2014 Update: CyanoHAB's within the Tulsa District, USACE

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November 19, 2014 – KDHE Harmful Algae Bloom Fall Partner's Meeting

Topeka, KS

Walnut Creek State Park
Keystone Lake, Oklahoma
July 9, 2011

US Army Corps of Engineers
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Topics to be discussed

1. Overview of cyanoHAB monitoring at select Tulsa District reservoirs in Oklahoma and Kansas.
2. Overview of cyanoHAB reporting requirements and limitations in Oklahoma.
3. HAB efforts within USACE nationally.
4. Harmful Algae Bloom and Hypoxia Research and Control Amendments Act of 2014.

Tulsa District
Civil Works Boundary

Arkansas River Basin

Southern Kansas
Northern Oklahoma

Red River Basin

Southern Oklahoma
Northern Texas & Panhandle

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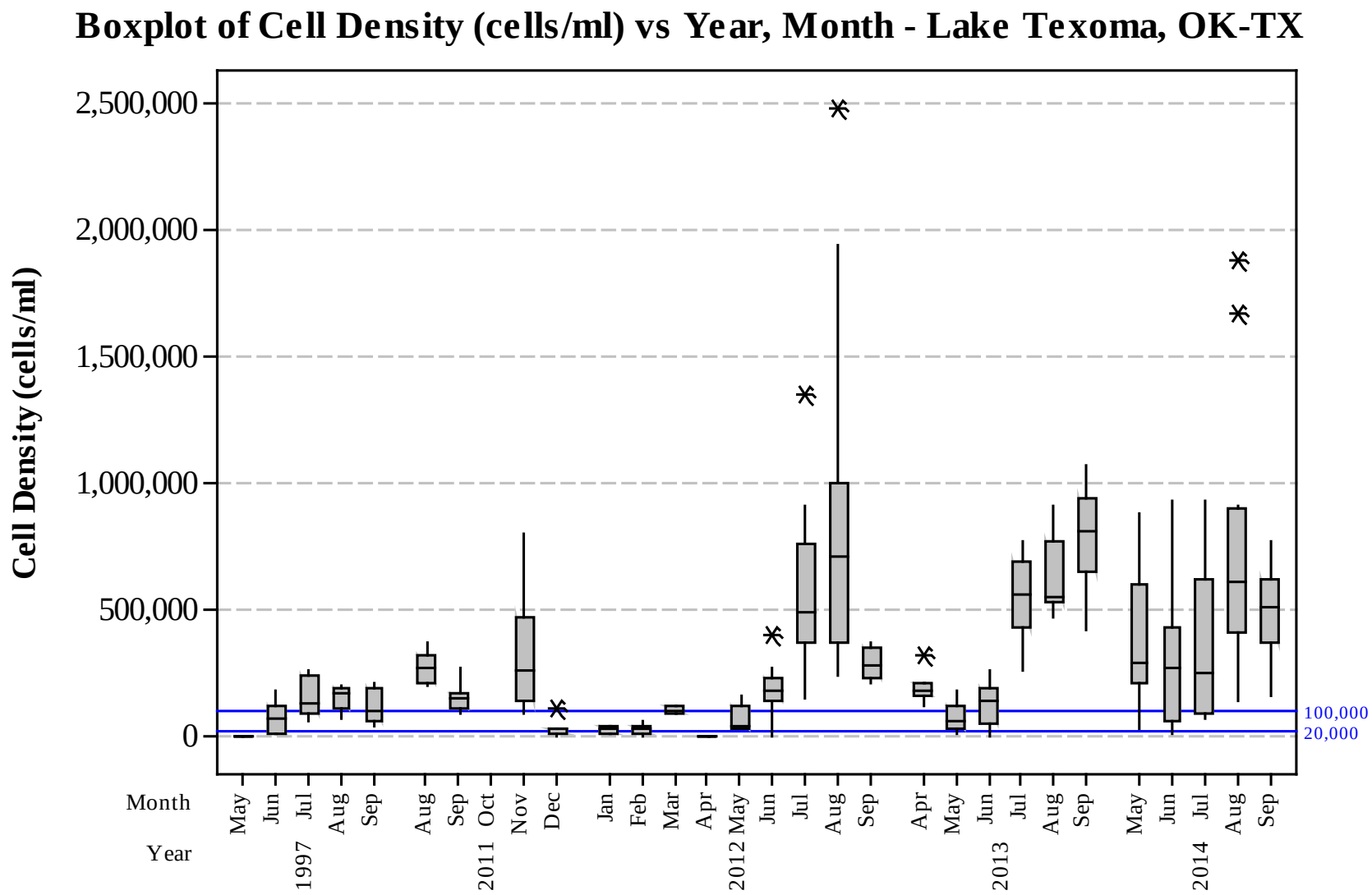
Boxplot of Cell Density (cells/ml) vs Year, Month - Lake Texoma, OK-TX
Cell Density (cells/ml)
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1,500,000
1,000,000
500,000
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100,000
20,000
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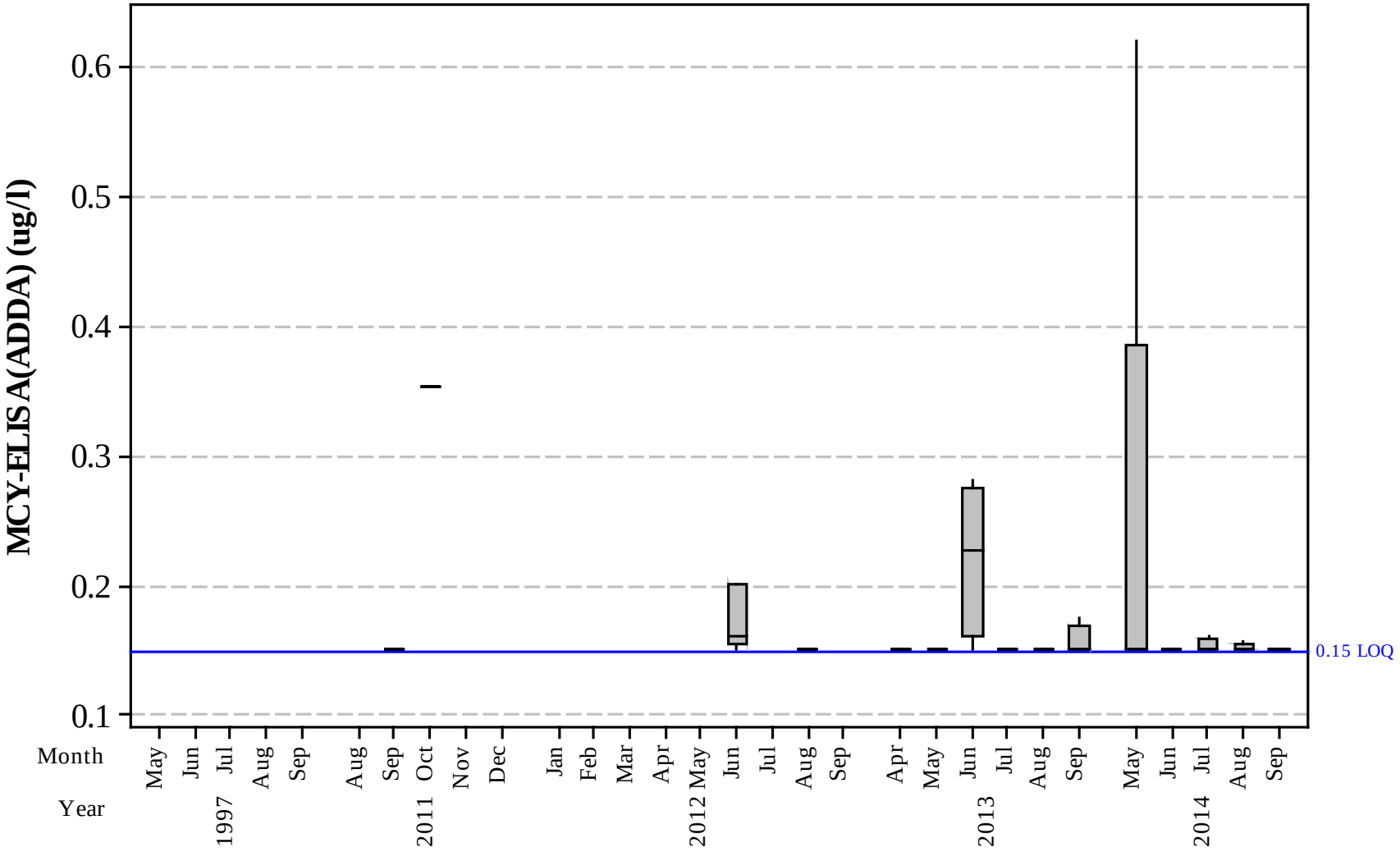
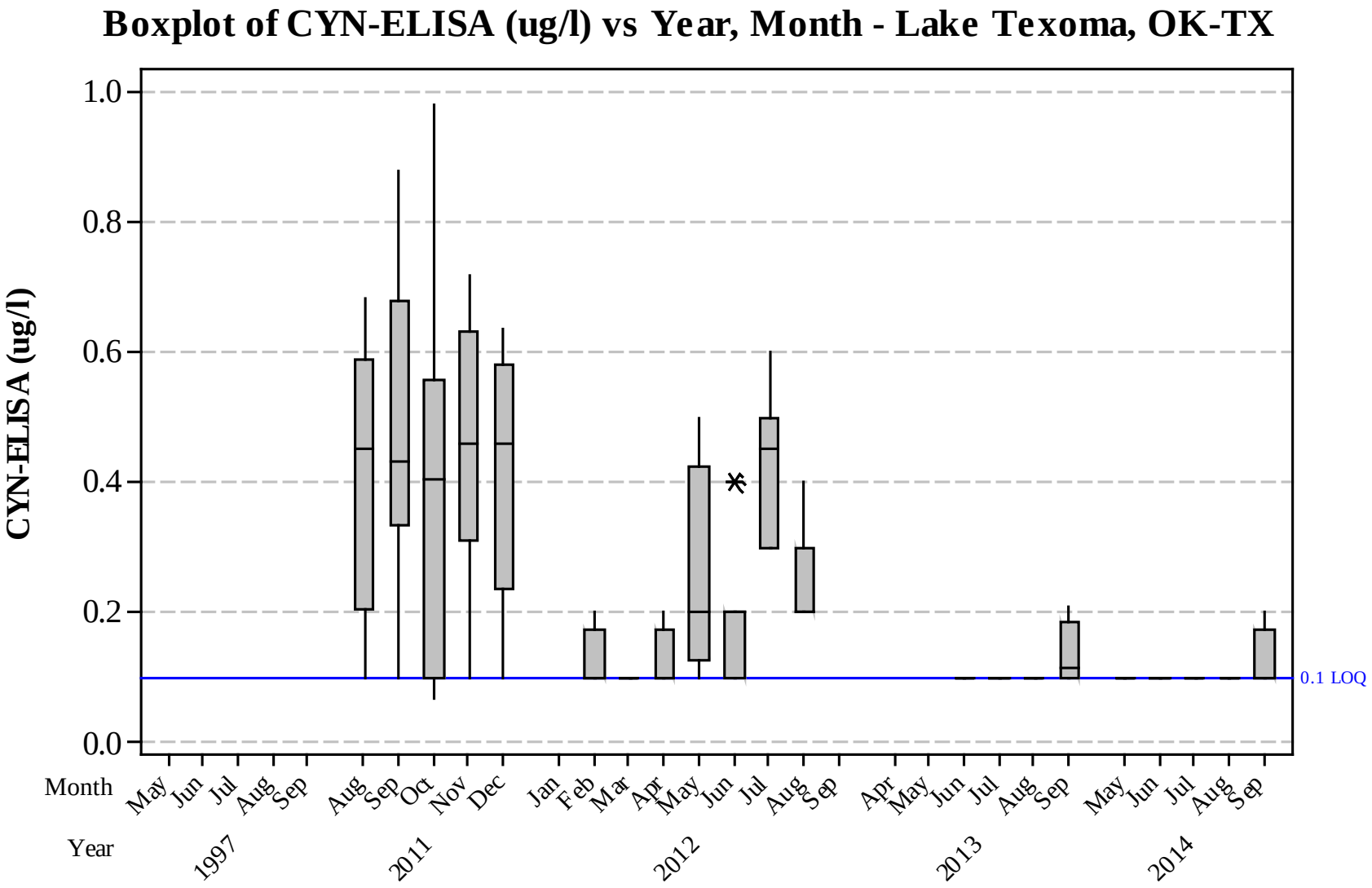
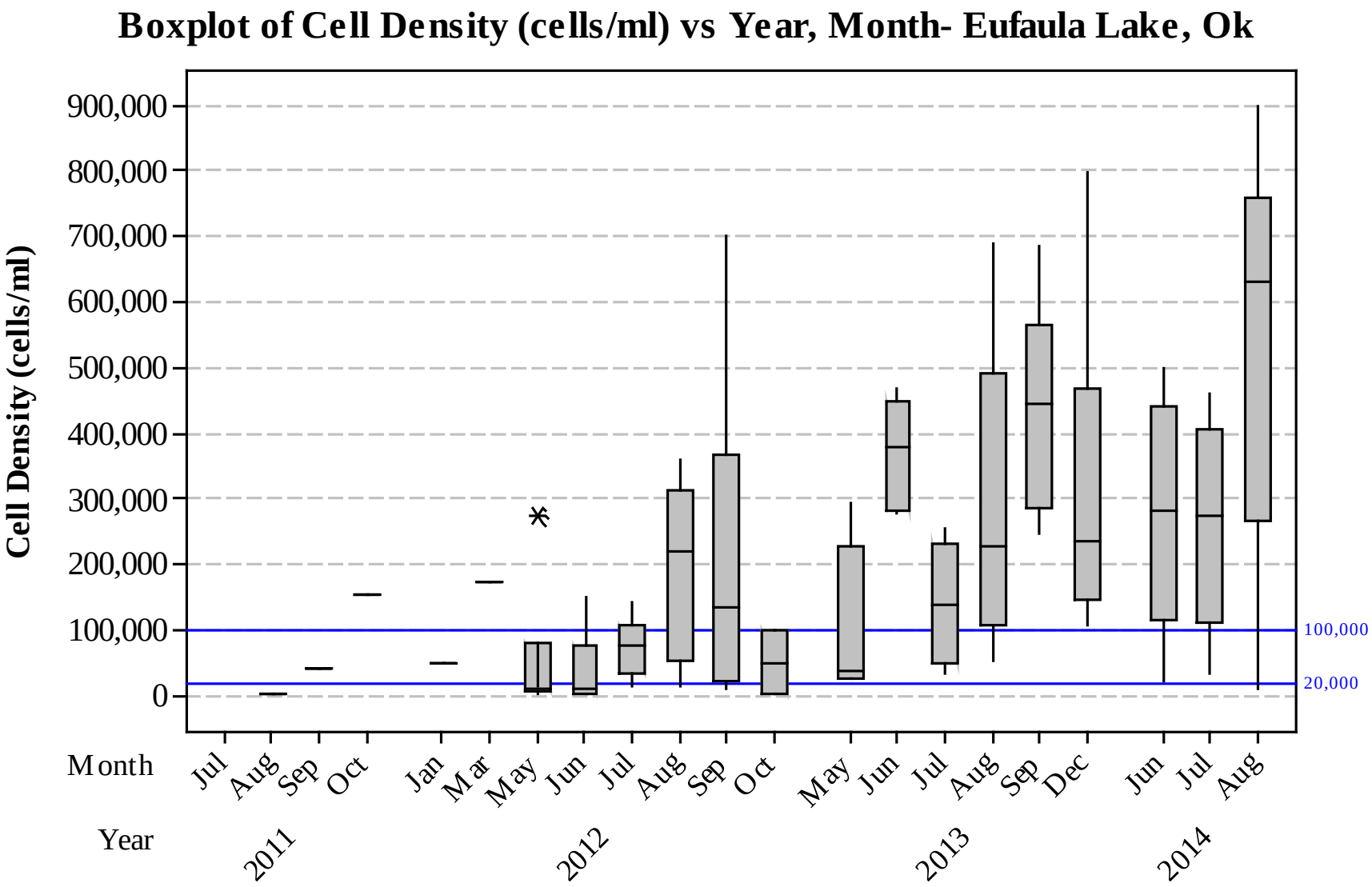
2012
2013
2014

