

The Drought of 2012 in Iowa

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The beginning of Iowa's drought of 2012 was in the summer of 2011. A cool and wet spring and early summer in 2011 quickly transitioned to a warm and dry pattern in late June. What at first was a welcome dry period began on June 27 with above normal temperatures becoming prevalent on June 30. Warm and humid weather intensified in July with Iowa recording its warmest July since 1955 and warmest calendar month since August 1983. At Fairfield in southeast Iowa July 2011 brought only 0.20 inches of rain (5% of normal). This was their seventh driest July among 132 years of records and followed what had been the seventh wettest May-June period of record. The heat index climbed to 110° or higher on nine dates among the ASOS network with maximum readings of 117° at Spencer on July 18 and 117° at Iowa City on August 2 (NOTE: The Iowa AWOS network has a strong warm bias and high dew point bias compared to the ASOS network, leading to unrealistically high heat indices). Actual temperatures peaked at 106° at Fairfield on August 2, Iowa's highest official temperature since 2006. Relatively dry conditions became more widespread in August (with the exception of far southwest Iowa) with Burlington recording their driest August since 1920 with only 0.44 inches of rain. Crop yields were reduced in parts of southeastern Iowa in 2011, however, for the state as a whole production was good thanks to abundant soil moisture reserves in most areas and the relatively late start to the drought.

Drier than normal weather spread to nearly all of the state during September 2011. Sioux City recorded their driest September since 1950. The statewide average pasture and range condition deteriorated to only 28% of Iowa reporting good to excellent conditions, the lowest percentage since August 2006. Streamflow levels were also becoming quite low in southeastern Iowa. The dryness intensified in October. Onawa (west central) reported only 0.04 inches of rain for the month. At Carroll (west central) and Lamoni (south central) the month ranked only behind 1953 and 1975 as the driest October in over 100 years. By the end of October 2011 the condition of the state's pastures (19% good to excellent) declined to the lowest level since November 2003. On the positive side dry weather allowed the harvest to proceed about two weeks ahead of the normal pace with only 13% of the corn and 2% of the soybeans remaining in the field by October 30.

A series of storms brought abundant precipitation to southeast Iowa during November 2011 and erased all drought conditions in that area. However, very dry weather intensified over far northwest Iowa where Orange City recorded only 0.01 inches of precipitation for the month.

The winter season, particularly in northwestern Iowa, is easily the driest season of the year. Thus, while evaporation rates decline to near zero and thus prevent any worsening

of drought over the winter the odds of having significant precipitation in mid-winter to improve the drought situation is slim. The winter of 2011-2012 was a mild one with temperatures for the December-February period averaging the ninth highest since 1895. Snowfall was infrequent with the 13th lowest statewide average amount among 125 years of records. The minimal snowfall resulted in the common perception that lack of snow was a major factor in the development of the drought. However, several mid-winter rain events more than made up for the lack of snowfall as the statewide average winter precipitation was actually the 14th highest total since 1895.

An unseasonably heavy late winter precipitation event brought widespread rain to northwest Iowa on February 28-29, 2012. Thanks to the mild winter much of this moisture was able to soak into the ground (which typically would be frozen well into March) and provide a much needed boost to soil moisture levels in this driest corner of the state.

March 2012 began with four days of cool, snowy weather. However, this would prove to be the last measurable snow of the winter in Iowa. An exceptionally mild period of weather began on March 10 and persisted into early April. The statewide average daily minimum temperatures were higher than normal maximums every day from March 14 through the 22nd. Numerous daily high temperature records were set such as at Cedar Rapids where records were recorded for seven consecutive days (14th-20th) among 120 years of records. The month went on to be the warmest ever March, in terms of statewide average temperature, at 51.1 degrees, 15.2 degrees above normal and 2.4 degrees above the previous March record set in 1910 (and 2.2 degrees warmer than the typical April). This warmth accelerated vegetation growth to about one month ahead of usual. This warmth had two major repercussions. First, it set the stage for a very damaging freeze event when seasonable cold returned on April 9. Second, the one month early start to the growing season resulted in an extra month of evapotranspiration and further depleted low soil moisture reserves.

