emailed 8/28

#1

New research proposal to Western National Parks Association (WNPA)

The information supplied should be limited to the space provided and submitted on these forms.
A proposal received in any other format will be returned. Additional attachments are not permitted.

Title of project: Three decades of ecological change: the 2020 Saguaro Census	Park(s) in which research is to be conducted: Saguaro National Park
Name, address, and phone number of principal investigator, (PI)(s): Don Swann, Saguaro National Park, 3693 South Old Spanish Trail, Tucson, AZ. #520-733-5177 Adam Springer, Saguaro National Park 3693 South Old Spanish Trail, Tucson, AZ. #520-733-5171	Payee information - individual name and address or Institution's name and address required: Payment to Saguaro National Park, 3693 South Old Spanish Trail, Tucson, AZ.
Is this a multiyear project? No Total amount requested: This year $ 7460.00 If multiyear project, estimated amount: 2nd year $ _____ 3rd year $ _____	Desired start date: 11/1/19 Note: Not prior to October 1st
Project duration: Project final completion date: 1/1/20 (see research guidelines)	
Name(s) of research participant(s) who will acquire advanced degree(s) as a result of working on this project, if any: None	Product(s) of research (articles, theses, maps, checklists, etc.) in addition to final report to WNPA (see research guidelines): Peer-reviewed journal article

Abstract to be provided by PI(s). Do not exceed the half-page space provided below.

Thanks in large part to support from WNPA, Saguaro National Park has monitored its saguaro population once per decade since 1990. Beyond providing scientific data on the status of the park's signature plant, this effort (called the "Saguaro Census") has been a highly-successful project for many reasons, including that it is a: 1) large-scale citizen science project (more than 300 volunteers in 2010); 2) high-profile public event that connects the Tucson community with the park; 3) scientific study with high credibility and value (results of the 2010 Census were published in the prestigious journal Ecology). The Census was first conducted in 1990 and has two major components. The first is counting and measuring of saguaros on 45 randomly located 200 x 200 meter plots, and the second is mapping of perennial plants associated with saguaros on 10 x 10 meter subplots nested within the larger plots. The objectives of this proposal are to initiate both components, and then focus on completing the mapping of perennial plants on the 10 x 10 meter subplots using a combination of interns and volunteer botanists. We will produce a study design and interpretive plan for the Census, and map perennial plants on all 45 subplots. Our goal is to publish the results of three decades of vegetative change at Saguaro National Park. We expect to find significant change over the past 30 years and will evaluate them in the context of park, regional, and global environmental factors.

(1) JUSTIFICATION (to be provided by submitting park): This section should specify the following: 1) Are NPS-appropriated funds available for the project (Yes/No)? 2) Where does this project rank in the submitting park's research priorities for all funding sources? 3) Was this proposal solicited by the park? If not, why is this project important to the park? 4) How will this research enrich visitors' understanding of the park? 5) What are the implications for resource management?

Saguaro National Park was created in 1933 to protect, interpret, and study the saguaro and other unique Sonoran Desert plants. The health of the saguaro community has always been our park's principal natural resource focus. When the park's famous "Cactus Forest" declined in the 1940s and 1950s, the NPS sponsored research that focused on the causes and gathered basic biological knowledge on the plant. Fortunately, saguaros began to rebound in the 1970s, and results of the Saguaro Census in 2000 and 2010 suggest that the population is generally quite healthy. However, recent studies have noted that establishment of new saguaros has slowed due to a >20-year drought. Although saguaros are very resilient, the lack of establishment could be a problem for this long-lived plant if the drought continues and represents a "new normal" as a result of global climate change.

The park's Saguaro Census occurs on a 10-year cycle, timed to coincide with the US Census, and was previously conducted in 1990, 2000, and 2010. Results of the major component of the Census, where saguaros are measured and counted, were recently published (Winkler et al., 2018) and have been of great interest to the Tucson community and beyond. However, results of a second component, which focuses on the saguaro in relation to the Sonoran Desert community, have never been published. This component of the Census has provided a remarkable data set of perennial plant cover mapped on 45 small plots embedded within the larger Census plots. Based on several smaller studies park biologists believe that vegetation associated with saguaros is also changing significantly due to climate and land use change, which is obviously of great interest to the park.

The two main goals of this project, Saguaro National Park's highest priority for 2019, are to initiate the Citizen Science aspects of the Census and to complete a significant part of the vegetation mapping component. The 2020 Census promises to be a high-profile event that will highlight the many ecological changes at our park over the past 85 years. We will support this project with NPS contributions of staff time and many hours of volunteer time. The park does not currently have support for the 2020 Census, but we are actively seeking additional funding.

