

Is Drought Bad for the Lake?

~ *Melissa Clark*

Well, it somewhat depends on your perspective and who and what you're concerned about. We have certainly experienced and heard about the difficulties that farmers are having nationwide with row crops and livestock. We have all seen the dried-out fields of wasted corn. We've seen our lawns turn brown while some have even turned to spray painting their turf green! At least we don't have to mow the lawn.

So, what is a drought? This also depends on what one measures. According to the National Drought Mitigation Center, "drought is a condition of moisture deficit sufficient to have an adverse effect on vegetation, animals, and man over a sizeable area." There are three additional ways to classify droughts:

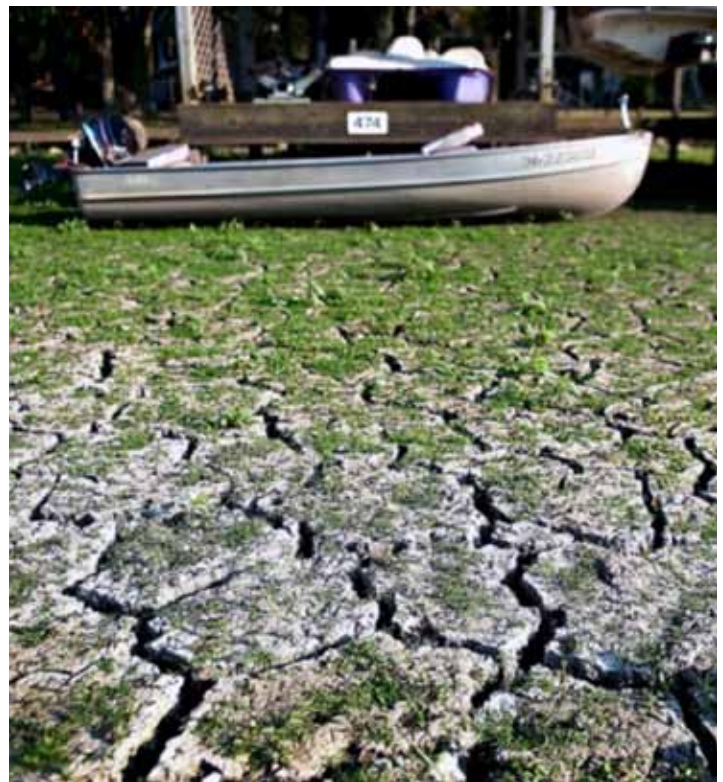
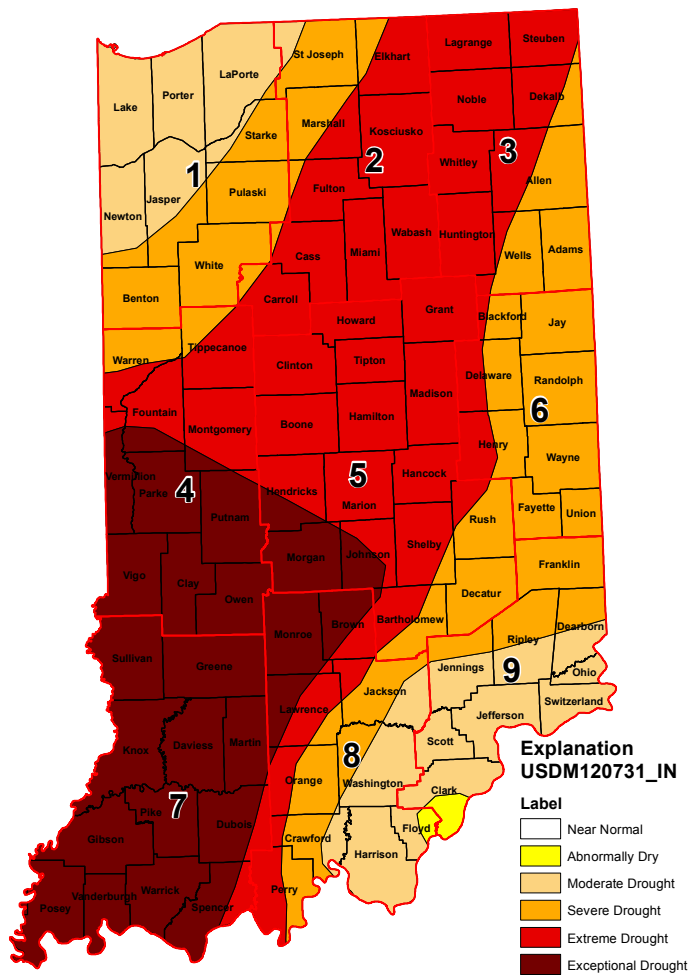
1. *Meteorological drought*: "A period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrologic imbalance in the affected area."
2. *Agricultural drought*: "A climatic excursion involving a shortage of precipitation sufficient to adversely affect crop production or range production."
3. *Hydrologic drought*: "A period of below average water content in streams, reservoirs, groundwater aquifers, lakes and soils."

