Project Proposal for 2015 Applied Research

EDWARDS AQUIFER AUTHORITY

Name of Proposed Project:

Algae Dynamics Study

Project Description:

Observations in the Upper Spring Run and Landa Lake sections of the Comal River as well as in Spring Lake of the San Marcos system have documented periodic algae blooms that can cover fountain darter (*Etheostoma fonticola*) and/or San Marcos salamander (*Eurycea nana*) habitat. Additionally, excessive algae blooms were observed during laboratory and pond studies conducted during HCP 2013 Applied Research (BIO-WEST 2013). Three types of algae were observed in the HCP 2013 Applied Research treatment tanks. *Spirogyra* sp. was observed to quickly invade the control tank which interestingly was the only treatment with high levels of CO2. In contrast, *Oscillatoria* sp., a blue-green algae, was noted growing in the *Riccia* sp. experimental cups in all tanks except the control. *Pithophora* sp. did not become prevalent until longer durations of exposure occurred. In some instances during the 2013 HCP Applied Research laboratory and pond studies, algae completely covered or replaced most of the *Riccia* sp. biomass.

Therefore, an Algae Dynamics study is proposed and directed at understanding the effect of water quality on algal growth, as well as the effect of algal growth on the survival of aquatic vegetation. There is considerable literature surrounding algae growth and water quality parameters, but limited to no information specific to the Comal and San Marcos Rivers. Growth of algae species is generally highly temperature dependent with community structure linked to temperature gradients (Roberts and Zohary 2010). In general, as temperatures increase, highest growth rates for algal groups change from diatoms, toward green algae to cyanobacteria (Canale and Vogel 1974) although species-specific responses are highly variable (Reynolds1984). O'Neal and Lembi (1995) found that growth of *Pithophora* sp. is inhibited in water temperatures of 15 °C with maximum growth rates occurring at 35 °C. *Spirogyra* sp. growth rates were only moderately inhibited at 15 °C and 35 °C with maximum growth rates at 25 °C.

Rationale and Benefit to the EAHCP Ecological Model, Groundwater Model or Phase II Strategic Adaptive Management Program:

The 2013 HCP Applied Research results from the Vegetation Tolerance study (BIO-WEST 2013) demonstrated that the rooted aquatic vegetation types tested were quite resilient to low-flow and resulting reduced water quality conditions (high temperatures, low CO2, etc.). As such these parameters presently serve as direct inputs to the HCP ecological model as tolerance thresholds for aquatic vegetation. However, based on the algae observed during low-flow conditions in the wild and experienced in the 2013 Applied Research activities, it is prudent to address the concern surrounding potential algae impacts to aquatic vegetation (fountain darter habitat). As shown in the laboratory and pond studies, rooted vegetation in the absence of algae can survive low-flow conditions and reduced water quality, but what happens when that rooted vegetation is covered in algae as has been experienced in the wild?

For example, every summer when ambient temperatures rise, the Upper Spring Run of the Comal River experiences an excessive green algae bloom. Although this condition occurs every summer, it clearly is exasperated during lower than average flow conditions. When an algae bloom occurs, it blankets all aquatic vegetation within the reach. The first aquatic vegetation that is shaded and physically killed off by the algae is the resident bryophytes. This is not surprising, nor really a concern, as bryophytes were shown to be less tolerant to low-flow conditions in the laboratory studies. However, rooted macrophytes are considerably more tolerant than bryophytes to the algae in the wild (during observed conditions) and persist for longer durations. Even such, during the 2013 drought, some rooted macrophytes were detrimentally affected in the Upper Spring Run reach at water quality conditions suitable for growth as predicted by 2013 laboratory and pond studies. When aquatic vegetation dies, fewer fountain darters are typically collected in the Upper Spring Run sample reach.

Aquatic vegetation as habitat continues to be the key variable relative to supporting fountain darters. Understanding the conditions in the San Marcos and Comal river systems that cause excessive algae growth, as well as if and when the rooted macrophytes (habitat) are rendered useless will directly support the refinement of threshold functions in the aquatic vegetation module of the HCP ecological model.

Respected Supporting Literature:

1. Anderson, T., and F. Anderson. 2006. Effects of CO2 concentration of growth of filamentous algae and *Littorella uniflora* in a Danish softwater lake. Aquatic Botany 84:267–271.

2. BIO-WEST 2013. Edwards Aquifer Habitat Conservation Plan (HCP) 2013 Applied Research. Prepared for the Edwards Aquifer Authority. October 2013. 109 p.

3. Canale, R. P. and A. H. Vogel. 1974. Effects of temperature on phytoplankton growth. Journal of the Environmental Engineering Division, American Society of Civil Engineers 100: 229–241.

4. O'Neal, S.W. and C.A. Lembi. 1995. Temperature and irradiance effects on growth of *Pithophora oedogonium* (Chlorophyceae) and Spirogyra sp. (Charophyceae). Journal of Phycology 31: 720–726.

5. Ozimek, T., E. Pieczyńska, and A. Hankiewicz. 1991. Effects of filamentous algae on submersed macrophyte growth: a laboratory experiment. Aquatic Botany 41:309–315.

6. Roberts, R.D. and Zohary, T. 2010. Temperature effects on photosynthetic capacity, respiration and growth rates of bloom forming cyanobacteria. New Zealand Journal of Freshwater and Marine Research. 21:391–399.

7. Sand-Jensen, K. 1977. Effect of epiphytes on eelgrass photosynthesis. Aquatic Botany 3:55–63.

Submitted by:

2013 Applied Research team (BIO-WEST, Baylor University, and USFWS Aquatic Resource Center)