



Water Quality Monitoring for Agate Fossil Beds National Monument *2014 Data Report*

Natural Resource Data Series NPS/AGFO/NRDS—2020/1295



**ON THIS PAGE**

Upstream view of the Niobrara River from the gage station at Agate Fossil Beds National Monument, Nebraska, in June 2014.
Photograph courtesy of the USGS and National Park Service.

ON THE COVER

Photograph of the Niobrara River at Agate Fossil Beds National Monument, Nebraska.
Photograph courtesy of T. Schaffner, National Park Service.

Water Quality Monitoring for Agate Fossil Beds National Monument

2014 Data Report

Natural Resource Data Series NPS/AGFO/NRDS—2020/1295

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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 those protocols

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Contents Page

Figures.....	iv
Tables.....	v
Abstract.....	vi
Introduction.....	1
Methods.....	5
Data Collection.....	5
Results.....	8
Further Analysis.....	19
Literature Cited	20
Appendix A. USGS Water Data Quality Report for Niobrara River 06454100, 2014	22

Figures

	Page
Figure 1. Map of Agate Fossil Beds National Monument and the Niobrara River in Nebraska.	2
Figure 2. Map of Agate Fossil Beds National Monument and water quality monitoring location (06454100, blue triangle) and nearby weather stations (red flags).	3
Figure 3. A sonde device is used to measure water quality in the Niobrara River at Agate Fossil Beds National Monument.	5
Figure 4. Daily mean gage height (black line) on the Niobrara River at Agate Fossil Beds National Monument from February 18 to November 17, 2014, at USGS Gaging Station 06454100.	8
Figure 5. Total monthly precipitation (light blue bars) and average monthly minimum (green) and maximum (blue) temperature for the 2014 calendar year in Agate Fossil Beds National Monument (top panel).	8
Figure 5. Total monthly precipitation (light blue bars) and average monthly minimum (green) and maximum (blue) temperature for the 2014 calendar year in Agate Fossil Beds National Monument (top panel).	9
Figure 6. Daily mean water temperature (black line) collected on the Niobrara River at Agate Fossil Beds National Monument from February 18 to November 17, 2014, at USGS Gaging Station 06454100.	11
Figure 7. Daily mean dissolved oxygen concentrations (black line; top graph) and daily discharge (bottom) of the Niobrara River at Agate Fossil Beds National Monument from February 18 to November 17, 2014, at USGS Gaging Station 06454100.	16
Figure 8. Daily mean specific conductance (top) and daily discharge (bottom) of the Niobrara River at Agate Fossil Beds National Monument from February 18 to November 17, 2014, at USGS Gaging Station 06454100.	17
Figure 9. Daily mean pH (black line) of the Niobrara River at Agate Fossil Beds National Monument from February 18 to November 17, 2014, at USGS Gaging Station 06454100.	18

Tables

	Page
Table 1. Water quality parameters measured as part of the Northern Great Plains Inventory & Monitoring Water Quality Program and associated state standards for the Niobrara River at Agate Fossil Beds (NEE 2019).	4
Table 2. Field journal for 2014 Water Quality Sampling at Agate Fossil Beds National Monument.	6
Table 3. Summary of descriptive statistics for water temperature, dissolved oxygen, specific conductance, and pH measured for the ice-free sampling period on the Niobrara River at Agate Fossil Beds National Monument from February 18 to November 17, 2014, at USGS Gaging Station 06454100.	10
Table 4. Monthly summary of descriptive statistics and percent exceedances for core water quality parameters for the ice-free sampling period on the Niobrara River at Agate Fossil Beds National Monument from February 18 to November 17, 2014, at USGS Gaging Station 06454100.....	12

Abstract

The Northern Great Plains Inventory and Monitoring Network (NGPN) began monitoring water quality in the Niobrara River at Agate Fossil Beds National Monument (AGFO) in 2014 with the assistance of the U.S. Geological Survey (USGS). This report summarizes the data collected during the 2014 ice-free season (February 18 through November 17) for streamflow, water temperature, dissolved oxygen, specific conductance, and pH.

A summary of our 2014 results can be found in Descriptive Statistics Summary tables for the ice-free season (Table 3) and for each month (Table 4). All water quality parameters in the Niobrara River showed seasonal variability, correlating with precipitation and temperature patterns recorded at AGFO. Of note, water temperatures, pH, and dissolved oxygen concentrations all exceeded Nebraska state thresholds for cold water fisheries.

NGPN's collaboration with USGS supported real-time and archived access to this data through the [USGS National Water Information System Website](#), where it remains available to the public.

Introduction

Agate Fossil Beds National Monument (AGFO) is located in the unglaciated high plains of northwest Nebraska, approximately sixty-five miles southeast and downstream of the Niobrara River headwaters. The park consists of 2,700 acres of short-grass prairie, bisected from west to east by the Niobrara River with wetlands expanding from the river to meet upland prairie terraces (Dibner et al 2020). Approximately 4 miles of the perennial spring-fed river flow through Agate Fossil Beds National Monument (Bowles et al 2013). Beneath the prairie surface, AGFO is home to a world-renowned concentration of Miocene fossils. These fossil beds were once a part of the James H. Cook Agate Springs Ranch, which became a gathering place for the Oglala Lakota people led by Chief Red Cloud (NPS 2017). Agate Fossil Beds National Monument was established in 1965 to protect, display, and interpret the Miocene epoch fossils and related geologic phenomena found within the park; to protect and curate the Cook-Red Cloud Native American artifact collection; and to preserve the short-grass prairie and Niobrara riparian ecotone (National Park Service 2008, 2017).

Across Nebraska, the Niobrara River is a prominent natural feature and an important agricultural, recreational, cultural, and ecologic resource. Protecting the water quality in the Niobrara River within AGFO is a high regional priority for the National Park Service (Wilson et al. 2014). The Niobrara River supports a riparian corridor dominated by native species such as bulrush (*Scirpus spp.*), broad-leaved cattail (*Typha latifolia*), and willow (*Salix spp.*) (Licht 2002). However, the spread and dominance of non-native yellow flag iris (*Iris pseudacorus*) along the stretch of the river flowing through AGFO has replaced native riparian plant species, thereby altering the overall riparian habitat (Spaak 2016). The NPS has been monitoring aquatic vegetation and wildlife in the park since 1979, and there has been a notable decline in species richness. In 1989, the Niobrara River in AGFO had 7 native fish species and one non-native species present. By 2011, only three species were recorded, including the non-native Northern Pike (*Esox lucius*) (Pegg and Pope 2008). In addition to species decline, observations of the Niobrara River show that the river channel in AGFO is deeper and narrower, when compared to non-infested river locations upstream, due to the increased bank stability caused by the mats of yellow flag iris. This alteration to flow regimes can alter the function of the river, further impacting the aquatic vegetation and wildlife species (Spaak 2016).