Boxplot of MCY-ELISA(ADDA) (ug/l) vs Year, Month - Lake Texoma, OK-TX




Boxplot of CYN-ELISA (ug/l) vs Year, Month - Lake Texoma, OK-TX
CYN-ELISA (ug/l)
1.0
0.8
0.6
0.4
0.2
0.0
0.1 LOQ
Month
May Jun Jul Aug Sep
Aug Sep Oct Nov Dec
Jan Feb Mar Apr May Jun Jul Aug Sep
Apr May Jun Jul Aug Sep
May Jun Jul Aug Sep
Year
1997
2011
2012
2013
2014


Boxplot of Cell Density (cells/ml) vs Year, Month- Eufaula Lake, Ok
Cell Density (cells/ml)
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
100,000
20,000
Month
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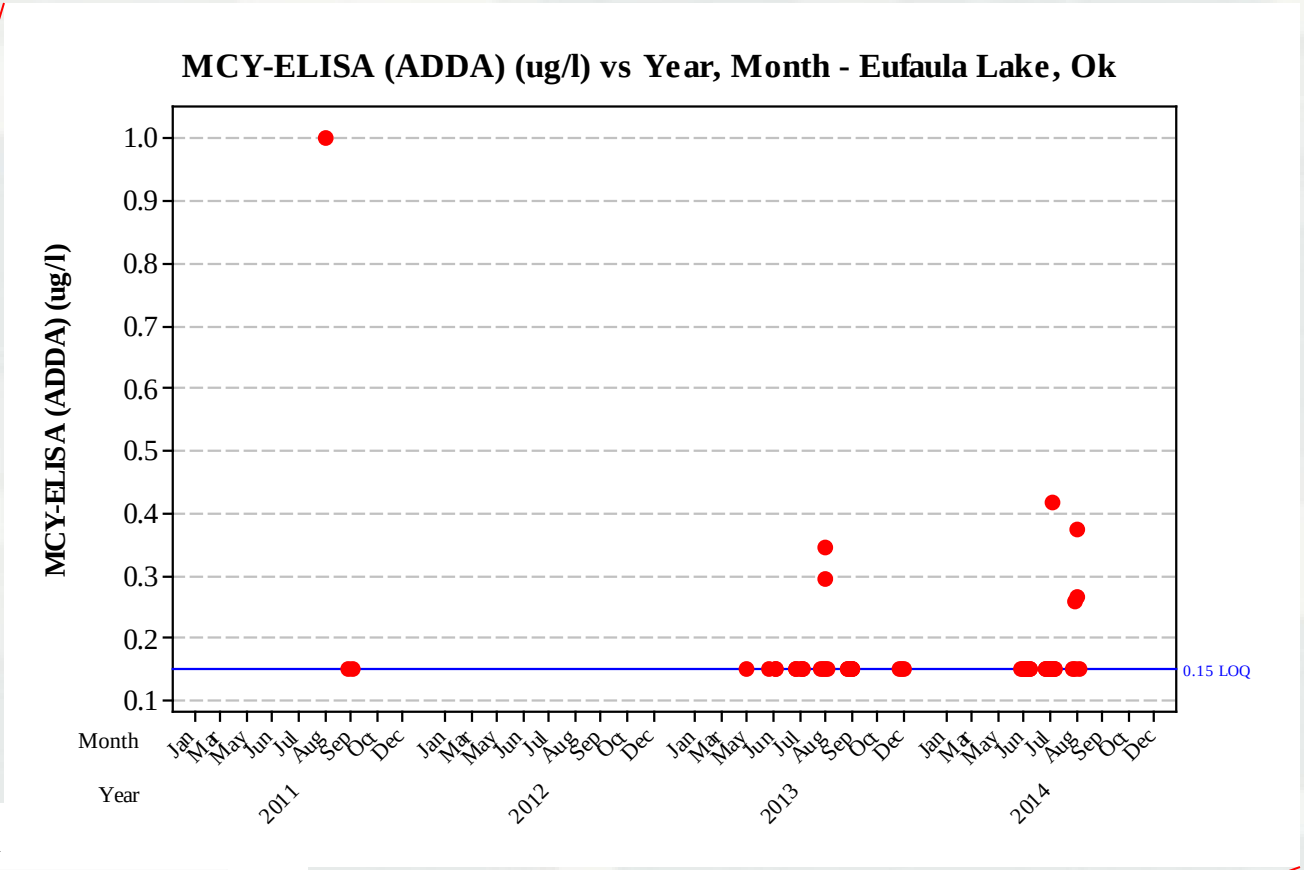
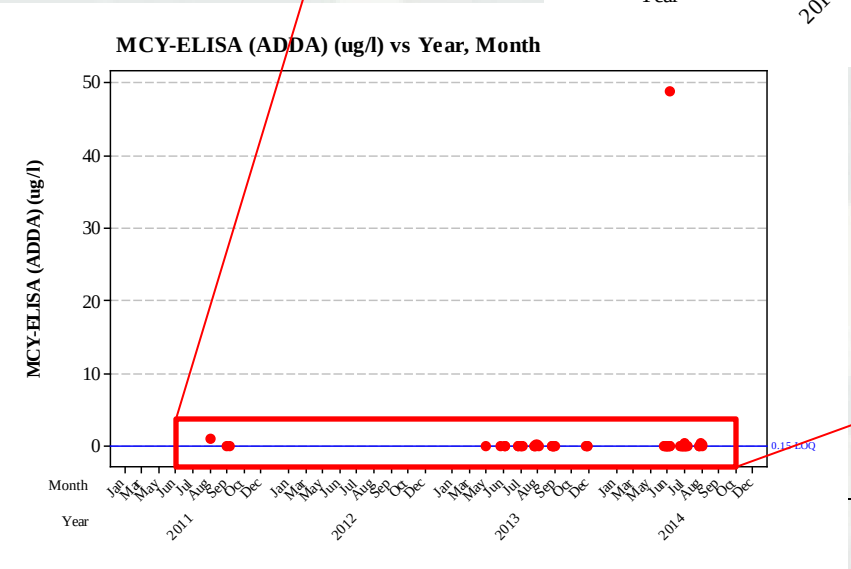
Dec
Jun
Jul
Aug
Year
2011
2012
2013
2014

Eufaula Lake, OK

- Isolated blooms continued throughout the winter of 2011-2012 at > 20,000 cells/ml
- As early as March 2012, cell densities > 100,000 cells/ml present in some areas
- In June 2012 blooms began forming at other locations across the lake
  - Cell densities ranged from 4,268 to 51,515 cells/ml
- In July 2012 blooms increasing in intensity
  - Cell densities ranged from 10,393 to 141,905 cells/ml
- In September 2012 blooms continue to be present at multiple locations
  - Cell densities ranged from 9,074 to 699,729 cells/ml





