



Greater Yellowstone Network Climate

2012 Data Summary Report

Natural Resource Data Series NPS/GRYN/NRDS—2013/534



ON THE COVER

Lingering snow pack near Arrastra Creek on the Gallatin National Forest
Photograph by: National Park Service

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

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

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

Data in this report were collected and analyzed using methods based on an established, peer-reviewed protocol and were analyzed and interpreted within the guidelines of the protocol. This report received formal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data, and whose background and expertise put them on par technically and scientifically with the authors of the information.

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Contents

	Page
Figures.....	iv
Tables.....	v
List of Acronyms	vii
Background and Methods	1
Source and Availability of Provider Data	1
Quality Control of Provider Data	2
Averages Used for Statistical Comparisons	3
Data Analysis Methods and Criteria.....	3
Grand Teton and Yellowstone National Parks and John D. Rockefeller, Jr. Memorial Parkway, 2012 Year-End Climate Summary.....	5
Literature Cited	9
Appendix A: Weather Stations Summarized in 2012	10
Appendix B. Climate Summary Tables for the Greater Yellowstone Network Parks.....	13
Appendix C. Departure of 2012 Temperature and Precipitation from Average	25
Appendix D. Mean Daily Discharge Compared to Average	28
Appendix E. Daily Measurements of Snowpack and Precipitation Compared to Average.....	30

Figures

Page

Figure 1. Missing days in the climate record at the Moose and Moran COOP stations in 2012 preclude the ability to compute reliable monthly and annual statistics. The red bar shows accumulated precipitation, N/A indicates missing data.	3
Figure 2. Quality control procedures in 2012 discovered what looks like missing data but are instead due to the observer leaving the field blank, rather than entering a zero, to indicate no precipitation. The chart on the left shows the precipitation values based on the original data whereas the chart on the right shows the actual total precipitation after the data file was corrected.	3
Figure 3. Monthly precipitation and average daily maximum temperature (Tmax) and average daily minimum temperatures (Tmin) during 2012 at key stations in and near Yellowstone and Grand Teton national parks.....	6
Figure 4. Monthly precipitation, average daily maximum temperature (Tmax), and average daily minimum temperatures (Tmin) during 2012 at key stations in and near Bighorn Canyon National Recreation Area.	8
Figure C2. Departure of 2012 average minimum and average maximum daily temperatures and precipitation from 1981-2010 average at key climate stations in and near Bighorn Canyon National Recreation Area. Missing bars (NA) indicate months in which there were insufficient data to calculate a total.	27
Figure D1. Mean daily discharge from USGS gauging stations on the Snake River at Moose and Flagg Ranch, and the Yellowstone River at Corwin Springs.....	28
Figure D2. Mean daily discharge from the USGS gauging stations on the Bighorn River at St. Xavier and Kane, and on the Shoshone River near Lovell. Values are compared to averages from the 1981-2010 period.	29
Figure E1. Daily measurements of snow water equivalent (SWE) and precipitation in and near Yellowstone National Park in 2012. Values are compared to averages from both the 1971-2000 and 1981-2010 periods.....	30
Figure E2. Daily measurements of snow water equivalent (SWE) and precipitation in and near Grand Teton National Park in 2012. Values are compared to averages from both the 1971-2000 and 1981–2010 periods.....	31
Figure E3. Daily measurements of snow water equivalent (SWE) and precipitation near Bighorn Canyon National Recreation Area in 2012. Values are compared to averages from both the 1971-2000 and 1981-2010 periods.....	33

Tables

	Page
Table 1. National and state climate monitoring programs used in the 2012 climate report.....	1
Table 2. End-of-year climate summaries from four Cooperative Observer Network climate stations during 2012. Average annual temperature and total precipitation rank is based on past 50 years from 1962-2012.....	5
Table 3. End-of-year climate summaries from four Cooperative Observer Network climate stations during 2012. Average annual temperature and total precipitation rank is based on past 50 years from 1962-2012.....	7
Table A1. National Weather Service Cooperative Observer Program (COOP) stations used in the 2012 Climate Data Summary Report.....	10
Table A2. Natural Resources Conservation Service Snowpack Telemetry (SNOTEL) stations and historic baseline period used to determine average condition in this report.	11
Table A3. USGS stream gauging stations and baseline period used to determine mean daily discharge.	12
Table B1. Total monthly precipitation in inches and percent of average monthly precipitation compared to 1981-2010 averages for select climate stations in or near Yellowstone and Grand Teton National Parks and John D. Rockefeller, Jr. Memorial Parkway during 2012.	13
Table B2. Average daily maximum temperatures (degrees Fahrenheit) and departure from the 1981-2010 average (\pm degrees Fahrenheit) in or near Grand Teton and Yellowstone National Parks and John D. Rockefeller, Jr. Memorial Parkway in 2012.	15
Table B3. Average minimum daily temperatures (degrees Fahrenheit) and departure from the 1981-2010 average (\pm degrees Fahrenheit) in or near Grand Teton and Yellowstone National Parks and John D. Rockefeller, Jr. Memorial Parkway.....	17
Table B4. First and last freeze and frost dates, spring and fall onset dates, accumulated growing degree days, and days above or below critical temperature thresholds for key stations in or near Grand Teton and Yellowstone national parks and John D. Rockefeller, Jr. Memorial Parkway during 2012. Values for 2012 are shown in the first line for each station and averages on the second line. Averages are published by the Western Region Climate Center in General Climate Summary Tables. Note that the reference period may differ from 1981-2010.....	19
Table B5. Total monthly precipitation in inches and percent of average monthly precipitation versus 1981-2010 averages for select climate stations in or near Bighorn Canyon National Recreation Area during 2012.....	21

Tables (continued)

	Page
Table B6. Average maximum daily temperatures (degrees Fahrenheit) and departure from 1981-2010 averages (\pm degrees Fahrenheit) for select climate stations in or near Bighorn Canyon National Recreation Area during 2012.....	22
Table B7. Average minimum daily temperatures (degrees Fahrenheit) and departure from 1981-2010 averages (\pm degrees Fahrenheit) for select climate stations in or near Bighorn Canyon National Recreation Area during 2012.....	23
Table B8. First and last freeze and frost dates, spring and fall onset dates, accumulated growing degree days, and days above or below critical temperature thresholds for key stations in or near Bighorn Canyon National Recreation Area during 2012. Averages are published by the Western Regional Climate Center. Note that the reference period may differ from 1981-2010.....	24

List of Acronyms

AGDD	Accumulated Growing Degree Days
BICA	Bighorn Canyon National Recreation Area
COOP	Cooperative Observer Program
GHCN	Global Historical Climatic Network
GRTE	Grand Teton National Park
JODR	John D. Rockefeller, Jr. Memorial Parkway
NCDC	National Climatic Data Center
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
SNOTEL	Snowpack Telemetry
SWE	Snow Water Equivalent
USGS	U.S. Geological Survey
WRCC	Western Region Climate Center
YELL	Yellowstone National Park

Background and Methods

This end-of-year climate summary for 2012 describes five key climate metrics: precipitation, temperature, snowpack, drought, and streamflow in four national park units including Yellowstone National Park, Grand Teton National Park, John D. Rockefeller, Jr. Memorial Parkway, and Bighorn Canyon National Recreation Area. The condition of park natural resources is linked, directly and indirectly, to the climate of a region, and consequently is of interest to park managers. The monitoring objectives for climate in these parks are described in the *Rocky Mountain Climate Protocol* (RMCWG 2010). These objectives, as they relate to annual status reports, are to determine the following:

- Minimum, maximum, and mean monthly temperatures, and departures from “normal” or average
- Number of growing degree days per year, timing of first and last frosts, number of frost-free days per year, and number of days per year above or below critical temperature thresholds
- Total accumulated precipitation and departures from average
- Frequency and duration of drought based on established thresholds
- Amount and timing of peak snowpack measured as snow water equivalent (SWE)
- Number of days with snow cover and timing of snowmelt
- Timing and intensity of peak and average streamflow and departures from average and other seasonal shifts in stream hydrographs.

Source and Availability of Provider Data

Data covering the 2012 calendar and water year (October 2011-September 2012) were obtained from national meteorological and surface water monitoring programs listed below in Table 1 through a variety of online sources. The climate stations from each data source, including the name, station ID, park, and location are further described in Tables A1-A3 in Appendix A.

Table 1. National and state climate monitoring programs used in the 2012 climate report.

Program	Measures and Metrics of Interest	Spatial Scale	Temporal Scale
National Weather Service Cooperative Observer Program	Temperature, precipitation	Local stations	Daily
U.S. Department of Agriculture Natural Resource Conservation Service Snowpack Telemetry	Precipitation, SWE	Local stations	Daily
U.S. Geological Survey Stream Gauging Network	Streamflow	Local stations	Daily
U.S. Drought Monitor	Drought	National, State, Region	Weekly

Note: SWE=snow water equivalent.

Daily precipitation and temperature data from the Cooperative Observer Program (COOP) came directly from the National Climate Data Center (NCDC). Daily snowpack and precipitation from the Natural Resource Conservation Service (NRCS) Snowpack Telemetry (SNOTEL) stations and daily discharge data from U.S. Geological Survey (USGS) gage stations were obtained through a Climate Web Interface (www.ClimateAnalyzer.org) The U.S. Drought Monitor (<http://droughtmonitor.unl.edu/>) was used to determine drought conditions.

Summaries of annual average daily temperature and annual total precipitation published by the Western Regional Climate Center (<http://www.wrcc.dri.edu/>; accessed 8 April 2013) were used to determine how 2012 ranked over the past 50 years. Temperature is ranked warmest to coldest and precipitation is ranked driest to wettest.

Quality Control of Provider Data

Much of the data quality control is completed by the provider before it is available to the public for download. Basic quality control by the NCDC, NRCS, and USGS prevents obvious errors and provides flags for known issues with the data.

We conducted additional quality control investigations to evaluate missing data and resolve data quality flags in GHCN COOP records. The Climate Data Screener and Summarizer version 4.4 (Tercek 2012) was used to generate a series of diagnostic plots that allow the user to visually inspect data for outliers and logical inconsistencies. Data flags alerted us to accumulated precipitation values at the Driggs, Idaho COOP station, which if ignored or dismissed, would under report annual totals by more than three inches, or 20 percent of the average total precipitation.

Missing data are handled through quality control to determine whether enough data of sufficient quality are available by month and by year to reliably compute summary statistics. If more than three days of precipitation data are missing for a particular month, then a monthly total is not calculated and the entire month is reported “missing.” If more than five days of daily maximum temperature (Tmax) or daily minimum temperature (Tmin) are missing then monthly average temperatures are not calculated or reported. Missing data at Moose and Moran in 2012 prevent us from making reliable monthly and annual summaries as illustrated in Figure 1.

Our quality control procedures discovered what looks like missing data at Yellowtail Dam (station ID 249240), but are instead due to the COOP observer leaving the precipitation field blank, rather than entering a zero, to indicate no precipitation. The blank field is interpreted as missing data in our analysis, so we corrected the data file for Yellowtail Dam to change the missing value to a zero precipitation value before analysis (Figure 2).

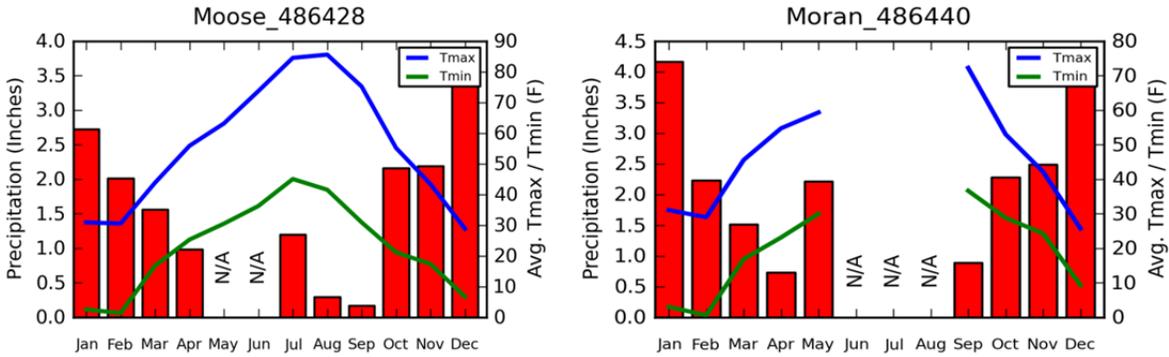


Figure 1. Missing days in the climate record at the Moose and Moran COOP stations in 2012 preclude the ability to compute reliable monthly and annual statistics. The red bar shows accumulated precipitation, N/A indicates missing data.

