

16 December 2016

Dear Thicket of Diversity Science and Executive Committees,

I am submitting proposal, asking for \$12,480, to conduct a lightshine survey of alligator populations within the Big Thicket National Preserve and conduct water quality analyses. As a member of the Thicket of Diversity Science Committee and Executive Council, I acknowledge a potential conflict of interest in submitting this proposal and asking for funding. To eliminate any potential conflict of interest, I am recusing myself from any discussion and voting relating to my proposal. I have also requested Randy Yoder, a member of the science committee and a fellow faculty member in my department, the Department of Biology at Lamar University, recuse himself from discussing and voting on my proposal to eliminate any perceived conflict of interest.

Sincerely,



Matthew I. Pyne  
Assistant Professor of Biology  
Lamar University

# Population Survey of American Alligators within the Big Thicket National Preserve

Matthew I. Pyne<sup>1</sup>

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## Introduction

The American alligator is an essential component of aquatic food webs in the southeastern United States. They are apex predators regulating the behavior, population size, and distributions of other organisms (Nifong and Silliman 2013). They are also ecosystem engineers, creating wallows or holes that provide habitat for other organisms (Jones et al. 1994). Alligators are good indicators of human-influenced disturbance on wetlands, being sensitive to the influence of heavy metal and other chemicals in aquatic systems, accumulating the pollutants in their tissues (Guillette et al. 2000). Thus, the monitoring of alligator populations has been an important tool in determining the “health” of aquatic systems.

Hunting and habitat loss led to a decline in alligator numbers so severe that the U.S. Fish and Wildlife Service listed the alligator as endangered in 1967, facilitating its recovery and eventually delisting in 1987 (U.S. Fish and Wildlife Service 2008). The number of alligators has continued to grow in east Texas, with some recent unofficial state estimates near half a million or more individuals, although there is no official current statewide estimate (G. Calkins, Texas Parks and Wildlife, personal communication). The state of Texas has monitored alligator numbers through some surveys, but most surveys have been limited to the wildlife management areas or state parks encompassing the marshes and wetlands located along the gulf coast in southeastern portion of the state (e.g., Eversole et al. 2015) or in the lakes and ponds among the forests and hills of northeastern portion of the state (e.g., Webb et al. 2009).

Waterbodies located within the Big Thicket National Preserve consist of transition zones between the forested regions of northeast Texas and the coastal plain near the Gulf of Mexico. Knowledge of alligator population dynamics of Big Thicket NP waterbodies are vital in understanding the distribution of alligators in east Texas as a whole, but no surveys have been conducted on alligators inhabiting the park, nor along the Neches River (G. Calkins, personal communication). While it appears that there are large populations of alligators surrounding the preserve, only small numbers of alligators have been observed within the preserve by park personnel and biologists (Ken Hyde, NPS, personal communication). The national park is unaware of the population status of alligators within the park and do not know which areas within the preserve might provide good habitat. Additionally, they are unaware of possible contaminants that may be present in the aquatic ecosystem that could impact alligator health, reproductive success and survival.

## **Project Objectives and Goals**

The objective of this study is to conduct a year-long survey of American alligators inhabiting the major waterways within the Big Thicket National Preserve, locate any nesting sites, and collect water, soil, biotic samples to detect contaminants that can impact alligator populations.

Specific objectives of this project are:

1. Conduct an inventory of alligator populations in larger waterways and lakes of the preserve.
2. Collect climate, water chemistry, and habitat data during surveys.
3. Locate alligator nest sites within the preserve and collect habitat data at those sites.
4. Collect and analyze water, soil, and macroinvertebrate samples to detect contaminants.

I seek funding from the Thicket of Diversity to support the completion of objectives 1 and 3 and part of objective 2. I am also currently seeking funding from Safari Club International Foundation (SCIF) to support the completion objective 4 and part of objective 2.