The stretch of the Niobrara River that runs through AGFO is designated as a Coldwater Class B stream for aquatic life by the state of Nebraska, defined as a water known to support non-reproductive populations of trout and important native fish species (NDEQ 2019). In Nebraska, surface waters with a Class B Coldwater designation are regulated for pH, dissolved oxygen, temperature, conductivity, turbidity, *E. coli*, and streamflow (Dibner et al 2020). No impairments were reported for the stretch of river running through AGFO in 2014 (Figure 1). This stretch was listed as Category 2 in the 2014 Nebraska Integrated Water Quality Report, indicating that only some of the designated waterbody uses were being met. A previous aquatic community assessment determined the aesthetics use was being met, however chronic water quality standards were not assessed due to the state's monitoring protocol. A stretch of the river downstream from the park is an impaired waterway under section 303(d) of the Clean Water Act for recreation use due to *E. coli*

bacteria concentrations (Figure 1). For more details and current impairment information visit the Nebraska Department of Environmental Quality [website](#).

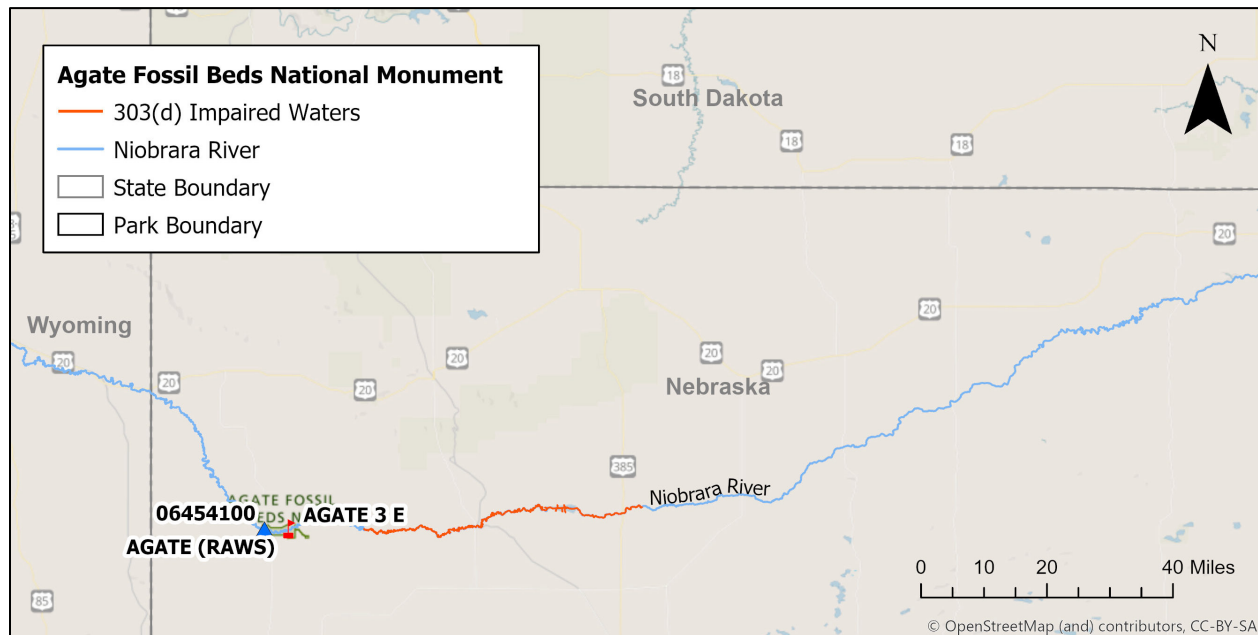


Figure 1. Map of Agate Fossil Beds National Monument and the Niobrara River in Nebraska. The stretch of the river highlighted in red is listed as impaired under 303(d) criteria for *Escherichia coli*.

The Northern Great Plains Inventory & Monitoring Network (NGPN) began monitoring water quality at AGFO in 2014 (Wilson et al. 2014) to better understand current conditions and changes over time in the Niobrara River. The monitoring is conducted at the gaging station at Agate Fossil Beds National Monument, NE (Monitoring Location 06454100; Figure 2) in collaboration with the United States Geological Survey (USGS). The objective is to determine the status and long-term trends of core water quality parameters during the ice-free season. NGPN plans to repeat water quality monitoring at AGFO every three years, and an in-depth analysis of status and trends will be conducted after 3 to 5 cycles of sampling (Wilson et al. 2014).

NGPN's core water quality parameters include streamflow, dissolved oxygen (DO), pH, specific conductivity, and water temperature (Table 1; Wilson et al. 2014). These parameters are measured every 15 minutes throughout the ice-free season (typically March to November), and results were made available in real-time on the [USGS National Water Information System Website](#).

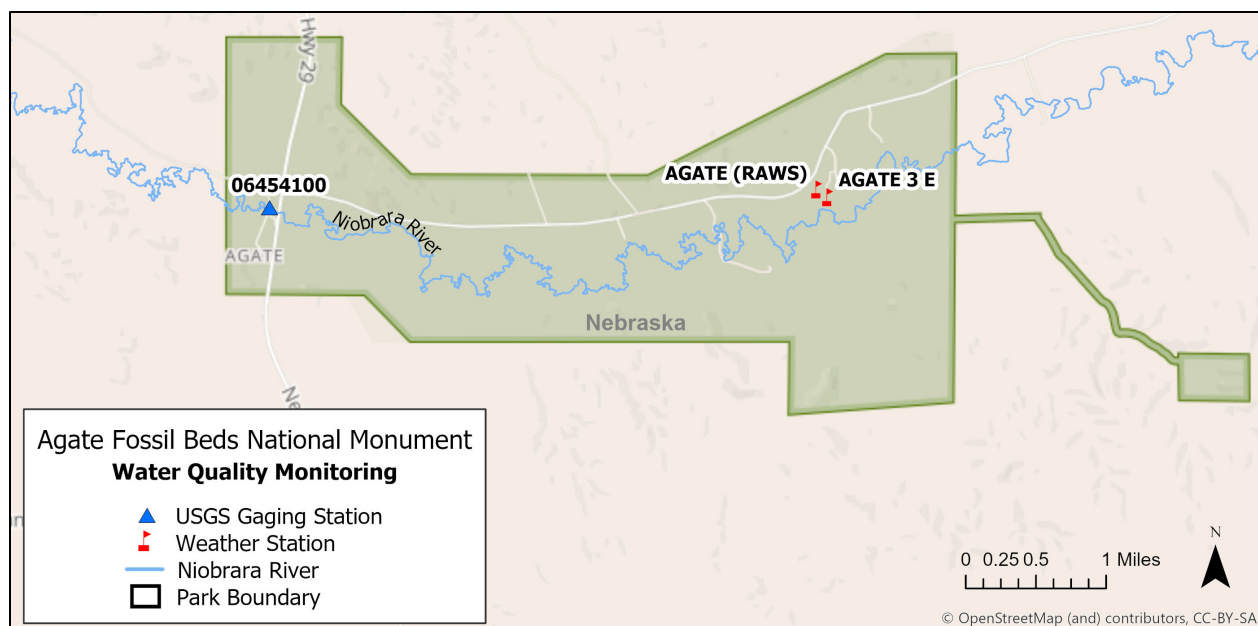


Figure 2. Map of Agate Fossil Beds National Monument and water quality monitoring location (06454100, blue triangle) and nearby weather stations (red flags). Climate data in this report is taken from the Agate 3 E weather station.

Table 1. Water quality parameters measured as part of the Northern Great Plains Inventory & Monitoring Water Quality Program and associated state standards for the Niobrara River at Agate Fossil Beds (NEE 2019).

