



Fixed-Station Water-Quality Monitoring at Cape Lookout National Seashore

2013–2014 Data Summary

Natural Resource Data Series NPS/SECN/NRDS—2017/1129



ON THE COVER

A green sea turtle (*Chelonia mydas*) at Cape Lookout National Seashore. SECN photo.

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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. This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. 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 2007, the National Park Service (NPS) Southeast Coast Network (SECN) Inventory and Monitoring Program began collecting water-quality data in the estuarine waters near Cape Lookout National Seashore (CALO). Two continuous-monitoring stations have been operational since 2008 at the Shackleford Banks Dock (CALO01) and in the Middle Marshes area (CALO02).

These stations collect pH, dissolved oxygen, temperature, salinity, conductivity, turbidity, and water level data every 15 minutes. Water-quality technicians make additional water quality measurements, which include monthly measurements of water clarity conditions, nutrient concentrations, and chlorophyll *a* levels. Staff follow methods that were adapted from the water-quality monitoring program established by the National Estuarine Research Reserve Program (Wenner and Geist 2001). Data and results are compared to EPA criteria (EPA 2012) which rate conditions as good, fair, or poor.

The Cape Lookout National Seashore fixed-station water-quality monitoring sites are part of the SECN estuarine water-quality monitoring program, which routinely collects data in the vicinity of seven coastal parks along the southeastern U.S. coast (DeVivo et al. 2008; Gregory et al. 2013). Information collected by this monitoring program will be used to help managers make better-informed decisions by understanding trends and variability related to water-quality conditions in park waters.

Highlights from the 2013–2014 data record are summarized in this report.

Site CALO01

- Monthly water-quality data collected during 2013–2014 at the Southeast Coast Network site CALO01 near Cape Lookout National Seashore reflected overall good water-quality conditions throughout the reporting period.
- Discrete samples of chlorophyll *a* and dissolved oxygen levels were good for the period of record (22 site visits). Water clarity was also good for 19 of the 22 visits, and fair twice.
- Seven samples were tested for dissolved inorganic nitrogen (DIN) and dissolved inorganic phosphorus

(DIP) during the two-year period of record. All DIN and DIP concentrations fell in the good range.

- Mean monthly dissolved oxygen levels were good throughout the period, ranging from 6.2 mg/L to 9.5 mg/L. Individual measurements ranged from a low of 2.8 mg/L in June 2013 to a high of 11.3 mg/L in February 2014.
- Mean monthly pH values ranged from 7.7 to 8.2. Individual measurements ranged from a low of 7.4 in June 2014 to a high of 8.4 in March 2013.
- Monthly mean turbidity ranged from 1 to 37.3 NTUs. The lowest individual turbidity reading for any given month was 0.0 NTUs, and a maximum reading of 298.8 NTUs was recorded in December 2013.
- Water temperatures in 2013–2014 ranged from a minimum monthly mean of 8.5°C (47.3°F) to a maximum monthly mean of 27.2°C (81.0°F). Individual temperatures ranged from a minimum of 1.9°C (35.4°F) in January 2014 to a maximum of 31.6°C (88.9°F) in July 2014.
- The tidal range at CALO01 was 1.7 meters (5.6 feet).

Site CALO02

- Monthly water-quality data collected during 2013–2014 at the Southeast Coast Network site CALO02 near Cape Lookout National Seashore reflected mostly good water-quality conditions throughout the year.
- Discrete samples of chlorophyll *a* and dissolved oxygen levels were mostly good for the period of record (22 site visits), with one fair reading for water clarity in June 2013.
- Dissolved inorganic nitrogen (DIN) and dissolved inorganic phosphorus (DIP) were tested for in six samples across the two-year period of record. All DIN and DIP concentrations fell in the good range except for one abnormally high DIP concentration in February 2014.
- Mean monthly dissolved oxygen levels were good throughout the period, ranging from 4.0 mg/L to 9.6

mg/L. Individual measurements ranged from a low of 2.6 mg/L in October 2013 to a high of 11.7 mg/L in March 2013.

- Mean monthly pH values ranged from 7.7 to 8.5. Individual measurements ranged from a low of 7.3 in May 2013 to a high of 8.8 in multiple months.
- Monthly mean turbidity ranged from 2.7 to 27.1 NTUs. The lowest individual turbidity reading for any given month was 0.0 NTUs, and a maximum reading of 154.5 NTUs was recorded in June 2013.
- Water temperatures in 2013–2014 ranged from a minimum monthly mean of 8.5°C (47.3°F) in February 2014 to a maximum monthly mean of 28.1°C (82.6°F) in September 2014. Individual temperatures ranged from a minimum of 1.1°C (34.0°F) in January 2014 to a maximum of 33.2°C (91.8°F) in July 2013.
- The tidal range at site CALO02 was 2.0 meters (6.6 feet).

Cape Lookout National Seashore Significant Waters Map

Southeast Coast Network
National Park Service
U.S. Department of the Interior



Figure 1. Location of continuous water-quality monitoring station at Cape Lookout National Seashore. Map shows estuarine and marine water resources in the vicinity of Cape Lookout National Seashore in North Carolina. Map indicates areas of salt marsh (U.S. Fish and Wildlife Service 2015), urbanization (U.S. Census Bureau 2015), areas listed as impaired (EPA 2017) and areas designated as having special uses or restrictions (NC OneMap 2015).

Introduction

Due to the importance of water resources to park management from ecological, regulatory, and visitor experience perspectives, estuarine water quality in and around parks was selected as one of several vital signs to be monitored by the National Park Service (NPS) Inventory and Monitoring (I&M) program (DeVivo et al. 2008). Data collected as a part of this effort are intended to foster a better understanding of water resources in and near park units, and to contribute to a better understanding of ecological processes and physical systems in the region (Gregory et al. 2013).

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

The Southeast Coast Network has identified four specific monitoring objectives (detailed below) for which data are collected and analyzed as part of this effort (Gregory et al. 2013). The contents of this report address objectives 1 and 2:

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 through collection of 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.

This report provides an annual summary of data collected during 2013–2014 at Cape Lookout National Seashore and places these values in context of current water-quality

criteria suggested by the U.S. Environmental Protection Agency (EPA 2012), as well as concurrent regional climatic conditions that may influence local water-quality conditions. This report is intended to provide park resource managers and partners with information on the short-term variability and seasonal trends in water quality across Cape Lookout National Seashore.

Cape Lookout National Seashore

Cape Lookout National Seashore is along the southern end of the Outer Banks and is largely undeveloped and accessible only by boat. The seashore is made up of three barrier islands covering 56 miles (90.1 km) of the central coast of North Carolina. Most of the seashore consists of North and South Core Banks, a 44-mile-long barrier system oriented in a southwest to northeast direction, and separated New Drum Inlet (Figure 1). The other barrier system within the seashore is Shackleford Banks which extends westward from Cape Lookout.

Instead of exhibiting the typical barrier island zonation of a wide berm, low dunes, grasslands, shrub thickets, and salt marsh, the northern end of Portsmouth Island is characterized by vast tidal sand flats (averaging 0.6 miles in width) located between the berm and the dunes of a series of marsh-fringed islands. At triangularly shaped Cape Lookout, continuous dunes similar to those on Shackleford Banks can be found on the southwest side, with several small freshwater marshes present in depressions between the dunes. High dunes significantly reducing overwash and thickets have further stabilized the flats of the Cape's interior. A long spit extends from the western tip of Cape Lookout and has encouraged accretion in this direction.

Specific issues of concern to Cape Lookout NS include off-road vehicle use and associated impacts to dunes, threatened and endangered species, commercial fishing, military overflights, and non-native species. Additionally, the Back Sound off Shackleford Banks at Cape Lookout receives runoff from the populated areas of Morehead City and Beaufort. Numerous water bodies in the vicinity of the seashore have been 303(d) listed for water-quality violations (Figure 1). For example, the marine waters both north and south of Cape Lookout—as well as those off Cape Lookout itself—have been listed for elevated mercury in fish and elevated bacteria levels. Areas in the Core and Bogue Sounds have also been listed for elevated pathogen levels which have caused shell fishing areas to be closed or only conditionally approved (EPA 2017).

Weather and Hydrologic Setting

Daily rainfall totals were collected at the Morehead City weather and climate station by the National Climate Data Center (NCDC 2015) and are included here (Figure 2) as an aid for interpreting water-quality results. These data are presented for 2013–2014.

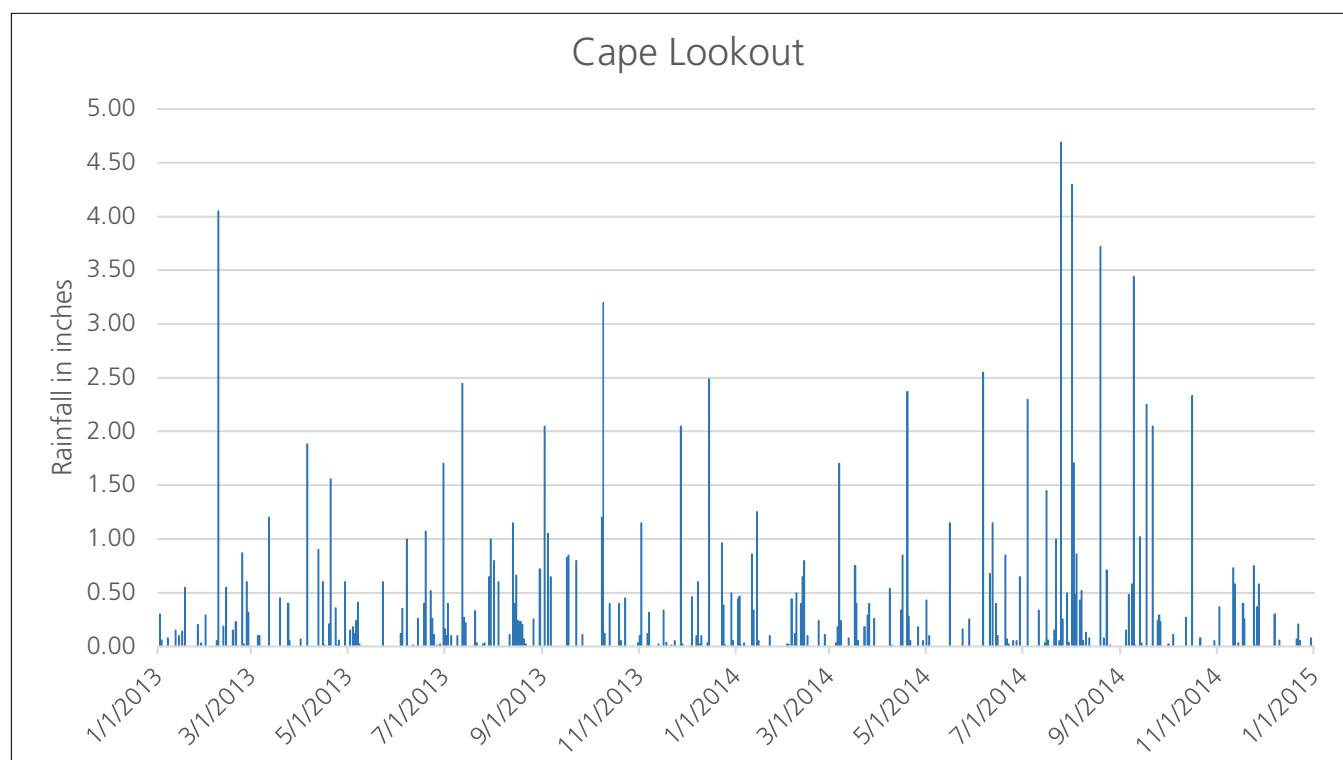


Figure 2. Daily precipitation at Morehead City weather and climate station near Cape Lookout National Seashore January 1, 2013–December 31, 2014. Data source: NCDC (2015).