(2) CONCISE STATEMENT OF RESEARCH OBJECTIVES, DESIGN, AND METHODOLOGY. This section should include the facilities and sites to be used. Note: Limit this section to the two pages provided.

The objectives of this study are to 1) initiate the 2020 Saguaro Census, including the component that focuses on saguaro counting and measuring; and 2) complete the second component of the Census that focuses on changes in the park's Sonoran Desert plant community during the past two decades. For the first objective we will produce a study design, develop an interpretive plan, and recruit Citizen Science volunteers. For the second objective we will sample vegetation on the 45 10 x 10 m subplots using a team of Next Gen Ranger interns and volunteer botanists.

Objective 1. The Saguaro Census is a major Citizen Science event (Winkler et al., 2018) that takes place every ten years. In 2010, more than 300 volunteers participated and donated more than 3,000 hours (O'Brien et al., 2011; Swann et al., 2011). We created a website for volunteers to learn about and prepare for the project. We posted photographs of the volunteers at work, and the results of each plot on the website within a few days after it was sampled, comparing the results from 2010 with previous surveys. We also conducted numerous pre-visits to schools and created press releases, interpretive programs, and interpretive posters and flyers about the Census.

With support from WNPA, in 2019 we will hire a dedicated intern who will design the interpretive and citizen science component of the 2020 Census. He/she will create a web site and social media group for volunteer learning and support. She will update the field protocol, recruit volunteer groups, and train a dedicated cadre of regular volunteers. She will also work with science advisors and saguaro experts including Ben Wilder, Tom Orum, Nancy Ferguson, Dale Turner, Carianne Campbell, Joshua Conver, Daniel Winkler, and others to create the final study design. We will seek additional funds to conduct the Census during the winter and spring of 2019-2020, which involves re-surveys of all 45 plots. These plots are 200 x 200 m; 20 are in the park's Tucson Mountain District and 25 are in the Rincon Mountain District (Duriscoe and Graban, 1992). We will relocate plots using GPS; flag the sides, then use volunteer teams to systematically locate and flag all saguaros using a triple-count method. We will directly measure all saguaros < 2.5 m and indirectly measure saguaros >2.5 m using a clinometer and measuring tape.

Objective 2. A second major activity of the 2020 Saguaro Census will be to map perennial plants associated with saguaros on 10 x 10 m subplots associated with each plot. The plots were established in 1990 by Duriscoe and Graban (1992), re-sampled in 2000 by Funicelli et al. (2001), and re-sampled in 2010 by Adam Springer and a crew of park interns and volunteers (Springer et al., 2011). With each repeat sample we are able to gain more specific information about how the park's desert plant community is changing over time. For example, concerns are growing over the impacts of climate change on the park's ecosystem. While it is uncertain whether this drought represents a permanent shift to a drier climate, some climatologists warn that the southwestern U.S. may be moving towards the conditions of the Dust Bowl (Seager et al., 2007).

In 2020 we will re-sample the plots for the fourth time with the goal of publishing the results. The specific objective of our study will be to highlight changes in vegetation at Saguaro National Park during the past three decades by individual plant species, families, and lifeforms. We will place these changes in the context of historic management practices (e.g. grazing and wood-cutting) and climate change. As in 2010, we will use a small cadre of volunteer botanists who will work with park interns to do the sampling. We will sample 45 10 x 10 m vegetation subplots located within the 45 Saguaro Census plots. Each subplot was originally centered on a randomly-selected adult saguaro (>2 m in height) within the larger plot. The plots are marked by rebar stakes placed at the 4 corners to increase the accuracy of future surveys (Funicelli et al., 2001).

(2) CONCISE STATEMENT OF RESEARCH OBJECTIVES, DESIGN, AND METHODOLOGY (Cont'd):

As in 2010 we will use a Nikon DTM-330 total station in 2020 to collect map points at the stem of every perennial plant within each plot and measure canopy diameter by collecting two (for circular canopy plants) or more (for irregular plants) points around the perimeter of each plant. To connect vertices and calculate canopy area we will use ArcGIS software. For ferns and perennial grasses (except for invasive buffelgrass (Pennisetum ciliare), which was treated like other perennial plants) we will pool percent cover for each individual species at the plot level.