Water Quality Parameter	Description	NE state standards applicable to cold water fisheries designations (class B)
Water temperature (°C)	Water temperature is affected by solar radiation, air temperature, rainfall, flow dynamics, stream shading, in-stream bed material and reflectance and land use/cover in the watershed.	• The temperature of a receiving water is not to be increased by a total of more than 3°C from natural background outside the mixing zone. • For cold waters, the maximum limit is 22°C
Dissolved Oxygen (mg/L)	Dissolved oxygen level is a measure of the amount of oxygen in the water column and an important indicator of a water body's ability to support aquatic life.	• One-day minimum of not less than 5.0 mg/L for coldwater fish early-life stages. This criterion applies from April 1 through June 30. • One-day minimum of not less than 4.0 mg/L for all life stages other than coldwater fish early-life stages. This criterion applies from July 1 through March 31. • Seven-day mean minimum of not less than 5.0 mg/L. This criterion applies from July 1 through March 31. • Seven-day mean of not less than 6.5 mg/L for coldwater fish early-life stages. This criterion applies from April 1 through June 30. • Thirty-day mean of not less than 6.5 mg/L. This criterion applies from July 1 through March 31.
Specific Conductance (µS/cm)	Specific conductivity is a measure of the water's ability to conduct electricity. Specific conductivity is typically proportional to the dissolved major ions in the water such as calcium, magnesium, sodium, and sulfate.	• Total dissolved solids 500 mg /L (~1000 uS)
pH	The pH of the stream is a measure of the hydrogen ion concentration in the water. Different organisms flourish within different ranges of pH.	• Maintained between 6.5 and 9.0, unless pH values outside this range are due to natural conditions

Methods

The NGPN Water Quality Monitoring Protocol (Wilson et al. 2014) sets out the methods used for sampling water quality and streamflow. The general approach is briefly described below. For more detail, please see Wilson et al. 2014 (available at <https://www.nps.gov/im/ngpn/water-quality.htm>).

Data Collection

Water quality data are collected at a real-time USGS stream gage (ID number 06454100) inside the park, at around 4405 ft. elevation. Water quality and streamflow are measured every 15 minutes throughout the ice-free season. Monitoring at AGFO began in 2014 and will be repeated every three years thereafter. Program funding currently limits monitoring to a cycle of one year of monitoring, followed by two years without.

In 2014, NGPN partnered with the USGS Wyoming-Montana Water Science Center to have USGS staff collect water quality and streamflow data at AGFO. The USGS deployed a continuous, multi-parameter sonde at the gage (Figure 3) on February 18, 2014 and visited the gaging station every 3–4 weeks for equipment maintenance. This instrument recorded dissolved oxygen, pH, specific conductivity, and water temperature every 15 minutes, while the gage simultaneously measured stream stage (or gage height, measured in feet) and discharge, a measure of streamflow.



Figure 3. A sonde device is used to measure water quality in the Niobrara River at Agate Fossil Beds National Monument. The United States Geological Survey Niobrara River gaging station (06454100) is set up for real-time data transmission via satellite. Photographs courtesy of NPS.

Satellite telemetry was used to transmit the water data to the Water Science Center in near real-time (<https://waterdata.usgs.gov/monitoring-location/06454100/>). The USGS staff reviewed the real-time data daily to verify the accurate transfer of provisional field data and to identify sensor malfunctions or erroneous data. Access to the real-time data allowed them to recognize problems such as recording equipment malfunction, sedimentation, electrical disruption, debris, or vandalism. If disruptions occurred, the USGS staff scheduled additional site visits to minimize the loss of data.

During each site visit, USGS staff conducted a site inspection and a side-by-side comparison with the in-the-water sonde and an independent field sonde (Table 2). They serviced and calibrated the sensors as needed. Calibration included pre- and post-calibration checks to quantify fouling errors and equipment drift – data critical to correction and grading of the final data. On November 17, 2014, the USGS removed the multi-parameter sonde from the Niobrara River.

Table 2. Field journal for 2014 Water Quality Sampling at Agate Fossil Beds National Monument.

Date	Notes
February 18, 2014	Initial installation of YSI 6920 monitor, at about 1:00 pm.
March 13, 2014	Routine monitor fouling check. Water deep and has been over road just downstream of gage. Cross-section measurements taken on downstream side of culvert.
April 3, 2014	Routine monitor fouling check. Minor silting on sonde. Calibrations for Specific Conductance and pH sensors. DO sensor calibrations not needed.
April 24, 2014	Routine monitor fouling check. Recalibrated DO sensor. Cross-section survey done 15ft upstream of monitor.
May 15, 2014	Monitor fouling check – minor to moderate silt on the sonde. Recalibrated DO sensor. Cross-section survey done 10 ft upstream of monitor.
June 6, 2014	Routine visit. Slight algae growth on stream channel bottom. Cleaned monitor and recalibrated DO sensor. Cross-section survey done 10 ft upstream of monitor.
June 24, 2014	Routine visit. Reeds growing along stream channel edges but remains fairly clean. Minor debris on sonde cleaned; no recalibration of sensors needed. Cross-section survey done 10 ft upstream of monitor.
July 15, 2014	Routine visit. Stream channel has silting and some algae growing. Cleaned monitor and recalibrated pH sensor. Also replaced wiper and recalibrated DO sensor. Cross-section survey done 18 ft upstream of monitor.
August 6, 2014	Routine visit. Stream channel was clear, visible sandy bottom. Cleaned monitor; no sensors needed recalibration. Cross-section survey done 10 ft upstream of monitor.
August 28, 2014	Routine visit. Stream channel clear, bottom sand and gravel. Light rainy day, and computer would not communicate with monitor sonde so only cleaned this visit and unable to calibrate. Cross-section survey done 15 ft upstream of monitor.
September 22, 2014	Routine visit. Stream channel bottom silty. Monitor cleaned of minor silting. No sonde recalibrations needed. Cross-section survey done 15 ft upstream of monitor.
October 20, 2014	Routine visit. Stream channel bottom silty. Monitor cleaned, and DO sensor recalibrated. Cross-section survey done 15 ft upstream of monitor.
November 17, 2014	Removed equipment at ~12:30pm. Ice had begun to form, and sonde was frozen in the pipe. All final calibration checks were done in the office. Cross-section survey done 15 ft upstream of monitor.

Quality assurance and quality control was conducted by USGS staff following established USGS guidelines (Wagner et al. 2006). NGPN received the final corrected (approved) data in February of 2015 from the USGS, and used AQUARIUS Workstation by Aquatic Informatics (<http://aquaticinformatics.com/>) and R (R Core Team 2019) to store and analyze water data. Water year reports are provided by USGS and the text can be found in Appendix A. Figures were generated in R and daily mean values were calculated from 15-minute interval data. In the case where there were missing data due to instrument error, means were generated by excluding the missing values and the maximum and minimum were left blank. Means were not calculated for days where all time steps were missing (i.e. the instrument didn't collect any data that day). We calculated the proportion of records that exceeded Nebraska environmental regulatory thresholds (Table 1).

Climate data were downloaded from the Agate 3 E (250030) National Weather Service Cooperator Observer Program station. The data were accessed and graphed using the web-based tool [Climate Analyzer](#).

