NORTH DAKOTA STATE CLIMATE OFFICE
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North Dakota Climate Bulletin

Summer 2007

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In This Issue

NDSCO

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From the State Climatologist

The Climate Bulletin is a digital quarterly publication of the North Dakota State Climate Office, the College of Agriculture, Food Systems and Natural Resources, North Dakota State University in Fargo, North Dakota.

Compared historically, North Dakota had a dry and warm summer. Temperature-wise, the summer of 2007 was the 20th warmest since 1895. Despite of the floods in June which led 11 counties into a disaster, it was the 30th driest summer since 1895. The summer temperature trend for the period of record (1895 to present) was 0.21° F per decade. The total precipitation as percentage of the normal and average temperature departure from normal are shown on pages 3 through 11 (Season in-Graphics). The Season in-Graphics also displays the time series of monthly total precipitation and average temperature of North Dakota for respective months of the season. You will also find the winter outlook in this issue. Hydro-Talk features agricultural impact of the available water during the past summer. The "Science Bits" features "Fall Colors of ND" by the guest writer, Dr. Joe Zeleznik, NDSU Extension Forester, explaining how trees changes into spectacular orange color in every fall. We hope you will enjoy this issue. This bulletin can be accessed at http://www.ndsu.edu/ndsco/. This web site hosts other great resources for climate and weather information.

Adnan Akyüz, Ph.D.
North Dakota State Climatologist

Weather Highlights

Seasonal Summary: by B. A. Mahoney

June 2007

Most June rainfall happened from June 1st through the 18th. Because of the severe storms and flooding, parts of North Dakota were officially declared a disaster. Areas covered by the declaration included Barnes, Bowman, Dickey, Grant, LaMoure, Logan, McHenry, Ransom, Richland, Sargent, and Stutsman counties. Other than a few spotty showers and a more wide spread rainfall around the 25th, the rains began to subside during the last one third of the month. The state average rainfall was 3.41" which is only slightly above the 1971-2000 normal of 3.19". Much of the central and west central areas ended the month with below average to slightly above average rainfall. Far northeastern, southeastern, south central and far south western areas had above normal rainfall. June 2007 ranked 62nd driest (or 52nd wettest) in the last 113 years. The maximum June state average rainfall was 7.21" in 2005 and the minimum was 1.14" in 1974.

Daily air temperatures varied throughout the month with a range of 15 ° F above to 15 ° F below normal. The actual average daily air temperatures ranged from around 50 ° to 80 ° F. The state average air temperature was 65.0 ° F which is above the 1971-2000 normal state average of 63.7 ° F. The month ended ranking the 29th warmest (or 85th coolest) in the past 113 years. The maximum June state average air temperature was 74.2 ° F in 1988 and the minimum was 56.2 ° F in 1915.

July 2007

The July state average precipitation was 2.18" which is below the 1971-2000 normal state average of 2.75". July precipitation was below normal for most of the state. Less than half of normal rainfall fell in a large strip in the western region. A few places had isolated large rain events that brought the rainfall to over 200% of normal. One such isolated rainfall was at Dickinson airport, which recorded 3.19" of rainfall on July 18th. The upper northeast corner, the Dickinson area, and a few places in the southeastern part of the state had normal to above normal rainfall. July was ranked 45th driest (or 69th wettest) in the past 113 years. The maximum state average precipitation was 7.88" in 1993 and the minimum was 0.62" in 1936.

The actual daily average air temperatures across July ranged from around 57 ° F to 90 ° F with departures from normal ranging from -11° to 22°. The monthly departures from normal were above normal all across the state. The July state average air temperature was 72.7 ° F which is above the 1971-2000 normal state average of 68.7 ° F. July ended as being ranked 6th warmest in the past 113 years. The state average maximum air temperature was 79.7 ° F in 1936 and the minimum was 61.8 in 1992.

August 2007

Rainfall events were scattered across the state throughout the month of August. The northwestern, western, and eastern parts of the state had below normal precipitation. The rest of the state was near to or below normal. Parts of the south central, southwestern, and central regions had 200 to 400% of normal rainfall. Sykeston reported 6.38" of rain and Shields reported 6.78". The August state average precipitation was 1.50" which is below the 1971-2000 normal state average of 2.10". The month ended as the 30th driest August in the past 113 years. The August state average maximum precipitation was 5.02" in 1900 and the minimum was 0.72" in 1961.

The average August air temperatures were near normal along the western regions and below normal for the rest of the state. The August state average air temperature was 66.0° F which is slightly below the 1971-2000 normal of 67.2° F. The month ended as being the 50th coolest August in the past 113 years. The state average maximum air temperature was 73.6° F in 1983 and the minimum was 60.9 in 1977.

Season in Graphics

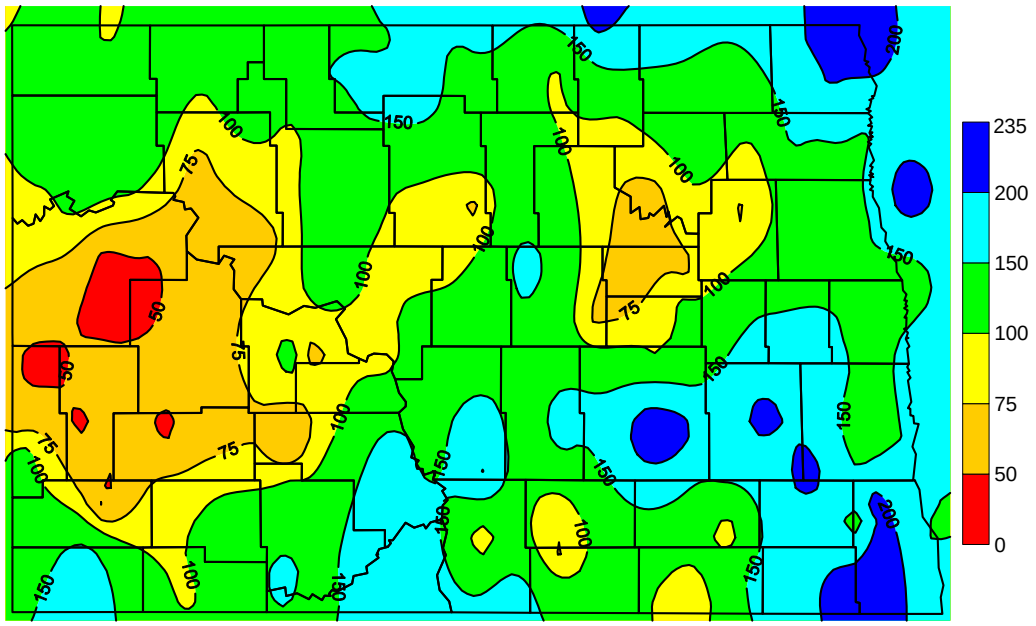
Summer 2007 Weather in North Dakota:

