

A golden opportunity



Researchers making progress in understanding toxic algae

Scientists at three Texas universities investigating golden algae, its explosive growth, and its deadly toxins have discovered an apparent competition between golden algae and blue green algae in certain Texas lakes. Understanding this competition could lead them closer to controlling this harmful algae, the researchers said.

“Our biggest finding so far,” said Dr. Daniel Roelke of Texas AgriLife Research and one of the investigators, “is that there appears to be a chemical warfare between golden algae and blue green algae. Only when golden algae wins this chemical warfare is it able to bloom.”

Roelke, along with Dr. Bryan Brooks of Baylor University and Dr. James Grover of the University of Texas at Arlington, have studied golden algae for four years. Funding comes from the Texas Parks and Wildlife Department, AgriLife Research, Baylor, and UTA. Support also includes U.S. Department of Energy funds secured by Rep. Chet Edwards in fiscal years 2006 and 2008. The Texas Water Resources Institute manages the congressionally funded portion of the research.

Although scientists have studied golden algae, or *Prymnesium parvum*, around the world for six decades, most of the studies

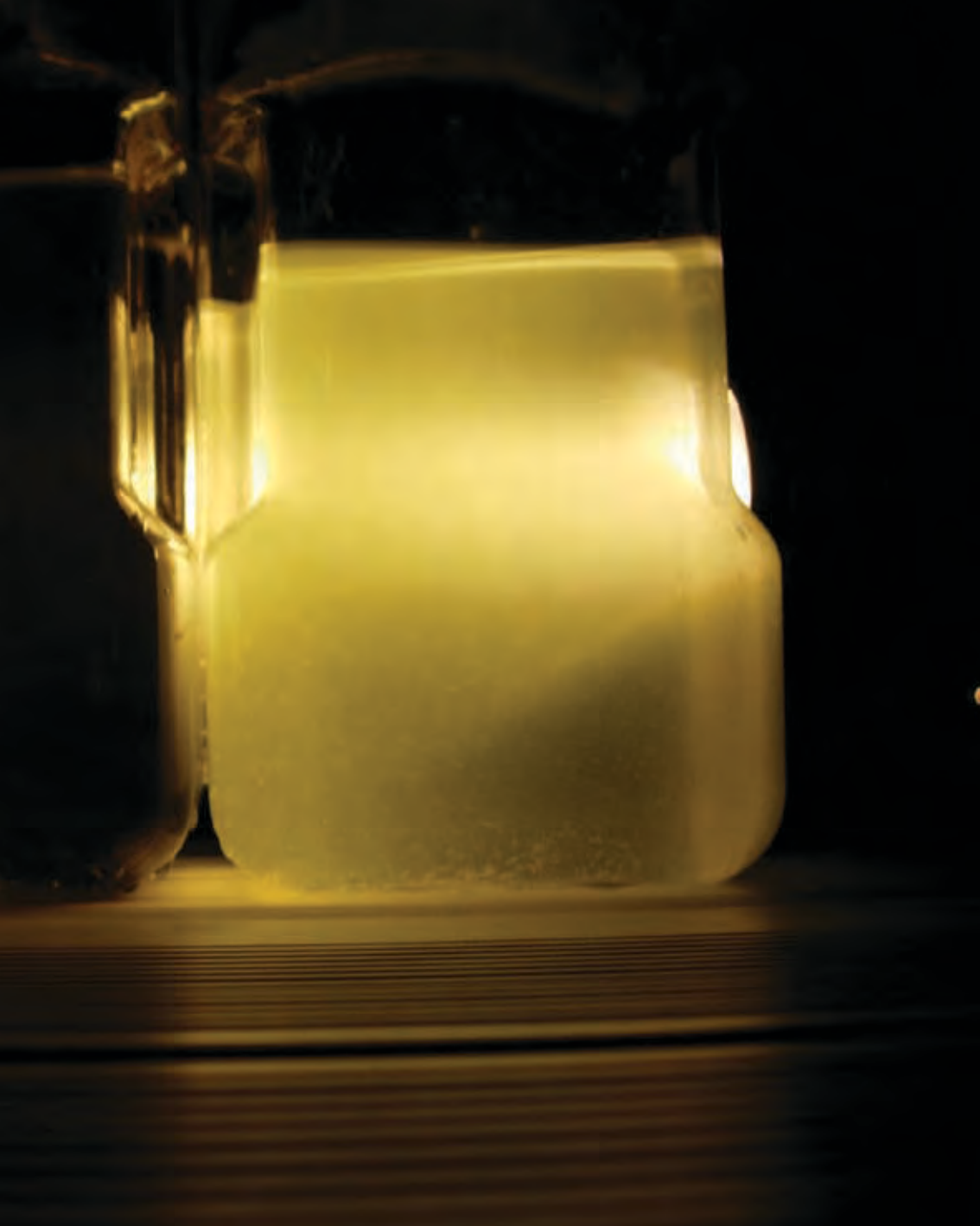


Photo courtesy of the Texas Parks and Wildlife Department

(photo left) Toxic golden algae have killed fish and other gill-breathing animals in Lake Granbury as well as other lakes in five of the state's river systems.

(photo right) Scientists researching golden algae, its explosive growth, and possible management strategies have studied the affects of nutrients such as nitrate and phosphate have on controlling the organism.

have examined the organism in coastal, saline environments. "Our research team represents one of the few in the world that is focused on the dynamics of the organism in inland waters," said Brooks, an associate professor of environmental science and biomedical studies at Baylor.