Results

The water quality monitoring season (ice-free) on the Niobrara River at AGFO lasted from February 18 to November 17, 2014. Discharge was measured from mid-April to December, showing a steady drop throughout the monitoring season, with late season spikes (Figure 4). According to the USGS Water-Year Summary for 2014 (Appendix A), maximum recorded gage height occurred on March 7 at a height of 10.47 ft. Spikes in discharge and gage height may correlate to temperature and precipitation patterns, with February and September both at least 300% of the average precipitation and a fast warm-up from February to March, when compared to the 30-year period from 1981-2010 (Figure 5).

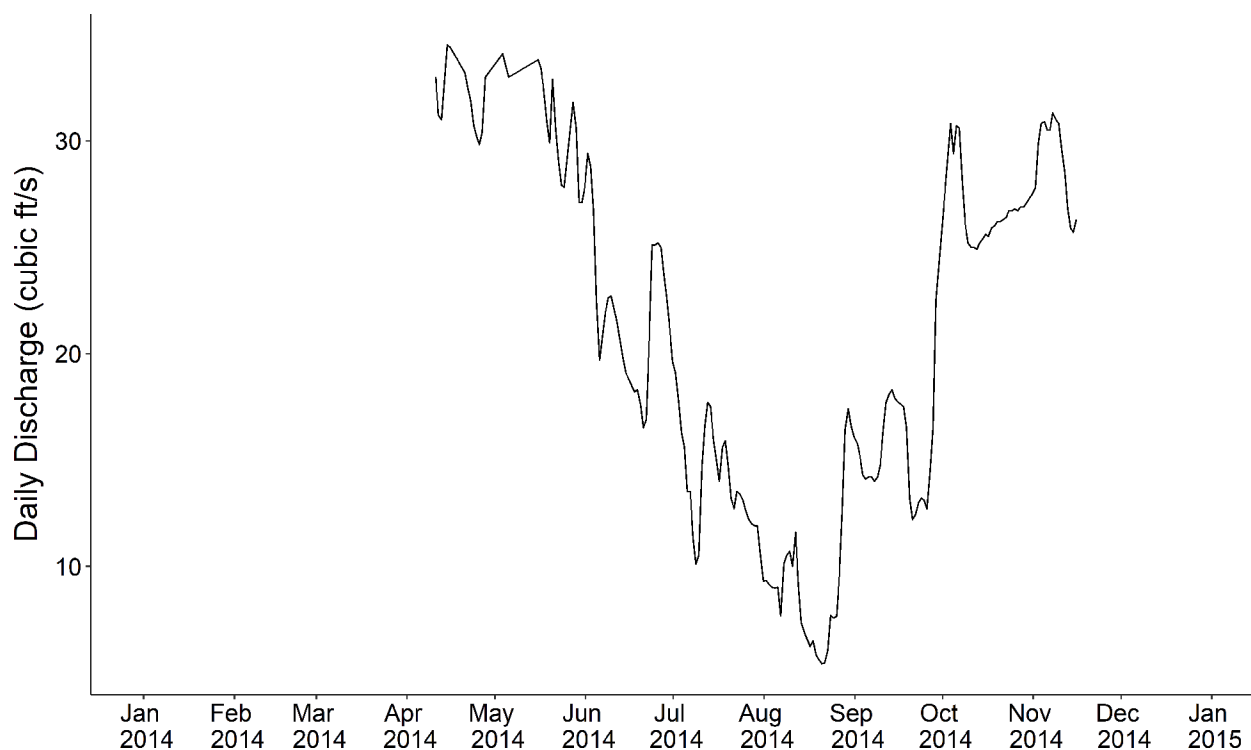


Figure 4. Daily mean gage height (black line) on the Niobrara River at Agate Fossil Beds National Monument from February 18 to November 17, 2014, at USGS Gaging Station 06454100.

Figure 5. Total monthly precipitation (light blue bars) and average monthly minimum (green) and maximum (blue) temperature for the 2014 calendar year in Agate Fossil Beds National Monument (top panel). Monthly departures from 1981-2010 average temperature and precipitation for the 2014 calendar year in Agate Fossil Beds National Monument (bottom panel). Climate data are from the Agate 3 E weather station (250030). The data were accessed and graphed using the web-based tool [Climate Analyzer](#).

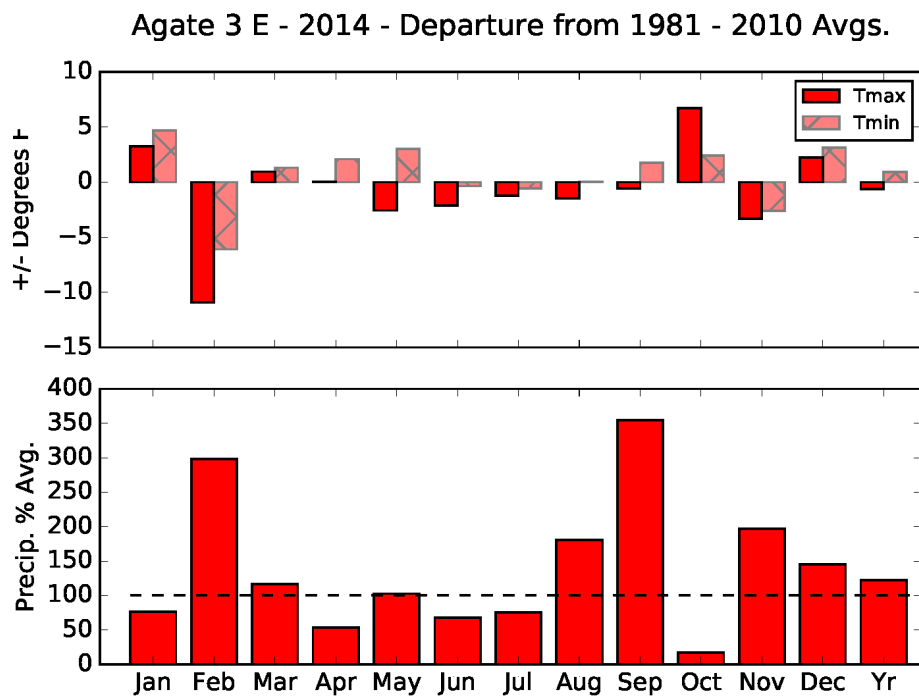
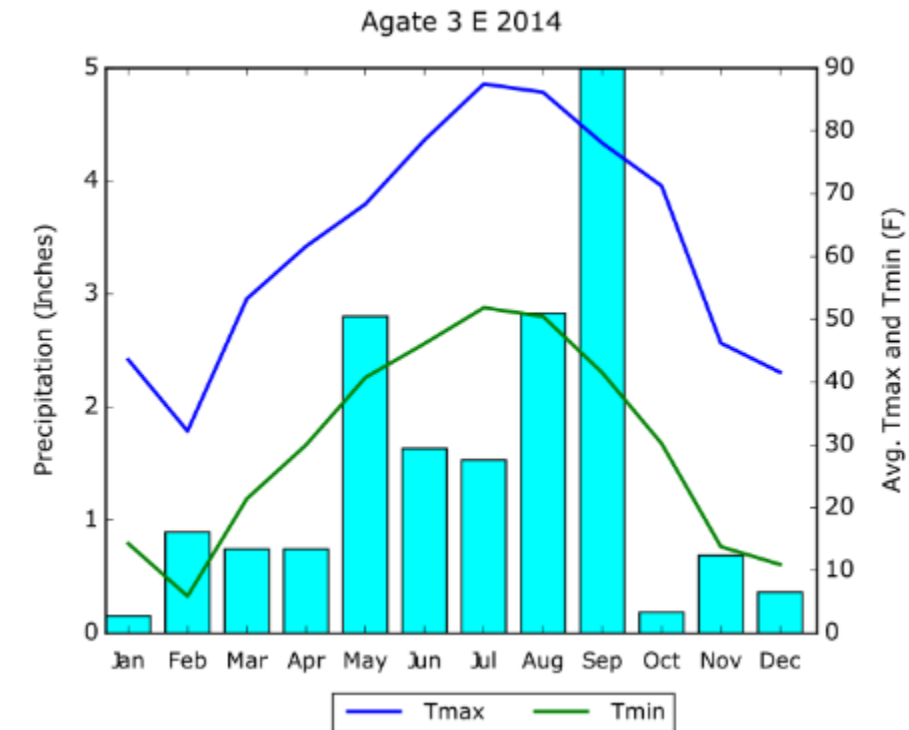