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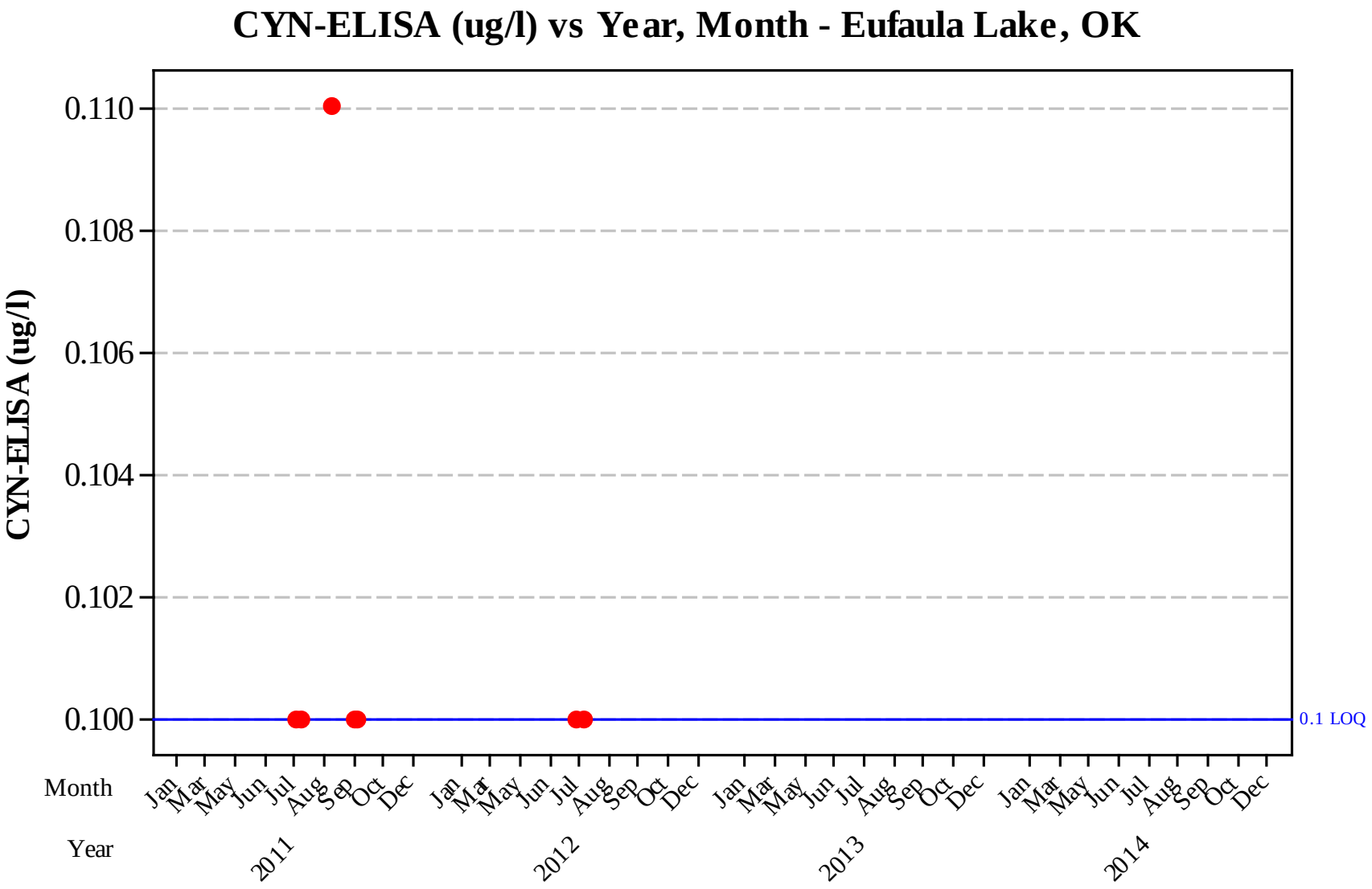

CYN-ELISA (ug/l) vs Year, Month - Eufaula Lake, OK
CYN-ELISA (ug/l)
0.110
0.108
0.106
0.104
0.102
0.100
0.1 LOQ
Month
Jan
Mar
May
Jun
Jul
Aug
Sep
Oct
Dec
Year
2011
2012
2013
2014

Copan Lake, OK - 2012

Beach Location	Date	Cell Density (cells/ml)	Microcystin (ug/l)
Copan Point	8/7/2012	1,442,397	--
Copan Point	8/21/2012	78,134	6.99
Post Oak	8/21/2012	66,968-56,811,116	10.38 – 3,455
Copan Point	9/18/2012	4,693	0.26
Post Oak	9/18/2012	25,790	<0.15

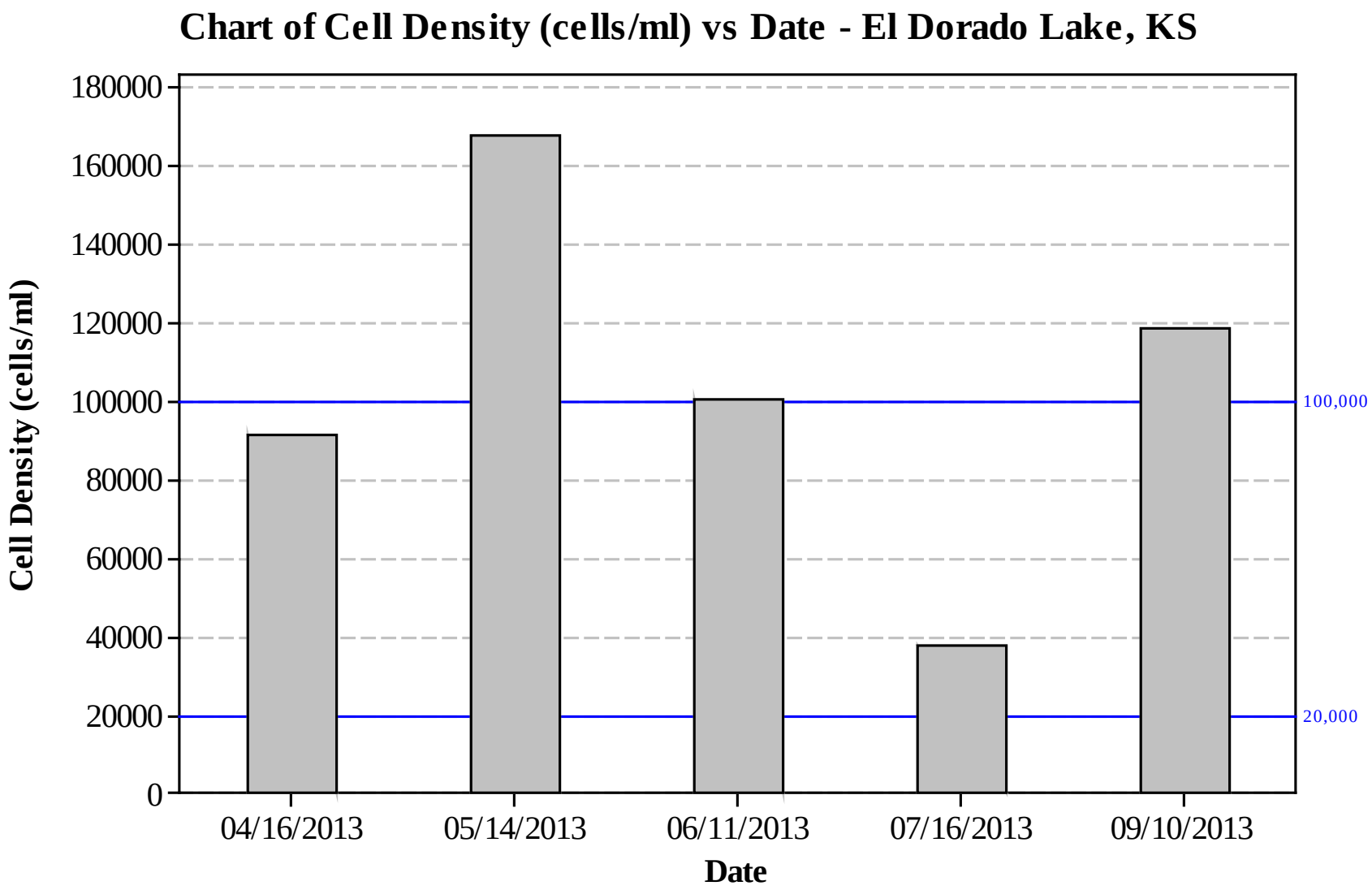


Chart of Cell Density (cells/ml) vs Date - El Dorado Lake, KS
Cell Density (cells/ml)
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
100,000
20,000
04/16/2013
05/14/2013
06/11/2013
07/16/2013
09/10/2013
Date