Methods

Data collection at the Cape Lookout sites are modeled after an ongoing water-quality monitoring program established by the National Estuarine Research Reserve System (NERRS) program (Wenner and Geist 2001). Detailed field and laboratory standard operating procedures and methods have been outlined for the continuously collected data in Gregory et al. (2013). Methods for both are briefly summarized in the following sections.

Sampling Locations

Shackleford Banks (CALO01)

This site is located at one of the most concentrated use areas on Shackleford Banks, approximately 0.5 mile (0.8 kilometers) from Beaufort Inlet (Figure 3). The station is located at Cape Lookout National Seashore park dock. A boat is required to access the island and boat traffic is heavy in this area. The tidal range in this area is usually 0.6–0.9 meters (2–3 feet). The site was selected by NC NERRS staff because of its proximity to a previous water-quality monitoring site.

Middle Marshes (CALO02)

This site is located near the center of Back Sound and within the boundary of the Rachel Carson Reserve, a protected area managed by the North Carolina National Estuarine Research Reserve (NC NERRS; Figure 4). It is located east of Beaufort Inlet Channel and approximately 1.5 miles (2.4 kilometers) east/northeast of the CALO01 station monitored as part of this effort. The station is not mounted to any permanent structure such as a dock or piling, but is housed horizontally in a modified crab pot to keep it submerged and protected from damage. A buoy is attached to the housing to aid in locating the sonde for retrievals. A boat is needed to access this site. The location for this site was selected by NC NERRS because of its approximate co-location with other state, federal, and university research and monitoring efforts. See Table 1 for specific location details.



Figure 3. Photo of continuous data collection station at Shackleford Banks Dock (CALO01) at Cape Lookout National Seashore. Photo by John Fear.

Table 1. Location of continuous water-quality monitoring station at Cape Hatteras National Seashore during 2013–2014.

Name	Location Description	Location (lat /long)	Period of Record
CALO01	Shackleford Banks Dock	34.68692/-76.64364	09/2007–Present
CALO02	Middle Marshes	34.694517/-76.6185	05/2008–Present



Figure 4. Photo of continuous data collection sonde and mount used at Middle Marshes (CALO2) at Cape Lookout National Seashore. Photo by John Fear.

Continuous Data

Continuously collected data include dissolved oxygen, pH, specific conductance, water temperature, depth and turbidity. Data are collected at 15-minute intervals using YSI data sondes (Model 6600). Sondes are deployed in three- to five-week intervals depending on routine instrument maintenance schedules. The data sondes were deployed and retrieved by NERRS staff.

The data collection platform at CALO01 consists of a 4-inch-diameter PVC tube attached vertically to a piling on the Shackleford Banks Dock with the sonde suspended within and approximately 1 meter from the bottom. 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 data collection platform at CALO02 consists of a modified crab pot design to house the sonde horizontally, approximately 0.3 meters from the bottom. The different mount design is a result of shallow water at the site and the lack of a

permanent structure to attach sonde mount. The sonde probe guard was covered with brass wire mesh to prevent fish, crabs, and detritus from entering the sensor area which could skew measurements or damage the instrument's probes. Figures 3 and 4 show a photo of each 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, dissolved oxygen, specific conductance, depth, and turbidity (YSI Incorporated 2011; 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 the Southeast Coast Network office in Athens, Georgia. After post-retrieval processing is complete, the sonde is cleaned, reconditioned, and readied for redeployment following methods outlined by YSI (2011). Performance specifications of the YSI 6600 are shown in Table 2.

Table 2. Performance specifications of YSI 6600 EDS data loggers deployed at the continuous monitoring site (YSI 2011). [mg/L—milligrams per liter; mS/cm—milli-Siemens per centimeter ; m—meter; ft—foot; ppt—parts per thousand; NTU—nephelometric turbidity unit].

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)	0.001 m (0.001 ft)	+/- 0.018 m (+/- 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.

Data generated during the deployment periods are reviewed and certified by SECN staff prior to being made available to park staff or the public. During 2013, the Southeast Coast Network transitioned continuous data management tasks to Aquarius (Aquatic Informatics Inc. 2015).

Beginning in January 2014, turbidity, dissolved oxygen, specific conductance, and pH values were assigned grades of excellent, good, fair, or poor—and corrections to these values were made when appropriate—based on differences between pre-calibration and post-calibration measurement data based on guidance from USGS (Wagner et al. 2006). Temperature and depth data were neither graded nor corrected, but were assumed accurate unless post calibration data indicated a failure. As with previous years, invalid or unusable data were deleted from datasets prior to publication. Data sets are available at the NPS Aquarius Web Data Portal at <https://irma.nps.gov/aqwebportal/>.

Discrete Data

Water sample collection for this project was conducted by NERRS staff. Secchi depth was measured with standard equipment—an 8-inch black and white Secchi disk. Water samples were collected as grabs in lab-cleaned and field-rinsed containers. Filtration was conducted using a 0.45-micron filter and samples were transported and shipped on wet ice. QA/QC field sampling included both field blanks and duplicates collected on random dates throughout the year. Filtered water samples and chlorophyll filters were placed on ice prior to shipment for laboratory analyses. Original chain-of-custody paperwork accompanied all samples to the laboratory. Data collection standard operating procedures are further documented in Gregory et al. (2013).

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 $a = 1.4$ (“ a ” is assigned to one of three values depending on the water body’s naturally occurring clarity conditions—i.e., $a = 1.0$ for naturally turbid conditions, $a = 1.4$ for moderately turbid conditions, or $a = 1.7$ for clear water estuaries). Cape Lookout National Seashore uses a coefficient of 1.4 for moderately turbid conditions. These constants were estimated for each water-clarity class based on values 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 to maintain data consistency across 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 using data from the monthly samples, and following the East/Gulf Coast site criteria in the EPA National Coastal Assessment IV Report (EPA 2012; Table 3). 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. Coastal water-quality monitoring condition criteria for water-quality parameters collected by the Southeast Coast Network. Based on thresholds set by EPA (2012). [$\mu\text{g/L}$ —micrograms per liter; mg/L —milligrams per liter].

Rating	Water Clarity (k) ¹	Chlorophyll a ($\mu\text{g/L}$)	Dissolved Inorganic Nitrogen (DIN) (mg/L)	Dissolved Inorganic Phosphorus (DIP) (mg/L)	Dissolved Oxygen (mg/L)
Good	< 1.61	< 5	< 0.1	< 0.01	> 5
Fair	1.61–2.30	5–20	0.1–0.5	0.01–0.05	2–5
Poor	> 2.30	> 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

Site CALO01

Monthly water-quality data collected during 2013–2014 at the Southeast Coast Network site CALO01 near Cape Lookout National Seashore reflected overall good water-quality conditions throughout the year.

Discrete samples of chlorophyll *a* and dissolved oxygen levels were rated good for the period of record (22 site visits). Water clarity was good for 19 of the 22 samples, and fair twice.

Dissolved inorganic nitrogen (DIN) and dissolved inorganic phosphorus (DIP) were tested for in seven samples across the two-year period of record. All DIN and DIP concentrations fell in the good range.

Mean monthly dissolved oxygen levels were good throughout the period, ranging from 6.2 mg/L to 9.5 mg/L. Individual measurements ranged from a low of 2.8 mg/L in June 2013 to a high of 11.3 mg/L in February 2014.

Mean monthly pH values ranged from 7.7 to 8.2. Individual measurements ranged from a low of 7.4 in June 2014 to a high of 8.4 in March 2013.

Monthly mean turbidity ranged from 1 NTU to 37.3 NTUs. The lowest individual turbidity reading for any given month was 0.0 NTUs, and a maximum reading of 298.8 NTUs was recorded in December 2013.

Water temperatures in 2013–2014 ranged from a minimum monthly mean of 8.5°C (47.3°F) to a maximum monthly mean of 27.2°C (81.0°F). Individual temperatures ranged from a minimum of 1.9°C (35.4°F) in January 2014 to a maximum of 31.6°C (88.9°F) in July 2014.

The tidal range at CALO01 was 1.7 meters (5.6 feet).

Site CALO02

Monthly water-quality data collected during 2013–2014 at the Southeast Coast Network site CALO02 near Cape Lookout National Seashore reflected mostly good water-quality conditions throughout the year.

Discrete samples of chlorophyll *a* and dissolved oxygen levels were mostly good for the period of record (22 site visits), with one fair reading for water clarity in June 2013.

Dissolved inorganic nitrogen (DIN) and dissolved inorganic phosphorus (DIP) were tested for in seven samples across the two-year period of record. One sample bottle broke, so there are six results. All DIN and DIP concentrations fell in the good range except for one abnormally high DIP concentration in February 2014.

Mean monthly dissolved oxygen levels were good throughout the period, ranging from 4.0 mg/L to 9.5 mg/L. Individual measurements ranged from a low of 2.6 mg/L in October 2013 to a high of 11.7 mg/L in March 2013.

Mean monthly pH values ranged from 7.7 to 8.5. Individual measurements ranged from a low of 7.3 in May 2013 to a high of 8.8 in multiple months.

Monthly mean turbidity ranged from 2.7 to 27.1 NTUs. The lowest individual turbidity reading for any given month was 0.0 NTUs, and a maximum reading of 154.5 NTUs was recorded in June 2013.

Water temperatures in 2013–2014 ranged from a minimum monthly mean of 8.5°C (47.3°F) in February 2014 to a maximum monthly mean of 28.1°C (82.6°F) in September 2014. Individual temperatures ranged from a minimum of 1.1°C (34.0°F) in January 2014 to a maximum of 33.2°C (91.8°F) in July 2013.

The tidal range at site CALO02 was 2.0 meters (6.6 feet).

Continuous Data

Figures 5 through 16 depict the daily mean for each parameter for the entire data collection period. Relative water depth collected by SECN staff at the site (Figures 15 and 16) is included in this section as an aid to data interpretation because it includes information that shows daily tidal fluctuations.

Summary statistics (minimum, maximum, mean, and standard deviation) are provided 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 valid 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 in which 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. For months in which the percentage of values is low, the statistics (mean, maximum and minimum) may be less accurate than for months in which all data were used in the calculation of summary statistics.

