CCSD Center for Conservation and Sustainable Development
Missouri Botanical Garden

RARE PLANT CONSERVATION

2014

2014 : A YEAR IN REVIEW

CONTENT OVERVIEW:

The ruggedly scenic Ouachita Mountains of Arkansas and Oklahoma host many endemic plant taxa, including Ouachita mountain goldenrod (*Solidago ouachitensis*).

The Center for Conservation and Sustainable Development (CCSD) at the Missouri Botanical Garden (MBG) works to conserve global biodiversity. Within the US, we take an integrated approach to rare plant conservation, combining both ex-situ (seed-banking, germination experiments) and in-situ (monitoring, habitat restoration) methods. The arrival of the new year presents an opportune time to share the highlights of our work from 2014. This past year was marked by both a continuation of established projects and the development of new research projects and collaborations. 2014 was very productive for seed-banking, including species not previously secured in any seed bank. We also have new developments from our germination research, demographic monitoring, and reintroduction of Pyne's Ground Plum (*Astragalus bibullatus*). It's been a successful year for sharing the results of our work via conferences, publications, and public outreach. Thank you to all of our many partners, without whom none of this would be possible. We hope that this annual newsletter will provide an informative synopsis of US plant conservation work at MBG for a broad audience and facilitate collaborations with new partners in this important conservation effort.

HIGHLIGHTS

- Eleven rare plants of the SE US secured in MBG seed-bank
- Organized symposium at the Natural Areas Conference on the *Restoration of Southeastern grasslands*
- New staff–members: Restoration Ecologists Leighton Reid and James Aronson

SEED-BANKING IMPERILED PLANTS OF THE SOUTHEAST

The Center for Plant Conservation (CPC) is a consortium of botanical institutions working to safeguard imperiled species from extinction. As a member of CPC, we seed-bank over 40 rare taxa in the Southeastern US. This past year we collected seed of 11 species in 6 states: Here are some of the highlights:

Leavenworthia exigua var. *laciniata*

***Leavenworthia exigua* var. *laciniata* (Kentucky glade cress)**

- USFWS listed as federally threatened in May of 2014
- Endemic to two counties in Kentucky
- Threatened by rapid development in the Louisville Metro Area
- MBG collected seed from 11 populations in a collaborative effort with the Kentucky State Nature Preserves Commission.

Seed-bank volunteers donated over 130 hours to cleaning and processing seed in 2014. Thank you!

2014 SEED-BANKING SUMMARY

Species	States
Ageratina luciae-brauniae	TN
Astragalus tennesseensis	TN
Dalea cahaba	AL
Dalea gattingerii	TN
Leavenworthia exigua var. laciniata	KY
Marshallia mohrii	AL
Minuartia cumberlandensis	TN
Onosmodium decipiens	AL
Solidago ouachitensis	AR, OK
Solidago shortii	IN, KY
Trifolium calcaricum	TN

A "Botanical Lost World" : the Ketona Glades of Alabama

- Unknown to botanists prior to 1992, the Ketona glades host eight endemic taxa and previously unknown populations of other rare southeastern species
- In coordination with colleagues from Birmingham Botanical Gardens and the Alabama Plant Conservation Alliance, MBG visited in late-July and seed-banked three species:

  Marshallia mohrii — Federally threatened.

  Onosmodium decipiens — Ketona endemic; < 20 populations

  Dalea cahaba — Ketona endemic; < 20 populations
- We believe this to be ***the first effort to seed-bank the flora of the Ketona glades***, and hope to facilitate more comprehensive efforts to conserve this unique flora.

Spigelia alabamensis, **one of the species endemic to Alabama's Ketona glades, was flowering during our visit in late-July.**

A good year for goldenrod : Seed-banking *Solidago shortii* and *S. ouachitensis*

Short's goldernord (*Solidago shortii*)

- Federally endangered species known only from a 5km long series of populations in the vicinity of Blue Licks, Kentucky and an outlier population in southern Indiana
- Comprehensively seed-banked the Kentucky populations, some of which occur in association with a historical buffalo trace.
- Indiana population seed-banked with help from IN Department of Natural Resources

Ouachita Mountain goldenrod (*Solidago ouachitensis*)

- Rare species known from the Southern Ouachita Mountains of AR and OK, with outlier populations at Mt. Magazine and Mt. Nebo in the Arkansas Valley
- Check out the blog from our November collection trip to the Ouachita Mountains.
- Our observations suggest that prescribed fire is beneficial for the species.

Solidago ouachitensis **with mature seed. A charred log in the background provides evidence of recent fire.**

SEED SCIENCE - GERMINATION ECOLOGY

Seed of *Parnassia grandifolia* (grass of Parnassus)

Beyond seed-banking, we research the germination requirements of rare species

- Our study of the germination niche of *Parnassia grandifolia*, a wetland specialist of the Southeastern US, was published in *Seed Science Research* (2014) 24, 239–245.
- We developed germination and propagation protocols for *Physaria globosa* (Short's bladderpod), a winter-annual mustard that was recently listed as federally endangered.
- We completed a series of experiments to optimize methods for breaking dormancy in the endangered *Astragalus bibullatus*. Our methods produce "*primed seeds*" that can be dried and stored at room temperature, ready to germinate once reintroduced into their natural habitat.
- We are currently conducting experiments to better understand ecological cues for dormancy break and germination in *Solidago ouachitensis* and *Marshallia mohrii*.

