

Project Title: Surveys of freshwater mussels in 3 units of the Big Thicket Preserve

Project Leader

Dr. Neil B. Ford
Department of Biology
3900 Univ. Blvd
University of Texas at Tyler
Tyler, TX 75799
(903) 566-7249
nford@mail.uttyl.edu

Coordinating Organization:

University of Texas at Tyler
Carla Reichard, Ph.D. Assistant Director
Office of Sponsored Research
3900 University Boulevard
Tyler, TX 75799
Phone: (903) 565-5670
Fax: (903) 565-5858
creichard@uttyler.edu

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 29 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 10 years in east Texas and has all of the necessary equipment to conduct field surveys on unionids.

Species Affected: Unionid mussels

Introduction:

Freshwater mussels have historically dominated riverine systems of the southeastern United States in terms of benthic biomass (Parmalee and Bogan, 1998) and can exceed all other bottom dwelling organisms by an order of magnitude (Strayer et al., 1994). They often occur in dense multispecies beds that perform significant functional roles such as removing suspended organic material, moving sediments and providing habitat for other animals (Christian and Berg, 2000; Strayer et al., 1997; Vaughn and Hakencamp, 2001). They are also sensitive to pollution and other environmental problems and so are widely recognized as indicator species for water quality (Shannon et al., 1993; Williams, et al., 1993). They are highly speciose with nearly 300 species in the family Unionidae in the United States alone (Neves, 1993; McMahon and Bogan, 2001). Riverine mussels are relatively sedentary, slow-growing and long-lived (> 25 years) and the larvae of most species must parasitize specific host fish (Watters 1994; Vaughn and Taylor 2000), all of which makes them extremely susceptible to anthropogenic effects.

North American mussel populations have been declining for over a century with 35 species now presumed extinct and nearly 50% imperiled to some degree (Neves et al., 1997; Vaughn, 1997). It is important to note that it is not only the rare species of mussels that are in trouble but nearly all are in decline in most rivers (Bogan, 1993; Vaughn and Taylor, 1999). In the southeastern United States where mussels are well studied, 42% of the unionid populations that had been abundant are now in poor condition and nearly 70% of the populations may not survive over the next 30 years (Neves et al., 1997). Other areas such as the major rivers of Illinois and Ohio have shown similar declines with nearly 40% of their original mussel fauna now eradicated (Shannon, et al., 1993). However, for many states, including Texas, the status of mussel species is simply not known (Howells, et al., 1996; Neves, 1992). We do know that overharvesting, pollution, reservoirs and other human activities, that have been implicated in the decline of species elsewhere, are occurring in Texas as well (Ford and Nicholson, 2006; Ford et. al., 2009; Howells, 1997; Howells et al., 1997).

Texas has over fifty species of unionid mussels in multiple river basins that often have isolated drainage into the Gulf of Mexico (Howells, et al., 1996). The species composition in southeastern Texas differs significantly from that of central and western areas (Neck, 1982). Southeast Texas is also a region where the construction of reservoirs and smaller impoundments has been prevalent. 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, water pollution and commercial harvesting have likely been impacting the freshwater mussels of this area (Neck, 1986). However, the Neches and its tributaries above Beaumont receive some environmental protection from the lands of the Big Thicket National Preserve. Whether this has reduced the factors causing mussel declines elsewhere is unknown since mussel surveys in the area are very 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 another Texas listed species is 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

