**Pre-Proposal Application Form**
**2017–2018 TWRI Graduate Student Research Programs**

***Basic Information:***
Which program are you applying for?
___ Mills Scholarship Program (Texas A&M or Galveston student requesting tuition only)
___ USGS Research Program (any Texas university requesting categorical funds and/or tuition)
_x_ Both the Mills & USGS Programs

1. **Title of Proposal:** An experimental approach to understanding the mechanism underlying site specific salinity thresholds linked to fish killing *Prymnesium Parvum* blooms in Texas reservoirs.

2. **Student:**
Sierra E. Cagle, Texas A&M University, Wildlife and Fisheries Science, Graduate Student
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PhD in Wildlife and Fisheries Science, starting date: September 2014, expected graduation date: 2019

3. **Faculty Advisor:**
Daniel Roelke, Texas A&M University, Wildlife and Fisheries Sciences, Professor, droelke@tamu.edu, 979-845-5777, College Station, TX 77843-2258.

**4. Use of Funds**
The funds provided by the Mills Scholarship will be put toward tuition costs.

**5. Abstract**
*Prymnesium parvum*, a harmful algal species, has invaded reservoirs throughout Texas, causing serious water quality issues in systems where blooms have occurred. During bloom events, toxic compounds produced by *P. parvum* can reach high concentration levels, causing fish kills of large magnitude and resulting in millions of dollars of economic losses for surrounding communities. To date, blooms have occurred throughout 5 Texas river basins, with 30 reservoirs being negatively impacted. Results from previous monitoring studies, have shown that bloom occurrence in some systems is linked to site specific salinity thresholds. Understanding what causes these salinity thresholds to differ between water bodies, even reservoirs along the same river basin, is important to facilitate proactive management and bloom prevention in lakes. To understand the mechanism underlying these thresholds we conducted in-field mesocosm experiments allowing for analysis of the impacts of salinity and plankton communities from different reservoirs on *P. parvum* dynamics. If mechanistic evidence for salinity level bloom thresholds can be discerned through this research, it can provide support for the importance of environmental flows that maintain salinity levels in reservoirs that are below bloom thresholds.

**6. Proposed Research**
*Prymnesium parvum*, a harmful algal species, has invaded reservoirs throughout Texas, causing serious water quality issues in systems where blooms have occurred. During bloom events, toxic compounds produced by *P. parvum* can reach high concentration levels. These compounds cause some cells to lyse, such as those of other single celled organisms, but also impact the gill cells of zooplankton, fish, and mollusks. Fish losses caused by this HAB species have numbered in the millions, even impacting hatcheries, where one such event at the Dundee State Fish Hatchery caused the loss of an entire season's production, over 5 million striped and hybrid bass. Fish kills of large magnitude have resulted in millions of dollars of economic losses for surrounding communities due to lost recreational revenue and negative impacts on game fish. To date, blooms have occurred throughout 5 Texas river basins, with 30 reservoirs being negatively impacted.

Results from previous monitoring studies, have shown that bloom occurrence in some systems is linked to site specific salinity thresholds, where blooms can only occur in a system once salinity is above a certain level. Understanding what causes these salinity thresholds to differ between water bodies, even reservoirs along the same river basin, is important to facilitate proactive management and bloom prevention in lakes. It is likely that plankton communities which historically have experienced natural salinity fluctuations that come about through erosion of salt-rich rocks and sediments have adapted and are able to cope with salt loading events. Consequently, these communities are likely to remain stable during a salt loading event, making the community better able to resist a *P. parvum* bloom. On the other hand, plankton communities occurring in systems that have not experienced frequent salinity fluctuations in their history may not be adapted to cope with such salt-loading events, and they may be less able to resist a *P. parvum* bloom if such an event was to occur. To test this hypothesis we conducted in-field mesocosm experiments that would allow us to tease apart the impacts of salinity and the plankton community on *P. parvum* dynamics for specific reservoirs. These experiments were conducted in the fall of 2015. Sample analysis is currently ongoing, though should be complete in early 2017. Subsequent statistical analysis will take place throughout the remainder of 2017 and hopefully by the end of the year a manuscript will have been submitted for publication.

The experimental design called for two lakes, within the same river basin, characterized by different historical salinity regimes. Lake Possum Kingdom and Lake Whitney, located in the Brazos River Basin, were chosen based on characterization of their historical salinity regimes using data obtained from an existing USGS database. The experiments were conducted during November, the time of year that bloom initiation is common in *P. parvum* Texas freshwater populations. The *in-situ* mesocosm experimental design consists 15 different treatments, each done in triplicate, at two different sites, for a total of 90 experimental units. Each experimental unit consisted of a 20L carboy containing ambient site water with a selected treatment. Treatments included additions of brine and/or *P. parvum* culture, as well as controls, to lake water containing either the whole plankton community, the phytoplankton assemblage, or bacteria and virus sized particles only. Response variables measured include total phytoplankton biomass and assemblage composition, *P. parvum* density and ambient toxicity, total zooplankton biovolume and biovolume of higher zooplankton taxonomic groups. Response variables are currently being characterized from analysis of a set of samples taken from each carboy at the experiment initiation, midpoint, and its conclusion, 7 days later. A 7-day experimental duration was chosen to avoid bottle effects, while providing a sufficient period of time for a significant plankton community response to occur. All sample analysis will take place in the TAMU Aquatic Ecology Laboratory.

If mechanistic evidence for salinity level bloom thresholds can be discerned through this research, it can provide support for the importance of environmental flows that maintain salinity levels in reservoirs that are below bloom thresholds. Additionally, by understanding why thresholds occur in currently impacted lakes, we may be able to approximate thresholds for non-impacted bodies and, via management and monitoring, make sure thresholds are not surpassed. Such knowledge may provide insight into whether other Texas water bodies, including bays, are vulnerable to *P. parvum* blooms, or could become vulnerable in the future due to changes in salinity level caused by climate change or anthropogenic related disturbance. The study proposed here will also advance the research and education programs of the PI and co-PI, and the institute to which they belong in the area of water resources, as well as result in the dissemination of resulting knowledge through publication.

**7. Budget**

**-Please indicate your specific funding needs:**

i. ___ Tuition support is needed
ii. ___ Other costs (salary, fringe, travel, other) is needed
iii. _X_ Either source of funds would be applicable to my project.

-**Proposed use of funds**

| Category | Request | Justification |
|---|---|---|
| Tuition | $5,000 | The tuition/fee rate for 9hrs in the TAMU College of Agriculture at the graduate level is $3,278.75. Funds are requested to offset Cagle's tuition and fees for at the maximum amount of $5,000. |
| **Total** | **$5,000** | *Not to exceed $5,000* |

-**Matching funds of 2:1**

Non-expendable property belonging to the TAMU-WFSC aquatic ecology lab that will be used to complete this research, and that the WFSC department has committed as their in-kind match, totals $10,035.

**9. Intended career path**

After obtaining my PhD, I hope to work for an agency doing water resource related research. My ultimate goal is a career as an aquatic ecologist working for a group such as the Edward's Aquifer Authority or the Texas Water Development Board, which not only manage water resources in a way that benefit the surrounding communities but also the important ecological and biological processes that occur throughout the systems. The future of Texas' freshwater is of critical importance and I intend to follow a career path in which I am able to help maintain this valuable resource for both people and wildlife.