

# FACULTY DEVELOPMENT ENDOWMENT FUNDS

## Application Cover

Date of Travel: 6 January 2016

Applying for: ☒ Eleanor Lane Endowment ☐ Nathan Deutsch Development Fund

Principal Investigator: Travis D. Marsico Dept: Biological Sciences

Other Investigators: \_\_\_\_\_

Proposal Title: Plant species assembly and community turnover along an elevation gradient within cloud forests on Volcán Maderas, Isla de Ometepe, Nicaragua

Have you received this funding in the past? ☐ Yes ☒ No If yes, when? \_\_\_\_\_

### Proposed Budget

	Funds Requested
Travel	\$ <u>1000</u>
Supplies & Materials	\$ <u>0</u>
Other (Specify)	\$ <u>0</u>
<b>TOTAL REQUEST</b>	\$ <u>1000</u>

Brief Abstract for Publication on RTT Website: [Attach separate page if you have difficulty with the form.]

With an ever-burgeoning human population, the threats to biodiversity continually increase. Developing an understanding of biodiversity patterns at small spatial scales provides the opportunity to make effective land management and conservation recommendations in situations for which conservation resources are limited. Moreover, with extinction rates accelerating, there is urgent need to understand patterns of biodiversity in diversity hotspots. A research project is developed that aims to answer important questions about the observed patterns of plant species assembly and community turnover along a steep elevation gradient within cloud forests on Volcán Maderas, Isla de Ometepe, Nicaragua. Maderas is geographically isolated and has an extraordinary density of vegetation zones due to the rapid change in elevation. For example, there is a 1400m elevation gradient over less than 5km of distance between the base of the volcano and the summit, a change that likely results in narrow bands of species assemblages that differ markedly along the gradient. Maderas is truly unique, and its isolation from other similar peaks and habitats may have resulted in unexplored endemism. Ometepe was designated as a Biosphere Reserve in 2010 by UNESCO's Man and Biosphere Programme, in part

Signature of Applicant: Travis Marsico Digitally signed by Travis Marsico  
DN: cn=Travis Marsico, o=University of Nevada, ou=College of Biological Sciences, email=tmarsico@unr.edu, c=US  
Date: 2015.10.25 10:25:20 -0700 Date: 25 October 2015

Signature of Department Chair: Travis Marsico Digitally signed by Travis Marsico  
DN: cn=Travis Marsico, o=University of Nevada, ou=College of Biological Sciences, email=tmarsico@unr.edu, c=US  
Date: 2015.10.25 10:25:20 -0700 Date: 25 October 2015

Signature of Collegiate Dean: John M. Pratte Digitally signed by John M. Pratte  
DN: cn=John M. Pratte, o=University of Nevada, ou=College of Biological Sciences, email=jmprat@unr.edu, c=US  
Date: 2015.10.25 10:25:20 -0700 Date: 10/25/2015

*\*Electronic signatures are acceptable. Submit electronically to [research@astate.edu](mailto:research@astate.edu) OR to RTT office.*

## **Plant species assembly and community turnover along an elevation gradient within cloud forests on Volcán Maderas, Isla de Ometepe, Nicaragua**

Eleanor Lane Faculty Endowment proposal respectfully submitted by Dr. Travis D. Marsico

### **a. Scope and significance of activities**

This proposal outlines a research project that aims to answer important questions about the observed patterns of plant species assembly and community turnover along a steep elevation gradient within cloud forests on Volcán Maderas, Isla de Ometepe, Nicaragua. Maderas is an isolated area of cloud forest habitat, owing its isolation to its position on Ometepe Island and also as a habitat island separated by the nearest other Pacific slope volcano cloud forests by 65km to the northwest (Volcán Mombacho, Nicaragua) and 50km to the south (Volcán Orosi, Costa Rica). Moreover, Maderas has an extraordinary density of vegetation zones due to the rapid change in elevation. Maderas is unique, and its isolation from other similar peaks and habitats may have resulted in unexplored endemism.

