

Project Title: Surveys of freshwater mussels in 9 units of the Big Thicket Preserve

Project Leader

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Dr. Neil Ford, Professor of Biology, will serve as Principal Investigator for the project. His research expertise is in life-history evolution. He has supervised 13 M.S. theses, and currently has 2 graduate students. Over the past 30 years he has been PI or co-PI on over 1/2 million dollars in extramural grants. Many of these projects have addressed conservation issues in east Texas, including three on unionid mussels. Dr. Ford has been doing surveys with mussels for the last 12 years in east Texas and has all of the necessary equipment to conduct field surveys on unionids.

Species Affected: Unionid mussels

Introduction:

Freshwater mussels of the family Unionidae are a diverse group of benthic organisms that historically were the dominant biomass of aquatic systems of the southeastern U. S. (Howard and Cuffey, 2006). Mussels often occur in dense multispecies beds that perform significant functional roles in rivers such as removing suspended organic material, moving sediments and providing habitat for other invertebrates (Strayer, 2008; Atkinson et al., 2011). Unionids are highly speciose with approximately 300 recognized extant species in North America (Neves, 1993; Strayer et al., 2004). They are relatively sedentary, slow-growing and long-lived and the larva of most species must parasitize specific host fish (Watters 1994, Vaughn, 2010). North American mussel populations have been declining for many decades (Neves et al. 1997; Vaughn, 2010) with 35 species now presumed extinct and more than 40% imperiled to some degree (Ricciardi and Rasmussen, 1999). How the loss of both specific species and overall benthic biomass is impacting stream ecosystems is unknown but because of the many ecological processes mussels perform, it will be significant. However, for many states, including Texas, the extent of the decrease in species and numbers is simply not known. We do know that the impacts of overharvesting, pollution, reservoirs and other human activities, that have been implicated for the decline of species elsewhere, are certainly occurring here.

Texas has over fifty species of unionid mussels in several river drainage basins, some of which are isolated and flow directly to the Gulf of Mexico (Howells, et al., 1996). The species composition of mussels in eastern Texas differs significantly from that of central and western areas (Neck, 1982). Because of its higher rainfall, east Texas is a region where the construction of reservoirs and smaller impoundments has been prevalent and more are planned for the near future. The change in water flow downstream of dams has major impacts on mussel diversity and abundance (Vaughn and Taylor, 1999). In addition, erosion from agricultural land and various types of water pollution have been impacting the freshwater mussels of this area (Howells, et al., 1996; Neck, 1982). Regulations relative to mussel harvesting began in the early 1990s and in 2008 a petition to list a number of Texas mussels was submitted to the USFWS. Eleven species were originally considered with 6 of those found in east Texas. In 2011 Texas Parks and Wildlife Department listed 15 species of unionids in the state as being threatened. The USFWS in a 90-day finding removed the Southern Hickorynut, *Obovaria jacksoniana*, from consideration. The five remaining east Texas species are the Louisiana Pigtoe, *Pleurobema riddellii*, the Texas Pigtoe, *Fusconaia askewi*, the Triangle Pigtoe, *Fusconaia lananensis*, the Sandbank Pocketbook, *Lampsilis satura*, and the Texas Heelsplitter, *Potamilus amphichaenus*. However, the Neches and its tributaries above Beaumont receive some environmental protection from the lands of the Big Thicket National Preserve have likely protected the lower Neches and Trinity and their tributaries from some of the antropogenic effects seen upstream in more urban areas. Whether this has reduced the factors causing mussel declines is not well known since mussel surveys in the area are limited.

The historical survey data on the mussels for the Big Thicket area is limited in scope and much of it is dated. Five of the Texas unionid species that may be listed by the U. S. Fish and Wildlife Service have been recorded within southeast Texas and two other Texas listed species are also present (TPWD 2005). Recent TPWD surveys of unionid mussels have typically been in reservoirs or at bridge crossings and were relatively unsuccessful at locating populations of the threatened species (i.e., Karatayev and Burlakova, 2007). Lakes and the areas at bridge crossings of rivers are **not** the optimal sites for these unionids. Reservoirs tend to support thin shelled lentic species that can tolerate silting rather than the threatened riverine species, and our recent work

on both the upper Sabine and Neches Rivers found Texas heelsplitters, Louisiana pigtoes and southern hickorynuts in sites quite distant from bridge crossings (Troia and Ford, 2010; Ford et al., 2012).

