INTERIM REPORT

for

Testing Approaches to Golden Algae Control: In-lake Mesocosm Experiments

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Project PI:

Dr. B.L. Harris, Acting Director, Texas Water Resources Institute, part of Texas AgriLife Research

Researchers:

Dr. Dan Roelke, Texas A&M University; Dr. Bryan Brooks, Baylor University;
Dr. James Grover, University of Texas at Arlington

BACKGROUND

Harmful Algal Blooms

Large scale fish kills caused by harmful algal blooms (HABs) can severely impact aquatic ecosystems and are increasing in severity at the global scale. *Prymnesium parvum* (aka golden algae) is an invasive marine HAB species that releases a complex mixture of toxins that lead to devastating fish kills. Anthropogenic and climatological influences have facilitated *P. parvum* invasions from marine ecosystems to inland waters. The severity of HABs have increased over the past decade. *P. parvum* has affected more than 33 reservoirs in Texas, resulting in millions of fish killed and tens of millions of dollars in economic impacts. A recent *P. parvum* HAB in Dunkard Creek, Pennsylvania/West Virginia highlighted the expansion of this organism to other states. It is now present in at least 19 states.

In Texas waters, *P. parvum* blooms occur in relatively cool weather, usually starting in autumn or winter and then ending in late winter or spring. *P. parvum* populations are consistently low during summer. In contrast, laboratory growth experiments have consistently shown very rapid population growth at temperatures characteristic of summer, and slow to moderate growth at the cooler temperatures of other seasons.

An inflow event during winter of 2006-2007 eliminated the toxic bloom in Lake Granbury and lowered salinity, resulting in golden algae not blooming. This event demonstrated in a striking way that inflow has an important influence. Additionally, they were able to verify that some of the equations used in their modeling approaches can make short-term forecasts of the influence of such events.

The time scales under which salinity and inflow work are different. Salinity, when it gets reduced, stays low for years. Salinity increases happen over years, typically during extended periods with low precipitation. The really wet winter during 2006-2007 lowered lake-wide salinity, below a bloom threshold for golden algae. The salinity has not gone back up from that year, and *P. parvum* is even further removed from its growth optimum.

SUMMARY OF RESEARCH THUS FAR

The researchers were able to effectively utilize pH manipulation; hydrologic flushing manipulation, where water deeper within the lake was used and brought to the surface; and ammonia addition manipulation. All three treatments prevented blooms from developing in pre-bloom conditions, and an experiment during a bloom lessened the effect of the bloom.

The researchers agree that the pH manipulation is the most promising lake management approach, and it wouldn't cost as much to implement as other approaches. They only reduced the pH down to seven, so those conditions are not stressful to other organisms within the lake, and they quantified that. It negatively affected the *P. parvum* but didn't affect other plankton. These relationships between lower pH and reduced toxicity were consistent with our previous experiments with *P. parvum* in the laboratory and observations in Lake Granbury.

For the hydrologic flushing, they took water from deeper within the lake, using the lake's own water for the treatment and moving it around within the lake. That seemed to work too, but the downside would be the infrastructure costs to pump the water might be high.

While the ammonia treatment worked, it does have some pitfalls. The low level of ammonia addition stimulated the bloom, and it became more toxic. When more ammonia was added, that quickly killed the *P. parvum*. However, the downside with that higher level of ammonia addition is there was a four-fold increased production of other algae, which might have negative downstream effects.

The results mentioned above are still preliminary in that samples are still being processed and data analyzed to determine the full effect of the treatments.

While the researchers know of many factors that influence golden algae blooms, they still need to understand them better to put into the model to better enhance our predictive availability.

The researchers need to continue determining the contours of the coves because they need a better feel of hydrologic residence times in the coves, because if they pursue pH manipulation, they will need to know the volume of the cove and how much chemical to add.

The researchers also continue to study the effects of these treatments and management options using experiments and models working toward a larger in-lake demonstration, implementing some of these treatments to see their large-scale effects.