

# Risk of Cyanotoxicoses to Pets & Livestock

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# Risk of Cyanotoxicoses to Pets & Livestock – Objectives of Talk

- Overview of cyanotoxins found in Nebraska waters
- Recommendations to minimize risk of cyanotoxicoses for pets and animals
- Review of a case of cyanotoxicosis in 2006



Algae bloom in Thomas Lake, NE, May 2006  
Photo by Dr. B. Brodersen, UNL VDC

# Cyanotoxins

- **Toxins produced by cyanobacteria (blue-green algae)**
- **Cyanobacteria**
  - **Photosynthetic organisms**
  - **> 2000 species**
  - **Some found in water column (pelagic)**
  - **Some found in sediments (benthic)**



Algae bloom in Thomas Lake, NE, May 2006  
Photo by Dr. B. Brodersen, UNL VDC

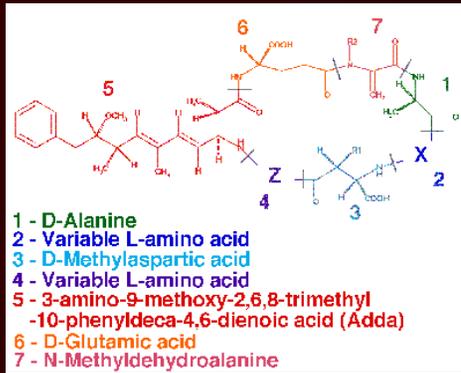
# Cyanotoxins

- Cyanobacterial blooms depend upon:
  - Water temperature - spring & summer months
  - Water N & P content
  - Concentrate on leeward side of water body
  - May rapidly appear and disappear
- Not all blooms are toxigenic – genetic & environmental factors



Algae bloom in Thomas Lake, NE, May 2006  
Photo by Dr. B. Brodersen, UNL VDC

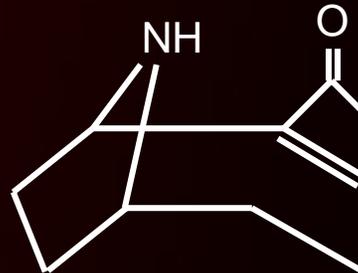
# Cyanotoxins found in Nebraska



Microcystins



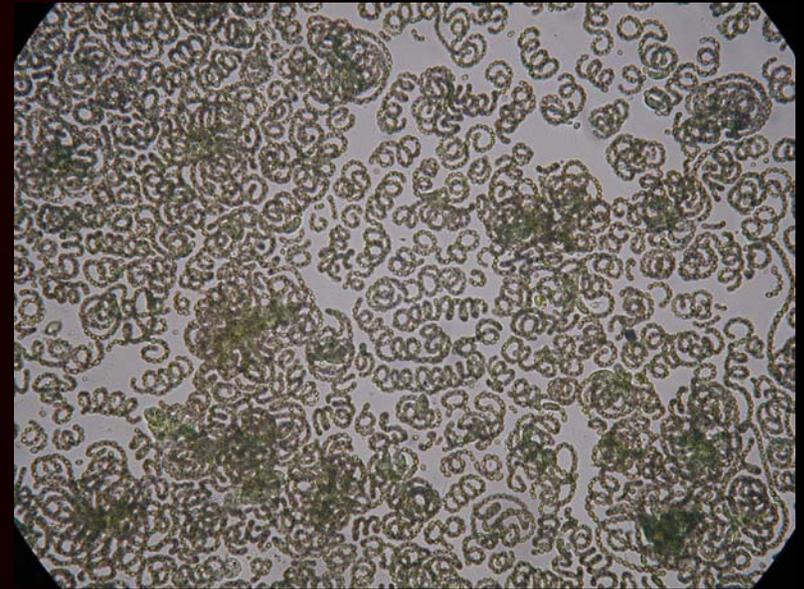
Anatoxin-a(s)



