Project Proposal

1. **Title of Proposal:** Does native freshwater vegetation from Texas affect golden algae, *Prymnesium parvum*, bloom dynamics?
2. **Focus Category:**
   ECOLOGY, MANAGEMENT AND PLANNING, TOXIC SUBSTANCES
3. **Keywords:** Prymnesium parvum, indigenous submerged macrophytes, allelopathy (chemical warfare), Harmful algal bloom mitigation, restoration
4. **Duration:** March 1, 2010 through February 28, 2011
5. **Federal Funds Requested.** $5,000
6. **Non-Federal (matching) Funds Pledged:** $18,000
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9. **Congressional District(s) where project will occur:** Texas Congressional District #17
10. **Abstract:**

Golden algae (*Prymnesium parvum*) occurs in almost all Texas state waters, some of these populations form toxic blooms resulting in massive fish kills whereas other waters never report blooms. With this study we aim to establish if there are any connections between allelopathic chemicals secreted by submerged macrophytes and golden algae bloom dynamics.

11. **Statement of Critical Regional Water Problems:**

Prymnesium parvum belongs the phylum Haptophyceae. It is a naturally occurring flagellated alga. *P. parvum* occurs worldwide in estuarine waters and is able to adjust to large fluctuations in salinity and temperature (Baker *et al*. 2007 and TPWD 2009). When golden algae are subjected to particular environmental stressors the alga will produce toxins, which result in high fish and bivalve mortality (Graneli and Johansson 2003). The toxins secreted by golden algae act on the exposed cellular membranes of fish. The toxin affects the outer layer, then the next and so forth until the gill membrane hemorrhages (TPWD 2008). This hemorrhaging allows the toxin and other particulates in the water column to enter the blood stream either affecting the circulatory system or internal organs. Prior to death the fish respond as if the dissolved oxygen content of the water is depleted. The fish float to the surface in shallow areas, when viewed the fish appears to bleed from the opercular area and around the non-scaled area around the fins. Fish are able to survive a toxic bloom if they are able to escape to a toxic free area (TPWD 2008).

Prymnesium parvum has been reported in six Texas (US) river basins: Canadian, Red River, Brazos, Colorado, Rio Grande, and the Nueces-Rio Grande Costal (TPWD 2009). The first documented case of *Prymnesium parvum* in Texas occurred in 1985 in the Rio Grande River Basin. Golden algae received its recognition in Texas in 2001 when it resulted in a massive fish kill at Dundee State Fish Hatchery (TPWD 2008). The aforementioned hatchery approximated that 5.0 million fish perished resulting in a loss of an entire year's production (TPWD 2009). The largest fish kill that occurred within a twenty-four hour period was in February 2005. This particular bloom occurred in Lake Whitney, of the Brazos River Basin, where approximately 4.9 million fish succumbed to the affects of the toxins produced by *Prymnesium parvum* (TPWD 2009). It was also approximated that nearly 4.0 million fish were killed in Lake Granbury, of the Brazos River Basin, during the winter and spring of 2005 (TPWD 2007).

Golden algae is not only limited to Texas waters. There are reports throughout the South Eastern United states that there is a growing concern with *Prymnesium parvum* and its toxic effects. There have been reports as far North as Elizabeth City, North Carolina that largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*) and hybrid bass (hybrid *Morone*) have all had increased mortalities due to golden algae (Barkoh *et. al.* 2004). There are facilities in multiple states even countries (Arizona, Colorado, Florida, Oklahoma, North Carolina, Germany, Sweden, and Norway) that are all dedicating research funds to try to decipher a solution to an ever-growing problem. If not solved this will continue to hamper the use of public waters as well as cause enormous economical losses at fish hatcheries.

12. Nature, Scope, and Objectives of the Research:

Submerged macrophytes, by their structuring effect, can alter the dynamics of each aquatic environment dramatically (Sondergaad and Moss 1998). Macrophytes alter phytoplankton by: increased grazing of zooplankton, nutrient cycling, increased sedimentation, reduction of light penetration, and allelopathy (Jeppesen *et al*. 1998, Sondergaad and Moss 1998, Van den Berg, *et al.* 1998). This experiment will be run in the mesocosm setting at the Texas A&M University ARTF (Aquatic Research and Teaching Facility) beginning during the spring semester of 2010. There will be a total of fifty-two mesocosms employed. Three parameters will be manipulated during the research. There will be three different indigenous juvenile submerged macrophytes selected: American eelgrass (*Vallisneria americana*), Thin-leaf pondweed (*Potamogeton pusillus*), and Water-milfoil (*Myriophyllum spicatum*). The densities of the selected macrophytes will be altered to represent three separate densities that are believed to have specific allelopathic effects (Sondergaard and Moss 1998). The densities 5-25%(low), 26- 74% (mid), and 75-100%(high) are measured as percent volume infested (PVI). The effect of having the macrophyte already planted in the soil prior to a *P. parvum* bloom versus dropping it in once a bloom has occurred will also be monitored. Each mesocosm will have White Crappie (*Pomoxis annularis*) added prior to inoculation with Golden algae to consume zooplankton to negate the effect of grazing. Each macrophyte will be planted or dropped in the mesocosm at its optimal depth to ensure maximum results and to negate any lack of light penetration due to depth. The objective of this research is to determine if there is any allelopathic effect from the submerged macrophytes acting on *Prymnesium parvum* that would reduce its density/toxicity in the water column. Cheng and Riemer (1989) isolated allelopathic compounds from American eelgrass that were shown to suppress photosynthetic activity. *Prymnesium parvum* being a photosynthetic alga may possibly be greatly affected by this allelochemical. Water samples will be taken from each mesocosm and the population of Prymnesium parvum will be enumerated. The water parameters of temperature, dissolved oxygen, specific conductions, resistivity, salinity, pH/ORP, and turbidity will also be monitored and analyzed using a QUNTA water quality multiprobe. We are planning to run a pilot study in January using the water filtrate and plant extract from the above macrophytes monocultures. This should provide insight on the affect and to what extent if any that the allelochemicals may have. The research of allelochemicals is much needed and the benefits of such not only provide critical knowledge to aquatic ecology, but also terrestrial systems, agriculture, and the use biological controls (Gopal and Goel 1993).

13. Results Expected from this Project

From this experiment we expect to establish if a particular macrophyte's allelopathic interaction with *Prymnesium parvum* will alter the alga bloom dynamics. We also hope to see a significant difference in the plant density applied and the affect of the allelochemical on *P. parvum*. If the allelochemicals of macrophytes proves to be a key component in the reduction of *P. parvum* density/toxicity, this study would show that establishment of macrophytes would be a critical step in controlling *Prymnesium parvum* blooms.

References:

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