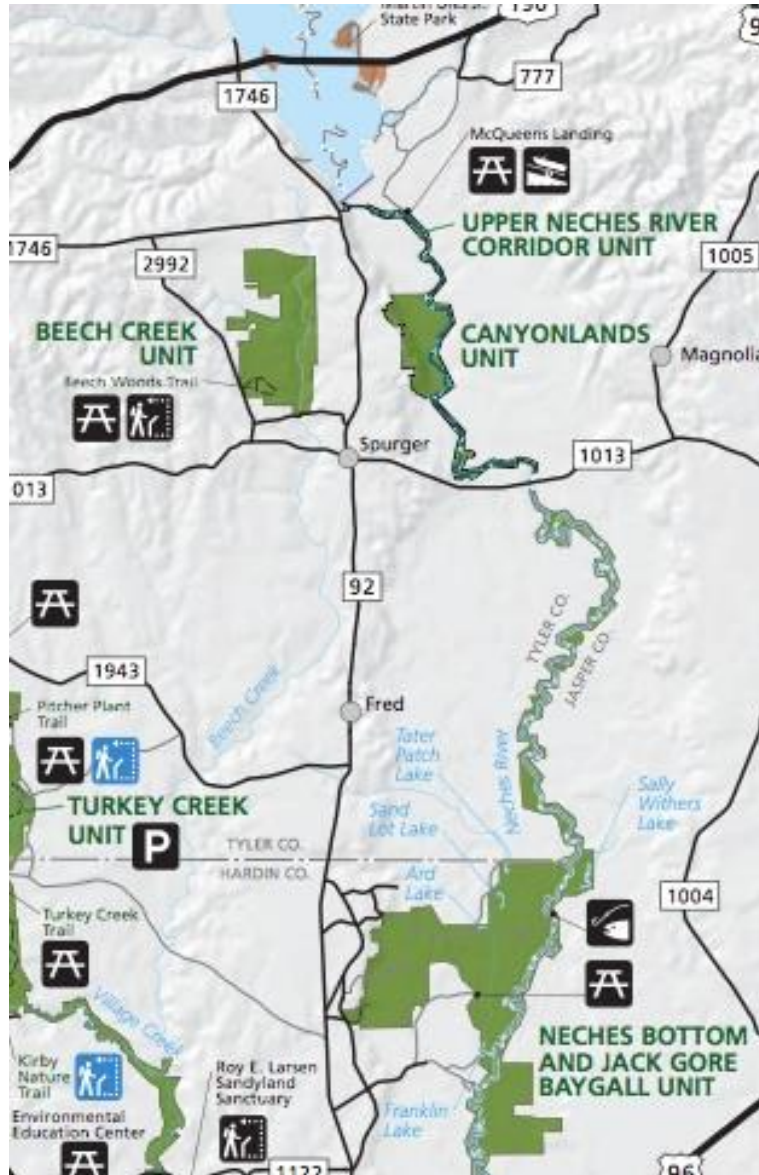
pigtoes and southern hickorynuts in sites quite distant from bridge crossings (Troia and Ford, 2010; Williams et al., 2009).

The proposed study will specifically survey for mussels in larger streams and rivers of 4 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 Upper Neches River Corridor Unit just south of B. A. Steinhagen Dam, the Beech Creek Unit, Canyonlands Unit and the Neches Bottom and Jack Gore Baygall 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 3 units of the Big Thicket that are just south of B. A. Steinhagen Dam and 1 unit further down the Neches River. The following methods will be used:

- 1:** Locate and delineate sites in the Beech Creek Unit, Upper Neches River corridor Unit, Canyonlands unit and the Neches Bottom and Jack Gore Baygall unit to survey. Because of limited access this will involve canoe and kayak trips starting from highway bridge crossings and canoeing 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.



Four Units to be surveyed (Map from National Park Service; U.S. Dept. of the Interior).

Location

Site name, or street address: Big Thicket National Preserve

County: Jasper/Tyler/Hardin

State: TX

Country: USA

Objectives.

The overall goal of this project is to survey mussel beds in the upper units of the Big Thicket National Preserve. In addition, information on abundance of the 6 mussel 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 2013 and continue until weather no longer permits that fall (Sept. 2013). Collecting will be conducted by the PI and one undergraduate student. A complete report will be delivered in December 2013 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 4 units of the Big Thicket, and some recommendations for their conservation. The final **Output** for this project would be a georeferenced database with current distributions of mussel species in the 4 upper Neches River Big Thicket Units. Scientific presentations will be prepared for the spring of 2014 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 \$3000 for one undergraduate assistant. Travel estimates are based on an expected 8 required trips with one night lodging, 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 undergraduate assistant	3000	1305
Fringe benefits (8%)	240	104
b. Travel:		
8 trips	2000	870
In state professional meeting	360	157
c. Supplies		
Diving gear, notebooks, PCR supplies	400	210
d. Indirect costs (0%)		
e. Unrecovered Indirects from Direct Costs (42%)		1,808
f. Total	\$6000	

