Utah Efforts to Address Harmful Algal Blooms

September 30, 2015

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Utah Department of Environmental Quality
## Cast of Characters: Cyanobacteria and their toxins (cyanotoxins) in Utah

- **Liver, nerve, or skin toxins**
- **Selectively produced by many genera but not very predictable**
- **Widely distributed but not often at acutely toxic levels**
- **Analyses are available for some but not all of these toxins**

### Anabaena or Dolichospermum
- Microcystins (liver)
- Anatoxin-a/a(s) (nerve)
- Saxitoxins (nerve)

### Microcystis
- Microcystin (liver)
- Toxin is most common and easily measured

### Cylindrospermopsis
- Cylindrospermopsins (liver)
- Saxitoxins (nerve)
- Benthic/epiphytic rather than planktonic

### Nodularia
- Nodularin (liver)
- Found in salt water including Great Salt Lake

### Aphanizomenon
- Anatoxin-a (nerve)
- Cylindrospermopsins (liver)
- Saxitoxins (nerve)
Algal Blooms Threaten Utah Waters

- Primarily concerned about lakes and reservoirs
- Fish kill as a result of low dissolved oxygen

- *Microcystis* bloom in Matt Warner Reservoir
- 18 cows died
- September 2004; reoccurrence in 2010
Algal Blooms Threaten Utah Waters

- October 2014
- *Aphanizomenon* and *Dolichispermum* bloom in Utah Lake
- 2 dog deaths
- Microcystin concentrations:
  - open water: n/d to 11.2 µg/L
  - shoreline: 730 µg/L
Utah Lake 2014: Cyanotoxin Results and Advisory Levels

Toxin producing species observed on 10/6/2014

- Dolichospermum solichospermum
- Dolichospermum sigmoideum
- Aphanizomenon flos-aquae*
- Microcystis species

<table>
<thead>
<tr>
<th>Toxin</th>
<th>Toxic Effects</th>
<th>Range Measured in Utah Lake</th>
<th>Recreation Advisory Levels (other states)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcystins (several types)</td>
<td>Liver toxin</td>
<td>Non-detect to 11.2 µg/l Shoreline sample from bloom: 730 µg/l</td>
<td>6 – 10 µg/l</td>
</tr>
<tr>
<td>Cylindrospermopsin</td>
<td>Liver toxin</td>
<td>Non-detect to 0.22 µg/l</td>
<td>10 µg/l</td>
</tr>
<tr>
<td>Anatoxin-a</td>
<td>Neurotoxin</td>
<td>Non-detect to 0.1 µg/l</td>
<td>1 – 20 µg/l</td>
</tr>
<tr>
<td>Saxitoxin</td>
<td>Neurotoxin</td>
<td>Non-detect</td>
<td>0.6 - 100 ug/</td>
</tr>
</tbody>
</table>
Algal Blooms Threaten Utah Waters

- August 2015
- HAB in Blackridge Reservoir
- Popular recreational water
Response Monitoring: Phytoplankton sampling during blooms

- **Purpose**
  - Provide LHDs with information to evaluate potential recreational health risks
  - Provide public water systems with information to evaluate potential risks to drinking water supplies
  - DWQ to record bloom conditions for use in evaluating lake water quality

- **Field Sampling**
  - Target areas where there is the highest likelihood of risk for interaction (beaches, piers, shoreline access areas) and wind direction
  - If bloom is floating scum - 1 grab sample; If bloom is mixed in water column - composite of 3 count replicate samples near shoreline (knee deep) or open-water.
<table>
<thead>
<tr>
<th>Water Use with Exposure Risk</th>
<th>Type 1</th>
<th>Type 2</th>
<th>Type 3</th>
<th>Type 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drinking water</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Swimming beach with surface scum</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Boat Launch</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Pets/livestock on shore</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Water skiing</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Boating/swimming- open water</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

**Type 1:** Surface grab– Near-shore (where surface scum has formed)

**Type 2:** Surface grab– Open water (where surface scum has formed)

**Type 3:** Composite– Near-shore

**Type 4:** Composite– Open water
Response: Analysis

- Algal Laboratory Analysis
  - Enumeration of dominant algae and all cyanobacteria present—qualitative analysis for fastest decision response
  - DWQ and partners have scopes and trained staff to provide initial screen at select locations (via NOAA)
  - Used to inform specific toxin for analysis and drinking water providers
Response: Algal Toxins Analyses

- Algal Toxin Analysis
  - Turn around time a concern for informing public health advisories
  - Case-by-case basis until funding source can be identified
    - Potential for NOAA/EPA to help fund or analyze for toxins
  - Could inform any of the tiers in DOH guidance
  - If data are available, could inform Tier 3 decisions.
  - Useful for determining the specific health risk; informing drinking water suppliers
## UDEQ/UDOH Guidelines for HABs