In the summer of 2013 I began mussel surveys on 4 units of the Big Thicket National Preserve (Beech Creek, Upper Neches corridor, Canyonlands, and Neches Bottom and Jack Gore Bayou Units). We recorded 564 live and 313 dead mussels of 23 species during 30 surveys. Many of these were found in the tributaries off of the Neches River. It appeared that the high flows from B. A. Steinhagen Dam have created poor habitat on the mainstem of the Neches. This suggests that the smaller bayous and creeks found in the lower units of the Preserve may be critical for maintaining the diversity of mussels in east Texas.

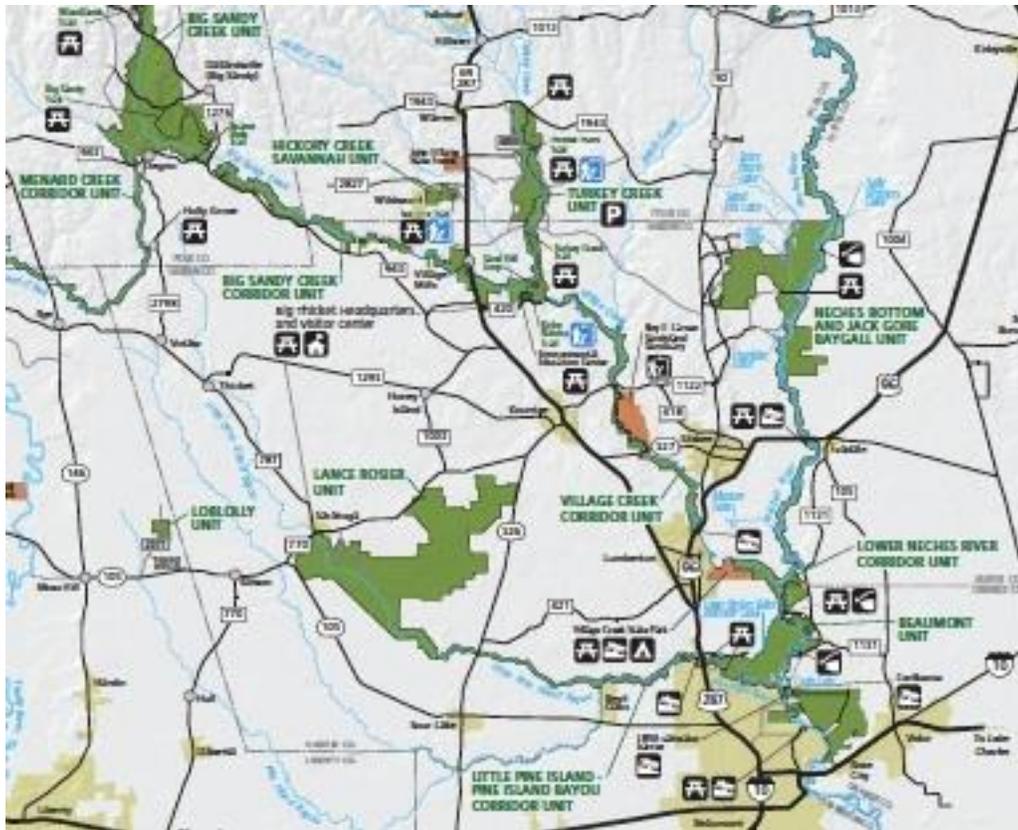
The proposed study will specifically survey for mussels in the lower Neches and the larger streams and bayous of 9 units of the Big Thicket Nature Preserve with emphasis given to areas where habitat characteristics are appropriate for mussels (see Appendix for targeted species). We will specifically survey for freshwater mussels in the Lower Neches River Corridor Unit just south of Evandale, the Beaumont Unit, the Village Creek Unit, the Lance Rosier Unit, the Little Pine Island – Pine Island Bayou corridor unit, The Big Sandy Creek and Corridor units, the Turkey Creek Unit and the Menard Creek Corridor unit. A timed search will be used in each area selected, as this is the best method to obtain the most species and particularly to locate rare species. The surveys will thus produce important inventory data on species of unionid mussels where little data is available. The surveyed sites will be georeferenced to allow for future monitoring of these areas.

