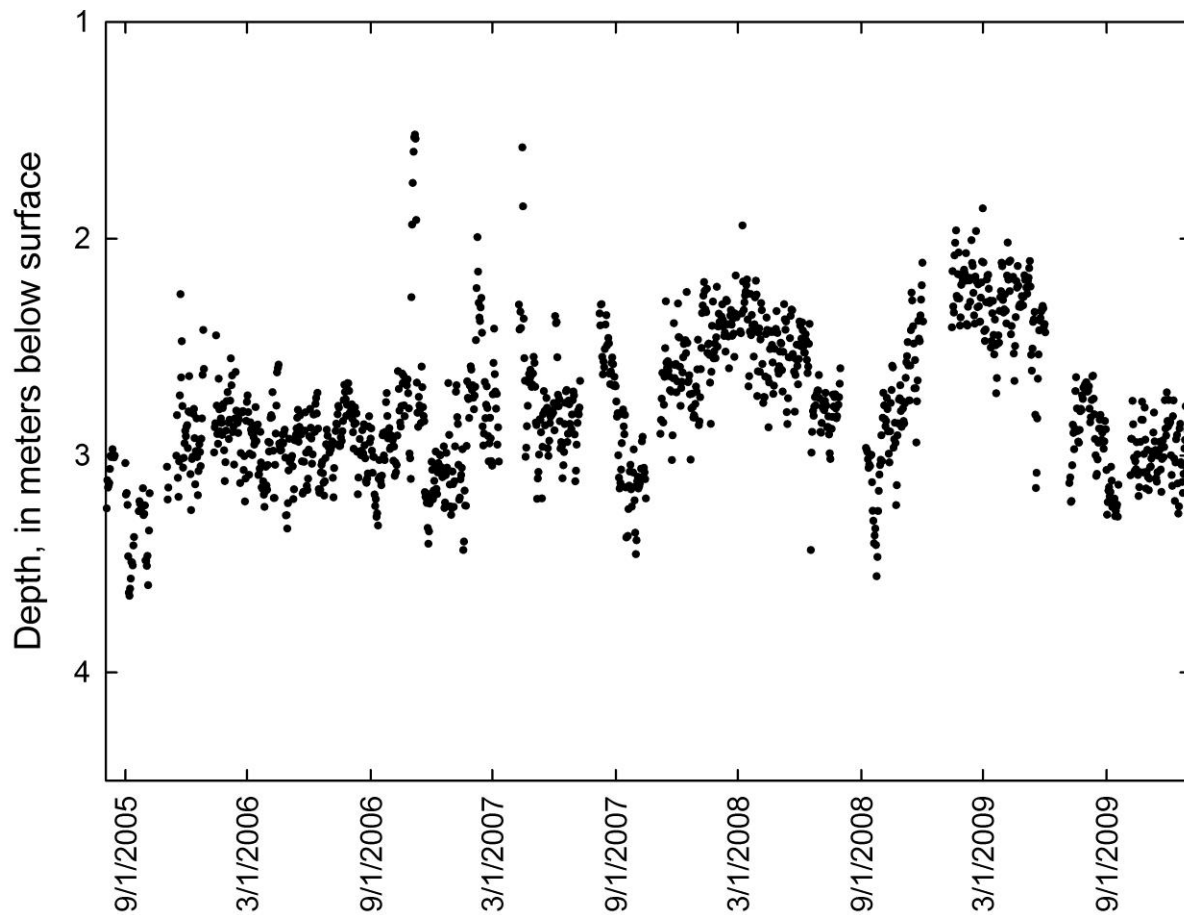


Figure 15. Mean daily depth at Plum Orchard at Cumberland Island National Seashore from 2005 to 2009. Breaks in data record indicate missing and/or flagged data.

Table 4. Monthly minimum, maximum, and mean values for parameters collected at Old House Creek at Cumberland Island National Seashore from 2007 to 2009. Standard deviations (stdev) of the mean values are provided in parentheses. Values for percentage valid n indicate the percentage of valid data points collected during the calendar month.

	Temp (°C)	Salinity (ppt)	DO Conc (mg/L)	Depth (m)	pH	Turbidity (NTU)
January 2007 (Expected count 1,488)						
Actual Count	1,216	1,216	1,166	1,216	1,216	279
Minimum	9.11	30.120	0.00	0.910	7.59	0.00
Mean (stdev)	14.7 (2.7)	31.4 (0.4)	4.3 (3.5)	2.3 (0.7)	7.80 (0.07)	2.4 (2.4)
Maximum	21.60	32.53	30.50	3.74	7.93	12.60
Percentage	82%	82%	78%	82%	82%	19%
February 2007 (Expected count 1,344)						
Actual Count	1,344	1,344	1,388	1,344	1,344	1,74
Minimum	9.88	29.060	0.10	0.679	7.70	0.00
Mean (stdev)	13.5 (1.8)	31.1 (0.3)	6.7 (9.1)	2.2 (0.7)	7.88 (0.06)	2.3 (2.5)
Maximum	17.94	31.87	183.70	3.59	7.98	13.70
Percentage	100%	100%	100%	100%	100%	13%
March 2007 (Expected count 1,488)						
Actual Count	1,298	1,298	1,024	626	1,298	840
Minimum	14.72	30.170	0.00	0.693	7.21	0.00
Mean (stdev)	19.5 (2.3)	33.7 (1.0)	6.3 (38.3)	2.2 (0.7)	7.68 (0.09)	14.8 (7.0)
Maximum	23.89	34.89	1210.90	3.56	7.90	47.80
Percentage	87%	87%	69%	42%	87%	56%
April 2007 (Expected count 1,440)						
Actual Count	1,438	1,437	1,389	1,438	1,438	1,024
Minimum	15.72	31.810	0.00	0.262	7.27	0.00
Mean (stdev)	20.8 (2.4)	33.9 (1.2)	42.4 (59.9)	2.2 (0.7)	7.63 (0.09)	218.6 (278.0)
Maximum	26.25	35.98	1139.00	3.83	7.81	999.30
Percentage	100%	100%	96%	100%	100%	71%
May 2007 (Expected count 1,488)						
Actual Count	1,488	1,488	1,485	1,488	1,488	681
Minimum	18.98	32.520	0.00	0.875	7.25	0.00
Mean (stdev)	24.5 (1.5)	34.3 (0.7)	16.8 (57.1)	2.5 (0.7)	7.59 (0.11)	7.2 (5.6)
Maximum	28.21	35.46	1264.40	3.94	7.89	37.90
Percentage	100%	100%	100%	100%	100%	46%
June 2007 (Expected count 1,440)						
Actual Count	1,394	1,392	1,326	1,394	1,394	1,169
Minimum	22.37	28.500	0.00	1.009	7.19	0.00
Mean (stdev)	27.8 (1.7)	32.4 (0.9)	15.1 (48.2)	2.4 (0.7)	7.53 (0.12)	93.3 (205.9)
Maximum	31.08	35.50	1211.40	4.04	7.88	986.30
Percentage	97%	97%	92%	97%	97%	81%
July 2007 (Expected count 1,488)						
Actual Count	723	720	723	723	451	722
Minimum	25.55	29.940	0.33	1.042	7.37	2.50
Mean (stdev)	29.1 (1.3)	32.7 (0.7)	3.8 (1.0)	2.4 (0.8)	7.65 (0.10)	38.0 (73.8)
Maximum	32.24	34.08	7.15	3.78	7.92	988.50
Percentage	49%	48%	49%	49%	30%	49%

Table 4. (continued).