Literature Cited

- Allan J.D. 1995. *Stream Ecology: Structure and Function of Running Waters*. Kluwer Academic Publishers, Dordrecht, The Netherlands.
- Bender, S., S Shelton, K. Conrad Bender, and A. Kalmbach (eds.). 2005. *Texas Comprehensive Wildlife Conservation Strategy: 2005-2010*. Texas Parks and Wildlife Department, Austin, Texas.
- Bogan, A.E. 1993. Freshwater bivalve extinctions (Mollusca: Unionidae): a search for causes. *Amer. Zool.* 33:599-609.
- Bordelon, V. L. and R. C. Harrel. 2004. Freshwater mussels (Bivalvia: Unionidae) of the Village Creek drainage basin in southeast Texas. *Texas J. Sci.* 56:63-72.
- Christian A.D. and D.J. Berg. 2000. The role of unionid bivalves (Mollusca: Unionidae) in headwater streams. *Bulletin North American Benthological Society* 17:189.
- Ford, N. B. and M. L. Nicholson. 2006. A survey of freshwater mussels (unionidae) of the Old Sabine Wildlife Management Area, Smith County, Texas. *Texas J. Sci.* 58: 243-254.
- Ford, N. B., J. Gullett, and M. E. May, 2009. Diversity and abundance of unionid mussels in three sanctuaries on the Sabine River in northeast Texas. *Texas J. Sci.* 61: 279-294.
- Howard, J. K. and K. M. Cuffey. 2006. The functional role of native freshwater mussels in the fluvial benthic environment. *Freshwater Biology* 51, 460-474
- Howells, R. G. 1997. Status of freshwater mussels (Bivalvia: Unionidae) of the Big Thicket Region of eastern Texas. *Texas J. Sci.*, 49 supplement: 21-34.
- Howells, R. G., C. M. Mather, and J. A. M. Bergmann. 1997. Conservation status of selected freshwater mussels in Texas. In: *Conservation and Management of Freshwater Mussels II, Proceedings of a UMRC Symposium, 12-14 April 1997*, (Eds. K.W. Cummings, A.C. Buchanan, C. A. Mayer and T. j. Naimo). Rock Island, Illinois.
- Howells, R. G., R. W. Neck and H. D. Murray. 1996. *Freshwater mussels of Texas*. Texas Parks and Wildlife Press, Austin, Texas.
- Howells, R. G., C. M. Mather, and J. A. M. Bergmann. 2000. Impacts of dewatering and cold on freshwater mussels (Unionidae) in B. A. Steinhagen Reservoir, Texas. *Texas J. Sci.*, 52: 93-104.
- McMahon, R.F. and A.E. Bogan. 2001. Bivalves. Pages 331-428 in J.H. Thorp and A.P. Covich (eds.), "Ecology and Classification of North American Freshwater Invertebrates," Second Edition. Academic Press, New York.
- McRae, S. E., J. D. Allan, and J. B. Burch. 2004. Reach- and catchment-scale determinants of the distribution of freshwater mussels (Bivalvia: Unionidae) in south-eastern Michigan, U.S.A. *Freshwater Biology.* 49:127–142.
- Morales, Y., Weber, L. J. Mynett, A. E. and T. J. Newton. 2006. Effects of substrate and hydrodynamic conditions on the formation of mussels beds in a large river. *J. N. Am. Benthol. Soc.* 25:664-676.
- Neck, R. W. 1986. Freshwater bivalves of Lake Tawakoni, Sabine River, Texas. *Texas J. Sci.* 38:241-249.
- Neves R.J. 1993. A state-of-the-unionids address. *Conservation and Management of Freshwater Mussels, Proceedings of a UMRC Symposium, 12-14 October 1992*, St. Louis, MO. (Eds. K.W. Cummings, A.C. Buchanan, L.M. Koch) pp. 1-10. Upper Mississippi River Conservation Committee, Rock Island, IL.
- Neves R.J., A.E. Bogan, J.D. Williams., S.A. Ahlstedt. and P.W. Hartfield. 1997. Status of the aquatic mollusks in the southeastern United States: a downward spiral of diversity. *Aquatic Fauna in Peril: The Southeastern Perspective* (Eds. G.W. Benz