Anatoxin-a

# Cyanotoxins - Microcystins

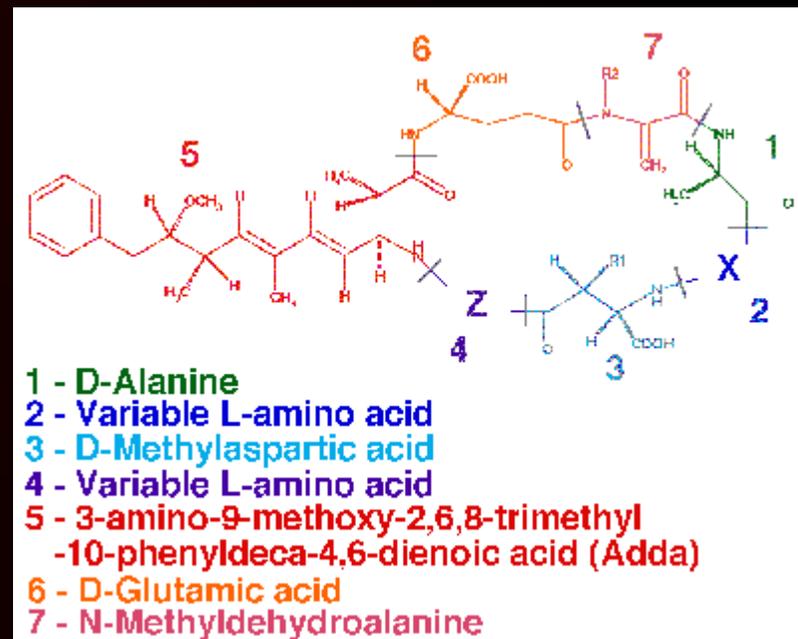
- Produced by:
  - *Microcystis* spp (“Mike”)
  - *Anabaena* spp (“Annie”)
  - Others, too.
- Normally present intracellularly
  - Released upon lysis of cell
    - Death of cell
    - Ingestion and lysis in GI track



*Anabaena* spp from Thomas Lake, NE – 1006  
Photo by Todd Barrow, UNL SNR

# Cyanotoxins Important to Nebraskans - Microcystins

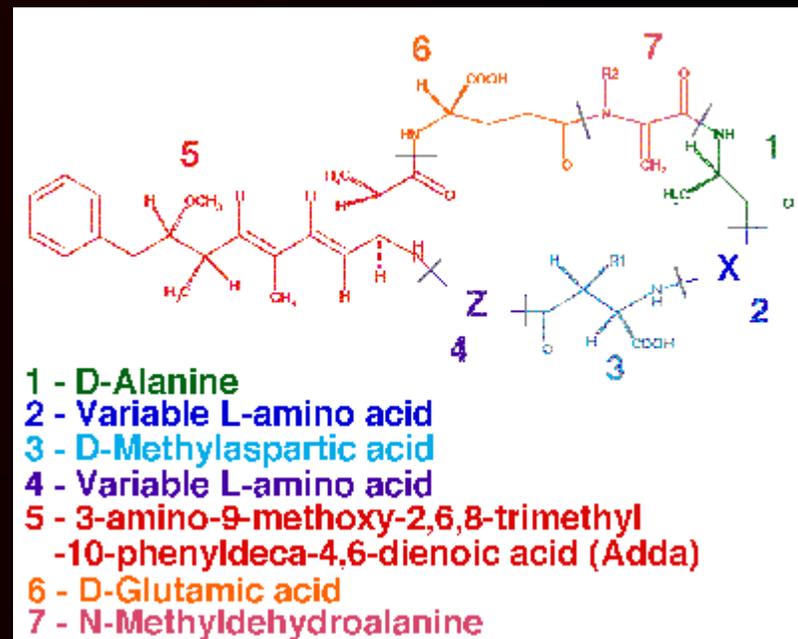
- Cyclic heptapeptides - small proteins containing 7 amino acids (AAs) bound to form a ring
  - 2 variable
  - 5 unvariable
- Over 80 microcystins have been IDd
  - Microcystin-LR most commonly found, most extensively studied
  - Name indicates variable AAs present in molecule



From the website Cyanosite: <http://www-cyanosite.bio.purdue.edu/>.

# Cyanotoxins Important to Nebraskans - Microcystins

- Liver poison (hepatotoxin)
  - Acute exposure – liver failure
  - Chronic exposure – cancer
- No liver disease = no significant microcystin exposure!



From the website Cyanosite: <http://www-cyanosite.bio.purdue.edu/>.