June 2007

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

(Data from NWS Cooperative Network)



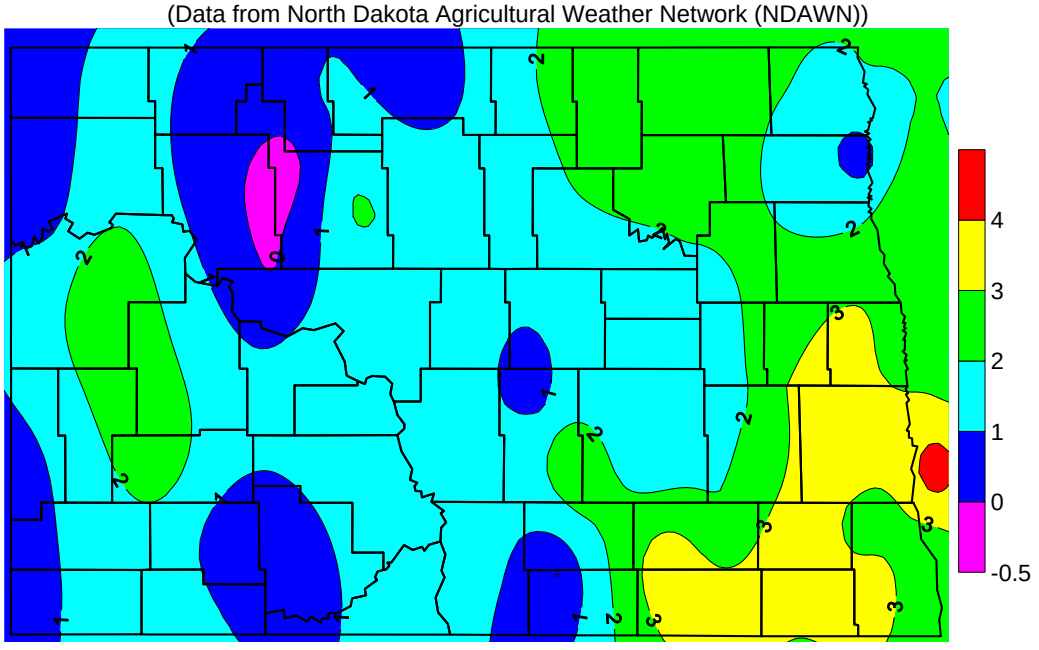
North Dakota State Climate Office

Average Temperature (°F) Deviation from Mean (1971-2000)

Departure From Normal Monthly

Average Air Temperature in degrees F

(Data from North Dakota Agricultural Weather Network (NDAWN))



North Dakota State Climate Office

Season in Graphics

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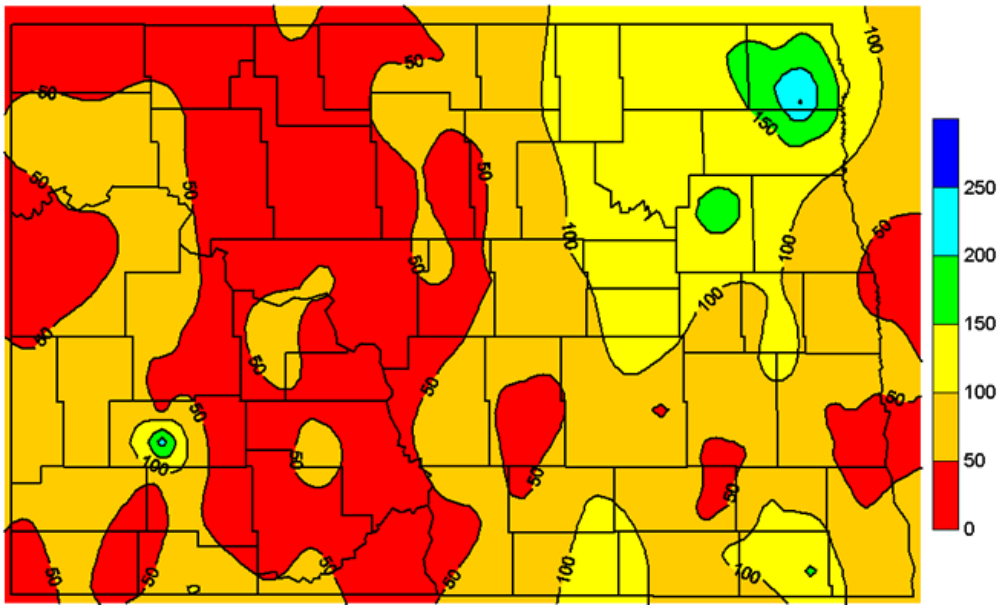

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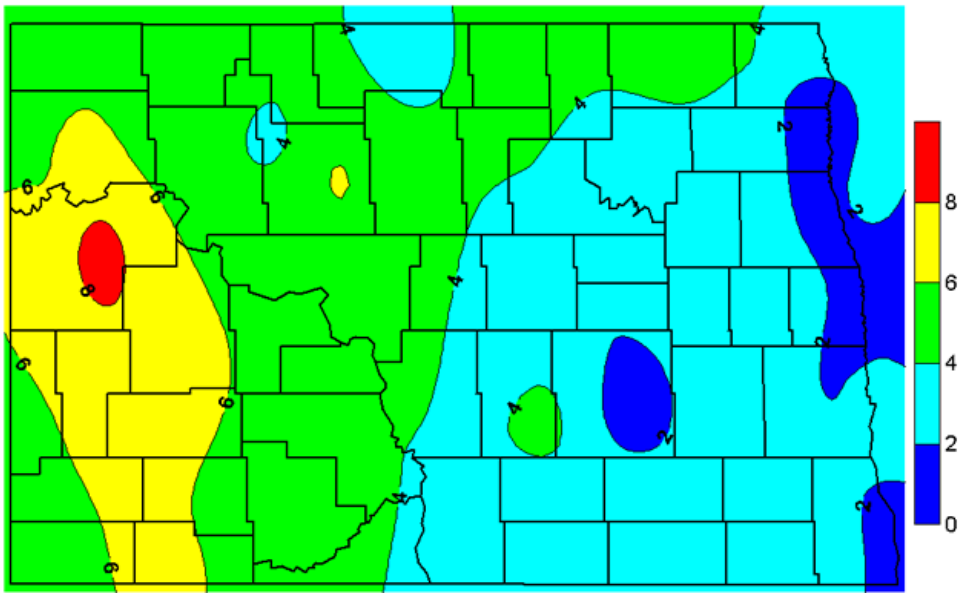


