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B. Project Information:

Title: **A Pilot Project to Evaluate Effectiveness of Using Aquatic Vegetation Islands to Control Golden alga Bloom in Pecos River Valley, New Mexico**

Location - GPS coordinates for the park are N 33.40665 W 104.50350.

Project focus – Protection and restoration of inland warm water reservoir fisheries of the Pecos River Valley

Estimated on-the-ground start and end dates – January 15, 2011 through November, 20, 2014

Estimated total cost - $10,000 grant requested with a total cost of $51,500. Details under section D. below.

List of partners: New Mexico Game and Fish Department, City of Roswell NM, City of Carlsbad NM, New Mexico BASS Federation Nation, Southwest Bass Anglers bass club, Pecos Valley Bassmasters bass club, Albuquerque HawgHunters bass club, New Mexico

State Parks Division, Corps of Engineers, Floating Islands International, Floating Islands West, Kids of the Southwest junior bass fishing club.

Contributing partners are Texas Parks and Wildlife Division, Seven Coves bass fishing club and several university and independent volunteer consultants on Golden Algae.

C. Project Description:

Problem Statement:

Fish kills have been reported in all of the New Mexico lower Pecos Valley reservoirs and nearby spring fed lakes. Fish kills from the golden alga, *Prymnesium parvum*, have been documented in inland waters in the New Mexico and Texas desert southwest since 1985. While originally noted in the Pecos River in the Rio Grande Basin, the alga has also caused fish kills in four other southwest river basins (Brazos, Canadian, Colorado, and Red River Basins) primarily in Texas. This algal species is found worldwide but may not be native to the southwest. Texas biologists were the first to note the occurrence of this alga in freshwater bodies in the Western Hemisphere. Subsequently, New Mexico and other states have reported its occurrence. Fish kills caused by the alga can be significant, resulting in ecological and economic harm to the affected water bodies. Fish stocking has been suspended by the New Mexico Game and Fish on several occasions due to alga blooms in the project waters. These fish kills have an ongoing impact on tourism, quality of life for anglers and the local economy.

Golden Alga (*Prymnesium parvum*)

Photo: Dr. Carmelo Tomas UNC Wilmington

- A naturally occurring microscopic flagellated alga that typically occurs in brackish waters
- Under certain environmental stresses, this alga can produce toxins which can cause massive fish and bivalve (i.e. clams and mussels) kills
- There is no evidence these toxins harm other wildlife, livestock or humans
- Research is under way to better understand, detect and manage Golden Alga blooms but no effective tool has been proven to control golden alga in large reservoirs and rivers.

B. Project overview : The project is a pathfinder project to develop biological control methodologies that when be applied to southwestern U.S. reservoirs, natural lakes, ranch ponds and river watersheds will reduce the occurrence and severity of fish kills caused by toxic bloom of Golden algae.

1. Methods: Methodologies to affect water quality, nutrient loading and biological balance will be developed and tested during the first phase on a small scale, controlled pond environment and expanded to larger southern New Mexico reservoirs as control techniques are developed. Specifically, control methods may be applied to southwest watershed reservoirs in the Pecos Valley including Brantley Lake, Seven Rivers, New Mexico and Carlsbad Municipal Lake, Carlsbad, New Mexico. Methodologies including water circulation, aeration will be developed based on recently published ***Texas A&M University – Lake Granbury and Lake Whitney Assessment Initiative* Annual Progress Report, July 14, 2010** that suggest production of toxins is related to salinity, pH levels and insufficient nutrients (http://twri.tamu.edu/reports/2010/tr392/tr392.pdf). The project will introduce a yet to be determined number of floating island structures, some with enhanced water circulation, wetland and aquatic plants, biological (bacteria) reservoirs and aeration features. Floating islands have been used successfully world-wide to modify water quality attributes in wetland restoration and stormwater runoff treatment applications (T.R. Headley, C.C. Tanner, 2006) The structures not only provide an artificial platform for wetland vegetation but also provides a complex environment that will enhance the growth and survival of beneficial bacteria and aquatic plants to help balance nutrient loading and ammonia concentration.

2. **Objectives:** The Spring River Pond and Brantley Lake have experienced several fish kills due to algae blooms and are no longer viable fisheries. The project seeks to naturally restore the Spring River Pond as a quality junior fishery during 2012. The goal is to apply control methods to Brantley and Carlsbad lakes during 2013 with demonstrated progress by 2014 to restore Brantley Lake to pre-2004 conditions. The project augments the experience base and methodologies for mitigating the effects of Golden alga blooms on fisheries.