<table>
<thead>
<tr>
<th>Relative Probability of Acute Health Risk</th>
<th>Toxin Producing Blue-green algae Cell Density (cells/mL)</th>
<th>Health Risks</th>
<th>Action Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>&lt;20,000</td>
<td>Negligible</td>
<td>None</td>
</tr>
<tr>
<td>Moderate</td>
<td>20,000-100,000</td>
<td>Short-term effects e.g. skin irritation, gastrointestinal illness</td>
<td>Issue caution advisory; Post CAUTION sign; Weekly sampling recommended</td>
</tr>
<tr>
<td>High</td>
<td>100,000 – 10,000,000 or reports of animal illnesses or death</td>
<td>As above for low risk, and potential for long-term illness</td>
<td>Issue warning advisory; Post WARNING sign; Weekly sampling recommended</td>
</tr>
<tr>
<td>Very High</td>
<td>&gt;10,000,000 or large scum mat layer or reports of human illness;</td>
<td>As above for moderate risk, and potential for acute poisoning</td>
<td>Issue Danger Advisory; Post DANGER sign; Weekly sampling recommended; Consider Closure</td>
</tr>
</tbody>
</table>
HAB Decision-making Algorithm [Tier 1]

Tier I
- Water changing to bright green or scum accumulations?
  - YES: LHD posts CAUTION sign
    - Water samples taken
    - Weekly sampling until bloom dissipation
  - NO: No Action
- Blue-green algae count > 100,000 or animal illness?
  - YES: LHD posts WARNING sign
    - Takes site-specific actions
    - Weekly sampling
  - NO: Blue-green algae count < 100,000
- Blue-green algae count > 10,000,000; or thick scum mats; or human illness?
  - YES: LHD posts DANGER sign
    - Lake closed
    - Weekly sampling
  - NO: Return to Tier II at LHD discretion
Example Caution Sign [Tier 1]

CAUTION

TOXIC ALGAE MAY BE PRESENT
Lake may be unsafe for people and pets

Until further notice:
- Do not swim or water ski in areas of scum.
- Do not drink lake water.
- Keep pets and livestock away.
- Clean fish well and discard guts.
- Avoid areas of scum when boating.

Call your doctor or veterinarian if you or your animals have sudden or unexplained sickness or signs of poisoning.

Report new algal bloom to the Department of Environmental Quality: Call your local health department:

[Logos: Utah Department of Environmental Quality, Utah Department of Health]
HAB Decision-making Algorithm [Tier 2]

TIER I
- Water changing to bright green or scum accumulations?
  - YES: LHD posts CAUTION sign
    - Water samples taken
    - Weekly sampling until bloom dissipation
  - NO: No Action
    - Bloom dissipates, remove sign

TIER II
- Blue-green algae count > 100,000 or animal illness?
  - YES: LHD posts WARNING sign
    - Takes site-specific actions
    - Weekly sampling
    - Blue-green algae count > 10,000,000; or thick scum mats; or human illness?
    - NO: Return to Tier II at LHD discretion
  - NO: Blue-green algae count < 100,000

TIER III
- LHD posts DANGER sign
- Lake closed
- Weekly sampling
Example Warning Sign [Tier 2]

WARNING

TOXIC ALGAE PRESENT
Lake unsafe for people and pets

Until further notice:
• Do not swim or water ski.
  No nade o practique el esquí acuático.
• Do not drink lake water.
  No tome el agua del lago.
• Keep pets and livestock away.
  Mantenga alejados las mascotas y el ganado.
• Clean fish well and discard guts.
  Limpie bien el pescado y deseche las tripas.
• Avoid areas of scum when boating.
  Evite las áreas con espuma o verdín cuando ande en lancha.

Call your doctor or veterinarian if you or your animals have
sudden or unexplained sickness or signs of poisoning.

Report new algae blooms to the Department of Environmental Quality:
Call your local health department:

UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY
UTAH DEPARTMENT OF HEALTH
HAB Decision-making Algorithm [Tier 3]

**Tier I**
- Water changing to bright green or scum accumulations?
  - NO: No Action
  - YES: LHD posts CAUTION sign
    - Water samples taken
    - Weekly sampling until bloom dissipation
    - Bloom dissipates, remove sign
    - Blue-green algae count < 100,000

**Tier II**
- Blue-green algae count > 100,000 or animal illness?
  - NO: Return to Tier II at LHD discretion
  - YES: LHD posts WARNING sign
    - Takes site-specific actions
    - Weekly sampling
    - Blue-green algae count > 10,000,000; or thick scum mats; or human illness?