Figure 5. Total monthly precipitation (light blue bars) and average monthly minimum (green) and maximum (blue) temperature for the 2014 calendar year in Agate Fossil Beds National Monument (top panel). Monthly departures from 1981-2010 average temperature and precipitation for the 2014 calendar year in Agate Fossil Beds National Monument (bottom panel). Climate data are from the Agate 3 E weather station (250030). The data were accessed and graphed using the web-based tool [Climate Analyzer](#).

During the ice-free season at AGFO, we collected over 20,000 water quality measurements in the Niobrara River (Table 3, Figure 6). We found mean water temperature of 12.56°C, dissolved oxygen concentrations of 6.83 mg/L, specific conductance of 420.24 µS/cm, and pH of 7.85 (Table 3). There was, however, variation across months in all parameters (Table 4). Mean water temperatures for the summer months of June, July, and August were around 18-20°C (Table 4). Maximum temperature exceeded the Nebraska water quality standard of 22°C (Table 1) from May through August 2014, with the highest exceedance occurring in May with 25.2°C (Table 4). Overall, only 4.54% of the recorded temperatures were above the state threshold for cold water fisheries (Table 3).

Table 3. Summary of descriptive statistics for water temperature, dissolved oxygen, specific conductance, and pH measured for the ice-free sampling period on the Niobrara River at Agate Fossil Beds National Monument from February 18 to November 17, 2014, at USGS Gaging Station 06454100. Percent exceedance is the proportion of samples that exceed the respective state regulatory threshold described in Table 1 (water temperature max. limit is 22.0°C; dissolved oxygen $\geq$ 5.0 mg/L; pH range is 6.5–9.0; and specific conductance thresholds and exceedances are not reported).

Descriptive Statistic	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Specific Conductance (µS/cm)	pH
Number of Measurements	26111	26107	25847	25344
Mean	12.56	6.83	420.24	7.85
Standard Deviation	6.78	2.74	45.60	0.33
Median	13.6	6.80	430.00	7.90
Minimum	0.00	0.60	149.00	6.40
Maximum	25.20	13.00	512.00	8.60
Number of Points below or above standard	1186 (above)	4771 (below)	–	31 (below)
% Exceedance	4.54%	18.27%	–	0.12%

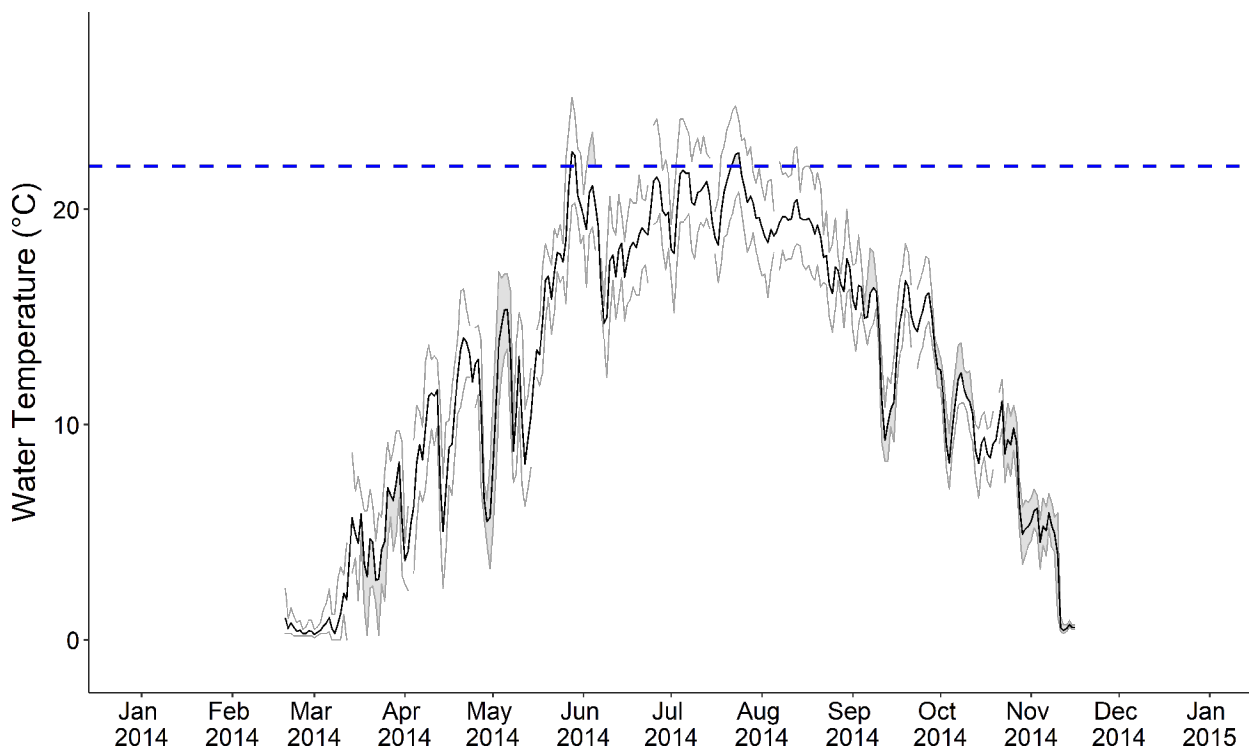


Figure 6. Daily mean water temperature (black line) collected on the Niobrara River at Agate Fossil Beds National Monument from February 18 to November 17, 2014, at USGS Gaging Station 06454100. The gray ribbon shows the daily maximum and minimum water temperature for the same period. The dashed blue line indicates one of the Nebraska state water quality standards (see Table 1 for more details). The periods where the instrument did not collect data are indicated by gaps in the record.

Dissolved oxygen displayed seasonal variation (Table 4, Figure 7), with higher concentrations typically recorded in colder months. Mean dissolved oxygen concentrations dropped below the state threshold in June and July. Atypical of colder months, February through April showed minimum dissolved oxygen concentrations below the ≥ 5.0 mg/L threshold, with a minimum concentration of 0.6 mg/L in March (Figure 8). However, the mean concentrations remained above the state threshold in the cold months.

