

NPSNM Interim Report (December 31, 2015)

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Pollination biology and systematics of native *Phyllanthus* (Phyllanthaceae; including *Reverchonia*) in New Mexico

The goal of this study is to (A) determine what insects pollinate the three species of *Phyllanthus* native to New Mexico: *P. polygonoides* (smartweed leafhopper), *P. abnormis* (Drummond's leafhopper), and *P. warnockii* (syn. *Reverchonia arenaria*; sand reverchonia), (B) determine their phylogenetic relationships to other species of *Phyllanthus* in North America and elsewhere in the world, and (C) examine these *Phyllanthus* for pollinating or non-pollinating leafhopper moths (*Epicephala* spp.), with the aim to determine how many species of moths they represent, and how they are related to other leafhopper moth species.

I received \$1000 from NPSNM to conduct this research in 2015. During mid-2015, I moved from a postdoctoral position at the University of California, Berkeley to a new postdoctoral position at the University of Arizona, where I began a new research project incorporating the project for which I had received NPSNM funding. This new project aimed to understand coevolution (including systematics and pollination biology) between *Phyllanthus* plants and *Epicephala* moths in the United States, and provided some additional funds. Consequently, I combined funds from NPSNM and my postdoctoral fellowship at the University of Arizona to conduct a field season from September 26 through October 7 in New Mexico and adjacent parts of west Texas (departing from and returning to Tucson, Arizona).

Because I had received supplementary funding for this research from my postdoctoral fellowship, and because of a two-month delay in moving from California to Arizona for professional reasons, I focused on the following goals for this trip. (I plan to make additional field trips in 2016—below.)

- 1) Identify populations of *Phyllanthus* for more in-depth pollination studies (since not all populations are easily accessible)
- 2) Search all these populations for *Epicephala* moths, since this is the most distinctive pollination syndrome in *Phyllanthus*, and easily verified through rearing of larvae from fruit
- 3) Collect plant samples in silica gel for molecular phylogenetic analysis

With regards to goal (1), the following sites were visited with one assistant (relevant permits were obtained in advance in all cases from federal and state agencies):

- 1) Dog Canyon, Oliver Lee Memorial State Park and Lincoln National Forest, Otero County (*P. polygonoides*)
- 2) White Sands National Monument, Otero Co. (no *Phyllanthus* found)
- 3) Mescalero Sands OHV Area, Chaves Co. (*P. abnormis*, *P. warnockii* syn. *Reverchonia arenaria*)
- 4) Unnamed site along county Hwy 126 (Maljamar Rd.) in Lea Co. (*P. warnockii*)
- 5) Carlsbad, Eddy Co. (*P. polygonoides*)

- 6) Carlsbad Caverns National Park, Eddy Co., multiple sites (*P. polygonoides*)
- 7) Guadalupe Mountains National Park, Culberson Co. (TX), multiple sites (*P. polygonoides*)
- 8) We inquired about visiting at the Jornada Experimental Range (Doña Ana Co., where *P. warnockii* is present), but were told that herbaceous plants were largely dried up by this point in the year.

Not all *Phyllanthus* populations in these areas were equally large or accessible for pollination observations, but this allowed us to determine that Mescalero Sands is the easiest location for more in-depth observations of *P. warnockii* and *P. abnormis*, and Carlsbad Caverns National Park is the best location for such work with *P. polygonoides*. (Brief pollinator observations were conducted on *P. warnockii* at Mescalero Sands, but no flower visitors were observed. These plants have unusual, wine-red, reduced flowers and may be visited infrequently by specialized pollinators.)

With regards to goal (2), we collected fruit in large quantities from all these sites and reared them for *Epicephala* moths. Most *Epicephala* known worldwide are pollinators as adults of *Phyllanthus* flowers, but feed on *Phyllanthus* seeds as larvae (analogous to yucca moths which pollinate yucca plants). However, some are non-pollinating parasites which feed on *Phyllanthus* seeds as larvae but do not pollinate the plants as adults (analogous to “cheater” yucca moths such as *Tegeticula corruptrix*, which is associated with yuccas such as *Yucca baccata* and *Y. elata*). The only *Epicephala* I obtained were from *P. polygonoides* at one site (McKittrick Canyon, Guadalupe Mountains National Park). This suggests two things: first, this *Epicephala* is likely not an obligate or the only pollinator (because it is not found at all sites where its host plant is) and second, that this moth is likely associated with *P. polygonoides* elsewhere in the Guadalupe Mountains region (although we did not find evidence of it at the six other sites where we searched in both the New Mexico and Texas portions of the mountain range). Further field observations in 2016 will determine whether this moth is a pollinator of *P. polygonoides* and whether it is found elsewhere in the Guadalupe Mountains.

Finally with regards to goal (3), I collected leaf samples in silica gel and herbarium vouchers for molecular phylogenetic analysis of these three *Phyllanthus* species in a worldwide context in 2016.

I sought approval from NPSNM to take a one-year extension on the remaining funds and this request was approved. Consequently, I used funds from this NPSNM grant to cover the following:

Gas (for rental vehicle): \$111.62

Lodging (in New Mexico): \$422.01

Total used: \$533.63

Remaining funds (to be used in 2016): \$466.37

In 2016 I plan 1-2 additional trips to New Mexico, using remaining funds from NPSNM and my postdoctoral fellowship, to continue this work. Specifically:

- 1) Conduct pollinator observations of *P. polygonoides*, and additional searching for *Epicephala* moths, in the Guadalupe Mountains region

- 2) Pollinator observations of *P. warnockii* (syn. *Reverchonia arenaria*) and *P. abnormis*, at Mescalero Sands OHV Area
- 3) Visit populations of *P. warnockii* at field stations in central-southern New Mexico for flower visitor observations: Sevilleta National Wildlife Refuge, Bosque del Apache National Wildlife Refuge, and the Jornada Experimental Range

I will also conclude molecular phylogenetic analysis to determine the relationships of these *Phyllanthus* species and their *Epicephala*, and if time permits, I will may conduct follow-up visits of additional sites in New Mexico where I am informed that *Phyllanthus* populations may be present.

I am happy to share further information or discuss any aspect of this project with any NPSNM members who may be interested.