North Dakota State Climate Office

Season in Graphics

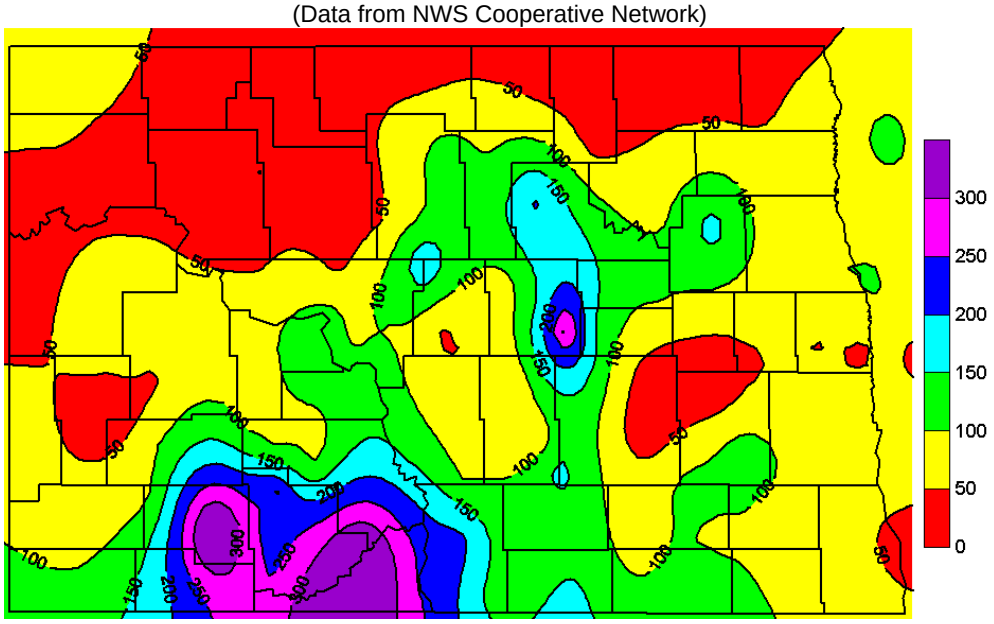
Spring 2007 Weather in North Dakota:

August 2007

Total Precipitation percent of mean (1971-2000)

Precipitation Percent of Normal

(Data from NWS Cooperative Network)

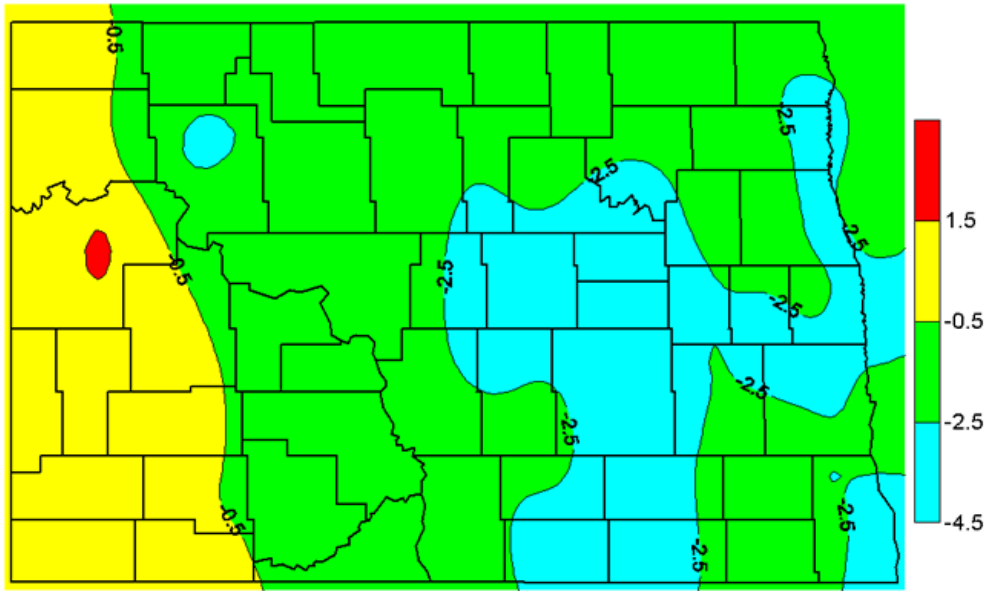


North Dakota State Climate Office

Average Temperature (°F) Deviation from Mean (1971-2000)