The project will contribute to one or more of the following RHP strategies:
Strategy 1 – Protect, restore and enhance fish habitat in reservoir systems to support productive fisheries and healthy aquatic ecosystems

Strategy 2 – Manage reservoir systems to provide, protect and enrich quality of life for the American people
Strategy 3 - Develop and foster partnerships that implement landscape-scale approaches to the conservation of fish habitat in reservoir systems
Strategy 4 – Develop and sustain institutional arrangements and sources of funding to support the long-term conservation of fish habitat in reservoir systems
Strategy 5 - Support education and outreach initiatives that advance public awareness and understanding of the value of healthy reservoir systems.

3. **Monitoring plan overview:** The project seeks to enhance the understanding of how minor changes in water quality and biological interactions impact Golden Algae growth and production of toxin. The goal will be to quantify the local affects of control methods. Key indicators of success will be golden algae ratio to other biota and the presence or absence of Golden Alga toxins. Water quality and tow samples have been part of an ongoing monitoring program by the New Mexico Game and Fish. The New Mexico Game and fish will continue to monitor the pond as one of the states public lakes with an emphasis on late winter and early spring conditions. It appears that the most important factor influencing the toxicity of *P. parvum* blooms is the relative amount of nitrogen and phosphorus found in the water, with toxicity increasing when both of these nutrients are limited . Toxicity appears to be enhanced by temperatures lower than 86˚F (30˚C) , pH greater than 7.0, and when cells are grown under nutrient limited. According to reports from other states and recent trends in New Mexico, most fish kills caused by *P. parvum* occur during the winter and spring months. This is the time of year when environmental conditions (cooler temperatures, limited nutrients) are not favorable to bacterium or other algae, and it appears to give golden algae an advantage. However, the exact environmental conditions favoring toxic algal blooms are not clear, and even though factors such as water temperature and salinity are somewhat helpful in predicting future blooms, there are many exceptions that have been reported.

4. Outreach plan: Numerous opportunities exist to obtain local and national media coverage of the efforts by the Albuquerque Hawg Hunters and New Mexico Game and Fish. The New Mexico Bass Federation Nation (NMBFN) publishes a quarterly newsletter, The BigMouth, and has an active conservation web page devoted to fish habitat restoration. At the national level, B.A.S.S. Times magazine has featured many habitat restoration and conservation projects including the Lake Conroe project supported by Friends of Reservoirs. Local television and newspaper media often publish highlights of activities at the Spring River Zoo and would likely do an article on the project. The New Mexico Game and Fish also has an active e-mail newsletter with wide distribution. Another special opportunity is the local tourist draw during "Alien Days Festival" when many out-of- state (if not out-of-planet) tourists visit the free park and zoo.

5. **Maintenance:** Provisions to protect the restoration project site after project completion: All activities at the Spring River Pond, including long term management of the project site will be under the control of the Spring River Park and Zoo manager. Volunteers from the local bass clubs will assist zoo volunteers with plant and equipment maintenance. At the conclusion of the project, a mutual agreement will be reached concerning what equipment will remain at the site and what will be removed. After removal of all unwanted equipment, maintenance responsibility will be transitioned entirely to the zoo manager.

6. **Permits:** List of required permits and any other environmental compliance issues to be considered (Federal, state, local). A local permit may be required for connection of electric utilities to water circulation equipment. Only FDA approved chemical or biological treatments are anticipated for this project. No additional permitting will be required. Should the project result in implementation at Brantley or Carlsbad lakes, normal consultation with the USFWS will occur prior to any field activity.

7. **Project timeline:** The project will begin by January 15, 2012 with the relocation of island platforms and detailed design drawings for the circulation and aeration equipment. Aquatic and wetland plant procurement and collection will also begin in January with an objective to plant the vegetation during March. Pump installation should be completed by the end of April to adequately affect water quality. Baseline water quality monitoring will be tailored to the project beginning in March and continuing for the duration of the project. The project will continue for two years at the Spring River Pond and will be expanded for trial experimentation at either Brantley or Carlsbad lakes depending upon the water conditions and applicability of the control methods to the needs of the lakes. The project will conclude by November 20, 2014. Quarterly progress reports will be generated by the project manager and approved by the NM Game and Fish point of contact. A final report will be generated by December 31, 2014 by the project manager.