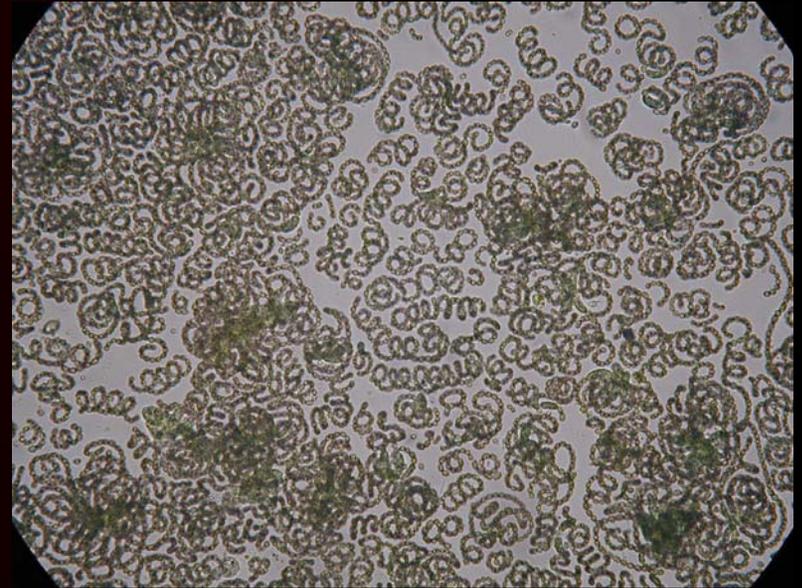
# Cyanotoxins Important to Nebraskans - Microcystins

- **Clinical signs and progression**
  - **Effects begin 1-4 hrs after ingestion**
    - **Lethargy, weakness**
    - **Vomiting**
    - **Diarrhea**
  - **Death within 24 hrs, sometimes longer**
- **Prognosis: poor to grave**
- **No antidote, supportive treatment**



# Cyanotoxins Important to Nebraskans – Anatoxin-a

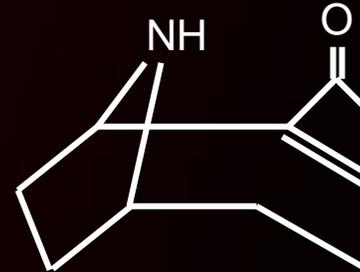
- Produced by:
  - *Anabaena* spp
  - *Aphanizomenon* spp (“Fannie”)
  - *Microcystis* spp
  - *Oscillatoria* spp



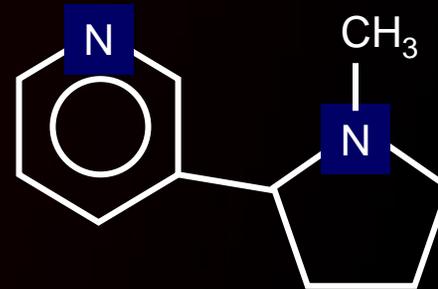
*Anabaena* spp from Thomas Lake, NE – 1006  
Photo by Todd Barrow, UNL SNR

# Cyanotoxins Important to Nebraskans – Anatoxin-a

- Cyclic amine producing effects akin to nicotine
- Clinical signs
  - Muscle tremors
  - Rigidity
  - Lethargy
  - Respiratory distress
  - Convulsions
- Death due to respiratory paralysis – often rapid, within 30 min onset of signs