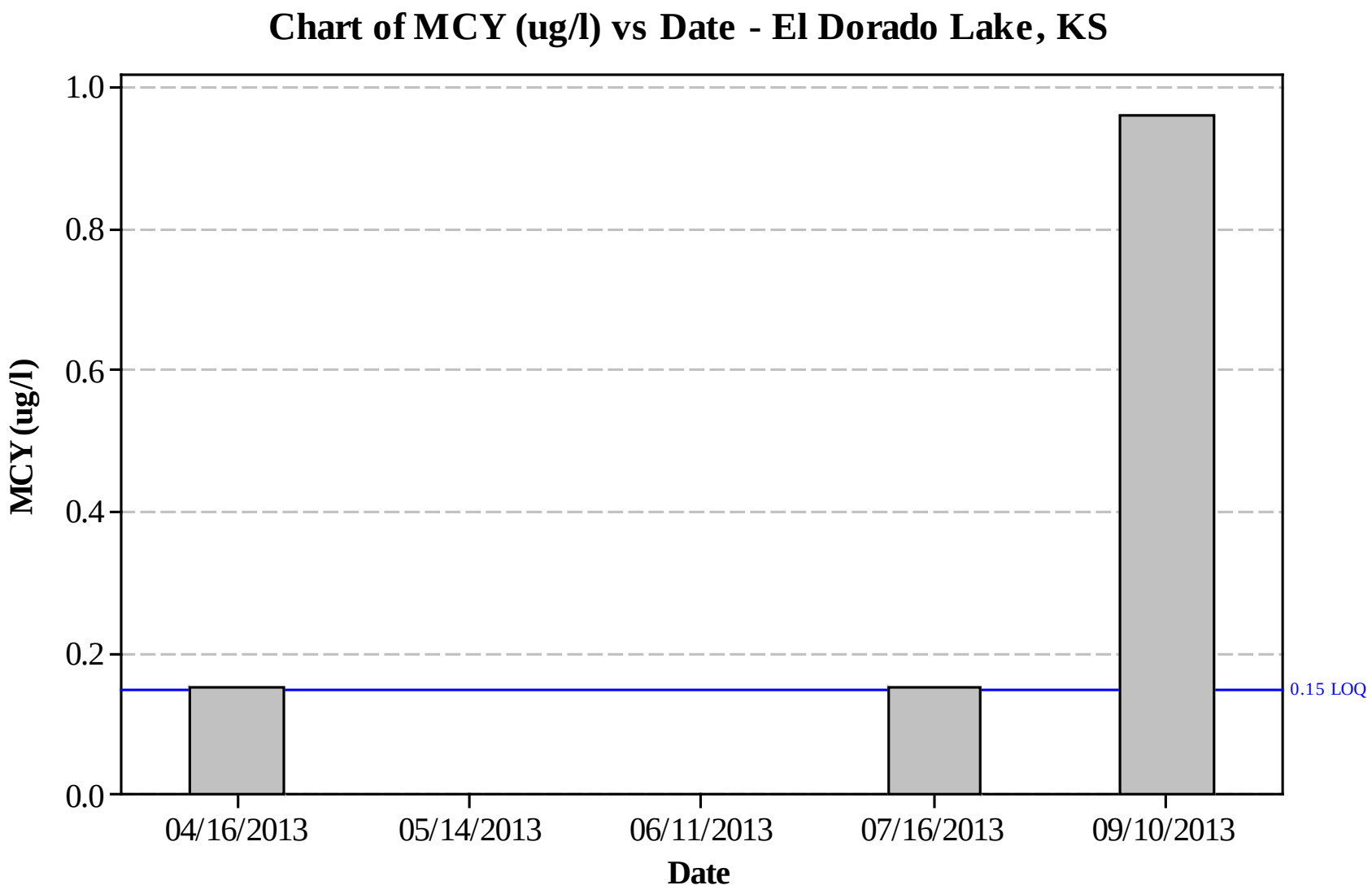
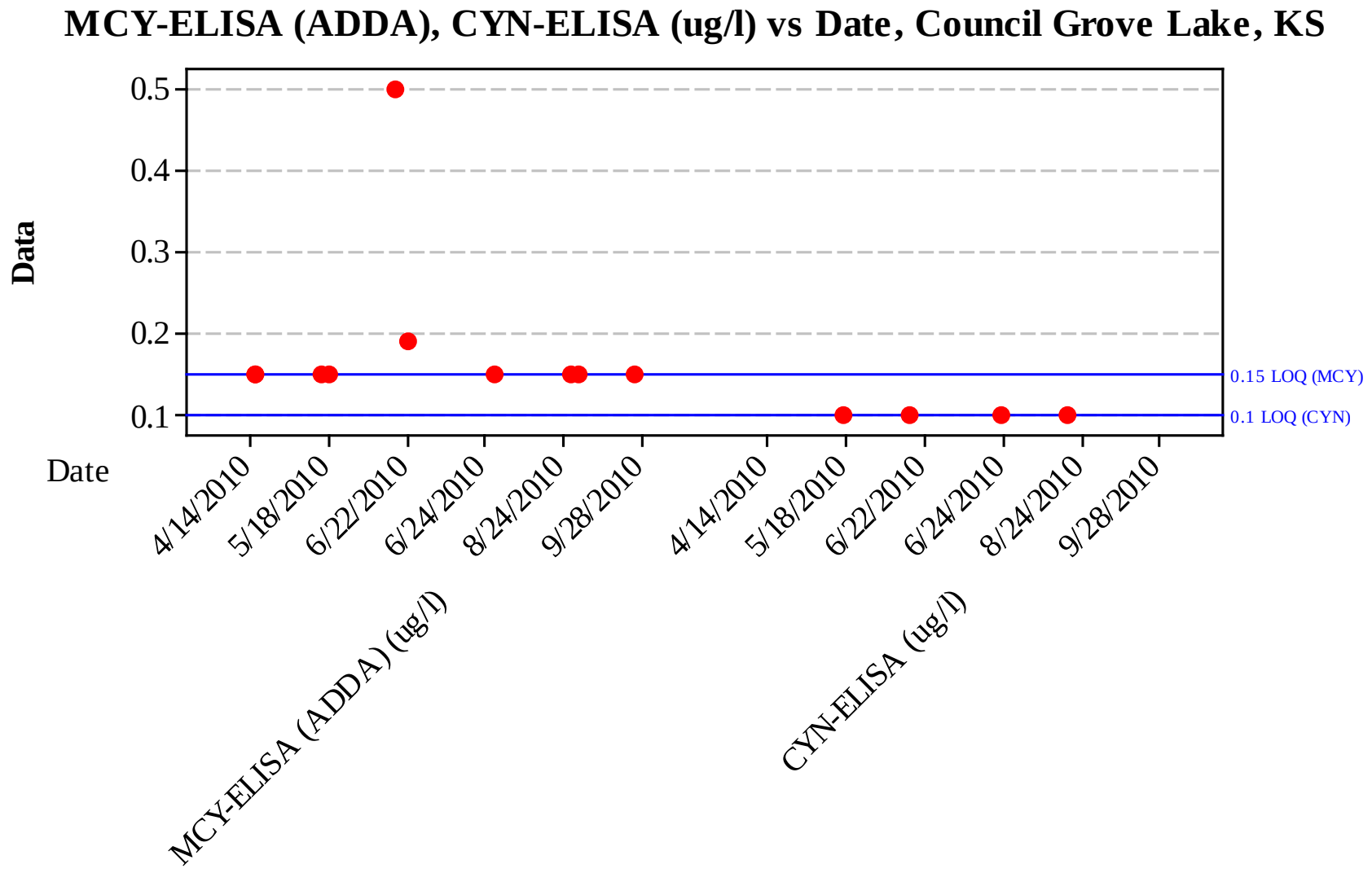
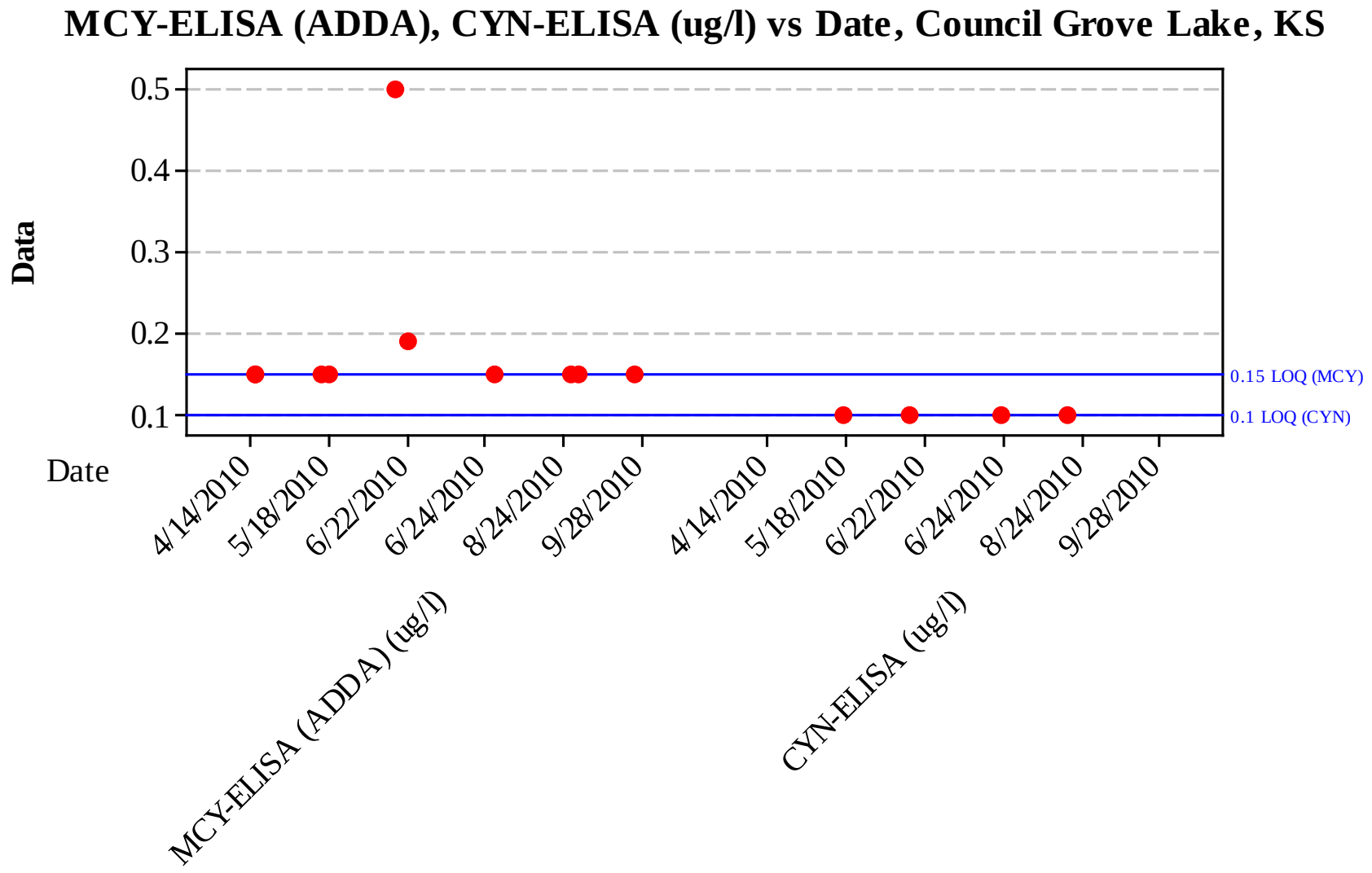


