



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

2015–2016 Data Summary

Natural Resource Data Series NPS/SECN/NRDS—2019/1216



ON THE COVER

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

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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 conductivity, dissolved oxygen, pH, salinity, temperature, 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 2015–2016 data record are summarized in this report.

Site CALO01

- Chlorophyll *a* concentrations were good (thirteen samples) and fair (two samples). Concentrations ranged from 1.3 µg/L to 7.6 µg/L.
- Five 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 concentrations were good throughout the period, ranging from 6.3 mg/L to 10.3 mg/L. Individual concentrations ranged from a low of 3.7 mg/L in July 2015 to a high of 12.0 mg/L in several months.
- Mean monthly pH values ranged from 7.6 in June 2015 to 8.3 in November 2016. Individual values ranged from a low of 7.1 in April 2016 to a high of 9.4 also in April 2016.
- Monthly mean turbidity values ranged from 3.7 NTU to 11.0 NTUs. The lowest individual turbidity values for any given month was 0.0 NTUs, and a maximum value of 197.5 NTUs was recorded in May 2016.
- Water temperatures in 2015–2016 ranged from a minimum monthly mean of 6.4 °C (43.5 °F) to a maximum monthly mean of 29.8 °C (85.6 °F).
- The tidal range at site CALO01 was 1.8 meters (5.9 feet).

Site CALO02

- Chlorophyll *a* concentrations were good at all seventeen site visits. Concentrations ranged from 0.4 µg/L to 4.8 µg/L.
- Five 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 except for one DIP sample which rated fair.
- Mean monthly dissolved oxygen concentrations were good throughout the period, ranging from 6.1 mg/L to 10.9 mg/L. Individual concentrations ranged from a low of 3.9 mg/L in August 2015 to a high of 12.5 mg/L in March 2015.
- Mean monthly pH values ranged from 7.8 to 8.2. Individual values ranged from a low of 7.4 in May 2015 to a high of 8.3 in December 2015.
- Monthly mean turbidity ranged from 2.0 to 13.1 NTUs. The lowest individual turbidity reading for any given month was 0.0 NTUs, and a maximum reading of 89.2 NTUs was recorded in August 2016.
- Water temperatures in 2015–2016 ranged from a minimum monthly mean of 6.8 °C (44.2 °F) to a maximum monthly mean of 29.7 °C (85.5 °F).
- 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 (USFWS 2019), urbanization (USCB 2019), areas listed as impaired (EPA 2019) and areas designated as having special uses or restrictions (NC OneMap 2017).

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, pH, salinity, temperature, 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 a summary of data collected during 2015–2016 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 (70.8-kilometer) 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 [1 kilometer] 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 2019).

Weather and Hydrologic Setting

Daily rainfall totals were collected at the Morehead City and Ocracoke weather and climate station on www.climateanalyzer.org and are included here (Figures 2 and 3)

as an aid for interpreting water-quality results. These data are presented for 2015–2016.

Additional climate data and analyses, such as departure from 30-year averages and extended drought and precipitation information, are available for individual interpretation on the [Southeast Coast Network Climate Analyzer Website](http://www.climateanalyzer.org/secn) (<http://www.climateanalyzer.org/secn>). This additional data may add context to the data presented in this report.

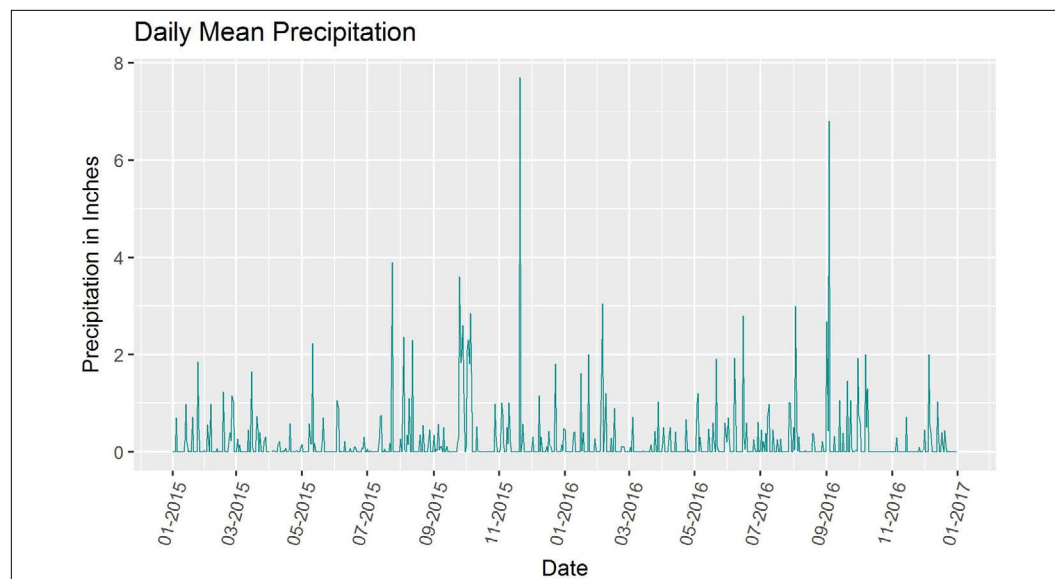


Figure 2. Daily precipitation at Morehead City weather and climate station near Cape Lookout National Seashore January 1, 2015–December 31, 2016. Data obtained from NOAA (NOAA-NCDC 2019) through The Climate Analyzer (www.climateanalyzer.org/secn; The Climate Analyzer 2019).

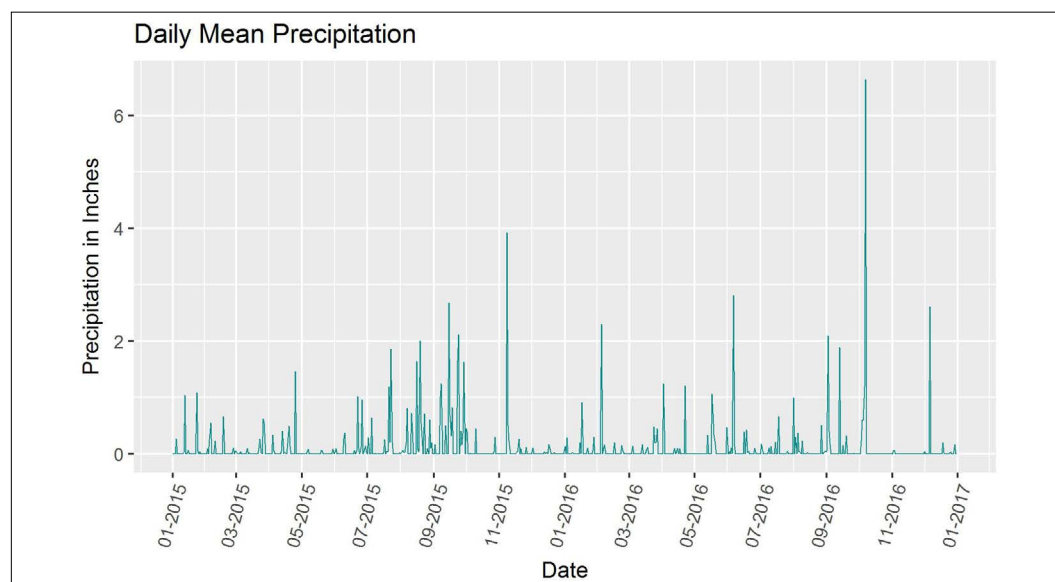


Figure 3. Daily precipitation at Ocracoke weather and climate station near Cape Lookout National Seashore January 1, 2015–December 31, 2016. Data obtained from NOAA (NOAA-NCDC 2019) through The Climate Analyzer (www.climateanalyzer.org/secn; The Climate Analyzer 2019).

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 4). 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 5). 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 4. Photo of continuous data collection station at Shackleford Banks Dock (CALO01) at Cape Lookout National Seashore. NPS photo / John Fear.

Table 1. Location of continuous water-quality monitoring station at Cape Hatteras National Seashore during 2015–2016.

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 5. Photo of continuous data collection sonde and mount used at Middle Marshes (CALO2) at Cape Lookout National Seashore. NPS photo / 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 calibrated, deployed and retrieved by NERRS staff.

The data collection platform at CALO01 consists of a 4-inch (10.2 centimeters) diameter PVC tube attached vertically to a piling on the Shackleford Banks Dock with the sonde suspended within and approximately 1 meter (3.3 feet) 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 (not shown in Figure 5) to prevent fish, crabs, and detritus from entering the sensor area which could skew measurements or damage the instrument's probes. Figures 4 and 5 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 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%: $\pm 2\%$ 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: $\pm 2\%$ of reading or 0.2 mg/L, whichever is greater.
Conductivity	0–100 mS/cm	0.001 to 0.1 mS/cm; range dependent	$\pm 0.5\%$ 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	$\pm 1\%$ of reading or 0.1 ppt, whichever is greater.
Turbidity	0–1000 NTU	0.1 NTU	$\pm 2\%$ 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. 2019).

Beginning in January 2015, depth, dissolved oxygen, pH, specific conductance, temperature and turbidity 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. USGS guidance served as the basis for data grades and corrections (Wagner et al. 2006). 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](#) (Aquatics Informatics Inc. 2019).

Discrete Data

Water sample collection for this project was conducted by NERRS staff. Secchi depth was measured with a 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; EPA 2016). 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 (EPA 2012).

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), [µg/L—micrograms per liter; mg/L—milligrams per liter].

Rating	Water Clarity (k) ¹	Chlorophyll a (µg/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

Chlorophyll *a* concentrations were good (thirteen samples) and fair (two samples). Concentrations ranged from 1.3 µg/L to 7.6 µg/L.

Five 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 concentrations were good throughout the period, ranging from 6.3 mg/L to 10.3 mg/L. Individual concentrations ranged from a low of 3.7 mg/L in July 2015 to a high of 12.0 mg/L in several months.