D. Budget:

1. **Amount requested** through Reservoir Fisheries Habitat Partnership: $10,000 is requested to purchase, transport and install bonded fiber matrix islands, biological reservoirs and associated water circulation equipment. Some permitting fees for electrical power connection and associated supplies are anticipated. No federal funds are currently expected or included in the estimated costs.

2. **Amount of matching** contributions: Volunteer contributions are expected to exceed twice the requested grant amount. State contributions will also be more than double the grant amount. Specific activities will include relocation of two experimental platforms from Lost Lake and Elephant Butte Lake to Roswell for early aquatic plant propagation. Albuquerque Hawg Hunters bass club, Cedar Cove bass club, Steve Bell Construction, Marina Del Sur, Kids of the Southwest and the project principles will retrieve, disassemble and load the Elephant Butte research platform onto a flatbed for relocation to Roswell, New Mexico. Heavy equipment rental and operation, labor and use of a flatbed trailer will be donated by the local businesses and bass club members. The flatbed trailer and truck provided by the Pecos River Bassmasters will travel approximately 500 miles round trip.

Figure 2. The suspended spawning island provided by Floating Islands West (FIW) provides a structurally sound floating platform with an adjustable suspended mid-section that will be used for aquatic vegetation propagation and experimentation.

A smaller floating island with a suspended platform has already been donated by Floating Islands International (FII) and transported by the New Mexico B.A.S.S. Federation Nation (NMBFN). It is currently located approximately 50 miles east of Roswell and will be relocated when the project begins.

Categories	**Grant Amount**	**Match Amount**	**Type of Match**
Personnel			
Staff (NM G&F)		**$25,000**	**New Mexico (NMG&F)**
Volunteers		**$6,000**	**In-kind labor (300 hours by clubs)**
Fringe			
Travel/Transport		**$1,100**	**Cash Donation (Clubs)**
Equipment*	**$8000**	**$7,500**	**Equip. Donation (FII)****

Supplies	**$1850**	**$300**	**Cash Donation (businesses)**
Contractual (permits and electrical)	**$150**	**$1,000**	**Equipment use (businesses)**
Other			
Utility Connection		**$600**	**In-kind labor (businesses)**
Total Direct Costs	$10,000	$41,500	

*Equipment is any individual item over $5,000. Even if an item is tangible, nonexpendable, and having a useful life of more than one year, items costing less than $5,000 should be placed under the Supplies category.

** FII has already donated one prototype floating island ($7,500) that is near Roswell. NM Bass Federation Nation donated $500 to transport the unit from Montana. FIW is loaning a $40,000 experimental platform for the duration of the project.

3. **Budget narrative:**

Professional consultation and monitoring by a New Mexico Game and Fish biologist will be provided by the State of New Mexico. Shawn Denny, the local fisheries biologist will provide enhanced monitoring for the duration of the project. All of the potential project waters are already under his care and will receive enhanced monitoring during the project. It is anticipated that the additional sampling will cost at least $25,000 in labor and supplies. ($25,000)

Volunteer labor will be provided as needed to relocate and install equipment, collect and plant wetland and aquatic plants, install electric utilities and provide routine maintenance. Earl Conway, project manager, will oversee all expenditures and activities to ensure project objectives are met safely and in compliance with all requirements. Russell Whithed, project coordinator will be the local point of contact and oversee volunteer activities in the Roswell/Carlsbad area. It is estimated that a minimum of 300 hours ($6,000) will be donated over the course of the project with 200 hours being donated by local bass clubs early in the project to relocate two island structures to Roswell. An electrician will also be required and it is anticipated that a local well servicing company will donate $600 for this activity. ($6,600)

One floating island structure valued at $7,500 has been donated by Floating Islands International and transported by NMBFN to Roswell ($500) for use in the project and is now located at Lost Lake east of Roswell. ($8,000)

Heavy equipment and transportation equipment will be donated by local businesses and bass club members. A crane will be required for some lifting for about ten hours at an average rate of $60/hr. ($600) The crane operator will be donated labor at $30/hr. ($300) Fuel costs are estimated to be $100. ($1000)

Transportation of the platforms to Roswell will require about $600 cash donation by bass clubs for a flatbed truck, fuel (500 miles) and one night lodging. ($600)

Equipment purchases are expected to include a minimum of $8000 for artificial islands, water recirculation and aeration pumps. ($8000)

Ancillary electrical motor starters, power disconnects, conduit/wiring are estimated at $1,850 with installation and building/utility permit fees of $150. ($2,000)

