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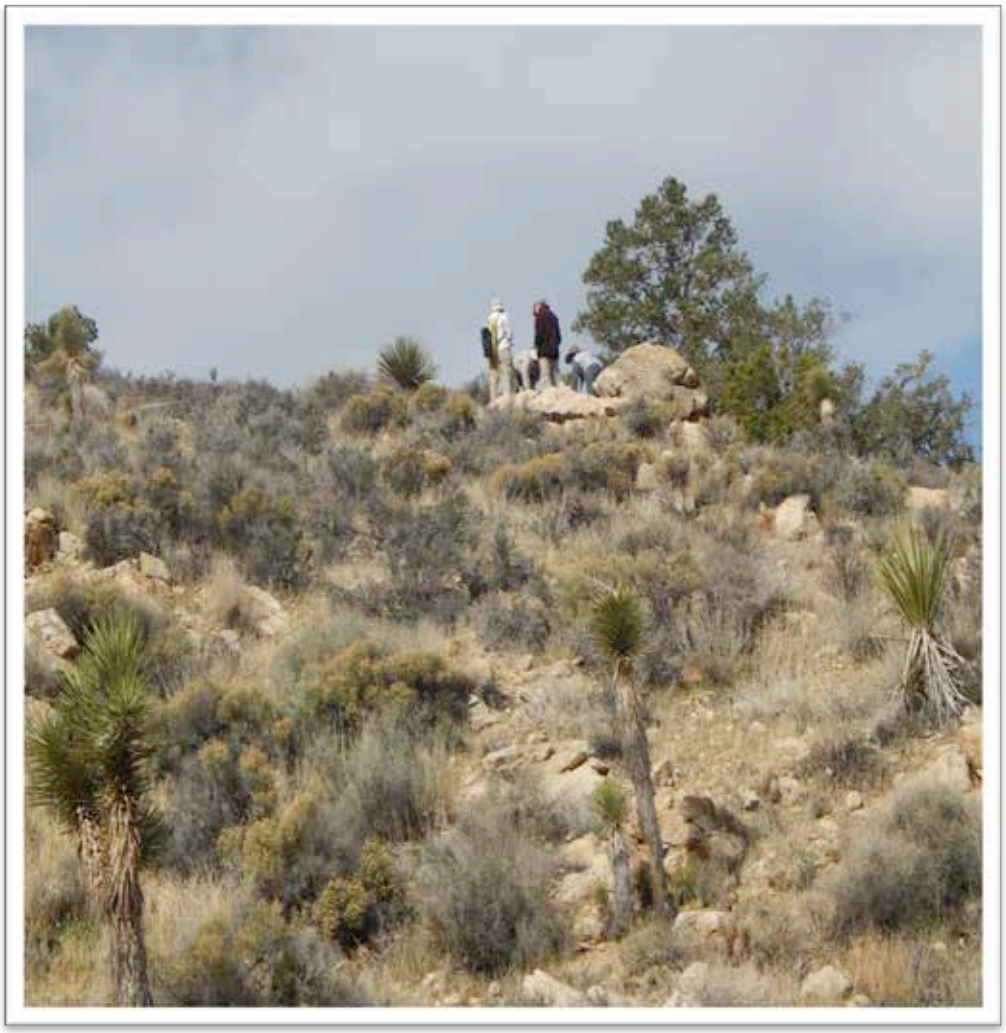

Earthwatch 2018 Annual Field Report

Saving Joshua Tree's Species

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REPORT COMPLETED BY: Cameron Barrows and Lynn Sweet

PERIOD COVERED BY THIS REPORT: 5/1/2017–4/6/2018

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Dear Citizen Scientists,

This was our fourth Earthwatch fielding season, working with you all to discover how plants and animals living in Joshua Tree National Park will cope with modern climate change. Mother Nature continues to give us the ups and downs of what the climate can do, mostly with regard to Rainfall—and of course, in deserts, rainfall means everything. Our first year, 2015, was dry (as was 2012–2014), 2016 was a bit wetter, 2017 had above average rainfall (and amazing flowers), and 2018 went back to being dry, dry, dry. While flowers are great, dry years like this one, give us a clearer view into what a future could bring. Insights we are gaining from directly measuring species' reactions to these shifts are therefore invaluable. This is not hyperbole, we do not know of any other research efforts that are collecting this kind of information, at this scale, and aimed at helping one of our premier national parks succeed at protecting our natural heritage.

As you all well know, we could never do this research without your incredibly generous support. We love working with you first-timers, and we are thrilled to be once again working with our returning Joshua Tree Citizen Science "veterans". Half of our Citizen Scientists in 2018 were returnees—some having joined us all four years. One might say it was the great food and plush accommodations—but probably not (although the 2018 food was a step up from previous years). We know it is because you have become just as invested as we are in this research, sorting out the complexities of nature in transition.