Discrete Data

Monthly water-quality data collected during 2013–2014 at the SECN sites near Cape Lookout National Seashore are shown in Table 6 (CALO01) and Table 7 (CALO02). Condition categories correspond to those used by the EPA in the National Coastal Condition Report IV (2012).

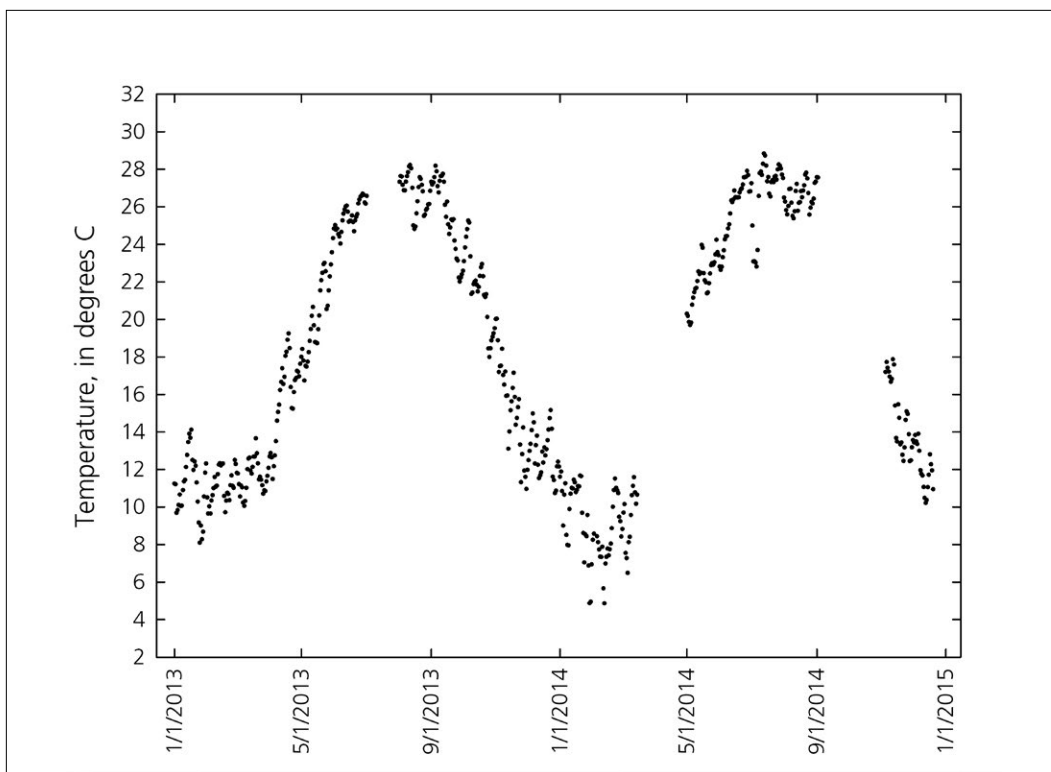


Figure 5. Mean daily water temperature at Cape Lookout National Seashore site CALO01 during 2013–2014. Breaks in data record indicate missing and/or flagged data.

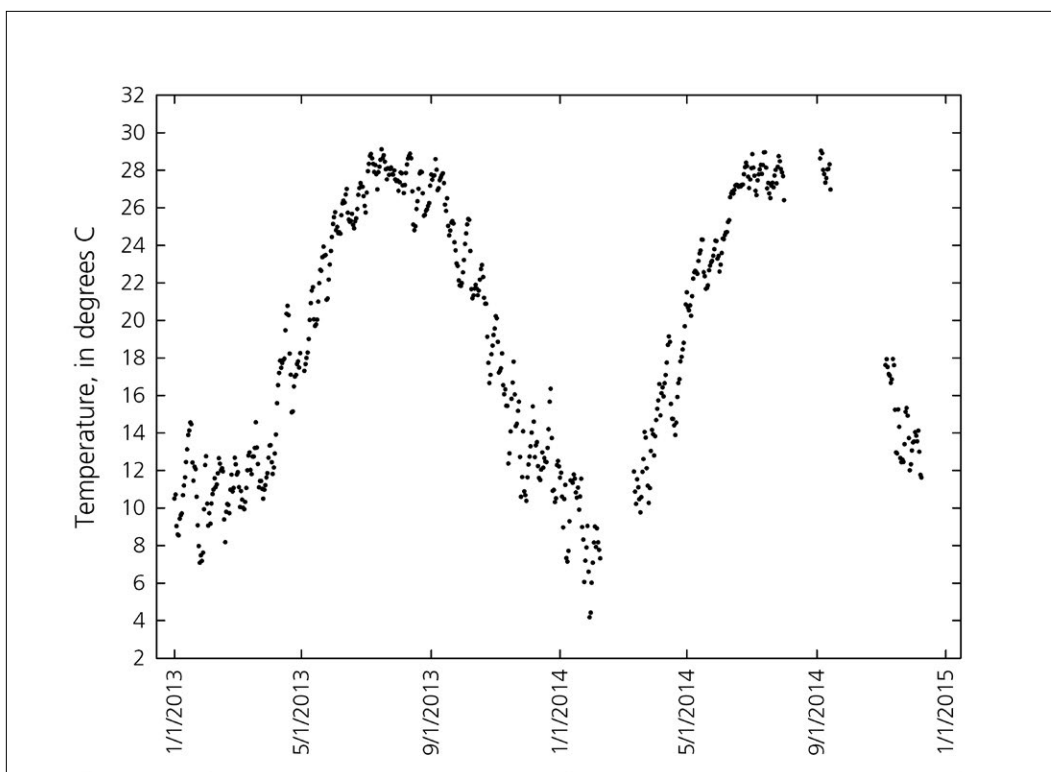


Figure 6. Mean daily temperature levels at Cape Lookout National Seashore site CALO02 during 2013–2014. Breaks in data record indicate missing and/or flagged data.

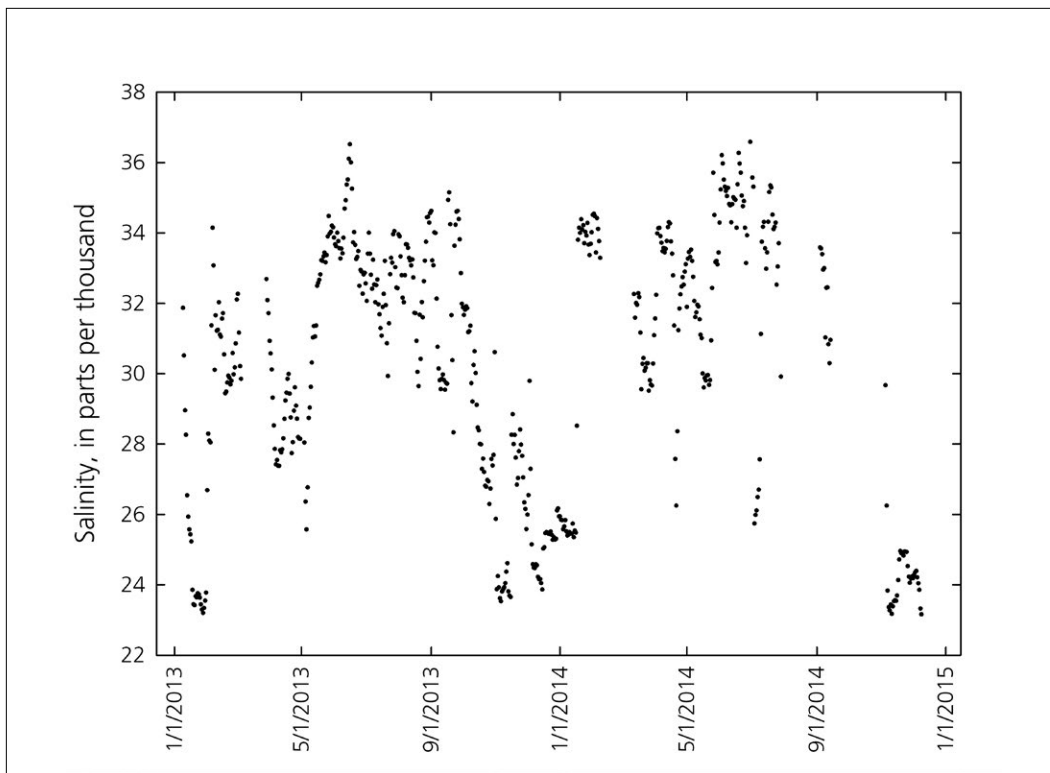


Figure 7. Mean daily salinity at Cape Lookout National Seashore site CALO01 during 2013–2014. Breaks in data record indicate missing and/or flagged data.

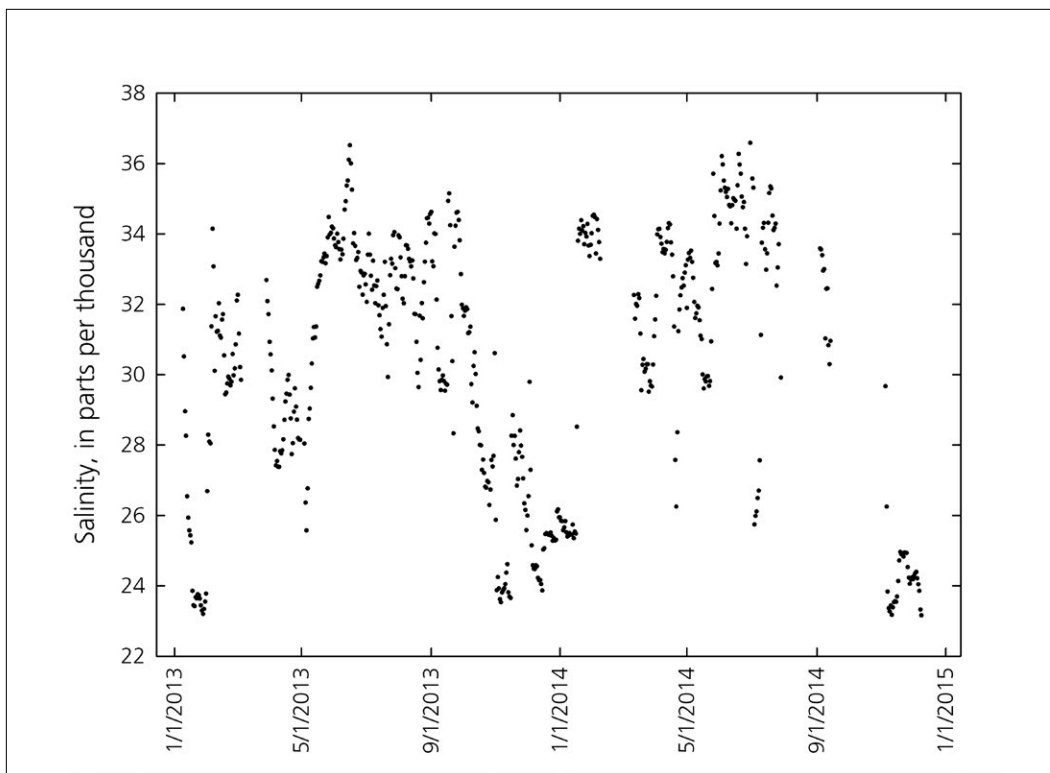


Figure 8. Mean daily salinity at Cape Lookout National Seashore site CALO02 during 2013–2014. Breaks in data record indicate missing and/or flagged data.