## **Methodology**

1. Conduct an inventory of alligator populations in larger waterways and lakes of the preserve.

Surveys will be conducted in 4 areas within the preserve: 1) Neches River, 2) Off-channel lakes and wetlands in the Neches River floodplain, including areas above and below the salt water barrier, 3) Pine Island Bayou and Little Pine Island Bayou, and 4) Village Creek watershed. We will consult with park staff to prioritize waterways.

Surveys will be conducted during 3 periods, fall of 2017, spring of 2018, and summer of 2018. No survey will be conducted in the winter of 2017, since alligators are not active during that time. Alligator surveys will incorporate nightlight eye shine techniques, which minimizes disturbance to alligators (Fujisaki et al. 2011), since the National Park Service prohibits the capture of alligators within the park. We will use established Texas Parks and Wildlife Department (TPWD) survey techniques. During the survey, 1) we will count spotlight reflections, 2) estimate alligator size using snout length and distance to boat, 3) assign GPS coordinates to all sightings, and 4) identify potential nest locations. Night surveys will cover nearly 75 miles of the Neches River, smaller backwater areas, and tributary creeks, where access may be limited, so we expect it will take 12 to 18 nights to conduct each survey period.

2. Collect climate, chemistry, and habitat data to determine which habitat conditions are most suitable for alligators.

We record habitat data near alligator stings and use a multiparameter (Hanna HI9829), already in Dr. Pyne's lab, to record temperature, pH, conductivity, turbidity, and dissolved oxygen during surveys. If SCIF funding is also obtained, we will purchase water quality test kits for 15-16 water quality chemicals and temperature loggers to be placed along the Neches River, its tributaries, and other locations.

3. Record habitat selection data at identified alligator nest sites.

During the daytime, we will visit potential alligator nests found during the inventories in the winter of 2017, after the hatchlings have left the nest. We will record habitat data that provide important nest site selection information, such as elevation, canopy cover, habitat type, distance to water, and distance to potential feeding areas (Saalfeld 2010).

4. Collect and analyze water, soil, and prey samples for detection of possible contaminants.

If SCIF funding is obtained, we will collect water, soil and invertebrate/small fish samples near nest sites and use the funding to test for two heavy metals, methyl mercury and selenium in the samples. Water samples will also be tested for organochlorides, such as DDE, which are endocrine disrupting contaminants known to affect alligator physiology.

### **Project Timeline**

Surveys will be conducted in October-November 2017, April-May 2018, and July-August 2018. Potential nests will be located and visited in the winter of 2017 and 2018 (if new nests are discovered during the summer survey). Water, soil, and biotic samples will be processed after they are collected. The graduate student will begin her Master's program at Lamar University in the fall of 2017. She will collect data from the field during the first year of the project and analyze the data and write the results during her second year.

### **Expected Outcomes**

The data will be incorporated into a master's thesis, providing detailed information that Big Thicket National Preserve can use to manage their alligator populations, both concerning what environmental factors lead to habitat selection of alligators and what potential contaminants may impede alligator growth and development. Texas Parks and Wildlife Department will be able to use the data to understand alligator population dynamics between their wildlife management areas and state parks, leading to better informed alligator management and conservation.

In addition to the Master's thesis, the graduate student and Dr. Pyne will prepare at least one scientific paper to be submitted to a peer-reviewed scientific journal. Additionally, the graduate student will travel to a scientific conference to present key findings of the study.

### **Abilities and Roles of Project Staff**

The principle investigator, Dr. Pyne, will mentor a graduate student during this project. Both individuals, along with hired undergraduate students and other volunteers, will participate in the surveys and sample collection. The graduate student will process samples, compile the data, and analyze the results. Both Dr. Pyne and the graduate student will write the publication.

## Budget

I seek funds from the Thicket of Diversity project (Table 1) to support Dr. Pyne's summer salary, undergraduate researcher salary, and fuel costs, per Texas Commission on Environmental Quality requirements. I am also currently seeking funding from Safari Club International Foundation (SCIF) to support a graduate student stipend, cost of field equipment, and the cost of analysis samples for the detection of contaminants (\$50,000). Lamar University will provide boats and vehicles as well as facilities to conduct the research. If I am unable to secure funds from SCIF, I will still be able to perform the alligator survey and basic water chemistry analysis, but I will not be able to perform detailed contaminant analyses of water, soil, and biotic samples.