The objectives of this study are three-fold: 1) to characterize the plant communities of the cloud forest along the steep elevation gradient of Maderas by generating a list of species represented by vouchered specimens; 2) to use diversity analyses to determine at what elevation diversity is highest on Maderas, and to identify the pattern of diversity changes along the entire elevation gradient; and 3) to investigate species identity at specific altitudes to understand the rate of plant community turnover from the base of the cloud forest (approx. 400m above sea level) to the summit of the volcano (approx. 1400m above sea level). I hypothesize that diversity patterns are predictable based upon interacting environmental factors such as habitat surface area, precipitation (measured as amount of rainfall), cloudiness (measured as proportion of fog and mist days), and temperature. Based on previous studies we predict that species in certain taxonomic groups (at the level of plant family and genus) will oppose general patterns of diversity such that some taxa will be more diverse at elevations where others are less so. Finally, I hypothesize that due to the steep environmental gradient there will be nearly complete species turnover between the base and summit of the cloud forest habitats on Maderas. This research will describe the pattern and will be the baseline for future research describing the mechanisms causing the observed patterns.

The project will include the following methodological phases 1) morphological identification of plant species within cloud forest study plots on Volcán Maderas, Nicaragua, and 2) diversity analyses. Study plots will be randomly selected along an elevation transect at least on the west slope of Maderas. At minimum, 3 study plots of 10 x 10m will be chosen at each of the three major cloud forest vegetation communities along the elevation gradient: 1) humid cloud forest (500-800 m), 2) wet cloud forest (800-1,100 m), and 3) dwarf forest (1,100-1,400 m) (for a minimum of 9 plots total). In each study plot a census will be taken on all plant species, and individual abundance of species within the plots will be counted. Specimens will be collected for each species encountered to maintain a permanent and verifiable record of species identification. Species will also be collected more than once for morphological quality assurance and to obtain genetic information to help identify cryptic species. At least two specimens from each plant species will be collected: one as a voucher for the Arkansas State University Herbarium (STAR), and one as a voucher for the collaborating herbarium in Nicaragua (HULE). The voucher is critical for accurate identification and future reference for location information.

**b. Benefit to A-State and contribution to the field**

In preparation for international research, I have created a new course called Community Ecology and Phylogenetics that fills a hole in the Department of Biological Sciences curriculum. This upper-level undergraduate and graduate level course is the only one on campus that explores patterns and mechanisms of ecological community diversity and species coexistence. My international research experience will provide the experience and foundational data for an externally funded research program on tropical plant diversity and ecology. I am greatly wanting to expand this aspect of research in my laboratory due to my interest in tropical species diversity and the threats associated anthropogenic development and other impacts in biodiversity hotspots. This research will expand the global reach of A-State. My classroom teaching will be enhanced by the experiences in Nicaragua, and I will be able to provide a more global perspective to students in my classes and laboratory through my teaching and through research experiences.

This research will result in a comprehensive list of plant species along an altitudinal gradient within the cloud forest on Volcán Maderas. Because data will be collected within specified study plots, important ecological indices such as species richness, evenness, density and diversity will be calculated. Additionally, the research may result in the discovery of previously uncollected or cryptic species that will require further investigation for new species descriptions. At least two peer-reviewed publications will result from this sabbatical including a species list of plants in cloud forest habitats of Volcán Maderas and the resulting ecological community analyses explaining patterns of biodiversity along the elevation gradient. The project also may result in new species descriptions due to the high biodiversity and low exploration of the research area. Significant contributions include the characterization of an underexplored elevation-dependent community that is globally under threat of land use conversion, climate change, and species invasions. The applications to conservation biology will be meaningful for this globally imperiled cloud forest ecosystem. With respect to understanding how biodiversity is distributed across the landscape and making conservation priorities for natural systems threatened by environmental change, increased knowledge of biodiversity patterns on small spatial scales is critical.

**c. Budget justification**

The grant allows for a maximum of \$1,000 to be awarded. I am requesting the full amount to cover the cost of flights from Jonesboro, Arkansas, to Managua, Nicaragua (and within Nicaragua to the field site) and other in-country travel for a preliminary visit from January 6-13, 2016. This trip will include making an initial site visit to the research location, continuing to build a relationship via a face-to-face meeting with my in-country collaborator, and securing research and collection permits through the Nicaraguan Ministry of the Environment and Natural Resources. My expectation is that complete cost of the travel will near \$2,000, and funds not covered by the Lane award will be covered by the STAR Herbarium Research Fund, a biology foundation account.

**d. Plan to disseminate or showcase benefits and contributions**

I will share results with the A-State community through my personal website ([www.travismarsico.com](http://www.travismarsico.com)) and the university herbarium website ([herbarium.astate.edu](http://herbarium.astate.edu)). Upon my return, I will present an overview of the preliminary trip through our Department Biology Seminar Series, and at a later event I will present again in the Biology Seminar the outcome of my sabbatical research results.