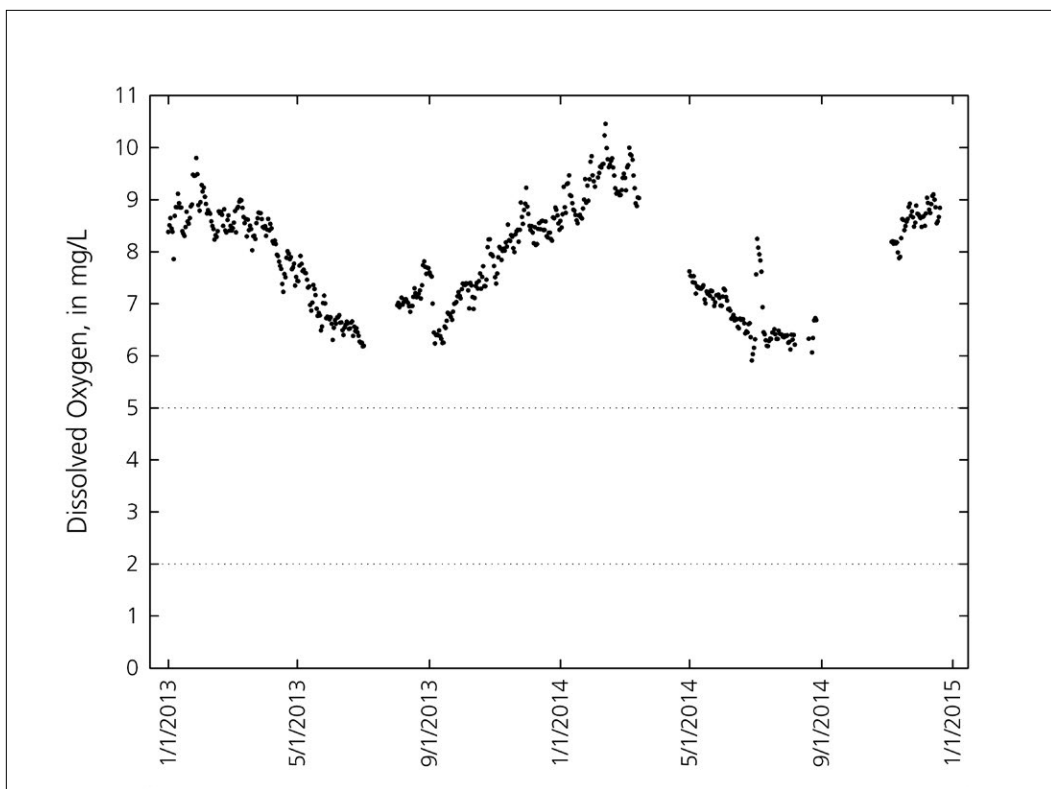


Figure 9. Mean daily dissolved oxygen concentrations at Cape Lookout National Seashore site CALO01 during 2013–2014. Breaks in data record indicate missing and/or flagged data. Dotted lines indicate minimum levels for "fair" and "good" concentrations.

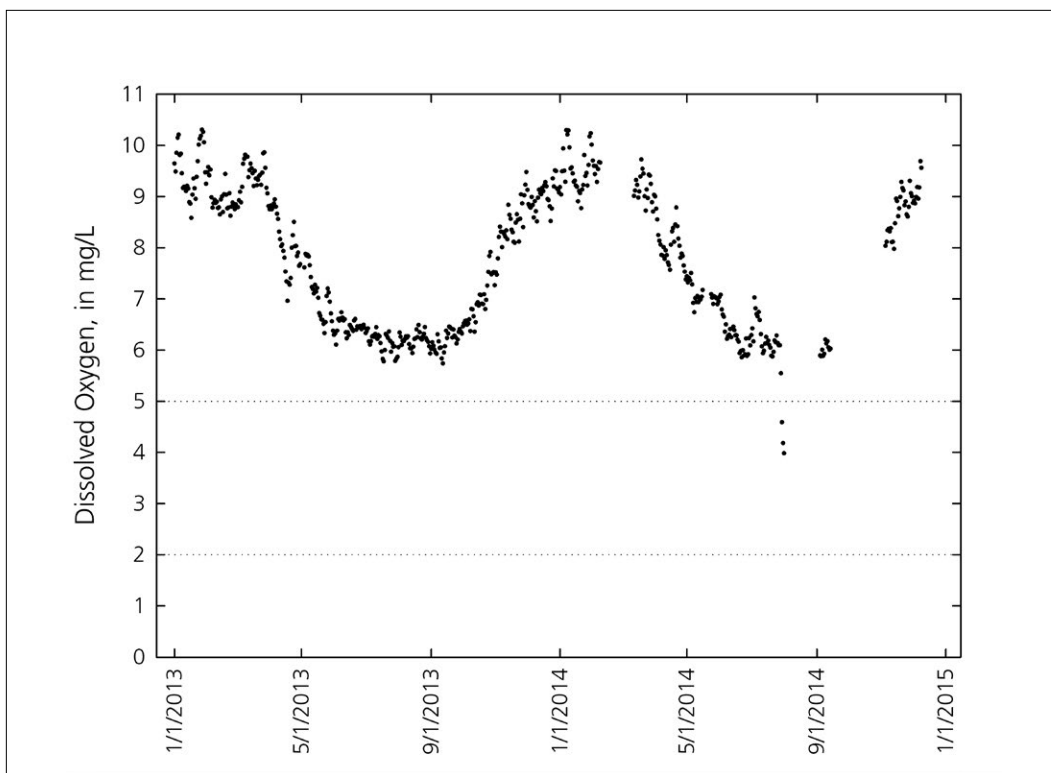


Figure 10. Mean daily dissolved oxygen concentrations at Cape Lookout National Seashore site CALO02 during 2013–2014. Breaks in data record indicate missing and/or flagged data. Dotted lines indicate minimum levels for "fair" and "good" concentrations.

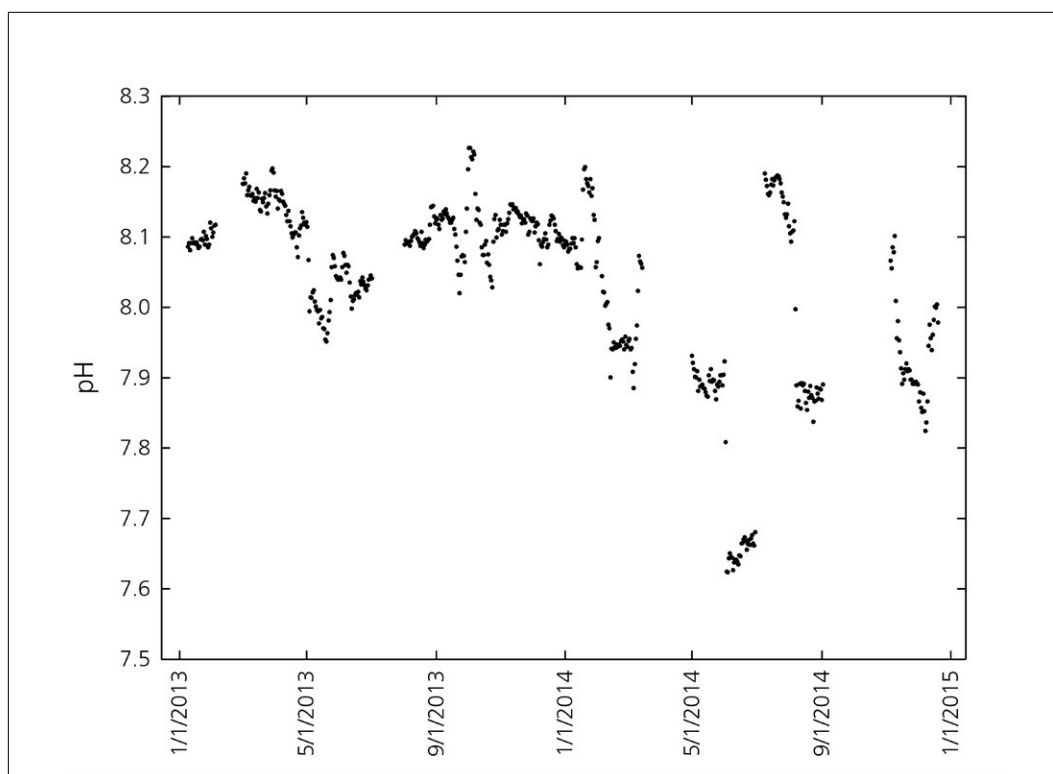


Figure 11. Mean daily water pH at Cape Lookout National Seashore site CALO01 during 2013–2014. Breaks in data record indicate missing and/or flagged data.

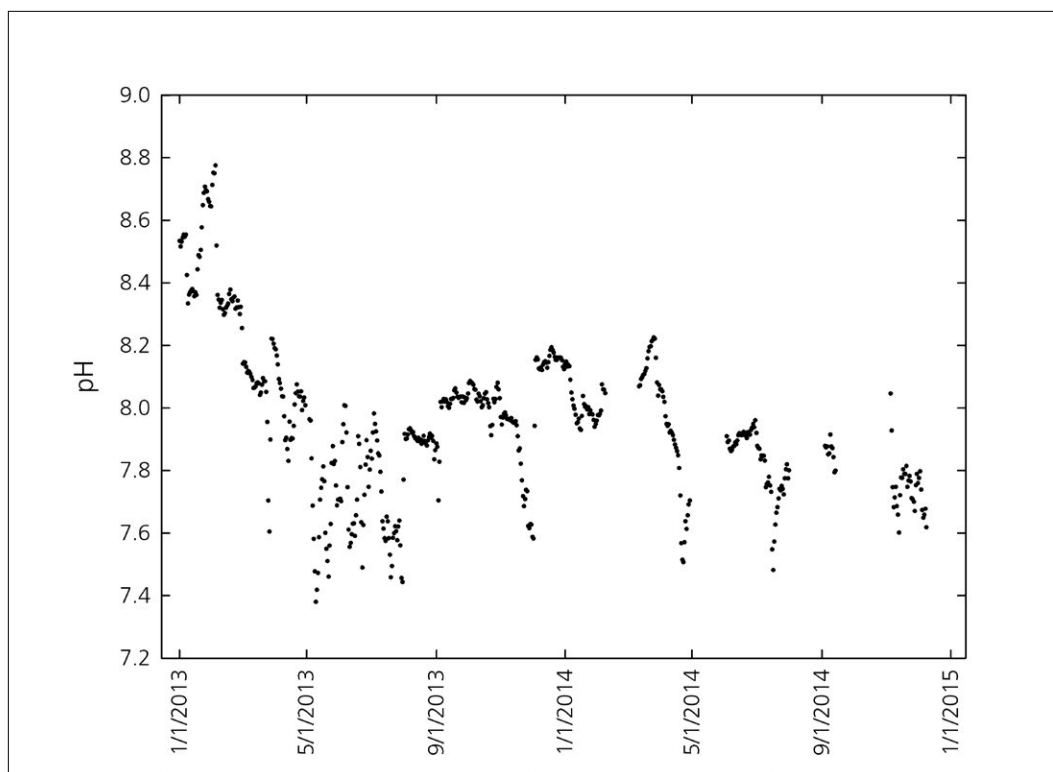


Figure 12. Mean daily water pH at Cape Lookout National Seashore site CALO02 during 2013–2014. Breaks in data record indicate missing and/or flagged data.