Mean monthly pH values ranged from 7.6 in June 2015 to 8.3 in November 2016. Individual values ranged from a low of 7.1 in April 2016 to a high of 9.4 also in April 2016.

Monthly mean turbidity values ranged from 3.7 NTU to 11.0 NTUs. The lowest individual turbidity values for any given month was 0.0 NTUs, and a maximum value of 197.5 NTUs was recorded in May 2016.

Water temperatures in 2015–2016 ranged from a minimum monthly mean of 6.4 °C (43.5 °F) to a maximum monthly mean of 29.8 °C (85.6 °F).

The tidal range at site CALO01 was 1.8 meters (5.9 feet).

Site CALO02

Chlorophyll *a* concentrations were good at all seventeen site visits. Concentrations ranged from 0.4 µg/L to 4.8 µg/L.

Five 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 except for one DIP sample which rated fair.

Mean monthly dissolved oxygen concentrations were good throughout the period, ranging from 6.1 mg/L to 10.9 mg/L. Individual concentrations ranged from a low of 3.9 mg/L in August 2015 to a high of 12.5 mg/L in March 2015.

Mean monthly pH values ranged from 7.8 to 8.2. Individual values ranged from a low of 7.4 in May 2015 to a high of 8.3 in December 2015.

Monthly mean turbidity ranged from 2.0 to 13.1 NTUs. The lowest individual turbidity reading for any given month was 0.0 NTUs, and a maximum reading of 89.2 NTUs was recorded in August 2016.

Water temperatures in 2015–2016 ranged from a minimum monthly mean of 6.8 °C (44.2 °F) to a maximum monthly mean of 29.7 °C (85.5 °F).

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

Continuous Data

Figures 6 through 17 depict the daily mean for each parameter for the entire data collection period. Relative water depth (Figures 16 and 17) 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 2015–2016 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 (EPA 2012; Table 3).

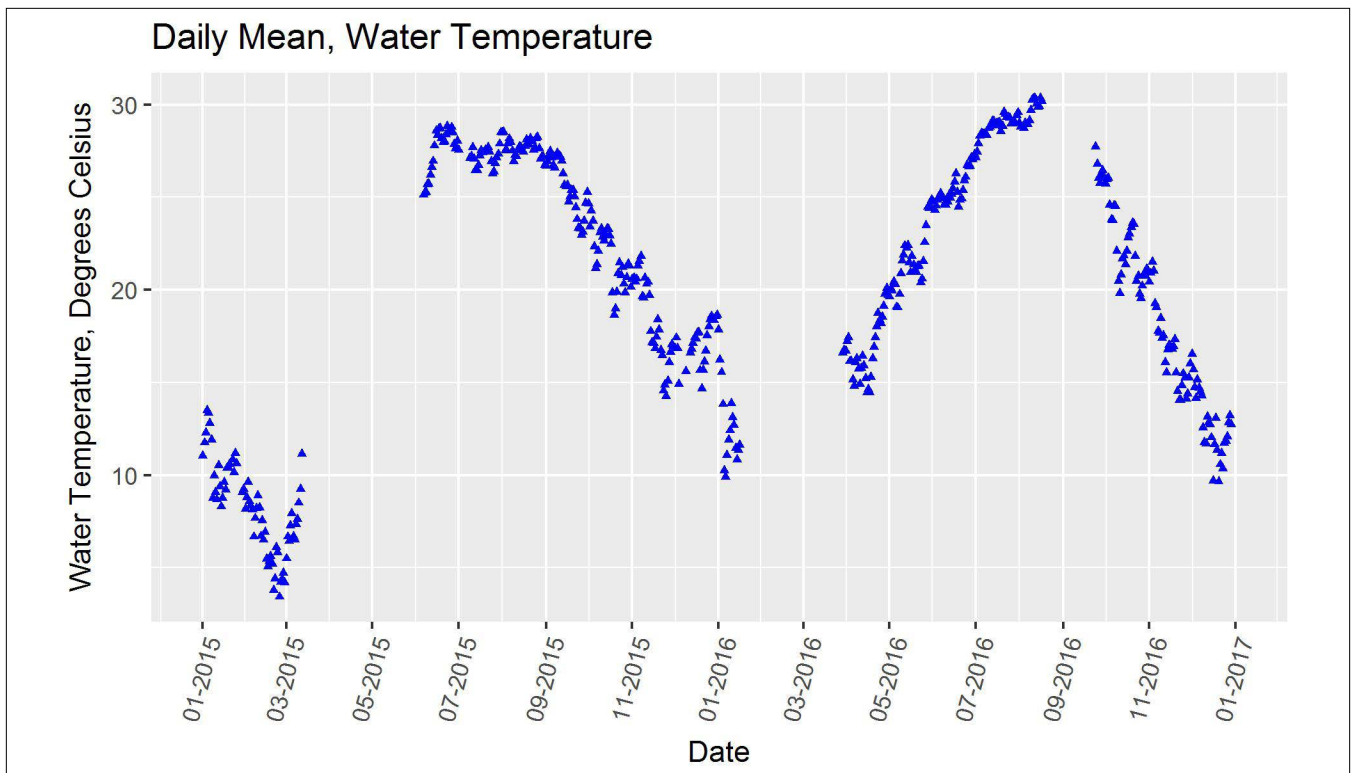


Figure 6. Mean daily water temperature at Cape Lookout National Seashore site CALO01 during 2015–2016. Breaks in data record indicate missing and/or flagged data.

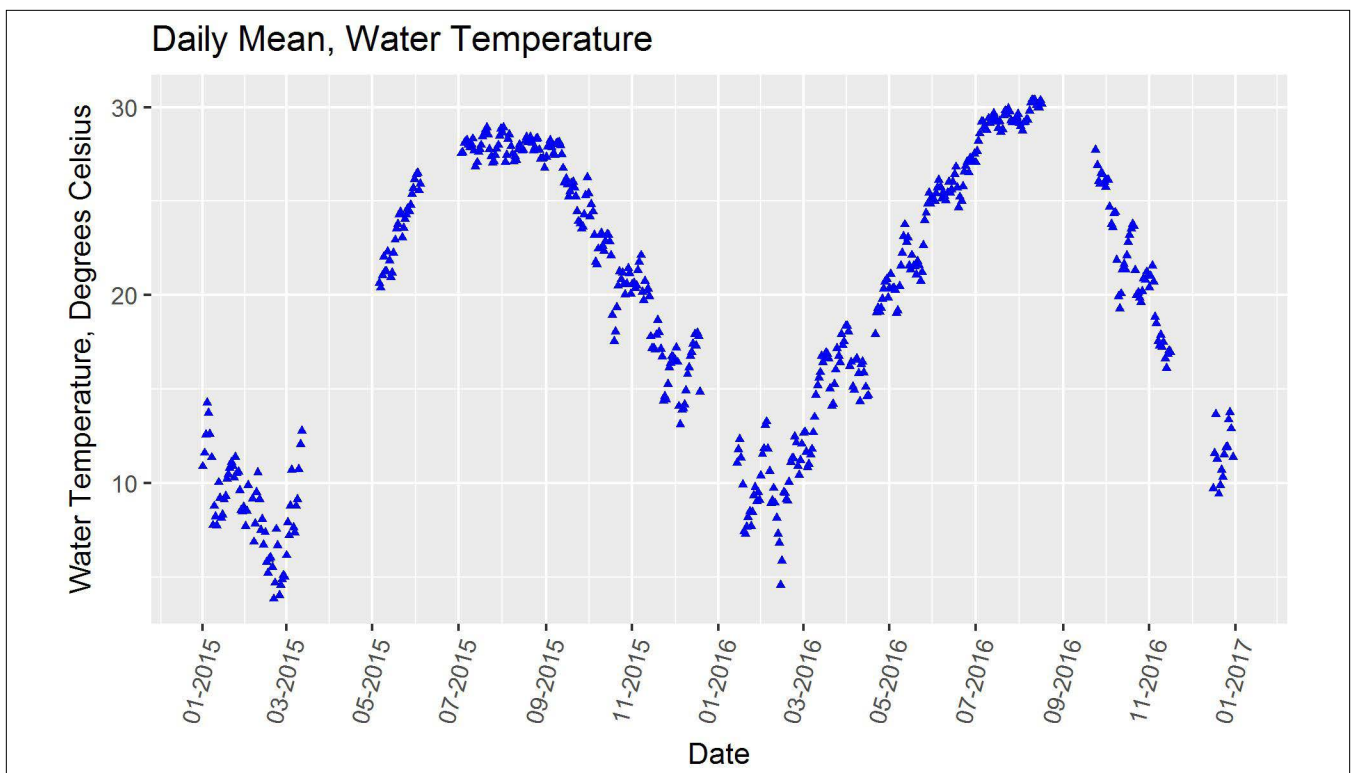


Figure 7. Mean daily temperature levels at Cape Lookout National Seashore site CALO02 during 2015–2016. Breaks in data record indicate missing and/or flagged data.