Chart of MCY (ug/l) vs Date - El Dorado Lake, KS
MCY (ug/l)
1.0
0.8
0.6
0.4
0.2
0.0
0.15 LOQ
04/16/2013
05/14/2013
06/11/2013
07/16/2013
09/10/2013
Date


MCY-ELISA (ADDA), CYN-ELISA (ug/l) vs Date, Council Grove Lake, KS
Data
0.5
0.4
0.3
0.2
0.1
0.15 LOQ (MCY)
0.1 LOQ (CYN)
Date
4/14/2010
5/18/2010
6/22/2010
6/24/2010
8/24/2010
9/28/2010
4/14/2010
5/18/2010
6/22/2010
6/24/2010
8/24/2010
9/28/2010
MCY-ELISA (ADDA) (ug/l)
CYN-ELISA (ug/l)


MCY-ELISA (ADDA), CYN-ELISA (ug/l) vs Date, Council Grove Lake, KS
Data
0.5
0.4
0.3
0.2
0.1
0.15 LOQ (MCY)
0.1 LOQ (CYN)
Date
4/14/2010
5/18/2010
6/22/2010
6/24/2010
8/24/2010
9/28/2010
4/14/2010
5/18/2010
6/22/2010
6/24/2010
8/24/2010
9/28/2010
MCY-ELISA (ADDA) (ug/l)
CYN-ELISA (ug/l)

Overview of cyanoHAB reporting requirements and limitations in Oklahoma

- Components of SB 259 incorporated into Tulsa District CyanoHAB Procedures for Oklahoma
  - Advisories issued for cyanoHAB's at reservoirs managed by the Tulsa District when:
    - ≥ 100,000 cells/ml total cyanobacteria AND
    - ≥ 20 ug/l microcystin
  - Advisories lifted for cyanoHAB's at reservoirs managed by the Tulsa District when:
    - ≤ 100,000 cells/ml total cyanobacteria AND
    - ≤ 20 ug/l microcystin
    - Two consecutive weeks within 30 calendar days
  - SB 259 available from the Oklahoma Secretary of State at: https://www.sos.ok.gov/documents/legislation/53rd/2012/2R/SB/259.pdf

Public notification in 2012 shifted away from the USACE to Oklahoma Tourism and Recreation Department (OTRD) in the Tulsa District OK-AOR

- SB 259 establishes the OTRD as the responsible agency reporting cyanoHAB information to the public (**web-based only**)
- Tulsa District procedures altered cyanoHAB reporting to the public in voluntary compliance with SB 259
- Tulsa District and OTRD partnering to implement a public education campaign – (web-based only)
- Tulsa District procedures focus on 3 conditions for cyanoHAB response
- Tulsa District continues to collaborate and share data with OK DEQ for reservoirs which provide PWS
- Advisories and Warnings are no longer issued by USACE or posted on-site. USACE is posting a Blue Green Algae Awareness Level sign on site when cell densities > 100,000 cells/ml

Blue-green Algae Awareness Level

Elevated Risk of Adverse Health Effects

BLUE-GREEN ALGAE BLOOMS ARE PRESENT

For Your Safety, The U.S. Army Corps of Engineers, Tulsa District Recommends the Following:

- **Children and pets are more likely to get sick because of blue-green algae.**
- **Use caution when swimming, water skiing and coming into contact with water.**
- **DO NOT drink untreated lake water.**
- **Keep pets/livestock off of the beach and out of the water.**
- **Avoid areas with visible algae accumulation.**

Symptoms from exposure may include nausea, vomiting, diarrhea, skin rash, eye irritation, respiratory problems or other unexplained illness.

For more information go to:

www.TravelOK.com/checkmyoklake
or
www.swt.usace.army.mil

To Report Illness Due to Exposure, Please Contact Your Doctor or the Oklahoma Poison Control Hotline at: 1-800-222-1222

Tulsa District CyanoHAB Response Conditions

- Condition 1: No cyanoHAB present or reported
  - Response: CyanoHAB educational material posted at all USACE managed areas
- Condition 2: CyanoHAB ≤ 100,000 cells/ml and microcystin ≤ 20 ug/l
  - Response: CyanoHAB educational material posted at all USACE managed areas and data provided to the OTRD for public notification through www.checkmyoklake.com
- Condition 3: CyanoHAB ≥ 100,000 cells/ml and microcystin ≥ 20 ug/l
  - Response: Same as response for Condition 2, and lake managers may, under extreme bloom conditions, close designated swim beaches with District Office approval

OTRD Main Page at
www.checkmyoklake.com

OKLAHOMA LAKE CONDITIONS

With more than 200 lakes and over one million surface acres of water for boating and swimming, Oklahoma has always been a haven for water recreation. In recent years, Oklahoma and other states have been impacted by the spread of blue-green algae. Learn how to keep you and your family safe on Oklahoma's waterways and find answers to all of your questions about blue-green algae and water safety here.

Simply browse this section for frequently asked questions, water safety tips, lake updates, blue-green algae identification tips and more. B efore you pack up the car and head to your lakeside destination, choose your lake from the drop-down menu below to view the most up-to-date lake conditions and testing results.