**Tier III**
- LHD posts DANGER sign
- Lake closed
- Weekly sampling
Example Danger/Closure Sign [Tier 3]

DANGER

LAKE CLOSED
due to toxic algae

KEEP OUT
OF LAKE

Call your doctor or veterinarian if you or your animals have sudden or unexplained sickness or signs of poisoning.

Report new algae blooms to the Department of Environmental Quality: Call your local health department:

[Logo of Utah Department of Environmental Quality] [Logo of Utah Department of Health]
Lake Assessment Guidance

- **Drinking Water**
  - **Beneficial Use Supported:**
    - The beneficial use is supported if cyanobacteria cell counts <20,000 cells/mL.
  - **Beneficial Use Not Supported:**
    - The beneficial use is categorized as “Threatened” if the cyanobacteria cell count exceeds 100,000 cells/mL once for waters that have Drinking Water Use (1C) designation.
    - The beneficial use is not supported if the cyanobacteria cell count exceeds 100,000 cells/mL for more than one sampling event for waters that have Drinking Water Use (1C) designation.
  - **Insufficient Data and Information:**
    - The waterbody will be categorized 3A if there is one exceedance >20,000 cells/mL. These waterbodies will be prioritized for further evaluation with respective public health managing partners such as the State Health Department, respective drinking water agencies, and State Parks Departments.
Lake Assessment Guidance

- **Recreational Use Support**
  - **Beneficial Use Supported:**
    - The beneficial use is supported if cyanobacteria cell counts <20,000 cells/mL.
  - **Beneficial Use Not Supported:**
    - The beneficial use is not supported if the cyanobacteria cell count exceeds 100,000 cells/mL for more than one sampling event or other narrative indicators (e.g., phycocyanin, chlorophyll-a, HAB beach warnings, suggest recreational uses are not being attained.
  - **Insufficient Data and Information**
    - The waterbody will be categorized 3A if there is one exceedance >20,000 cells/mL. These waterbodies will be prioritized for further evaluation with respective public health managing partners such as the State Health Department and State Parks Departments.
Coordination

**Partners***:
- Monitor waterbodies
- Take photos and samples
- Analyze for species/toxins
- Post and unpost advisory signs
- Consult with UDOH

**UDOH**:
- Consult with partners
- Evaluate water quality results
- Issue and lift advisories
- Provide public health information
- Investigate illness reports

**Communicate water quality results**

**Communicate health risks**

**Potential exposure groups**: Pets/pet owners Property owners Recreational Users Water systems customers

**Interested groups**: Advocacy groups Business owners Interested citizens Legislatures Local governments Medical providers Regulatory agencies Researchers Veterinarians

Thanks OR DOH
Coordination

*Partners:

- UDEQ: DWQ/DDW, UDNR: State Parks/Fish & Game, Water Conservancy Districts, US EPA and NOAA, Rushforth Phycology, Universities, volunteer monitors and more to come…
Coordination

- Draft a strategic communication plan across partner agencies with 3 primary goals:
  - Implement coordinated communication procedures during blooms
  - Increase public awareness through education and outreach
  - Respond to blooms through standardized Single Overriding Communication Objectives (SOCOs)
Outreach: HAB Tri-Fold Fact Sheet

Fast Sheet: Harmful Algal Blooms in Utah Lakes

Harmful algal blooms (HABs) are the result of a rapid increase or accumulation of algae on the surface of a water body. Cyanobacteria (or blue-green algae) can flourish and cause blooms in Utah lakes when nutrients, sunlight and temperatures are just right. Some types of blue-green algae can produce toxins which can harm the liver or nervous systems of humans and animals. The algae itself can cause rashes in contact with skin, or stomach and lung problems if it is swallowed or gets inhaled by accident.

How Can I Tell if the Water is Safe?

You may see these blooms on ponds and lakes throughout Utah. They can be a variety of colors, such as fluorescent blue, green, white, red or brown. More than one color may be present. They may look like thick paint pools floating on the water and frequently give off a foul odor.

The Dos and Don'ts of Harmful Algal Blooms

**DON'T** swim, water ski or boat in areas where the water is discolored or where you see foam, scum or mats of algae on the water.

**DON'T** let pets or livestock swim in or drink from areas where the water is discolored or where you see foam, scum or mats of algae on the water.

**DON'T** let pets lick algae off of their fur.

**DO** rinse yourself and your pet immediately if there is contact with algae-affected waters.

**DO** look for beach postings and water quality notices before swimming.

**DO** get medical treatment right away if you think you, your pet or your livestock might have been poisoned by algae toxins.

Potential Symptoms

Blue-green algae related illness becomes a concern in Utah as the weather warms and people and pets spend more time outside on or near lakes. Illnesses can be caused by toxins produced by the algae or by the algae themselves. Symptoms will vary depending on the type of exposure.