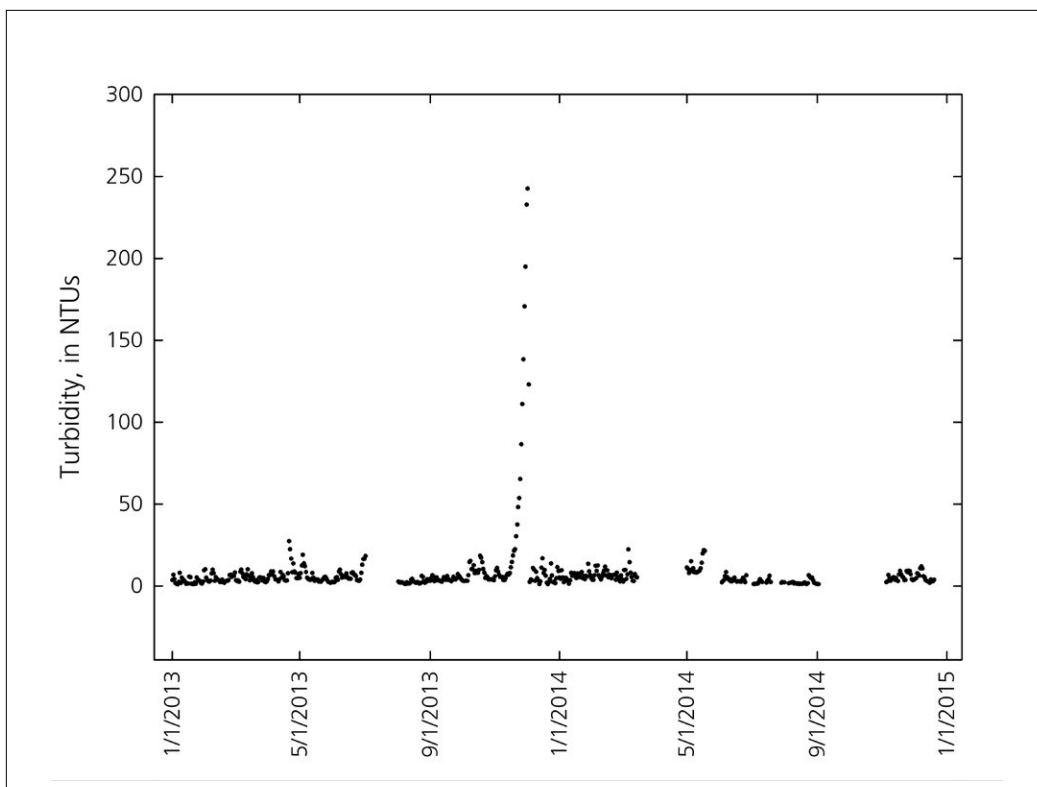


Figure 13. Mean daily turbidity levels at Cape Lookout National Seashore site CALO01 during 2013–2014. Breaks in data record indicate missing and/or flagged data.

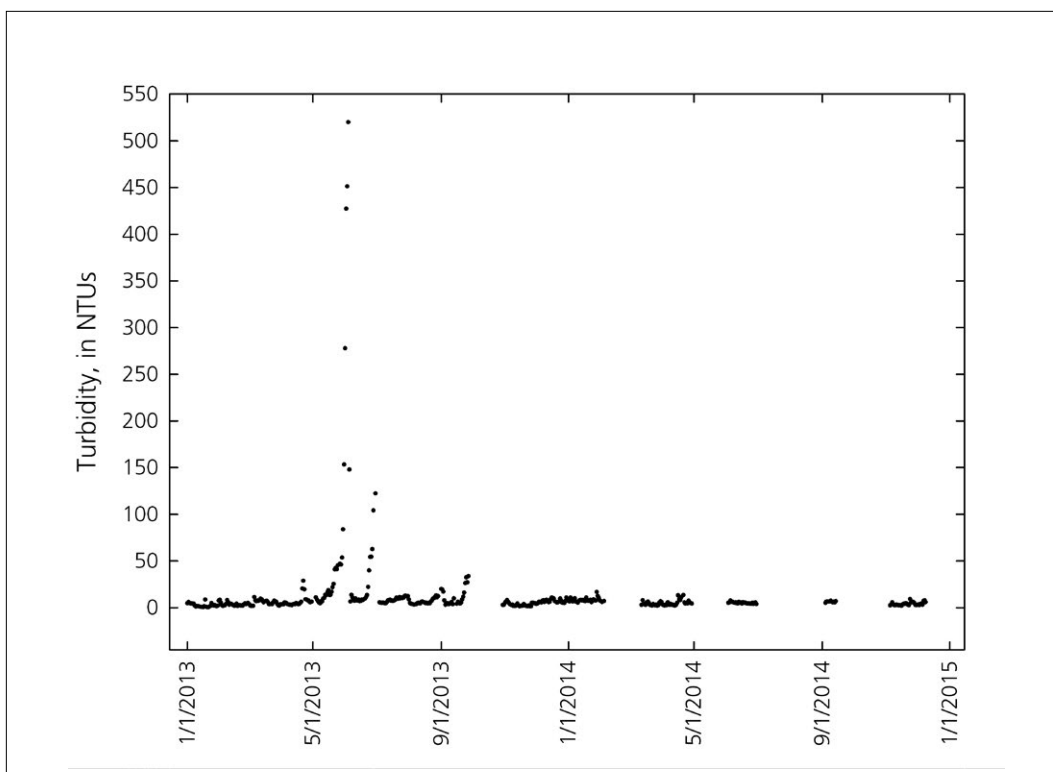


Figure 14. Mean daily turbidity levels at Cape Lookout National Seashore site CALO02 during 2013–2014. Breaks in data record indicate missing and/or flagged data.

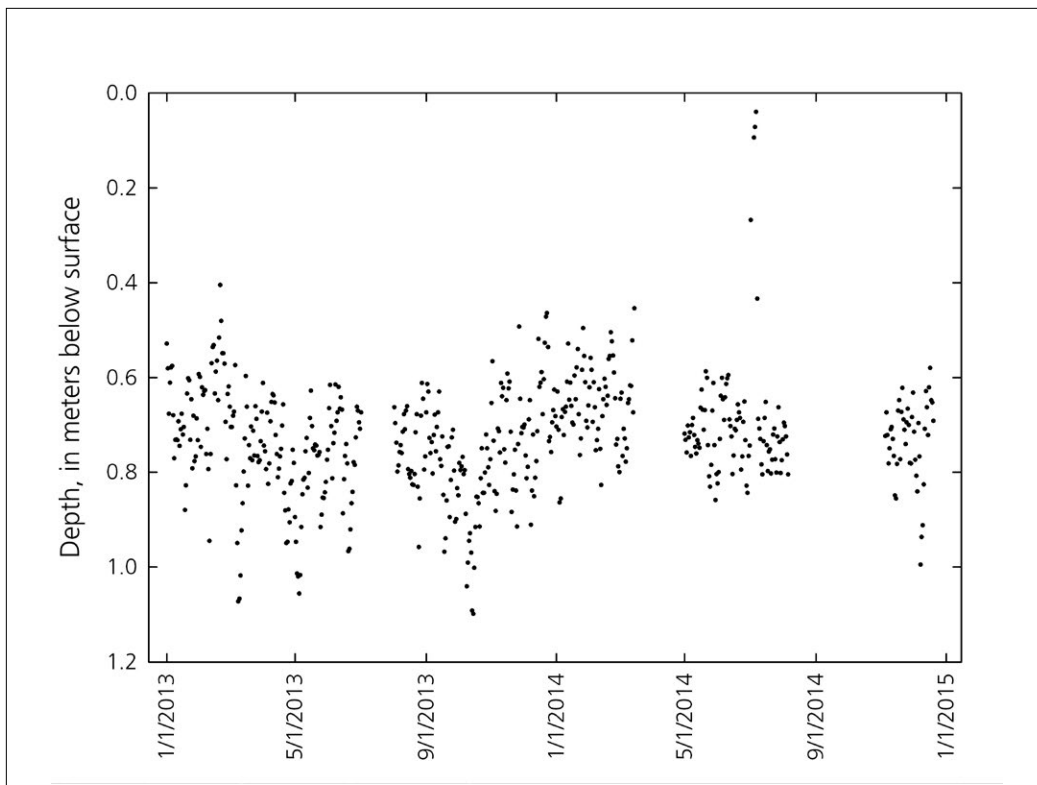


Figure 15. Mean daily depth at Cape Lookout National Seashore site CALO01 during 2013–2014. Breaks in data record indicate missing and/or flagged data.

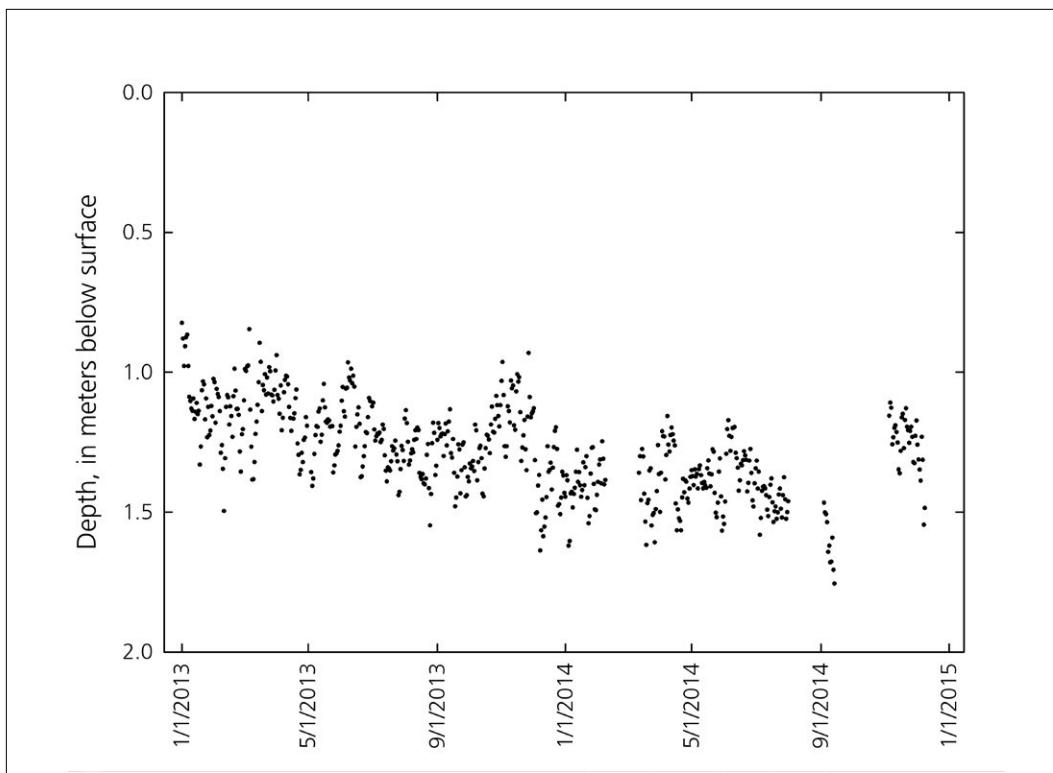


Figure 16. Mean daily depth at Cape Lookout National Seashore site CALO02 during 2013–2014. Breaks in data record indicate missing and/or flagged data.

