



# Management of *Microcystis aeruginosa* and *Microcystin* with Cutrine®-Ultra in Pawnee Reservoir-Lancaster County-Nebraska

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## Goal: Control of *Microcystis aeruginosa* and *microcystin* production to permit recreational access.

- Measure responses (chlorophyll-*a* concentration, cell density, and *microcystin* production) of *M. aeruginosa* from Pawnee Reservoir to selected algaecide exposures in the laboratory
- Measure responses (chlorophyll-*a* concentration, cell density, and *microcystin* production) of *M. aeruginosa* from Pawnee Reservoir to an algaecide exposure in the field
- Compare and contrast laboratory and field results

### STUDY SITE: PAWNEE RESERVOIR, LANCASTER COUNTY, NEBRASKA

- Constructed by the U.S. Army Corps of Engineers (COE) primarily as a flood control reservoir with recreation and irrigation as secondary uses.
- Surface Area: 300 ha (728 ac)
- Max. Depth: 12.8 m (38.3 ft)
- Mean Depth: 3.4 m (11.7 ft)
- Retention time: ~ 1.4 years
- Brief summer thermal stratification



Pawnee Reservoir Before



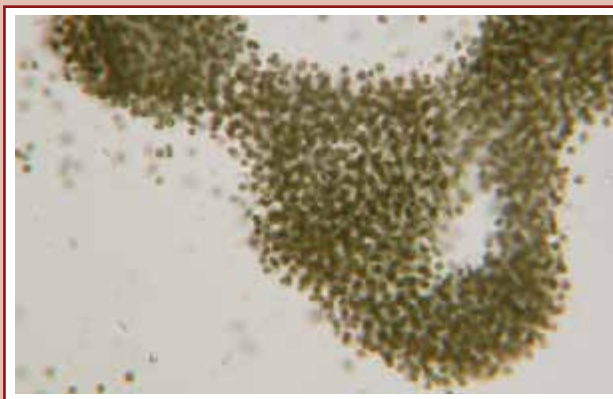
Pawnee Reservoir After

## Chemical Control of Blue Green Algae:

- Blue Green Algae (cyanobacteria) can produce toxins like *Microcystin*
- Responses of algae to algaecide exposures at different sites vary widely
- Identification of an efficacious treatment for critical water resources are needed

### Why Algaecides?

- Critical water resource uses need to be restored rapidly
- Site Specific
- Accounts for restrictions, usages, and specific characteristics of a site



### *MICROCYSTIN*

- Hepatotoxic Cyclic Peptide Toxin
- Many Forms: LA, LL, AR, YA, RR, LR
- WHO Drinking Water Guideline = 1 µg/ L total *microcystin*
- Water Soluble

**ACT (Algal Challenge Test):** Laboratory Studies: Efficient for measuring responses of specific problematic algae in site water to multiple algaecides.

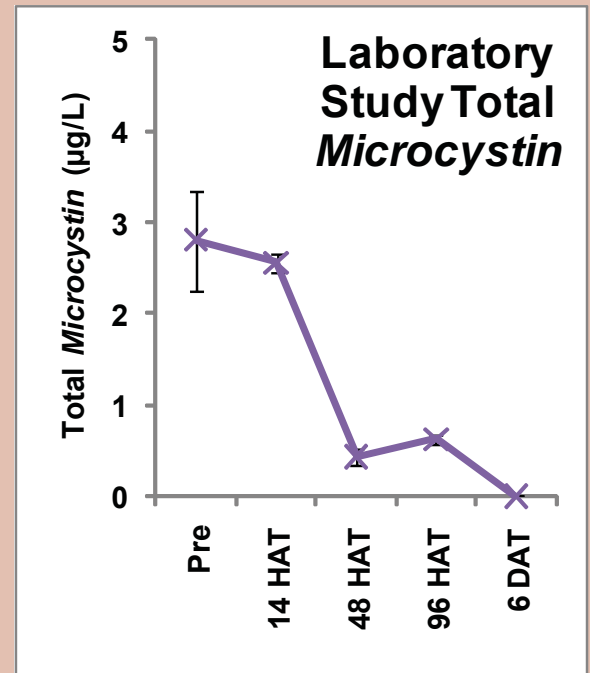
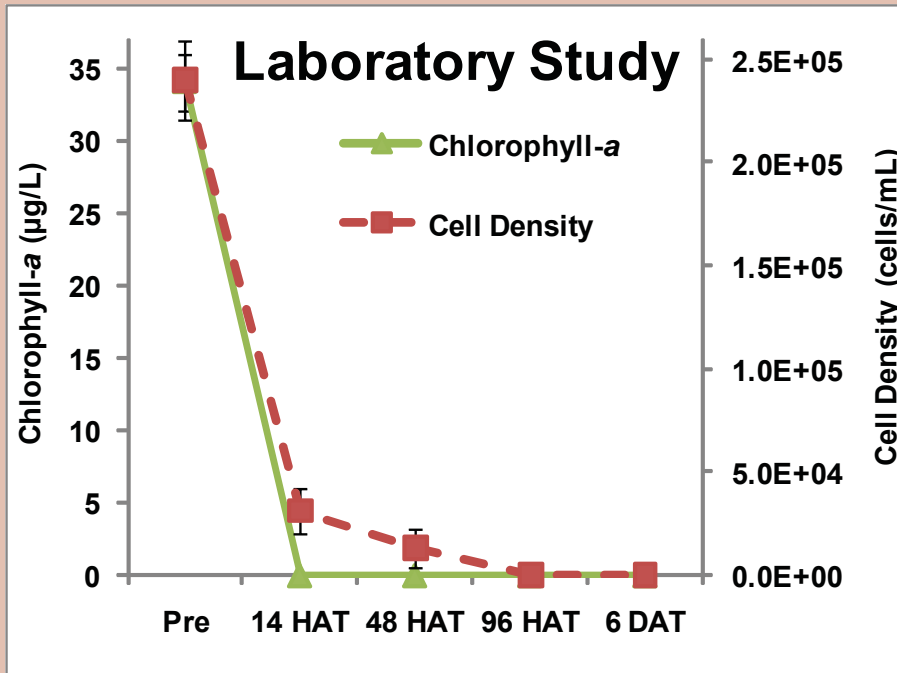
### Procedure:

1. Obtain field sample
2. Measure water characteristics and identify problematic species
3. Test multiple, appropriate algaecides
4. Observe the responses (measurements):
  - Chlorophyll-*a* concentration (extraction and fluorescence)
  - Cell (colony) density (light microscopy)
  - Total *Microcystin* concentration (ELISA)
5. Recommend an algaecide that is site specific



	pH (SU)	Dissolved Oxygen (mg O <sub>2</sub> /L)	Alkalinity (mg / L as CaCO <sub>3</sub> )	Hardness (mg / L as CaCO <sub>3</sub> )	Conductivity (µS / cm <sup>2</sup> )	Temperature (°C)
Laboratory Study	8.1	8.4	184	160	432	21
Field Study (range)	8.8 (8.7-8.9)	8.9 (8.7-9.0)	170 (170)	156 (154-158)	333 (323-342)	25 (25)

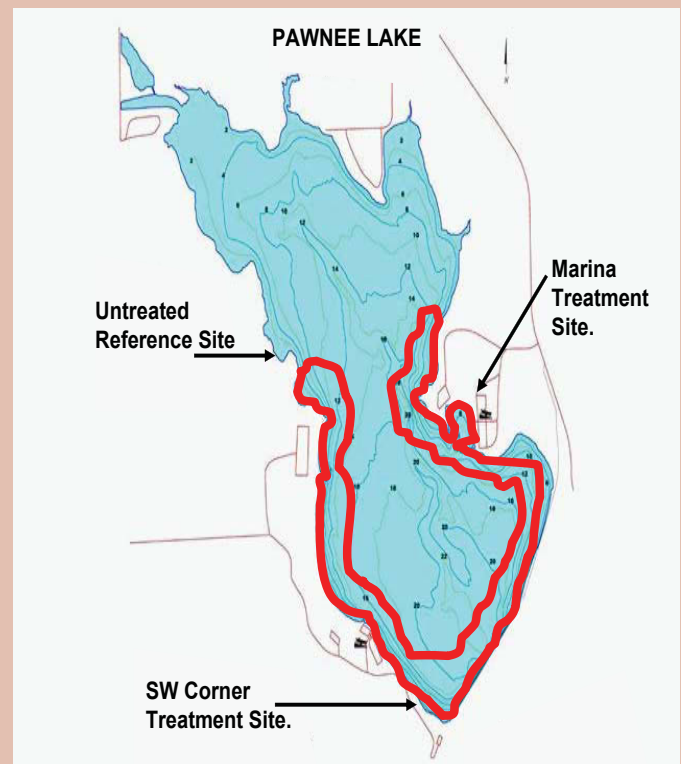
## Laboratory Study Results



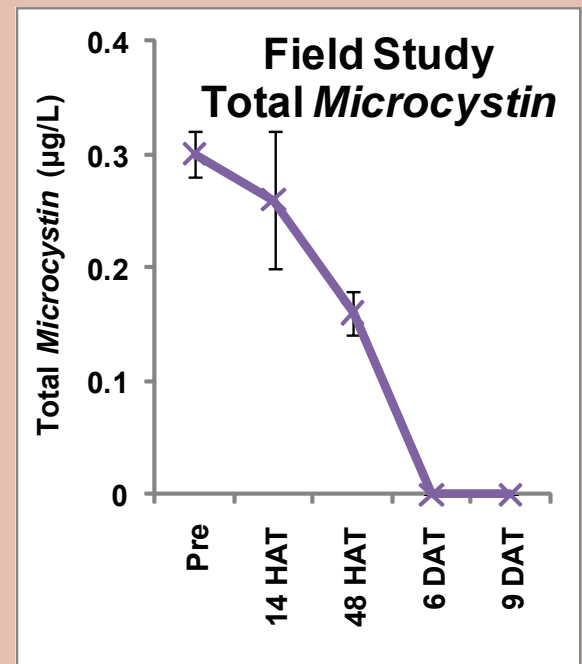
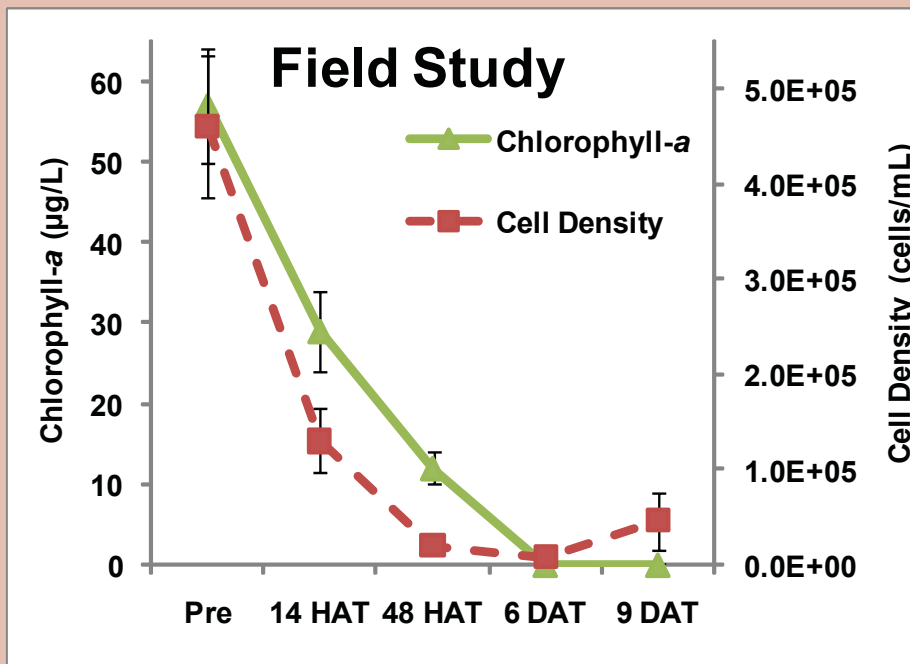
Laboratory responses of *Microcystis aeruginosa* from Pawnee Reservoir exposed to 0.2 mg Cu/L as Cutrine-Ultra.

### Field Application of Cutrine-Ultra:

- On June 6, 2006, Cutrine-Ultra was applied over approximately 71 hectares (175.7 acres) in Pawnee Reservoir, NE.
- Approximately 1,597 liters (422 gallons) of Cutrine-Ultra were applied to the total treatment area.
- A target concentration of 0.4-0.5 mg Cu/L was selected for the entire treatment area due to algal densities observed in Pawnee Reservoir prior to treatment ( $4.6 \times 10^5$  cells/mL, compared to  $2.4 \times 10^5$  cells/mL in the laboratory study).
- Water samples were collected from the two treatment sites as well as an untreated reference site pre-treatment, 4 hours, 24 hours, 48 hours, 6 days and 9 days after treatment.
- Measurements: water characteristics, total copper concentrations, algal cell densities, chlorophyll-*a* concentrations, and total *microcystin* concentrations.



## Field Study Results



Field responses of *Microcystis aeruginosa* from Pawnee Reservoir exposed to ~0.4 mg Cu/L as Cutrine-Ultra.

### Summary

The laboratory study (ACT) results predicted an effective algaecide and responses of algae following the field application.

Total microcystin measurements decreased to non-detect following effective treatments in both the laboratory and field.

The uses of this water resource were restored.

Relative to the laboratory study, higher *Microcystis* cell densities in the field required proportionally more algaecide to achieve control, emphasizing the importance of early intervention.

### Acknowledgements

- Nebraska Game and Parks Commission (Rob Ruskamp and Jay Woltemath)
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