**Travis D. Marsico**

Associate Professor of Botany, Associate Chair, and Curator, Arkansas State University  
Herbarium (STAR)

Department of Biological Sciences, Arkansas State University, AR 72467

**(a) Professional Preparation:**

Arkansas Tech University	Biological Sciences	B.S., 2001
University of Arkansas	Biological Sciences	M.S., 2004
University of Notre Dame	Biological Sciences	Ph.D., 2009
Mississippi State University	Plant-Insect Interactions (Postdoc)	2008-2009

**(b) Appointments:**

**Associate Chair**, July 2014 – present

Department of Biological Sciences, Arkansas State University

**Associate Professor**, May 2014 – present

Department of Biological Sciences, Arkansas State University

**Assistant Professor**, January 2010 – April 2014

Department of Biological Sciences, Arkansas State University

**(c) Products:**

*(i) Related Publications* (undergraduate authors underlined)

Nelson, G., P. Sweeney, L. E. Wallace, R. K. Rabeler, D. Allard, H. Brown, J. R. Carter, M. W. Denslow, E. R. Ellwood, C. C. Germain-Autrey, E. Gilbert, E. Gillespie, L. R. Goertzen, B. Legler, D. B. Marchant, **T. D. Marsico**, A. B. Morris, Z. Murrell, M. Nazaire, C. Neefus, S. Oberreiter, D. Paul, B. R. Ruhfel, T. Sasek, J. Shaw, P. S. Soltis, K. Watson, A. Weeks, A. R. Mast. 2015. Digitization workflows for flat sheets and packets of plants, algae, and fungi. *Applications in Plant Sciences* 3(9): 1500065.

Burge, D. R. L., **T. D. Marsico**, and M. B. Edlund. 2015. *Stauroneis kingstonii* sp. nov. (Bacillariophyta: Naviculales), a new diatom species from the Black Swamp, Arkansas, USA. *Phytotaxa* 205: 177-186.

Harris, K. M., M. B. Foard, and **T. D. Marsico**. 2012. Understanding floristic diversity through a database of Greene County specimens. *Journal of the Arkansas Academy of Science* 66: 94-105.

**Marsico, T. D.**, J. W. Burt, E. K. Espeland, G. W. Gilchrist, M. A. Jamieson, L. Lindström, G. K. Roderick, S. Swope, M. Szűcs, and N. D. Tsutsui. 2010. Underutilized resources for studying the evolution of invasive species during their introduction, establishment, and lag phases. *Evolutionary Applications* 3: 203-219.

**Marsico, T. D.** 2005. The vascular flora of Montgomery County, Arkansas. *Sida* 21: 2389-2423.

*(ii) Other Publications*

**Marsico, T. D.**, K. E. Sauby, C. P. Brooks, M. E. Welch, and G. N. Ervin. 2015. Phylogeographic evidence for a Florida panhandle-peninsula discontinuity in the distribution of *Melitara prodenialis* Walker (Lepidoptera: Pyralidae), a native cactus-boring moth. *Insect Conservation and Biodiversity*. Early View: DOI: 10.1111/icad.12115.

- Woodard, A. M., G. N. Ervin, and **T. D. Marsico**. 2012. Host plant defense signaling in response to a coevolved herbivore combats introduced herbivore attack. *Ecology and Evolution* 2: 1056-1064. DOI: 10.1002/ece3.224.
- Marsico, T. D.**, L. E. Wallace, G. N. Ervin, C. P. Brooks, J. E. McClure, and M. E. Welch. 2011. Geographic patterns of genetic diversity from the native range of *Cactoblastis cactorum* (Berg) support the documented history of invasion and multiple introductions for invasive populations. *Biological Invasions* 13: 857-868.
- Pelini, S. L., J. D. K. Dzurisin, K. M. Prior, C. M. Williams, **T. D. Marsico**, B. J. Sinclair, and J. J. Hellmann. 2009. Translocation experiments with butterflies reveal limits to enhancement of poleward populations under climate change. *Proceedings of the National Academy of Sciences of the United States of America* 106: 11160-11165.
- Marsico, T. D.**, J. J. Hellmann, and J. Romero-Severson. 2009. Patterns of seed dispersal and pollen flow in *Quercus garryana* (Fagaceae) following post-glacial climatic changes. *Journal of Biogeography* 36: 929-941.