April 2012 precipitation was near seasonal averages but would later prove to be the wettest month of the year. April temperatures averaged from one degree above normal in the northeast to five degrees above normal in the southwest. Nevertheless, over much of eastern Iowa April averaged cooler than March.

May 2012 appeared destined to finish among the ten warmest Mays of record if not for a brief turn to very cool weather the last two days of the month. Statewide temperatures averaged five degrees above normal while rainfall was much below normal except over far northwest Iowa. The month began with frequent rainfall but very dry weather developed during the second week of May. Some south central and east central Iowa locations recorded 19 consecutive days without rain and the focus of the drought moved from northwest to east central Iowa.

June brought temperatures averaging about two degrees above normal while drought intensified over all but the southwest corner of the state. Several northwest Iowa locations experienced a record dry June such as Sibley where their 0.36 inch total was

well below their previous June record of 0.96 inches (set in 1888) among 113 years of data at that location. The season's first triple digit heat arrived on June 27 with 101° at Des Moines, Little Sioux and Sioux Center. The month's highest reading came at Keokuk on the 28th with 104°, Iowa's highest June temperature since 1988.

July is known as being the single most critical month for Iowa's row crops. However, July 2012 will long be remembered for extremely hot and dry weather. Every reporting point in the state recorded below normal precipitation. No measurable rain was recorded for 39 consecutive days at Underwood (southwest) from June 29 through August 7. Numerous locations, mainly in the southwest, saw record low July rain totals such as Atlantic where a trace easily beat the previous record low of 0.43 inches set in 1975 among 125 years of data. All but four days in July brought above normal temperatures with daytime highs of 90 degrees or higher recorded on 28 days at Atlantic, Mount Ayr, Osceola and Shenandoah. Statewide there was an average of 21 days of 90°+ temperatures and three days of 100° or higher during July while a typical *year* brings 23 days of 90 degree heat and one day in the triple digits. Highest official temperatures were 107 degree readings on the 23rd at Donnellson, Fairfield and Keokuk. These were Iowa's first 107 degree readings since July 29, 1999.

The excessive heat continued into the first four days of August. A strong, but brief, cool down on the 5th and 6th brought a few daily record low temperatures on the morning of the 6th with Belle Plaine (east central) falling to 43°. The heat quickly returned with Keosauqua soaring back to 103° on the 7th. However, a very welcome period of much cooler weather brought below normal temperatures from the 9th through the 21st. Daily record low temperatures were set in some areas on the 11th, 17th, 18th and 19th with Battle Creek (west central) and Sibley (northwest) reporting 38° on the morning of the 17th. These were Iowa's lowest temperatures for so early in the season since 1978. However, the heat was not done as above normal temperatures returned for the final ten days of August. There were a few daily record high temperatures set on the 29th and 30th with Hawarden reaching 104° on the 30th. Precipitation was more frequent than in July but remained well below normal over most of the state. The somewhat cooler and wetter weather slowed the rate of decline in crop conditions but did not improve conditions. Crops and pastures were generally rated the worst for the season since at least 1989.

September's weather began with temperatures mostly above normal, but cooler than usual weather dominated most of the remainder of the month. There were scattered freezes in northwest Iowa on the mornings of the 18th and 22nd. However, a widespread freeze came on the morning of the 23rd when 70% of the state reported temperatures of 32 or lower. Sheldon and Spencer reported the lowest temperatures with 22 degree readings. This was Iowa's most widespread freeze for so early in the season since September 22-23, 1983. An additional 10% of the state (mostly in eastern Iowa) recorded a freeze the next morning with additional scattered light freezes on the 26th, 27th and 28th. Typically freezes occurring this early in the fall could potentially cause significant crop damage, however, the very warm growing season pushed the maturity of all vegetation well ahead of the usual pace, thus no freeze damage was reported. September precipitation continued to be well below normal in most of Iowa. The dry

weather and early maturity of crops led to a very early completion of the corn and soybean harvest. A few farmers were even harvesting corn in August with over one-half of corn and soybeans harvested by the end of September, compared to typical progress of 8% of the corn and 21% of the soybeans by October 1. Overall, the harvest was completed three to four weeks earlier than usual in 2012. The very long and warm growing season allowed crops to dry down naturally in the field thus requiring virtually no expenses in artificially drying grain to allow for long-term storage.