	Temp (°C)	Salinity (ppt)	DO Conc (mg/L)	Depth (m)	pH	Turbidity (NTU)
August 2007 (Expected count 1,488)						
Actual Count	1,140	1,140	1,140	1,140	1,140	1,127
Minimum	29.75	30.160	0.78	0.813	7.46	4.30
Mean (stdev)	31.3 (0.9)	33.4 (0.6)	4.1 (1.2)	2.2 (0.7)	7.87 (0.15)	20.6 (20.9)
Maximum	34.21	34.78	8.37	3.55	8.24	288.20
Percentage	77%	77%	77%	77%	77%	76%
September 2007 (Expected count 1,440)						
Actual Count	1,438	1,437	1,438	1,438	1,438	1,433
Minimum	24.23	28.060	1.29	0.947	7.37	5.30
Mean (stdev)	28.3 (1.4)	32.7 (0.9)	4.4 (1.0)	2.4 (0.7)	7.72 (0.13)	17.4 (16.0)
Maximum	32.64	34.35	6.67	3.94	8.02	259.30
Percentage	100%	100%	100%	100%	100%	100%
October 2007 (Expected count 1,488)						
Actual Count	1,487	1,487	1,487	1,486	1,487	172
Minimum	19.33	29.470	2.53	1.080	7.17	10.10
Mean (stdev)	24.9 (1.9)	31.5 (0.7)	4.6 (1.0)	2.6 (0.7)	7.45 (0.15)	30.3 (17.2)
Maximum	28.40	33.62	7.04	4.28	7.90	159.40
Percentage	100%	100%	100%	100%	100%	12%
November 2007 (Expected count 1,440)						
Actual Count	1,367	1,368	1,368	1,368	1,368	1,075
Minimum	14.54	28.540	4.65	0.852	7.45	0.00
Mean (stdev)	17.7 (1.5)	30.1 (1.1)	6.6 (0.7)	2.5 (0.7)	7.73 (0.11)	7.1 (8.5)
Maximum	22.09	32.81	8.07	4.12	7.96	71.40
Percentage	95%	95%	95%	95%	95%	75%
December 2007 (Expected count 1488)						
Actual Count	1,486	1,486	215	1,486	1,486	184
Minimum	12.75	29.680	5.74	0.990	7.52	0.00
Mean (stdev)	16.7 (1.9)	31.8 (0.6)	6.6 (0.4)	2.4 (0.7)	7.68 (0.08)	3.8 (3.9)
Maximum	21.18	32.70	7.34	4.04	7.90	27.00
Percentage	100%	100%	14%	100%	100%	12%
January 2008 (Expected count 1,488)						
Actual Count	1,487	1,487	1,176	1,487	1,486	1,166
Minimum	7.70	31.230	6.29	0.824	7.54	0.00
Mean (stdev)	12.9 (2.2)	32.7 (1.0)	8.0 (0.6)	2.3 (0.7)	7.93 (0.12)	4.3 (3.5)
Maximum	18.06	35.23	9.15	3.80	8.15	30.50
Percentage	100%	100%	79%	100%	100%	78%
February 2008(Expected count 1,392)						
Actual Count	1,390	1,390	1,390	1,390	1,390	1,388
Minimum	12.58	25.370	5.86	0.818	7.59	0.10
Mean (stdev)	15.9 (1.7)	29.5 (1.1)	7.4 (0.5)	2.2 (0.7)	7.84 (0.09)	6.7 (9.1)
Maximum	21.02	31.72	8.78	3.44	8.04	183.70
Percentage	100%	100%	100%	100%	100%	100%
March 2008 (Expected count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,023
Minimum	14.04	25.210	5.01	0.436	7.45	0.00
Mean (stdev)	18.0 (1.5)	26.9 (0.9)	6.9 (0.6)	2.2 (0.7)	7.80 (0.12)	5.1 (6.7)

Table 4. (continued).

	Temp (°C)	Salinity (ppt)	DO Conc (mg/L)	Depth (m)	pH	Turbidity (NTU)
Maximum	21.85	29.61	8.94	3.52	8.08	67.20
Percentage	100%	100%	100%	100%	100%	69%
April 2008 (Expected count 1,440)						
Actual Count	1,440	1,438	1,440	1,440	1,440	1,386
Minimum	15.80	25.190	3.04	0.874	7.33	0.00
Mean (stdev)	21.1 (1.9)	31.0 (1.7)	6.1 (0.7)	2.4 (0.7)	7.70 (0.12)	40.0 (31.8)
Maximum	25.88	33.89	7.70	3.96	7.98	544.10
Percentage	100%	100%	100%	100%	100%	96%
May 2008 (Expected count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	321	1,482
Minimum	20.85	29.450	2.29	0.896	7.31	0.00
Mean (stdev)	24.9 (1.6)	32.6 (1.3)	5.2 (0.9)	2.4 (0.7)	7.64 (0.13)	14.4 (23.1)
Maximum	28.58	36.34	7.43	3.99	7.95	581.70
Percentage	100%	100%	100%	100%	22%	100%
June 2008 (Expected count 1,440)						
Actual Count	1,330	1,330	1,330	1,330	592	1,324
Minimum	26.68	32.790	0.76	0.807	7.35	0.00
Mean (stdev)	29.1 (1.0)	34.7 (0.6)	4.7 (1.2)	2.3 (0.7)	7.60 (0.09)	13.4 (13.5)
Maximum	32.47	35.77	7.98	3.74	7.84	363.70
Percentage	92%	92%	92%	92%	41%	92%
July 2008 (Expected count 1,488)						
Actual Count	1,487	1,485	1,486	1,484	1,487	1,472
Minimum	26.39	28.010	1.87	0.848	7.24	3.10
Mean (stdev)	29.2 (1.0)	34.4 (1.3)	4.6 (1.0)	2.3 (0.7)	7.53 (0.10)	37.9 (87.7)
Maximum	32.38	36.52	7.15	3.82	7.81	985.20
Percentage	100%	100%	100%	100%	100%	99%
August 2008 (Expected count 1,488)						
Actual Count	1,487	1,481	1,467	1,487	1,487	1,462
Minimum	25.40	18.060	1.81	0.914	6.95	2.40
Mean (stdev)	28.8 (1.4)	32.1 (5.1)	4.2 (1.1)	2.5 (0.7)	7.39 (0.18)	68.1 (162.9)
Maximum	33.56	36.24	7.05	4.05	7.71	995.10
Percentage	100%	100%	99%	100%	100%	98%
September 2008 (Expected count 1,440)						
Actual Count	1,439	1,432	1,433	1,439	354	1,426
Minimum	21.15	18.010	1.96	1.168	6.98	2.60
Mean (stdev)	27.5 (2.3)	28.0 (4.4)	4.0 (1.1)	2.6 (0.7)	7.15 (0.09)	42.5 (100.9)
Maximum	31.67	33.70	7.10	3.90	7.42	984.00
Percentage	100%	99%	100%	100%	25%	99%
October 2008 (Expected count 1,488)						
Actual Count	1,488	117	1,488	1,488	1,368	1,476
Minimum	14.99	31.470	2.72	1.077	7.15	0.70
Mean (stdev)	23.0 (3.0)	33.0 (0.5)	5.1 (0.9)	2.6 (0.7)	7.43 (0.11)	14.8 (36.6)
Maximum	28.13	34.02	7.41	3.87	7.65	736.50
Percentage	100%	8%	100%	100%	92%	99%

Table 4. (continued).