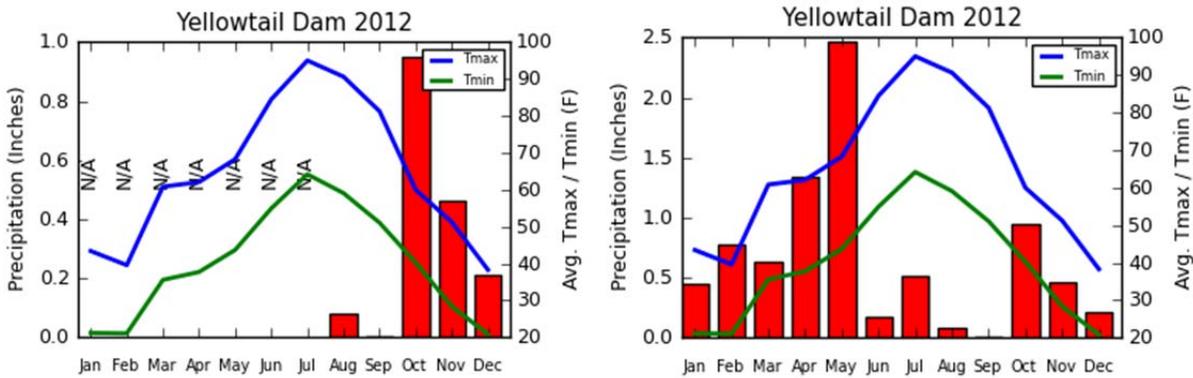


Figure 2. Quality control procedures in 2012 discovered what looks like missing data but are instead due to the observer leaving the field blank, rather than entering a zero, to indicate no precipitation. The chart on the left shows the precipitation values based on the original data whereas the chart on the right shows the actual total precipitation after the data file was corrected.

Averages Used for Statistical Comparisons

In reporting climate conditions, meteorologists and climatologists regularly use normals for placing recent climate conditions into a historical context (NOAA 2012). In this report we mainly use the World Meteorological Organization’s suggested climate normals (“averages”) from the latest three decades, the 1981-2010 period, that are published by the NCDC, NRCS, and the Western Regional Climate Center. In other cases, we have specified the normal period used for statistical comparisons.

Data Analysis Methods and Criteria

Summary analyses for this report was completed using the *Climate Data Screener and Summarizer version 4.4* (Tercek 2012) and the Climate Web Interface (Tercek 2013; www.ClimateAnalyzer.org), both of which were designed to automate the production of annual climate status reports using criteria from Kittel et al. (2010) and the *Rocky Mountain Climate Protocol* (RMCWG 2010).

Monthly and annual precipitation totals were calculated from daily COOP and SNOTEL station data, while average monthly and average annual minimum and maximum temperatures were calculated

from COOP station data only. All calculated values were compared with 1981-2010 averages. The onset of spring and fall are based on freeze free temperatures, e.g. when minimum temperatures stay above 28° F. Daily discharge data from USGS were plotted over the water year to show peak discharge and current midpoint of discharge compared to the 1981-2010 average. Precipitation and SWE from NRCS SNOTEL stations were plotted over the water year to show peak SWE and accumulated precipitation compared to both the 1971-2000 and 1981-2010 average. The results of these analyses are presented by park unit and summarized in tabular and graphical formats in Appendices B-D.

Grand Teton and Yellowstone National Parks and John D. Rockefeller, Jr. Memorial Parkway, 2012 Year-End Climate Summary

The year 2012 featured above-average temperatures throughout Yellowstone and Grand Teton national parks and the western United States as a whole (Crouch et al 2013). Average annual daily temperatures were especially warm, ranking as the warmest on record for the past 50 years at Yellowstone Park Mammoth and Lake Yellowstone, and the second warmest at Snake River and Moose COOP stations. Temperatures climbed above freezing earlier than average in the spring and continued later in the fall. Consequently, the number of Accumulated Growing Degree Days were higher than average.

Annual precipitation was lower than average at Cooke City 2, Alta 1NNW, Ashton 1N and Cody COOP stations, but normal at Yellowstone Park Mammoth, Lake Yellowstone, and Snake River, and above normal at Northeast Entrance, Fisher Creek, Parker Peak and Old Faithful. Seasonally, precipitation during the months of February and March, and in some places April and May, tended to be above average, however by summer, precipitation declined, and June, August, and September were far below average (refer to Appendices). Drought conditions developed early in the summer and by the close of the year the U.S. Drought Monitor had classified the Yellowstone region as having extreme drought conditions.

Maximum snowpack in the mountains tended to be at or above the 1981-2010 average, yet below average when compared to the 1971-2000 time period. Snowmelt began earlier in most places and melt-off occurred several days to weeks earlier than either average period.

The timing of peak streamflow was the same or slightly earlier than average. Total annual run-off in 2012 was 103% of average at Corwin Springs on the Yellowstone River, and 98% to 103% of average on the Snake River at Moose and above Jackson Lake at Flagg Ranch, respectively.

Table 2. End-of-year climate summaries from four Cooperative Observer Network climate stations during 2012. Average annual temperature and total precipitation rank is based on past 50 years from 1962-2012.

	Moose	Snake River	Lake Yellowstone	Yellowstone Pk Mammoth
TEMPERATURE				
Rank of 2012 average annual temperature (warmest in 50 yrs)	2 nd	2 nd	1 st	1 st
Highest temperature recorded in 2012	92°F	87°F	82°F	92°F
Average annual daily maximum temperature in 2012	56°F	52°F	48°F	56°F
Departure from 1981-2010 avg (± °F)	+3.2	+1.7	+1.3	+3.3
Lowest temperature recorded in 2012	-18°F	-20°F	-15°F	-6°F
Average annual daily minimum temperature in 2012	23°F	20°F	24°F	31°F
Departure from 1981-2010 avg (± °F)	+0.2	+1.6	+2.7	+2.5
Days with high ≥90°F (avg)	4(3)	0(1)	0(0)	1(3)
Days with low ≤32°F (avg)	248(249)	296(285)	252(280)	182(208)
PRECIPITATION				
Rank of 2012 total annual precipitation (driest in 50 yrs)	15 th	15 th	16 th	15 th
Accumulated annual (inches)	(-)	32	21	14
Departure from 1981-2010 avg (%)	(-)	107%	100%	100%

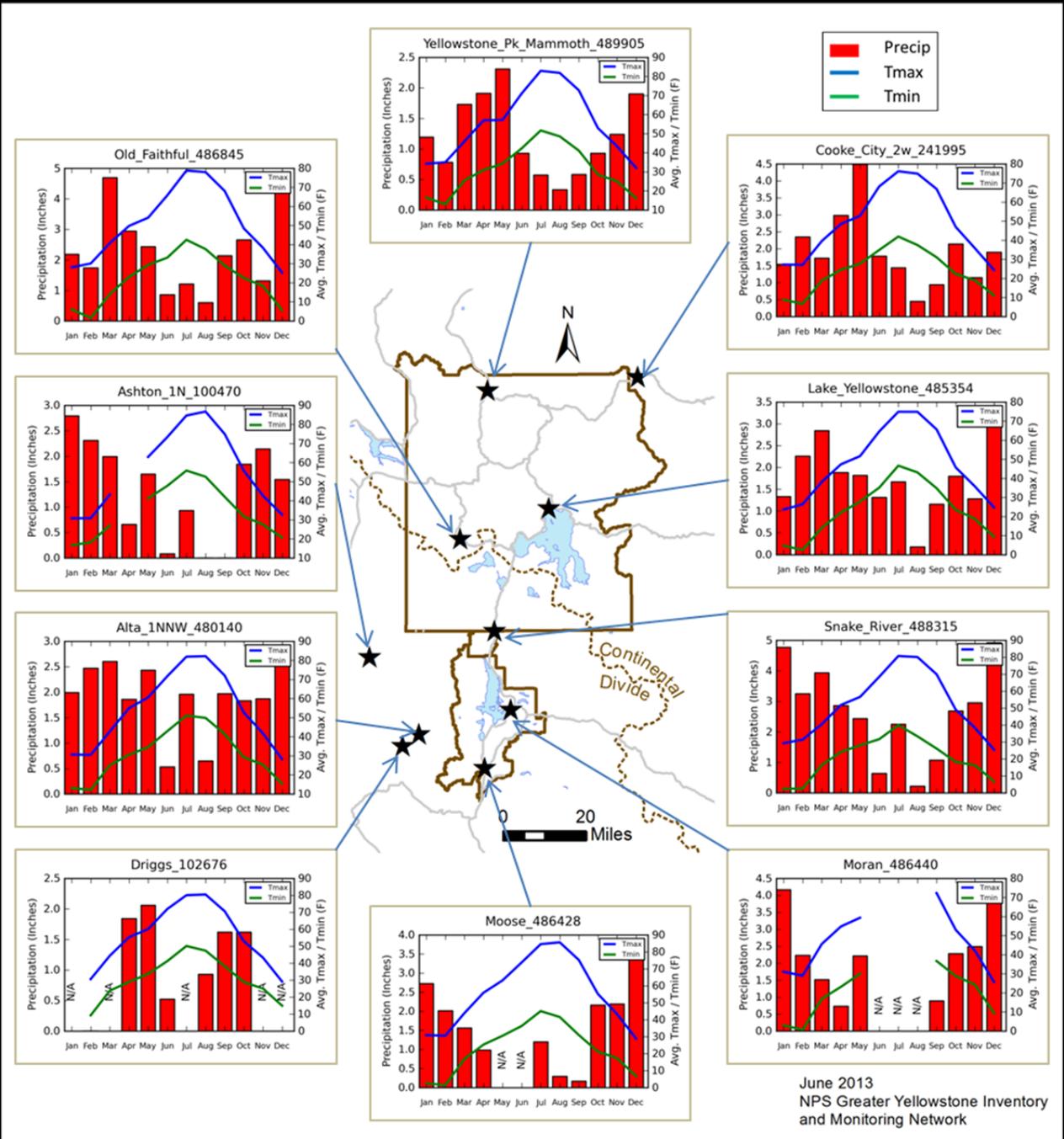


Figure 3. Monthly precipitation and average daily maximum temperature (Tmax) and average daily minimum temperatures (Tmin) during 2012 at key stations in and near Yellowstone and Grand Teton national parks.

Bighorn Canyon National Recreation Area, 2012 Year-End Climate Summary

The year 2012 featured below-average precipitation throughout the Bighorn Basin and surrounding area. Compared to 2011, when the region experienced extreme flooding, 2012 was especially dry, ranking as the driest on record for the past 50 years at Hardin and Yellowtail Dam, and second driest at Lovell and Shell 1NE COOP Stations. Total annual precipitation ranged from 3” (48% of average) at Lovell to 8” (47% of average) at Yellowtail Dam.

Average annual daily temperatures at Lovell ranked the second highest in 50 years. At Lovell and Yellowtail Dam, both average annual maximum and minimum daily temperatures were warmer than average. Temperatures stayed above freezing sooner than average in the spring and continued later in the fall and, consequently, the number of AGDD were higher than average. Drought conditions developed early in the summer and by late summer, the U.S. Drought Monitor had classified the Bighorn region as having extreme drought, a condition that lingered through the fall and early winter.

Maximum snowpack measured at Bald Mountain and Shell Creek was above the 1981-2010 average, but close to or below the 1971-2000 average. Late-season snowpack on June 1 was near average at Bald Mountain, but over 150% of average at Shell Creek. The timing of snowmelt was similar to the 1981-2010 average, but earlier than the 1971-2000 average.

The timing of peak streamflow on the Bighorn and Shoshone rivers was earlier than average. Total annual run-off in 2012 was 83% of average on the Bighorn River at St. Xavier and 74% of average on the Shoshone River near Lovell.

Table 3. End-of-year climate summaries from four Cooperative Observer Network climate stations during 2012. Average annual temperature and total precipitation rank is based on past 50 years from 1962-2012.