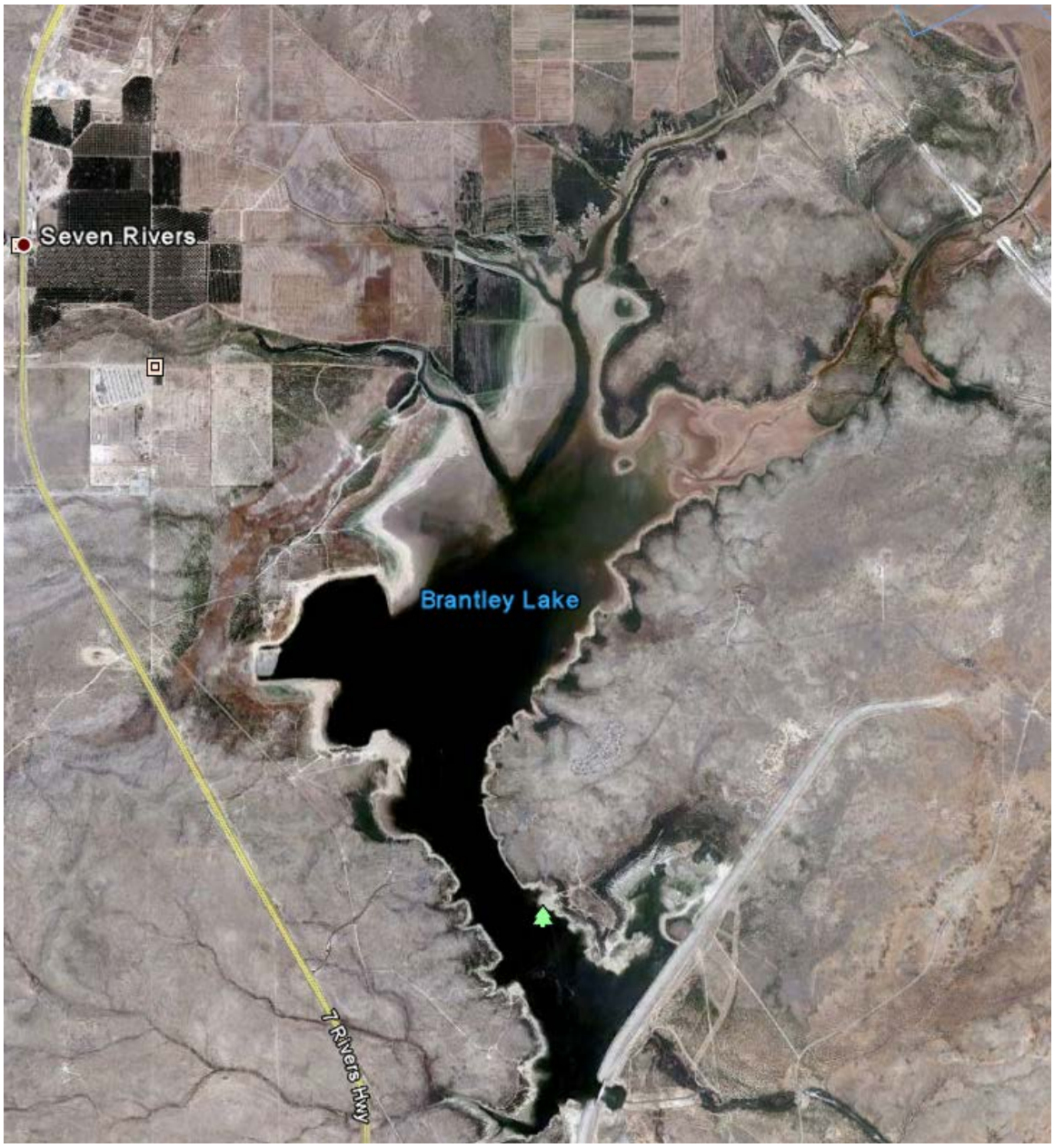
Optional supporting materials:
1. Map(s) of the proposed project location and site in addition to the described location under B above.

The Spring River Park & Zoo, located on the northeast side of Roswell, New Mexico is the only free Zoo In New Mexico and has within its boundaries, a youth (age 15 and under) fishing lake. Unfortunately, the fishing lake has been plagued with toxic algae blooms, temporarily limiting fishing opportunities. GPS coordinates for the park are N 33.40665 W 104.50350.