November 2008 (Expected count 1,440)						
Actual Count	1,440	1,214	1,440	1,440	1,440	1,440
Minimum	10.42	31.970	3.87	0.863	7 32	1.70
Mean (stdev)	16.3 (2.9)	33.8 (0.3)	6.8 (0.8)	2.4 (0.7)	7.67 (0.11)	15.3 (19.7)
Maximum	22.55	34.26	8.28	3.83	7.88	580.50
Percentage	100%	84%	100%	100%	100%	100%
December 2008 (Expected count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,487
Minimum	11.54	32.320	5.80	0.146	7.32	1.20
Mean (stdev)	15.4 (1.7)	34.9 (0.8)	7.2 (0.5)	2.1 (0.7)	7.62 (0.11)	10.2 (24.0)
Maximum	19.14	36.00	8.37	3.71	7.83	630.00
Percentage	100%	100%	100%	100%	100%	100%
January 2009 (Expected count 1,488)						
Actual Count	2,042	2,042	2,042	2,042	406	2,042
Minimum	7.48	28.570	5.67	0.448	7.28	1.40
Mean (stdev)	12.4 (2.5)	31.3 (0.9)	8.2 (0.8)	2.0 (0.7)	7.48 (0.07)	5.4 (6.5)
Maximum	17.86	34.24	9.58	3.36	7.60	164.50
Percentage	137%	137%	137%	137%	27%	137%
February 2009 (Expected count 1,344)						
Actual Count	1,344	1,344	1,344	1,344	1,170	1,343
Minimum	6.45	28.470	5.92	0.446	7.60	0.80
Mean (stdev)	13.5 (2.5)	30.1 (0.3)	8.0 (0.7)	2.0 (0.7)	7.90 (0.13)	13.6 (22.3)
Maximum	18.53	31.12	9.76	3.42	8.18	178.50
Percentage	100%	100%	100%	100%	87%	100%
March 2009 (Expected count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,488
Minimum	11.02	28.850	4.64	0.449	7.56	0.70
Mean (stdev)	17.9 (2.4)	31.8 (1.1)	6.8 (0.8)	2.1 (0.7)	7.94 (0.15)	5.7 (4.7)
Maximum	23.09	33.24	8.94	3.46	8.34	69.10
Percentage	100%	100%	100%	100%	100%	100%
April 2009 (Expected count 1,440)						
Actual Count	1,440	1,440	1,440	1,440	1,440	1,440
Minimum	15.39	19.370	3.34	0.558	7.14	5.00
Mean (stdev)	20.8 (2.1)	23.8 (2.4)	5.9 (0.8)	2.1 (0.7)	7.66 (0.22)	13.4 (6.5)
Maximum	27.15	31.32	7.72	3.52	8.27	69.70
Percentage	100%	100%	100%	100%	100%	100%
May 2009 (Expected count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	559	1,488
Minimum	20.16	23.920	2.80	0.798	7.20	3.90
Mean (stdev)	25.3 (2.0)	29.1 (2.4)	5.0 (0.8)	2.3 (0.8)	7.45 (0.10)	14.2 (9.0)
Maximum	30.00	33.01	7.66	3.74	7.66	176.50
Percentage	100%	100%	100%	100%	38%	100%
June 2009 (Expected count 1,440)						
Actual Count	1,440	1,428	1,437	1,440	0	1,440
Minimum	25.17	18.250	1.87	0.991		2.80
Mean (stdev)	29.1 (1.7)	25.8 (1.9)	4.0 (0.8)	2.7 (0.7)		14.4 (9.1)
Maximum	33.70	29.10	6.57	4.38		92.20
Percentage	100%	99%	100%	100%	0%	100%

Table 4. (continued).

July 2009 (Expected count 1,488)						
Actual Count	1,369	1,366	1,365	1,369	0	1,365
Minimum	26.19	27.900	1.88	1.276		2.30
Mean (stdev)	29.3 (1.2)	29.9 (0.9)	4.3 (0.9)	2.7 (0.7)		21.0 (23.8)
Maximum	32.68	31.57	7.62	4.19		299.30
Percentage	92%	92%	92%	92%	0%	92%
August 2009 (Expected count 1,488)						
Actual Count	1,222	1,222	1,219	1,222	1,222	1,219
Minimum	27.78	29.590	1.82	1.278	7.07	5.40
Mean (stdev)	29.8 (1.0)	33.3 (0.9)	4.1 (1.0)	2.7 (0.7)	7.35 (0.12)	24.2 (31.1)
Maximum	32.91	34.81	7.13	4.18	7.73	607.40
Percentage	82%	82%	82%	82%	82%	82%
September 2009 (Expected count 1,440)						
Actual Count	1,440	1,440	1,440	1,440	1,073	1,435
Minimum	24.17	27.850	1.89	1.672	7.10	1.00
Mean (stdev)	28.2 (1.2)	31.5 (0.7)	4.2 (1.0)	3.0 (0.7)	7.38 (0.09)	26.6 (25.6)
Maximum	31.24	32.73	6.19	4.33	7.57	266.40
Percentage	100%	100%	100%	100%	75%	100%
October 2009 (Expected count 1,488)						
Actual Count	941	941	941	941	0	940
Minimum	18.02	30.700	2.22	1.579		3.40
Mean (stdev)	25.7 (2.8)	31.7 (0.5)	4.6 (1.2)	2.9 (0.7)		18.1 (12.4)
Maximum	30.38	32.42	8.02	4.31		84.90
Percentage	63%	63%	63%	63%	0%	63%
November 2009 (Expected count 1,440)						
Actual Count	1,318	1,318	1,290	1,318	1,318	1,315
Minimum	13.78	30.860	2.07	1.264	7.37	0.20
Mean (stdev)	19.2 (2.0)	32.9 (0.3)	5.2 (0.9)	2.6 (0.7)	7.64 (0.12)	4.9 (4.0)
Maximum	22.01	33.34	6.99	3.95	7.97	72.20
Percentage	92%	92%	90%	92%	92%	91%
December 2009 (Expected count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,480
Minimum	10.10	30.250	3.19	0.967	7.64	0.00
Mean (stdev)	14.6 (2.0)	31.7 (0.7)	6.9 (0.9)	2.6 (0.7)	8.11 (0.19)	5.2 (4.7)
Maximum	18.96	33.90	8.87	3.94	8.44	61.50
Percentage	100%	100%	100%	100%	100%	99%

Table 5. Monthly minimum, maximum, and mean values for parameters collected at Plum Orchard at Cumberland Island National Seashore from 2005 to 2009. Standard deviations (stdev) of the mean values are provided in parentheses. Values for percentage valid n indicate the percentage of valid data points collected during the calendar month.