Overall View. A common question received during the development of the drought was how does this compare to previous droughts? And when was it last this dry? Given the multitude of factors that combine to create drought conditions it is never easy to accurately place a drought in historical perspective. This is compounded by the fact that when the drought is occurring we do not know what the ultimate course it will take. Will this be a long-lasting drought or is relief perhaps just around the corner? In Iowa there were continual comparisons made between the 2012 drought and that of 1988, which was the last time Iowa experienced a combination of prolonged excessive summer heat and substantial precipitation shortfalls (frequent drought in the 1999-2003 period largely took place without unusual heat). The 1988 drought began with very dry conditions in the spring while that of 2012 was initially characterized by a very dry second one-half of 2011 and a warm spring in 2012. July 2012 went on to be much hotter, and drier than July 1988, thus more frequent comparisons began to be made with earlier droughts, such as the mid 1950's and the 1930's. However, the worst of the heat in 1988 came in August while in 2012 the worst of the heat was over by the end of July. Overall, the two years compare somewhat similarly. In 1988 Iowa recorded its fourth hottest and 14th driest summer while in 2012 it was the fifth driest and 14th hottest summer. Precipitation for the calendar year of 1988 averaged about five inches less than in 2012, mainly thanks to a drier spring. Precipitation was also much more variable in 1988 with a few extremely dry locations (only 14.02 inches for the year at Blockton along the Missouri border in southwest Iowa) while parts of northwest Iowa received near-normal precipitation. In 2011-2012 the geographic center of the drought impacts seemed to be constantly on the move. In the beginning it was southeast Iowa with the greatest impacts in late summer 2011. By the end of 2011 it was far northwest Iowa. By the beginning of the summer of 2012 the worst conditions seemed to be over east central Iowa but by mid summer practically no rain was falling over parts of west central and southwest Iowa (which had been the wettest area of the state early-on).

Now that 2012 is well behind us it is apparent that the drought was not a particularly long-lasting drought, thus in terms of water supply issues, simply was not persistent enough to result in the types of water supply issues seen in droughts such as the 1930's and 1950's (and in fact the overall precipitation totals of the recent drought were not even as low as much more recent droughts in 1988 and 1976). In short, the 2012 drought was intense, with the particular misfortune of a very hot and dry July (fourth hottest and fifth driest among 140 years of data), but comparatively brief. Also, an important factor that limited hydrological impacts from the intense drought of 2012 is that Iowa experienced an exceptionally wet, and often unusually cool, period from December 2006 through June 2011. This was the wettest extended period in Iowa since at least 1860 (some indication

of similarly wet weather in the mid Nineteenth Century). Among 140 years of statewide average statistics 2007 ranked as Iowa's 6th wettest calendar year, 2008 was 5th wettest, 2009 was 12th wettest and 2010 was 2nd wettest. This, combined with a cool and wet spring season in 2011 meant that all of Iowa's aquifers were at or near historically high levels and soil moisture reserves were abundant at the onset of the drought.

Another difference between this and earlier droughts is that following the 1988 drought a major effort was made to develop regional rural water associations. The rural water systems greatly mitigated the local water supply issues that were frequent in 1988 and 1989 when many municipalities and hundreds of rural farm families had no alternative to shallow wells for their water. However, the nature of water use also had changed greatly between 1988 and 2012. Large livestock confinement operations were few and far between in 1988 and were commonplace in 2012. Thus, there were literally hundreds of relatively large rural water users in 2012 that had a critical need for water. In some cases in 2012 there were parts of western Iowa where even the rural water systems were very close to not having enough water to meet the minimum daily water needs. Additionally, the recent development of the renewable fuel industry also created much greater water demand in those areas where they were located, a water need that simply did not exist in 1988. In most cases the ethanol production facilities developed their own sources of water, independent of municipal or regional water systems. Production of ethanol also declined in 2012 owing to a drought-induced spike in corn prices, thus simultaneously decreasing the demand for water needed for that purpose. As the drought intensified the Iowa DNR worked to identify water systems most at risk of being unable to meet water demand. Potential breakdowns in water treatment, or losses of water owing to water main breaks, became very important as many systems were just barely meeting water demand with 24-hour per day operations. Thus a sudden loss of storage or treatment capability would have immediate impacts. Water systems were strongly encouraged to be sure their water allocation priorities were set and that the public was made aware of potential rationing policies prior to their having to be implemented.