	Shell 1NE	Lovell	Yellowtail Dam	Hardin
TEMPERATURE				
Rank of 2012 average annual temperature (warmest in 50 years)	3 rd	2 nd	13 th	5 th
Highest temperature recorded in 2012	102°F	100°F	106°F	103°F
Average annual daily maximum temperature in 2012	64°F	63°F	65°F	66°F
Departure from 1981-2010 avg (±°F)	+3.4	+4	+3.4	+2.5
Lowest temperature recorded in 2012	-14°F	-13°F	-9°F	-14°F
Average annual daily minimum temperature in 2012	32°F	33°F	40°F	35°F
Departure from 1981-2010 avg (±°F)	+1.1	+1	+3	+1.1
Days with high ≥90°F (avg)	50 (39)	35 (33)	55 (46)	62 (48)
Days with low ≤32°F (avg)	184 (199)	186 (188)	110 (131)	152 (176)
PRECIPITATION				
Rank of 2012 total annual precipitation (driest in 50 years)	2 nd	2 nd	1 st	1 st
Accumulated annual (inches)	6	3	8	6
Departure from 1981-2010 avg (%)	59%	48%	47%	52%

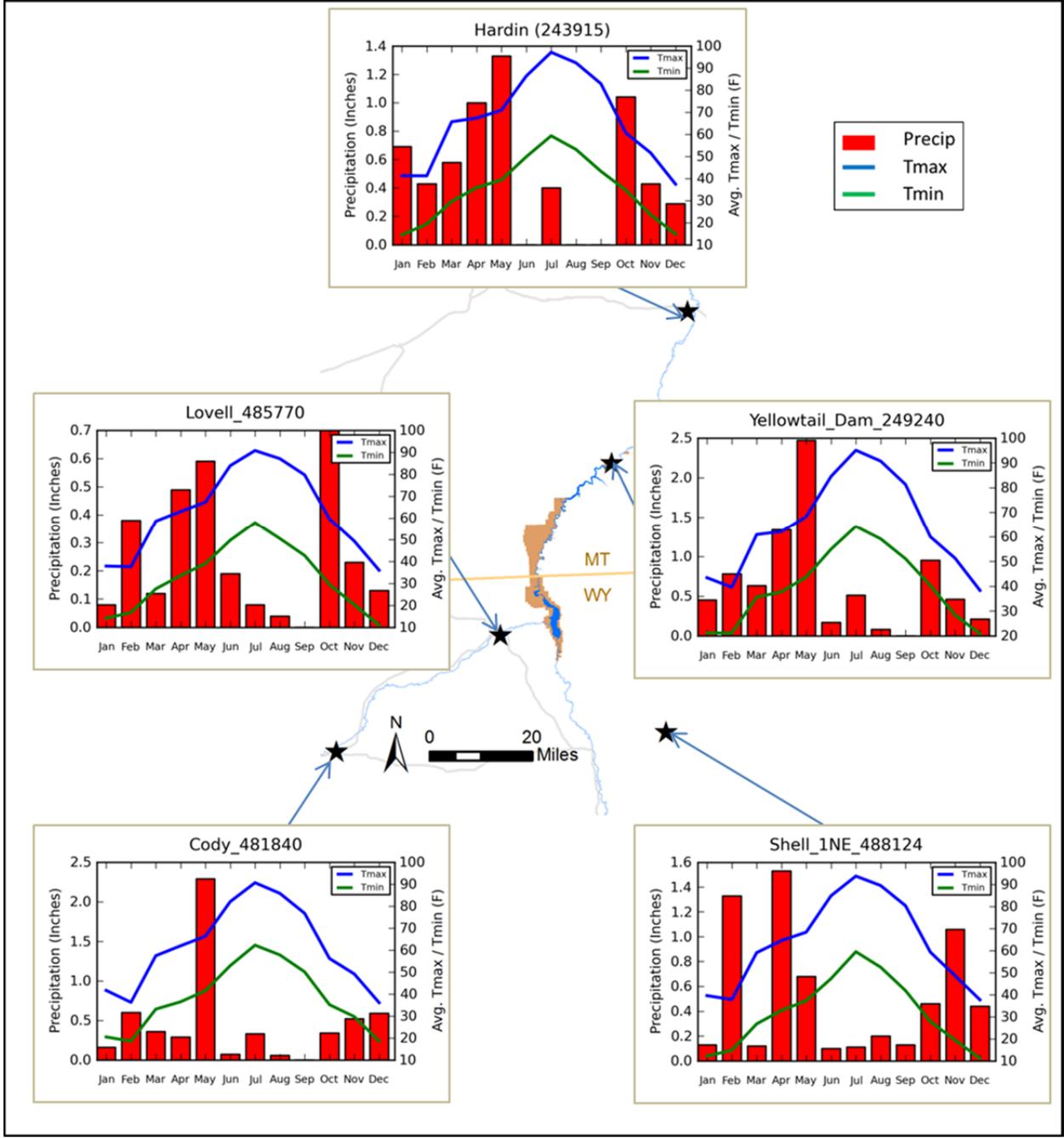


Figure 4. Monthly precipitation, average daily maximum temperature (Tmax), and average daily minimum temperatures (Tmin) during 2012 at key stations in and near Bighorn Canyon National Recreation Area.

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Appendix A: Weather Stations Summarized in 2012

Table A1. National Weather Service Cooperative Observer Program (COOP) stations used in the 2012 Climate Data Summary Report.

Park	Station ID	Station	Latitude _deg	Longitude _deg	Elevation (ft)	State
BICA	243915	Hardin	45.7322	-107.608	2905	MT
BICA	485770	Lovell	44.8375	-108.404	3837	WY
BICA	488124	Shell 1NE	44.5478	-107.763	7360	WY
BICA	249240	Yellowtail Dam	45.3128	-107.938	3305	MT
GRTE/YELL/JODR	480140	Alta 1 NNW	43.7728	-111.034	6437	WY
GRTE/YELL/JODR	100470	Ashton 1N	44.0425	-111.274	5212	ID
GRTE/YELL/JODR	481840	Cody	44.5219	-109.064	5082	WY
GRTE/YELL/JODR	241995	Cooke City 2W	45.0189	-109.955	7483	MT
GRTE/YELL/JODR	485345	Lake Yellowstone	44.5619	-110.399	7870	WY
GRTE/YELL/JODR	486428	Moose	43.6536	-110.717	6444	WY
GRTE/YELL/JODR	486440	Moran 5 WNW	43.8567	-110.589	6798	WY
GRTE/YELL/JODR	486845	Old Faithful	44.4569	-110.833	7360	WY
GRTE/YELL/JODR	488315	Snake River	44.1333	-110.666	6882	WY
GRTE/YELL/JODR	489905	Yellowstone Park Mammoth	44.9767	-110.696	6230	WY

Note: BICA=Bighorn Canyon National Recreation Area, GRTE=Grand Teton National Park, JODR=John D. Rockefeller, Jr. Memorial Parkway, YELL=Yellowstone National Park.

Table A2. Natural Resources Conservation Service Snowpack Telemetry (SNOTEL) stations and historic baseline period used to determine average condition in this report.

Park	Station ID	Station	Latitude	Longitude	Elevation	State	Daily Precip/SWE	Monthly Precip
			_deg	_deg	(ft)			
BICA	07E21S	Bald Mountain	44.800	-107.833	9380	WY		1981-2010
BICA	07E23S	Shell Creek	44.500	-107.417	9581	WY		1981-2010
GRTE/YELL/JODR	10E03S	Canyon	44.716	-110.500	7871	WY		1981-2010
GRTE/YELL/JODR	09D06S	Fisher Creek	45.050	-109.933	9101	MT		1981-2010
GRTE/YELL/JODR	10D07S	Northeast Entrance	45.000	-110.000	7350	MT	1971–2000	1981-2010
GRTE/YELL/JODR	09E07S	Parker Peak	44.733	-109.900	9400	WY	and	1981-2010
GRTE/YELL/JODR	10F23S	Phillips Bench	43.310	-110.540	8200	WY	1981-2010	1981-2010
GRTE/YELL/JODR	10E12S	Snake River Station	44.800	-110.400	6920	WY		1981-2010
GRTE/YELL/JODR	10E06S	Sylvan Lake	44.466	-110.150	8419	WY		1981-2010
GRTE/YELL/JODR	10E20S	Sylvan Road	44.466	-110.033	7120	WY		1981-2010
GRTE/YELL/JODR	10E17S	Two Ocean Plateau	44.900	-110.390	9240	WY		1981-2010
GRTE/YELL/JODR	09F18S	Younts Peak	43.550	-109.490	8350	WY		1981-2010

Note: BICA=Bighorn Canyon National Recreation Area, GRTE=Grand Teton National Park, JODR=John D. Rockefeller, Jr. Memorial Parkway, YELL=Yellowstone National Park.

Table A3. USGS stream gauging stations and baseline period used to determine mean daily discharge.

Park	Station ID	Station	Latitude _deg	Longitude _deg	Elevation (ft)	State	Period to determine mean daily discharge
BICA	06279500	Bighorn River at Kane	44.7587	-108.182	3660	WY	1980-2010
BICA	06287000	Bighorn River near St Xavier	45.31696	-107.919	3158	MT	1980-2010
BICA	06285100	Shoshone River near Lovell	44.5019	-108.2604	3856	WY	1980-2010
GRTE/YELL/JODR	13010065	Snake River above Jackson Lake at Flagg Ranch	44.09848	-110.667	6802	WY	1983-2010
GRTE/YELL/JODR	13013650	Snake River at Moose	43.65379	-110.715	6431	WY	1995-2010
GRTE/YELL/JODR	06191500	Yellowstone River at Corwin Springs	45.11217	-110.794	5079	WY	1980-2010

Note: BICA=Bighorn Canyon National Recreation Area, GRTE=Grand Teton National Park, JODR=John D. Rockefeller, Jr. Memorial Parkway, YELL=Yellowstone National Park.

Appendix B. Climate Summary Tables for the Greater Yellowstone Network Parks

Table B1. Total monthly precipitation in inches and percent of average monthly precipitation compared to 1981-2010 averages for select climate stations in or near Yellowstone and Grand Teton National Parks and John D. Rockefeller, Jr. Memorial Parkway during 2012.

Station Name (ID)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Total
Alta 1 NNW (480140)	2.0	2.5	2.6	1.9	2.4	0.5	2.0	0.7	2.0	1.8	1.9	2.7	22.8
% avg.	80.7	132.2	136.0	83.9	72.1	23.0	115.6	49.6	120.0	92.0	86.6	113.4	90.2
Ashton 1 N (100470)	2.8	2.3	2.0	0.7	1.7	0.1	0.9	0.0	0.0	1.8	2.1	1.5	15.9
% avg.	130.9	162.8	154.1	42.4	73.2	4.4	104.4	0.0	0.0	114.9	101.3	68.7	82.9
Canyon (10E03S)	2.6	2.6	2.6	3.4	4.3	1.8	1.3	0.2	1.7	1.9	1.8	3.2	27.4
% avg.	89.7	113.0	104.0	130.8	148.3	72.0	86.7	15.4	121.4	95.0	62.1	103.2	98.2
Cody (481840)	0.2	0.6	0.4	0.3	2.3	0.1	0.3	0.1	0.0	0.3	0.5	0.6	5.6
% avg.	47.7	181.3	64.7	27.5	125.9	4.2	29.8	6.5	0.0	38.0	109.1	179.0	53.1
Cooke City 2 W (241995)	1.5	2.4	1.7	3.0	4.5	1.8	1.4	0.5	0.9	2.1	1.2	1.9	22.9
% avg.	73.7	157.7	91.8	159.2	159.7	56.7	63.1	23.8	53.7	116.8	61.3	101.2	92.3
Fisher Creek (09D06S)	6	5.2	7	6.9	6	2.6	2.1	0.8	1.1	5.1	4.8	8.6	56.2
% avg.	103.5	113.0	142.9	146.8	120.0	61.9	80.8	38.1	44.0	141.7	87.3	145.8	109.3
Lake Yellowstone (485345)	1.3	2.3	2.8	1.9	1.8	1.3	1.7	0.2	1.2	1.8	1.3	3.3	20.8
% avg.	80.9	140.6	157.9	105.5	73.8	58.4	102.8	11.3	79.6	152.8	69.2	202.2	99.7
Moose (486428)	2.7	2.0	1.6	1.0	(-)	(-)	1.2	0.3	0.2	2.2	2.2	3.7	(-)
% avg.	105.3	110.3	96.2	66.1	(-)	(-)	93.4	22.3	12.0	147.0	82.9	138.0	(-)
Moran5WN W (486440)	4.2	2.2	1.5	0.7	2.2	(-)	(-)	(-)	0.9	2.3	2.5	4.4	(-)
% avg.	145.5	105.3	71.1	35.7	94.6	(-)	(-)	(-)	63.1	128.8	85.2	151.2	(-)
Northeast Entrance (10D07S)	2.2	2.7	2.1	3.4	3.9	2.7	1.8	0.6	1	2.3	1.7	2.3	26.7
% avg.	104.3	165.6	117.3	161.9	133.1	95.7	85.3	38.7	60.6	125.7	74.6	112.8	107.5
Old Faithful (486845)	2.2	1.7	4.7	2.9	2.4	0.9	1.2	0.6	2.1	2.7	1.3	4.3	27.0
% avg.	103.2	87.5	212.2	133.3	86.9	34.9	78.2	41.0	145.9	159.4	57.4	135.9	106.6

Table B1. Total monthly precipitation in inches and percent of average monthly precipitation compared to 1981-2010 averages for select climate stations in or near Yellowstone and Grand Teton National Parks and John D. Rockefeller Jr. Memorial Parkway during 2012 (*continued*).