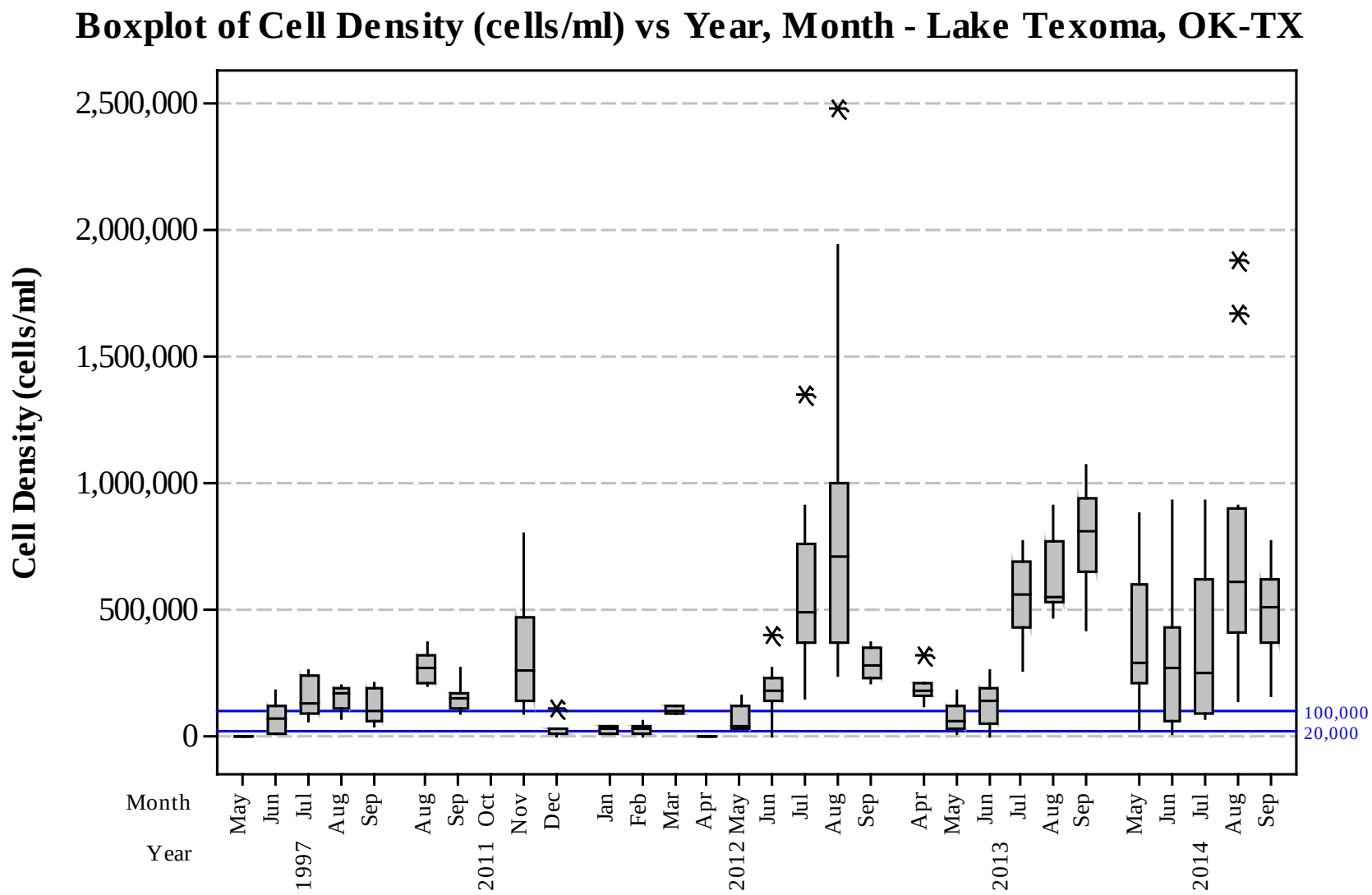
Check Current Conditions >> --Choose a Lake-- GO

http://www.travelok.com/checkmyoklake/

Example of OTRD web notification from www.checkmyoklake.com

Lake Texoma

- Updated: Sunday October 7th, 2012
- **September 1, 2012: Blue-green Algae Update -** Testing was performed on 8-29-12 at several areas of Lake Texoma including Sheppard Annex, Johnson Creek, Little Glasses Creek, Lakeside PUA, Burns Run East, Little Mineral Arm, Treasure Island and the Highway 377/99 bridge. While blue-green algae cell counts were elevated, toxicity levels reported on 9-1-12 are below the World Health Organization threshold. If you or your pet swim in water that may have blue-green algae present, rinse off with soap and fresh water.
- **October 7, 2012:** Elevation is currently 3 ft. below normal, water temperatures are around 83 degrees and the water appears clear.
- **October 7, 2012: Fishing Report -** Largemouth and smallmouth bass are fair to good at 5-15 ft. in creek channels on plastic worms, spinnerbaits and shad colored crankbaits. Striped and white bass are fair to good from 10-30 ft. in the river channels on surface lures, live bait and sassy shad. Channel and blue catfish are fair to good from 10-20 ft. deep from Little Glasses Creek to Johnston Creek on live bait, worms and stink bait. Crappie are fair to good from 5-20 ft. deep in the upper creeks and brush piles on minnows and jigs and small lures. Sunfish are fair to good 5-15 ft. deep around the fishing docks on worms, small tube jigs and shrimp.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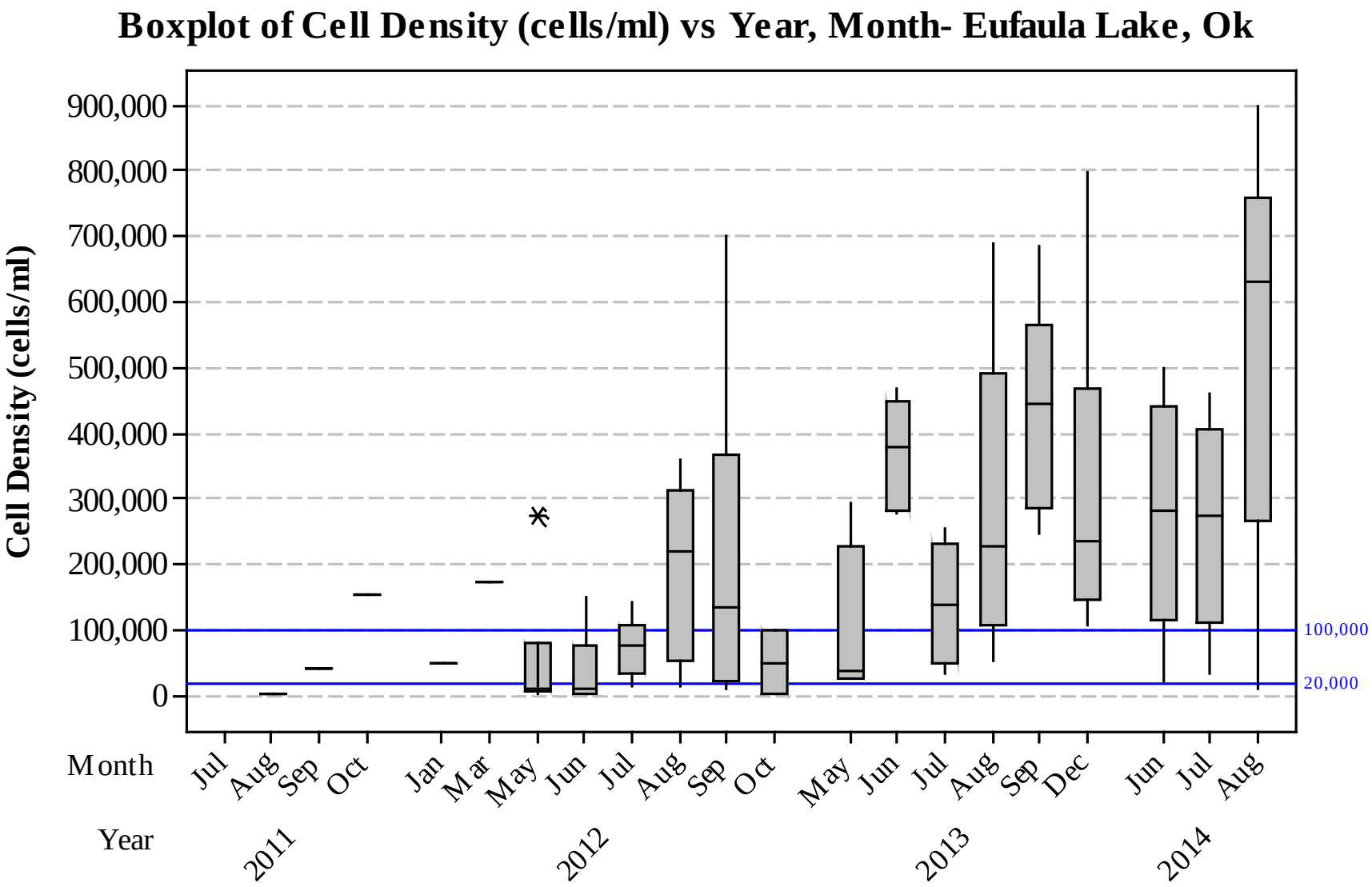
Example of OTRD web notification at www.checkmyoklake.com