	Temp (°C)	Salinity (ppt)	DO Conc (mg/L)	Depth (m)	pH	Turbidity (NTU)
August 2005 (Expected Count 1,488)						
Actual Count	656	656	656	656	1325	649
Minimum	29.44	21.860	2.92	1.731	7.24	3.80
Mean (stdev)	30.7 (0.6)	25.5 (1.6)	4.6 (0.7)	3.1 (0.7)	7.42 (0.08)	12.6 (21.8)
Maximum	32.14	27.84	6.15	4.20	7.64	296.50
Percentage	44%	44%	44%	44%	89%	44%
September 2005 (Expected Count 1,440)						
Actual Count	1,102	1,102	1,102	1,102	1,102	902
Minimum	25.84	23.050	3.14	2.050	7.27	2.00
Mean (stdev)	28.3 (1.3)	26.7 (1.3)	5.0 (0.7)	3.3 (0.6)	7.51 (0.08)	73.0 (156.3)
Maximum	31.01	29.17	6.32	4.50	7.69	998.60
Percentage	77%	77%	77%	77%	77%	63%
October 2005 (Expected Count 1,488)						
Actual Count	336	336	336	336	336	336
Minimum	25.73	19.280	3.07	2.139	7.27	2.50
Mean (stdev)	27.3 (0.9)	27.0 (2.4)	5.3 (0.9)	3.4 (0.7)	7.49 (0.06)	14.9 (11.6)
Maximum	28.96	29.52	6.80	4.57	7.61	136.50
Percentage	23%	23%	23%	23%	23%	23%
November 2005 (Expected Count 1,440)						
Actual Count	823	823	823	823	823	822
Minimum	14.22	22.630	4.92	1.452	7.45	0.60
Mean (stdev)	17.9 (1.8)	26.8 (1.4)	7.0 (0.7)	2.9 (0.7)	7.75 (0.10)	9.1 (5.9)
Maximum	22.31	28.28	8.28	4.41	7.92	40.80
Percentage	57%	57%	57%	57%	57%	57%
December 2005 (Expected Count 1,488)						
Actual Count	1,282	1,282	1,282	1,282	1,282	1,281
Minimum	10.95	23.890	6.77	1.396	7.67	0.30
Mean (stdev)	13.8 (1.7)	27.1 (1.3)	8.0 (0.4)	2.9 (0.7)	7.80 (0.04)	8.7 (5.7)
Maximum	17.00	29.19	8.95	4.39	7.90	40.10
Percentage	86%	86%	86%	86%	86%	86%
January 2006 (Expected Count 1,488)						
Actual Count	978	978	666	978	978	978
Minimum	11.98	21.810	6.94	1.149	7.52	1.20
Mean (stdev)	14.2 (1.0)	23.6 (0.6)	7.7 (0.3)	2.8 (0.7)	7.76 (0.07)	6.8 (4.6)
Maximum	16.49	24.75	8.31	4.36	7.90	35.60
Percentage	66%	66%	45%	66%	66%	66%
February 2006 (Expected Count 1,344)						
Actual Count	1,344	1,344	987	1,344	1,344	1,344
Minimum	10.48	21.720	7.23	1.272	7.55	0.70
Mean (stdev)	13.8 (1.4)	23.8 (0.7)	8.1 (0.4)	2.9 (0.7)	7.72 (0.07)	6.2 (5.0)
Maximum	16.13	25.18	8.85	4.49	7.85	35.80
Percentage	100%	100%	73%	100%	100%	100%

Table 5. (continued).

March 2006 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,488
Minimum	14.39	23.150	6.15	1.149	7.50	2.00
Mean (stdev)	17.6 (1.3)	25.4 (0.9)	7.4 (0.4)	3.0 (0.8)	7.64 (0.05)	9.7 (6.1)
Maximum	20.51	26.80	8.38	4.66	7.78	47.80
Percentage	100%	100%	100%	100%	100%	100%
April 2006 (Expected Count 1,440)						
Actual Count	1,440	1,440	1,440	1,440	1,440	1,439
Minimum	18.92	26.120	4.41	1.340	7.42	2.00
Mean (stdev)	22.4 (1.5)	28.6 (1.3)	6.5 (0.7)	2.9 (0.8)	7.67 (0.09)	11.5 (6.4)
Maximum	25.69	31.84	7.74	4.75	7.86	60.40
Percentage	100%	100%	100%	100%	100%	100%
May 2006 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,487
Minimum	21.11	29.890	3.72	1.455	7.33	0.30
Mean (stdev)	24.7 (1.8)	31.7 (0.8)	5.8 (0.7)	3.0 (0.7)	7.56 (0.07)	9.2 (5.2)
Maximum	28.44	33.80	7.15	4.61	7.70	59.00
Percentage	100%	100%	100%	100%	100%	100%
June 2006 (Expected Count 1,440)						
Actual Count	1,440	1,440	1,440	1,440	1,440	1,434
Minimum	26.05	32.340	3.35	1.446	7.42	1.30
Mean (stdev)	28.4 (0.9)	34.0 (0.7)	5.3 (0.5)	3.0 (0.7)	7.58 (0.06)	14.5 (15.7)
Maximum	30.62	35.50	6.65	4.48	7.71	268.70
Percentage	100%	100%	100%	100%	100%	100%
July 2006 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,484
Minimum	27.77	32.110	3.86	1.462	7.45	1.50
Mean (stdev)	30.2 (0.9)	35.7 (0.7)	5.2 (0.5)	2.9 (0.7)	7.58 (0.04)	11.4 (12.7)
Maximum	32.10	37.13	6.43	4.28	7.69	269.20
Percentage	100%	100%	100%	100%	100%	100%
August 2006 (Expected Count 1,488)						
Actual Count	1,397	1,397	1,397	1,397	1,397	1,396
Minimum	29.17	33.560	3.51	1.306	7.38	0.00
Mean (stdev)	30.4 (0.6)	36.2 (0.6)	4.9 (0.7)	2.9 (0.7)	7.56 (0.10)	7.0 (4.3)
Maximum	32.09	37.50	7.06	4.41	7.80	35.90
Percentage	94%	94%	94%	94%	94%	94%
September 2006 (Expected Count 1,440)						
Actual Count	1,430	1,430	1,430	1,430	1,430	1,420
Minimum	26.45	33.330	3.15	1.546	7.20	0.00
Mean (stdev)	28.4 (1.0)	35.5 (0.6)	4.7 (0.6)	3.0 (0.7)	7.42 (0.10)	7.9 (5.0)
Maximum	30.68	36.43	6.54	4.56	7.74	65.60
Percentage	99%	99%	99%	99%	99%	99%
October 2006 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,486
Minimum	19.94	33.990	3.83	1.506	7.36	0.70
Mean (stdev)	23.6 (2.2)	35.5 (0.4)	5.7 (0.6)	2.8 (0.7)	7.61 (0.09)	6.5 (4.0)
Maximum	27.81	36.62	6.98	4.50	7.79	69.60
Percentage	100%	100%	100%	100%	100%	100%

Table 5. (continued).

