

Using historic data to evaluate the effect of climate change on saguaros and associated vegetation



The invasive grass buffelgrass growing among saguaros in Saguaro National Park, Tucson Mountain District.

Final Report for the Desert Southwest Cooperative Ecosystem Studies Unit

Park

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In 2009, Saguaro National Park was declared one of America's twenty-five national parks most imperiled by climate change (Saunders et al. 2009). In the effort to understand how the changes have and will affect its resources, Saguaro National Park benefits from having several long-term repeat vegetation studies. While these historic studies are useful for examining long-term vegetation change in the park, they were not designed to isolate the influence of climate change.

The goal of this project was to support long-term vegetation monitoring projects being conducted by the park in 2010 and 2011, and to augment projects where possible to provide insight into the role of climate on these changes.

The initial CESU proposal was written to provide seven deliverables:

1. Compile and archive Saguaro Census data from the 1990, 2000 and 2010 surveys into statistical and spatial databases.
2. Create a series of maps highlighting change in vegetation for each of the 45 Saguaro Census subplots using data from the 1990, 2000 and 2010 surveys.
3. Summarize and organize data from the repeated 1965 and 1976 studies so the results of the three studies can be combined in a valid and meaningful way.
4. Analyze shifts in plant and animal populations and examine the extent to which these shifts are due to changing climate conditions.
5. Create a report and interpretive materials for communicating results to park staff and the public, including materials for the Learning Center of the American Southwest website.
6. Create a manuscript suitable for publication in a peer-reviewed scientific journal.
7. Provide information and monitoring recommendations useful for adaptive management strategies for managing exotic plants and fire in Saguaro National Park.

Unanticipated funding from the National Park Service's George Melendez Wright Climate Change Fellowship Program was secured for funding some of these activities. An amendment to the scope of work was filed to use CESU funds to provide support for the original seven action items, but primarily be used for five additional deliverables:

1. Assemble all available climate data for the two districts of the park.
2. Standardize the protocol for collecting perennial grass data for long-term vegetation plots.
3. Conduct an analysis of the saguaro population at high elevation.
4. Create a saguaro distribution map.
5. Create a manuscript for publication in Park Science.

Each of the proposed activities were accomplished. Appendices to this final report reference each of the written products produced with CESU and other funding support. This project supported the creation of five reports and manuscripts as well as three presentations at symposia and conferences. These documents and presentations are listed below.

- O'Brien, K., D.E. Swann, and A.C. Springer. 2011. The 2010 Saguaro Census. Unpublished report to Saguaro National Park.
- Springer, A.C., C. Hannum, and D.E. Swann. 2011. Two decades of vegetation change in Saguaro National Park, 1990 to 2010. Unpublished report to Saguaro National Park.

- Springer, A.C., C. Pruden, and D.E. Swann. 2011. A study of the saguaro cactus in a sky island ecotone. Unpublished report to Saguaro National Park.
- Springer, A.C., K. O'Brien, D.E. Swann, A. Hubbard, and R. MacEwen. 2011. Climate change, saguaros, and perennial vegetation at Saguaro National Park. The George Wright Society Conference on Parks, Protected Areas, & Cultural Sites. March 15-18, 2011. New Orleans, LA.
- Springer, A.C., D.E. Swann, A. Hubbard, and B. Hontz. 2011. Livestock grazing and its impacts on vegetation communities at Saguaro National Park. Unpublished report to Saguaro National Park.
- Springer, A.C. and D.E. Swann. 2012. A predictive model for saguaro habitat at Saguaro National Park. Madrean Conference. May 1-5, 2012. Tucson, AZ.
- Springer, A.C., D.E. Swann, and C. Pruden. Climate change and the fate of the saguaro cactus. In preparation for submission to Global Change Biology.
- Springer, A.C., D.E. Swann, and R.M. Turner. 2012. The herbivore exclosure plots at Saguaro National Park: A 40-year study. Unpublished report to Saguaro National Park.
- Swann, D.E., K. O'Brien, A.C. Springer, and R. MacEwen. 2010. Long-term monitoring of the saguaro cactus at Saguaro National Park. Phenology Research and Observations of Southwest Ecosystems Symposium. Tucson, AZ.
- Swann, D.E., A.C. Springer, and K. O'Brien. 2011. Using historic data and citizen science to study climate change at Saguaro National Park. *Park Science* 28(1): 65-68.

Literature Cited

- Saunders, S., T. Easley, S. Farver, J.A. Logan, and T. Spencer. 2009. National parks in peril: the threats of climate disruption. A report by The Rocky Mountain Climate Organization and Natural Resources Defense Council.

- Appendix A. Resource Brief for the public
- Appendix B. Saguaro Census report
- Appendix C. Vegetation subplot report
- Appendix D. Ecotone report
- Appendix E. Livestock grazing report
- Appendix F. Exclosure plot report
- Appendix G. Park Science manuscript
- Appendix H. Global Change Biology manuscript
- Appendix I. Poster for PROSE Symposium
- Appendix J. Poster for Saguaro National Park Visitor's Center