Station Name (ID)		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Total
Parker Peak (09E07S)		3.5	3.5	4	3.8	4.9	1.1	1.7	0.5	0.7	2.6	3.7	4.7	34.7
	% avg.	125.0	134.6	137.9	118.8	129.0	34.4	100.0	38.5	38.9	100.0	123.3	162.1	109.1
Phillips Bench(10F23S)		8	4.2	3.5	2.5	2.9	0.4	1.5	0.2	0.4	3.8	3.6	5.9	36.9
	% avg.	148.2	93.3	79.6	71.4	85.3	18.2	150.0	20.0	23.5	146.2	75.0	93.7	90.4
Snake River (488315)		4.8	3.3	3.9	2.9	2.4	0.6	2.3	0.2	1.1	2.7	3.0	4.9	32.0
	% avg.	134.8	120.0	153.3	122.7	93.1	26.9	139.0	15.0	64.4	131.4	95.3	124.0	106.5
Snake River Station (10E12S)		5.2	4.6	3.3	2.6	2.7	0.5	2.9	0.5	0.7	3	4.1	5.5	35.6
	% avg.	114.8	148.9	111.1	83.1	89.7	19.0	232.0	31.9	46.1	113.2	103.5	124.4	102.5
Sylvan Lake (10E06S)		3.3	4.2	4.2	4.8	4.1	0.9	1.8	0.2	1.3	3.8	4.5	5.2	38.3
	% avg.	89.2	140.0	123.5	129.7	95.4	26.5	100.0	13.3	61.9	122.6	107.1	130.0	100.3
Sylvan Road (10E20S)		2.5	3.3	2.1	3.6	3	1.2	1.4	0.6	0.8	3.1	2.8	4	28.4
	% avg.	86.2	165.0	95.5	144.0	111.1	46.2	107.7	42.9	47.1	134.8	77.8	129.0	100.4
Two Ocean Plateau (10E17S)		5.8	4.2	4	4.3	3.4	1.2	2	0.4	1.4	3.5	4.1	7	41.3
	% avg.	123.7	99.3	87.9	110.3	78.3	37.7	109.3	26.5	68.0	111.5	82.7	152.2	96.3
Yellowstone Park Mammoth (489905)		1.2	0.8	1.7	1.9	2.3	0.9	0.6	0.3	0.6	0.9	1.2	1.9	14.4
	% avg.	162.3	121.8	181.9	146.9	112.4	47.7	38.8	31.6	50.8	72.9	120.0	234.3	99.9
Younts Peak (09F18S)		3.6	2.8	1.5	2.4	3.6	0.2	1.7	0.5	1	1.9	2.1	2.7	24
	% avg.	128.6	133.3	57.7	100.0	116.1	8.0	85.0	27.8	43.5	86.4	72.4	100.0	81.6

Note: Percentages of average monthly precipitation compared to 1981-2010 averages are given in the second line of data for each station. Station IDs are from NWS Cooperative Observer Program (COOP) stations and NRCS Snowpack Telemetry (SNOTEL) stations. Monthly statistics are not reported if more than three days of data are missing. Individual months are not used for calculating annual statistics if more than five days of data are missing.
 (-) Indicates missing data.

Table B2. Average daily maximum temperatures (degrees Fahrenheit) and departure from the 1981-2010 average (\pm degrees Fahrenheit) in or near Grand Teton and Yellowstone National Parks and John D. Rockefeller, Jr. Memorial Parkway in 2012.

Station Name (ID)		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Alta 1 NNW (480140)	Degrees F	30.6	30.4	42.7	54.9	60.5	71.6	81.9	82.1	72.0	52.6	41.7	28.1	54.1
	Departure (\pm °F)	1.8	-1.4	3.6	6.7	1.3	3.5	4.3	5.2	4.5	-0.6	4.3	0.3	2.7
Ashton 1 N (100470)	Degrees F	30.7	30.8	43.2	(-)	62.9	73.3	84.6	86.7	74.9	55.7	42.6	32.6	(-)
	Departure (\pm °F)	2.5	-1.7	1.9	(-)	-1.4	0.8	2.9	5.3	3.4	-1.7	3.2	4.4	(-)
Cody (481840)	Degrees F	41.6	36.2	57.4	61.9	66.2	82.0	90.6	85.8	76.7	56.1	49.1	36.0	61.6
	Departure (\pm °F)	4.2	-4.1	8.3	4.7	0.1	6.8	6.8	3.5	4.6	-3.4	3.9	0.0	2.8
Cooke City 2 W (241995)	Degrees F	27.2	27.1	39.5	48.5	52.7	68.1	76.1	74.8	66.8	46.9	35.8	24.3	49.0
	Departure (\pm °F)	1.2	-4.1	0.6	2.1	-3.0	2.9	1.5	1.3	3.6	-1.9	3.4	0.4	0.6
Driggs (102676)	Degrees F	(-)	30.6	44.4	55.3	60.0	71.9	80.0	80.4	70.5	52.9	43.2	29.1	(-)
	Departure (\pm °F)	(-)	-2.1	3.7	4.0	-1.3	1.6	1.1	1.9	1.6	-2.1	3.8	0.4	(-)
Lake Yellowstone (485345)	Degrees F	23.6	26.4	38.1	47.3	51.6	64.5	74.9	74.8	65.6	45.7	35.7	24.7	47.7
	Departure (\pm °F)	-0.8	-1.6	1.9	4.0	-0.3	2.9	3.3	3.4	4.0	-2.1	2.2	0.4	1.3
Moose (486428)	Degrees F	30.9	30.5	43.8	55.8	63.1	73.7	84.5	85.5	75.1	55.1	43.4	28.8	55.9
	Departure (\pm °F)	4.4	-0.8	3.1	5.5	1.9	2.7	3.9	6.0	5.6	-0.3	5.2	2.2	3.2
Moran 5 WNW (486440)	Degrees F	31.0	28.9	45.5	54.7	59.3	(-)	(-)	(-)	72.2	53.0	42.1	25.7	(-)
	Departure (\pm °F)	4.7	-2.7	4.7	5.8	0.4	(-)	(-)	(-)	4.3	-0.5	6.1	0.2	(-)

Table B2. Average daily maximum temperatures (degrees Fahrenheit) and departure from 1981-2010 averages (\pm degrees Fahrenheit) in or near Grand Teton and Yellowstone National Parks and John D. Rockefeller, Jr. Memorial Parkway (*continued*).

Station Name (ID)		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Old Faithful (486845)	Degrees F	28.0	30.0	40.7	49.7	54.0	65.7	78.7	77.9	68.0	48.4	38.3	25.2	50.4
	Departure (\pm °F)	-0.2	-1.9	1.6	3.8	-0.8	1.0	3.8	3.9	4.3	-1.8	3.3	-1.1	1.2
Snake River (488315)	Degrees F	29.2	31.3	40.4	51.8	56.5	68.3	80.6	80.0	69.8	49.0	38.3	25.4	51.7
	Departure (\pm °F)	2.2	0.5	1.4	5.1	-0.2	1.4	3.7	3.6	3.7	-2.6	3.1	-0.4	1.7
Yellowstone Park Mammoth (489905)	Degrees F	34.2	35.0	45.9	56.9	57.1	71.0	82.9	81.8	72.7	52.9	43.4	32.0	55.5
	Departure (\pm °F)	4.0	1.6	5.1	8.0	-1.9	2.4	3.6	3.2	5.3	0.1	5.7	3.3	3.3

Note: Monthly average maximum daily temperature departures from 1981-2010 averages are given in the second line of data for each station in degrees Fahrenheit. Station IDs are from National Weather Service Cooperative Observer stations. Monthly statistics are not reported if more than five days of data are missing. Individual months are not used for calculating annual statistics if more than five days of data are missing.
 (-) Indicates missing data.

Table B3. Average minimum daily temperatures (degrees Fahrenheit) and departure from the 1981-2010 average (\pm degrees Fahrenheit) in or near Grand Teton and Yellowstone National Parks and John D. Rockefeller, Jr. Memorial Parkway.

Station Name (ID)		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Alta 1 NNW (480140)	Degrees F	13.0	12.1	25.0	30.5	34.5	42.8	51.0	49.8	41.3	29.1	25.3	15.4	30.8
	Departure (\pm °F)	1.8	-0.4	4.9	3.1	-0.6	0.3	2.5	3.0	2.5	-1.0	6.1	4.6	2.1
Ashton 1 N (100470)	Degrees F	16.6	18.2	27.0	(-)	41.2	47.7	55.7	52.5	42.0	31.7	27.5	20.6	(-)
	Departure (\pm °F)	5.3	3.4	4.2	(-)	3.3	3.7	6.8	5.4	2.3	1.0	6.1	8.7	(-)
Cody (481840)	Degrees F	20.4	18.5	33.1	36.4	41.5	52.9	62.2	57.8	50.0	35.1	29.7	18.5	38.0
	Departure (\pm °F)	4.0	0.3	7.2	3.6	0.2	3.7	6.1	3.3	4.4	-0.2	4.8	2.7	3.3
Cooke City 2 W (241995)	Degrees F	8.8	6.6	18.7	24.5	27.6	34.8	41.9	37.4	31.0	22.3	18.9	11.1	23.6
	Departure (\pm °F)	3.6	0.8	5.4	3.6	-0.8	0.4	3.1	0.1	0.1	-1.3	5.9	7.5	2.3
Driggs (102676)	Degrees F	(-)	9.2	23.7	28.9	33.6	41.1	50.1	47.3	38.2	28.8	25.0	14.9	(-)
	Departure (\pm °F)	(-)	-1.9	4.2	2.0	-0.6	0.2	3.7	2.0	1.0	0.2	6.4	5.7	(-)
Moose (486428)	Degrees F	2.5	1.3	16.8	25.3	30.5	36.2	45.0	41.5	30.9	21.1	17.3	6.6	22.9
	Departure (\pm °F)	1.6	-2.3	2.8	1.5	-1.9	-2.2	1.9	0.4	-2.4	-3.1	3.2	4.2	0.2
Moran 5 WNW (486440)	Degrees F	3.0	0.6	16.8	23.1	29.9	(-)	(-)	(-)	36.6	28.8	24.2	9.3	(-)
	Departure (\pm °F)	2.1	-1.9	4.6	2.1	0.3	(-)	(-)	(-)	4.2	4.5	10.1	5.8	(-)
Lake Yellowstone (485345)	Degrees F	4.7	2.4	14.1	22.0	27.9	35.1	46.6	43.1	34.8	23.5	18.8	9.3	23.5
	Departure (\pm °F)	3.5	1.2	4.9	4.0	-0.2	-0.4	5.0	3.2	3.0	-0.2	5.0	4.3	2.7

Table B3. Average minimum daily temperatures (degrees Fahrenheit) and departure from 1981-2010 averages (\pm degrees Fahrenheit) in or near Grand Teton and Yellowstone National Parks and John D. Rockefeller, Jr. Memorial Parkway (continued).

Station Name (ID)		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Old Faithful (486845)	Degrees F	6.0	1.5	14.0	23.0	29.3	33.1	42.4	37.6	28.9	22.4	18.3	5.6	21.8
	Departure (\pm °F)	5.7	0.1	4.2	4.2	1.0	-1.9	2.8	0.6	-0.4	0.8	8.7	5.4	2.5
Snake River (488315)	Degrees F	2.3	2.5	16.3	24.1	28.0	31.6	39.9	33.3	26.0	18.2	16.2	6.7	20.4
	Departure (\pm °F)	2.7	1.7	6.2	5.0	0.2	-2.7	1.7	-2.3	-1.7	-2.1	6.0	6.5	1.6
Yellowstone Park Mammoth (489905)	Degrees F	16.4	12.9	25.5	30.9	34.2	42.2	51.6	48.5	41.1	28.5	25.0	16.2	31.1
	Departure (\pm °F)	4.4	-0.1	5.4	4.2	-0.6	-0.1	3.3	1.8	2.7	-1.0	5.2	4.9	2.5

Note: Monthly average minimum daily temperature departures from 1981-2010 averages are given in the second line of data for each station in degrees Fahrenheit. Station IDs are from National Weather Service Cooperative Observer stations. Monthly statistics are not reported if more than five days of data are missing. Individual months are not used for calculating annual statistics if more than five days of data are missing.