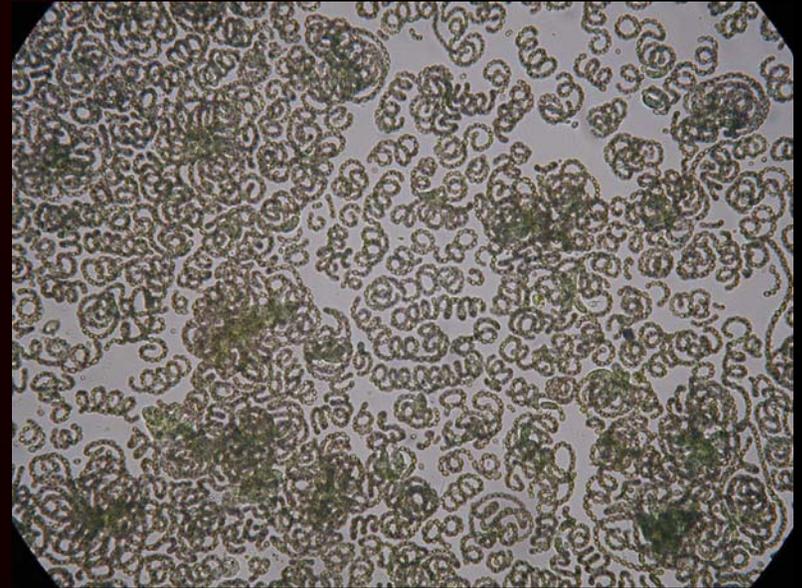
Anatoxin-a



Nicotine

# Cyanotoxins Important to Nebraskans – Anatoxin-a(s)

- Produced by:
  - *Anabaena* spp
  - Others (?)



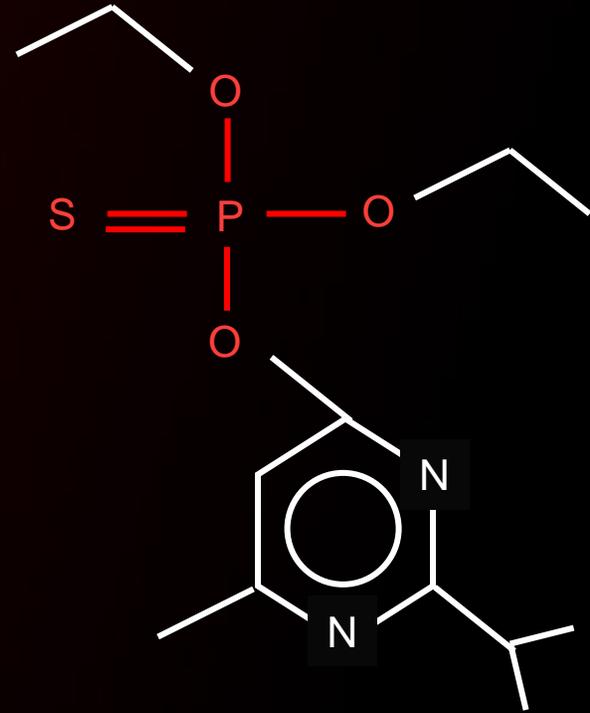
*Anabaena* spp from Thomas Lake, NE – 1006  
Photo by Todd Barrow, UNL SNR

# Cyanotoxins Important to Nebraskans – Anatoxin-a(s)

- Naturally occurring organophosphate



Anatoxin-a(s)



Diazinon (insecticide)

# Cyanotoxins Important to Nebraskans – Anatoxin-a

- Clinical signs
  - **SLUD** syndrome
    - **S**alivation
    - **L**acrimation
    - **U**rination
    - **D**efecation
  - Tremors
  - Difficulty breathing
  - Convulsions
- Death due to respiratory paralysis – usually within 60 min onset of signs



Anatoxin-a(s)

# Risk Assessment for Cyanotoxicosis in Animals

- All animals are at risk: livestock and pets.
- Ponds, lakes & stagnant areas in streams.
  - Stock tanks - unlikely
- State system used to close recreational waters IS NOT good for risk assessment for animals.
  - Exaggerates risk significantly
- **Keep animals away from ANY algal bloom**
  - No matter the color or location
  - Animals grooming themselves after wading in bloom may ingest algal cells



Algae bloom in the lake and on-shore  
Thomas Lake, NE, May 2006  
Photo by Dr. B. Brodersen, UNL VDC

# Cyanotoxicosis in a Dog – May 2006

- 8 yr old, spayed female German Shorthair presented to vet
  - Unresponsive
  - Salivating
  - HR: 25 – 30 bpm
  - Rectal temp: 102 °F
    - Introduction of thermometer elicited BM colored green with spots of blood
  - Died about 10 min after presentation