No matter which definition one selects, we are certain that Indiana is experiencing a drought, with some regions in an exceptional drought state (Figure 1). These regions are characterized by exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies (Table 1).

Lakes are certainly not shielded from the impacts of these drought conditions. Many headlines across Indiana have highlighted the consequences – from dampened summer recreation (Figure 2), additional safety concerns due to shallow conditions and submersed obstacles, to previously inundated cities resurfacing, like Monument City in Salamonie Lake. Of the reservoirs monitored by the U.S. Army Corps of Engineers, 7 out of 8 are below their normal pool elevation, with Salamonie Lake ~14 feet down. These low lake levels have made it difficult for many recreational and boating activities. The Indiana Clean Lakes Program has also been impacted because we have not been able to access and sample many lakes due to shallow boat ramps.

Water Budgets

These drought conditions primarily impact the water budget of lakes, which consequently impact the nutrient budgets, wetland ecosystem functions, fisheries, benthic macroinvertebrates, and algal populations. The inflows and outflows can be significantly impacted by drought (Figure 3). The severity is dependent on the proportion of these inputs and the hydrologic position relative to groundwater. Lakes that are higher elevation and proportionally receive more inputs from precipitation may be severely impacted by the drought; while lakes lower in elevation and



The dry section of the Morse Reservoir, one of three reservoirs which supply water to nearby Indianapolis, in Cicero, Indiana, on July 12, 2012.

Figure 1. The U.S. drought monitor for the period ending July 31, 2012.

Table 1. Drought Severity Classification.

Category	Description	Possible Impacts	Palmer Drought Index	Ranges			
				CPC Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Standardized Precipitation Index (SPI)	Objective Short and Long-term Drought Indicator Blends (Percentiles)
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	-1.0 to -1.9	21-30	21-30	-0.5 to -0.7	21-30
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	-2.0 to -2.9	11-20	11-20	-0.8 to -1.2	11-20
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	-3.0 to -3.9	6-10	6-10	-1.3 to -1.5	6-10
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions	-4.0 to -4.9	3-5	3-5	-1.6 to -1.9	3-5
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0-2	0-2	-2.0 or less	0-2

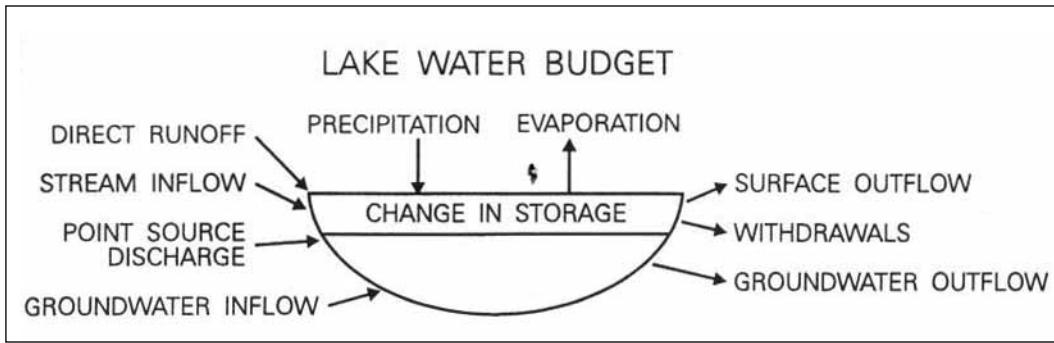


Figure 3. Schematic water budget.

that proportionally receive more groundwater may respond less to the drought. Droughts do, however, impact the overall hydrologic cycle, so groundwater inputs could also be diminished. In addition to the lack of precipitation, we've had scorching temperatures this summer, increasing the evaporation.