(-) Indicates missing data

Table B4. First and last freeze and frost dates, spring and fall onset dates, accumulated growing degree days, and days above or below critical temperature thresholds for key stations in or near Grand Teton and Yellowstone national parks and John D. Rockefeller, Jr. Memorial Parkway during 2012. Values for 2012 are shown in the first line for each station and averages on the second line. Averages are published by the Western Region Climate Center in General Climate Summary Tables. Note that the average reference period is based on the period of record.

Station Name (ID)		AGDD40	AGDD50	Last date in spring ≤28°F	Earliest date in fall ≤28°F	Last date in spring ≤32°F	Earliest date in fall ≤32°F	# of days Tmax		# of days Tmin	
								≥80°F	≥90°F	≤0°F	≤32°F
Alta 1 NNW (480140)	2012	3230	1576	7-Jun	4-Oct	20-Jun	12-Sep	58	0	5	191
	avg.	2656	1152	30-May	12-Sep	28-Jun	2-Sep	(-)	2.2	27.4	222.7
Ashton 1 N (100470)	2012	(-)	(-)	6-May	9-Sep	19-Jul	9-Sep	(-)	(-)	(-)	(-)
	avg.	3096	1422	18-May	18-Sep	14-Jun	8-Sep	(-)	7.4	23	206.1
Cody (481840)	2012	5000	2828	16-Apr	6-Oct	26-May	4-Oct	93	30	5	132
	avg.	4048	2110	5-May	1-Oct	17-May	20-Sep	(-)	18.1	18.3	168.3
Cooke City 2 W (241995)	2012	1845	587	7-Jun	12-Sep	28-Jun	4-Aug	13	0	27	267
	avg.	1604	470	26-Jun	30-Aug	12-Jul	9-Aug	(-)	0	46.3	275
Driggs (102676)	2012	(-)	(-)	7-Jun	4-Oct	11-Jun	12-Sep	(-)	(-)	(-)	(-)
	avg.	2752	1193	31-May	11-Sep	27-Jun	1-Sep	(-)	2.8	33.9	221.2
Lake Yellowstone (485345)	2012	1995	749	8-Jun	4-Oct	28-Jun	7-Sep	10	0	35	252
	avg.	1427	390	29-Jun	24-Aug	21-Jul	9-Aug	(-)	0	61.8	279.7
Moose (486428)	2012	2572	1154	20-Jun	12-Sep	27-Jun	25-Aug	71	4	45	248
	avg.	2339	927	9-Jun	2-Sep	29-Jun	24-Aug	(-)	2.6	53.8	248.8
Moran 5 WNW (486440)	2012	(-)	(-)	25-May	4-Oct	29-May	12-Sep	(-)	(-)	(-)	(-)
	avg.	1971	675	17-Jun	2-Sep	9-Jul	15-Aug	(-)	0.5	59.9	265.2

Table B4. First and last freeze and frost dates, spring and fall onset dates, accumulated growing degree days, and days above or below critical temperature thresholds for key stations in or near Grand Teton and Yellowstone national parks and John D. Rockefeller, Jr. Memorial Parkway during 2012. Values for 2012 are shown in the first line for each station and averages on the second line. Averages are published by the Western Region Climate Center in General Climate Summary Tables. Note that the reference period may differ from 1981-2010 (continued).

Station Name (ID)		AGDD40	AGDD50	Last date in spring ≤28°F	Earliest date in fall ≤28°F	Last date in spring ≤32°F	Earliest date in fall ≤32°F	# of days Tmax		# of days Tmin	
								≥80°F	≥90°F	≤0°F	≤32°F
Old Faithful (486845)	2012	1936	678	21-Jun	25-Aug	29-Jun	4-Aug	27	0	43	275
	avg.	1713	540	27-Jun	17-Aug	18-Jul	3-Aug	(-)	0.5	57	276
Snake River (488315)	2012		602	28-Jun	25-Aug	30-Jun	2-Aug	45	0	50	296
		1869									
	avg.		559	5-Jul	9-Aug	22-Jul	3-Aug	(-)	0.9	58.7	284.8
		1776									
Yellowstone Park Mammoth (489905)	2012	3212	1545	8-May	4-Oct	7-Jun	12-Sep	60	1	5	182
	avg.	2733	1203	18-May	15-Sep	10-Jun	9-Sep	(-)	3.2	20.2	208

Note AGDD=Accumulated Growing Degree Days

(-) Indicates missing data

Table B5. Total monthly precipitation in inches and percent of average monthly precipitation versus 1981-2010 averages for select climate stations in or near Bighorn Canyon National Recreation Area during 2012.

Station Name (ID)		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Total
Bald Mountain (07E21S)		1.1	4.2	1.9	3.6	2.9	3.5	0	0.1	0.2	1.7	1.1	0.6	20.9
	% avg.	39.3	175.0	59.4	105.9	74.4	106.1	0.0	8.3	8.0	60.7	44.0	22.2	64.3
Hardin (243915)		0.7	0.4	0.6	1.0	1.3	0.0	0.4	0.0	0.0	1.0	0.4	0.3	6.2
	% avg	168.0	111.0	74.2	80.3	59.0	0.0	30.7	0.0	0.0	84.5	81.7	58.3	51.5
Lovell (485770)		0.1	0.4	0.1	0.5	0.6	0.2	0.1	0	0	0.7	0.2	0.1	3
	% avg	39.4	238.7	34.7	79.4	51.3	18.2	12.2	11.4	0	107.8	114.2	56.5	48
Shell 1 NE (488124)		0.1	1.3	0.1	1.5	0.7	0.1	0.1	0.2	0.1	0.5	1.1	0.4	6.3
	% avg	23.2	255.2	22.6	161.2	34.7	6.7	13.9	37.9	11.4	48.1	176.5	81.7	59.4
Shell Creek (07E23S)		1.3	5	1.5	4.3	3.2	2.6	1.4	1.4	0.8	2.6	2.5	2	28.6
	% avg	54.2	294.1	60	138.7	88.9	83.9	77.8	127.3	34.8	104	113.6	105.3	101.4
Yellowtail Dam (249240)		0.5	0.8	0.6	1.3	2.5	0.2	0.5	0.1	0	1	0.5	0.2	8
	% avg	64.1	103.4	47.7	74.6	86.6	6.6	35.8	10.1	0	53	58.3	27.8	46.9

Note: Percentages of average monthly precipitation versus 1981–2010 averages are given in the second line of data for each station. Station IDs are from NWS Cooperative Observer Program (COOP) stations and NRCS Snowpack Telemetry (SNOTEL) stations. Monthly statistics are not reported if more than three days of data are missing. Individual months are not used for calculating annual statistics if more than five days of data are missing.

(-) Indicates missing data

Table B6. Average maximum daily temperatures (degrees Fahrenheit) and departure from 1981-2010 averages (\pm degrees Fahrenheit) for select climate stations in or near Bighorn Canyon National Recreation Area during 2012.

Station Name (ID)		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Lovell (485770)	Degrees F	37.8	37.6	58.5	63	67.2	83.9	90.7	87	79.7	59.6	49.2	36	62.5
	Departure (\pm °F)	7	0.5	9.6	4.5	-0.1	7.2	4.6	2.3	6.9	0.5	5.5	4.9	4.3
Hardin (243915)	Degrees F	41.2	41.2	65.6	67.3	70.8	86.3	97.1	92.3	82.9	60.6	51.6	37.4	66.2
	Departure (\pm °F)	3.9	-2.0	12.1	3.8	-2.1	4.3	5.7	1.8	4.0	-4.1	3.4	0.4	2.5
Shell 1 NE (488124)	Degrees F	39.5	37.8	59	64.5	68.3	84.8	93.7	89.4	80.3	59.3	48.6	37.7	63.6
	Departure (\pm °F)	7	-1.2	8.4	4.1	-0.9	5.1	4.5	2.3	5.5	-1.8	3.8	5	3.4
Yellowtail Dam (249240)	Degrees F	43.4	39.5	60.8	62.1	68.3	84.5	95	90.7	81.3	60	51.2	38.3	64.6
	Departure (\pm °F)	4.8	-1.9	10.8	3.1	-0.1	6.3	6.8	3.1	5.9	-1.2	4.3	0.4	3.4

Note: Monthly average maximum daily temperature departures from 1981-2010 averages are given in the second line of data for each station in degrees Fahrenheit.

Station IDs are from NWS Cooperative Observer Program (COOP) stations. Monthly statistics are not reported if more than five days of data are missing. Individual months are not used for calculating annual statistics if more than five days of data are missing.

Table B7. Average minimum daily temperatures (degrees Fahrenheit) and departure from 1981-2010 averages (\pm degrees Fahrenheit) for select climate stations in or near Bighorn Canyon National Recreation Area during 2012.

Station Name (ID)		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Lovell (485770)	Degrees F	14.1	16.7	27.5	33.5	39	49.7	57.8	50.4	42.7	29.5	20.3	10.9	32.7
	Departure (\pm °F)	6.7	3.6	4.5	1.7	-2.7	-0.4	2.2	-2.1	0.7	-2.2	0.2	2.5	1.2
Hardin (243915)	Degrees F	14.4	19.3	29.6	35.8	39.3	49.8	59.3	53.1	43.2	34.7	23.5	14.8	34.7
	Departure (\pm °F)	2.2	3.2	4.8	2.6	-3.3	-0.8	2.6	-1.5	-1.4	1.2	2.0	2.8	1.1
Shell 1 NE (488124)	Degrees F	12.1	14.8	26.7	32.8	37.2	47.3	59.4	52.4	41.8	27.8	19.4	11.1	31.9
	Departure (\pm °F)	5.2	0.6	2.6	1.9	-1.5	-1.1	4.8	0.7	-0.3	-2.9	0.5	3.7	1.1
Yellowtail Dam (249240)	Degrees F	21.2	21	35.6	37.7	43.7	54.9	64.2	59.1	51	40.2	28.4	20.8	39.8
	Departure (\pm °F)	2	-0.3	8.5	2.4	0.6	3.6	6.9	3.3	4.6	3	1.1	1.8	3

Note: Monthly average minimum daily temperature departures from 1981-2010 averages are given in the second line of data for each station in degrees Fahrenheit. Station IDs are from NWS Cooperative Observer Program (COOP) stations. Monthly statistics are not reported if more than five days of data are missing. Individual months are not used for calculating annual statistics if more than five days of data are missing.

Table B8. First and last freeze and frost dates, spring and fall onset dates, accumulated growing degree days, and days above or below critical temperature thresholds for key stations in or near Bighorn Canyon National Recreation Area during 2012. Averages are published by the Western Regional Climate Center. Note that the average reference period is based on the period of record.

Station Name		AGDD40	AGDD50	Last date in spring ≤28°F	Earliest date in fall ≤28°F	Last date in spring ≤32°F	Earliest date in fall ≤32°F	# of days Tmax		# of days Tmin	
								≥80°F	≥90°F	≤0°F	≤32°F
Lovell (485770)	2012	4465	2448	15-Apr	5-Oct	11-Jun	3-Oct	100	35	11	186
	avg.	4077	2209	1-May	3-Oct	14-May	20-Sep	(-)	33.1	26.5	188.4
Hardin (243915)	2012	5057	2849	9-Apr	6-Oct	12-May	6-Oct	120	62	13	152
	avg.	4606	2580	30-Apr	3-Oct	14-May	22-Sep	(-)	48.4	24.7	176.3
Shell 1 NE (488124)	2012	4566	2574	8-May	4-Oct	24-May	14-Sep	109	50	11	184
	avg.	4083	2211	8-May	28-Sep	24-May	18-Sep	(-)	39.1	23.2	199.2
Yellowtail Dam (249240)	2012	5629	3303	7-Mar	6-Oct	26-May	6-Oct	107	55	6	110
	avg.	5186	2930	18-Apr	16-Oct	6-May	5-Oct	(-)	46.1	14.6	130.6

Note: (-) temperature data or published averages are missing.