Specific conductance of the Niobrara River stayed roughly between 400 and 500 $\mu\text{S}/\text{cm}$ (Table 3, Figure 8), with one notable drop to a minimum of 149 $\mu\text{S}/\text{cm}$ in March. The pH of the Niobrara River remained within the state threshold of 6.5-9.0, with an annual mean of 7.85 (Table 3). There was some seasonal variability, particularly in the spring and fall months. The pH dipped below the state threshold 0.12% of the monitoring period, occurring in November (Figure 9, Table 4).

Table 4. Monthly summary of descriptive statistics and percent exceedances for core water quality parameters for the ice-free sampling period on the Niobrara River at Agate Fossil Beds National Monument from February 18 to November 17, 2014, at USGS Gaging Station 06454100. Percent exceedance is the proportion of samples that exceed the respective state regulatory threshold described in Table 1 (water temperature max. limit is 22.0°C; dissolved oxygen $\geq$ 5.0 mg/L; pH range is 6.5–9.0; and specific conductance thresholds and exceedances are not reported).

Dates	Descriptive Statistic	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)	pH
February 18-28, 2014	Number of measurements	960	960	960	960
	Mean	0.52	5.72	392.20	7.72
	Standard Deviation	0.39	2.09	21.95	0.10
	Median	0.40	5.70	391.00	7.70
	Minimum	0.20	1.70	352.00	7.60
	Maximum	2.40	9.60	433.00	7.90
	% Exceedance	0.00%	43.23%	–	0.00%
March 2014	Number of measurements	2970	2970	2969	2970
	Mean	3.45	8.68	335.61	8.07
	Standard Deviation	2.76	2.94	80.89	0.30
	Median	3.00	9.50	357.00	8.10
	Minimum	0.00	0.60	149.00	7.50
	Maximum	9.70	130	440.00	8.60
	% Exceedance	0.00%	12.63%	–	0.00%
April 2014	Number of measurements	2876	2875	2875	2875
	Mean	9.41	8.64	406.46	8.15
	Standard Deviation	3.45	2.35	20.06	0.22
	Median	9.80	8.80	402.00	8.20

Table 4 (continued). Monthly summary of descriptive statistics and percent exceedances for core water quality parameters for the ice-free sampling period on the Niobrara River at Agate Fossil Beds National Monument from February 18 to November 17, 2014, at USGS Gaging Station 06454100. Percent exceedance is the proportion of samples that exceed the respective state regulatory threshold described in Table 1 (water temperature max. limit is 22.0°C; dissolved oxygen $\geq$ 5.0 mg/L; pH range is 6.5–9.0; and specific conductance thresholds and exceedances are not reported).

Dates	Descriptive Statistic	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)	pH
April 2014 (continued)	Minimum	2.30	3.80	371.00	7.70
	Maximum	16.30	12.90	461.00	8.60
	% Exceedance	0.00%	0.87%	–	0.00%
May 2014	Number of measurements	2971	2970	2970	2971
	Mean	14.87	5.58	444.96	7.88
	Standard Deviation	4.44	2.56	14.49	0.20
	Median	14.9	5.30	445.00	7.80
	Minimum	5.10	1.30	415.00	7.60
	Maximum	25.20	11.70	483.00	8.40
	% Exceedance	6.36%	32.42%	–	0.00%
June 2014	Number of measurements	2875	2878	2849	2877
	Mean	18.78	3.33	444.08	7.71
	Standard Deviation	2.23	1.31	7.52	0.08
	Median	18.90	3.00	443.00	7.70
	Minimum	12.20	1.40	431.00	7.60
	Maximum	24.20	7.30	464.00	7.90
	% Exceedance	6.57%	70.95%	–	0.00%

Table 4 (continued). Monthly summary of descriptive statistics and percent exceedances for core water quality parameters for the ice-free sampling period on the Niobrara River at Agate Fossil Beds National Monument from February 18 to November 17, 2014, at USGS Gaging Station 06454100. Percent exceedance is the proportion of samples that exceed the respective state regulatory threshold described in Table 1 (water temperature max. limit is 22.0°C; dissolved oxygen $\geq$ 5.0 mg/L; pH range is 6.5–9.0; and specific conductance thresholds and exceedances are not reported).

Dates	Descriptive Statistic	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)	pH
July 2014	Number of measurements	2973	2972	2957	2972
	Mean	20.60	4.79	432.38	7.82
	Standard Deviation	1.89	1.35	7.48	0.11
	Median	20.50	4.50	432.00	7.80
	Minimum	15.20	2.70	415.00	7.60
	Maximum	24.80	8.10	459.00	8.10
	% Exceedance	25.50%	36.78%	–	0.00%
August 2014	Number of measurements	2975	2975	2870	2975
	Mean	18.59	5.78	431.07	7.87
	Standard Deviation	1.78	0.84	19.50	0.10
	Median	18.40	5.70	423.00	7.80
	Minimum	14.30	3.90	406.00	7.70
	Maximum	22.90	8.00	512.00	8.20
	% Exceedance	1.68%	1.01%	–	0.00%
September 2014	Number of measurements	2877	2873	2763	2878
	Mean	14.430	7.30	433.30	7.97
	Standard Deviation	2.30	0.93	6.96	0.09
	Median	14.80	7.10	432.00	8.00

Table 4 (continued). Monthly summary of descriptive statistics and percent exceedances for core water quality parameters for the ice-free sampling period on the Niobrara River at Agate Fossil Beds National Monument from February 18 to November 17, 2014, at USGS Gaging Station 06454100. Percent exceedance is the proportion of samples that exceed the respective state regulatory threshold described in Table 1 (water temperature max. limit is 22.0°C; dissolved oxygen $\geq$ 5.0 mg/L; pH range is 6.5–9.0; and specific conductance thresholds and exceedances are not reported).

Dates	Descriptive Statistic	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)	pH
September 2014	Minimum	8.30	5.80	413.00	7.80
	Maximum	18.80	9.90	467.00	8.20
	% Exceedance	0.00%	0.00%	–	0.00%
October 2014	Number of measurements	2974	2974	2974	2206
	Mean	9.38	8.94	430.45	7.97
	Standard Deviation	2.13	1.18	12.54	0.16
	Median	9.50	8.90	427.00	8.00
	Minimum	3.50	6.00	415.00	7.20
	Maximum	13.80	11.90	470.00	8.20
	% Exceedance	0.00%	0.00%	–	0.00%
November 1-17, 2014	Number of measurements	1660	1660	1660	1660
	Mean	3.69	10.31	446.21	6.91
	Standard Deviation	2.41	1.14	28.95	0.23
	Median	4.70	10.20	433.00	6.90
	Minimum	0.30	6.70	415.00	6.40
	Maximum	7.00	12.70	512.00	7.50
	% Exceedance	0.00%	0.00%	–	0.00%