Table 1. Funds sought from the Thicket of Diversity project to support alligator surveys within Big Thicket National Preserve. Note: that the Thicket of Diversity grants do not allow funds to be used to support university indirect costs.

<u>Item</u>	<u>Cost Per Item</u>	<u># items</u>	<u>Total</u>
<u>Salary</u>			
Dr. Pyne's summer 2018 salary	\$50 per hour	120 hours	\$6,000
Undergraduate researchers	\$12 per hour	300 hours	\$3,600
<u>Equipment</u>			
Fuel costs for boats and university vehicles	~\$65 per trip	45 trips	\$2,880
			<b>Total Direct Costs: \$12,480</b>

## References

- Eversole, C. B., S. E. Henke, D. B. Wester, B. M. Ballard, and R. L. Powell. 2015. Responses of American alligators (*Alligator mississippiensis*) to environmental conditions: implications for population and ecosystem monitoring. *Herpetologica* **71**:37-45.
- Fujisaki, I., F. J. Mazzotti, R. M. Dorazio, K. G. Rice, M. Cherkiss, and B. Jeffery. 2011. Estimating Trends in Alligator Populations from Nightlight Survey Data. *Wetlands* **31**:147-155.
- Guillette, L. J., Jr, D. A. Crain, M. P. Gunderson, S. A. E. Kools, M. R. Milnes, E. F. Orlando, A. A. Rooney, and A. R. Woodward. 2000. Alligators and endocrine disrupting contaminants: A current perspective. *American Zoologist* **40**:438-452.
- Jones, C. G., J. H. Lawton, and M. Shachak. 1994. Organisms as Ecosystem Engineers. *Oikos* **69**:373-386.
- Nifong, J. C., and B. R. Silliman. 2013. Impacts of a large-bodied, apex predator (*Alligator mississippiensis* Daudin 1801) on salt marsh food webs. *Journal of Experimental Marine Biology and Ecology* **440**:185-191.
- Saalfeld, D. T. 2010. American alligator (*Alligator mississippiensis*) ecology in inland wetlands of east Texas. PhD dissertation. Stephen F. Austin State University.
- U.S. Fish and Wildlife Service. 2008. American alligator (*Alligator mississippiensis*).in U.S. Fish and Wildlife Service, editor. U.S. Fish and Wildlife Service, Arlington, Virginia, U.S.A.
- Webb, K. K., W. C. Conway, G. E. Calkins, and J. P. Duguay. 2009. Habitat use of American alligators in east Texas. *Journal of Wildlife Management* **73**:566-572.

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## **Professional Appointments:**

2014 – Present Assistant professor, Department of Biology, Lamar University,  
Beaumont, Texas

## **Education:**

2014 **Doctor of Philosophy** in Ecology, Colorado State University

Dissertation Title: The distribution of lotic insect traits in relation to reference conditions and projected climate change in the western United States

2006 **Master of Science** in Integrative Biology, Brigham Young University

Thesis Title: Prediction of local biological characteristics in streams: a comparison of landscape classifications

2003 **Bachelor of Science** in Wildlife and Range Resources, Brigham Young University

## **Research Experience:**

- Assistant Professor, Lamar University, 2014–present
  - Surveyed Rangia clam populations along the Neches River, TX, in relation to salinity gradients.
  - Experimentally manipulated water temperatures to measure how aquatic insects may respond to climate change.
  - Developed statistical models to determine which hydrological variables best differentiate California stream types.
  - Predicted the distribution of pitcher plants in the Big Thicket Preserve using GIS modeling.
- Ph.D. Graduate Student, Colorado State University, 2006–2014
  - Developed Bayesian hierarchical regression models to describe the distribution of lotic insect traits due to changes in the stream environment.
  - Predicted the future distribution of aquatic insect taxa in western U.S. streams from climate change scenarios using general linear models and thermal/flow tolerances.

