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A Race Against Time: Deciphering Evolution and Describing New Species of Threatened Tropical Stick Insects (Phasmatodea)

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Michael F. Whiting, Biology

Funding was received in 2016 to support mentored research into the phylogeny and evolution of stick insects. Specific goals include providing students with scientific design experience, field-based research experience, collections-based experience, molecular lab experience, bioinformatics experience, and experience in presentation at national meetings and publication in peer reviewed journals. One particular focus was to describe new stick insect species, but it became clear very quickly that the phylogeny portion of this work was essential before any new species could be described, so we concentrated our efforts on stick insect phylogeny. The following is a brief summary of accomplishments.

Evaluation of Academic Objectives:

The overall academic objective of this research was to reconstruct the evolutionary history of stick insects using a combination of DNA and morphological data. Prior to this funding, we had a phylogeny with three genes for 120 taxa. Due in part to this funding, we have been able to expand this to a data set of seven genes by 250 taxa, giving us the most detailed and comprehensive view of stick insect evolution to date. A preliminary analysis based on this work was published in late 2018, and the “magnum opus” of stick insect phylogeny is scheduled for publication in 2019.

Evaluation of Mentoring Environment:

Over the past two years, I have had an active mentored learning environment with postdocs, graduate students, and undergraduates working together on a variety of projects. My lab works very closely with that of a fellow faculty member (Dr. Seth Bybee) and our students interact on a weekly basis on a wide diversity of insect evolution projects, allowing the students to have a broader mentored learning experience. What I report below are the students who were specifically assigned to the stick insect project, but please note that each of these students were involved in projects beyond that described in the original MEG proposal, and that other students in the Bybee lab were involved with the stick insect project.

Student Participants assigned to Stick Insect Project:

Tyson Dawson (Undergraduate):

He is bioinformatics major and was seeking some experience in data collection. He helped generate the DNA sequence data and is the go-to person for bioinformatic analyses of the evolutionary data. Note that Tyson just received a CURA award to continue his work.

John Goodson (Undergraduate):

Lasted about one semester in the lab and then learned his interest were in another field. He is no longer with me.
Jackson Linde (Undergraduate):

Began with me during Fall semester, 2018. He is learning the molecular tools and has experience in insect collection. He is very excited to be part of the stick insect project and I anticipate having him in the lab for the next few years. Note that Jackson just received a CURA award to continue his work.

Ellie McGregor (Undergraduate):

Generated extensive DNA data, learned bioinformatics tools, currently on a mission in Orlando, Florida, but is scheduled to continue with me when she returns.

Joseph Mugleston (Graduate Student):

Joey was completing the work resulting from his dissertation with me during the time of this MEG funding, and played a critical role in the field work and in the training of the undergrads who participated on this project. He is author on three publications.

Michael Naegle (Undergraduate):

Fieldwork in Ghana, coauthor on three publications, currently in medical school.

Yelena Pancheco (Undergraduate and grad student):

Fieldwork in Ghana and Vietnam (twice), extensive museum experience, completed a Masters degree with me on stick insect evolution (two publications in prep), and is currently a Ph.D. student at the University of Georgia.

Kimberly Paulsen (Undergraduate):

Generated extensive DNA data, learned bioinformatics tools, currently applying to Ph.D. programs in molecular biology.

James Robertson:

Postdoctoral Fellow, now has a job at USDA, National Identification Services. Coauthor on three publications.

Presentations from this Work:

The Whiting lab made 9 presentations at National and International Scientifics meetings that focused on the evolution of stick insects and other insect groups. Undergraduates were coauthors on 5 of these presentations and graduate students on 6 of these presentations.

Publications from this Work:


**Use of Budget:**

The budget was used primarily to cover undergraduate student wages (no grad students or postdocs were supported with the MEG money), molecular expenses associated with DNA sequence generation, and for field work in exotic localities (Ghana and Vietnam).

**Summary:**

I feel very proud of my undergraduates and what they have accomplished over the past two years of mentored research. From an academic standpoint, we made major strides in understanding the evolution of these remarkable insects, and our publication lay the foundation for insect phylogenetics for many years to come. From a more personal side, I was pleased to see how each student became involved with the research, and how for some students it opened the doors for graduate work in evolution and for others, it helped them get into medical school. It has been a productive past two years.

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