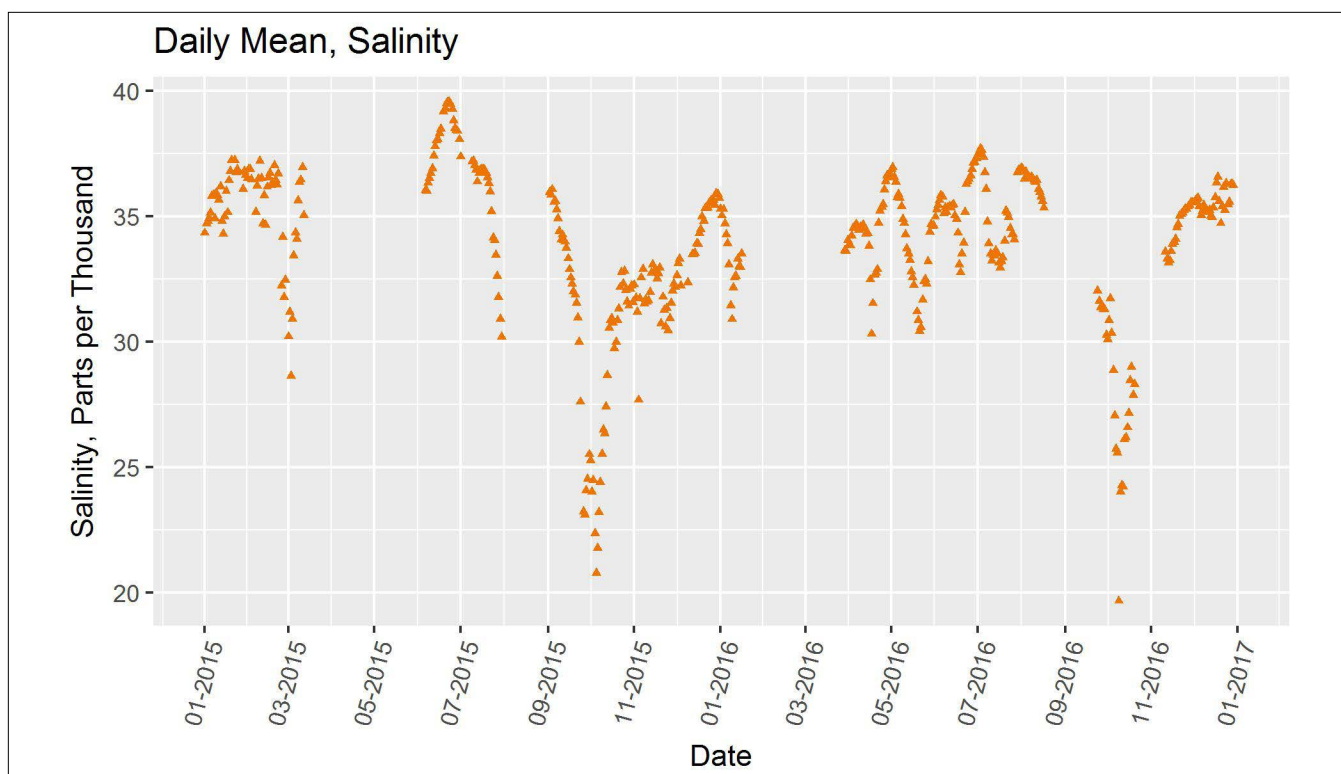


Figure 8. Mean daily salinity at Cape Lookout National Seashore site CALO01 during 2015–2016. Breaks in data record indicate missing and/or flagged data.

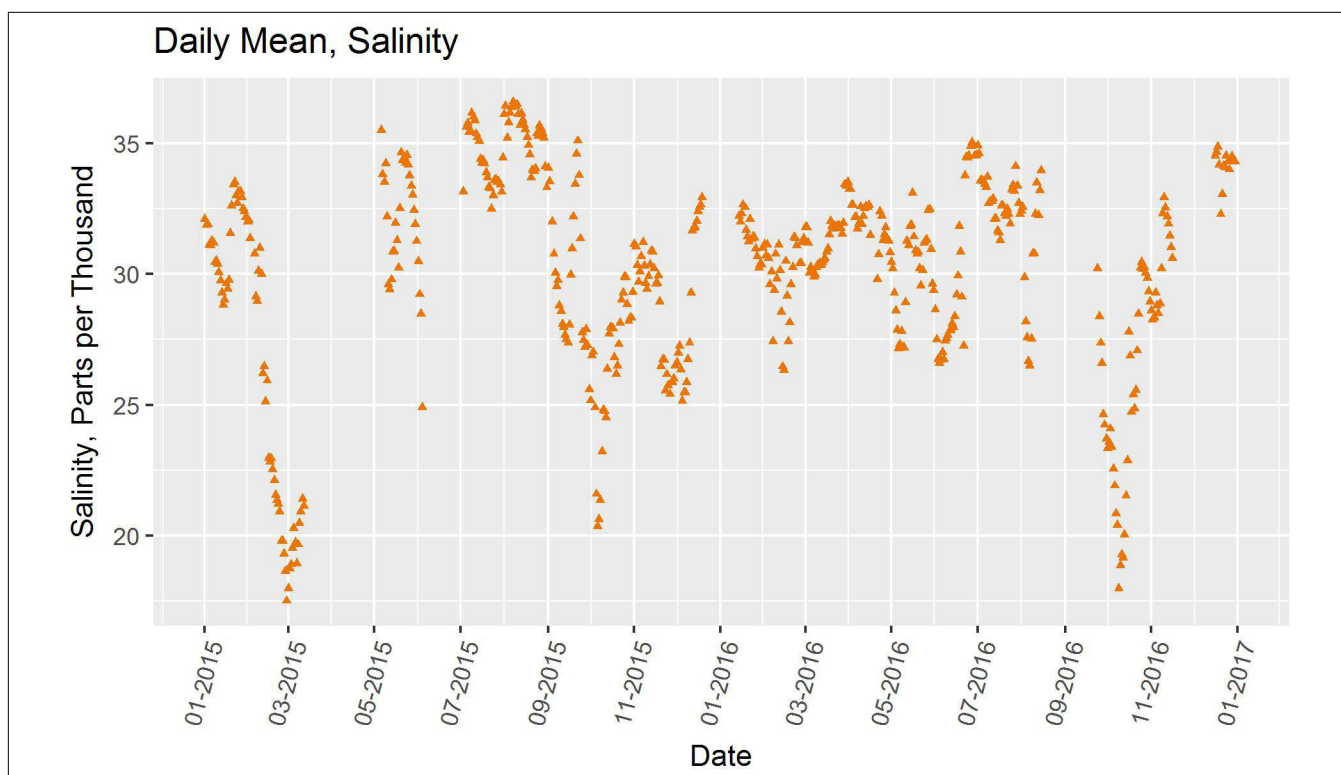


Figure 9. Mean daily salinity at Cape Lookout National Seashore site CALO02 during 2015–2016. Breaks in data record indicate missing and/or flagged data.

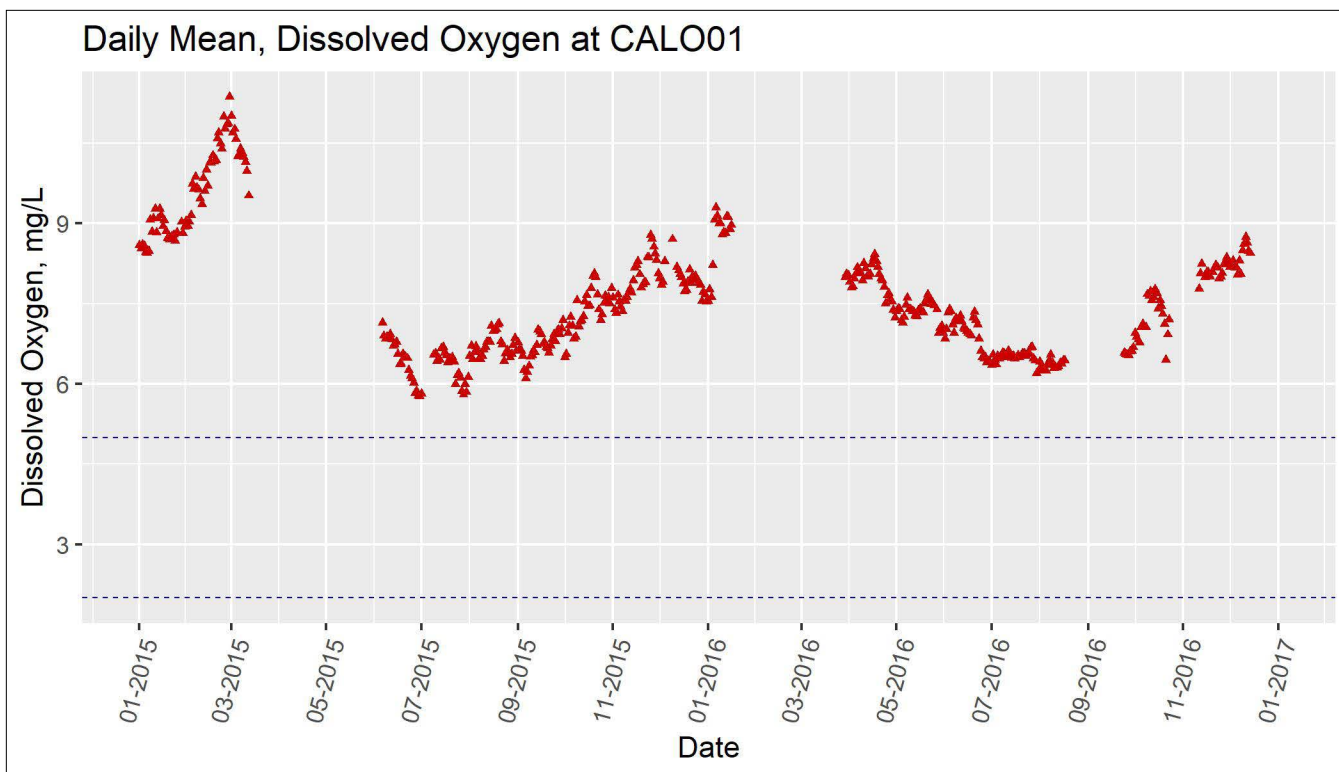


Figure 10. Mean daily dissolved oxygen concentrations at Cape Lookout National Seashore site CALO01 during 2015–2016. Breaks in data record indicate missing and/or flagged data. Dashed lines indicate thresholds for good (above 5 mg/L), fair (2–5 mg/L), and fair (less than 2 mg/L) criteria.