Nutrient Budgets

Nutrient budget changes mirror the water budget (Figure 4). There are two main mechanisms that can actually counteract each other:

1. *Increased water retention time and evapoconcentration:* nutrients and cations (e.g., calcium for crayfish and snails) remain longer in the water column and can become more concentrated.
2. *Decreased groundwater:* concentrations can decrease due to less dissolved cation inputs.

Each lake is a unique case regarding these budgets and watershed uses. For example, many lake side property owners and farmers will

use the lake water for irrigation. This will increase the rate of drawdown. These uses and position within the landscape can determine how a lake responds to drought (Webster et al., 1996).

Ecology

Many organisms are impacted by drought. While some are more resilient and capable of immediate stressors, some sessile (i.e., fixed in one place) organisms are less tolerant. Wetland and littoral species often dry out. Some fauna are stranded, such as mussels and snails. Plants communities may see a shift from submersed vegetation to a proliferation of emergent plants. In general, the wetland ecosystem services are diminished due to the water table draw down.

Fish can be particularly susceptible depending on the degree of drawdown. The low water levels expose and reduce spawning areas, killing eggs and fry and consequently reducing reproductive success. There is often a decrease in dissolved oxygen availability, which is compounded by the high water

temperature. The CLP crew has been sampling many littoral habitat sites for the IDEM funded National Lakes Assessment for the state of Indiana requiring that we fully explore the littoral perimeters. Many of these littoral habitats have been very shallow with 100 percent macrophyte coverage. These quiet standing waters have reached water temperatures >90°F. Such warm waters have less dissolved oxygen for fish.

Not only is Indiana coping with the drought, but we experienced such a strange year overall. The early warm spring and the very different water budgets have created ripe conditions for algal blooms. Many algae, particularly some cyanobacteria, thrive in high temperatures.

Each lake is unique in how it will respond to drought. How we use the lake and the lake resources, where it's located within the landscape (higher or lower elevations), where it's located within the state, and its overall health will all determine how resilient the lake is to drought stress. Recognizing that lakes are often already subjected to so many stresses due to our love of lakes and our desires to recreate on and around them and live at their edge, please make a special lake courtesy to not over-love the lake. Be gentle on the shorelines and play safely!

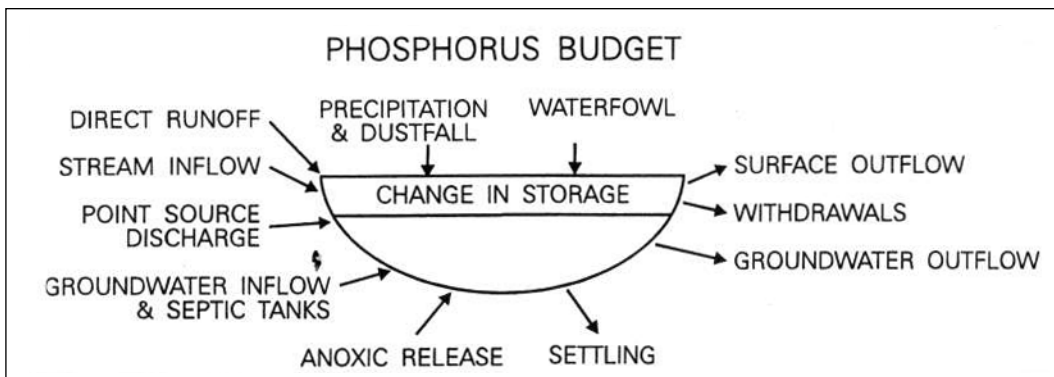


Figure 3. Schematic phosphorous budget.

Have you checked out the Indiana Clean Lakes Program Web page lately? Take a look at www.indiana.edu/~clp/ and see what's new and happening with the program and with Indiana lakes!

