Overview of Texas Hatchery Management of Golden Alga, *Prymnesium parvum*

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A. E. Wood Fish Hatchery

San Marcos, Texas

Dundee State Fish Hatchery

- Near Wichita Falls, TX
- Lake Diversion
- Water quality
  - Salinity 2-3 ppt
  - Chlorides 1899 mg/L
  - Calcium 296 mg/L
  - Magnesium 63 mg/L
- Fish produced
  - striped bass, hybrid striped bass, smallmouth bass, largemouth bass, channel catfish, koi carp, rainbow trout

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Dundee State Fish Hatchery

- February 2001
- Mortality begins
  - Rainbow trout
  - Cause unknown

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Dundee State Fish Hatchery

- March 2001
- Mortality continued
  - Smallmouth bass broodstock
  - Northern largemouth bass broodstock

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Dundee State Fish Hatchery

- Cause of fish mortality?
  - *P. parvum*
    - Dave Buzan (TPWD-RP) confirmed on 3/15/01

Image by Carmelo Tomas

- April 2001
- Complete mortality
  - Striped bass fry
  - Hybrid striped bass fry

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TPWD Hatchery Water Sources Affected by *P. parvum*

- Lake Diversion

Dundee State Fish Hatchery

- Possum Kingdom Reservoir

Possum Kingdom State Fish Hatchery

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TPWD Inland Fisheries *P. parvum* Task Force

- Goal
  - To develop strategies to effectively control *P. parvum* to ensure fish production

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TPWD Inland Fisheries *P. parvum* Task Force

- **Process**
  - **Understanding *P. parvum***
    - **Literature review and contact experts**
      - **How do blooms occur?**
      - **What causes production and release of toxins?**
      - **What are the best control strategies?**
  - **Research**
  - **Develop hatchery management plan**

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TPWD Inland Fisheries *P. parvum* Task Force

- Hatchery *P. parvum* Management Plan
  - Identification
  - Monitor densities
  - Monitor toxin levels
  - Pond treatment
  - Prevent dispersal

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Identifying *P. parvum*

- **Compound light microscope** (≥ 400X)
  - 8 - 12 µm
  - 2 flagella
  - 1 haptonema
  - C-shape or saddle-shape chloroplast
  - Characteristic swimming patterns

Image by Carmelo Tomas

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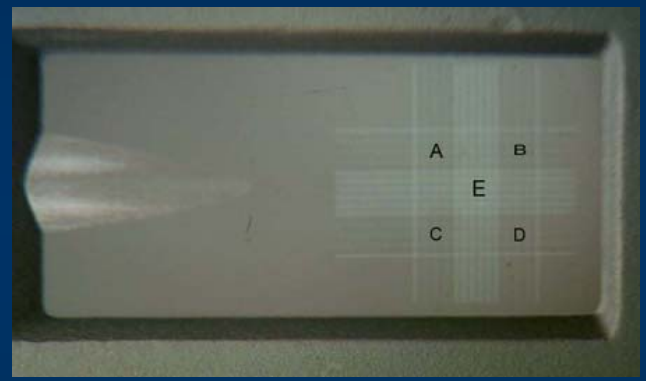
Monitoring *P. parvum* densities

- Cell density
  - Hemacytometer
  - Fixation with Lugol's solution



  - Count # of *P. parvum* cells per large square on hemacytometer grid
  - $[(A+B+C+D+E) \div 5] \times 10^4 =$ # cells/mL

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Monitoring Toxin Levels

- **Bioassay***
  - Water sample
  - Cofactor (pH 9.0)
    - 0.02 M TRIS
    - 0.003 M 3,3'-iminobis-propylamine
  - Test organism
    - *Pimephales promelas* (fathead minnow) juveniles
  - 28°C for 2 hours

*Dr. Isaac Bejerano - Central Fish Health Lab, Israel

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Monitoring Toxin Levels

- **Bioassay**
  - **Mortality determines treatment**
    - **sample + cofactor = 1 ITU***
      - **Low toxicity → no treatment, monitor cell density**
    - **1/5 diluted sample + cofactor = 5 ITU**
      - **Moderate toxicity → immediate treatment**
    - **sample = 25 ITU**
      - **Water is toxic to fish**

***ITU = Ichthyotoxic unit (1/25th the lethal dose to fish)**

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Cell Counts vs. Bioassay Toxicity

- Problems with current applications
  - Toxicity variable of cell concentration
  - Both methods are:
    - time consuming
    - labor intensive
    - not always reliable as a measure of impending bloom or toxic event