- Performed multivariate statistical techniques (e.g., RDA, CART, multinomial regression) exploring the relationship between aquatic insect traits and environmental gradients.
- Collected the flatworm *Polycelis* in and around Rocky Mountain National Park, Colorado, for a genetics study.
- Estimated demographic parameters for the bison population at Badlands National Park, South Dakota, part of a collaborative effort with statistics and mathematics graduate students.
- M.S. Graduate Student, Brigham Young University, 2003–2006
  - Validated a stream classification system developed by the USDA Forest Service.
  - Led a 4-person team collecting algal, macroinvertebrate, and brook trout samples from 69 field sites over a 10-week period.
  - Coordinated and supervised preparation of trout otoliths and sorting of macroinvertebrate samples.
  - Analyzed ~1500 trout otoliths and identified ~69,000 macroinvertebrates to genus.
  - Performed multivariate statistical analyses.
- Biological Technician, USDA Forest Service, Shrub Sciences Laboratory, 2001–2004.
  - Collected wood cores and other wood samples, collected site data, and analyzed wood samples in the laboratory for a southern Utah and eastern Nevada fire history study.
  - Assisted in site preparation, treatment application, and data collection for a study on how changing fire regimes and increased cheatgrass fuel loads affect sagebrush steppe and pinyon-juniper ecosystems.
  - Assisted in collection of data in and maintenance of the USDA Forest Service Desert Experimental Range, Utah.

### **Publications:**

1. **Pyne, M. I.**, D. M. Carlisle, C. P. Konrad, and E. D. Stein. 2016. Classification of California streams using combined deductive and inductive approaches: setting the foundation for analysis of hydrologic alteration. *Ecohydrology*: DOI: 10.1002/eco.1802
2. **Pyne, M. I.**, and N. L. Poff. 2016. Vulnerability of stream community composition and function to projected thermal warming and hydrologic change across ecoregions in the western United States. *Global Change Biology*: DOI: 10.1111/gcb.13437
3. Terry, R.G., **M. I. Pyne**, J. A. Bartel, and R. P. Adams. 2016. A molecular biogeography of the New World cypresses (*Callitropsis*, *Hesperocyparis*; Cupressaceae). *Plant Systematics and Evolution* 302 (7): 921-942
4. Auerbach, D. A., N. L. Poff, R. R. McShane, D. M. Merritt, **M. I. Pyne**, and T. Wilding. 2012. Streams past and future: fluvial responses to rapid environmental change in the context of historical variation. Pages 232-245 in J. A. Wiens, G. D. Hayward, H. D. Safford, and C. Giffen, editors. *Historical Environmental Variation in Conservation and Natural Resource Management*. John Wiley & Sons, Ltd., Hoboken, New Jersey.

5. Buhnerkempe, M. G., N. Burch, S. Hamilton, K. M. Byrne, E. Childers, K. A. Holfelder, L. N. McManus, **M. I. Pyne**, G. Schroeder, and P. F. Doherty. 2011. The utility of transient sensitivity for wildlife management and conservation: Bison as a case study. *Biological Conservation* 144:1808-1815.
6. Poff, N. L., **M. I. Pyne**, B. P. Bledsoe, C. C. Cuhaciyan, and D. M. Carlisle. 2010. Developing linkages between species traits and multiscaled environmental variation to explore vulnerability of stream benthic communities to climate change. *Journal of the North American Benthological Society* 29:1441-1458.
7. **Pyne, M. I.**, K. M. Byrne, K. A. Holfelder, L. Mcmanus, M. Buhnerkempe, N. Burch, E. Childers, S. Hamilton, G. Schroeder, and P. F. Doherty. 2010. Survival and breeding transitions for a reintroduced bison population: a multistate approach. *Journal of Wildlife Management* 74:1463-1471.
8. Webb, C. T., J. A. Hoeting, G. M. Ames, **M. I. Pyne**, and N. L. Poff. 2010. A hierarchical and dynamic framework to advance traits-based theory and prediction in ecology. *Ecology Letters* 13: 267-283.
9. **Pyne, M. I.**, R. B. Rader, and W. F. Christensen. 2007. Predicting local biological characteristics in streams: a comparison of landscape classifications. *Freshwater Biology* 52:1302-1321.