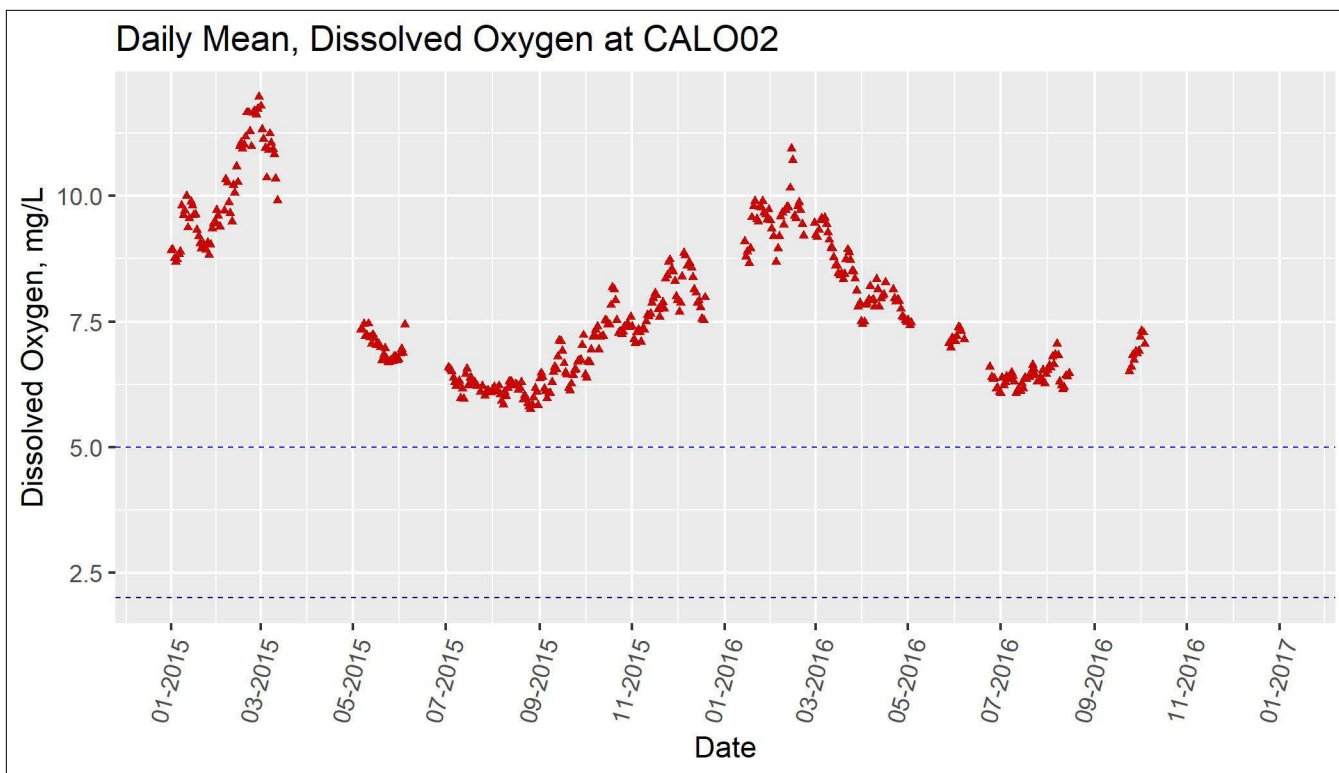


Figure 11. Mean daily dissolved oxygen concentrations at Cape Lookout National Seashore site CALO02 during 2015–2016. Breaks in data record indicate missing and/or flagged data. Dashed lines indicate thresholds for good (above 5 mg/L), fair (2–5 mg/L), and fair (less than 2 mg/L) criteria.

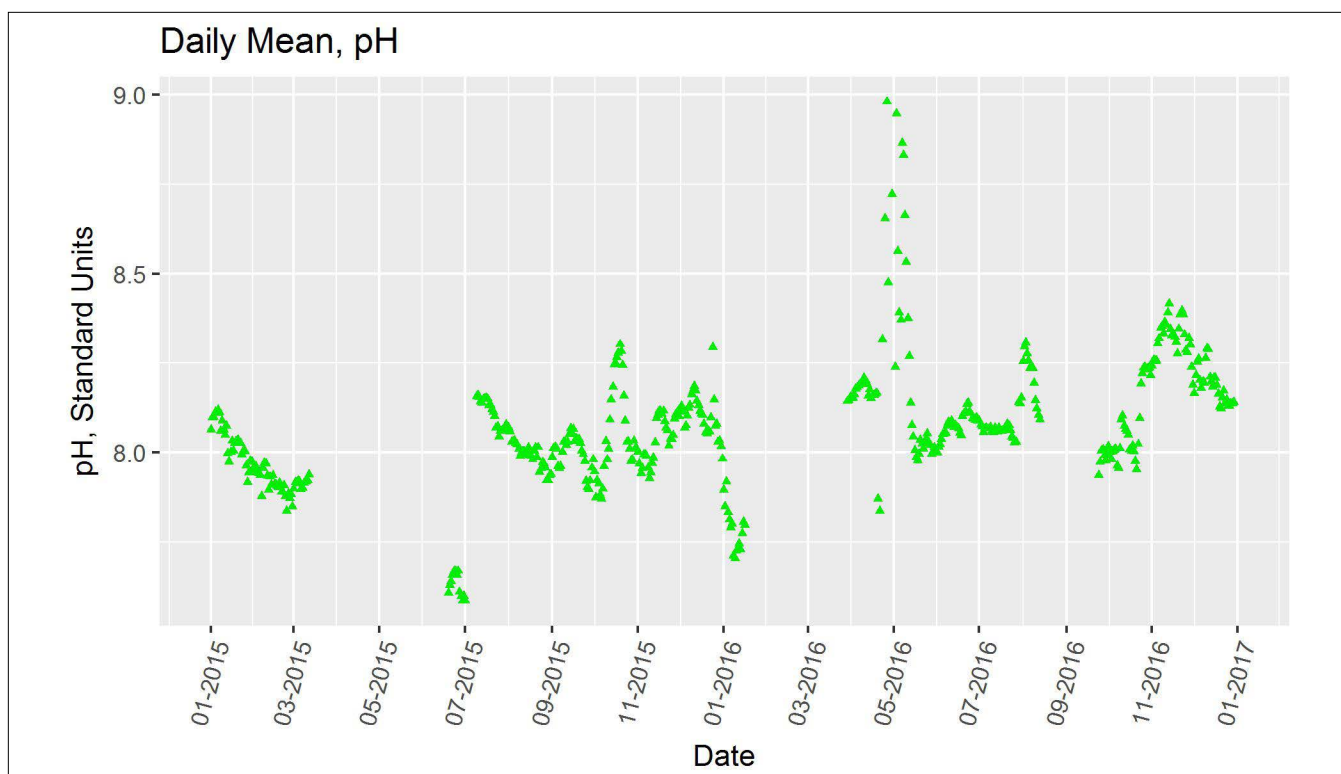


Figure 12. Mean daily water pH at Cape Lookout National Seashore site CALO01 during 2015–2016. Breaks in data record indicate missing and/or flagged data.

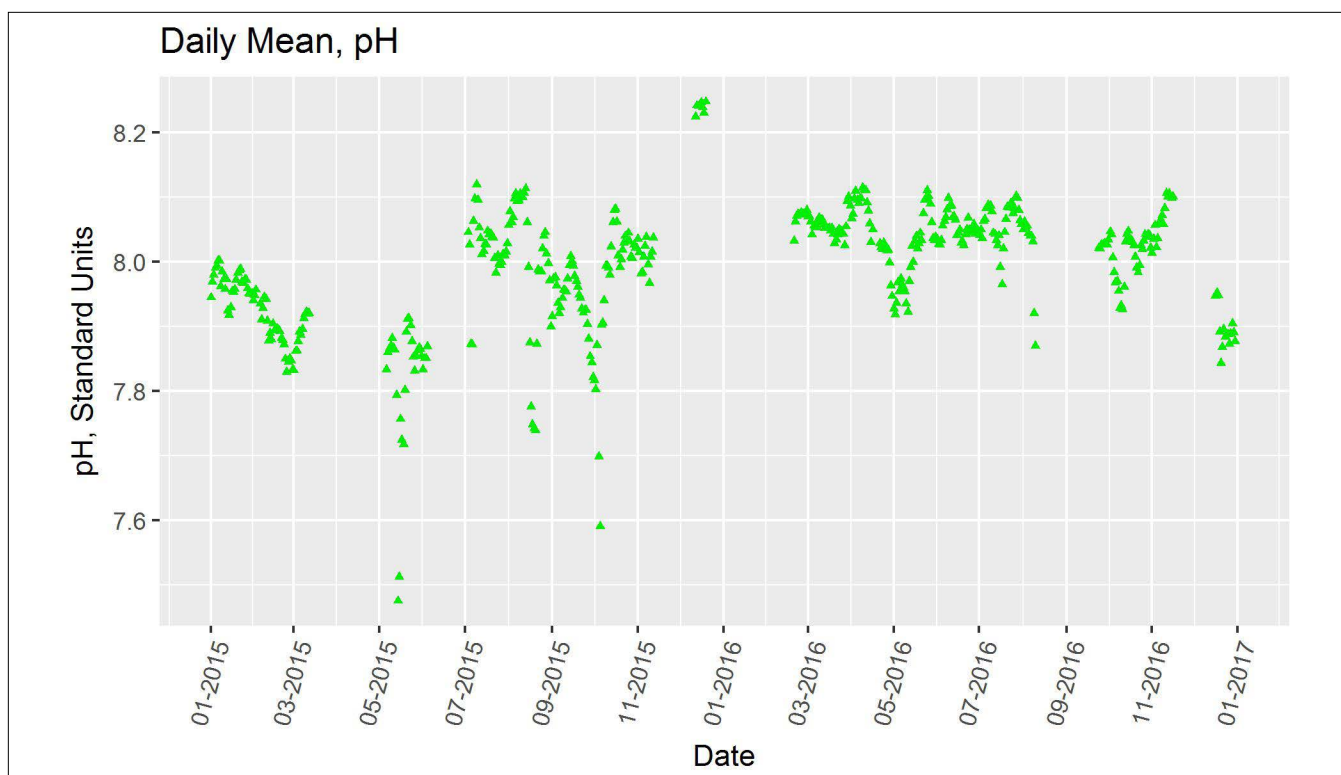


Figure 13. Mean daily water pH at Cape Lookout National Seashore site CALO02 during 2015–2016. Breaks in data record indicate missing and/or flagged data.