The Indiana Department of Environmental Management's Cyanobacteria Surveillance Program

~ Cyndi Wagner

In 2010, the Indiana Department of Environmental Management (IDEM) received a grant from the United States Environmental Protection Agency (U.S. EPA) to begin a pilot program to develop internal capacity for a cyanobacteria surveillance program. The 2010 and 2011 sampling seasons were devoted to perfecting our skills at sample collection, identification, and enumeration of cyanobacteria, and running our Abraxis Enzyme Linked Immunosorbent Assay (ELISA) system for microcystin toxin analysis in our own laboratory. Our partner in this endeavor was the Center for Earth and Environmental Science (CEES) at Indiana University-Purdue University at Indianapolis (IUPUI).

Dr. Lenore Tedesco and Nicolas Clercin provided training and support, and performed all of the analyses that were reported out to the public on Indiana's website, www.algae.IN.gov. IDEM staff performed the same tasks, comparing our results with those from CEES's lab. This collaboration allowed us to become proficient in the skills necessary to run our own program.

This summer finds our staff up to speed and reporting out our own results to the public. Because of the appearance and dominance of *Cylindrospermopsis raciborskii* in our lakes last summer, we have added the cylindrospermopsin toxin analysis along with the analysis for microcystin this year. IDEM's Watershed Assessment and Planning branch has staff working from June through Labor Day on sample collection, identification and enumeration, and toxin analysis. Samples are collected

on Monday and Tuesday, with all analyses performed so the www.algae.IN.gov can be updated on Friday.

IDEM samples the following public swimming areas owned or managed by the Indiana Department of Natural Resources (DNR) or the United States Fish and Wildlife Service: Mississinewa Lake, Salamonie Lake, Sand Lake at Chain O'Lakes State Park, Lake James at Pokagon State Park, Worster Lake at Potato Creek State Park, Cecil M. Harden Reservoir (Raccoon Lake), Lake Monroe, Hardy Lake, Brookville Lake, and Whitewater Lake at Whitewater Memorial State Park. The lakes are sampled monthly, unless cyanobacterial cell counts exceed 100,000 cells/ml. If that occurs,

the lakes are sampled biweekly as long as cell counts remain high. Because there are no regulations governing cyanobacterial cell counts or toxin levels, Indiana follows the high-risk recreational health recommendations from the World Health Organization for cell counts. We use the same toxin level recommendations that Ohio uses: 6 parts per billion (ppb) of microcystin and 5 ppb of cylindrospermopsin.

This summer's drought has a number of the swimming beaches closed due to low water. In these cases, IDEM has been sampling at boat ramps suggested by the DNR property managers. The drought has caused the waters to become more stagnant and warm,

New EPA Information About Harmful Algal Blooms Online

If you want additional information from what IDEM has to offer or to get a national perspective check out the new EPA web page:

<http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/cyanohabs.cfm>

EPA has published a new web page on harmful algal blooms to help inform states, tribal and local governments, other federal agencies, and the public about key issues regarding cyanobacteria, or blue-green algae, blooms in recreational waters and drinking water.

The web page includes information on the causes of bloom occurrence, prevention and mitigation measures, adverse human health effects from exposure to cyanotoxins (toxins from blue-green algae), ecological effects, sampling and detection methods, policies and guidelines, past and ongoing research, and links to other sites with information on algal toxins in freshwater.



Algal bloom at Grand Lake St. Mary's, Ohio, 2010. Photo by Russ Gibson, Ohio EPA.

concentrating nutrients and, thereby, creating ideal conditions for cyanobacterial growth. As of August 7, 2012, we have been seeing a number of lakes with cyanobacterial cell counts in the millions and the resurgence of *Cylindrospermopsis raciborskii* in a couple of lakes. IDEM has not seen toxin levels in any amount of concern. Two dogs have died and two others were sickened after swimming in a remote cove in Salamonie Reservoir in mid-July. Veterinarians from the State Board of Animal Health and Purdue University have indicated the culprit was microcystin toxin.

For a complete description of IDEM's program, sampling results and other resources, please visit www.algae.IN.gov.

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WATER COLUMN

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The Volunteer Lake Monitoring Corner

~ Sarah Powers

This has been a very busy summer for the Volunteer Lake Monitors and I would like to say thank you for all your hard work. As we are nearing the end of another summer I would like to recap some of the work we have been doing this summer and take this opportunity to highlight one of our volunteers.