#### **Invited Talks/Presentations:**

1. **Pyne, M. I.** 2016. A review and evaluation of trait-flow relationships in stream ecosystems. Annual Meeting of the Society for Freshwater Science, Sacramento, California. Oral Presentation.

#### **Volunteered Presentations at Professional Meetings:**

1. Brown, J. E., **Pyne, M. I.** 2016. Thermal tolerance in a warm-water Cheumatopsyche caddisfly. Annual Meeting of the Society for Freshwater Science, Sacramento, California. Poster Presentation.
2. **Pyne, M. I.**, N. L. Poff. 2015. Modeling the response of climate-sensitive, aquatic insect traits to multiple environmental factors in the western United States using a Bayesian path model. Annual Meeting of the Society for Freshwater Science, Milwaukee, Wisconsin. Oral Presentation.
3. **Pyne, M. I.**, N. L. Poff. 2014. Vulnerabilities of Stream Insect Communities to Temperature and Hydrologic Change from Global Warming. 1<sup>st</sup> Joint Aquatic Sciences Meeting, Portland, Oregon. Oral Presentation.
4. **Pyne, M. I.**, N. L. Poff. 2014. Environmental Limits and Climate Change: Thermal and Hydrology Tolerances of Stream Insects in the Western United States Projecting changes in benthic community structure to climate change: a traits-based model. 20th Front Range Student Ecology Symposium, Colorado State University, Fort Collins, Colorado. Oral Presentation.
5. **Pyne, M. I.**, N. L. Poff. 2012. Projecting changes in benthic community structure to climate change: a traits-based model. 60th Annual Meeting of the Society for Freshwater Science, Louisville, Kentucky. Oral Presentation.



6. **Pyne, M. I.,** N. L. Poff. 2010. Testing a priori concepts of environmental-trait relationships. 58th Annual Meeting of the North American Benthological Society, Santa Fe, New Mexico. Oral Presentation.
7. **Pyne, M. I.,** N. L. Poff, B. P. Bledsoe, C. C. Cuhaciyan, D. Carlisle . 2010. Developing linkages between species traits and multi-scaled environmental variation in streams to assess ability to detect benthic community responses to climate change. 16th Annual Front Range Student Ecology Symposium, Colorado State University, Fort Collins, Colorado. Oral Presentation.
8. **Pyne, M. I.,** N. L. Poff, J. A. Hoeting, and D. Johnson. 2009. Application of a Bayesian hierarchical regression model to explain multiple trait distributions of lotic insects across environmental gradients. 57th Annual Meeting of the North American Benthological Society, Grand Rapids, Michigan. Oral Presentation.
9. **Pyne, M. I.,** H. Tan. 2009. Use of Bayesian hierarchical regression model to predict species trait distributions of aquatic insects in streams. 15th Annual Front Range Student Ecology Symposium, Colorado State University, Fort Collins, Colorado. Oral Presentation.
10. **Pyne, M. I.,** N. L. Poff, B. B. Bledsoe, and A. T. Herlihy. 2008. Estimation of taxa abundances using a Bayesian Belief Network. 56th Annual Meeting of the North American Benthological Society, Salt Lake City, Utah. Poster Presentation.
11. **Pyne, M. I.,** N. L. Poff, B. B. Bledsoe, and A. T. Herlihy. 2007. Traits versus taxonomy: community composition along environmental gradients in streams. 55th Annual Meeting of the North American Benthological Society, Columbia, South Carolina. Poster Presentation.
12. **Pyne, M. I.,** R. B. Rader, and D. Winters. 2005. Testing differences in the biological community of streams using watershed classifications. 90th Annual Meeting of the Ecological Society of America, Montreal, Quebec, Canada. Oral Presentation.