#### (d) Research Support:

##### Current

*Project/Proposal Title:* Digitization TCN: Collaborative Research: The key to the cabinets: building and sustaining a research database for a global biodiversity hotspot

*Source of Support:* National Science Foundation (Lead PI: Z Murrell)

*Role:* PI (Arkansas)

*Total Award Amount:* \$127,553

*Total Award Period:* 08/15/2014-07/31/2018

*Location of Project:* Arkansas State University

*Time Per Year Committed to the Project:* Academic – 0; Summer – 1 month

*Project/Proposal Title:* Morphological identification of plant propagules entering the United State from abroad via the Port of Savannah

*Source of Support:* USDA Forest Service, Southern Research Station

*Role:* PI

*Total Award Amount:* \$73,204

*Total Award Period:* 06/01/2015-08/31/2017

*Location of Project:* Arkansas State University

*Time Per Year Committed to the Project:* Academic – 1.5; Summer – 0 month

*Project/Proposal Title:* A meta-analysis of biocontrol experiments to elucidate mechanisms of herbivorous insect invasions and effective control options

*Source of Support:* USDA Forest Service, Southern Research Station

*Role:* PI

*Total Award Amount:* \$51,204

*Total Award Period:* 06/01/2014-09/30/2016

*Location of Project:* Arkansas State University

*Time Per Year Committed to the Project:* Academic – 0; Summer – 0.25 month

*Project/Proposal Title:* Predicting the next high-impact insect invasion: elucidating traits and factors determining the risk of introduced herbivorous insects on North American native plants

*Source of Support:* USGS Powell Center

*Role:* co-PI

*Total Award Amount:* \$150,819  
*Total Award Period:* 10/01/2015-09/30/2017  
*Location of Project:* Arkansas State University  
*Time Per Year Committed to the Project:* Academic – 0; Summer – 0.25 month

*Project/Proposal Title:* The Experiential Learning Fellowship (ELF) Program  
*Source of Support:* National Science Foundation  
*Role:* PI  
*Total Award Amount:* \$567,185  
*Total Award Period:* 08/01/2011-07/31/2016  
*Location of Project:* Arkansas State University  
*Time Per Year Committed to the Project:* Academic – 0.25; Summer – 0 month

### **Pending**

*Project/Proposal Title:* CSBR: Natural History: Development of the Arkansas Center for Biodiversity Collections to advance biodiversity research and education  
*Source of Support:* National Science Foundation  
*Role:* co-PI  
*Total Award Amount:* \$478,094  
*Total Award Period:* 05/01/2016-04/30/2019  
*Location of Project:* Arkansas State University  
*Time Per Year Committed to the Project:* Academic – 0; Summer – 1 month in year 3

*Project/Proposal Title:* Collaborative Research: Upper Delta Region Biodiversity Scholarship  
*Source of Support:* National Science Foundation  
*Role:* Lead Project PI (and PI for A-State campus)  
*Total Award Amount:* \$3,180,260  
*Total Award Period:* 06/01/2016-05/31/2021  
*Location of Project:* Arkansas State University and Murray State University, Kentucky  
*Time Per Year Committed to the Project:* Academic – 0; Summer – 1 month

### **(e)Synergistic Activities:**

1. A founding member of the editorial board of *Ecology and Evolution* (2011-present).
2. Mentored 30 undergraduate students in the laboratory, 10 of whom presented their research at campus, state, or regional meetings, and 2 of whom published peer-reviewed contributions. Of the 30 students, 21 are women.
3. Presented or co-authored 17 talks and posters in the last 5 years at state, regional, national, and international meetings focused on natural history collection specimen digitization, student involvement in collections and biodiversity research, and the role of small collections in contributing to biodiversity distribution data.
4. Small Herbarium Digitization Workshop, Botany 2014, Boise, Idaho (31 July 2014), Co-Organized with Gil Nelson, Pam Soltis, Ed Gilbert, Emily Gillespie, Kari Harris, George Johnson, Anna Monfils, and Ashely Morris.
5. Co-developed “Connecting Students to Citizen Science and Curated Collections: Students Contributing to our Understanding of Global Biodiversity” available to students and instructors at [www.collectionseducation.org](http://www.collectionseducation.org).