Methodology

Personnel from The University of Texas at Tyler (UT-Tyler) will conduct surveys in multiple sites (3 – 6) in 9 units of the south and western Big Thicket National Preserve. The following methods will be used:

1: Locate and delineate sites in the Lower Neches River Corridor Unit just south of Evandale, the Beaumont Unit, the Village Creek Unit, the Lance Rosier Unit, the Little Pine Island – Pine Island Bayou corridor unit, The Big Sandy Creek and Corridor units, the Turkey Creek Unit and the Menard Creek Corridor unit to survey. Because of limited access this will involve kayak and boat trips starting from highway bridge crossings and travelling both upstream and downstream to quickly find areas to survey multiple sections of the river. In these surveys we will look for areas with shells and appropriate mussel habitat. When sites are located we will sample using a timed hand search and snorkel gear to determine the extent of mussel beds (Strayer et al., 1997; Strayer and Smith, 2003; Vaughn, et al., 1997). Then multiple samples representing approximately 150m of the river at each site will be made. All live unionids will be collected, identified and counted then returned to the river. One voucher of each non-endangered species will be retained in the University of Texas at Tyler collection.

2: The sites of mussel bed surveys will be delineated with GPS coordinates.



Nine Units to be surveyed excluding the Neches Bottom and Jack Gore unit that was previously surveyed. (Map from National Park Service; U.S. Dept. of the Interior).

Location

Site name, or street address: Big Thicket National Preserve
 County: Polk/Jasper/Tyler/Hardin/Orange/Jefferson
 State: TX
 Country: USA

Objectives.

The overall goal of this project is to survey mussel beds in 9 units of the Big Thicket National Preserve. In addition, information on abundance of the 6 mussels species that are State Threatened will be gathered (Williams et al., 1993; Howells et al., 1996). These data will help determine locations of mussels within areas of the Big Thicket, which will provide important information for future conservation work.

Time-line

We will begin surveys in April of 2014 and continue until weather no longer permits that fall (Sept. 2014). Collecting will be conducted by the PI and two graduate students. A complete report will be delivered in December 2014 including excel files of all data with GPS points alongside copies of all publications to BTA. The final **Outcome** for this project will be a database for locations of mussels in 9 units of the Big Thicket, and

recommendations for future studies. The final **Output** for this project would be a georeferenced database with current distributions of mussel species in the 9 Big Thicket National Preserve Units. Scientific presentations will be prepared for the spring of 2015 at a meeting within Texas such as the American Fisheries Society. A publication will be submitted in that year with acknowledgement of the support of the Big Thicket Association.

Budget:

Budget information. The University of Texas at Tyler has waived the indirect cost of 42% salaries, wages and fringe benefits required for the project. This is therefore listed as matching funds from the university on the budget form. Student salaries are calculated at \$5500 for one graduate assistant and \$3300 for 2 undergraduate assistants. Travel estimates are based on an expected 9 required trips with two nights lodging each time, per diem and mileage at \$0.50 per mile. Supplies requested are consumable supplies such as mesh bags, gloves, notebooks and snorkel gear. Funds may be moved between categories if it becomes necessary within the limits allowed by the granting agency and within the total amounts for each year.

Description (2013)	TOD	U. T. Tyler Match
a. Personnel:		
1 graduate student researchers	5500	
Fringe benefits (8%)	440	
2 undergrad assistants	3300	
Fringe benefits (8%)	264	
b. Travel:		
9 trips (18 days)	2850	
In state professional meeting	500	
c. Supplies		
Diving gear, notebooks	220	
d. Indirect costs (0%)		
e. Unrecovered Indirects from Direct Costs (42%)		\$4,068
f. Total	\$13,074	

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Appendix: Threatened East Texas Unionid Mussels

The following is a summary for each of the 6 species found that are considered threatened by Texas Parks and Wildlife department that either occur in the Big Thicket National Preserve currently or are in the historical record.