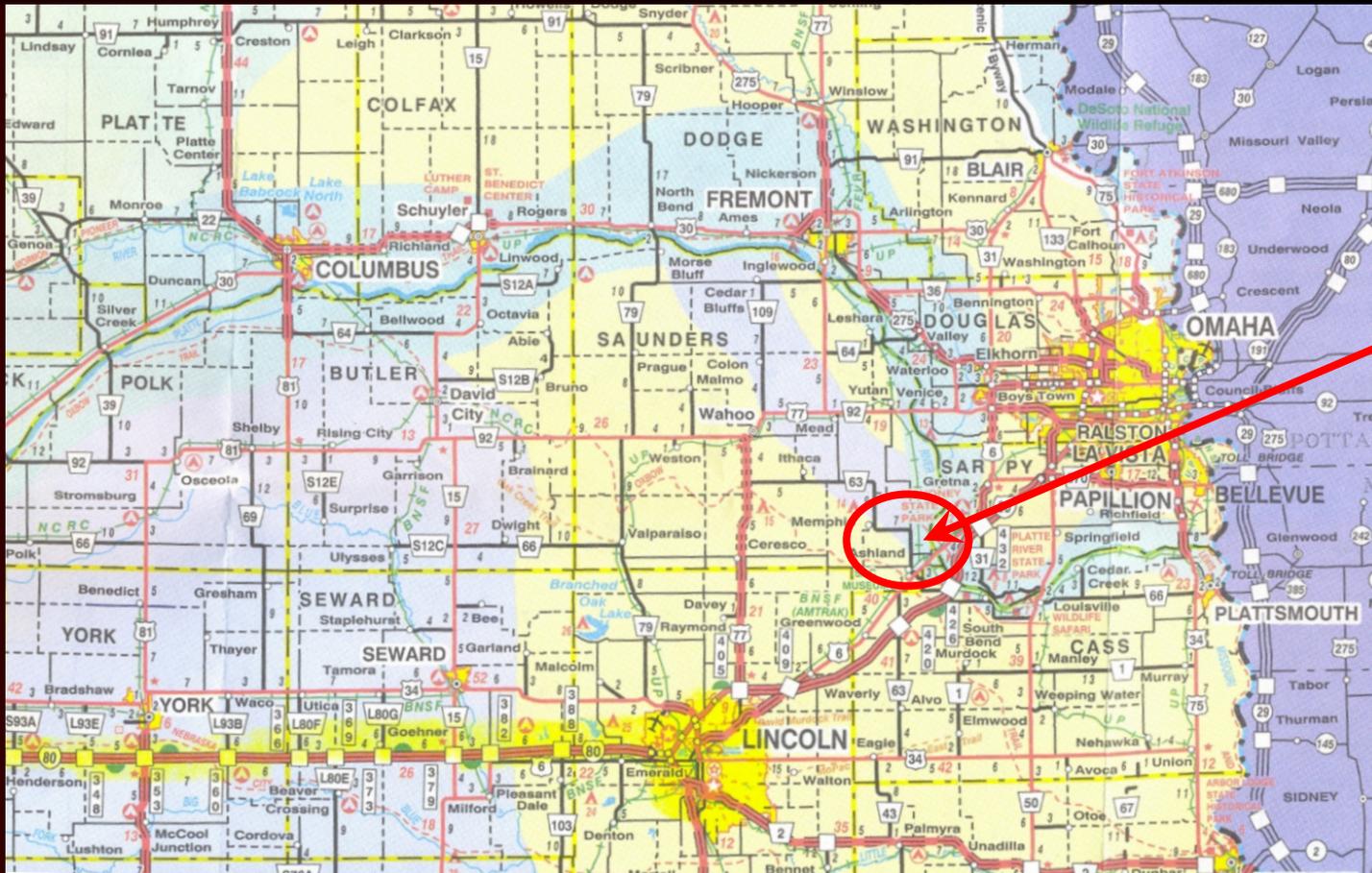


Picture from German Shorthair Page,  
<http://www.shorthairs.net/>. No copyright statement.