- and D.E. Collins), pp. 43-86. Special Publication 1, Southeast Aquatic Research Institute.
- Parmalee, P.W. and A.E. Bogan. 1998. The freshwater mussels of Tennessee. University of Tennessee Press, Knoxville. 328 pp.
- Shannon, L., R.G. Biggins, and R.E. Hylton. 1993. Freshwater mussels in peril: perspectives of the U.S. Fish and Wildlife Service. Pp 66 - 68, in, Cummings, K.S., Buchanan, A.C. and Koch, L.M. (eds)., Conservation and Management of Freshwater Mussels. Proceedings of a UMRCC symposium, 12-14 October 1992, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island, Illinois.
- Strayer, D.L., D.C. Hunter, L.C. Smith, and C.K. Borg. 1994. Distribution, abundance, and roles of freshwater clams (*Bivalvia*, *Unionidae*) in the freshwater tidal Hudson River. *Freshwater Biology* 31:239-248.
- Strayer, D. L., S. Claypool, and S. J. Sprague. 1997. Assessing unionid populations with quadrats and timed searches. Pages 163–169 in K. S. Cummings, A. C. Buchanan, C. A. Mayer, and T. J. Naimo, editors. Conservation and management of freshwater mussels. II. initiatives for the future. Proceedings of a Symposium, 16–18 October 1995, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island, Illinois.
- Strayer, D. L. and D. R. Smith, 2003. A guide to sampling freshwater mussel populations. American fisheries Soc. Monograph 8. Pp. 103.
- M. J. Troia and N. B. Ford. 2010. Notes on habitat and burrowing behavior of *Obovaria jacksoniana* (*Bivalvia*: *Unionidae*) in the upper Neches River. *Texas Acad. Sci.* 62:195-204.
- Vaughn, C.C. 1997. Catastrophic decline of the mussel fauna of the Blue River, Oklahoma. *Southwestern Naturalist* 42:333-336.
- Vaughn, C.C. and C.M. Taylor. 1999. Impoundments and the decline of freshwater mussels: a case study of an extinction gradient. *Conservation Biology* 13:912-920.
- Vaughn, C.C. and C.M. Taylor. 2000. Macroecology of a host-parasite relationship. *Ecography* 23:11-20.
- Vaughn, C.C. and C.C. Hakenkamp. 2001. The functional role of burrowing bivalves in freshwater ecosystems. *Freshwater Biology* 46:1431-1446.
- Vaughn, C.C., C.M. Taylor and K.J. Eberhard. 1997. A comparison of the effectiveness of timed searches vs. quadrat sampling in mussel surveys. Pages 157-162, in Cummings, K.S., A.C. Buchanan, C.A. Mayer and T.J. Naimo (eds)., Conservation and Management of Freshwater Mussels II: Initiatives for the Future. Proceedings of a UMRCC symposium, 16-18 October 1995, St. Louis, Missouri.
- Watters, G.T. 1994. An annotated bibliography of the reproduction and propagation of the Unionoidea (primarily of North America). *Ohio Biological Survey Misc. Contrib.* No. 1.
- Williams, J. D., M. L. Warren, Jr., K. S. Cummings, J. L. Harris and R. J. Neves. 1993. Conservation status of the freshwater mussels of the United States and Canada. *Fisheries* 18:6-22.

Appendix: Threatened East Texas Unionid Mussels

Texas Pigtoe (*Fusconaia askewi*)

Listed as threatened by Texas Parks and Wildlife and under evaluation by U. S. Fish and Wildlife for potential listing as endangered. Only found in very small numbers in limited sites in the Neches River drainage. I have found a few individuals in sites in the upper Neches River. Bordelon and Harrel (2004) reported finding this species surviving in Village Creek, Hardin County, in 2002, and others were found in this stream in 2005 by SFASU personnel (Howells 2006). DNA work to define the taxonomic status of these specimens is underway in Arkansas.

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.

Louisiana pigtoe (*Pleuroberma riddellii*)

Bordelon and Harrel (2004) reported specimens from Village Creek, Hardin County, as did SFASU personnel in 2005 (Howells 2006). The only confirmed living specimens in Texas waters in recent decades have been below Town Bluff dam and in Village Creek. None of the other previously reported population sites have produced living or recently dead specimens in many years.