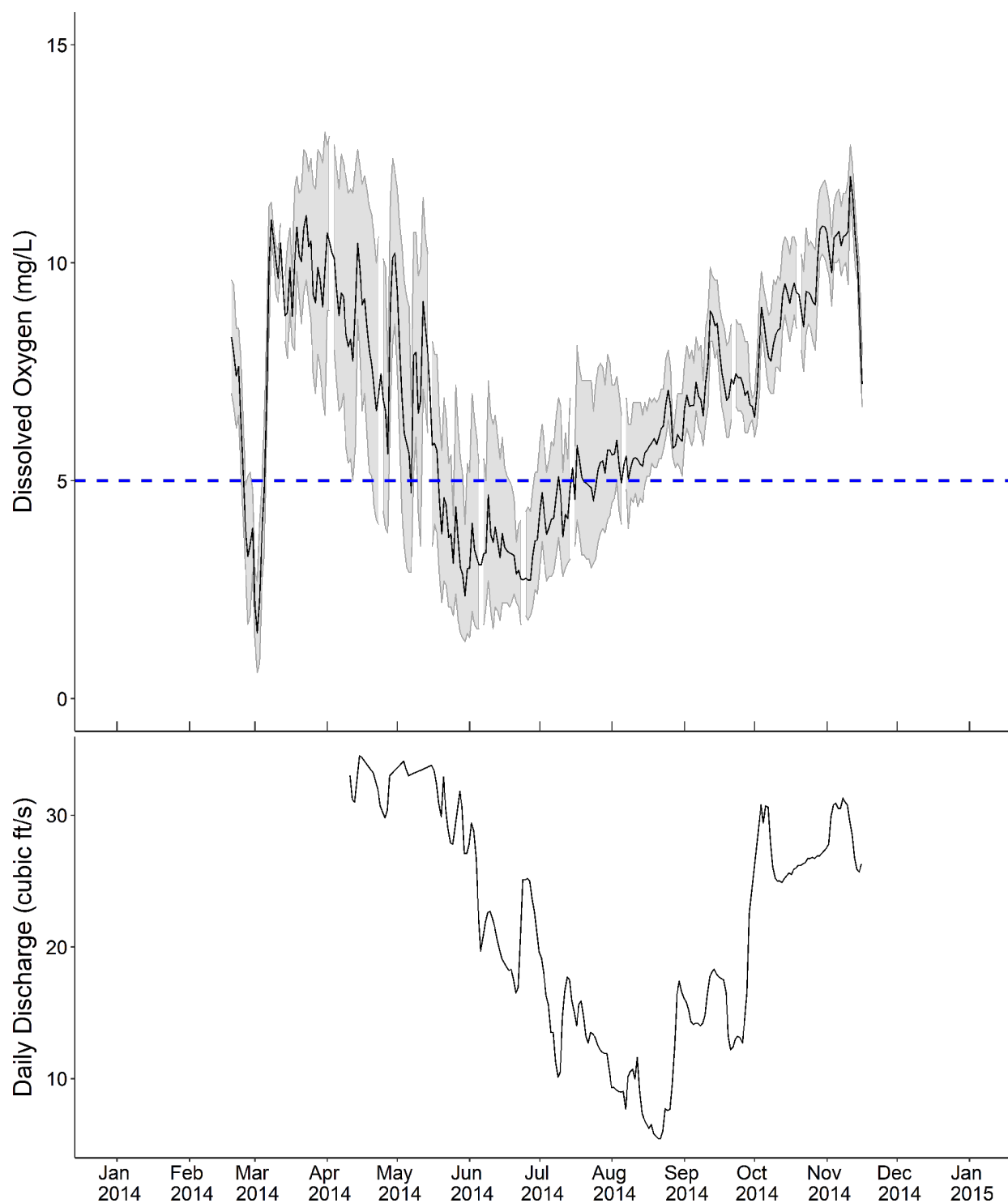


Figure 7. Daily mean dissolved oxygen concentrations (black line; top graph) and daily discharge (bottom) of the Niobrara River at Agate Fossil Beds National Monument from February 18 to November 17, 2014, at USGS Gaging Station 06454100. The gray ribbon shows the daily maximum and minimum dissolved oxygen for the same period. The dashed blue line indicates one of the Nebraska state water quality standards (see Table 1 for more details). The periods where the instrument did not collect data are indicated by gaps in the record.

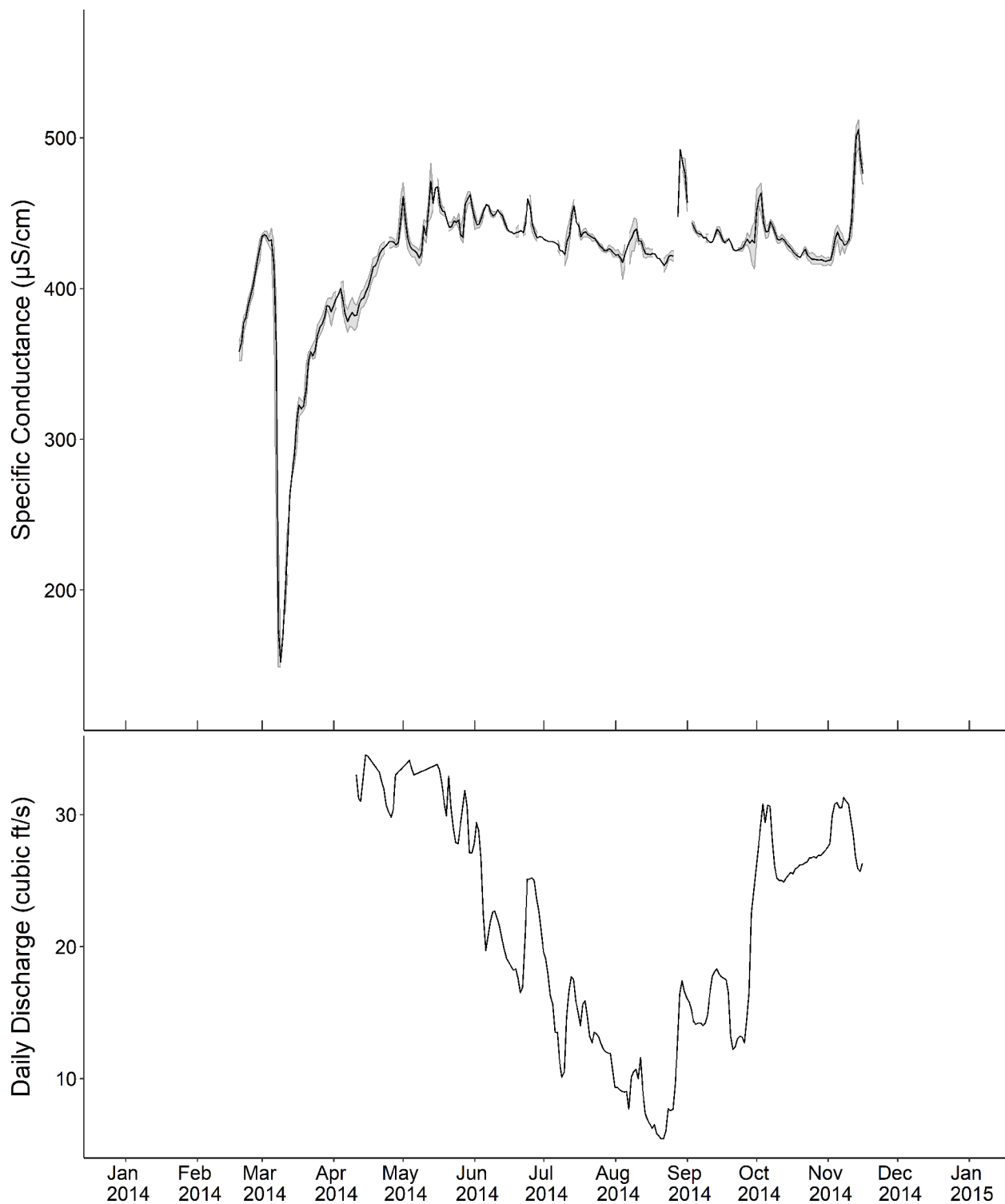


Figure 8. Daily mean specific conductance (top) and daily discharge (bottom) of the Niobrara River at Agate Fossil Beds National Monument from February 18 to November 17, 2014, at USGS Gaging Station 06454100. The gray ribbon shows the daily maximum and minimum specific conductivity for the same period. The periods where the instrument did not collect data are indicated by gaps in the record.