November 2006 (Expected Count 1,440)						
Actual Count	1,440	1,440	1,433	1,440	1,440	1,440
Minimum	12.68	33.360	4.90	1.460	7.61	0.30
Mean (stdev)	17.5 (2.2)	34.8 (0.3)	6.8 (0.7)	2.7 (0.8)	7.80 (0.12)	7.1 (4.9)
Maximum	21.90	35.44	8.13	4.47	8.07	39.10
Percentage	100%	100%	100%	100%	100%	100%
December 2006 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,460	1,488	1,488	971
Minimum	12.34	30.650	5.80	1.491	7.64	0.00
Mean (stdev)	16.1 (1.6)	33.5 (1.0)	6.9 (0.7)	3.1 (0.7)	7.77 (0.06)	5.7 (3.3)
Maximum	19.41	34.59	8.42	4.56	7.92	22.00
Percentage	100%	100%	98%	100%	100%	65%
January 2007 (Expected Count 1,488)						
Actual Count	1,485	1,485	1	1,485	1,485	405
Minimum	10.57	30.020	6.28	1.107	7.63	0.00
Mean (stdev)	15.3 (2.2)	31.7 (0.3)	6.3 ()	3.0 (0.8)	7.84 (0.08)	4.8 (3.2)
Maximum	19.19	32.28	6.28	4.61	7.98	20.80
Percentage	100%	100%	0%	100%	100%	27%
February 2007 (Expected Count 1,344)						
Actual Count	1,341	1,341	1,115	1,341	1,341	60
Minimum	10.71	29.160	7.58	1.038	7.66	0.00
Mean (stdev)	13.3 (1.4)	31.6 (0.6)	8.7 (0.4)	2.6 (0.8)	7.81 (0.05)	1.8 (1.9)
Maximum	17.28	32.53	9.74	4.26	7.98	8.80
Percentage	100%	100%	83%	100%	100%	4%
March 2007 (Expected Count 1,488)						
Actual Count	1,046	1,046	1,046	1,046	1,046	608
Minimum	15.36	31.330	4.36	0.680	7.30	0.00
Mean (stdev)	19.0 (2.4)	33.5 (1.1)	6.6 (0.5)	2.6 (0.8)	7.62 (0.13)	4.2 (4.3)
Maximum	23.48	35.32	7.94	4.13	7.88	26.70
Percentage	70%	70%	70%	70%	70%	41%
April 2007 (Expected Count 1,440)						
Actual Count	1,197	1,197	1,197	1,197	1,197	1,149
Minimum	17.13	32.060	2.78	0.500	7.19	0.20
Mean (stdev)	21.1 (1.9)	33.9 (0.8)	6.3 (0.7)	2.5 (0.7)	7.57 (0.13)	10.6 (8.7)
Maximum	24.24	36.17	7.52	4.41	7.76	71.10
Percentage	83%	83%	83%	83%	83%	80%
May 2007 (Expected Count 1,488)						
Actual Count	1,486	1,486	1,486	1,486	1,486	970
Minimum	20.99	32.190	2.45	1.182	7.36	0.00
Mean (stdev)	24.4 (1.2)	33.6 (0.6)	5.5 (0.7)	2.9 (0.7)	7.64 (0.08)	9.1 (12.6)
Maximum	26.61	38.02	7.05	4.40	7.82	99.70
Percentage	100%	100%	100%	100%	100%	65%
June 2007 (Expected Count 1,440)						
Actual Count	1,440	1,440	1,440	1,440	1,440	611
Minimum	23.63	33.030	1.69	1.277	7.24	0.00
Mean (stdev)	27.8 (1.6)	35.9 (0.9)	5.3 (0.8)	2.8 (0.7)	7.51 (0.08)	9.8 (15.4)
Maximum	30.74	38.02	6.88	4.52	7.71	178.10
Percentage	100%	100%	100%	100%	100%	42%

Table 5. (continued).

July 2007 (Expected Count 1,488)						
Actual Count	1,427	1,427	1,427	1,427	1,427	1,115
Minimum	26.53	30.340	0.00	1.291	7.18	0.00
Mean (stdev)	29.4 (1.0)	33.7 (2.2)	4.4 (1.6)	2.7 (0.7)	7.56 (0.19)	10.0 (11.8)
Maximum	32.26	37.98	9.55	4.28	8.03	183.70
Percentage	96%	96%	96%	96%	96%	75%
August 2007 (Expected Count 1,488)						
Actual Count	1,381	1,381	1,381	1,381	1,381	242
Minimum	27.79	30.790	0.51	1.020	7.15	4.00
Mean (stdev)	30.7 (0.9)	33.0 (0.7)	4.0 (1.2)	2.6 (0.8)	7.53 (0.11)	14.5 (8.0)
Maximum	32.34	35.29	7.64	4.10	7.84	85.20
Percentage	93%	93%	93%	93%	93%	16%
September 2007 (Expected Count 1,440)						
Actual Count	1,438	1,438	1,438	1,438	1,438	512
Minimum	24.75	25.850	0.42	1.325	7.18	4.20
Mean (stdev)	28.3 (1.2)	30.6 (2.6)	4.6 (1.0)	3.1 (0.7)	8.02 (0.28)	14.0 (5.7)
Maximum	30.76	34.44	7.18	4.64	8.41	39.60
Percentage	100%	100%	100%	100%	100%	36%
October 2007 (Expected Count 1,488)						
Actual Count	750	750	750	750	750	0
Minimum	24.76	23.670	1.82	1.770	7.76	
Mean (stdev)	26.0 (0.7)	25.7 (1.1)	4.5 (0.7)	3.1 (0.7)	8.03 (0.11)	
Maximum	27.66	28.16	6.28	4.58	8.31	
Percentage	50%	50%	50%	50%	50%	0%
November 2007 (Expected Count 1,440)						
Actual Count	1,127	1,127	1,127	1,127	1,127	1,127
Minimum	15.87	28.470	5.96	0.995	7.67	0.30
Mean (stdev)	17.3 (0.7)	29.6 (0.7)	6.9 (0.3)	2.7 (0.7)	7.80 (0.04)	7.7 (6.4)
Maximum	18.87	31.21	7.62	4.43	7.91	48.50
Percentage	78%	78%	78%	78%	78%	78%
December 2007 (Expected Count 1,488)						
Actual Count	1,487	1,487	1,487	1,487	1,487	214
Minimum	14.07	30.580	6.45	1.109	7.66	0.00
Mean (stdev)	16.8 (1.4)	32.2 (0.6)	7.1 (0.2)	2.6 (0.7)	7.76 (0.04)	2.8 (2.1)
Maximum	20.16	32.96	7.73	4.32	7.86	10.90
Percentage	100%	100%	100%	100%	100%	14%
January 2008 (Expected Count 1,488)						
Actual Count	1,486	1,486	1,486	1,486	1,486	1,175
Minimum	10.37	31.090	6.68	0.948	7.53	0.70
Mean (stdev)	13.0 (1.7)	32.9 (0.9)	8.2 (0.4)	2.5 (0.7)	7.92 (0.08)	5.9 (3.5)
Maximum	16.93	34.56	9.12	4.09	8.06	23.10
Percentage	100%	100%	100%	100%	100%	79%
February 2008 (Expected Count 1,392)						
Actual Count	1,341	1,341	1,341	1,341	1,341	928
Minimum	12.39	26.150	5.97	0.910	7.51	0.00
Mean (stdev)	15.9 (1.5)	29.1 (1.2)	7.6 (0.5)	2.4 (0.7)	7.74 (0.11)	3.9 (3.0)
Maximum	18.84	31.71	8.80	3.72	7.99	21.80
Percentage	96%	96%	96%	96%	96%	67%