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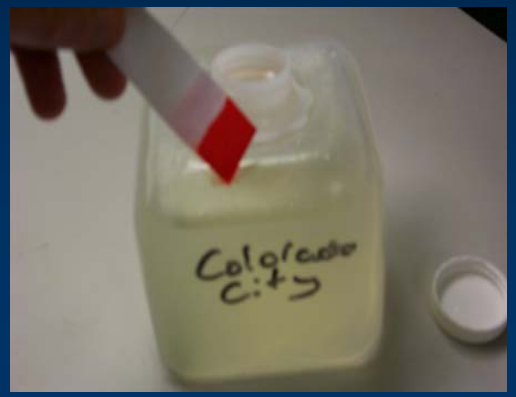
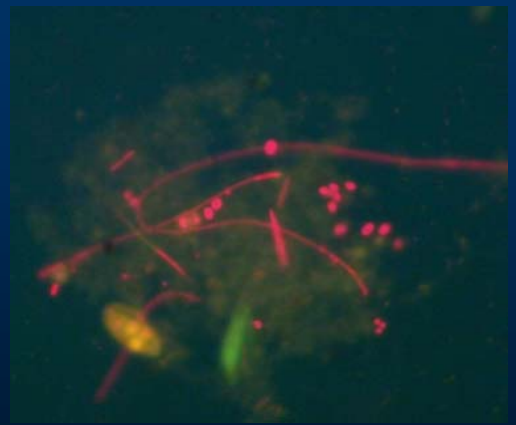
Monitoring of *P. parvum*

- **Needs**
  - **Simpler, quicker, and more accurate method(s) for:**
    - **Identification**
    - **Estimating concentration**
    - **Monitoring for impending toxicity**



"Dip-test" similar to a litmus test



Epifluorescence image of mixed algal community

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Treatments

- Physical methods
  - cause lysis
- Chemical methods
  - lysis and/or detoxify

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Physical Treatments

X Sonication (i.e., Aquasonic)

? Ozonation

? Bio-control agents

✓ Ultraviolet Sterilization

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Treatments - Physical

- **Ultraviolet sterilization**
  - **Treatment**
    - **Mean dose of 210 mJ/cm^2**
    - **Intensity of 91.5 mW/cm^2**
  - **Results/Conclusions**
    - **All cells were destroyed; toxicity reduced**
    - **Not suitable for large scale water treatment**
    - **UV-sterilized water is option for hauling unit tank water**

TPWD fish hauling units

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Chemical Treatments

- X Hydrogen peroxide
- X Acids (HCl and H_2SO_4)
- ? Nitrogen : Phosphorous ratio
- ✓ Potassium permanganate
- ✓ Ammonium sulfate
- ✓ Copper sulfate & Cutrine® Plus

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Treatments – Chemical

- Potassium permanganate - $KMnO_4$
  - Detoxifying agent
  - Treatment rate = 2 mg/L $KMnO_4$ above the oxidative demand
    - e.g., oxidative demand (4 mg/L), then treatment rate would be at 6 mg/L $KMnO_4$
  - $KMnO_4$ suitable for treating toxic water, but ineffective in *P. parvum* cell lysis

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Treatments – Chemical

- Ammonium sulfate - $(NH_4)_2SO_4$
  - Most commonly used method by TPWD
  - Effective at 15°C to 28°C
  - Prophylactic treatment maintaining a minimum effective level of un-ionized ammonia (NH_3) = 0.2 mg/L
  - Not recommended for low temperatures, low pH, high ambient NH_3, or sensitive fish species or delicate life stages

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Treatments – Chemical

- Copper sulfate – $CuSO_4$
  - Effective at temperatures <18°C
  - Effective rate dependent upon organic load and alkalinity concentrations
  - Some species and life stages of fish are very sensitive to copper ion in water
  - Not a preferred method
    - Harmful to primary and secondary production
    - Corrosive to aluminum screens in ponds

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Treatments – Chemical

- Cutrine® Plus
  - Chelated form of copper
  - Research indicated to be safe for rainbow trout and effective at lysing *P. parvum*
    - Used when temperature ≤15 °C
    - Effective treatment = 0.2 mg/L total copper
    - Treatments ≥ 0.4 mg/L caused significant fish mortality

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Prevent Dispersal

- **Hazard Analysis and Critical Control Point (HACCP) Plan for *P. parvum***
  - ***P. parvum*-free water (UV-treated or well) water used to fill hauling unit tanks**
  - **Production fish rinsed 2X in *P. parvum*-free water**
  - **Water samples from unit checked for alga**
  - **Tank is flushed with (UV-treated or well) water if *P. parvum* detected**

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Achievements

- Development of hatchery strategies
- Effective control methods
- Fish production returned to normal

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Challenges

- **Needs**
  - **Efficient and sensitive method(s) to**
    - **Identify *P. parvum***
    - **Estimate density**
    - **Monitor toxin levels in water**
  - **Better algal control methods**
  - **Time-release products that allow long-lasting treatments**

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