# Owner's Account

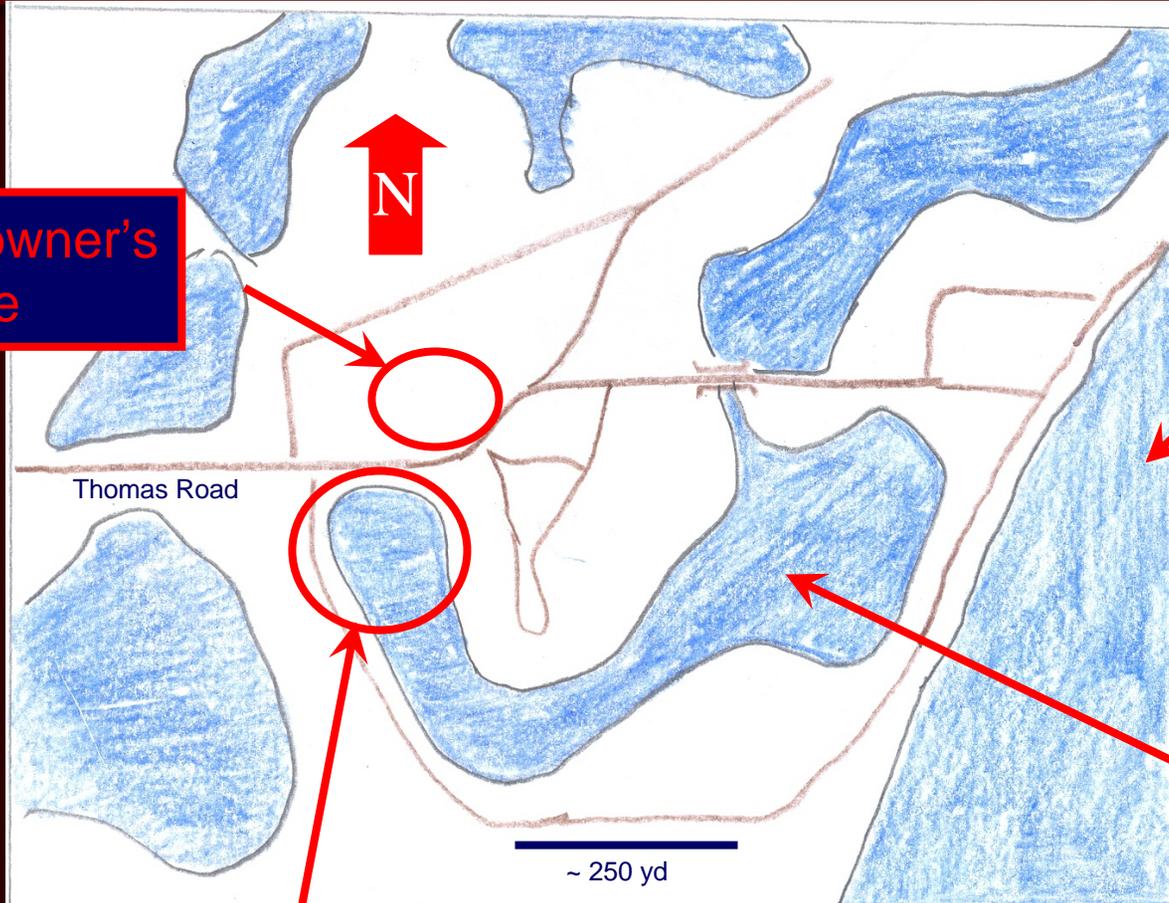
- **Dog ran free** starting about 4 pm, May 25, 2006, while lawn was being mowed.
- Was let out **about 9:30 pm** for ~ 10 minutes; looked like **something was wrong with the dog.**
- Came back inside and laid by the television:
  - **Salivation, bubbles from the mouth.**
  - **Body tremors.**
  - **Refused water.**
- Presented to vet about 10:30 pm.
  - Dog vomited in car en route – dog food and clear fluid.
- **Algal blooms present on Thomas Lakes for several days.**

# Locale of Incident



General location of Thomas Lakes

# Locale of Incident – Sketch



Area of owner's residence

Platte River

Thomas Road

Thomas Lakes

~ 250 yd

Area where exposure likely occurred.