Texas Pigtoe (*Fusconaia askewi*)

The Texas pigtoe has a small range in eastern Texas and Louisiana and is found primarily in the Trinity, San Jacinto, Neches and Sabine River drainages. Since 1990, it has been documented in the Trinity River above Lake Livingston, in a tributary of the San Jacinto River, and is abundant in the Sabine River (Howells et al., 1996). In our surveys of the upper Big Thicket units we did not record the Texas pigtoe. This species has been recorded in mud, sand and fine gravel substrates in protected areas associated with fallen trees or other structures (Howells et al., 1996).

Triangle pigtoe, (*Fusconaia lananensis*)

Since 1992 only a few living specimens have been recorded from the Neches-Angelina drainage in Nacogdoches and San Augustine Counties. Bordelon and Harrel (2004) reported specimens from Village Creek, Hardin County that may be this species, as did SFASU personnel in 2005 (Howells 2006). SFASU personnel also confirmed the species persisting in Attoyac Bayou and Sandy Creek (a tributary of Attoyac Bayou) (Howells 2006). Populations are almost certainly eliminated from the type localities (Lanana and Bonita creeks (Howells, pers. comm.). DNA work to define the taxonomic status of these specimens is underway in Arkansas.

Sandbank pocketbook, (*Lampsilis satura*).

The sandbank pocketbook is considered rare throughout its entire range, which historically included the Mississippi Interior Basin, and the western Gulf Drainages of Arkansas, Mississippi, Louisiana, and Texas. Sandbank pocketbooks have been recorded from the Neches and Sabine and Angelina Rivers (Karatayev and Burlakova, 2007; Randklev and Kennedy, 2008; Ford, N. et al., 2009; Ford, D., 2013). In our surveys the sandbank pocketbook was the 14th most abundant species and was most common in the mainstem of the Neches River. This species is often found in gravel, gravel-sand, and sandy substrates in rivers with moderate to swift flows in Texas (Howells et al., 1996), while specimens from Oklahoma have been collected from slow moving streams, in areas with mud and/or sand-gravel substrates (Isely, 1924).

Southern Hickorynut (*Obovaria jacksoniana*)

Southern hickorynuts have been recorded from the Neches, Sabine, and Red River drainages of eastern Texas (Howells et al., 1996), and from the San Jacinto, Angelina and Trinity Rivers (TPWD, 2009). We did not record this species in the upper Big Thicket units surveyed in 2013. It has been recorded from Village Creek in recent times. Oesch (1984) reported that this species occurs in the gravel of creeks and rivers with moderate currents; however, southern hickorynuts have also been found in the Neches River in very little flow, within mud and silt substrates, surrounded by tree matter without any gravel or rocky substrate present (Troia and Ford, 2010).

Louisiana pigtoe (*Pleurobema riddellii*)

The historic range of the Louisiana pigtoe included several eastern Texas drainages, and other areas within the state of Louisiana (Howells et al., 1996; Vidrine, 1993). Over the last 20 years, living Louisiana pigtoes have been found in the Neches River (Howells, 2006), Village Creek (Bordelon and Harrel, 2004; Howells, 2006; Karatayev and Burlakova, 2007), and the Angelina River (Karatayev and Burlakova, 2007). A recently dead specimen was found in the Sabine River south of Marshall, Texas (N. Ford, pers. obs.). In addition, several live Louisiana pigtoes were found in the Elm Fork Trinity River near the California Crossing Dam in Dallas (Halff, 2012). In our surveys

we only recorded 2 dead specimens. The Louisiana pigtoe seems to be a stream-associated species that prefers areas of moving water over stagnant areas (Strecker, 1931; Howells et al., 1996). Louisiana pigtoes have been found in streams with variable substrate compositions, including sand with pockets of silt, clay and detritus (Bordelon and Harrell, 2004), sand, silty sand, gravel-sand, clay-sand (Karatayev and Burlakova, 2007), and cobble (Troia, 2010).