Table 4. Monthly minimum, maximum, and mean values for parameters collected by the YSI 6-series data sonde at Cape Lookout National Seashore site CALO01 during 2013–2014. Percent of values for each month indicates the number of data points collected during one calendar month of data collection / total number of expected points for a complete month of data [PPT—parts per thousand; mg/L—milligrams per liter; m—meter; NTU—nephelometric turbidity unit; SD—standard deviation].

Month / Expected count	Metric	Temperature (°C)	Salinity (PPT)	Dissolved Oxygen, (mg/L)	Depth (m)	pH	Turbidity (NTU)
January 2013 (Expected count 2976)	Actual Count	2976	2976	2976	2976	2261	2974
	Minimum	4.8	31.2	5.9	0.07	8	0.4
	Maximum	15.6	35	10.6	1.43	8.2	148.1
	Mean	11.1	33.4	8.8	0.69	8.1	3
	SD	1.8	0.8	0.6	0.3	0.02	5.1
	Percent	100%	100%	100%	100%	76%	100%
February 2013 (Expected count 2688)	Actual Count	2687	2687	2687	2685	422	2685
	Minimum	7.6	28.7	6.7	0	8.1	0.6
	Maximum	13.8	35.5	9.6	1.62	8.1	27.9
	Mean	11.1	33.6	8.7	0.63	8.1	4.5
	SD	1.1	1.1	0.4	0.3	0.01	3.6
	Percent	100%	100%	100%	100%	16%	100%
March 2013 (Expected count 2976)	Actual Count	2975	2973	2975	2965	2909	2975
	Minimum	8.7	31.4	5.9	0	8.1	1
	Maximum	14.9	36.6	10.3	1.62	8.4	111.2
	Mean	11.6	34	8.6	0.77	8.2	4.7
	SD	1.1	0.9	0.4	0.3	0.03	4.4
	Percent	100%	100%	100%	100%	98%	100%
April 2013 (Expected count 2880)	Actual Count	2880	2880	2880	2880	2880	2880
	Minimum	10.1	30.1	4.1	0.11	8	0.8
	Maximum	21.5	35.2	9	1.58	8.3	77.3
	Mean	15.9	33.4	7.9	0.77	8.1	7.6
	SD	2.3	1.1	0.6	0.3	0.04	7.1
	Percent	100%	100%	100%	100%	100%	100%
May 2013 (Expected count 2976)	Actual Count	2975	2975	2975	2975	2975	2973
	Minimum	15.9	25.3	4.6	0.15	7.8	0.6
	Maximum	25.5	35.7	8.5	1.63	8.2	64.3
	Mean	20.2	32.5	7.2	0.83	8	5.4
	SD	2.2	2.4	0.7	0.3	0.05	5.3
	Percent	100%	100%	100%	100%	100%	100%
June 2013 (Expected count 2880)	Actual Count	2879	2879	2879	2879	2879	2878
	Minimum	23	33.9	2.8	0.13	7.9	0.6
	Maximum	27.6	36.1	7.3	1.58	8.1	28.1
	Mean	25.5	35.6	6.5	0.75	8	6
	SD	0.9	0.4	0.4	0.3	0.03	4
	Percent	100%	100%	100%	100%	100%	100%

Table 4 (continued). Monthly minimum, maximum, and mean values for parameters collected by the YSI 6-series data sonde at Cape Lookout National Seashore site CALO01 during 2013–2014. Percent of values for each month indicates the number of data points collected during one calendar month of data collection / total number of expected points for a complete month of data [PPT—parts per thousand; mg/L—milligrams per liter; m—meter; NTU—nephelometric turbidity unit; SD—standard deviation].

Month / Expected count	Metric	Temperature (°C)	Salinity (PPT)	Dissolved Oxygen, (mg/L)	Depth (m)	pH	Turbidity (NTU)
July 2013 (Expected count 2976)	Actual Count	228	228	228	228	228	228
	Minimum	25.7	35.4	5.1	0.21	8	13.1
	Maximum	27.4	35.8	6.8	1.14	8.1	36.3
	Mean	26.5	35.6	6.2	0.7	8	17.2
	SD	0.5	0.1	0.4	0.3	0.02	2.4
	Percent	8%	8%	8%	8%	8%	8%
August 2013 (Expected count 2976)	Actual Count	2936	1323	2936	2936	2936	2930
	Minimum	22.2	35.3	5.3	0.12	7.9	0
	Maximum	29.9	36.9	8.6	1.46	8.2	22.4
	Mean	26.8	36.5	7.2	0.75	8.1	2.5
	SD	1.2	0.3	0.5	0.3	0.03	2.1
	Percent	99%	44%	99%	99%	99%	98%
September 2013 (Expected count 2880)	Actual Count	2880	1733	2880	2880	2880	2880
	Minimum	20.1	32.8	5	0.15	7.9	1.2
	Maximum	30.6	36.2	8.3	1.5	8.2	16.4
	Mean	25.6	35.3	6.8	0.77	8.1	4.3
	SD	2.1	0.6	0.6	0.3	0.04	2.2
	Percent	100%	60%	100%	100%	100%	100%
October 2013 (Expected count 2976)	Actual Count	2976	59	2976	2976	2976	2970
	Minimum	14.7	33.8	5.4	0.24	7.9	1.9
	Maximum	27	34.6	9.1	1.7	8.3	47.4
	Mean	21.7	34.4	7.5	0.87	8.1	7.6
	SD	2.1	0.2	0.5	0.3	0.07	5.4
	Percent	100%	2%	100%	100%	100%	100%
November 2013 (Expected count 2880)	Actual Count	2880	2880	2880	2874	2880	2880
	Minimum	8.6	28.6	6.7	0	8	2.3
	Maximum	20.4	35.3	9.9	1.56	8.2	237.8
	Mean	15.5	33.7	8.2	0.72	8.1	37.3
	SD	2.6	1.2	0.5	0.3	0.02	51.4
	Percent	100%	100%	100%	100%	100%	100%
December 2013 (Expected count 2976)	Actual Count	2976	2926	2976	2969	2976	2857
	Minimum	8.2	28.5	7.6	0	8	0
	Maximum	16	36.4	9.7	1.53	8.2	298.8
	Mean	12.8	34.5	8.5	0.68	8.1	26
	SD	1.4	1.3	0.3	0.3	0.02	65.8
	Percent	100%	98%	100%	100%	100%	96%

Table 4 (continued). Monthly minimum, maximum, and mean values for parameters collected by the YSI 6-series data sonde at Cape Lookout National Seashore site CALO01 during 2013–2014. Percent of values for each month indicates the number of data points collected during one calendar month of data collection / total number of expected points for a complete month of data [PPT—parts per thousand; mg/L—milligrams per liter; m—meter; NTU—nephelometric turbidity unit; SD—standard deviation].

Month / Expected count	Metric	Temperature (°C)	Salinity (PPT)	Dissolved Oxygen, (mg/L)	Depth (m)	pH	Turbidity (NTU)
January 2014 (Expected count 2976)	Actual Count	2968	2941	2968	2958	2970	2961
	Minimum	1.9	32.6	7.9	0	8	0
	Maximum	13.1	36.2	10.6	1.54	8.2	40
	Mean	9.6	35.2	9	0.66	8.1	5.9
	SD	2.2	0.6	0.4	0.3	0.05	3.8
	Percent	100%	99%	100%	99%	100%	99%
February 2014 (Expected count 2688)	Actual Count	2531	2458	2537	2685	2533	2685
	Minimum	2.7	28.1	8.6	0	7.8	1.4
	Maximum	13.3	37	11.3	1.4	8.1	60.7
	Mean	8.5	35.5	9.5	0.65	8	6.6
	SD	1.8	1.4	0.4	0.3	0.05	4.9
	Percent	94%	91%	94%	100%	94%	100%
March 2014 (Expected count 2976)	Actual Count	1393	1325	1393	1382	1393	1390
	Minimum	5.3	24.9	8.6	0	7.8	1.1
	Maximum	12.3	36.9	10.4	1.48	8.1	72.3
	Mean	9.3	33.7	9.4	0.67	8	7.4
	SD	1.7	2.6	0.4	0.3	0.06	6.8
	Percent	47%	45%	47%	46%	47%	47%
April 2014 (Expected count 2880)	Actual Count	43	43	43	43	43	41
	Minimum	19.3	33.8	7.6	0.24	7.9	5.9
	Maximum	22.1	35	8.1	1.38	8	24.9
	Mean	20.4	34.8	7.8	0.8	7.9	12.8
	SD	1	0.3	0.2	0.4	0.01	5.2
	Percent	1%	1%	1%	1%	1%	1%
May 2014 (Expected count 2976)	Actual Count	2976	2973	2976	2976	2976	1685
	Minimum	17.4	33.7	5.4	0.06	7.7	4.5
	Maximum	27.1	35.4	8.1	1.41	8	53.5
	Mean	22.1	34.9	7.2	0.72	7.9	11.7
	SD	1.5	0.3	0.4	0.3	0.03	5.5
	Percent	100%	100%	100%	100%	100%	57%
June 2014 (Expected count 2880)	Actual Count	2880	2877	2879	2880	2879	2499
	Minimum	20.2	33.7	5.1	0.02	7.4	0.8
	Maximum	30.4	37.9	8.2	1.49	8	91.9
	Mean	25.8	36.6	6.7	0.71	7.7	4.1
	SD	1.8	0.9	0.5	0.3	0.07	6.3
	Percent	100%	100%	100%	100%	100%	87%

Table 4 (continued). Monthly minimum, maximum, and mean values for parameters collected by the YSI 6-series data sonde at Cape Lookout National Seashore site CALO01 during 2013–2014. Percent of values for each month indicates the number of data points collected during one calendar month of data collection / total number of expected points for a complete month of data [PPT—parts per thousand; mg/L—milligrams per liter; m—meter; NTU—nephelometric turbidity unit; SD—standard deviation].

