Addendum:
Freshwater mussel biodiversity survey within the Big Thicket National Preserve

State-threatened mussel species documented in BTNP:

*Fusconaia askewi* (Texas Pigtoe); *Fusconaia lananensis* (Trinangle Pigtoe); *Lampsilis saturatia* (Sandbank Pocketbook); *Obovaria arkansasensis* (Southern Hickorynut); *Pleurobema riddellii* (Lousiana Pigtoe); *Potamilus amphichaenus* (Texas Heelsplitter)

*F. lananensis* has limited distribution range and is only known to inhabit specific tributaries of the Neches-Angelina drainage basin including Village Creek but not in the Neches River mainstream (Howells et al., 2012).

*F. askewi* is endemic to the Sabine, Neches, and Angelina Rivers.

Study sites:

This project will primarily focus the creation of a detailed mussel species inventory list for the lower stream reaches of the Village Creek drainage basin located within the BTNP, in addition to the previously un-surveyed wetlands of the BTNP located in Orange County, TX. As time and funding allow, Pine Island and Little Pine Island Bayous and other portions of the lower units will be surveyed.

Past studies:

With the exception of the mainstream of the Neches River, the majority of sites from the most recent survey of freshwater mussels in the BTNP, completed by Ford 2015 (Unpublished), were located at easily accessible locations such as bridge crossings. Though several state-threatened mussels were detected in Ford’s survey, *P. riddellii* was not reported. Additionally, only informal methods were employed in Ford’s survey, so the resulting data cannot be used in a statistically sound assessment of temporal change in populations because, according to Strayer and Smith (2003), the only accurate inference that can be made from such a survey is
that of species occurrence near bridges and easy access points. However, some basic insight on the effects of the 2016 flood may be gained through comparison of site specific current vs. past species presence / absence data.

Karatayev and Burloko (2007) attempted to survey Village Creek, but were unable to complete their work due to violent currents resulting from flooding. However, they were able to locate the state-threatened species, *P. riddellii*.

Bordelon and Harrel (2004) performed the most intensive survey of the Village Creek basin to date. The state-threatened species documented in this survey were *F. askewi, O. arkansasensis, P. riddellii*, and *L. satra*. Sites from this study will be revisited with the assistance of Bordelon (confirmed through personal communication). Relative abundance of mussel species at these sites will be compared to the 2004 inventory.

**Survey design:**

Sampling will be performed in multiple stages. Preliminary surveys will utilize low-cost, informal methods to survey the waters of the BTNP. Non-quantitative random timed searches, based on the methods of Metcalfe-Smith et al., 2000, will be conducted in areas where adequate beneficial habitat is located. Though this method is known to be beneficial in the location of rare species, quantitative inferences of population dynamics, such as temporal population change, cannot be established through such a design. Therefore, further probability based sampling efforts will be concentrated at sites found by our preliminary surveys to contain dense mussel populations. This multi-stage sampling will allow statistically valid inferences of population dynamics to be established (Strayer and Smith, 2003). A literary review failed to
show any such quantitative data to have been collected on mussels in the BTNP. This project will provide current baseline freshwater mussel population data which can be used for statistically credible future assessments of temporal population change.

**Field transportation:**

If required in the lower unit wetlands, the use of an airboat will be donated to the research team through arrangements with a private benefactor. All other forms of transportation used in this study will be provided by the researcher or research institution.

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**Literature Cited (updated)**


Introduction

The Big Thicket National Preserve (BTNP) has been noted as one of the most extraordinarily biodiverse regions in North America (Moring, 2003). Unfortunately, the BTNP is also recognized as the most at-risk of the ‘crown jewel’ parks in the national parks system (Callicott et al., 2006). Concurrently, freshwater mussels (Bivalvia: Unionidae), valuable bio-indicators of overall ecosystem health and habitat quality (Bordelon and Harrel, 2004; Burlakova et al., 2011), have been noted as the most highly threatened and rapidly declining North American fauna (Karatayev and Burlakova, 2007; Vaughn and Taylor, 1999). The highest number of regional endemic unionid species in the state occurs in the waters of East and Southeast Texas where six of the fifteen state-threatened species can be found (Howells, 2010). The Neches River basin has been noted as the “hot spot” of Texas unionid diversity (Burlakova et al., 2011). The upper units of the BTNP were known to contain areas of exceptional mussel diversity (Howells, 1997), and the lower Neches River, downstream from Town Bluff Dam (B.A. Steinhagen), was noted as recently as 2007 to hold the most abundant and diverse assemblage of mussels in Texas (Karatayev and Burlakova, 2007). Unfortunately, Ford (2016) reports that waters released at B.A. Steinhagen resulted in the loss of a large mussel bed formerly documented below the dam. He also states that habitat within the Upper Neches River Corridor unit no longer appears to support the historic diverse population of mussel species.