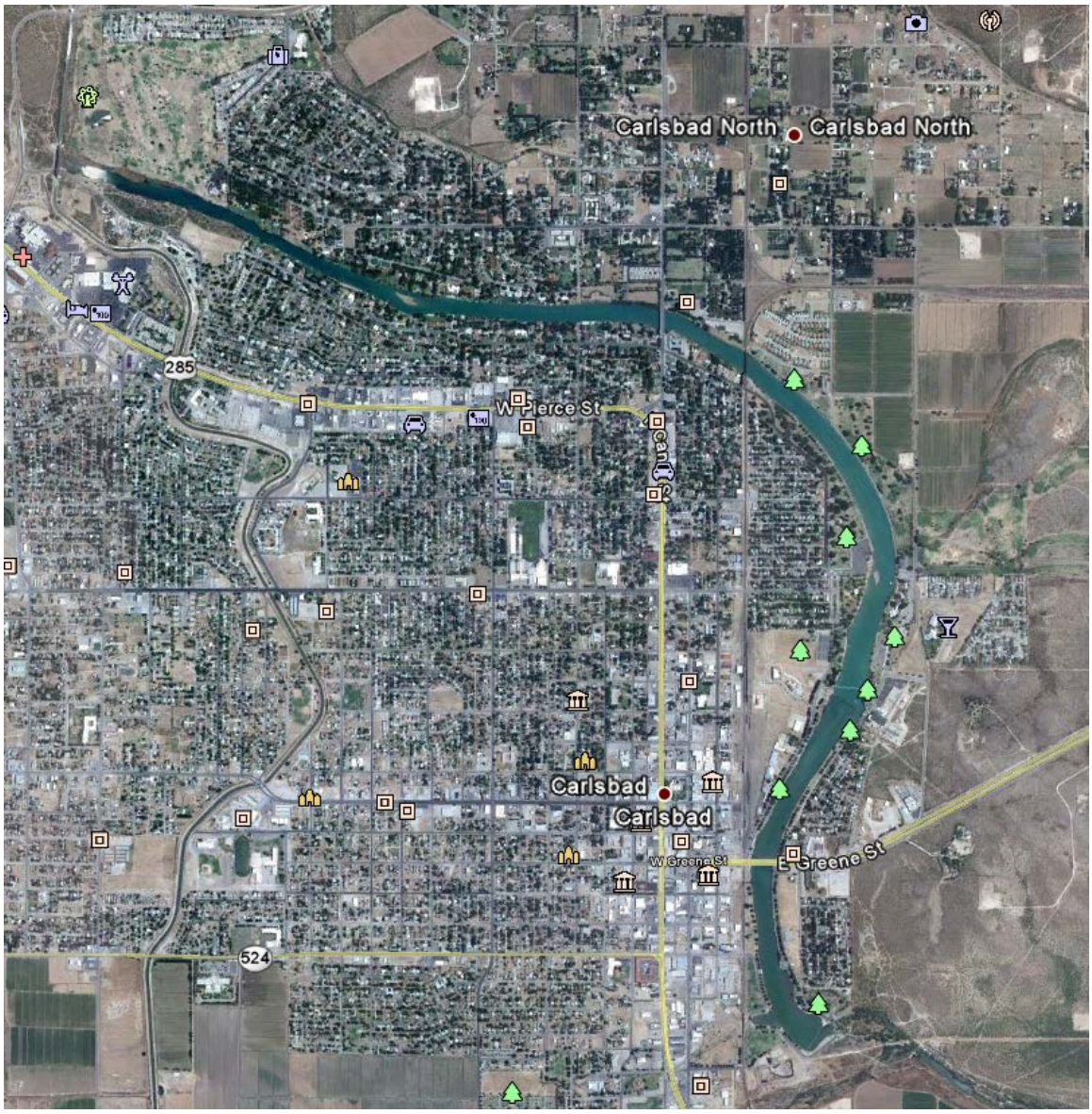
2. Aerial or on-the-ground photos of the proposed project site. (Spring River Pond)

Aeration has been used in the past at Spring River Pond to sustain fish populations. Historical data is available to study the effects of aeration during previous fish kills. Date of photo unknown.

Other nearby reservoirs that may benefit or become test waters during the project include Brantley and the Carlsbad municipal lakes (Tansill).



Brantley Lake is located approximately 15 miles north of Carlsbad, New Mexico and approximately 65 miles south of the Spring River Pond in Roswell, New Mexico. It is the largest reservoir in southeastern New Mexico and is no longer stocked due to Golden Algae fish kills. Although it may not be possible to prevent fish kills, an objective of the project is to identify methods that mitigate the intensity of fish kills and provide local safe havens for fish during toxic blooms to speed recovery.



The Carslbad municipal lakes (Tansill) are mostly surrounded by public park areas including an information center and amusement parks. The setting provides high visibility and exceptional opportunities for educational outreach.

The Carlsbad municipal lakes (Upper and Lower Tansill lakes) are separated by an old dam, allowing for comparative studies between the pools. *Photo by Gjorasvik, Date unknown.*

Ducks and other waterfowl contribute to nutrient loading at Spring River Pond. This may be an important element of the studies as *additional* nutrients may reduce the likelihood of toxic blooms. Floating islands have been noted to attract waterfowl.

3. Letters of Support-Besides letters in support of the project from community leaders, stakeholders, or others, documentation may include support letter(s) from those owning land upon which project will be undertaken, such as private landowners or appropriate public land owners agency resource personnel. Personal communications have occurred with the Shawn Denny, NM G&F, and all partners but letters of support were not requested prior to project submittal.

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The first confirmed blooms of *P. parvum* in North America were identified in Texas in 1985 on the Pecos River (James and De La Cruz, 1989). Since then, fish kills caused by golden algae blooms have occurred in 33 reservoirs in Texas along major river systems, including the Brazos, Canadian, Rio Grande, Colorado, and Red Rivers, and have resulted in more than an estimated 30 million fish killed and tens of millions of dollars in lost revenue (Sager et al., 2008). *Prymnesium parvum* has invaded reservoirs and river systems in 15 other states, including Alabama, Arizona, Arkansas, California, Washington, Hawaii, New Mexico, Wyoming, North Carolina, South Carolina, Florida, and Georgia (Sager et al., 2008).

In New Mexico, *P. parvum* was first reported in the 1980s (New Mexico Department of Game and Fish [NMDGF], 2004). From 2002 to 2007, *P. parvum* blooms caused extensive fish kills in Brantley, Bataan, and Carlsbad Municipal Reservoirs in the lower Pecos River (New Mexico Aquatic Invasive Species Management Plan, 2008). Blooms were also reported in isolated ponds near Eunice and Roswell (NMDGF, 2004, 2005), and toxic golden algae blooms led to fish kills in McAllister

Lake in Las Vegas (S. Hopkins, personal communication, January 22, 2009).

It does appear that the most important factor influencing the toxicity of *P. parvum* blooms is the relative amount of nitrogen and phosphorus found in the water, with toxicity increasing when both of these nutrients are limited (Johansson and Graneli, 1999).

Toxicity appears to be enhanced by temperatures lower than 86˚F (30˚C) (Shilo and Ashner, 1953), pH greater than 7.0, and when cells are grown under nutrientlimited conditions (Dafni et al., 1972; Graneli and Johansson, 2003).

According to reports from other states and recent trends in New Mexico, most fish kills caused by *P. parvum* occur during the winter and spring months. This is the time of year when environmental conditions (cooler temperatures, limited nutrients) are not favorable to other algae, and it appears to give golden algae an advantage. However, the exact environmental conditions favoring toxic algal blooms are not clear, and even though factors such as water temperature and salinity are somewhat helpful in predicting future blooms, there are many exceptions that have been reported.

"it does appear that the most important factor influencing the toxicity is the relative amount of nitrogen and phosphorus found in the water, with toxicity increasing when both of these nutrients are limited".
(Johansson and Graneli, 1999 and 2003)

The presence of golden algae does not necessarily mean toxins will be produced. To test for the presence of ichthyotoxins and estimate toxicity, a bioassay (a test to measure biological activity or potency of a substance) can be used (Ulitzer and Shilo, 1964). This test can identify waters that have high enough concentrations of the toxin to pose a risk to fish, and can help to decide if treatments are warranted.

One possible avenue to pursue for long term control of *P. parvum* may be to reduce salinity to levels that are below tolerance levels of the alga, either by source attenuation or dilution of the water through manipulations of water levels and flow, or some combination of the two (S. Hopkins, personal communication, January 22, 2009). Another possibility being considered is to use large-scale fertilization to help control blooms of *P. parvum*, but that could lead to other ecological problems (S. Denny, personal communication, January 9, 2009). Recently, the use of clay minerals to flocculate (form into a lumpy, aggregated mass) and sediment algal blooms from the water column has shown some promise in laboratory and field trials (Sengco and Anderson, 2005).