Month / Expected count	Metric	Temperature (°C)	Salinity (PPT)	Dissolved Oxygen, (mg/L)	Depth (m)	pH	Turbidity (NTU)
July 2014 (Expected count 2976)	Actual Count	2976	2044	2976	2893	2329	2135
	Minimum	22.4	32.8	4.7	0	7.4	0
	Maximum	31.6	36.9	8.4	1.48	8.3	38.8
	Mean	26.9	35.8	6.7	0.62	8.2	2.5
	SD	2	0.9	0.7	0.4	0.09	2.9
	Percent	100%	69%	100%	97%	78%	72%
August 2014 (Expected count 2976)	Actual Count	2974	485	2261	615	2969	2562
	Minimum	21	23.6	4.7	0.02	7.5	0
	Maximum	31	35.3	7.5	1.32	8.2	25.3
	Mean	26.5	31.9	6.4	0.74	7.9	2.1
	SD	1.3	2.4	0.4	0.3	0.11	2.5
	Percent	100%	16%	76%	21%	100%	86%
September 2014 (Expected count 2880)	Actual Count	250	0	135	0	247	215
	Minimum	17.8	NA	5.8	NA	7.7	0
	Maximum	29.6	NA	6.8	NA	8	6.2
	Mean	27.2	NA	6.4	NA	7.9	1
	SD	2	NA	0.2	NA	0.07	1
	Percent	9%	0%	5%	0%	9%	7%
October 2014 (Expected count 2976)	Actual Count	0	0	0	0	0	0
	Minimum	NA	NA	NA	NA	NA	NA
	Maximum	NA	NA	NA	NA	NA	NA
	Mean	NA	NA	NA	NA	NA	NA
	SD	NA	NA	NA	NA	NA	NA
	Percent	0%	0%	0%	0%	0%	0%
November 2014 (Expected count 2880)	Actual Count	2554	2458	2554	2548	2554	2410
	Minimum	8.5	32.3	7.3	0	7.8	1.1
	Maximum	19.1	36.6	9.7	1.44	8.1	17.7
	Mean	15	35.6	8.4	0.73	8	5.2
	SD	2	0.5	0.4	0.3	0.08	2.8
	Percent	89%	85%	89%	88%	89%	84%
December 2014 (Expected count 2976)	Actual Count	2019	1984	2019	2019	2013	1895
	Minimum	8.2	30.2	8	0.1	7.8	1.2
	Maximum	14.6	37.9	10	1.61	8.1	23.3
	Mean	12.1	36	8.8	0.74	7.9	5.1
	SD	1.5	1.3	0.3	0.3	0.07	3.7
	Percent	68%	67%	68%	68%	68%	64%

Table 5. Monthly minimum, maximum, and mean values for parameters collected by the YSI 6-series data sonde at Cape Lookout National Seashore site CALO02 during 2013–2014. Percent of values for each month indicates the number of data points collected during one calendar month of data collection divided by the total number of expected points for a complete month of data [PPT—parts per thousand; mg/L—milligrams per liter; m—meter; NTU—nephelometric turbidity unit; SD—standard deviation].

Month / Expected count	Metric	Temperature (°C)	Salinity (PPT)	Dissolved Oxygen, (mg/L)	Depth (m)	pH	Turbidity (NTU)
January 2013 (Expected count 2976)	Actual Count	2975	2265	2975	2975	2971	2954
	Minimum	3	22.2	6.8	0.39	8.3	-0.6
	Maximum	17.1	33.5	11.4	1.75	8.8	52.8
	Mean	10.7	25.3	9.5	1.09	8.5	2.6
	SD	2.5	2.7	0.7	0.3	0.13	3.7
	Percent	100%	76%	100%	100%	100%	99%
February 2013 (Expected count 2688)	Actual Count	2688	2688	2688	2688	2688	2680
	Minimum	4.8	23.9	5.4	0.6	8.2	0.1
	Maximum	15.2	34.4	11.4	2.09	8.8	39.9
	Mean	10.9	30.4	9	1.18	8.4	3.5
	SD	1.5	1.9	0.7	0.3	0.16	3.1
	Percent	100%	100%	100%	100%	100%	100%
March 2013 (Expected count 2976)	Actual Count	2973	821	2973	2973	2973	2947
	Minimum	7.2	28.1	7.2	0.23	7.5	0.4
	Maximum	17.5	34	11.7	1.87	8.4	36
	Mean	11.7	31.4	9.4	1.08	8.1	5.4
	SD	1.6	1.3	0.6	0.3	0.14	3.3
	Percent	100%	28%	100%	100%	100%	99%
April 2013 (Expected count 2880)	Actual Count	2880	2880	2880	2854	2880	2849
	Minimum	10.6	25.6	2.9	0.52	7.7	0.9
	Maximum	24.7	31.6	10.7	1.91	8.3	102.5
	Mean	16.5	28.7	8.1	1.16	8	6.5
	SD	2.9	1.2	1	0.3	0.1	7.4
	Percent	100%	100%	100%	99%	100%	99%
May 2013 (Expected count 2976)	Actual Count	2772	2772	2772	2772	2772	2732
	Minimum	16.5	23.2	3.6	0.64	7.3	0.8
	Maximum	28.8	35.2	9.4	1.98	8.1	248.8
	Mean	21.2	31.5	7.1	1.23	7.7	28.3
	SD	2.7	2.7	0.9	0.3	0.17	32
	Percent	93%	93%	93%	93%	93%	92%
June 2013 (Expected count 2880)	Actual Count	2880	2880	2880	2806	2880	2828
	Minimum	23.1	31.4	4	0.54	7.4	1
	Maximum	31.2	37.1	8.4	1.92	8.1	1499.2
	Mean	25.8	34	6.5	1.15	7.7	83.9
	SD	1.5	1.1	0.7	0.3	0.16	154.5
	Percent	100%	100%	100%	97%	100%	98%

Table 5 (continued). Monthly minimum, maximum, and mean values for parameters collected by the YSI 6-series data sonde at Cape Lookout National Seashore site CALO02 during 2013–2014. Percent of values for each month indicates the number of data points collected during one calendar month of data collection divided by the total number of expected points for a complete month of data [PPT—parts per thousand; mg/L—milligrams per liter; m—meter; NTU—nephelometric turbidity unit; SD—standard deviation].

Month / Expected count	Metric	Temperature (°C)	Salinity (PPT)	Dissolved Oxygen, (mg/L)	Depth (m)	pH	Turbidity (NTU)
July 2013 (Expected count 2976)	Actual Count	2976	2973	2976	2967	2976	2827
	Minimum	24.8	28.8	4	0.68	7.4	-1.8
	Maximum	33.2	35.3	8.1	1.92	8.1	136.9
	Mean	28	32.5	6.2	1.28	7.7	11.2
	SD	1.3	1.1	0.7	0.3	0.17	17.6
	Percent	100%	100%	100%	100%	100%	95%
August 2013 (Expected count 2976)	Actual Count	2976	2976	2976	2976	2976	2914
	Minimum	23	27.1	3.9	0.71	7.5	-0.9
	Maximum	32.2	35.3	7.5	1.99	8	62.9
	Mean	27	32.7	6.2	1.3	7.9	6.7
	SD	1.6	1.4	0.6	0.3	0.07	5.6
	Percent	100%	100%	100%	100%	100%	98%
September 2013 (Expected count 2880)	Actual Count	2879	2879	2879	2879	2879	2395
	Minimum	20	26.2	3.7	0.7	7.5	-1.3
	Maximum	31.6	35.6	7.6	1.95	8.2	115.6
	Mean	25.6	32.2	6.2	1.29	8	10.4
	SD	2.3	2.2	0.7	0.3	0.1	10.8
	Percent	100%	100%	100%	100%	100%	83%
October 2013 (Expected count 2976)	Actual Count	2975	2975	2975	2975	2975	193
	Minimum	13.1	24.5	2.6	0.62	7.8	NA
	Maximum	28	34.1	8.7	1.98	8.2	NA
	Mean	21.5	29	6.9	1.26	8	NA
	SD	2.5	2.2	0.8	0.3	0.06	1.6
	Percent	100%	100%	100%	100%	100%	6%
November 2013 (Expected count 2880)	Actual Count	2880	2880	2880	2880	2880	2838
	Minimum	7.2	22.5	6.1	0.42	7.6	0.4
	Maximum	21.5	32.9	10.3	1.91	8	14.7
	Mean	15.2	25.8	8.4	1.14	7.9	3.2
	SD	3	2.1	0.7	0.3	0.13	2.4
	Percent	100%	100%	100%	100%	100%	99%
December 2013 (Expected count 2976)	Actual Count	2974	2974	2972	2974	2974	2942
	Minimum	7.3	21.7	6.8	0.57	7.5	1
	Maximum	18.5	33.8	10.8	2.15	8.3	26.1
	Mean	12.8	25.3	9	1.39	8.1	6.9
	SD	1.7	1.4	0.5	0.3	0.15	3.3
	Percent	100%	100%	100%	100%	100%	99%

Table 5 (continued). Monthly minimum, maximum, and mean values for parameters collected by the YSI 6-series data sonde at Cape Lookout National Seashore site CALO02 during 2013–2014. Percent of values for each month indicates the number of data points collected during one calendar month of data collection divided by the total number of expected points for a complete month of data [PPT—parts per thousand; mg/L—milligrams per liter; m—meter; NTU—nephelometric turbidity unit; SD—standard deviation].