Appendix C. Departure of 2012 Temperature and Precipitation from Average

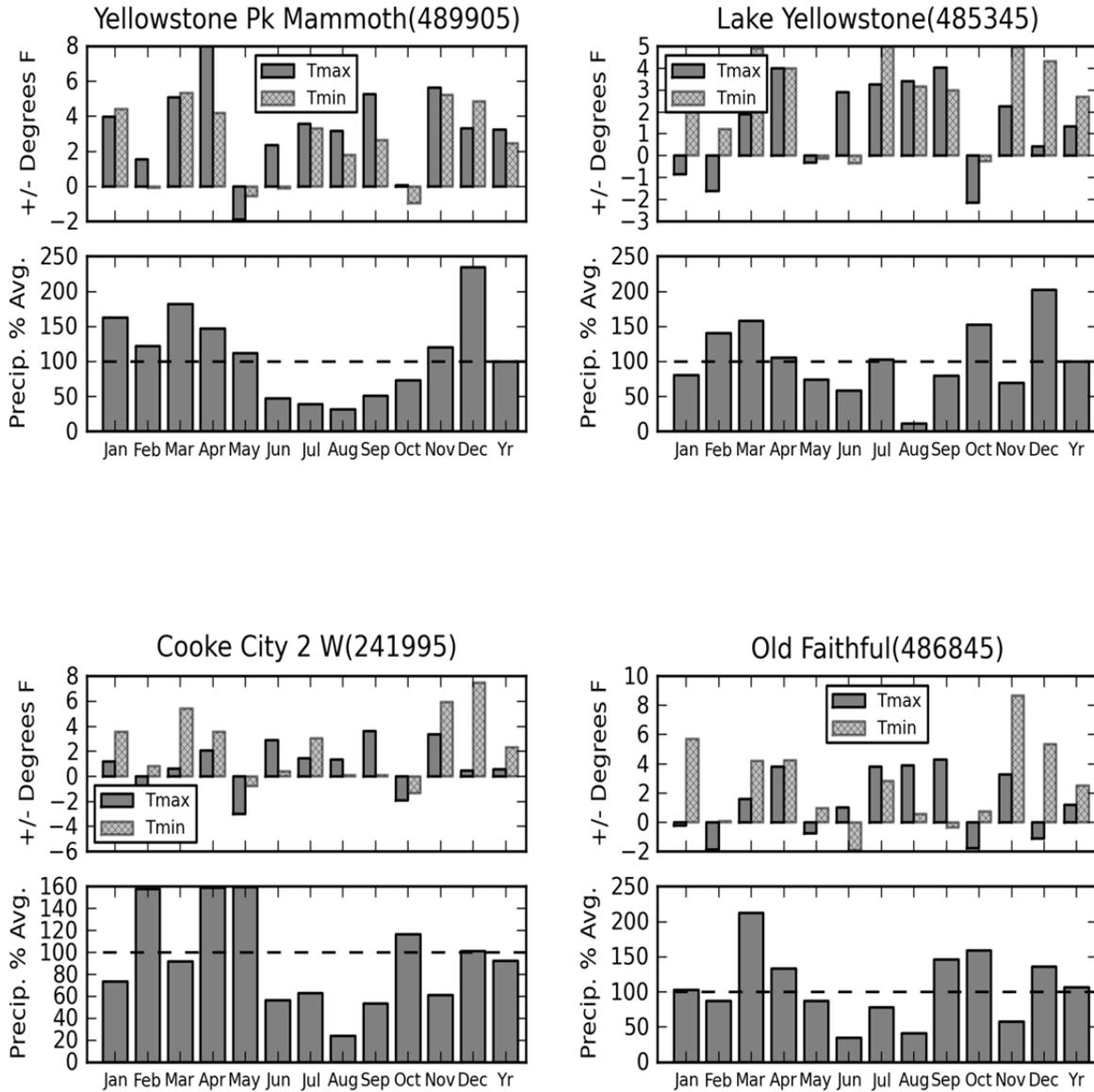


Figure C1. Departure of 2012 average minimum and average maximum daily temperatures and precipitation from 1981-2010 average at key climate stations in and near Yellowstone and Grand Teton national parks. Missing bars (NA) indicate months in which there were insufficient data to calculate a total.

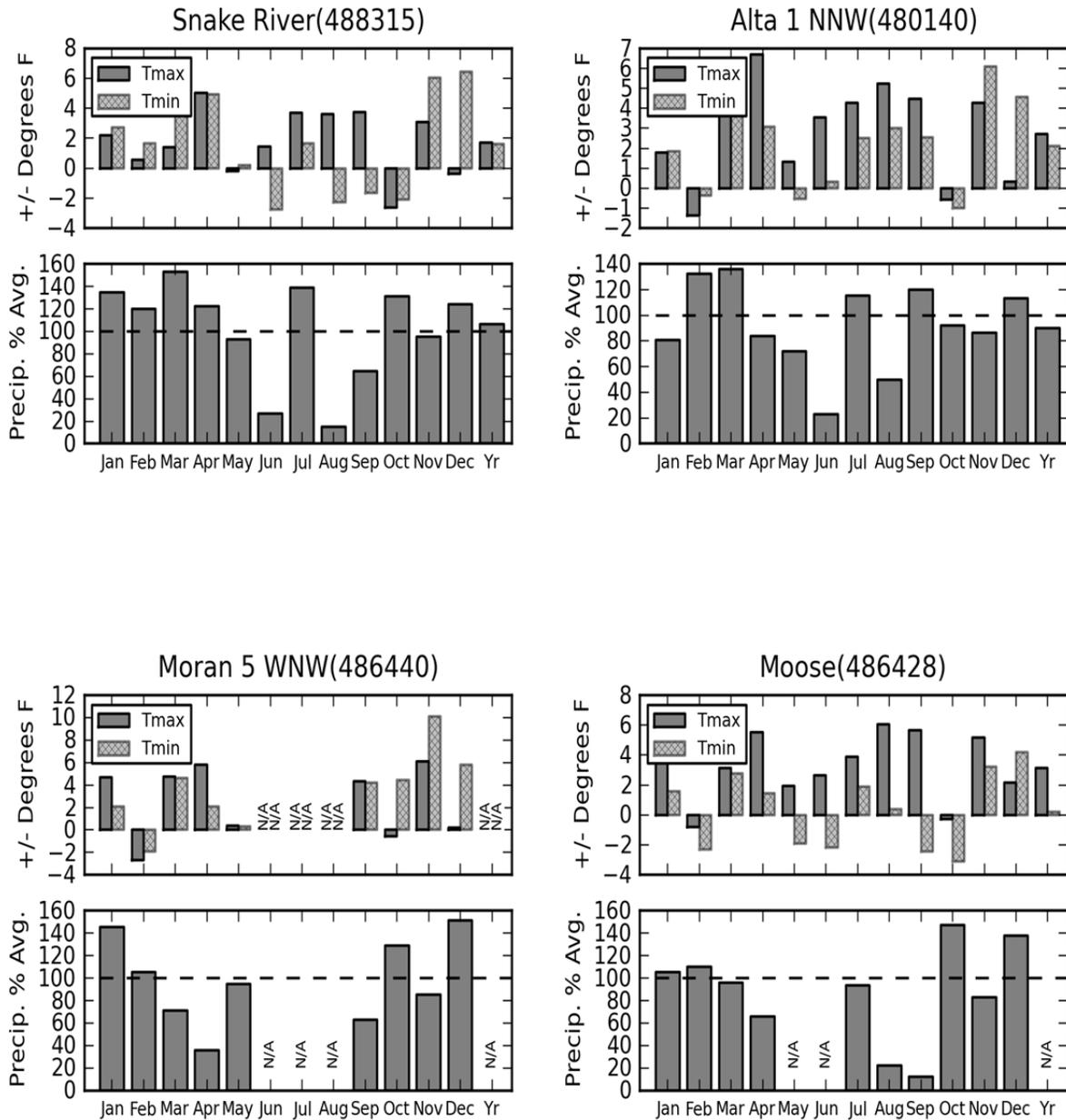


Figure C1. Departure of 2012 average minimum and average maximum daily temperatures and precipitation from 1981-2010 average at key climate stations in and near Yellowstone and Grand Teton national parks. Missing bars (NA) indicate months in which there were insufficient data to calculate a total (continued).

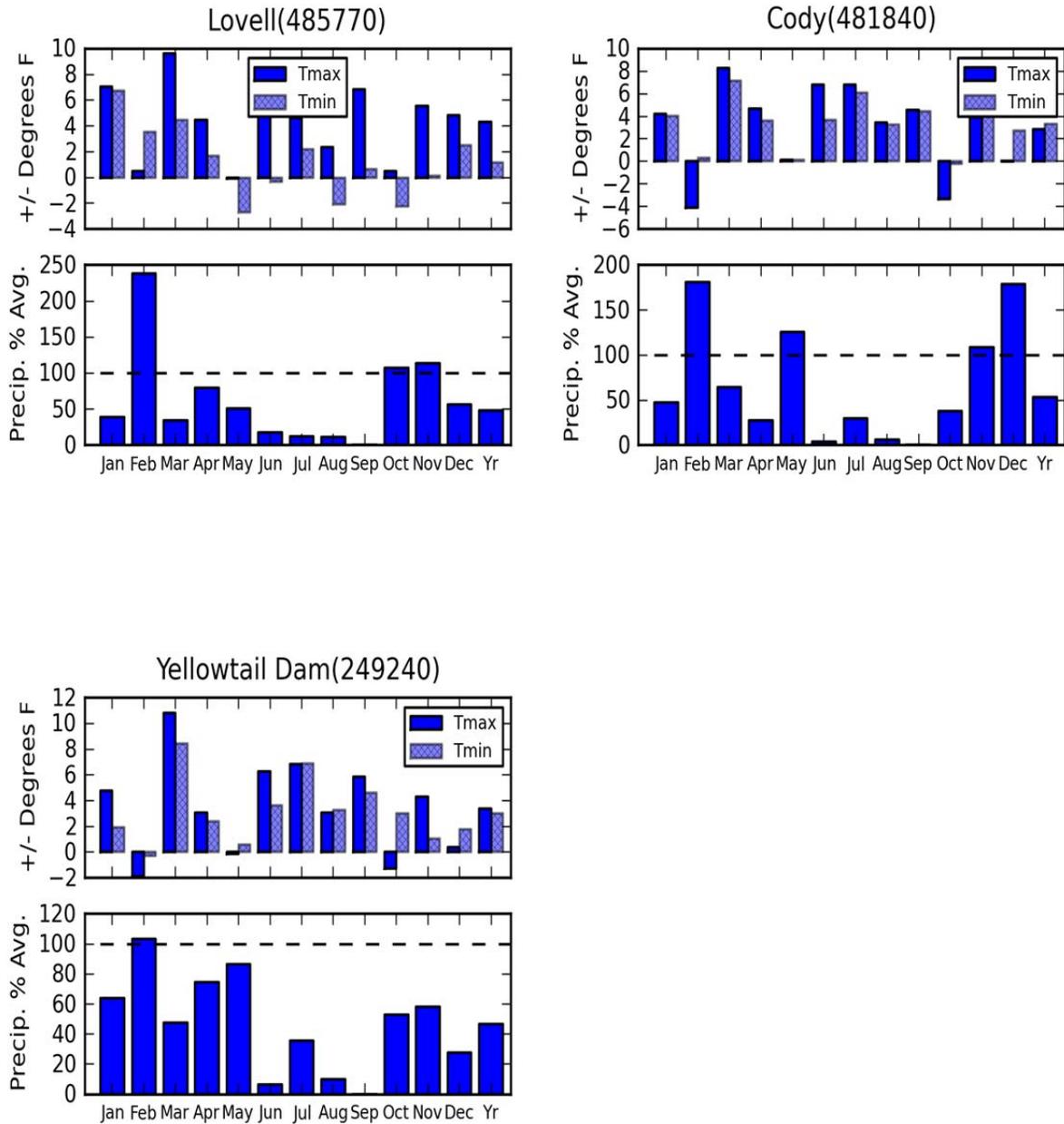


Figure C2. Departure of 2012 average minimum and average maximum daily temperatures and precipitation from 1981-2010 average at key climate stations in and near Bighorn Canyon National Recreation Area. Missing bars (NA) indicate months in which there were insufficient data to calculate a total.