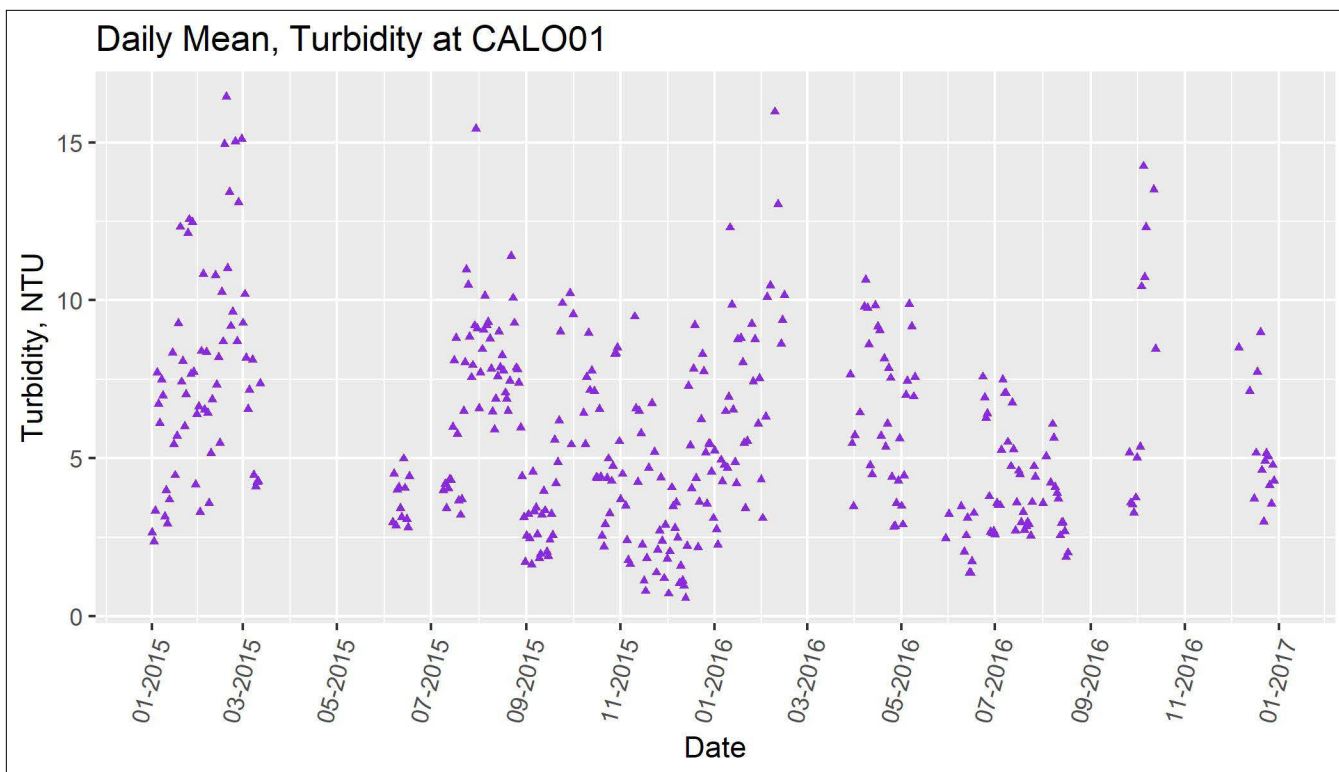


Figure 14. Mean daily turbidity levels at Cape Lookout National Seashore site CALO01 during 2015–2016. Breaks in data record indicate missing and/or flagged data.

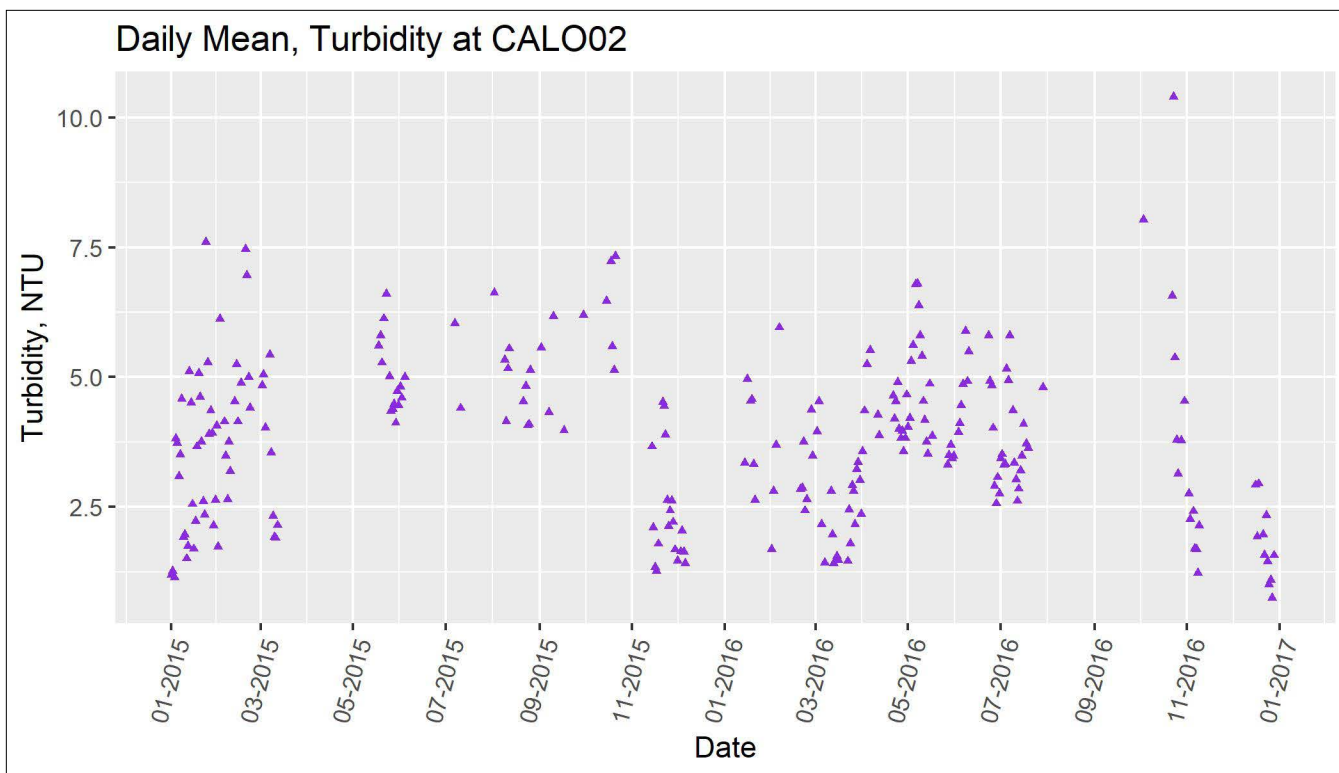


Figure 15. Mean daily turbidity levels at Cape Lookout National Seashore site CALO02 during 2015–2016. Breaks in data record indicate missing and/or flagged data.