Month / Expected count	Metric	Temperature (°C)	Salinity (PPT)	Dissolved Oxygen, (mg/L)	Depth (m)	pH	Turbidity (NTU)
January 2014 (Expected count 2976)	Actual Count	2976	2859	2975	2975	2976	2962
	Minimum	1.1	23.9	7.3	0.72	7.8	4
	Maximum	14.7	35	11.4	2.22	8.2	47.6
	Mean	9.2	29.2	9.5	1.42	8	8.1
	SD	2.6	4.2	0.6	0.3	0.07	3.6
	Percent	100%	96%	100%	100%	100%	100%
February 2014 (Expected count 2688)	Actual Count	922	908	918	788	921	570
	Minimum	4.2	25.6	7.6	0.77	7.9	NA
	Maximum	15.9	35.2	11.4	1.97	8.2	NA
	Mean	8.5	33.5	9.6	1.36	8	NA
	SD	2.3	2.4	0.5	0.3	0.06	3.2
	Percent	34%	34%	34%	29%	34%	21%
March 2014 (Expected count 2976)	Actual Count	1990	1985	1990	1968	1990	1964
	Minimum	7.8	25.6	7.3	0.71	8	NA
	Maximum	18	33.9	11.3	2.1	8.3	NA
	Mean	11.9	30.7	9.2	1.43	8.1	NA
	SD	1.8	1.6	0.5	0.3	0.07	2.6
	Percent	67%	67%	67%	66%	67%	66%
April 2014 (Expected count 2880)	Actual Count	2874	2858	2873	2873	2832	2688
	Minimum	11.8	22.5	4.7	0.68	7.4	0.4
	Maximum	25	34.6	10.3	2.12	8.1	32.7
	Mean	16.6	32.6	8.1	1.36	7.8	5
	SD	2.3	2.2	0.7	0.3	0.18	4.7
	Percent	100%	99%	100%	100%	98%	93%
May 2014 (Expected count 2976)	Actual Count	2976	2949	2580	2976	0	0
	Minimum	18.2	29	4.1	0.81	NA	NA
	Maximum	29.5	36.9	9.9	2.07	NA	NA
	Mean	22.6	31.9	7.1	1.39	NA	NA
	SD	1.8	1.6	0.8	0.3	NA	NA
	Percent	100%	99%	87%	100%	0%	0%
June 2014 (Expected count 2880)	Actual Count	2880	2797	2865	2879	2722	2689
	Minimum	20	31.7	2.7	0.68	7.7	0.2
	Maximum	32.2	37.1	8.5	2.02	8	21.3
	Mean	26.3	35.1	6.3	1.32	7.9	5.1
	SD	2	0.9	0.8	0.3	0.06	2.6
	Percent	100%	97%	99%	100%	95%	93%

Table 5 (continued). Monthly minimum, maximum, and mean values for parameters collected by the YSI 6-series data sonde at Cape Lookout National Seashore site CALO02 during 2013–2014. Percent of values for each month indicates the number of data points collected during one calendar month of data collection divided by the total number of expected points for a complete month of data [PPT—parts per thousand; mg/L—milligrams per liter; m—meter; NTU—nephelometric turbidity unit; SD—standard deviation].

Month / Expected count	Metric	Temperature (°C)	Salinity (PPT)	Dissolved Oxygen, (mg/L)	Depth (m)	pH	Turbidity (NTU)
July 2014 (Expected count 2976)	Actual Count	2975	2777	2974	2975	2974	62
	Minimum	24.5	25	2.9	0.87	7.4	NA
	Maximum	32.6	37.1	7.9	2.12	8	NA
	Mean	27.8	32.3	6.1	1.45	7.8	NA
	SD	1.2	3.4	0.8	0.3	0.11	1.7
	Percent	100%	93%	100%	100%	100%	2%
August 2014 (Expected count 2976)	Actual Count	115	83	115	115	115	0
	Minimum	25.7	27.1	3.2	1.1	7.7	NA
	Maximum	27.3	33	4.6	1.88	7.9	NA
	Mean	26.4	30.3	4	1.49	7.8	NA
	SD	0.4	1.6	0.3	0.2	0.04	NA
	Percent	4%	3%	4%	4%	4%	0%
September 2014 (Expected count 2880)	Actual Count	1136	1029	1135	1136	1126	1126
	Minimum	25.2	29.2	4.4	0.97	7.7	NA
	Maximum	31.3	34.8	7.5	2.22	8	NA
	Mean	28.1	32.2	6	1.6	7.9	NA
	SD	0.9	1.4	0.6	0.3	0.05	2.9
	Percent	39%	36%	39%	39%	39%	39%
October 2014 (Expected count 2976)	Actual Count	0	0	0	0	0	0
	Minimum	NA	NA	NA	NA	NA	NA
	Maximum	NA	NA	NA	NA	NA	NA
	Mean	NA	NA	NA	NA	NA	NA
	SD	NA	NA	NA	NA	NA	NA
	Percent	0%	0%	0%	0%	0%	0%
November 2014 (Expected count 2880)	Actual Count	2552	2550	2552	2552	2552	2487
	Minimum	7.8	22.5	6.8	0.46	7.5	0.1
	Maximum	19.4	35.1	10	1.85	8.1	26.4
	Mean	14.9	24.6	8.6	1.22	7.8	3.6
	SD	2.3	1.9	0.6	0.3	0.1	2.7
	Percent	89%	89%	89%	89%	89%	86%
December 2014 (Expected count 2976)	Actual Count	967	967	967	967	967	937
	Minimum	8.8	18.4	7.3	0.7	7.6	NA
	Maximum	15.7	33.4	10.1	2.12	8	NA
	Mean	13	24.3	9.2	1.34	7.7	NA
	SD	1.3	1.7	0.5	0.3	0.08	2.5
	Percent	32%	32%	32%	32%	32%	31%

Table 6. Monthly water-quality data collected by the Southeast Coast Network at Cape Lookout National Seashore site CALO01 during 2013–2014. Water clarity was assessed with light attenuation values (k) using a constant for estuarine water with moderately turbid conditions (Smith et al. 2006) and assessment categories that correspond to EPA (2012) criteria. Condition of other assessed parameters based on EPA (2012) [^agreen—good; ^byellow—fair; k—light attenuation coefficient; µg/L—micrograms per liter; mg/L—milligrams per liter; -- data not collected; ¹Light 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; ² There are no EPA condition criteria for TDN and TDP].

Collection Date	Water Clarity (k) ¹	Chlorophyll a (µg/L)	Dissolved Inorganic Nitrogen (mg/L)	Dissolved Inorganic Phosphorus (mg/L)	Dissolved Oxygen (mg/L)	Total Dissolved Nitrogen (mg/L) ²	Total Dissolved Phosphorus (mg/L) ²
01/08/2013	0.70 ^a	1.35 ^a	--	--	9.1 ^a	0.21	0.015
02/05/2013	--	1.45 ^a	0.0172 ^a	0.0029 ^a	9.2 ^a	0.19	0.018
03/01/2013	1.12 ^a	2.50 ^a	--	--	8.1 ^a	0.18	0.013
03/28/2013	1.12 ^a	0.89 ^a	--	--	8.8 ^a	0.15	0.010
05/03/2013	1.40 ^a	2.68 ^a	0.0058 ^a	0.0029 ^a	7.7 ^a	0.2	0.015
06/05/2013	1.27 ^a	4.25 ^a	--	--	7.3 ^a	0.22	0.014
07/03/2013	1.06 ^a	2.95 ^a	--	--	6.1 ^a	0.22	0.019
08/01/2013	0.78 ^a	3.44 ^a	0.0153 ^a	0.0027 ^a	6.8 ^a	0.19	0.010
09/03/2013	0.80 ^a	3.77 ^a	--	--	7.8 ^a	0.32	0.018
10/31/2013	0.70 ^a	2.40 ^a	0.0202 ^a	0.0029 ^a	8.3 ^a	0.19	0.016
12/03/2013	1.12 ^a	3.50 ^a	--	--	8.6 ^a	0.25	0.022
02/04/2014	1.87 ^b	--	0.0170 ^a	0.0072 ^a	9.4 ^a	0.19	0.021
03/11/2014	0.88 ^a	--	--	--	9.4 ^a	0.29	0.009
04/02/2014	0.93 ^a	--	--	--	--	0.17	0.011
04/30/2014	1.87 ^b	--	0.0137 ^a	0.0034 ^a	8.1 ^a	0.23	0.016
06/02/2014	1.17 ^a	--	--	--	7.7 ^a	0.17	0.013
07/01/2014	0.70 ^a	--	--	--	6.8 ^a	0.14	0.010
08/07/2014	0.93 ^a	--	0.0122 ^a	0.0028 ^a	7.0 ^a	0.26	0.009
09/03/2014	0.78 ^a	--	--	--	--	0.25	0.029
10/10/2014	0.93 ^a	--	--	--	--	0.16	0.011
12/10/2014	0.64 ^a	1.02 ^a	--	--	8.8 ^a	0.17	0.014
12/31/2014	0.93 ^a	1.59 ^a	--	--	9.5 ^a	0.22	0.011

Table 7. Monthly water-quality data collected by the Southeast Coast Network at Cape Lookout National Seashore site CALO02 during 2013–2014. Water clarity was assessed with light attenuation values (k) using a constant for estuarine water with moderately turbid conditions (Smith et al. 2006) and assessment categories that correspond to EPA (2012) criteria. Condition of other assessed parameters based on EPA (2012) [^agreen—good; ^byellow—fair; ^cred—poor; k—light attenuation coefficient; µg/L—micrograms per liter; mg/L—milligrams per liter; -- data not collected; ¹Light 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; ²There are no EPA condition criteria for TDN and TDP].

Collection Date	Water Clarity (k) ¹	Chlorophyll a (µg/L)	Dissolved Inorganic Nitrogen (mg/L)	Dissolved Inorganic Phosphorus (mg/L)	Dissolved Oxygen (mg/L)	Total Dissolved Nitrogen ² (mg/L)	Total Dissolved Phosphorus (mg/L) ²
01/08/2013	*	0.8 ^a	--	--	9.2 ^a	0.20	0.015
02/05/2013	*	0.29 ^a	0.0116 ^a	0.0028 ^a	9.0 ^a	0.20	0.012
03/01/2013	*	0.84 ^a	--	--	9.7 ^a	0.21	0.017
03/28/2013	*	0.39 ^a	--	--	10.7 ^a	0.16	0.013
05/03/2013	1.56 ^a	2.82 ^a	0.0101 ^a	0.0025 ^a	7.4 ^a	0.24	0.014
06/05/2013	1.75 ^b	2.12 ^a	--	--	6.6 ^a	0.26	0.020
07/03/2013	1.56 ^a	2.10 ^a	--	--	6.3 ^a	0.26	0.023
08/01/2013	1.40 ^a	2.52 ^a	0.0374 ^a	0.0048 ^a	4.9 ^b	0.25	0.017
09/03/2013	1.40 ^a	2.31 ^a	--	--	6.5 ^a	0.22	0.020
10/31/2013	*	0.99 ^a	--	--	6.8 ^a	--	--
12/03/2013	*	1.48 ^a	--	--	9.0 ^a	0.37	0.026
02/04/2014	1.12 ^a	--	0.0205 ^a	0.4314 ^c	10.1 ^a	0.19	0.500
03/11/2014	1.40 ^a	--	--	--	9.6 ^a	0.23	0.011
04/02/2014	1.40 ^a	--	--	--	9.4 ^a	0.23	0.017
04/30/2014	1.40 ^a	--	0.0250 ^a	0.0035 ^a	8.1 ^a	0.25	0.016
06/02/2014	1.00 ^a	--	--	--	7.5 ^a	0.21	0.015
07/01/2014	1.08 ^a	--	--	--	7.1 ^a	0.16	0.015
08/07/2014	1.17 ^a	--	0.0334 ^a	0.0034 ^a	--	0.20	0.011
09/03/2014	1.40 ^a	--	--	--	5.5 ^a	0.27	0.023
10/10/2014	1.08 ^a	--	--	--	--	0.17	0.016
12/10/2014	0.70 ^a	1.62	--	--	9.9 ^a	0.17	0.012
12/31/2014	1.17 ^a	0.81	--	--	9.5 ^a	0.21	0.013

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