AQUATIC ECOSYSTEM SCIENCES LLC

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Technical Memorandum

Copco/Irongate Reservoir and Klamath River Toxic Cyanobacteria Results: July 13th and July 27th, 2006

To all concerned:

Recent phytoplankton cell count results for July 12-13th and 26-27th were received from Aquatic Analysts (White Salmon, WA). Reservoir data are from a variety of shoreline and open-water sites, including the standard open-water locations: IR01 and CR01 (Figure 1). Stations IR01 and CR01 are open-water locations and are sampled biweekly as part of ongoing nutrient loading studies. Other reservoir stations are sampled specifically to assess the extent of toxic cyanobacteria (Figure 1). Samples from the Klamath River are also collected biweekly as part of ongoing Karuk and Yurok Tribe river assessment studies; these are, from upstream to downstream, KRAC, KRBI, SV (Seiad Valley), and OR (Orleans) (Figure 1).

Shoreline samples consist of grab samples of surface algal material, and open-water samples consist of a surface or 1 m grab taken with a Van-Dorn water collection bottle. Samples for phytoplankton density and biovolume are preserved in Lugol's Iodine and are sent to Aquatic Analysts in White Salmon, WA. Samples for determination of microcystin toxin are placed in a cooler with gel-ice and shipped overnight air to Wright State University in Dayton, OH. Toxin results are pending for samples collected on these dates (but see below for preliminary ranges for results).

These data clearly show that hepato-toxic (capable of causing chronic liver damage and acting as a tumor promoter) blooms of *Microcystis aeruginosa* (MSAE) have increased dramatically in intensity and extent since the July 13th sample period (Table 1; Figures 2 and 3). All reservoir stations on July 27th exceeded the World Health Organization Moderate Probability of Adverse Health Effect Level (MPAHEL) of 100,000 cells/ml (Figure 4). In fact, the maximum MSAE cell count of over 393 million cells/ml at CRCC exceeded the WHO MPAHEL by over 3,900 times. This is the highest cell density yet recorded for the reservoirs. The open-water stations CR01 and IR01 also exceeded the MPAHEL level by 163 and 65 times, respectively.

No MSAE was detected at KRAC above Copco Reservoir, 35,985 cells/ml were detected at KRBI below Iron Gate Reservoir, and no MSAE was detected at either Seiad Valley (SV) or Orleans (OR). However, because cells are entering the river below Iron Gate, downstream monitoring, through cell counts, toxin samples and visually, should continue. As noted in 2005, substantial growth increases can occur downstream on the Klamath River (Kann 2006).

As noted above we are waiting for final microcystin toxin results, but as expected based on the extremely high cell counts in the reservoirs, preliminary results indicate microcystin levels approaching or even exceeding 2 mg/L (see below email from the Wright State CyanoHab Laboratory). Such levels would exceed the WHO MPAHEL of 20 µg/L microcystin by over 100 times. As soon as final toxin data are received we will provide a more comprehensive toxin analysis.

Given the buoyant nature of these algae, conditions can change rapidly and cell density is likely to be spatially dynamic. A particular area that appears to be less dense may rapidly increase, thus increasing the risk of adverse health effects.

These samples represent both shoreline areas where human and pet access are likely to occur and lake-wide conditions likely to be experienced by boaters and water skiers. Given existing guidelines, current MSAE bloom conditions in Copco and Iron Gate Reservoirs represent a clear public health risk with respect to water contact recreation. Similar to the new Australian guideline of 50,000 cells/ml MSAE, at which point a water body is considered to be unsuitable for primary contact recreation (NHMRC 2005), WHO guidelines consider a cyanobacterial scum in a bathing (swimming) area to be cause for a high probability of adverse health effects. At that point they recommend "immediate action to control scum contact" (WHO 2003).

Copco and Iron Gate reservoirs are currently experiencing both high MSAE cell density (10 to1000's of times higher than guideline levels) and the presence of scums in shoreline and open-water areas; thus, immediate action should be taken to prevent primary contact recreation.

Please let me know if you have any questions. Thank you.

Sincerely,

Jacob Kann, Ph.D.
Aquatic Ecologist

Disclaimer
Due to the patchy nature of blue-green algal blooms it is possible for higher Microcystis aeruginosa densities (and therefore higher microcystin toxin concentrations) to have been present in locations not covered in this survey, particularly along shorelines or protected coves and backwaters during calm conditions of little to no wind. Recreational users should always avoid contact with water whenever noticeable surface concentrations of algae are evident. Moreover, because pets or other domestic animals are the most likely to ingest contaminated water, these animals should not be allowed access to areas of either noticeable surface concentrations of algae or when an obvious green to blue-green appearance is evident

References

Chorus, I, and M. Cavalieri. 2000. Cyanobacteria and algae. Pages 219-271 *in*: J. Bartram and G Rees, editors. *Monitoring Bathing Waters: a practical guide to the design and implementation of assessments and monitoring programmes.* World Health Organization Report. E & FN Spon, London and New York.