The Iowa corn and soybean crops fared much better than most analysts expected in 2012. Preliminary data suggest that Iowa's corn yield averaged about 20% less than the prior four-year average compared to a 33% decline in 1988. Similarly the statewide average soybean yield in 2012 was 10% less than the most recent four-year average compared to a 20% decline in 1988. Improved genetics, as well as increased use of conservation tillage, has been noted as possible factors explaining the relatively better yield in 2012 versus what was realized in 1988. For the state as a whole, higher grain prices in 2012 roughly offset the drought-reduced production. However, it was a much more difficult year for livestock producers as feed costs were very high, excessive heat reduced the efficiency of weight gain and insurance to protect revenue was not available for livestock production as it was for grain production.

The Iowa Dept. of Natural Resources reported that the dry weather brought a large increase in the number of campers utilizing the state parks. Public swimming pools and water parks also enjoyed a brisk business. However, boating, canoeing and kayaking activities were greatly curtailed owing to low water levels. A positive effect of the low

water was the great fishing that anglers experienced due to the fish being concentrated into the remaining areas containing deeper water.

The drought provided very favorable conditions for the spread of Epizootic Hemorrhagic Disease in deer. Deer mortality was high in many areas in 2012 owing to EHD. Drought can also cause toxins to develop in corn which can impact some wildlife species. However, in some instances dry conditions can produce favorable conditions, such as for shorebirds by exposing additional mudflats used for foraging.

The low water conditions of 2012, combined with heavy spring rains and flooding in April 2013 resulted in poor production of Canada geese in 2013. Other effects of the drought are more difficult to assess. For example, the 2012 drought may have reduced the mast crop in 2013 which can affect wildlife dependent upon hard mast. Additionally, 2012's drought resulted in reduced growth of native warm season grasses and forbs and it appears that this may have reduced numbers of some butterfly and other prairie obligate insect species due to lack of production or over-wintering habitat. Any impact in insect numbers may result in unpredictable impacts up the food chain in animals such as birds and bats.

A positive impact of the 2012 drought; the zebra mussel population in Clear Lake, the largest natural lake in north central Iowa, decreased dramatically. Prior to 2012, surveys for adult zebra mussels sometimes gave results of over 30 individuals per square inch and rocks that were frequently 75-100% covered with zebra mussels. Veliger samples during those years at times had over 200 individuals per liter. The drop in water level during 2012 stranded many zebra mussels out of the water while ice action during the winter of 2012-2013 scoured off many more. In 2013, there were only 3 veligers per liter of water and less than 10% (usually 0%) coverage on all rocks collected. The rocks that had anything on them had 1-3 adults and/or juveniles.

Finally, 2012 was a very quiet year for severe weather in Iowa. Iowa recorded only 16 tornadoes during the year which was the lowest annual total for the state since 1953 (when tornado records were far less complete than today). The drought-induced dearth of 2012 tornadoes, combined with a very cool spring in 2013 resulted in the longest tornado-free period known in Iowa (May 25, 2012 through May 18, 2013). Additionally, the state recorded a very long snow-free period during 2012. The last measurable snow of the 2011-2012 winter season was on March 4 (about five weeks earlier than usual) while the first widespread accumulating snow in the fall did not arrive until December 7 (about three weeks later than normal).

* Crop and pasture statistics are from data collected by the USDA National Agricultural Statistics Service; weather statistics are derived from raw data collected by the U.S. Dept. of Commerce National Weather Service. Finally, information regarding water supply issues and fish & wildlife impacts came from the Iowa Dept. of Natural Resources.