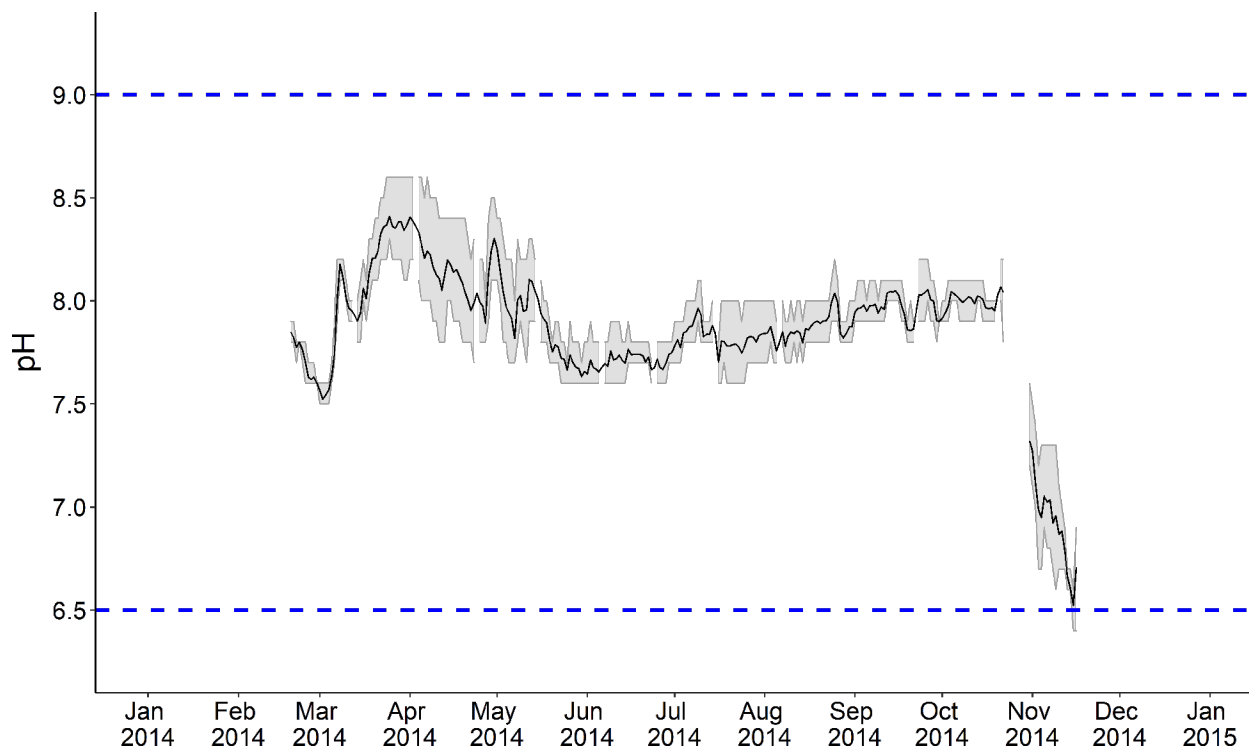


Figure 9. Daily mean pH (black line) of the Niobrara River at Agate Fossil Beds National Monument from February 18 to November 17, 2014, at USGS Gaging Station 06454100. The gray ribbon shows the daily maximum and minimum pH for the same period. The dashed blue lines indicate the Nebraska state water quality standards (see Table 1 for more details). The periods where the instrument did not collect data are indicated by gaps in the record.

Further Analysis

This Data Report is intended to provide a basic review of the data collected during the 2014 water quality monitoring season at Agate Fossil Beds National Monument. All data included in this report is available upon request from the Northern Great Plains Inventory and Monitoring Network, as well as in the archives found on the USGS National Water Information System for site 06454100.

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Appendix A. USGS Water Data Quality Report for Niobrara River 06454100, 2014

06454100 NIOBRARA RIVER AT AGATE, NEBR.

LOCATION—Lat 42°25'25", long 103°47'32" referenced to North American Datum of 1983, Sioux County, NE, Hydrologic Unit 10150002, on the right bank, 19 miles southeast of Harrison, Nebraska.

SURFACE-WATER RECORDS

PERIOD OF RECORD—October 1958 to September 1991, February 18 to November 17, 2014 (discontinued).

GAGE—Water-stage recorder. Elevation of gage is 4,405 ft above sea level, from topographic map. U.S. Geological Survey data collection platform with satellite telemetry at station.

REMARKS—Records excellent.

EXTREMES FOR PERIOD OF RECORD—Maximum discharge, 181 ft³/s, June 23, 1959, gage height, 5.00 ft; maximum recorded gage height, 10.47 ft, March 7, 2014, discharge not determined.

WATER-QUALITY RECORDS

PERIOD OF DAILY RECORD—February 18, 2014 to November 17, 2014 (discontinued).

REMARKS—Specific conductance records are excellent except those for March 8-13, 18-30, and April 10-24, which are good; and March 31 to April 3, which are fair. pH records are excellent except those for July 6-15, which are good. Water temperature records are excellent. Water-temperature records represent water temperature at sensor within 0.2°C. Dissolved oxygen records are excellent except those for April 15-20, May 6-15, May 31 to June 6, July 9-15, July 31 to August 6, and October 12, 16-20, which are good; February 18, Mar. 8-13, April 21-24, which are fair; and February 19 to Mar. 7, which are poor. Maximum and minimum recorded values in the EXTREMES paragraphs may have occurred during days of partial record and may not appear in the daily values tables.

EXTREMES FOR PERIOD OF DAILY RECORD—SPECIFIC CONDUCTANCE: Maximum recorded, 512 uS/cm, August 29, November 14, 2014; minimum recorded, 149 uS/cm, March 8, 9, 2014. pH: Maximum recorded, 8.6 units, March 24, 2014; minimum recorded, 6.4 units, November 15, 16, 2014. WATER TEMPERATURE: Maximum recorded, 25.2°C, May 28, 2014; minimum recorded 0.0°C, March 7-10, 12, 2014. DISSOLVED OXYGEN: Maximum recorded, 13.0 mg/L, March 31, 2014; minimum recorded, 0.6 mg/L, March 2, 2014.

For this water year report and more information about specific water quality parameters, visit the archives found on the USGS National Water Information System for site 06454100.

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NPS 165/173820, November 2020

National Park Service
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