Presently, the biodiversity of mussel populations in the BTNP is unknown. First, heavy precipitation in 2016 caused the largest flood ever recorded in the region. Multiple USGS gage stations in the Thicket recorded the highest stream-flow velocities in more than 20 years. These high-flow events occurred after the completion of the study by Ford (2016), and no formal surveys have been conducted since. Second, the rivers that flow through the BTNP are heavily modified (Benke, 1990). Therefore, increased studies of the smaller streams are needed as they receive some protection from the flow disturbances created by upstream dams, making the lower units likely vital to mussel recruitment. Third,
the current proposal to construct toll roads threatens the abundance and diversity of mussel species currently protected by the southern units of the BTNP. Though minimally surveyed, these far downstream locations likely provide habitat suitable for rare and sensitive mussel species.

Objectives

In poorly surveyed areas, biodiversity hotspots—areas where rare and/or endemic species are found in exceptional concentrations and where habitat alteration could lead to the rapid decline or eradication of such species—should be identified and frequently monitored for priority conservation efforts (Lydeard et al., 2004). In addition, documenting detailed baseline water quality data along with mussel status, abundance, and diversity in such areas needs to be completed in a timely manner, prior to any major land-use changes (Downing et al, 2010).

The purpose of this project is to identify/document such areas within the BTNP, particularly in areas of proposed impact, and to evaluate changes in documented mussel communities, like those in Village Creek, a known mussel sanctuary in need of continuous monitoring (Bordelon and Harrel, 2004; Karatayev and Burlakova, 2007).

The numerous backwaters within the lower BTNP are likely critical to mussel recruitment within the Thicket. Although mussel surveys have been completed in the BTNP as recently as 2015, none have focused on such locations and none have been completed since the 2016 flooding. While Ford (2016) notes that mussel diversity and abundance are highest in the backwater-type habitats of the Preserve, with few exceptions, the selected survey sites were at easy access locations like bridges, leaving most of the more beneficial mussel habitat un-checked.
Output

As stream systems are at the mercy of upstream hydraulic management practices, a proper understanding of flow in relation to the habitat requirements of sensitive aquatic organisms, including mussels, is required in order to adapt flow management to their benefit (Benke, 1990). On the completion of this project, an interactive georeferenced map of hydraulic conditions and mussel bed locations in this and previous surveys will be created. This interactive platform will allow for continuous adaptive management of spatially explicit areas that may need additional protection and regulation to benefit the critical habitat needs of threatened mussels. Additional abundance and distribution data of all mussels, including non-natives, will be recorded. Furthermore, results will be shared at a minimum of one public presentation and published in a peer-reviewed journal.

Methodology

To locate mussels, we will identify and survey areas with hydraulic characteristics beneficial to threatened mussel species, including areas not reached by past surveys. Sites will be selected through a combination of in situ observation, examination of past flow patterns, and evaluation of historic imagery related to specific habitat requirements suitable to the life history needs of the state’s threatened mussels. Continuous access to areas of interest will be made by motor boat, kayak, vehicle, or foot when conditions require.

We will locate mussels in the streams of the BTNP. While all mussels found will be photographed and identified, no live mussels will be retained. DNA samples, particularly for rare species, will be taken in the field. Shells of recently dead animals may be retained and stored at Texas State University for reference.

Timeline
## Budget

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**Primary Investigator:** Astrid Schwalb, Ph.D. (Assistant professor; Texas State University – San Marcos)
Email: schwalb@txstate.edu

**Assisting Investigator:** Thom Hardy, Ph.D. (Professor and Chief Science Officer, The Meadows Center for Water and the Environment; Texas State University – San Marcos, TX) Email: Thom.Hardy@txstate.edu

**Primary Contact:** Alison Tarter (Masters Candidate, Aquatic Biology; Texas State University – San Marcos, TX) 409-920-5889 - Email: TARTERA@ME.Com or AAT43@txstate.edu
Literature Cited