Springer et al. (2011) found that vegetative communities of the plots are recognizable and measureable across all three surveys despite slight changes in methodology and three different groups of researchers. Following Springer et al. (2011) for three very common subshrubs (brittlebush (Encelia farinosa), desert zinnia (Zinnia acerosa) and hairyseed bahia (Bahia absinthifolia)) we will map only large individuals (>30 cm in diameter) that are well-established and likely to have longer-term survival rates; for smaller individuals we will count the number in each size class and calculate an average diameter using a random sample. We will assess the significance of change observed in forbs, shrubs, subshrubs, succulents, trees and vines by species, family, and lifeform at the plot level using the Wilcoxin Signed-Rank Test, a non-parametric version of the paired t-test with an alpha levels of 0.10 (Funicelli et al., 2001). We will migrate all data to the ArcGIS 10.6 format and archive it at the NPS data center and Saguaro National Park server.

References

Duriscoe, D.M. and S.L. Graban. 1992. Epidermal browning and population dynamics of giant saguaros in long-term monitoring plots. Pages 237 – 258 in C.P. Stone and E.S. Bellantoni, editors. Proceedings of the Symposium on Research in Saguaro National Monument, 23-23 January, 1991. Southwest Parks and Monuments Association, Globe, Arizona.

Funicelli, C.S., P.J. Anning, and D.S. Turner. 2001. Long-term vegetation monitoring at Saguaro National Park: a decade of change. United States Geological Survey. Technical Report No. 70.

O'Brien, K., D.E. Swann, and A.C. Springer. 2011. 2010 Saguaro Census Final Report. Unpublished report, Saguaro National Park, Tucson, Arizona.

Seager, R., M. Ting, I. Held, Y. Kushnir, and others. 2007. Model projections of an imminent transition to a more arid climate in Southwestern North America. Science 316: 1181-1184.

Springer, A., C. Hannum, and D. Swann. 2011. Two Decades of Vegetation Change in Saguaro National Park, 1990-2010. Saguaro National Park, unpublished report. Tucson, AZ.

Springer, A., D. E. Swann, and M. Crimmins. 2015. Climate change impacts on high elevation saguaro range expansion. Journal of Arid Environments 115:57-62.

Swann, D.E., Springer, A.C., O'Brien, K. 2011. Using citizen science to study saguaros and climate change at Saguaro National Park. Park Science 28(1): 69-71.

Winkler, D.E., J.L. Conver, T.E. Huxman, and D.E. Swann. 2018. The interaction of drought and habitat explain space-time patterns of establishment in saguaro (Carnegiea gigantea). Ecology 99:621-631.

(3) CONCISE STATEMENT OF HOW YOUR RESEARCH CAN ENHANCE THE INTERPRETIVE MISSION OF THE PARK. Also include one paragraph describing the plan for an interpretation-related product of the research. Use this page only.

This project will be fully integrated with Saguaro National Park's interpretive mission at all stages. Saguaro National Park has a long history of interpretive and resource management staff sharing training, interns, and results with the public (Swann et al., 2011). As in the past, the Next Gen Ranger intern we hire for this project will have a background in both interpretation and science. He/she will develop interpretive materials in advance of the Saguaro Census that will include: 1) an interpretive brochure describing the project; 2) an interpretive poster for the Visitor Center; 3) a dedicated website for the project; 4) social media content that will be shared through Facebook, Instagram, Twitter, Snapchat, and other platforms. These materials will be used to recruit volunteers and raise public awareness of the project and the saguaro.

During the project, we will conduct at least 10 pre-visits to high schools and college groups who will participate as Citizen Scientists. We will present at least 3 interpretive programs at the Visitor Center, and 5 programs to external groups. We will produce at least 3 press releases and anticipate participating in at least 5 interviews with major media outlets. We will also continue to maintain the website and social media sites to engage volunteers and the public with the project and its results.

We will present our results at least three times at interpretive trainings and two All Employee meetings at the park. We will invite interpretive interns and volunteers to assist in the project. As with other saguaro projects at the park, all data will be made publically available following QA-QC through the NPS Data Store (https://irma.nps.gov/DataStore), and we will distribute a guide for teachers so they can access and use these data in classroom applications. Finally, for the vegetation sampling objective of this project, we will directly engage at least 10 citizen scientist volunteers who will fully participate in field sampling on a regular basis.

(4) QUALIFICATIONS OF THE PI(S) CONDUCTING THE RESEARCH. Use this page only. List only those qualifications directly related to this grant request. Include a list of other WNPA-funded research conducted by this PI.