# Algal Scum on Thomas Lakes

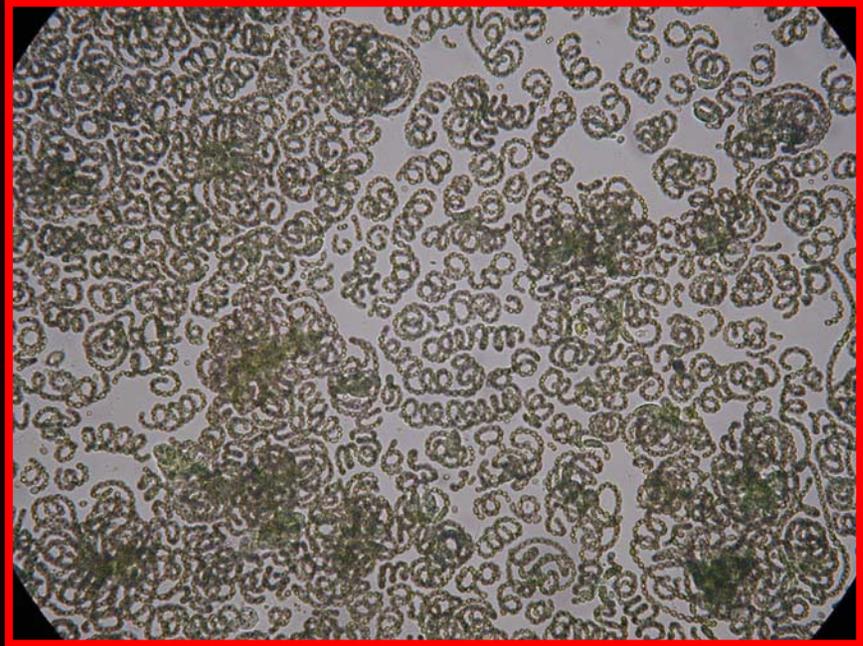


# Necropsy Findings

- Necropsy performed at UNL VDC about 12 hours after death the following day.
- Carcass in good condition,
- Vomitus around mouth,
- No evidence of algal scum on coat,
- Cecum and LI contained small amounts of green mucoid contents with spots of blood,
- Liver & spleen: moderately congested,
- No other gross lesions noted.

# Cyanobacteria in Ingesta and Lake Water Specimens

- Stomach content collected at necropsy.
- Water specimen & vomitus submitted by owner.
- **Microscopic examination found *Anabena* spp. in all specimens.**
  - **Practically 100% *Anabena* spp. in the water specimen.**



*Anabena* spp. found in the lake water specimen.

Picture by Tadd Barrow, UNL School of Natural Resources

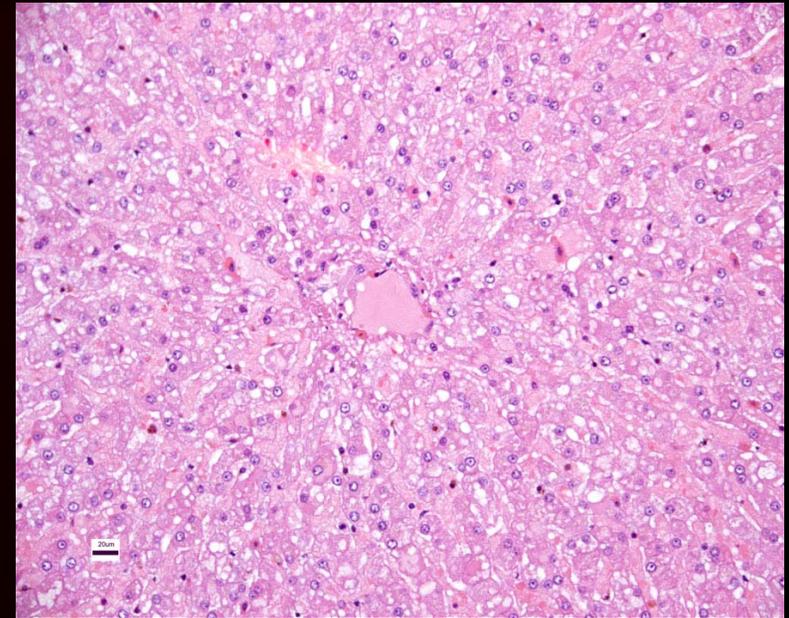
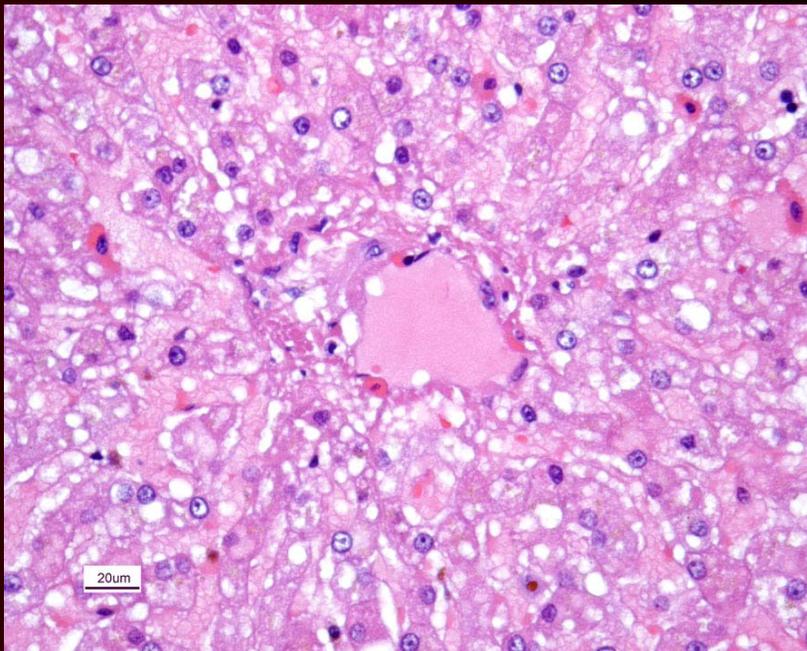
# Histopathology