Texas Heelsplitter (*Potamilus amphichaenus*)

Only about 150 specimens have ever been recorded and only a few living individuals within the last 15 years (Howells et al., 1996). This species appears to have been reduced to a small number of survivors in the upper Sabine River, a population in B.A. Steinhagen Reservoir and the Neches River immediately downstream of Town Bluff Dam (Howells et al. 2000; Howells 2006), and a stretch of the Trinity River upstream of Lake Livingston (Howells 1997 MDS 144, collections by Mather and Bergmann in 1996). However, B.A. Steinhagen Reservoir has been periodically dewatered to kill exotic macrophytes and stranded many mussels. When refilled rotting terrestrial plants created anoxic conditions that likely eliminated much of the unionid assemblage in this reservoir.

Sandbank pocketbook, (*Lampsilis satura*)

Although recently found as a small population in the Village Creek drainage basin of the Neches (Bordelon and Harrel, 2004) this species is still poorly known in Texas (Howells pers. comm.). I have found populationa in the upper Neches and Angelina. The only other significant population in Texas waters is present in the Neches River below Town Bluff Dam, with limited numbers living or recently dead individuals documented in Village Creek (Hardin County; Howells 2006).

Southern Hickorynut (*Obavaria jacksoniana*)

The only known population was found in the village creek drainage of the lower Neches river (Bordelon and Harrel, 2004) however, it is a difficult species to identify. Extensive statewide mussel surveys have only located one other population in the upper Neches.

CURRICULUM VITAE

Neil Bowman Ford
Department of Biology
The University of Texas at Tyler

Telephone: office (903) 566-7249
home (903) 566-4012
e-mail: neil_ford@uttyler.edu

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

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

Coleman, J. L., **N. B. Ford**, and K. Herriman. 2008. A road survey of amphibians and reptiles in a bottomland hardwood forest. *Southeastern Naturalist*. 7: 339-348.

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.

Ford N. B. and P. M. Hampton. 2009. Ontogenetic and sexual differences in diet in an actively foraging

snake, *Thamnophis proximus*. Can. J. Zool. 87: 254-261.

- Ford, N. B.**, J. Gullett, and M. E. May, 2009. Diversity and abundance of unionid mussels in three sanctuaries on the Sabine River in northeast Texas. Texas J. Sci. 61: 279-294.
- Hampton, P.M., **N.B. Ford**, and K. Herriman. 2010. Impacts of Active Oil Pumps and Deer Feed Plots on Amphibian and Reptile Assemblages in a Floodplain. American Midland Naturalist. 163:44-53.
- Sparkman, A. M., D. Byars, **N. Ford**, and A. Bronikowski. 2010. The role of insulin-like growth factor-1 (IGF-1) in growth and reproduction in female brown house snakes (*Lamprophis fuliginosus*). Gen. Comp. Endo. 168: 408-414.
- Byars, D. J., **N. B. Ford**, A. M. Sparkman and A. M. Bronikowski. 2010. Influences of diet and family on age of maturation in Brown House snakes, *Lamprophis fuliginosus*. Herpetologica 66: 2010, 456-463.
- Ford, N. B.** and R. A. Seigel, 2010. An experimental test of the fractional egg hypothesis. Herpetologica. 66: 451-455.
- M. J. Troia and **N. B. Ford**. 2010. Notes on habitat and burrowing behavior of *Obovaria jacksoniana* (Bivalvia: Unionidae) in the upper Neches River. Texas Acad. Sci. 62:195-204.

PAPERS IN PRESS

- A. Sparkman, T. Schwartz, J. Madden, S. Boyken, **N. Ford**; J. Serb, A. Bronikowski. In press. Evolutionary rates vary in vertebrates for insulin-like growth factor-1 (IGF-1), a pleiotropic locus involved in life history traits. General and Comparative Endocrinology.
- B. T. Martin, D. D. Goodding, **N. B. Ford** and J. S. Placyk, Jr. In press. Sensory Mediation of Foraging Behavior in the Western Lesser Siren (*Siren intermedia nettingi*). J. of Herpetology.
- A. Dunithan and N. B. Ford. Submitted. Impact of drought on predation of an endangered mussel species, *Potamilus amphichaenus*. Southwestern Naturalist.

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.