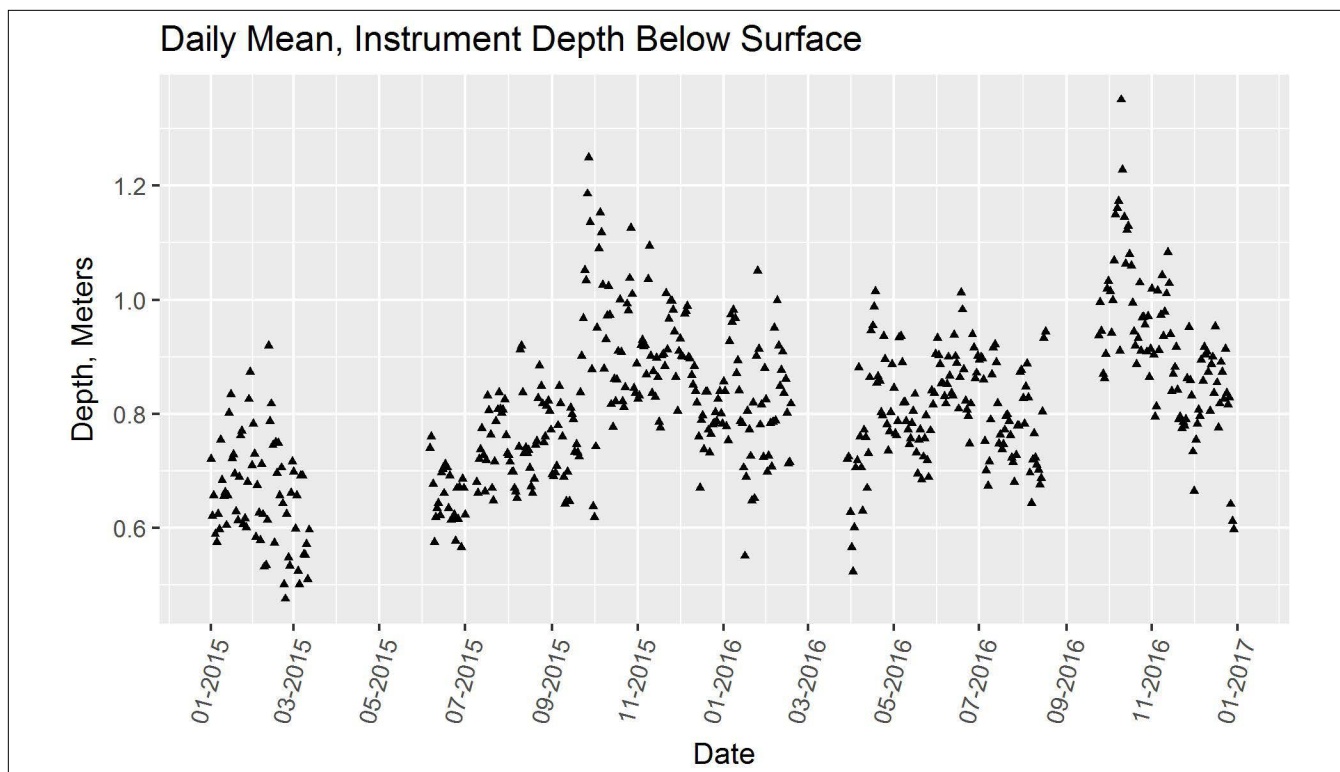


Figure 16. Mean daily depth at Cape Lookout National Seashore site CALO01 during 2015–2016. Breaks in data record indicate missing and/or flagged data.

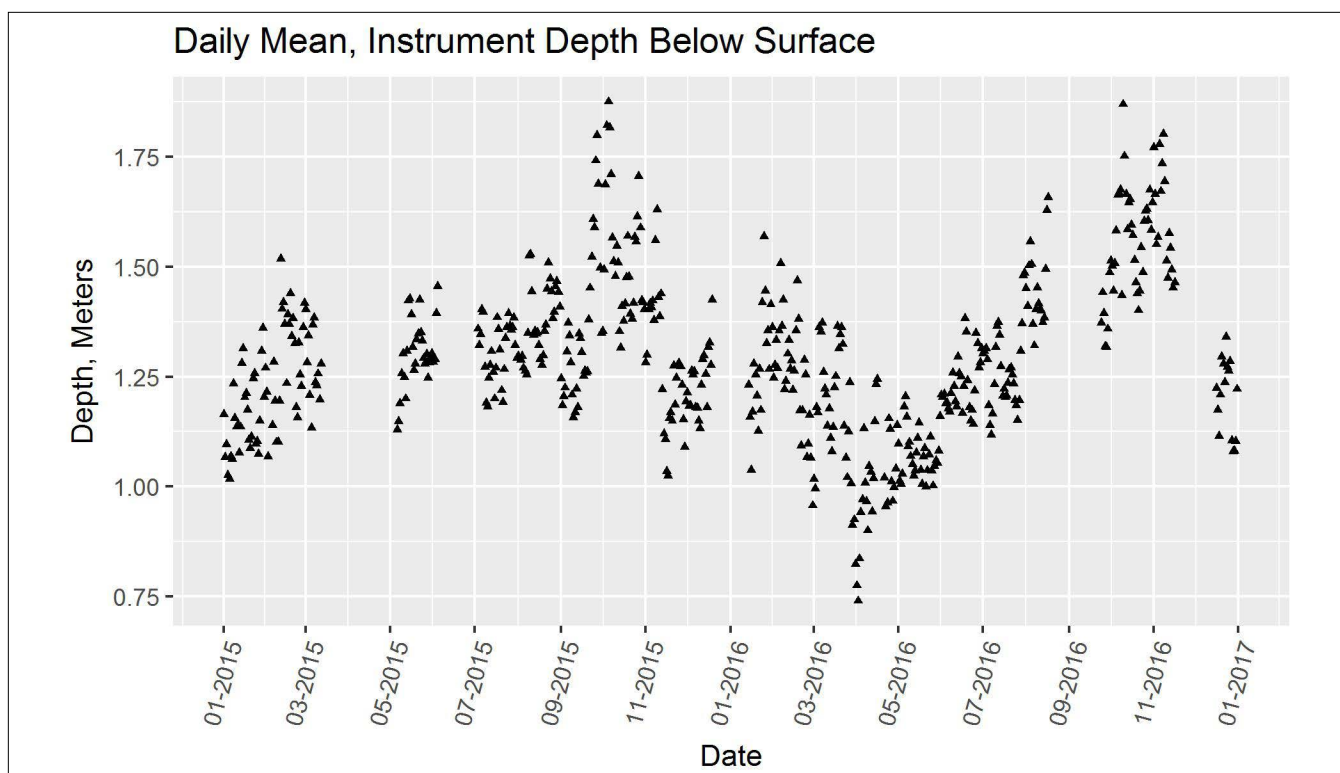


Figure 17. Mean daily depth at Cape Lookout National Seashore site CALO02 during 2015–2016. Breaks in data record indicate missing and/or flagged data.

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 2015–2016. 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 2015 (Expected count 2976)	Actual Count	2685	2725	2795	2972	2922	2819
	Minimum	5.4	30.1	8.0	0.0	7.8	1.4
	Maximum	14.2	38.3	10.1	1.43	8.2	31.4
	Mean	10.4	35.9	8.8	0.69	8.0	6.7
	SD	1.7	1.4	0.4	0.3	0.06	4.1
	Percent	90%	92%	94%	100%	98%	95%
February 2015 (Expected count 2688)	Actual Count	2622	2412	2631	2688	2673	2404
	Minimum	0.4	25.0	8.6	0.04	7.8	1.8
	Maximum	10.4	38.0	12.0	1.43	8.0	66.1
	Mean	6.4	35.7	10.0	0.65	7.9	9.7
	SD	2.0	2.4	0.7	0.3	0.05	5.4
	Percent	98%	90%	98%	100%	99%	89%
March 2015 (Expected count 2976)	Actual Count	1163	1072	1169	1173	1174	1069
	Minimum	3.6	22.5	9.1	0.01	7.8	2.5
	Maximum	14.0	37.7	12.0	1.18	8.0	38.8
	Mean	7.6	33.7	10.3	0.6	7.9	7.1
	SD	1.7	3.6	0.5	0.3	0.02	4.7
	Percent	39%	36%	39%	39%	39%	36%
April 2015 (Expected count 2880)	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%
May 2015 (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%
June 2015 (Expected count 2880)	Actual Count	2395	2401	2387	2458	1174	1215
	Minimum	23.4	35.2	5.0	0.05	7.5	0.9
	Maximum	32.3	39.7	8.0	1.36	7.7	26.2
	Mean	27.5	38.1	6.5	0.66	7.6	3.7
	SD	1.4	1.2	0.6	0.3	0.04	2.2
	Percent	83%	83%	83%	85%	41%	42%

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 2015–2016. 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 2015 (Expected count 2976)	Actual Count	6787	6749	6683	6835	6833	6450
	Minimum	23.1	29.3	3.7	0.07	7.5	0.9
	Maximum	31.3	37.8	7.5	1.4	8.2	28.1
	Mean	27.2	35.4	6.3	0.74	8.1	6.8
	SD	0.8	2.3	0.5	0.3	0.09	4.1
	Percent	228%	227%	225%	230%	230%	217%
August 2015 (Expected count 2976)	Actual Count	2964	0	2852	2976	2976	2843
	Minimum	24.7	NA	4.7	0.1	7.8	0.9
	Maximum	30.0	NA	7.7	1.43	8.1	27.7
	Mean	27.7	NA	6.7	0.76	8.0	7.5
	SD	0.8	NA	0.4	0.3	0.05	2.6
	Percent	100%	0%	96%	100%	100%	96%
September 2015 (Expected count 2880)	Actual Count	2865	2742	2805	2879	2879	2575
	Minimum	22.1	17.4	5.2	0.05	7.6	0.0
	Maximum	29.2	36.5	8.3	1.84	8.1	41.0
	Mean	25.6	31.8	6.7	0.82	8.0	4.4
	SD	1.6	4.3	0.4	0.4	0.07	4.7
	Percent	99%	95%	97%	100%	100%	89%
October 2015 (Expected count 2976)	Actual Count	2922	2776	2853	2975	2975	2487
	Minimum	14.9	17.5	5.0	0.04	7.7	0.7
	Maximum	25.7	34.2	9.0	1.78	8.4	44.6
	Mean	21.8	28.8	7.4	0.92	8.1	6.9
	SD	1.8	4.3	0.6	0.3	0.14	5.5
	Percent	98%	93%	96%	100%	100%	84%
November 2015 (Expected count 2880)	Actual Count	2824	2699	2827	2880	2878	2484
	Minimum	11.4	24.1	6.6	0.28	7.8	0.0
	Maximum	22.8	34.1	9.8	1.66	8.2	22.8
	Mean	18.4	31.8	7.9	0.91	8.0	4.0
	SD	2.4	2.0	0.6	0.3	0.07	3.6
	Percent	98%	94%	98%	100%	100%	86%
December 2015 (Expected count 2976)	Actual Count	2689	2640	2660	2976	2949	2593
	Minimum	12.8	27.4	7.1	0.11	7.9	0.0
	Maximum	19.7	36.1	9.3	1.46	8.5	33.3
	Mean	1.0	34.3	8.0	0.83	8.1	4.0
	SD	1.4	1.6	0.4	0.3	0.07	3.3
	Percent	90%	89%	89%	100%	99%	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 2015–2016. 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 2016 (Expected count 2976)	Actual Count	1567	1584	1574	2975	1570	2556
	Minimum	7.2	24.2	7.1	0.08	7.6	0.6
	Maximum	18.8	36.1	10.1	1.64	8.1	30.0
	Mean	12.7	33.4	8.7	0.82	7.8	6.7
	SD	2.4	2.0	0.7	0.3	0.08	4.9
	Percent	53%	53%	53%	100%	53%	86%
February 2016 (Expected count 2784)	Actual Count	0	0	0	1769	0	1273
	Minimum	NA	NA	NA	0.2	NA	1.0
	Maximum	NA	NA	NA	1.65	NA	48.7
	Mean	NA	NA	NA	0.82	NA	11.0
	SD	NA	NA	NA	0.3	NA	6.9
	Percent	0%	0%	0%	64%	0%	46%
March 2016 (Expected count 2976)	Actual Count	318	324	326	326	323	285
	Minimum	13.6	32.9	7.5	0.25	8.1	2.0
	Maximum	20.1	34.3	8.7	1.2	8.2	16.6
	Mean	16.7	33.8	8.0	0.68	8.1	5.6
	SD	1.2	0.4	0.3	0.3	0.02	2.5
	Percent	11%	11%	11%	11%	11%	10%
April 2016 (Expected count 2880)	Actual Count	2847	2833	2844	2881	2642	2375
	Minimum	12.5	25.4	6.5	0.0	7.1	1.5
	Maximum	22.6	37.1	9.0	1.49	9.4	63.8
	Mean	16.8	34.4	7.9	0.79	8.2	6.8
	SD	1.8	1.8	0.4	0.3	0.27	4.1
	Percent	99%	98%	99%	100%	92%	82%
May 2016 (Expected count 2976)	Actual Count	2955	2937	2762	2975	2850	1114
	Minimum	17.7	29.7	5.2	0.17	7.8	0.0
	Maximum	28.2	37.2	8.3	1.58	9.1	197.5
	Mean	21.5	33.8	7.4	0.79	8.2	6.0
	SD	1.7	1.9	0.4	0.3	0.32	14.2
	Percent	99%	99%	93%	100%	96%	37%
June 2016 (Expected count 2880)	Actual Count	2844	2844	2755	2880	2826	2122
	Minimum	21.8	31.0	4.6	0.21	7.8	0.0
	Maximum	29.2	37.5	8.3	1.54	8.2	36.1
	Mean	25.5	35.4	7.0	0.87	8.1	4.1
	SD	1.2	1.2	0.5	0.3	0.04	3.8
	Percent	99%	99%	96%	100%	98%	74%