This summer I have introduced a pilot project "Aquatic Weed Watchers." We have hosted one training workshop so far, but will be continuing to plan more for September and October. The first workshop was a great success. I had four Volunteer Lake Monitors join me. We met at the nature center at Pokagon State Park.

The first half of the workshop was in a classroom setting where I gave a presentation on the survey method and plant identification. I also gave the attendees a chance to look at samples that had been collected that week all over the state to see a variety of plants. The last hour of the training we went out to the lake for field identification. We used a plant rake to collect specimens and a key to identify the plant types. This portion of the workshop was very beneficial by giving the participants an opportunity to see the difference in plants and the distinct characteristics of the plants.

The training allowed me to see some things that we could do better to help the volunteers with the surveys. Better plant identification materials will be needed in the future, and we will work to provide the best materials that we can. We also discussed the opportunity to create a sharing center for aquatic invasive plant materials on the Clean Lakes Program website. I am currently working on putting these materials together for the website and will have them uploaded in the near future.

Based on the success of the first training session, I am interested in having more training opportunities. I have been working on setting up another workshop in late October in Lagrange County with the Lagrange County Lakes Council. I hope to have further details soon. I will also be setting a workshop up in the central part of the state to allow our southern volunteers an opportunity to be trained. If you are interested in attending a training workshop email me at indianaclp@gmail.com.

I will be setting aside a portion of the Volunteer Corner to regularly highlight the hard work of the Volunteer Lake Monitors. This issue spotlights volunteer is Tom Camire. Tom Camire is the longest current participant in the Volunteer Lake Monitoring Program. I asked Tom if he could provide me with a little background information about himself and why he loves his lake. Here is what Tom had to share.

Tom Camire was born in Chicago in 1943. Tom had spent his summers at Koontz Lake since 1948 and in 1972 he purchased the family cottage and moved to the lake permanently. Through this time he came to realize that the health of the lake was deteriorating, which bothered him greatly as he frequently recreates on the lake. He felt as if the human use on the lake was deteriorating the quality and adversely affecting his personal health.

So, in 1987 when a group began meeting to try to stop sediment from Pontuis Ditch from flowing into the lake, he joined in. The group later became the Koontz Lake Environmental Enhancement Committee (KLEEC). From there Tom has gone on to form the Koontz Lake Regional Sewer District that was successful this year in having a professional sewer system installed for Koontz Lake that is already improving the lakes quality. Tom is still working with the KLEEC to have the lake dredged. Tom says that it is his love for Koontz Lake that he has made it

a life-time purpose to be an active part of the community committed to lake enhancement and future generation enjoyment.

Tom has collected 347 Secchi depth measurements over the past 23 years. He has also been a part of the expanded monitoring program since the beginning and has collected 81 sets of chlorophyll-*a* and total phosphorus samples to date. Tom goes above and beyond to participate in the program by collecting temperature and dissolved oxygen measurements on his lake. Tom continues to be a valuable asset to the Volunteer Lake Monitoring Program. We appreciate all his efforts and all of our volunteers. Without the help of the Volunteer Lake Monitors we would not be able to collect the vast amounts of data that we do.

Thank you!

Perspectives

“To meet an old friend
in a distant country is like the
delight of rain after a
long drought.”

~ Chinese proverb

Aquatic Weed Watchers Plant Highlight

We will now be featuring one plant in each *Water Column*. We will feature both native and invasive plants in an effort to keep us all on the lookout for these pesky invaders.

Parrotfeather (*Myriophyllum aquaticum*) – INVASIVE

Parrotfeather is an invasive plant that is not currently found in Indiana. It is primarily sold as a water garden plant and has the capability of growth in Indiana. It has feathery like whorled leaves that resemble Eurasian water milfoil, but can emerge up to 1 foot above the water surface.

Identification tips:

- emergent up to 1 ft. above water
- leaves in whorls around stem
- leaves feathery like milfoil
- dense mat of brownish rhizomes
- leaves 20 to 30 divisions per leaf below surface 6 to 18 divisions above the water surface

For more information go to

http://www.in.gov/dnr/fishwild/files/fw-Risk_Assessment_Parrotfeather_Aug_2008.pdf