Table 5. (continued).

March 2008 (Expected Count 1,488)						
Actual Count	1,290	1,290	1,290	1,290	69	1,265
Minimum	16.01	21.760	5.21	0.384	7.56	0.40
Mean (stdev)	18.3 (1.0)	25.6 (1.3)	6.7 (0.4)	2.4 (0.8)	7.64 (0.04)	101.7 (172.1)
Maximum	20.70	29.32	7.77	3.69	7.71	955.10
Percentage	87%	87%	87%	87%	5%	85%
April 2008 (Expected Count 1,440)						
Actual Count	1,438	1,438	1,438	1,438	1,363	1,386
Minimum	17.63	25.450	3.22	0.851	7.51	1.10
Mean (stdev)	21.1 (1.6)	29.3 (1.2)	6.2 (0.5)	2.5 (0.7)	7.73 (0.08)	100.8 (198.9)
Maximum	24.45	31.82	7.19	4.16	7.92	995.50
Percentage	100%	100%	100%	100%	95%	96%
May 2008 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	322	1,259
Minimum	22.04	29.140	1.66	0.928	7.47	0.10
Mean (stdev)	24.9 (1.2)	31.9 (0.7)	5.5 (0.7)	2.5 (0.8)	7.64 (0.08)	38.3 (115.6)
Maximum	28.14	34.05	7.10	4.19	7.81	998.40
Percentage	100%	100%	100%	100%	22%	85%
June 2008 (Expected Count 1,440)						
Actual Count	1,330	1,330	1,330	1,330	593	1,302
Minimum	27.34	31.600	1.02	0.880	7.58	0.30
Mean (stdev)	29.2 (0.7)	35.3 (1.2)	4.8 (0.9)	2.6 (0.8)	7.68 (0.04)	37.3 (77.0)
Maximum	30.79	36.89	6.91	4.11	7.80	984.80
Percentage	92%	92%	92%	92%	41%	90%
July 2008 (Expected Count 1,488)						
Actual Count	1,486	1,486	1,486	1,486	563	563
Minimum	27.23	31.880	2.36	1.216	7.50	1.30
Mean (stdev)	29.4 (0.8)	34.8 (0.9)	4.6 (0.6)	2.8 (0.8)	7.61 (0.04)	72.2 (74.8)
Maximum	31.51	36.51	7.00	4.38	7.72	638.90
Percentage	100%	100%	100%	100%	38%	38%
August 2008 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,463	1,448
Minimum	25.55	22.300	2.56	1.296	7.24	5.70
Mean (stdev)	28.8 (1.2)	32.7 (3.3)	4.5 (0.7)	3.0 (0.8)	7.54 (0.12)	71.3 (97.2)
Maximum	31.62	36.25	6.37	4.60	7.75	973.00
Percentage	100%	100%	100%	100%	98%	97%
September 2008 (Expected Count 1,440)						
Actual Count	1,440	1,440	1,440	1,440	1,440	1,425
Minimum	22.30	22.320	2.76	1.649	7.16	4.70
Mean (stdev)	27.5 (2.2)	29.0 (3.0)	4.4 (0.8)	3.2 (0.7)	7.39 (0.14)	32.6 (80.1)
Maximum	30.59	34.47	6.20	4.52	7.70	981.00
Percentage	100%	100%	100%	100%	100%	99%
October 2008 (Expected Count 1,488)						
Actual Count	1,487	1,487	1,487	1,487	1,487	1,487
Minimum	16.32	29.660	3.46	1.210	7.15	1.80
Mean (stdev)	23.1 (2.7)	31.5 (0.9)	5.5 (0.7)	2.9 (0.7)	7.55 (0.08)	18.3 (39.3)
Maximum	26.88	34.16	7.56	4.18	7.72	682.00
Percentage	100%	100%	100%	100%	100%	100%

Table 5. (continued).

November 2008 (Expected Count 1,440)						
Actual Count	1,439	1,439	1,439	1,439	222	1,438
Minimum	11.82	29.620	4.95	0.851	7.52	0.30
Mean (stdev)	16.5 (2.5)	32.2 (0.7)	6.9 (0.6)	2.6 (0.7)	7.66 (0.03)	16.6 (47.9)
Maximum	21.32	33.24	8.16	4.04	7.74	504.40
Percentage	100%	100%	100%	100%	15%	100%
December 2008 (Expected Count 1,488)						
Actual Count	1,488	77	1,488	1,488	1,409	1,484
Minimum	12.89	31.210	6.27	0.186	7.64	0.00
Mean (stdev)	15.2 (1.3)	31.9 (0.3)	7.2 (0.4)	2.3 (0.7)	7.78 (0.05)	6.3 (11.2)
Maximum	17.91	32.54	8.33	3.97	7.90	377.10
Percentage	100%	5%	100%	100%	95%	100%
January 2009 (Expected Count 1,488)						
Actual Count	1,252	845	1,252	1,252	1,252	1,252
Minimum	9.18	29.600	4.02	0.480	7.66	0.40
Mean (stdev)	13.1 (2.3)	30.7 (0.4)	7.9 (0.8)	2.2 (0.7)	7.87 (0.10)	5.4 (3.5)
Maximum	17.08	34.94	9.16	3.59	8.07	47.70
Percentage	84%	57%	84%	84%	84%	84%
February 2009 (Expected Count 1,344)						
Actual Count	1,344	1,344	1,344	1,344	1,344	1,344
Minimum	8.86	28.960	6.84	0.554	7.73	1.40
Mean (stdev)	13.4 (1.9)	29.9 (0.4)	8.0 (0.5)	2.2 (0.8)	7.87 (0.06)	5.1 (2.3)
Maximum	16.66	30.88	9.06	3.70	8.00	19.60
Percentage	100%	100%	100%	100%	100%	100%
March 2009 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,488
Minimum	12.74	28.220	3.65	0.525	7.53	1.30
Mean (stdev)	17.7 (2.1)	31.4 (1.3)	6.8 (0.7)	2.3 (0.8)	7.77 (0.09)	7.5 (4.6)
Maximum	21.18	33.18	8.24	3.73	7.96	58.00
Percentage	100%	100%	100%	100%	100%	100%
April 2009 (Expected Count 1,440)						
Actual Count	1,439	1,439	1,439	1,439	1,439	1,439
Minimum	16.85	15.660	2.64	0.641	7.25	5.40
Mean (stdev)	20.6 (1.8)	22.6 (3.2)	5.8 (0.7)	2.3 (0.8)	7.48 (0.10)	14.8 (5.5)
Maximum	25.29	30.01	7.18	3.78	7.72	44.30
Percentage	100%	100%	100%	100%	100%	100%
May 2009 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,488
Minimum	20.70	21.920	2.38	0.881	7.25	1.60
Mean (stdev)	25.3 (1.8)	28.6 (2.9)	5.0 (0.7)	2.4 (0.8)	7.48 (0.13)	12.7 (6.6)
Maximum	28.96	33.20	6.60	3.91	7.88	69.50
Percentage	100%	100%	100%	100%	100%	100%
June 2009 (Expected Count 1,440)						
Actual Count	68	68	68	68	68	68
Minimum	27.58	26.960	2.54	0.696	7.25	1.40
Mean (stdev)	28.3 (0.3)	27.6 (0.5)	4.2 (0.6)	2.4 (0.8)	7.31 (0.02)	6.2 (2.5)
Maximum	28.84	29.17	4.93	3.45	7.35	14.40
Percentage	5%	5%	5%	5%	5%	5%