### **Grants, Fellowships, Scholarships:**

- Christensen, A., **M. I. Pyne.** “The effects of the permanent salt water barrier on the brackish water clam, *Rangia cuneata*, in the lower Neches River.” Center for the Advances in Water and Air Quality, Lamar University, \$25,000 (2016-2017).
- **Pyne, M.I.** “Digitization, data extraction, and archiving of environmental and biological data from the Big Thicket National Preserve”, National Park Service, \$5,000 (2015-2016).
- **Pyne, M.I.** “Thermal tolerances of aquatic insects across a temperature gradient in a stream: implications for climate change”, Lamar University, \$5,000 (2015-2016).
- Edward and Phyllis Reed Fellowship, Colorado State University, \$16,900; 2011
- Edward and Phyllis Reed Fellowship, Colorado State University, \$18,000; 2010
- Edward and Phyllis Reed Fellowship, Colorado State University, \$11,100; 2009
- PRIMES Fellowship, Colorado State University, \$30,000; 2008
- Edward and Phyllis Reed Fellowship, Colorado State University, \$7500; 2007
- Colorado State Graduate Fellowship, Colorado State University, \$800; 2006
- Vernon J. Tipton Family Scholarship, Brigham Young University, \$1000; 2005

- Julia Greenwell Scholarship, Brigham Young University, \$1773; 2004
- Frank and Helen Rist Scholarship, Brigham Young University, \$1530; 2002
- J. Willard Marriott Scholarship, Brigham Young University, \$3060; 2001
- Norris-Hill-Maddock Scholarship, Brigham Young University, \$2940; 2000
- Biology and Agriculture Scholarship, Brigham Young University, \$1250; 2000

**Teaching Experience:**

- *Instructor* – Anatomy and Physiology (undergraduate), Lamar University, Spring 2016
- *Instructor* – Graduate Seminar, Lamar University, Fall 2015-2016
- *Instructor* – Limnology (undergraduate and graduate), Lamar University, Spring 2015-2016
- *Instructor* – Ecology (undergraduate and graduate), Lamar University, Fall 2014-2016
- *Teaching Assistant* – Invertebrate Biology (undergraduate), Colorado State University, 2012-2013
- *Teaching Assistant* – Biology of Organisms: Animals and Plants (undergraduate), Colorado State University, 2012.
- *Teaching Assistant* – Limnology (undergraduate), Colorado State University, 2006 & 2010.
- *Teaching Assistant* – Stream Ecology (undergraduate), Colorado State University, 2009.
- *Teaching Assistant* – Animal Biology Laboratory (undergraduate), Colorado State University, 2006 & 2009.
- *Teaching Assistant* – Animal Diversity (undergraduate), Brigham Young University, 2003 & 2005.
- *Teaching Assistant* – Introduction to Biology (undergraduate). Brigham Young University, 2004.
- *Guest Lecturer* – Sustainable Watersheds (undergraduate), Colorado State University, 2013.
- *Guest Lecturer* – Stream Ecology (undergraduate lab), Colorado State University, 2011.
- *Guest Lecturer* – Stream Ecology (undergraduate), Colorado State University, 2007 - 2013.
- *Guest Lecturer* – Limnology (undergraduate), Colorado State University, 2008 & 2010.
- *Guest Lecturer* – Introductory Biology (undergraduate), Colorado State University, 2007 & 2008.
- *Guest Lecturer* – Stream and Wetland Ecology (graduate), Brigham Young University, 2005.
- *Guest Lecturer* – General Ecology (undergraduate), Brigham Young University, 2005.
- *Guest Lecturer* – Community Ecology (graduate), Brigham Young University, 2004.

**Professional Affiliations:**

Ecological Society of America (since 2004)

Society for Freshwater Science (since 2006)

National Association of Biology Teachers (since 2013)

Southeast Texas Clean Air and Water, Inc. (since 2014)

**Computer Skills:**

ESRI ArcGIS

R Statistical Program

Microsoft Office (Excel, Word, Access, PowerPoint)

**References:**

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