Falconer et al. 1999. Safe levels and safe practices. Pages 155-177 *in*: I. Chorus and J. Bartram, editors. *Toxic Cyanobacteria in water: a guide to their public health consequences*. World Health Organization Report. E & FN Spon, London and New York.

Kann, J. 2006. *Microcystis aeruginosa* Occurrence in the Klamath River System of Southern Oregon and Northern California. Technical Memorandum Prepared for the Yurok Tribe Environmental and Fisheries Programs. February 2006.

NHMRC. 2005. Cyanobacteria and Algae in Fresh Water. *Pages* 95-120 *in:* Australian Government National Health and Medical Research Council: Guidelines for Managing Risk in Recreational Water. http://www.ag.gov.au/cca

WHO 1998. Guidelines for Drinking-water Quality. Second Ed. Addendum to Vol. 2, Health Criteria and Other Supporting Information. World Health Organization, Geneva.

WHO 2003. Chapter 8: Algae and Cyanobacteria in Fresh Water. *Pages 128-133* in: Volume 1: Coastal and Fresh Waters. World Health Organization, Geneva

Figure 1. Location of Copco and Irongate Reservoir and Klamath River toxic cyanobacteria sampling/photo stations, 2006. (note: not all stations sampled in each sampling period)

Table 1. Cell density and risk exceedance for toxigenic cyanobacteria in Copco and Irongate Reservoirs and the Klamath River, 2006.

DATE	STATION NAME	DEPTH	*Microcystis aeruginosa* (cells/ml)	*Anabaena sp.* (cells/ml)	Microcystin Total (µg/L)	Exceedance of WHO moderate risk level of 100,000 cells/ml *Microcystis* (x greater than 10^5 cells/ml)	Exceedance of moderate risk level of 20 µg/L microcystin (x greater than 20 µg/L)	Exceedance of TDI of 0.04 µg/kg/day for a 40 lb (18kg) child ingesting 100 mls (x greater than TDI)
7/12/2006	KRAC	0	0	0		0		
7/13/2006	KRBI	0	0	0		0		
7/13/2006	CR01	1	2,492	0		0		
7/13/2006	CRCC	0	11,783,212	6,086		118		
7/13/2006	IR01	1	13,377	0		0		
7/26/2006	KRAC	0	0	0		0		
7/27/2006	CR01	0	16,340,580	0		163		
7/27/2006	CRCC	0	393,395,000	0		3934		
7/27/2006	IR01	0	6,504,808	0		65		
7/27/2006	IRJW	0	25,043,386	32,214		250		
7/27/2006	KRBI	0	35,985	0		0		
7/26/2006	SV	0	0	0		0		
7/26/2006	OR	0	0	0		0		

CRCC 7-13-06

IRO1 Boom 7-13-06

Figure 2. Cyanobacterial algal blooms in Copco and Irongate Reservoirs; July 13, 2006.

CRCC 7-27-06

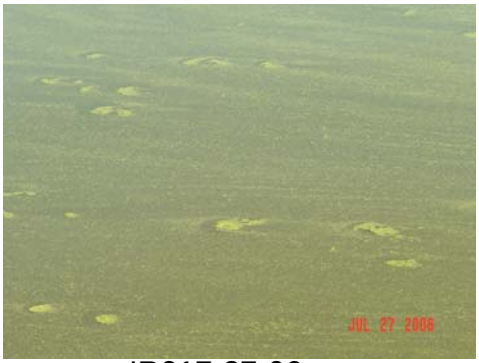
CRCC 7-27-06

CR01 7-27-06

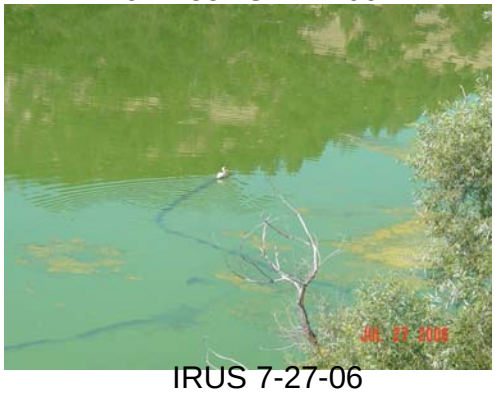
KRAI downstream 07-27-06

KRAI 7-27-06

IR01 Booms 7-27-06



IR017-27-06



IRUS 7-27-06

Figure 3. Cyanobacterial algal blooms in Copco and Irongate Reservoirs; July 26-27, 2006.