Table 5. (continued).

July 2009 (Expected Count 1,488)						
Actual Count	1,123	1,123	1,123	1,123	1,123	1,118
Minimum	26.84	28.760	1.85	1.341	7.14	0.00
Mean (stdev)	29.4 (0.9)	30.8 (0.8)	4.4 (0.6)	2.9 (0.8)	7.44 (0.16)	14.7 (10.5)
Maximum	31.37	32.79	5.69	4.45	7.91	159.10
Percentage	75%	75%	75%	75%	75%	75%
August 2009 (Expected Count 1,488)						
Actual Count	1,488	1,411	1,485	1,488	1,488	1,469
Minimum	27.93	24.410	1.87	1.325	7.03	0.00
Mean (stdev)	29.8 (0.7)	32.8 (1.8)	4.1 (0.7)	2.8 (0.7)	7.34 (0.17)	15.5 (13.6)
Maximum	31.96	36.14	6.40	4.44	7.80	201.20
Percentage	100%	95%	100%	100%	100%	99%
September 2009 (Expected Count 1,440)						
Actual Count	884	884	883	884	884	879
Minimum	26.45	21.900	2.30	1.726	6.90	0.00
Mean (stdev)	27.9 (0.6)	30.3 (2.6)	4.3 (0.6)	3.2 (0.7)	7.24 (0.12)	10.7 (8.1)
Maximum	29.50	34.45	5.76	4.57	7.49	57.30
Percentage	61%	61%	61%	61%	61%	61%
October 2009 (Expected Count 1,488)						
Actual Count	1,184	1,184	1,184	1,184	1,184	1,184
Minimum	19.50	31.050	3.41	1.585	7.28	1.80
Mean (stdev)	24.4 (2.8)	32.4 (0.4)	5.6 (1.1)	3.0 (0.7)	7.62 (0.22)	11.4 (6.7)
Maximum	29.24	33.44	7.93	4.43	7.98	41.30
Percentage	80%	80%	80%	80%	80%	80%
November 2009 (Expected Count 1,440)						
Actual Count	1,440	1,440	1,440	1,440	1,440	1,440
Minimum	15.34	31.630	4.27	1.542	7.45	1.40
Mean (stdev)	19.8 (1.8)	32.0 (0.2)	6.2 (0.4)	3.0 (0.7)	7.56 (0.06)	8.7 (4.3)
Maximum	24.21	32.48	7.19	4.41	7.84	35.10
Percentage	100%	100%	100%	100%	100%	100%
December 2009 (Expected Count 1,488)						
Actual Count	1,488	1,488	1,488	1,488	1,488	1,464
Minimum	11.30	28.170	6.34	1.241	7.58	0.00
Mean (stdev)	14.7 (1.6)	32.1 (1.1)	7.4 (0.6)	3.0 (0.7)	8.04 (0.15)	6.4 (5.5)
Maximum	17.85	34.36	8.57	4.37	8.28	115.40
Percentage	100%	100%	100%	100%	100%	98%

Discrete Data

Monthly water-quality data collected by Southeast Coast Network sites at Cumberland Island National Seashore from 2005 through 2009 are shown in Tables 6 and 7 below. A total of 35 discrete samples were taken at each site. Condition categories of assessed parameters are from the EPA (2012) except for water clarity, which was assessed using light attenuation values (k) derived from Secchi depth readings using a constant for estuarine water with naturally turbid conditions (Smith et al. 2006).

For Old House Creek (Table 6), these data indicate mostly *good* water clarity conditions (80% of samples), with seven *poor* water clarity ratings spread across the period of record. Dissolved inorganic nitrogen (DIN) concentrations were mostly *good* (80%) with some poor readings (20%), and dissolved inorganic phosphorus (DIP) concentrations were mostly *fair* (90%), with one *poor* reading in November 2009. Chlorophyll *a* levels rated *fair* for 25 months, *good* for four months, and *poor* for six months. Dissolved oxygen concentrations were mostly good (71.4%) with 28.6% regarded as *fair*. *Fair* dissolved oxygen readings occurred in warmer months, from May to September. Condition categories correspond to those used by the EPA in the National Coastal Condition Report IV (2012).

For Plum Orchard (Table 7), these data indicate mostly *good* water clarity conditions (97.1% of samples), with only one *poor* water clarity rating in September of 2008. Dissolved inorganic nitrogen (DIN) was mostly *good* (80%) with two *fair* readings (20%), and dissolved inorganic phosphorus (DIP) readings were all *fair* (100%). Chlorophyll *a* levels rated *fair* for 29 months, *good* for four months, and *poor* for two months. Dissolved oxygen concentrations were mostly *good* (74.3%) with 25.7% being regarded as *fair*. *Fair* dissolved oxygen readings occurred in warmer months, from June to September. Condition categories correspond to those used by the EPA in the National Coastal Condition Report IV (2012).

Table 6. Monthly water-quality data collected by the Southeast Coast Network at the Old House Creek site at Cumberland Island National Seashore 2007–2009. Water clarity was assessed using light attenuation values (*k*) using a constant for estuarine water with naturally turbid conditions (Smith et al. 2006) and assessment categories that correspond to the EPA (2012). Condition of other assessed parameters from EPA (2012). [Green ()—good; yellow ()—fair; and red ()—poor; *k*—light attenuation coefficient; µg/L—micrograms per liter; mg/L—milligrams per liter; “--”—data missing; Chl *a*—chlorophyll *a*; DIN—dissolved inorganic nitrogen; DIP—dissolved inorganic phosphorus; DO—dissolved oxygen; TDN—total dissolved nitrogen; TDP—total dissolved phosphorus].