First appearing in Texas in 1985 in the Pecos River, golden algae has since surfaced in most of the 25 major river systems throughout Texas. Although it can exist in waters without being harmful, the algae has caused major fish kills in five of the state's river systems. When this algae has explosive increases in its

population, called "blooms," it secretes toxic chemicals into the water. These toxins kill fish and other gill-breathing animals. According to the Texas Parks and Wildlife Department, golden algal blooms have killed more than 25 million fish valued at \$10 million since 1985 and caused major negative impacts on lake ecosystems and recreational opportunities.

In research started at Lake Possum Kingdom and continuing at Lakes Whitney, Granbury, and Waco, the scientists have identified certain environmental and chemical factors, including low temperatures, low nutri- ➔

(photo left) Dr. Daniel Roelke, Texas A&M associate professor, works with other team members to investigate golden algae and its relationship to other algae and bacteria in Lakes Granbury, Whitney, and Waco.

(photo right) Dr. Bryan Brooks, Baylor University associate professor, finishes taking a water sample from Lake Whitney as part of the golden algae research.

Photo by Matthew Minard, Baylor Photography



ents, and low salinity that stress the organism, causing it to become more toxic.

However, even when the same conditions exist in different lakes, blooms don't always occur, said Roelke, an associate professor of wildlife and fisheries sciences at Texas A&M.

The researchers have compared water taken from Lake Whitney that has golden algal blooms to water from Lake Waco that has golden algae which doesn't bloom.

"When we mixed the waters, the water from Lake Waco suppressed the blooms in Lake Whitney," he said.

Roelke said at the time they took the water samples, Lake Waco had a high population of blue green algae. "The chemicals produced by blue green algae may have suppressed the growth of golden algae," he said.

The researchers are now examining what environmental conditions allow blue green algae to win the chemical warfare over golden algae in Lake Waco and what conditions allow golden algae to win in Lakes Granbury and Whitney.

"That is what we want to discover," Roelke said. "What are those conditions and more importantly are those conditions something we can control from a management perspective?"

In lab experiments, Grover's lab is further investigating the toxins produced by the algae.

"We are looking at the potential for toxins produced by the golden algae to impact the other kinds of algae (such as blue green algae) that compete with it and the reciprocal effect of those other algae on golden algae," he said.

In the modeling portion of the research, Grover, a UTA biology professor, and his laboratory are testing a suite of models that will simulate the population dynamics of golden algae. Their research is based on the factors in the environment that are important to its growth: the nutrients, nitrate and phosphate; water temperature; salinity; light; water flow; and other factors.

Grover said they are now verifying the models against one year of field observation data for Lake Granbury. Once a model is selected and verified, Grover said they will use the model to understand the population dynamics of golden algae in different environments and then evaluate different management options.

"The model would be a test bed where you could manipulate things and see what happens," he said. "For example, we could simulate the effects of adding or decreasing nutrients going into the lake and see if that has an influence (on the algae)."

Brooks said that in the previous lab studies, they have found that adding nutrients has decreased the toxicity of golden algae. He sug-



(photo left) TWRI Director Dr. Allan Jones talks with Rep. Chet Edwards and Hood County Judge Andy Rush (back to camera) about the research that was accomplished using the custom-designed data flow unit purchased by federal funds.

(photo right) Dr. James Grover, UTA professor, and his laboratory staff are investigating the toxins produced by golden algae when it blooms.

Photo by Robert Crosby, UTA University Publications

gested nutrient amendment is “a way forward” in determining management options.

In its first year of monitoring Lake Granbury, the team employed a new technology—a custom-designed, boat-mounted data flow unit that enabled system-wide characterization of the lake. The unit continuously samples water as the boat moves along the lake. This sampling allowed the team to document details of a bloom’s formation, how extensive it was, and where and when it occurred.

Through this monitoring, the scientists found that golden algal blooms do not occur simultaneously throughout the lakes. Roelke said they are trying to determine if there are “hot spots” where blooms begin within the lakes.

“If blooms initiate in the coves, we might be able to manipulate nutrients to create conditions that promote blue green algae; and that might circumvent golden algae blooms altogether,” Roelke said.

At Lake Granbury, the scientists are also investigating a linkage between golden algae and bacteria found in the lake, possibly from leaking septic systems.

Roelke said sampling in open waters of Lake Granbury revealed a weak correlation between golden algae, bacteria, and dissolved organic matter.

“However, we have not ruled out yet that leaky septic systems might play a role in golden algal bloom development,” he said.

In their second year of research at Lake Granbury, they are extending the monitoring into the lake’s coves to see if the longer hydraulic residence time (where water stays in one place longer) of the coves might enable the bacteria to grow and in some way stimulate the golden algae.

In another area of research, the scientists are trying to understand bloom termination by looking at past occurrences of golden algal blooms.

“If we are unable to stop the blooms from occurring, we might be able to cause the blooms to terminate,” Roelke said.

In the four years they have studied golden algae, the researchers say they have learned much about this particular organism and give credit to the multi-institutional financial and research support.

“What has made the team very effective is that we all bring different skill sets to the table,” Brooks said. “It’s really incredible over the last three to four years how much progress our research team has made—from not having much of an understanding at all about the dynamics of this organism in inland waters to now being very close to making some very viable management recommendations.” 💧