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 2015–2016. 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 2016 (Expected count 2976)	Actual Count	2971	2868	2901	2975	2904	2545
	Minimum	26.5	31.7	4.8	0.18	7.9	1.1
	Maximum	31.6	37.8	7.4	1.53	8.2	20.2
	Mean	28.8	35.0	6.5	0.8	8.1	4.2
	SD	0.8	1.6	0.4	0.3	0.04	2.3
	Percent	100%	96%	97%	100%	98%	86%
August 2016 (Expected count 2976)	Actual Count	1680	1576	1634	1697	1210	1461
	Minimum	26.7	34.8	5.2	0.22	8.1	0.7
	Maximum	31.6	37.1	7.4	1.49	8.3	13.3
	Mean	29.6	36.3	6.4	0.78	8.2	3.7
	SD	0.9	0.5	0.4	0.3	0.07	1.9
	Percent	56%	53%	55%	57%	41%	49%
September 2016 (Expected count 2880)	Actual Count	745	688	679	757	693	550
	Minimum	22.4	27.8	5.2	0.4	7.8	0.7
	Maximum	29.6	34.0	7.5	1.5	8.1	12.3
	Mean	26.6	31.4	6.6	0.94	8.0	4.1
	SD	0.9	1.5	0.4	0.3	0.04	2.4
	Percent	26%	24%	24%	26%	24%	19%
October 2016 (Expected count 2976)	Actual Count	2931	1868	2042	2974	2840	1162
	Minimum	16.2	14.5	5.1	0.19	7.8	2.1
	Maximum	27.7	33.3	9.1	1.77	8.3	65.1
	Mean	22.3	27.5	7.3	1.03	8.1	9.9
	SD	2.1	3.6	0.6	0.3	0.11	6.5
	Percent	98%	63%	69%	100%	95%	39%
November 2016 (Expected count 2880)	Actual Count	2839	1968	1803	2879	2866	46
	Minimum	11.8	31.3	7.2	0.18	8.2	0.0
	Maximum	23.0	35.7	8.8	1.7	8.5	84.2
	Mean	16.9	34.5	8.1	0.89	8.3	5.1
	SD	2.3	1.0	0.3	0.3	0.06	15.6
	Percent	99%	68%	63%	100%	100%	2%
December 2016 (Expected count 2976)	Actual Count	2757	2747	1341	2792	2782	1756
	Minimum	7.3	32.4	7.3	0.07	8.1	0.0
	Maximum	17.2	37.1	9.5	1.66	8.4	27.8
	Mean	12.7	35.6	8.4	0.82	8.2	5.4
	SD	1.9	0.9	0.3	0.3	0.05	4.2
	Percent	93%	92%	45%	94%	93%	59%

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 2015–2016. 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 2015 (Expected count 2976)	Actual Count	2976	2975	2920	2976	2976	2964
	Minimum	3.3	25.9	7.7	0.45	7.8	0.1
	Maximum	16.7	34.4	10.9	1.83	8.1	21.7
	Mean	10.1	31.4	9.3	1.16	8.0	3.3
	SD	2.0	1.8	0.6	0.3	0.04	2.5
	Percent	100%	100%	98%	100%	100%	100%
February 2015 (Expected count 2688)	Actual Count	2581	2581	2555	2581	2581	2006
	Minimum	0.0	16.3	8.6	0.61	7.8	0.5
	Maximum	13.5	33.7	13.0	2.02	8.0	24.8
	Mean	6.8	24.8	10.7	1.28	7.9	5.6
	SD	2.2	4.6	0.9	0.3	0.04	5.3
	Percent	96%	96%	95%	96%	96%	75%
March 2015 (Expected count 2976)	Actual Count	1186	1186	1149	1186	1186	995
	Minimum	3.8	16.1	8.2	0.65	7.8	0.9
	Maximum	16.9	22.1	12.5	1.85	8.0	20.3
	Mean	9.1	19.9	10.9	1.28	7.9	3.8
	SD	2.5	1.4	0.7	0.3	0.04	3.2
	Percent	40%	40%	39%	40%	40%	33%
April 2015 (Expected count 2880)	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%
May 2015 (Expected count 2976)	Actual Count	2534	2527	2387	2534	2534	1724
	Minimum	18.1	28.3	4.7	0.61	7.4	0.2
	Maximum	31.1	36.2	8.8	1.94	8.0	29.2
	Mean	23.1	32.7	7.0	1.3	7.8	5.9
	SD	2.2	1.9	0.7	0.3	0.12	6.1
	Percent	85%	85%	80%	85%	85%	58%
June 2015 (Expected count 2880)	Actual Count	409	409	387	409	409	333
	Minimum	23.7	23.6	5.0	0.8	7.7	0.4
	Maximum	31.2	31.1	8.7	2.0	7.9	12.4
	Mean	26.0	28.0	7.0	1.35	7.8	4.9
	SD	1.5	2.3	0.8	0.3	0.06	4.8
	Percent	14%	14%	13%	14%	14%	12%

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 2015–2016. 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 2015 (Expected count 2976)	Actual Count	2823	2736	2507	2823	2821	1677
	Minimum	25.5	30.6	4.0	0.7	7.7	0.3
	Maximum	32.3	36.8	7.5	1.92	8.2	21.5
	Mean	27.9	34.3	6.3	1.31	8.0	5.2
	SD	1.2	1.1	0.7	0.3	0.08	5.1
	Percent	95%	92%	84%	95%	95%	56%
August 2015 (Expected count 2976)	Actual Count	2976	2973	2815	2976	2976	2060
	Minimum	25.3	32	3.9	0.8	7.7	0.5
	Maximum	32.2	36.9	7.4	2.0	8.2	21.3
	Mean	27.8	35.4	6.1	1.37	8.0	5.5
	SD	1.1	1.0	0.6	0.3	0.13	5.4
	Percent	100%	100%	95%	100%	100%	69%
September 2015 (Expected count 2880)	Actual Count	2881	2766	2734	2879	2878	1881
	Minimum	23.0	21.2	4.6	0.67	7.6	0.0
	Maximum	30.7	36.2	8.5	2.33	8.1	25.0
	Mean	26.3	30.0	6.5	1.36	7.9	5.7
	SD	1.7	2.8	0.6	0.3	0.07	5.8
	Percent	100%	96%	95%	100%	100%	65%
October 2015 (Expected count 2976)	Actual Count	2973	2911	2789	2973	2973	1310
	Minimum	13.3	17.9	5.2	0.83	7.5	2.6
	Maximum	26.2	33.1	9.0	2.29	8.2	50.6
	Mean	21.8	26.5	7.3	1.52	8.0	8.1
	SD	2.1	3.3	0.6	0.3	0.13	7.6
	Percent	100%	98%	94%	100%	100%	44%
November 2015 (Expected count 2880)	Actual Count	2879	2879	2779	2879	1204	1408
	Minimum	10.9	21.1	6.2	0.58	7.8	0.5
	Maximum	24.0	32.6	9.7	2.03	8.1	13.7
	Mean	18.4	28.7	7.8	1.27	8.0	2.8
	SD	2.5	2.6	0.7	0.3	0.06	2.3
	Percent	100%	100%	96%	100%	42%	49%
December 2015 (Expected count 2976)	Actual Count	1809	1791	1762	1809	800	1004
	Minimum	11.0	23.0	6.6	0.7	8.1	0.1
	Maximum	19.2	33.7	9.7	1.82	8.3	23.1
	Mean	16.0	28.9	8.2	1.24	8.2	2.0
	SD	1.8	3.1	0.6	0.3	0.04	1.5
	Percent	61%	60%	59%	61%	27%	34%