Don Swann is a biologist at Saguaro National Park. Don has an MS in Wildlife Ecology from University of Arizona and an undergraduate degree in Biology-Geology from Brown University. He is an author or co-author on more than 30 peer-reviewed scientific papers. For both his science and Citizen Science activities in US national parks, Don has been the recipient of the NPS Regional Award for Excellence in Natural Resource Management (2006, 2018), the NPS Director's Award for Excellence (2006), and the WNPA Emil Haury Award (2014). Don has been PI or co-PI on more than 15 WNPA-funded projects, most of which have produced peer-reviewed scientific papers. Some of Don's recent WNPA projects include: 1) The impact of cattle grazing in Saguaro National Park (with Yvette Gibson, 2017); 2) Are springs and tinajas in Saguaro National Park threatened by groundwater withdrawal outside the park? (with Colleen Filippone, 2016); and 2) Climate change impacts on the nurse-protégé relationships and the seasonality of water use of Saguaro cacti, Carnegiea gigantea, and the dominant tree species of Sonoran Desert (with Travis Huxman, 2015).

Adam Springer is also a biologist at Saguaro National Park. Adam has a PhD in Natural Resources from the University of Arizona. He is co-author of the 2010 Saguaro Census results (Springer et al., 2011) and lead author of a major paper on saguaros and climate change (Springer et al., 2015).

Budget for New Research Proposal

Project title and submitting park: Three decades of ecological change: the 2020 Saguaro Census

Sagauro National Park

Personnel

PRINCIPAL INVESTIGATOR(S)	Funds requested from WNPA	Cash or in-kind contribution (Please specify which type and source.)
1 Don Swann (two pay periods, including ERE)		$8,423
2 Adam Springer (one pay period, including ERE)		$3,402
3		

OTHER PERSONNEL (Specify number in brackets. Specify duties to be performed to earn funds on next page.)	Funds requested from WNPA	Cash or in-kind contribution (Please specify which type and source.)
1 Next Gen Ranger Intern (10 weeks @ $646/wk)	$6,460	
2 Volunteers (10 x 40 hrs/each @$24.14/hr)		$9,656
3		
4		
5		
TOTAL PERSONNEL COSTS	$6,460	$21,481

EQUIPMENT COSTS (List item and dollar amounts for those items costing more than $100 each on next page.)

TRAVEL AND SUBSISTENCE (Itemize on next page.)

OTHER COSTS

1 Supplies and material	$1,000	
2 Consulting services		
3 Computer services		
4 Subcontracts (Itemize on next page.)		
TOTAL OTHER COSTS	$1,000	

TOTAL COSTS If multiyear project, summarize estimated subsequent year(s) budget(s) on next page.	$7,460	$21,481

COSTS (Cont'd). Note: Be sure to explain here the duties that will be performed by any funded individual.

Most funds will be spent on hiring a "Next Gen Ranger intern" through Saguaro National Park's cooperative agreement with the Friends of Saguaro National Park. The intern will be paid $16.15/hour. She/he would accomplish the work outlined in the proposal under the supervision of the PIs. She will probably work part-time on the project for 20 weeks, but may work full-time for some weeks.

Volunteer costs were based on Independent Sector (independentsector.org).

Supplies for the project will include clinometers (2 @ $150 ea.), measuring folding rulers (10 @$10 ea.), hand-held GPS units (4 @ $100 ea.), and digital cameras (2 @ $100).

A special note for researchers and the park superintendent:

WNPA is the funder of this grant on behalf of NPS, and WNPA monitors progress, administers the payment schedule, and determines successful completion or default.

All other decisions regarding the conduct of this research grant (e.g., park access, laws, safety, protocols, etc.) and uses of the research, data, and its products (e.g., release of information, publication, intellectual property, etc.) rest in the hands of NPS and are the responsibility of NPS. Researchers and NPS should clarify any questions or assumptions before accepting the grant.

Due to several factors, ALL WNPA grants are for ONE YEAR ONLY (1 year only); however, we welcome and will carefully consider applications for second or third years following a successful first year.

Best wishes and hopes for a successful project. Thank you from WNPA.

I have read and agree to abide by the research guidelines in effect at the time of this application.

Signature of Principal Investigator(s) — Date: 8/25/18

Signature of Park Superintendent — Date: 8/27/18

Signature of Chief of Interpretation — Date: 8/27/18

For WNPA Use Only

WNPA Research Committee Review: Action and Date:

Amount Granted: