

**The geographic and ecological basis of species richness: diversification in
western North American *Mertensia* (Boraginaceae)**
Report for the Native Plant Society of New Mexico

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My dissertation research focuses on the evolutionary relationships, biogeographic patterns, and ecological diversification in the genus *Mertensia* (bluebells; Boraginaceae). *Mertensia* consists of approximately 45 species in Asia and North America, with its greatest diversity centered in the Rocky Mountains of the American West. In order to elucidate the evolutionary relationships, and geographic and ecological diversification in *Mertensia*, a better understanding of the taxonomy and systematics of *Mertensia* – which have been historically problematic – is essential. With this in mind, sampling efforts have been directed to resolving species level relationships in *Mertensia*. I have spent the last year examining herbarium specimens and conducting fieldwork throughout the American West to collect material for phylogenetic reconstruction of the genus.

Grant funding awarded by the Native Plant Society of New Mexico in early 2011 has supported (approximately \$400.) a two-week collection trip to various field sites in New Mexico during late July of 2011. Time was spent collecting primarily in the southern part of the Rocky Mountain Range in northern New Mexico, in the Carson and Santa Fe National Forests. I obtained multiple representatives of *M. ciliata*, *M. franciscana*, *M. lanceolata* and its varieties, and *M. viridis* and its varieties to represent their geographic and ecological ranges. I was unable to obtain three New Mexican taxa during my collection trip: the timing of my collection trip was a bit late for the collection of *M. brevistyla*; for *M. alpina* and *M. bakeri*, I was not able to locate populations.

I have also used the funds from the Native Plant Society of New Mexico grant to cover expenses for lab work. Approximately \$600. was used to cover the costs associated with chemistry (e.g. primers, *Taq*, dNTP, Big Dye Terminator) and sequencing. DNA from collected New Mexico material was extracted and of this material has been sequenced for ten chloroplast markers (*matK*, *ndhF*, *trnL-trnF*, *psbJ-petA*, *rpl32-trnL*, *ndhF-rpl32*, *trnK-rps16*, *trnQ-rps16*, *ycf6-psbM*, *ndhJ-trnF*). I am currently in the final stages of sequencing remaining accessions.

I have conducted preliminary analyses using maximum likelihood, which includes several Asian taxa and most of the North American representatives, including the material collected from New Mexico. Although not complete, preliminary analyses suggest that several taxa are not monophyletic, such as *M. ciliata*, *M. lanceolata*, and *M. viridis*. One pattern that appears to be emerging from my preliminary phylogenetic reconstructions (particularly with the non-monophyletic *M. lanceolata* and *M. viridis* accessions) is a “Northern Rocky Mountain Clade” consisting of primarily Colorado, Wyoming, Montana, and Idaho taxa, and a “South Western/Great Basin Clade” consisting of primarily of New Mexico, Arizona, Utah, and Nevada taxa. While this is still a preliminary result, it potentially suggests two things: (1) the possibility that the north-south orientation of Rocky Mountain Range as well as a northwest-southeast migration through or around the Great Basin may have been important in the geographic diversification of western North American *Mertensia*; and (2) the possibility of cryptic taxa in New Mexico. For example, with the non-monophyletic *M. lanceolata* and *M. viridis*, I have examined both herbarium specimens and material obtained during my collection trip and have

noted some definitive morphological differences between the “Northern Rocky Mountain Clade” and the South Western/Great Basin Clade” of *M. lanceolata* and *M. viridis* accessions. This inference is still quite preliminary and further analyses will help to clarify and resolve these patterns.

Future Directions

With the completion of sequencing, final phylogenetic analyses will be conducted using maximum parsimony, maximum likelihood, and Bayesian methods to obtain a phylogenetic hypothesis that can be used in biogeographic and ecological analyses to infer the geographic and ecological diversification of *Mertensia*. In conjunction with phylogenetic reconstruction, I am also working on the taxonomy of the genus. Given the taxonomic confusion in *Mertensia*, the presence of cryptic taxa and undescribed diversity is quite plausible. This may be particularly important for the Native Plant Society of New Mexico in addressing conservation concerns; however, further research is needed to clarify these relationships. Such information will be provided to the Native Plant Society as this research continues to develop.