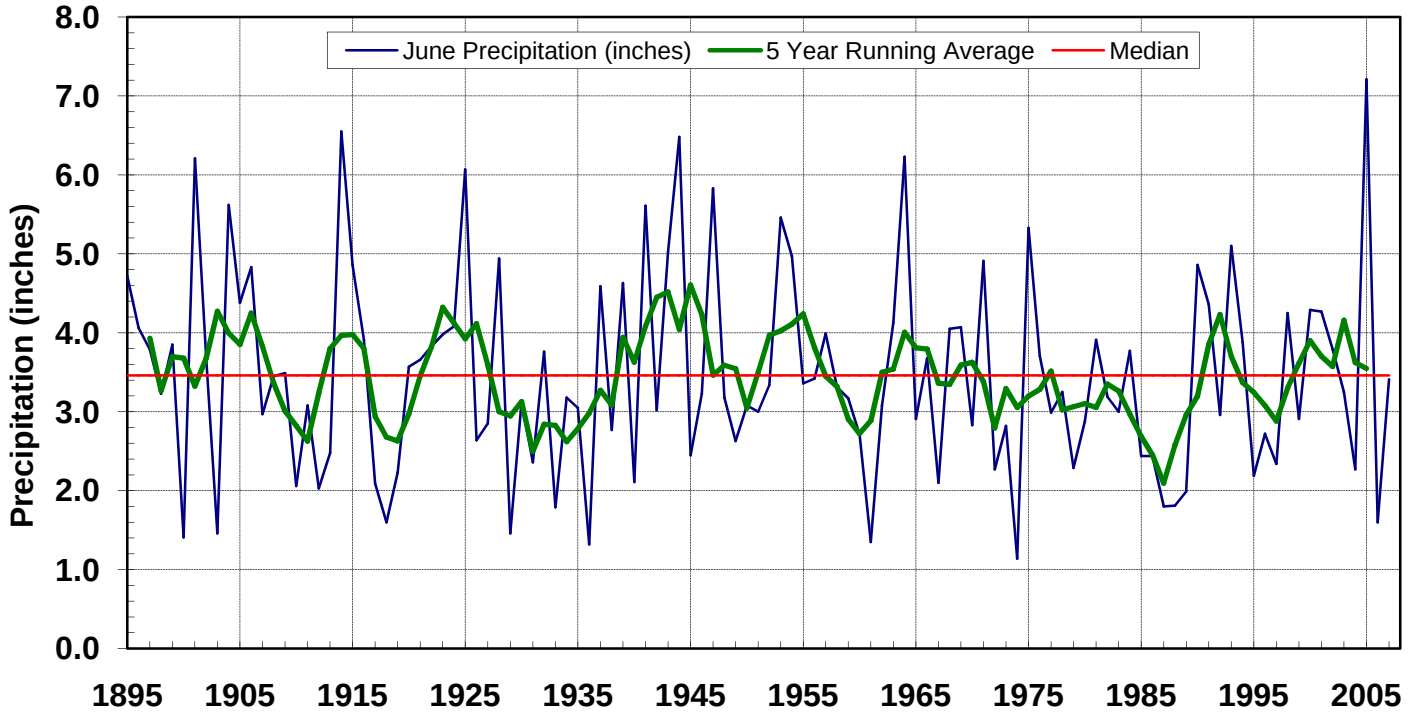
Departure From Normal Monthly
Average Air Temperature in degrees F

(Data from North Dakota Agricultural Weather Network (NDAWN))



North Dakota State Climate Office

Historical June Precipitation for North Dakota

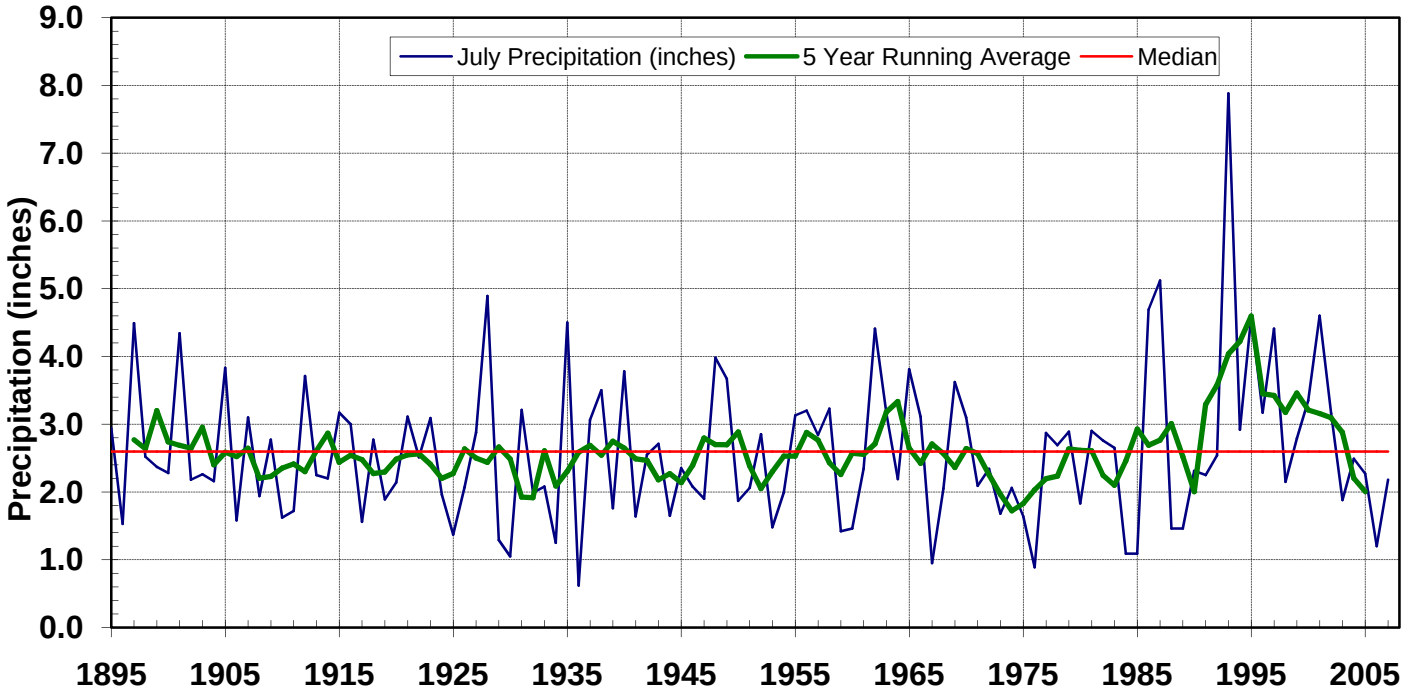


June Precipitation Statistics

2007 Amount: **3.41 inches**
Maximum: 7.21 inches in 2005
State Normal: 3.19" (1971-2000)

Monthly Ranking: 62nd Driest in 113 years
Minimum: 1.14 inches in 1974
Years in Record: 113