Texas Heelsplitter (*Potamilus amphichaenus*)

The Texas heelsplitter has been historically recorded from the Sabine, Neches, and Trinity Rivers. The Texas Heelsplitter is one of the rarest of the riverine species in east Texas with only a few dead specimens recorded during our surveys. Recent localities for the Texas heelsplitter include the Angelina (Karatayev and Burlakova, 2007), Trinity, Sabine, and Neches Rivers (Ford, D., 2013). This species has been collected from stable sand and sandy mud substrates (Howells et al., 1996), and may be tolerant of impounded waters (Howells et al., 1996).

CURRICULUM VITAE

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EDUCATION

B. S. University of Kansas (Systematics and Ecology), 1973
M. S. University of Oklahoma (Zoology), 1976
Ph. D. Miami University, Oxford, Ohio (Zoology), 1979

PROFESSIONAL EXPERIENCE

1979-84 Assistant Professor of Biology, Univ. of Texas at Tyler
1984-1991 Associate Professor of Biology, Univ. of Texas at Tyler
1991-present Professor of Biology, Univ. of Texas at Tyler
1985-1997 Faculty Research Participant, Savannah River Ecology Lab, U. S. Dept. of Energy
1988-2000 Adjunct Professor, Southeastern Louisiana University
1989-present Director of the Ophidian Research Colony, U. T. Tyler
2000-2003 Mary John and Ralph Spence Distinguished Professor
2013-present College of Arts and Sciences Distinguished Professor

RESEARCH EXPERTISE

My **primarily research interest** in the last 5 years has been in collaboration with two other U. T. Tyler faculty members to examine how landscape and geomorphology are related to the abundance and species composition of freshwater mussels in rivers of northeast Texas. Several of these organisms have been listed as threatened in Texas and understanding why is important to our protecting them. I have had 5 recent grants from TPWD and U.S. Fish and Wildlife supporting this research on mussel conservation.

SUMMARY OF PUBLICATIONS AND PRESENTATIONS

I have given over 84 presentations at scientific meetings, 26 of those within the last 5 years. I have written 69 peer-reviewed scientific papers, 11 book chapters and one book on my research. Twenty three of those papers have been in the last 5 years. I am invited to present seminars at other Universities and at scientific meetings at least once each year. I have presented 18 symposium talks and have organized 6 national and international symposia in my field of research. In 2011 I organized the Annual meeting of the Southwestern Association of Naturalists held at U. T. Tyler April 21-24.

HONORS

1996 Elected Fellow of the Texas Academy of Science
2000 Mary John and Ralph Spence Distinguished Professor (U. T. Tyler)
2003 President' Scholarly Achievement Award

PEER-REVIEWED PUBLICATIONS IN THE LAST 5 YEARS

Hunkapiller, T. R., **N. B. Ford** and Kevin Herriman, 2009. The effects of all-Terrain vehicle use on the herpetofauna of an East Texas Floodplain. Texas J. Sci. 61: 3-14.

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PAPERS SUBMITTED

- M. J. Troia, , M. G. Williams, L. R. Williams and N. B. Ford. Submitted. Geomorphology and hydraulics structure fish and mussel assemblages at multiple spatial scales along a river mainstem. *Freshwater Biology.*
- A. Dunithan, M. Williams, J. Banta, N. Ford, and L. Williams. Submitted. Ecological niche modeling reveals little association between freshwater mussel distribution and road and dam densities. *Ecological Applications.*

BOOK CHAPTERS IN LAST 5 YEARS

Ford, N. B. and R. A. Seigel. 2010. Factors affecting offspring size in snakes. In Reproductive Biology and Phylogeny of Snakes. R. D. Aldridge and D M. Sever (eds). Science Publishers, Inc. Enfield, NH, USA.

Bronikowski, A. M., A. M Sparkman, D. Byars and **N. B. Ford.** 2010. The role of Insulin/IGF1 signaling (IIS) in snake reproduction. In Reproductive Biology and Phylogeny of Snakes. R. D. Aldridge and D M. Sever (eds). Science Publishers, Inc. Enfield, NH, USA.