Date	Water Clarity (<i>k</i>)	Chl <i>a</i> (µg/L)	DIN (mg/L)	DIP (mg/L)	DO (mg/L)	TDN (mg/L)	TDP (mg/L)
02/05/2007	0.80	4.3	0.0245	0.0224	8.4	0.26	0.0456
03/02/2007	1.33	4.1	--	--	5.9	0.34	0.0509
04/10/2007	0.80	7.7	--	--	--	0.32	0.0423
05/07/2007	2.00	16.8	--	--	8.4	0.39	0.0574
06/12/2007	4.00	23.5	--	--	5.8	0.50	0.0435
07/10/2007	2.00	26.9	--	--	3.7	0.47	0.0647
08/14/2007	4.00	26.6	0.0252	0.0275	4.7	0.06	0.0356
09/05/2007	1.67	30.0	--	--	3.5	0.27	0.0424
10/03/2007	2.00	9.0	--	--	5.0	0.51	0.0603
11/07/2007	2.00	6.5	0.1061	0.0379	6.6	0.52	0.0672
12/05/2007	1.33	8.1	--	--	6.9	0.42	0.0654
01/07/2008	0.80	5.9	--	--	7.6	0.41	0.0574
02/05/2008	1.00	6.3	0.0283	0.0230	7.6	0.33	0.0540
03/06/2008	1.33	7.9	--	--	7.1	0.40	0.0506
04/02/2008	2.00	10.8	--	--	6.2	0.46	0.0493
05/07/2008	4.00	17.6	0.0223	0.0181	6.4	0.45	0.0722
06/16/2008	1.33	9.0	--	--	3.4	0.41	0.0818
07/10/2008	1.33	25.1	--	--	5.1	0.55	0.0822
08/01/2008	2.00	21.6	--	--	4.8	0.50	0.0716
09/08/2008	4.00	6.4	--	--	2.5	0.79	0.0876
10/01/2008	4.00	4.8	--	--	6.1	0.60	0.0624
11/05/2008	1.33	6.9	0.0598	0.0285	6.7	0.48	0.0801
12/02/2008	2.00	5.5	--	--	8.2	0.37	0.0818
01/09/2009	2.00	7.9	--	--	7.0	0.41	0.0652
02/01/2009	0.80	4.5	0.0158	0.0219	8.9	0.40	0.0502
03/07/2009	2.00	8.3	--	--	7.6	0.00	0.0000
04/15/2009	2.00	5.8	--	--	7.0	0.55	0.0529
05/12/2009	2.00	13.7	0.0745	0.0237	4.1	0.48	0.0577
06/02/2009	4.00	9.6	--	--	4.0	0.47	0.0476
07/08/2009	4.00	17.7	--	--	4.7	0.48	0.0624
08/06/2009	2.00	10.3	0.1249	0.0211	4.6	0.59	0.2071
09/10/2009	1.43	8.1	--	--	5.4	0.51	0.0559
10/08/2009	2.00	8.1	--	--	5.9	0.53	0.0674
11/03/2009	1.33	6.5	0.0169	0.1590	6.3	0.33	0.0585
12/02/2009	2.00	5.5	--	--	5.9	0.39	0.0682

Table 7. Monthly water-quality data collected by Southeast Coast Network at the Plum Orchard site at Cumberland Island National Seashore 2007–2009. Water clarity was assessed using light attenuation values (*k*) using a constant for estuarine water with naturally turbid conditions (Smith et al. 2006) and assessment categories that correspond to the EPA (2012). Condition of other assessed parameters from the EPA (2012). [Green ()—good; yellow ()—fair; and red ()—poor; *k*—light attenuation coefficient; µg/L—micrograms per liter; mg/L—milligrams per liter; “—”—data missing; Chl *a*—chlorophyll *a*; DIN—dissolved inorganic nitrogen; DIP—dissolved inorganic phosphorus; DO—dissolved oxygen; TDN—total dissolved nitrogen; TDP—total dissolved phosphorus].

Date	Water Clarity (<i>k</i>)	Chl <i>a</i> (µg/L)	DIN (mg/L)	DIP (mg/L)	DO (mg/L)	TDN (mg/L)	TDP (mg/L)
02/05/2007	0.80	6.5	0.0111	0.0138	9.3	0.26	0.0904
03/02/2007	1.00	4.2			6.7	0.28	0.0707
04/10/2007	1.00	7.1			6.1	0.41	0.0359
05/07/2007	1.33	10.2			6.8	0.35	0.0496
06/12/2007	2.00	12.6			5.1	0.40	0.0519
07/10/2007	1.33	9.6			4.7	0.53	0.0533
08/14/2007	1.33	22.0	0.0588	0.0354	5.5	0.43	0.0622
09/05/2007	1.54	17.4			4.7	0.48	0.0650
10/03/2007	1.33	7.8			5.3	0.47	0.0601
11/07/2007	2.00	5.3	0.1266	0.0352	6.5	0.52	0.0730
12/05/2007	1.00	5.7			7.1	0.43	0.0514
01/07/2008	0.80	9.4			8.6	0.34	0.0457
2/5/2008	1.00	7.35	.0208	.0186	7.7	0.29	0.0445
03/06/2008	1.33	7.4			7.3	0.41	0.0376
04/02/2008	1.00	7.3			7.1	0.42	0.0379
05/07/2008	2.00	10.0	0.0225	0.0138	5.8	0.42	0.0387
06/16/2008	1.33	9.2			2.7	0.44	0.0875
07/10/2008	1.00	11.6			4.0	0.52	0.0620
08/01/2008	1.33	20.2			4.6	0.47	0.0796
09/08/2008	4.00	4.4			4.0	0.74	0.0552
10/01/2008	2.00	9.6			5.5	0.49	0.0563
11/05/2008	1.33	5.4	0.0622	0.0293	6.7	0.46	0.0580
12/02/2008	2.00	7.1			8.2	0.34	0.0519
01/09/2009	2.00	8.4			7.0	0.35	0.0525
02/01/2009	0.67	7.7	0.0090	0.0148	8.8	0.34	0.0433
03/07/2009	1.00	6.9			8.0	0.00	0.0000
04/15/2009	1.33	5.5			6.0	0.58	0.0392
05/12/2009	2.00	8.9	0.0802	0.0262	5.1	0.50	0.0626
06/02/2009	1.33	3.2			4.7	0.49	0.0643
07/08/2009	1.33	7.2			5.0	0.50	0.0718
08/06/2009	1.33	6.0	0.1212	0.0296	4.7	0.50	0.1116
09/10/2009	1.00	6.2			5.4	0.42	0.0662
10/08/2009	2.00	6.5			5.2	0.53	0.0692
11/03/2009	1.00	6.4	0.0246	0.0165	6.4	0.32	0.0546
12/02/2009	1.33	4.7			7.1	0.37	0.0524

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