RESTORATION ECOLOGY

Restoring glade habitat and reintroducing rare species

- MBG collaborated with the Tennessee Department of Environment and Conservation (TDEC) and the USFWS to thin cedar encroachment and restore critical glade habitat. It is now apparent that *Astragalus bibullatus* and other glade species of the TN central basin have responded very positively to this restoration effort.
- Our experimental reintroduction of *A. bibullatus* into protected glade habitats examines the influence of light availability on survival, growth, and reproduction, which helps identify ecological reference conditions for glade restoration.

MBG welcomed the addition of two Restoration Ecologists to our staff in 2014.

- Dr. Leighton Reid works with tropical forest restoration and is looking to develop additional research programs focused on restoration of temperate communities in the Ozark region.
- For over 25 years, Dr. James Aronson has been a passionate advocate for the global need for ecological restoration, authoring numerous publications and contributing to many seminal books on the subject.

Prior to restoration, this population of *Echinacea simulata* had few flowering individuals due to cedar encroachment

RARE PLANT POPULATIONS

Astragalus bibullatus (Pyne's Ground Plum)

Demographic monitoring and ecological experiments to facilitate recovery of Pyne's Ground Plum (*Astragalus bibullatus*)

- MBG has been monitoring natural populations of *A. bibullatus* since 2005, recording detailed demographic and environmental information to enhance our understanding of habitat requirements for the species.
- We used experimental populations at Shaw Nature Reserve to isolate the influence of light exposure on growth, using shade cloth to mimic light variation in natural habitats. This project relied upon funding from the NSF Research Experience for Undergraduates (REU) program and the efforts of REU student Rachel Becknell.
- We recently received funding to examine the influence of fire seasonality on regrowth and survival of *A. bibullatus*. Although it is increasingly apparent that the habitat conditions produced by prescribed fire are beneficial, the direct impact of fire exposure on plants is unknown.

CONSERVATION GENETICS

The conservation genetics program at MBG investigates the evolutionary and ecological causes and consequences of rarity in endangered plant species

- *Polygala lewtonii* is a federally endangered Florida endemic that has three kinds of flowers: normal aboveground flowers that are open, allowing for cross-pollination, and above- and belowground closed flowers that are obligately self pollinated.
- Our research suggest that most individuals of *P. lewtonii* are produced by self-pollination, yielding low genetic diversity within, and high diversity among, patches of plants. Conservation efforts should maximize the number of patches protected.
- We are using genetic tools to investigate whether the southwestern federally endangered *Lilaeopsis schaffneriana* subsp. *recurva* may in fact be a subpopulation of the more widespread *L. schaffneriana* subsp. *schaffneriana*, which is broadly distributed in Mexico and Ecuador.

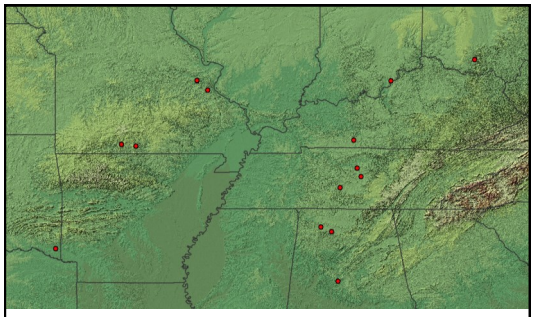
Polygala lewtonii (Schaffner's grasswort)

CLIMATE CHANGE

Examining the impact of climate change on rare species and plant communities

- Monitoring air and soil temperature of glades at 14 sites throughout the Southeastern US in order to better understand the environmental extremes to which glade species are adapted, thus improving models of climate change impacts on these species and plant communities

- Nearing completion of a project to rank climate change vulnerability of 100 rare plants in the North American Central Highlands, a region encompassing the Ouachita and Ozark Plateaus west of the Mississippi and the Interior Low Plateaus and Appalachian Plateaus to the east



Locations of temperature stations being monitored at 14 limestone and dolomite glades throughout the Southeastern US.

PRESENTATIONS AND OUTREACH

The Oak Woodlands and Forest Fire Consortium invited MBG researchers to speak at a field tour and conference on prescribed fire in the Mid-South.

- Matthew Albrecht presented research that identifies ecosystem reference conditions for cedar glades of TN using rare plant population dynamics, historical tree abundance, and other lines of evidence to suggest that this was historically a more open, fire adapted system.

- Quinn Long presented findings from our experimental reintroduction of *Astragalus bibullatus* at one of the reintroduction sites in Stone's River National Battlefield.