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 2015–2016. 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 2016 (Expected count 2976)	Actual Count	1764	1683	1748	1765	0	1115
	Minimum	3.8	26.1	8.1	0.63	NA	1.0
	Maximum	13.4	34.6	11.0	2.08	NA	22.8
	Mean	9.4	31.5	9.5	1.28	NA	4.3
	SD	2.0	1.7	0.6	0.3	NA	3.7
	Percent	59%	57%	59%	59%	0%	37%
February 2016 (Expected count 2784)	Actual Count	2782	2535	2224	2782	1015	1445
	Minimum	1.2	19.3	7.2	0.64	7.9	0.8
	Maximum	16.0	34.8	11.8	2.12	8.2	79.4
	Mean	10.1	29.9	9.6	1.26	8.1	4.6
	SD	2.4	2.6	0.7	0.3	0.04	3.9
	Percent	100%	91%	80%	100%	36%	52%
March 2016 (Expected count 2976)	Actual Count	2976	2972	2922	2976	2976	2176
	Minimum	9.1	28.8	6.3	0.47	7.9	0.0
	Maximum	22.3	33.9	10.2	1.88	8.2	32.7
	Mean	15.0	31.3	8.8	1.17	8.1	2.3
	SD	2.6	1.0	0.7	0.3	0.04	2.1
	Percent	100%	100%	98%	100%	100%	73%
April 2016 (Expected count 2880)	Actual Count	2568	2522	2496	2568	2568	1928
	Minimum	9.6	27.0	6.1	0.32	7.8	1.4
	Maximum	24.3	34.7	9.2	1.68	8.2	31.1
	Mean	17.4	32.0	7.9	1.02	8.1	5.3
	SD	2.4	1.1	0.5	0.3	0.06	4.7
	Percent	89%	88%	87%	89%	89%	67%
May 2016 (Expected count 2976)	Actual Count	2975	2969	722	2975	2975	1979
	Minimum	17.8	26.7	5.4	0.49	7.8	0.0
	Maximum	29.4	34.3	9.0	1.78	8.2	20.0
	Mean	22.1	30.1	7.3	1.07	8.0	4.8
	SD	2.2	1.7	0.7	0.3	0.07	4.8
	Percent	100%	100%	24%	100%	100%	66%
June 2016 (Expected count 2880)	Actual Count	2879	2820	1869	2879	2879	1580
	Minimum	23.1	25.4	4.8	0.63	7.9	0.0
	Maximum	30.8	36.3	9.3	1.86	8.2	15.1
	Mean	25.9	30.1	6.8	1.23	8.1	4.4
	SD	1.4	3.3	0.8	0.3	0.05	4.5
	Percent	100%	98%	65%	100%	100%	55%

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 2015–2016. 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 2016 (Expected count 2976)	Actual Count	2975	2936	2838	2975	2972	2143
	Minimum	26.2	27.3	4.3	0.66	7.8	0.0
	Maximum	33.5	35.8	7.8	2.01	8.2	26.4
	Mean	29.1	32.9	6.3	1.26	8.1	4.1
	SD	1.3	1.0	0.7	0.3	0.06	4.0
	Percent	100%	99%	95%	100%	100%	72%
August 2016 (Expected count 2976)	Actual Count	1681	1496	1399	1680	957	491
	Minimum	26.9	26.2	4.0	0.91	7.7	2.1
	Maximum	33.4	34.9	7.9	2.15	8.1	89.2
	Mean	29.7	30.7	6.5	1.46	8.0	13.1
	SD	1.2	2.7	0.8	0.3	0.08	13
	Percent	56%	50%	47%	56%	32%	16%
September 2016 (Expected count 2880)	Actual Count	737	732	704	737	732	414
	Minimum	24.4	22.1	5.1	0.9	7.9	0.0
	Maximum	29.1	33.7	8.2	1.9	8.1	24.4
	Mean	26.7	26.9	6.8	1.39	8.0	5.6
	SD	0.9	2.9	0.6	0.3	0.06	6.2
	Percent	26%	25%	24%	26%	25%	14%
October 2016 (Expected count 2976)	Actual Count	2974	2974	879	2974	2974	1554
	Minimum	17.0	16.3	5.6	0.96	7.8	0.0
	Maximum	27.7	33.3	9.2	2.26	8.1	61.3
	Mean	22.2	24.8	7.4	1.58	8.0	8.9
	SD	2.2	4.2	0.6	0.3	0.06	7.8
	Percent	100%	100%	30%	100%	100%	52%
November 2016 (Expected count 2880)	Actual Count	1520	1520	0	1519	1517	744
	Minimum	13.3	26.3	NA	0.86	7.9	0.0
	Maximum	23.1	34.1	NA	2.25	8.2	10.0
	Mean	18.3	30.4	NA	1.61	8.1	2.2
	SD	2.0	1.9	NA	0.3	0.05	2.1
	Percent	53%	53%	0%	53%	53%	26%
December 2016 (Expected count 2976)	Actual Count	1573	1535	0.0	1573	1573	1260
	Minimum	5.1	30.2	NA	0.55	7.8	0.0
	Maximum	15.9	36.1	NA	1.86	8.0	17.3
	Mean	11.5	34.2	NA	1.2	7.9	2.3
	SD	1.7	1.2	NA	0.3	0.05	1.5
	Percent	53%	52%	0%	53%	53%	42%

Table 6. Monthly water-quality data collected by the Southeast Coast Network at Cape Lookout National Seashore site CALO01 during 2015–2016. 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—good; 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 (mg/L) ²	Total Dissolved Phosphorus (mg/L) ²
02/04/2015	1.17 ^a	1.26 ^a	0.021 ^a	0.0047 ^a	9.6 ^a	0.19	0.011
03/11/2015	2.80 ^c	1.97 ^a	—	—	9.8 ^a	0.25	0.014
06/05/2015	0.80 ^a	2.41 ^a	—	—	6.6 ^a	0.16	0.010
07/02/2015	0.93 ^a	2.59 ^a	—	—	6.7 ^a	0.20	0.015
09/01/2015	0.80 ^a	3.88 ^a	—	—	7.1 ^a	0.18	0.014
10/09/2015	1.40 ^a	7.85 ^b	—	—	8.4 ^a	0.33	0.012
12/11/2015	—	3.55 ^a	—	—	8.6 ^a	0.23	0.014
01/12/2016	1.12 ^a	2.41 ^a	—	—	8.9 ^a	0.20	0.011
02/19/2016	2.80 ^c	2.58 ^a	0.024 ^a	0.0091 ^a	—	0.16	0.009
03/28/2016	0.80 ^a	1.88 ^a	—	—	8.4 ^a	0.14	0.011
4/20/2016	—	—	—	—	8.2 ^a	—	—
5/27/2016	—	—	—	—	7.7 ^a	—	—
06/22/2016	1.12 ^a	6.03 ^b	—	—	7.4 ^a	0.23	0.012
07/28/2016	0.82 ^a	3.91 ^a	0.0178 ^a	0.0038 ^a	6.2 ^a	0.15	0.017
08/18/2016	0.93 ^a	2.15 ^a	0.040 ^a	0.0031 ^a	6.9 ^a	0.15	0.015
09/23/2016	1.87 ^b	4.01 ^a	—	—	5.8 ^a	0.24	0.025
11/10/2016	0.93 ^a	3.99 ^a	0.007 ^a	0.0098 ^a	7.9 ^a	0.16	0.017
12/15/2016	—	—	—	—	8.9 ^a	—	—

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.

² There are no EPA condition criteria for TDN and TDP.

Table 7. Monthly water-quality data collected by the Southeast Coast Network at Cape Lookout National Seashore site CAL002 during 2015–2016. 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
02/04/2015	1.40 ^a	0.60 ^a	0.011 ^a	0.0033 ^a	10.4 ^a	0.16	0.012
03/11/2015	1.40 ^a	0.44 ^a	—	—	10.3 ^a	0.21	0.012
06/05/2015	—	2.38 ^a	—	—	6.5 ^a	0.14	0.010
07/02/2015	—	2.65 ^a	—	—	6.6 ^a	0.21	0.020
09/01/2015	—	2.86 ^a	—	—	6.8 ^a	0.21	0.016
10/09/2015	1.56 ^a	4.82 ^a	—	—	8.5 ^a	0.35	0.014
12/11/2015	1.00 ^a	0.99 ^a	—	—	9.0 ^a	0.19	0.013
01/12/2016	1.27 ^a	1.60 ^a	—	—	9.8 ^a	0.34	0.025
02/19/2016	2.80 ^c	2.99 ^a	0.051 ^a	0.0123 ^b	9.9 ^a	0.19	0.010
03/28/2016	0.93 ^a	1.57 ^a	—	—	8.6 ^a	0.17	0.015
04/20/2016	2.00 ^b	2.33 ^a	—	—	8.4 ^a	0.21	0.014
05/27/2016	0.93 ^a	1.12 ^a	—	—	8.0 ^a	0.24	0.018
06/22/2016	1.40 ^a	2.49 ^a	—	—	7.2 ^a	0.27	0.020
07/28/2016	1.47 ^a	2.36 ^a	0.041 ^a	0.0054 ^a	5.9 ^a	0.25	0.023
08/18/2016	1.40 ^a	2.04 ^a	0.034 ^a	0.0034 ^a	5.7 ^a	0.16	0.015
09/23/2016	4.67 ^c	4.49 ^a	—	—	6.1 ^a	0.22	0.016
10/24/2016	—	—	—	—	7.4 ^a	—	—
11/10/2016	1.75 ^b	1.29 ^a	0.013 ^a	0.0053 ^a	—	0.16	0.018
12/15/2016	—	—	—	—	—	—	—

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.

² There are no EPA condition criteria for TDN and TDP.

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