The most common exposure for people is skin contact with scum or water containing algae cells or toxins.

HAB-Related Skin Rash

People may also inhale tiny droplets of water containing toxins or cells; this is most common when people are water skiing, wakeboarding, etc.

The most common exposure for animals is ingesting water with toxins or algal cells.

Common Human Symptoms Include:

Sore throat, congestion, cough, wheezing, eye irritation, rash, blistering, abdominal pain, headache, vomiting and diarreah.

Common Animal Symptoms Include:

Vomiting, lethargy, diarrhea, convulsions, difficulty breathing and general weakness.

If you need urgent information related to a suspected algal exposure, call the Utah Poison Control Center:

1-800-222-1222.

For more information: [UDEQ contact/webpage; UDOH contact/webpage]
Outreach: Websites

- UT Department of Health:
  http://health.utah.gov/enviroepi/appletree/HAB

- DEQ website:
  www.deq.utah.gov/Pollutants/H/harmfulalgalblooms
Monitoring: Utah’s Vulnerable Waters

- Drinking water sources
- High-use recreational water

<table>
<thead>
<tr>
<th></th>
<th>Drinking water sources</th>
<th>State Parks</th>
<th>Other high recreation uses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reservoirs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue-green algal blooms in past</td>
<td>11</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>Nutrient related impairments</td>
<td>4</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Completed TMDLs</td>
<td>1</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td><strong>Streams</strong></td>
<td></td>
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<tr>
<td>Blue-green algal blooms in past</td>
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<td>1</td>
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<tr>
<td>Nutrient related impairments</td>
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<tr>
<td>Completed TMDLs</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
Monitoring: Utah’s Vulnerable Waters

- At least 44% of surface acres in Utah have excess nutrients;
- Affect tourism and recreational uses such as fishing and boating—recently pegged at $12B/year.
- Excess nutrients impact economic survey in Utah
Monitoring: Utah’s Vulnerable Waters

- **Increase monitoring of most vulnerable waters**
  - Coordination with Division of Drinking Water, State Parks, Water Conservancy Districts, District Engineers, and Local Health Departments.

- **Develop inter-agency coordination process**
  - Local Health Departments are the lead
  - All relevant agencies should be notified
  - Public Notification Process
## Monitoring: 2015 Lakes

<table>
<thead>
<tr>
<th>Waterbody</th>
<th>Drinking Water Intake</th>
<th>Recreation</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flaming Gorge Reservoir</td>
<td>DW Intake</td>
<td>State Park</td>
<td></td>
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<tr>
<td>Long Park Reservoir</td>
<td>DW Intake</td>
<td>Limited</td>
<td></td>
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<tr>
<td>Millsite Reservoir</td>
<td>DW Intake</td>
<td>State Park</td>
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<tr>
<td>Pineview Reservoir</td>
<td>DW Intake</td>
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<td>Yes</td>
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<tr>
<td>Red Fleet Reservoir</td>
<td>DW Intake</td>
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<tr>
<td>Rockport Reservoir</td>
<td>DW Intake</td>
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<td>Sand Hollow Reservoir</td>
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<td>Starvation Reservoir</td>
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<td>Steinaker Reservoir</td>
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<td>EAST CANYON RES</td>
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<td>OTTER CK RES</td>
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</tr>
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<td>LOST CK RES</td>
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<td>JORDANELLE RES</td>
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<td>MINERSVILLE RES</td>
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<td>ROCKPORT RES</td>
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<td>WIDE HOLLOW RES</td>
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<td>High Rec</td>
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<td>YUBA RESERVOIR</td>
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<tr>
<td>Deer Creek Reservoir</td>
<td>DW Intake</td>
<td>State Park</td>
<td>Partner</td>
</tr>
</tbody>
</table>
Algal shift in East Canyon Reservoir

**IKONOS Multispectral Imagery of East Canyon Reservoir**
Collected October 11, 2000

**Algal Dominance in East Canyon Reservoir 1995 - 2001**

- **Percent Biovolume**
  - 0%
  - 20%
  - 40%
  - 60%
  - 80%
  - 100%

**Month**
- May
- Jun
- Jul
- Aug
- Sep
- Oct
- Annual

- **Diatom**
- **Other**
- **Green**
- **Blue Green**

**2003: Major upgrade of East Canyon WWTP including significant phosphorus reduction**

**Algal Dominance in East Canyon Reservoir 2002 - 2007**

- **Percent Biovolume**
  - 0%
  - 20%
  - 40%
  - 60%
  - 80%
  - 100%

**Month**
- May
- Jun
- Jul
- Aug
- Sep
- Oct
- Annual
Questions?