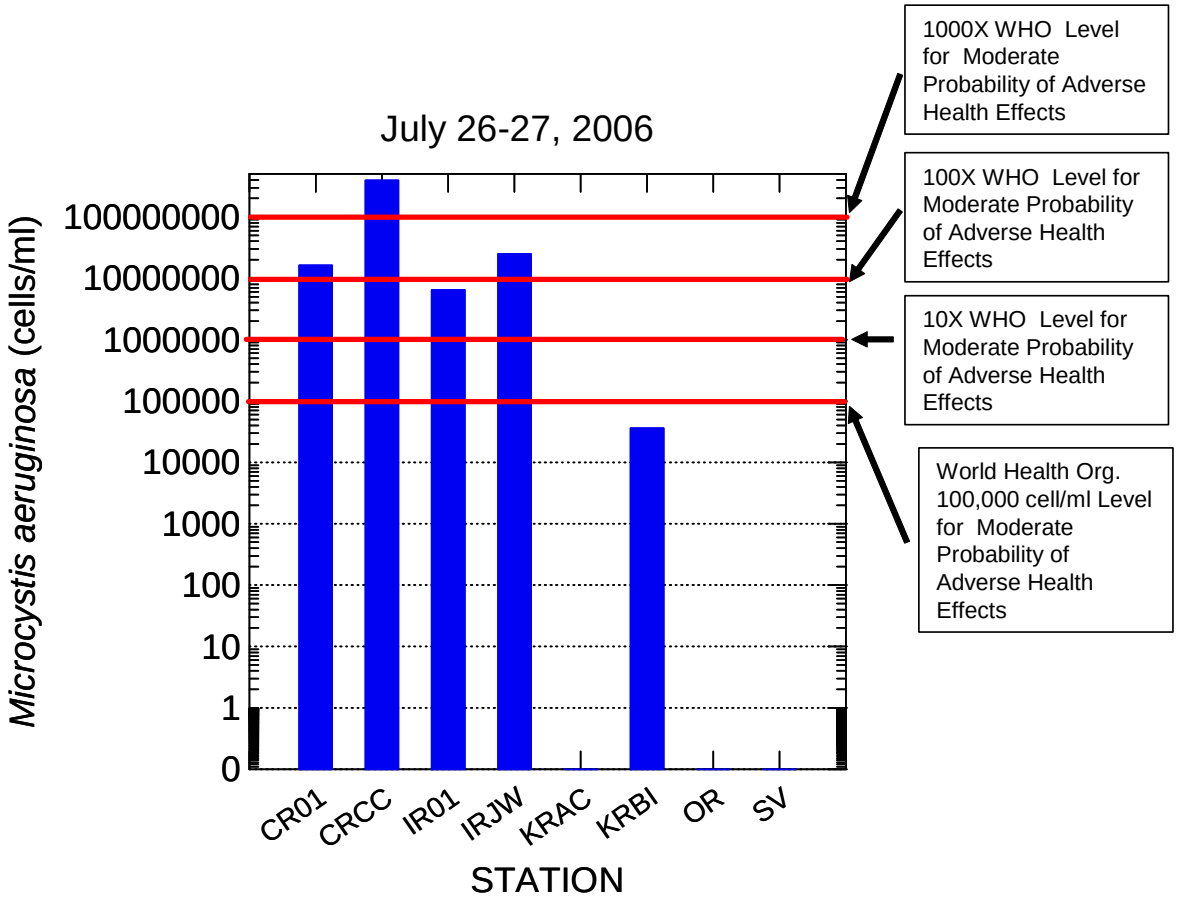


Figure 4. *Microcystis aeruginosa* cell density in Copco and Irongate Reservoirs and the Klamath River, July 26-27, 2006. Note y-axis is log scaled.

Email from Jeanette Frey, CyanoHab Laboratories Wright State University

Subject RE: Karuk Samples

Date: 8/3/2006 1:02:47 P.M. Pacific Standard Time
From: jeanette.frey@wright.edu
To: Jacobkann@aol.com
CC: scorum@karuk.us

Sent from the Internet (Details)

Dear Susan and Jake,

I apologize, but I will not be able to get the final report to you this afternoon. I will have to test your samples a third time tomorrow at even higher dilutions (1:40,000 was not dilute enough to put your samples into the range for the assay!). That means that your samples have mcysts present in the mg range. Here is my best approximation at this point...I hope these values will help you make management decisions until I can get final concentrations to you:

287-1: Kann – Reservoirs CRCC072706 – SG 7/27/06 0815 - in the 2 mg/L range

287-2: CRCC071306 – SG 7/13/06 0830 KR Nutr. Bndg. - in the 1 mg/L range

287-3: Kann – Reservoirs CROI072706-00 7/27/06 0840 - in the 1 mg/L range

287-4: Kann – Reservoirs 7/27/06 IRJW072706 – SG 1130 - slightly below the 1 mg/L range

287-5: Kann – Reservoirs IROI072706-00 7/27/06 1030 - in the 1 mg/L range

287-6: Kann – Reservoirs KRBI072706 – SG 7/27/06 1150 - around 2.5 ug/L

287-7: Yurok – KR Nutrients OR072706 – SG 7/26/06 0830 - around 1.5 ug/L

At these levels we would recommend posting warnings for blue-green algal toxins.

I will contact you as soon as I have further information.

Jeanette