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- **Varying amounts of congestion in all tissues examined**
- **Lungs: small aggregates of macrophages containing black intracytoplasmic granular pigment seen in bronchioles (pneumonconiosis).**
- **Spleen: small siderotic plaques noted in association with larger caliber arteries.**

# Histopathology

- Liver:
  - Mild vacuolar degeneration in hepatocytes.



Liver, 20X, H&E stain

Liver, 40X, H&E stain

# Preliminary Diagnosis

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- **Anatoxin-a or Anatoxin-a(S) toxicosis.**
  - Salivation, vomiting, defecation.
  - Rapid death (~ 5.5 hours between suspected exposure & death).
- **Ruled out microcystin toxicosis.**
  - Absence of hepatic lesions.

# Analysis of Water & Vomitus for Cyanobacterial Toxins

- **Method of analysis: LC/MS/MS** (UNL Water Science Laboratory)
- **Water contained:**
  - 585 ng anatoxin-a/mL,
  - 5,000 ng microcystin LR/mL.
  - No detectable amount (NDA) other microcystins.
- **Vomitus contained:**
  - 5,980 ppb anatoxin-a,
  - 307 ppb microcystin LR.
  - NDA other microcystins.

# Evidence for Diagnosis of Anatoxin-a Toxicosis

- *Anabena* spp. found in scum taken from lake.
- *Anabena* spp. found in vomitus and stomach content.
- Anatoxin-a found in water and stomach content specimens.
- Clinical signs, time to death, post mortem & histological findings consistent with anatoxin-a toxicosis.
  - Dog was exposed to microcystin LR and observed hepatopathy may be an early manifestation of microcystin toxicosis.
  - Hepatopathy was not sufficient to cause death.

# Conclusions

- **Dog died due to anatoxin-a toxicosis.**
  - Anatoxin-a(S) toxicosis cannot be completely ruled out:
    - No peripheral AChE activity was measured.
    - Lability of the compound may have prevented its detection.
- Time of occurrence odd with respect to reports in veterinary toxicology references.
  - Expected in late summer or early fall, not in the spring.
  - **Second time that cyanobacterial toxicoses have occurred in Nebraska in the spring.**
    - Spring 2004 – three deaths attributed cyanobacterial toxicoses.

# Principals in the Case

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- **Attending veterinarian:** Dr. Monte Pauli.
- **Pathologist:** Dr. Bruce Brodersen.
- **Cyanobacterial toxin analyses:** Dr. Daniel Snow.
- **Cyanobacterial identification:** Mr. Tadd Barrow, Extension Educator, UNL School of Natural Resources.

# Please contact me if you questions

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# Risk of Cyanotoxicoses to Pets & Livestock – Questions?

- Overview of cyanotoxins found in Nebraska waters
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