Historical July Precipitation for North Dakota



July Precipitation Statistics

2007 Amount: **2.18 inches**
Maximum: 7.88 inches in 1993
State Normal: 2.75" (1971-2000)

Monthly Ranking: 45th Driest in 113 years
Minimum: 0.62 inches in 1936
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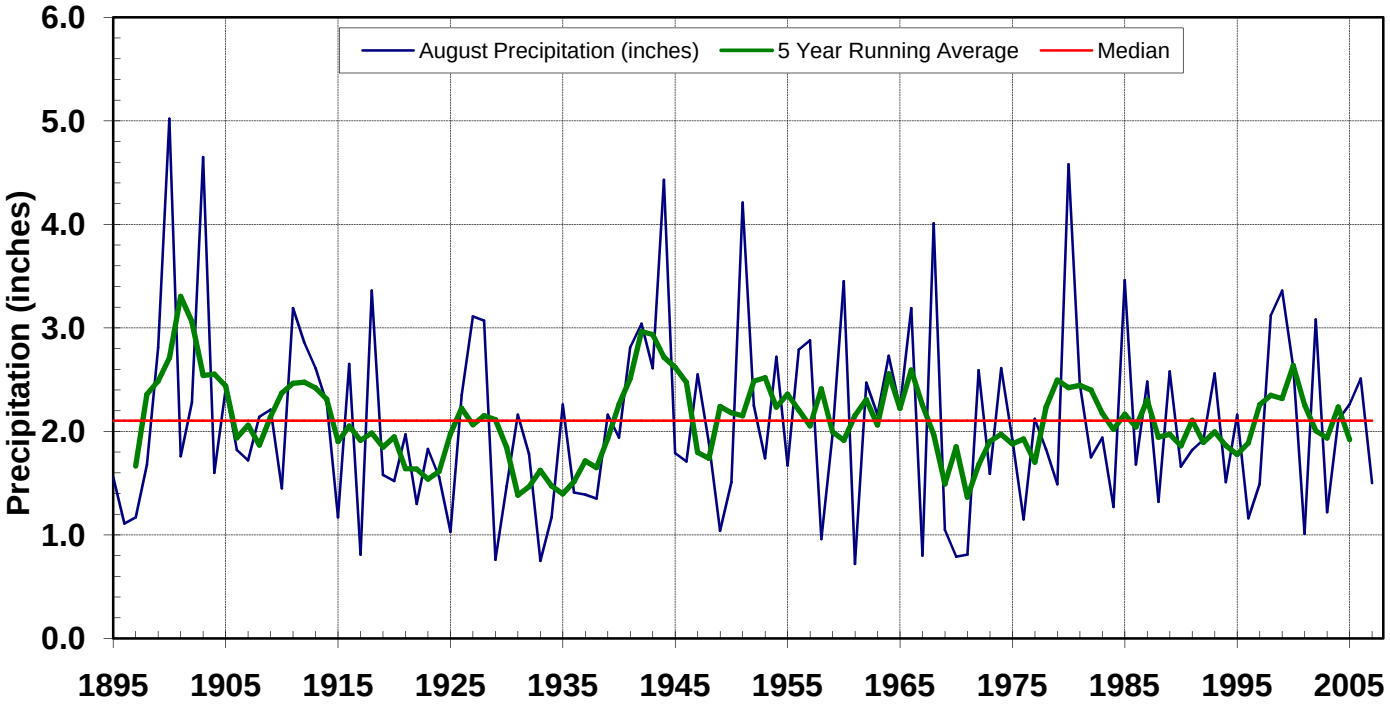
Historical August Precipitation for North Dakota

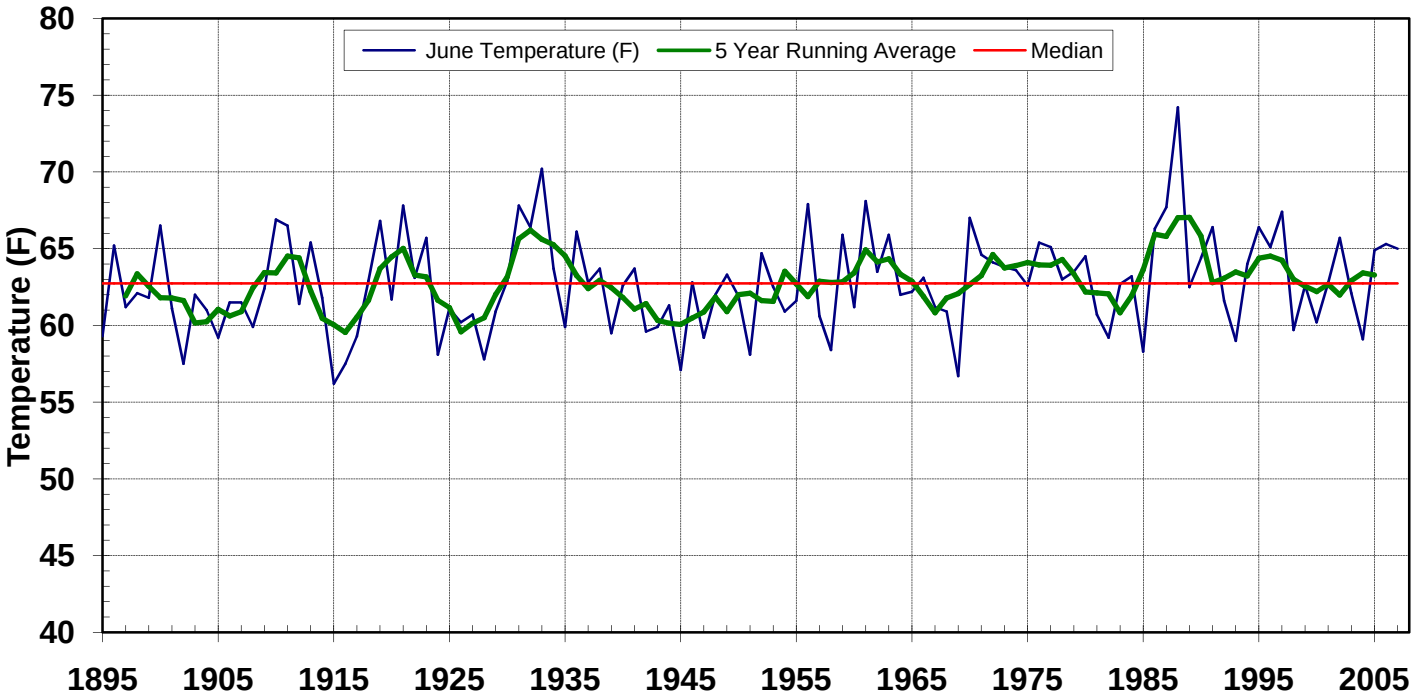


August Precipitation Statistics

2007 Amount: **1.50 inches**
Maximum: 5.02 inches in 1900
State Normal: 2.10” (1971-2000)

Monthly Ranking: 30th Driest in 113 years
Minimum: 0.72 inches in 1961
Years in Record: 113