Appendix D. Mean Daily Discharge Compared to Average

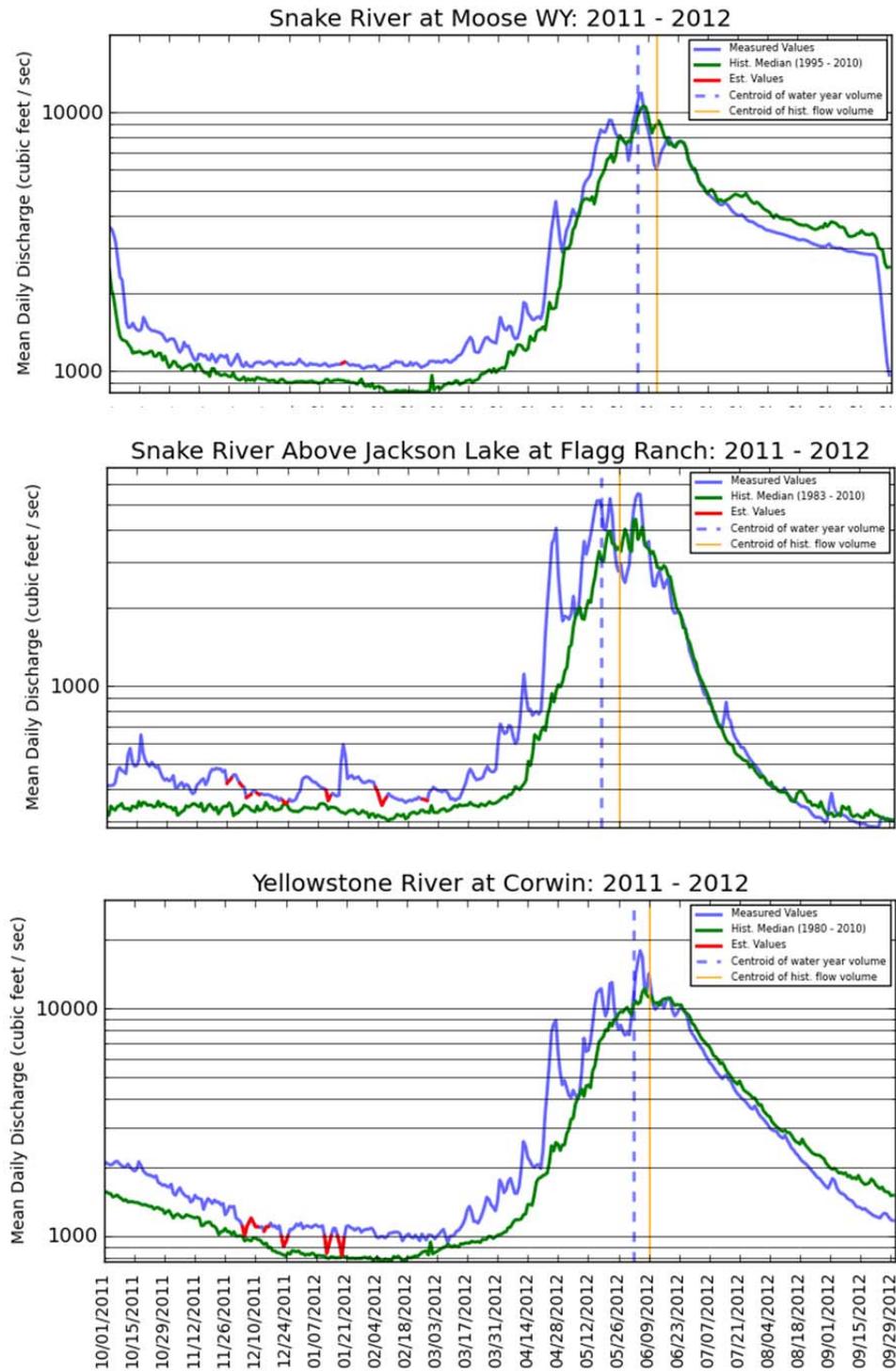


Figure D1. Mean daily discharge from USGS gauging stations on the Snake River at Moose and Flagg Ranch, and the Yellowstone River at Corwin Springs.

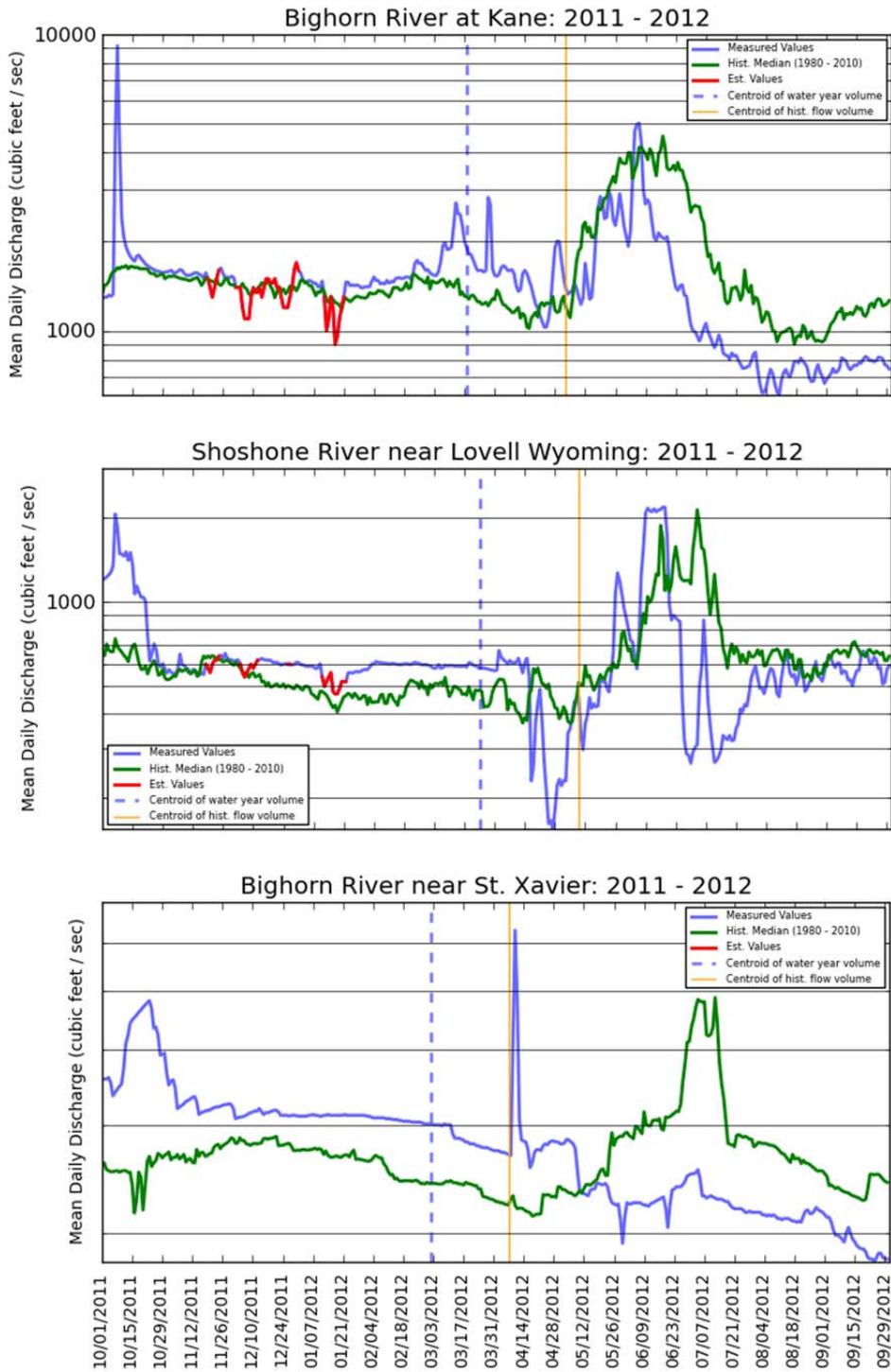


Figure D2. Mean daily discharge from the USGS gauging stations on the Bighorn River at St. Xavier and Kane, and on the Shoshone River near Lovell. Values are compared to averages from the 1981-2010 period.

Appendix E. Daily Measurements of Snowpack and Precipitation Compared to Average

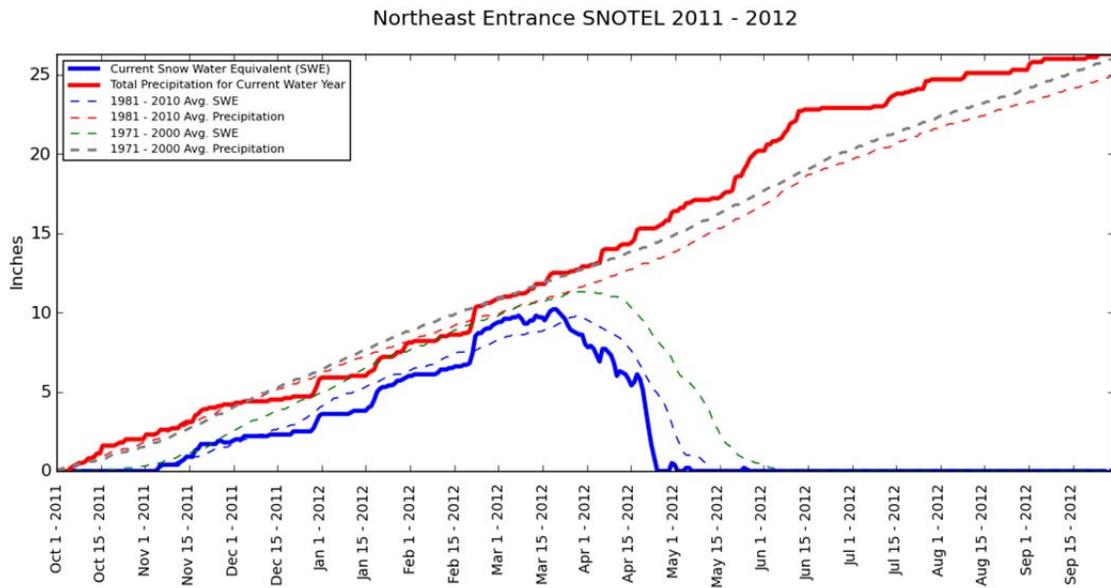
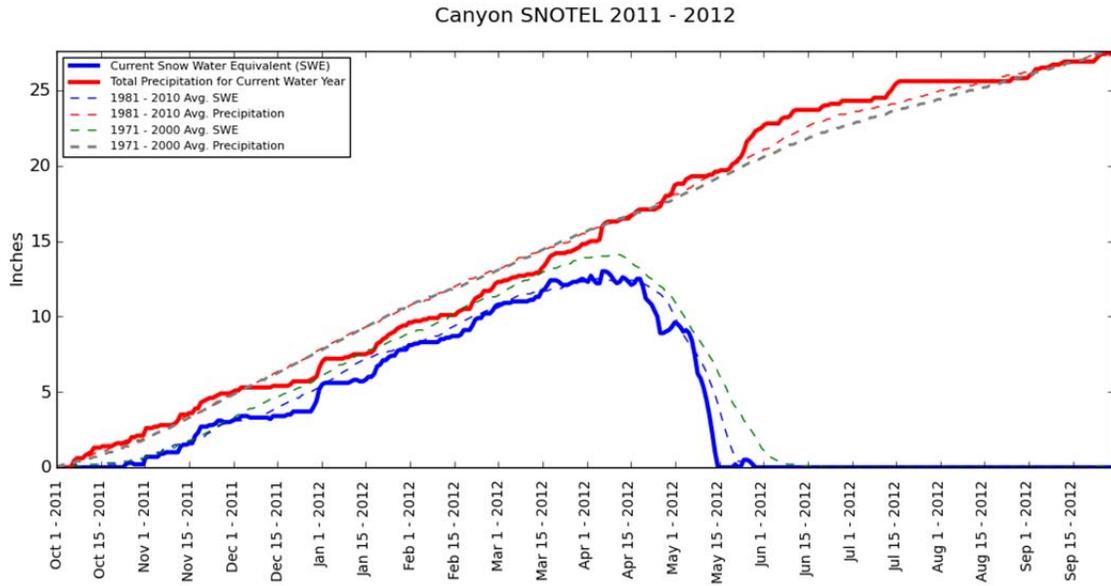


Figure E1. Daily measurements of snow water equivalent (SWE) and precipitation in and near Yellowstone National Park in 2012. Values are compared to averages from both the 1971-2000 and 1981-2010 periods.