Interpreting habitat restoration and rare plant reintroduction for participants in the Mid-South prescribed fire tour and conference

2014 CONFERENCE PRESENTATIONS

- Botanical Society of America
- Center for Plant Conservation National Symposium
- Ecological Restoration Alliance
- Ecological Society of America
- Kentucky Botanical Symposium
- Missouri Botanical Symposium
- Natural Areas Conference
- Prescribed Fire in the Mid-South: Tour and Conference

We organized a symposium on *Restoration of Southeastern Grasslands* for the 41st annual Natural Areas Conference. Thank you to each of the presenters for your efforts to make this such a successful symposium session.

Dwayne Estes: A review of grassland communities of the mid-South US

Jesser Miller: Drivers of diversity and woody encroachment in Ozark dolomite glades

Melissa Caspary: Effects of disturbance in granite rock outcrop communities

Cecil Frost: Pre-European fire regimes for the barrens of Kentucky and Tennessee

Quinn Long: Historical disturbance regimes of glades in the TN Central Basin

Reed Noss: Climate change, lightning fire, stressful soils, megaherbivores, and other non-human factors maintained most southeastern grasslands.

Public outreach to increase awareness and understanding of invasive species

- Each year, we deliver presentations to professional organizations, garden and nature-study clubs, and student groups about invasive species ecology and control.

- In 2014, our invasive species outreach was highlighted by presenting at a well-attended workshop for landscape professionals held at the Shaw Nature Reserve (SNR) and coordinated by SNR, Grow Native, and the Missouri Prairie Foundation.

Bush honeysuckle, one of the region's most invasive species, intermingled with leatherleaf viburnum, which has only more recently begun to escape cultivation. Early detection is key.

PUBLICATIONS

2014 was a productive year for disseminating our research in scientific publications.

- **Albrecht, M. A**. and **Q. G. Long**. 2014. Germination niche of the permanent wetland specialist, *Parnassia grandifolia* DC. *Seed Science Research*. 24: 239-245.
- Brandt, L., He, H., Iverson, L., Thompson, F., Butler, Patricia, Handler, S., Janowiak, M., Swanston, C., **Albrecht, M.,** Blume-Weaver, R., Dijak, B., Deizman, P., DePuy, J., Dinkel, G., Fei, S., Jones-Farrand, T., Leahy, M., Matthews, S., Nelson, P., Oberle, B., Perez, J., Peters, M., Prasad, A., Schneiderman, J.E., Shuey, J., **Smith, A.B.,** Studyvin, C., Tirpak, J., Walk, J., Wang, W., Watts, L., Weigel, D., Westin, S. 2014. *Central Hardwoods ecosystem vulnerability assessment and synthesis: A report from the Central Hardwoods Climate Change Response Framework project.* General Technical Report NRS-124, Newtown Square, PSA, U.S. Department of Agriculture, Forest Service, Northern Research Station.
- **Albrecht, M. A.**, L.A. Broecker, C. Romero-Hernandez, and A. J. Miller. 2014. Conservation genetics of edaphic endemics in naturally isolated habitats: a case study with *Geocarpon minimum* (Caryophyllaceae). *Journal of the Torrey Botanical Society* 141: 1-13.
- **Edwards, C. E.,** D. L. Lindsay, P. Bailey, and R. F. Lance. 2014. Patterns of genetic diversity in the rare *Erigeron lemmoni* and comparison with its more widespread congener, *Erigeron arisolius* (Asteraceae). *Conservation Genetics* 15: 419-428.

The miniscule seed of *Geocarpon minimum*, on top of a penny for scale. A 2014 study by Albrecht et al. found limited gene flow among geographically isolated populations of this federally threatened annual, which is restricted to sandstone outcrops and saline slicks in MO, AR, TX, and LA.

- Kindscher, K. C. Cao, R. Gallagher, H. Zhang, **Q. Long**, L. Service, L. Martin, and B. Timmermann. 2014. Comparison of bioactive secondary metabolites in experimental and natural populations of wild tomatillos, *Physalis longifolia* Nutt. Ethnobotany Research and Applications. 12: 175-182.
- **Long, Q.**, B. Foster, and K. Kindscher. 2014. Seed and microsite limitations mediate stochastic recruitment in a low-diversity prairie restoration. *Plant Ecology*. 215(11): 1287-1298.
- **Reid, JL**, EK Holste, KD Holl, and RA Zahawi. 2014. Does any bat box facilitate forest recovery? - Reply to Kelm. *Biological Conservation*. 170:330-331.
- **Reid, JL**, CD Mendenhall, JA Rosales, RA Zahawi, KD Holl. 2014 Landscape context mediates avian habitat choice in tropical forest restoration. *PLoS One.* 9(3):e90573.
- **Smith, A.B., Albrecht, M.A.**, and Hird, A. 2014. "Chaperoned" managed relocation. *BGjournal* 11:19-22.
- Williams, R.B., L. Du, V. L. Norman, M. G. Goering, M. O'Neil-Johnson, S. Woodbury, **M.A. Albrecht**, D. R. Powell, R. H. Cichewicz, G. R. Eldridge, and C.M Starks. Diterpenes from the endangered goldenrod *Solidago shortii*. *Journal of Natural Products*. 77:1438-44.
- Zahawi, RA, **JL Reid**, and KD Holl. 2014. Hidden costs of passive restoration. *Restoration Ecology.* 22:284-287.

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