- Lake Eufaula
- Updated: Monday October 8th, 2012
- **September 21, 2012: Blue-green Algae Update -** Due to elevated blue-green algae cell counts, contact with the water in the Porum Landing, Brooken Cove and Highway 9 Landing areas is discouraged until toxicity tests can be completed. Visitors should not drink untreated water or let themselves or pets come in contact with areas of discolored water. If you or your pet swim in water that may have blue-green algae present, rinse off with soap and fresh water. Although swimming is discouraged, visitors can still enjoy boating and many land activities at Lake Eufaula State Park, Arrowhead State Park and at other locations around the lake.
- **October 8, 2012:** Lake elevation is currently 4 ft. below normal. The Frisbee boat ramp at Lake Eufaula State Park is currently closed due to low water. The boat ramp at Deep Fork near the marina remains open.
- **October 8, 2012: Fishing Report** - Black bass are good on plastic and crank baits in rocky areas and windy points. White bass are good trolling in shallow flats and windy points. Blue catfish are good on shad in shallow flats. Crappie are fair on minnows and jigs in standing timber and riprap.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500,000
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0
100,000
20,000
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HAB efforts within USACE nationally

- May 2014 meeting in Portland
  - Targeted field personnel from across USACE
  - Included golden algae, costal/estuarine HABs, inland HABs
  - Impacts of HABs to USACE Civil Works Projects, budgeting, WQ activities, etc...
  - Updating of ERDC/TN ANSRP09-1, The Impact of Harmful Algae Blooms on USACE Operations
    - National survey to be completed by Feb 15

Historical USACE CyanoHAB Activities

Table 3. HAB occurrence and impact summary table.

District	HAB Occurrence	HAB Impact
Louisville	Blooms occur at multiple Corps projects every summer, late in the season. Blue-green algae blooms have become a larger issue in the Louisville District in the past three years, most often in Indiana lakes, but also in Ohio and Kentucky bodies of water. Associated factors are thought to include eutrophication, oxygen depletion, high temperatures, and drought conditions.	Multiple projects have reported fish kills. Anecdotal reports of dogs that died after jumping into/drinking water high in algal toxins. Blooms have necessitated an increase in filtration and application of carbon to remove taste and toxins in the water supply. Beaches have been closed down due to blooms, and some people have reported skin rashes.
Norfolk	Large bloom occurred at the Craney Island Dredged Material Management Area in the summer of 2005.	Algal toxin effects are negligible, as the toxins dissipate in the wide mixing area of Norfolk Harbor and recreational activities do not take place in the region.
Buffalo	The Buffalo District manages and maintains many harbors along the south shore of Lake Erie, which currently faces multiple problems and concerns with algal blooms. Blooms have occurred on Lake Erie every summer, with a peak of 2-3 weeks, for at least the past 5 years.	No documented human health impacts have resulted thus far. Beaches have been closed as a precautionary measure.
Portland	Most of the Portland District projects have experienced algal blooms at one time or another. Blooms begin in June and last through the summer. In 2005, large blooms occurred at three of the 17 district projects; typically up to two-thirds of the district's projects experience a large bloom in a given year.	Despite bloom prevalence, health and property impacts were not specified.
Jacksonville	Blooms occurred at several of the district's biggest projects in 2005. Blooms seem to be associated with heavy rainfall periods.	Anecdotal reports of dead manatees. Many human health concerns, especially relating to potable water. Concerns will likely impact the design of a costly project where a downstream water quality treatment installation could increase costs.
Tulsa	Blooms occurred at six of the district's 36 projects in 2005. Marion Reservoir in Kansas blooms annually.	A dog is thought to have gotten sick from Microcystin at Marion Reservoir, Kansas. A golden algae bloom at Lake Texoma in January 2004 killed 25-30,000 fish. Golden algae threaten the striped bass fishery on the lake, which is a $40 million/year economic asset as reported by Paul Mauk, Oklahoma Department of Wildlife Conservation.

Table 5. HAB monitoring summary table.

District	HAB Monitoring
Louisville	The Louisville District collects data from each of their reservoir projects, from the inflows and from the tail waters. At Harsha Lake the District conducted a modeling study, collecting data on a weekly basis through the summer of 2005. Sampling included five locations within the lake every four weeks at different depths. Measurements included metals, nutrients, phytoplankton, chlorophyll, and physical parameters. However, the budget only contains enough money to monitor other locations once a year (in August or September). The Corps collects water for analysis from different depths at tail waters, dam sites, and major tributaries. Special circumstances may warrant a closer look at other places. Other agencies, such as the Division of Water, Fish & Wildlife, and USGS, also collect data in Kentucky, as well as many Indiana agencies.
Norfolk	The Norfolk District has recently measured chlorophyll A levels at Craney Island. USACE noticed these levels increasing over the summer of 2005. Levels started fairly low (i.e. levels the previous winter were around 1-2 ug/L, but levels in the spring and summer were 15-20 ug/L). USACE does not have past summer background measurements and has not done testing until the last few years.
Buffalo	The Buffalo District does not collect data related to algal blooms.
Portland	For the past ten years, the Portland District has taken comprehensive measurements at three projects: the Willow Creek Reservoir (which often experiences algal blooms), Lost Creek Lake, and Applegate Dam. Sample analysis consists of organism ID, cell counts, cell density, and biovolume, as well as environmental factors (including temperature, pH, turbidity, dissolved oxygen, dissolved solids, etc.). Samples are generally 500 mL to 1 L, taken from the top layer of water. Due to budget constraints, samples are not taken regularly at other projects and often include analysis for fewer factors. The interviewee estimated that monitoring all projects on a weekly basis would take over $100,000 per year, which is much larger than the District's entire water quality budget.
Jacksonville	Rather than USACE, the Florida DEP and South Florida Water Management District often sample for algal blooms. The Jacksonville District has, however, collected data about cyanobacteria at sites connected with the Aquifer Storage & Recovery Project. These data are taken from four sites (Lake Okeechobee, Kissimmee River, Hillsboro Canal, Caloosahatchee River), quarterly for one year. Sampling is expensive.
Tulsa	In 2005, the Tulsa District took measurements at the Marion and Fort Gibson reservoirs. Microcystin levels ranged from 2.9 to 9.6 ppb at Marion (June 8th to July 13th, samples taken every two weeks, possibly 60 or 70 samples); 2.8 to 3.6 ppb at Fort Gibson (July 6th, possibly 40 samples). Samples were also taken at Tenkiller Reservoir in 2005, and Skiatook Lake samples were taken on a day at peak of cylindrospermopsin bloom near a swim beach. All told, approximately 360 samples were taken during the year. Data include nutrient levels, total phosphorous, nitrate/nitrite, ammonia, organic carbon, chloride, and total calcium in some lakes, as well as vertical profiles of turbidity, oxygen, pH, conductivity, temperature, chlorophyll, and some light data. Most samples are surface samples; others are a half meter below surface or a meter above the bottom, taken in 1-L amber bottles, split between microcystin and cylindrospermopsin analysis. Historically, the District has had chlorophyll data, but now Dr. Bob Lynch at OU is doing phytoplankton analysis for them.

Excerpted from ERDC/TN ANSRP09-1, The Impact of Harmful Algae Blooms on USACE Operations: http://el.erdc.usace.army.mil/elpubs/pdf/ansrp09-1.pdf

HAB and USACE managed reservoirs

- Nationally, the intensity and frequency of cyanoHAB's at USACE managed reservoirs is increasing
- Currently, the USACE is responding to cyanoHAB's specifically, and HAB's generally, within a local - regional context
  - Individual local/county and state policies, procedures, and statutes
  - Lack of national guidelines/policies with regard to HAB's
  - Stakeholders in different jurisdictions within any given USACE District/Division Office AOR are not provided consistent environmental heath risk assessments and information to make informed decisions for themselves and their families
    - The USACE manages 422 lakes in 43 states
    - > 90% of USACE recreation areas are within 50 miles of a major metropolitan center
    - 55,000 miles of shoreline; 4,500 miles of trails; 90,000 campsites; 3,400 boat ramps
    - The USACE provides PWS storage capacity of 329.2 million ac-ft
- The scope of the USACE recreation and water supply missions necessitates a national approach to cyanoHAB guidance

Harmful Algae Bloom and Hypoxia Research and Control Amendments Act of 2014

- Inter-Agency Working Group reestablished
- Focus expanded to include FW HAB/hypoxia
- Tasked with preparing comprehensive research plans/action strategies for submission to Congress:
  - Marine/FW HAB
  - Marine/FW Hypoxia
  - Great Lakes HAB/Hypoxia Assessment
  - Great Lakes HAB/Hypoxia Action Plan