Historical June Temperature for North Dakota

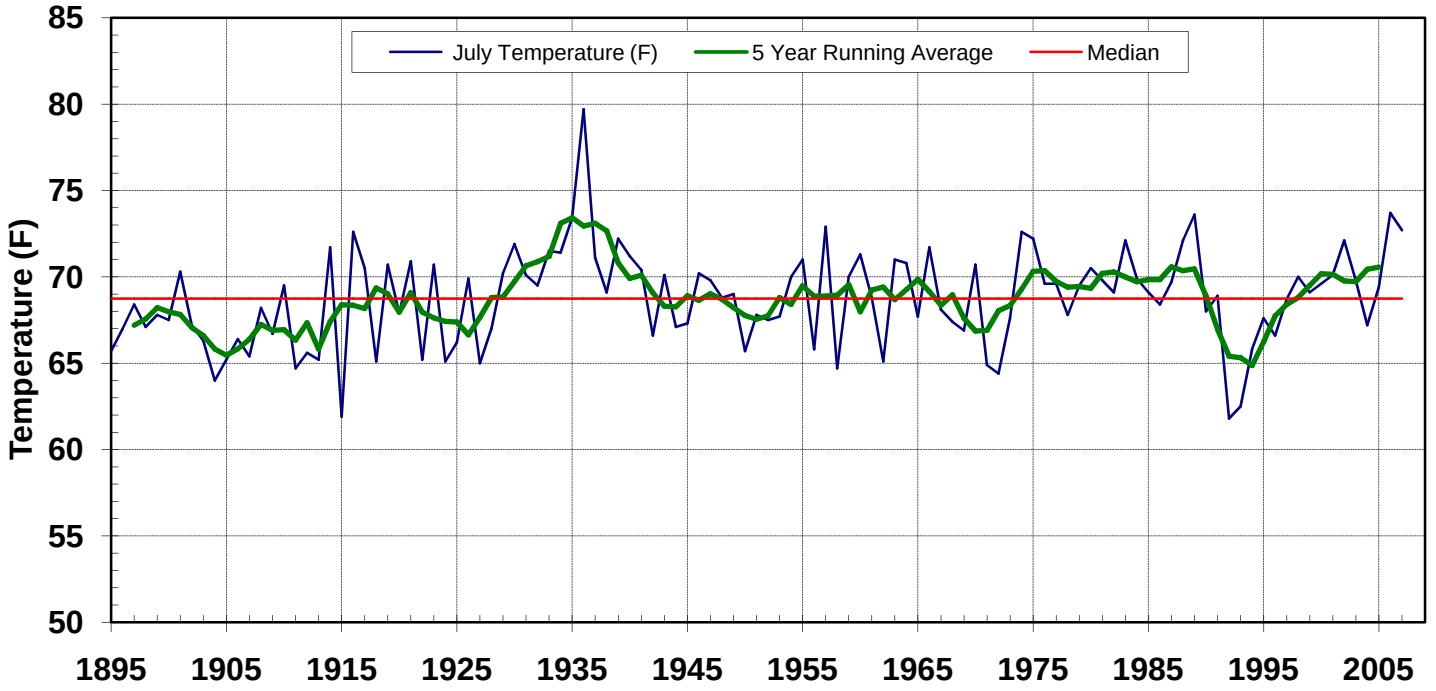


June Temperature Statistics

2007 Average: **65.0 °F**
Maximum: 74.2 °F in 1988
State Normal: 63.7 °F (1971-2000)

Monthly Ranking: 29th Warmest in 113 years
Minimum: 56.2 °F in 1915
Years in Record: 113

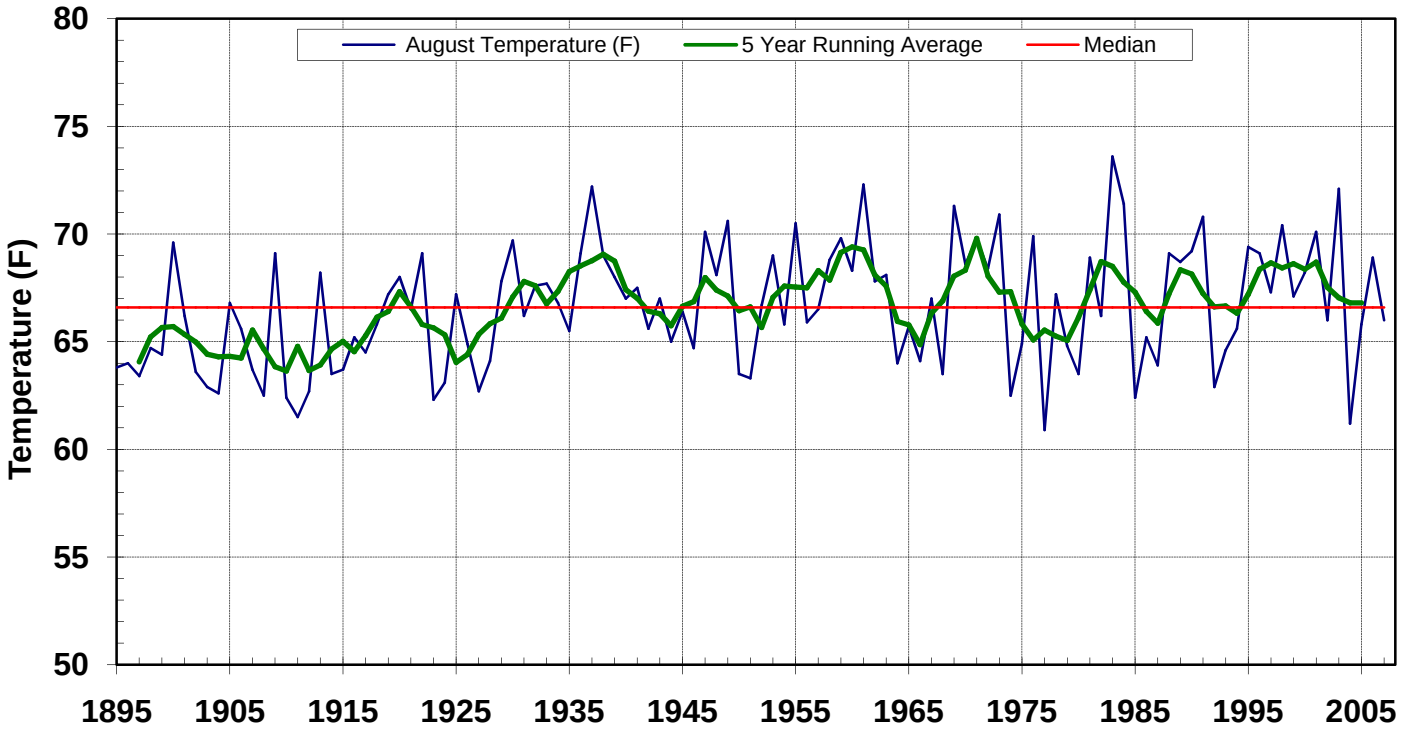
Historical July Temperature for North Dakota



July Temperature Statistics

2007 Average:	**72.7 °F**	Monthly Ranking:	6th Warmest in 113 years
Maximum:	79.7 °F in 1936	Minimum:	61.8 °F in 1992
State Normal:	68.7 °F (1971-2000)	Years in Record:	113

Historical August Temperature for North Dakota



August Temperature Statistics

2007 Average: **66.0 °F**
Maximum: 73.6 °F in 1983
State Normal: 67.2 °F (1971-2000)

Monthly Ranking: 50th Coolest in 113 years
Minimum: 60.9 °F in 1977
Years in Record: 113

Storm Center

State Tornado, Hail, and Wind Reports for Summer 2007 by B. A. Mahoney

North Dakota Counties	Tornado 20	Hail 220	Wind 89
Reports by Month			
Month	**Wind**	**Hail**	**Tornado**
Total June	29	82	7
Total July	46	53	2
Total August	14	85	11

Maximum by County	
County with Most Tornado Reports	Grand Forks and Nelson with 3 each
County with Most Hail Reports	Benson with 14
County with Most Wind Reports	Ward with 6
County with Most Total Reports	Ransom with 26

Maximum by Date	
Date with Most Tornado Reports	8/26/07 with 7
Date with Most Hail Reports	8/10/07 and 8/13/07 each with 26
Date with Most Wind Reports	6/17/07 with 12
Date with Most Total Reports	8/10/07 with 34

Summer 2007 Extremes:

Largest Tornado: EF4 on the Enhanced Fujita (EF) Scale

Where: Northwood North Dakota
When: Sunday August 26th between 8:45 and 8:50 pm

Greatest wind speed: 95 miles per hour

Where: Dickey county, one mile west of Monango
When: July 15, 2007

Where: Sioux county, 10 miles south of Solen
When: July 9, 2007

Largest Hail: 4.25 inches (softball sized)

Where: Logan county, 17 miles east of Napoleon
When: August 26, 2007

Winter Outlook

Seasonal Climate Outlooks

by M. Ewens

"Everybody talks about the weather, but nobody does anything about it." Charles D. Warner

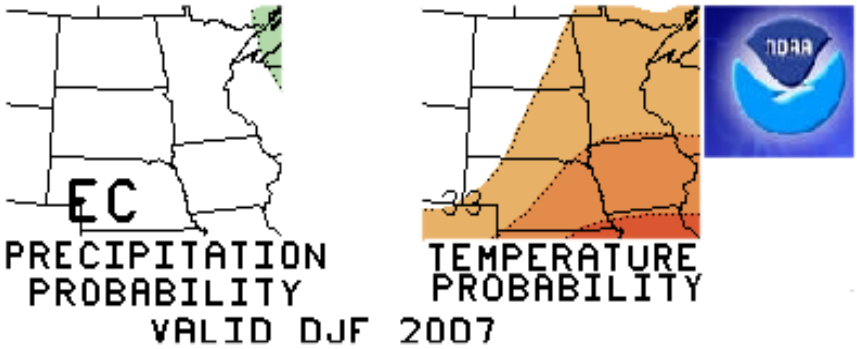
Over the past several decades our understanding of the intricate interactions between the seas, land and atmosphere has dramatically improved. Yet there is much to learn about this interaction that will ultimately make for truly accurate long term climate predictions. The NOAA's Climate Prediction Center (CPC) works with other federal agencies such as National Aeronautics and Space Administration (NASA), and University entities such as National Center for Atmospheric Research (NCAR) to improve climate prediction.

One example of recent research shows a strong correlation between the amount of early winter snows in Siberia and the severity of eastern United States winters. Other developing technique includes the use of statistical modeling tools to look at ongoing trends in the climate to make predictions about future climate. Another is the use of long range complex computer models called General Circulation Models (GCM) in an *Ensemble Technique*. The ensemble technique uses the same computer model, called a **simulation**, but runs it many times over and over. Each simulation starts with slightly different initial conditions called perturbations. The perturbations represent the uncertainty inherent in the analysis of the model. Ultimately an "average outlook" is generated and is used by the forecaster to make the climate prediction.

Other tools such as *neural networks* and *trends analysis* are employed by the CPC in making long range predictions. Neural networks are complex mathematical filters used to predict the climate. Trend analysis look at the overall affects of *Climate Change* to make an assessment of future climate.

Climate outlooks are expressed in degrees of probability of occurrence. Below are the CPC outlooks for the upcoming winter months of December, January and February. The CPC indicates that the upcoming winter will feature normal climatic variability in precipitation, with slightly better than average chances that the Red River Valley east will be warmer than normal (see the shaded map below).

These outlooks are updated on the third Thursday of each month, with a final monthly outlook issued at the end of each month. Most updated local 3-month temperature outlooks for your region can be accessed from the state climate office web site: http://www.soilsci.ndsu.nodak.edu/ndawn/Outlook/L3MTO.html



Hydro-Talk

Summer rains – Smashing success or, too much?

by Charlene Prindiville

All of North Dakota was classified "drought-free" according to the US Drought Monitor by the end of June. Rain totals of 2-7 inches (60% - 200% normal) were common. July moisture, for the most part, averaged 1-5 inches and was below normal in the west to slightly above normal east. However, July's 100+ temperatures and below normal moisture in August, for the western part of the state, bumped the extreme western counties back to a Moderate drought status. The most current Drought Monitor can be viewed at: www.drought.unl.edu/dm

Numerous flash flood events from thunderstorms in June resulted in minor flooding along the Cannonball River in Sioux and Grant Counties, along the lower James River near the South Dakota Border, and near the Williston river bottoms near the confluence of the Missouri and Yellowstone Rivers. Flood damage was mainly the inundation of farmland and county road washouts.

Too much rain?

The prolonged wet period of May and June flooded homes and public infrastructure, created road damage and culvert washouts in 11 North Dakota counties. In the Bismarck County Warning Area these counties included Bowman, Grant, Lamoure, Logan, McHenry, and Stutsman. Crop losses occurred due to overland flooding and standing water. Some crops could not be seeded. According to the Department of Emergency Services, on July 3rd Governor Hoeven requested President Bush to issue a federal Presidential Disaster Declaration for the affected counties. This triggered the release of federal assistance monies to help with community response.

Urban and Small Stream Flood Advisories were issued for the counties of Wells, Foster, Kidder, Logan, McHenry, McLean, Stutsman, and Lamoure during the month of August.

"A Smashing Success" quotes Jay Fuhrer, District Conservationist for Burleigh County, describing the summer growing season. He attributes this success to the farmers and ranchers who have been working toward higher levels of crop health by practicing the use of the no-till system on cropland and the grazing system on rangeland. "These folks weathered the drought better than those that did not". In essence, what that means is that there was a higher efficiency of water usage during the drought. Using these methods, field moisture converts to bio-mass more effectively even with less water. "The top farm and ranch managers today are much more drought resistant than they were ten years ago". (M. Anderson, USDA-NRCS). Good results were obtained this year planting non-conventional crop mixtures. More plant growth and residue that is properly managed improves the overall soil health.

Stock ponds, reservoirs and wildlife refuge pools greatly benefitted from the early summer rains. Soil moisture levels have recharged, mainly central and southeast. Garrison Dam peaked mid July with an elevation of 1818.3 feet, an increase of 11 feet since the drought.

The Bismarck National Weather Service Forecast Office: www.weather.gov/bis
The Grand Forks National Weather Service Forecast Office: www.weather.gov/fgf

Science Bits

Fall Colors of North Dakota

by Joe Zeleznik

One of the great things about living in a temperate climate like what we have in North Dakota is that we have four distinct seasons. Autumn is my favorite season – I enjoy the crisp air, watching migrating birds and viewing the fall colors. Whether it's the bright yellows of quaking aspen trees, the red of staghorn sumac or even the brown of bur oaks, the changing colors signal a time of harvest and the upcoming rest of winter. Many stories have been offered to explain the changes that we see. One of the most commonly-told stories is that of Jack Frost, painting the leaves with his palette of multiple colors. While these stories are intriguing, the truth is a lot more fascinating . It really comes down to the biochemical changes associated with preparation for dormancy.

The chemicals

Four main groups of biochemicals are responsible for the various yellows, oranges, reds and browns that we see in the fall – chlorophyll, carotenoids, anthocyanins and tannins. Each has its own color and chemistry. Varying amounts of these chemicals will give subtle variations in color from one leaf to the next or even from tree-to-tree.

Chlorophyll

The green color that we see on most plant leaves throughout the spring and summer is due to the pigment called chlorophyll. Chlorophyll is one of several pigments that gather energy from sunlight in the process of photosynthesis. Chlorophyll absorbs both the blue and the red wavelengths from sunlight, and reflects the green wavelengths. Nitrogen is one of the main components of chlorophyll. As daylengths shorten and temperatures get cooler, chlorophyll is broken down faster than it's produced. The majority of the nitrogen migrates back to the twigs, being placed in storage for next year's new growth. As chlorophyll breaks down, the carotenoids are revealed.

Carotenoids

Many of the yellows and oranges we see in nature are the result of the various carotenoids compounds. The best-known carotenoids are the ones that give carrots their orange color. Carotenoids play a minor role in photosynthesis so they're present throughout the growing season, but are only revealed when chlorophyll breaks down.

Most of North Dakota's native trees turn yellow in the fall. Some years the leaves are a bright golden yellow while other years may produce soft, dull yellow-to-brown foliage. Brilliant colors are more often seen when the fall weather has warm, sunny days with cool nights between 32° and 45 °F. Indeed, shade-grown leaves often are a duller color than leaves that are in the full sun, even on the same plant.

Anthocyanins

The reds and purples found during the fall are due to the anthocyanins compounds. These are produced when sugars combine with compounds called anthocyanidins. Many things affect the exact color produced by anthocyanins, including the pH (acidity or alkalinity) of the cell sap in the leaves. With an acid pH, anthocyanins are often red; in alkaline solution they become purple-to-blue. Many tree cultivars are known for their purple color during the growing season. Purple-leaf sandcherry, 'Schubert' (or 'Canada Red') chokecherry, and 'Thunderchild' flowering crabapple are found in many North Dakota cities and towns.

Because anthocyanins need sugar for their creation, weather conditions that favor sugar production – i.e., photosynthesis – are essential. Bright, sunny fall days produce the best colors. Very little photosynthesis will occur on cloudy days while rain can actually leach out the anthocyanins and carotenoids from the leaves. Various combinations of anthocyanins and carotenoids can result in yellow, orange and red leaves all on the same tree.

The exact color that is produced by a tree varies from year-to-year. Some people believe that a more brilliant red color can be produced by fertilizing with acid-forming fertilizers, especially aluminum sulfate. While this method sounds like it should work, there is no scientific evidence to support its use.

Tannins

In many forests, oak trees don't add much to the collage of fall colors. They often turn brown because of a group of compounds called tannins. Tannins are unmasked when both chlorophyll and carotenoids are broken down in the leaves. While some oaks do produce a light red or pink color in the fall, our native bur oak does not.

Conifers

Conifers, or "evergreens", may also change color and lose their leaves in the fall. Shedding the older needles – those toward the interior of the plant – naturally occurs every year in many conifers such as spruce and pine. This type of pattern of needle drop is normal. Larch trees are unique among the conifers in that they lose all of their needles every year. They are "deciduous evergreens." The needles turn a bright golden yellow and are beautiful to observe as they float lazily to the ground.

An Autumn Blaze® maple in full fall coloration. Photo by Dale Herman.

Conclusion

Fall colors vary from one species to the next, from one tree to another within the same species, and even from year-to-year. I really enjoy that change because I never know what to expect! In North Dakota, most of our native forestland is along the rivers, in the Turtle Mountains or through the Pembina Gorge. Peak colors are usually seen in early October, but may be a week earlier or later. Some individual trees may even hold their leaves even into early November. The challenge is to see the colors before the next big wind blows all the leaves away!

North Dakota citizens can tune into the "North Dakota Tourism" web site @ http://www.ndtourism.com/ for the latest foliage report.

CONTACTING THE NORTH DAKOTA STATE CLIMATE OFFICE

Please contact us if you have any inquiries, comments, or would like to know how to contribute to this quarterly bulletin.

North Dakota State Climate Office

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