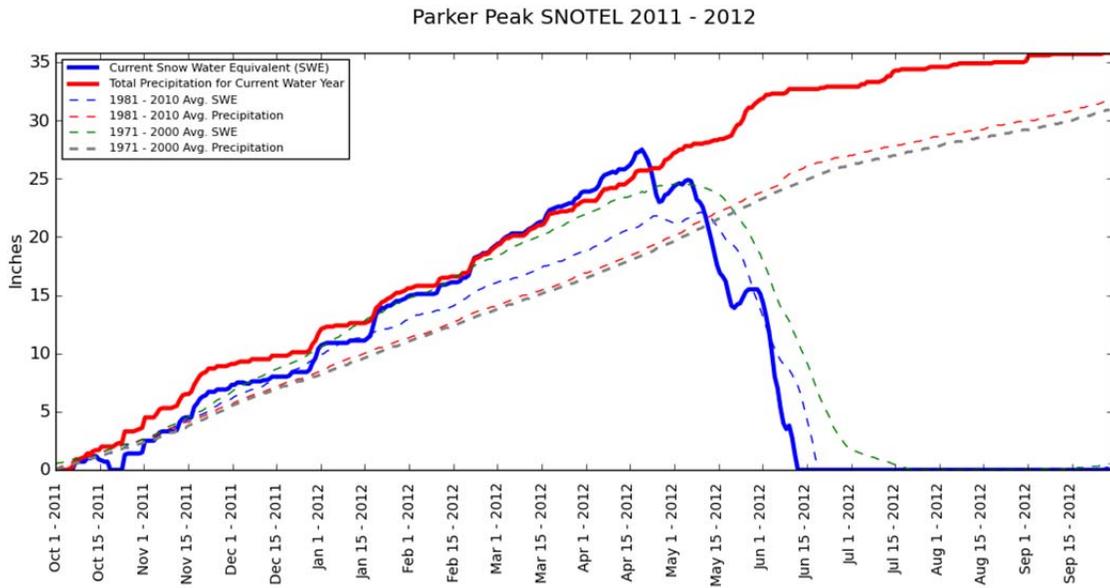


Figure E1. Daily measurements of snow water equivalent (SWE) and precipitation in and near Yellowstone NP in 2012. Values are compared to averages to both the 1971-2000 and 1981–2010 periods (*continued*).

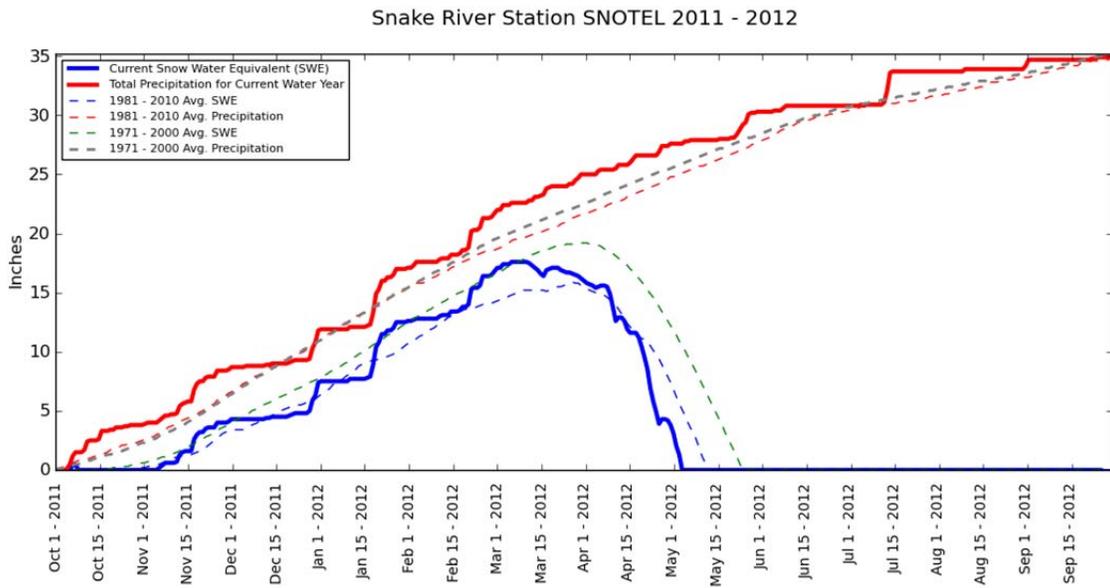
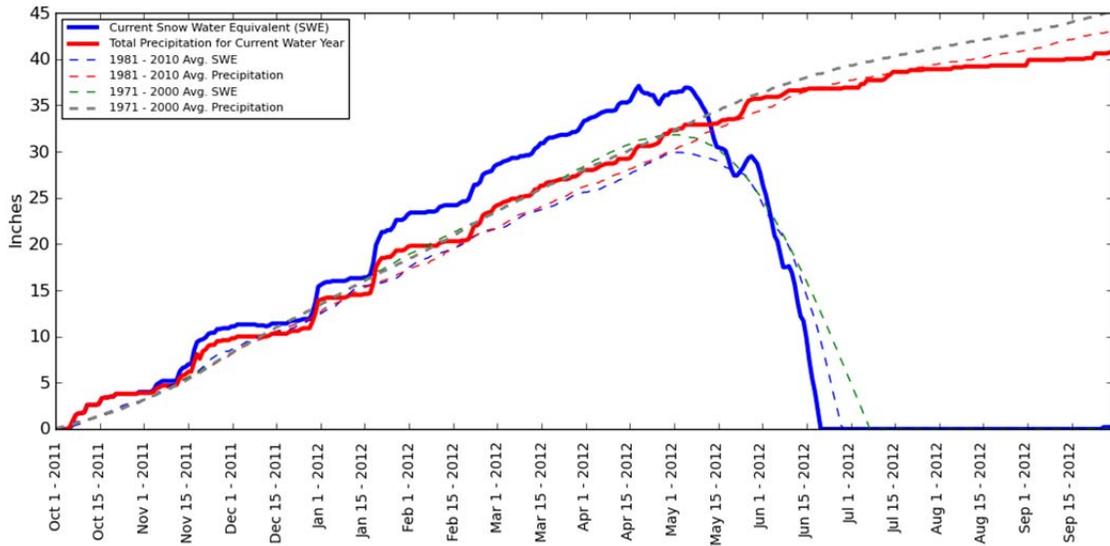


Figure E2. Daily measurements of snow water equivalent (SWE) and precipitation in and near Grand Teton National Park in 2012. Values are compared to averages from both the 1971-2000 and 1981–2010 periods.

Two Ocean Plateau SNOTEL 2011 - 2012



Yount's Peak SNOTEL 2011 - 2012

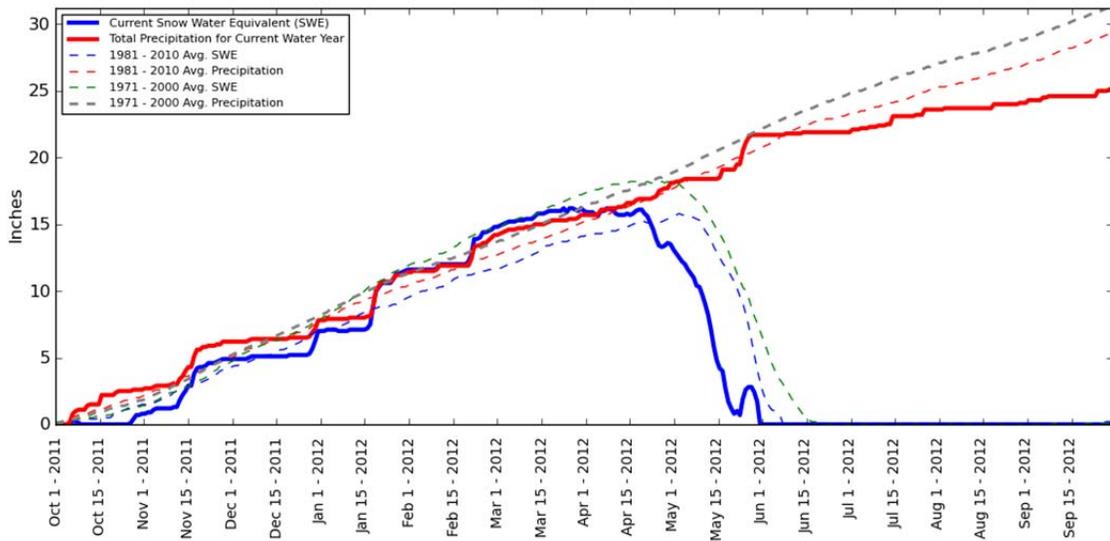
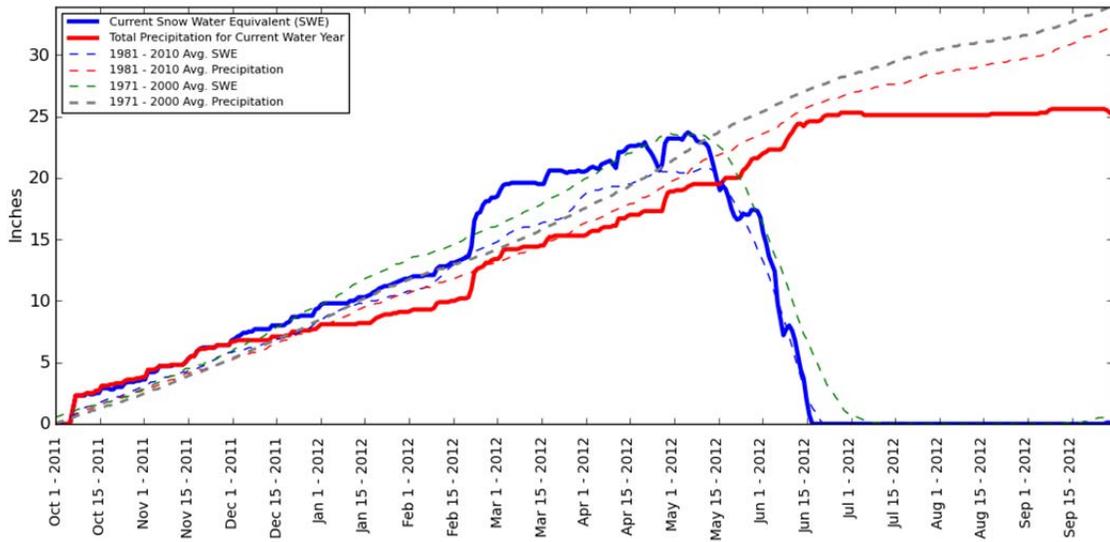


Figure E2. Daily measurements of snow water equivalent (SWE) and precipitation in and near Grand Teton NP in 2012. Values are compared to averages from both the 1971-2000 and 1981-2010 periods (*continued*).

Bald Mountain SNOTEL 2011 - 2012



Shell Creek SNOTEL 2011 - 2012

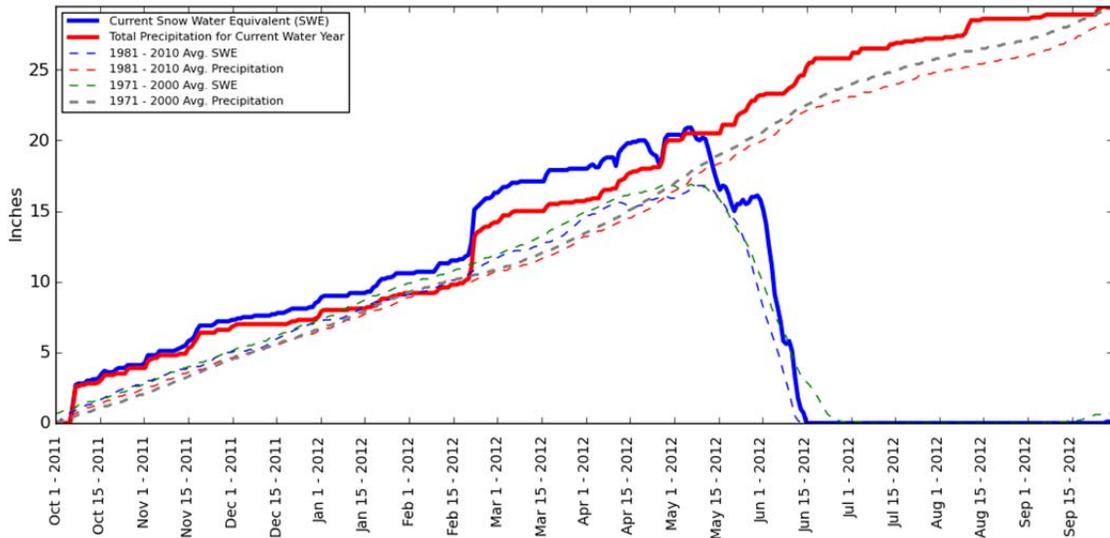


Figure E3. Daily measurements of snow water equivalent (SWE) and precipitation near Bighorn Canyon National Recreation Area in 2012. Values are compared to averages from both the 1971-2000 and 1981-2010 periods.