Thank you all so very, very much,

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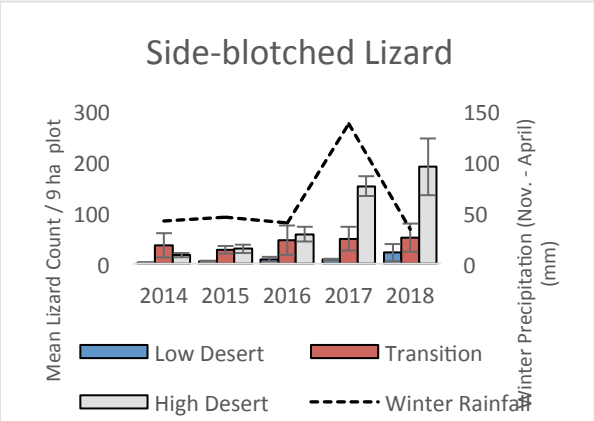
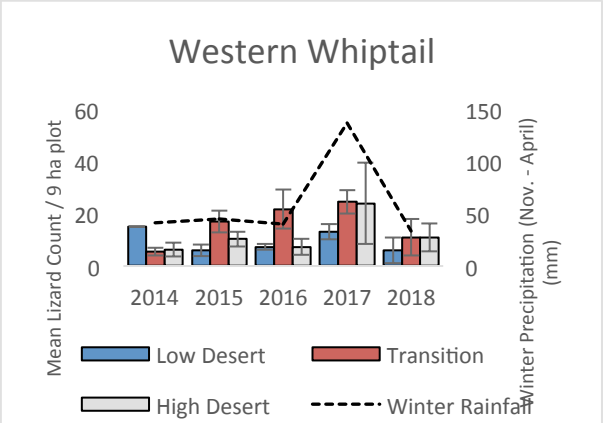
SUMMARY

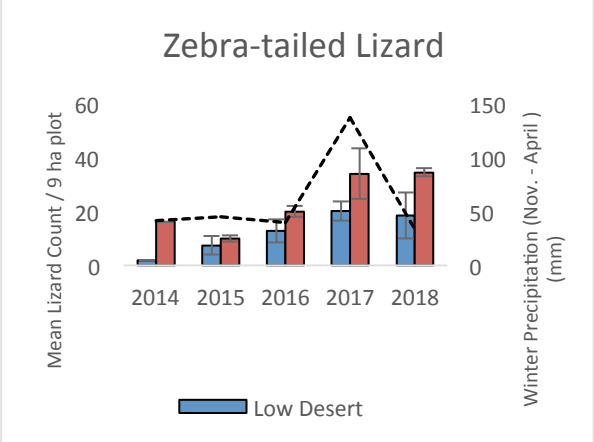
This year (2018) was an abrupt shift back to drought conditions. From a research perspective, that has allowed us to see the latent effects of last years' wet conditions. Did populations once again crash? Alternatively, were there enough resources, (soil moisture, recent plant growth and associated insects) to maintain the relative abundance we measured in 2017? The answers depended on the species; night lizard and whiptail populations crashed while zebra-tails and side blotched lizards were able to sustain high populations, but only at higher elevations. As expected, annual plants stayed dormant; however, we are beginning to see higher mortality levels for perennial shrubs – especially at lower elevations. Full demographic sweeps this year focused on completing counts of Joshua trees, pinon pines and California junipers in our macroplots. For all of these species, we have documented shifts in the distribution of younger, as opposed to older individuals, indicating that the areas suitable for current recruitment in these species in the future may differ from where these plants established previously. All this is beginning to sort out the complex responses of the biodiversity of this desert region to a warmer, and an especially drier, future.

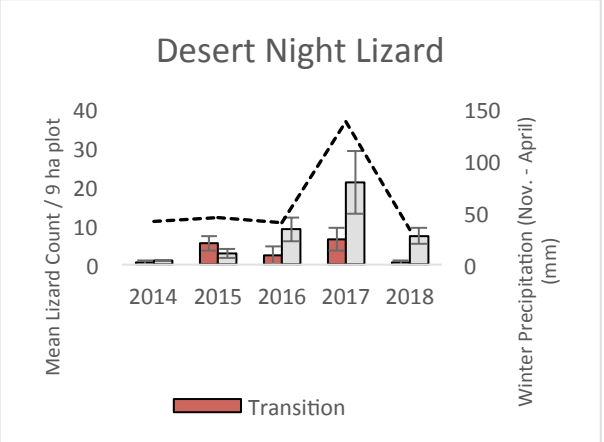
GOALS, OBJECTIVES, AND RESULTS

Our research has three components: vegetation, pitfalls and Sherman trapping, and reptile surveys. In each case, our objective is to document change, and then determine if that change is attributable to climate or any other factor. Through our analyses of those data, we then hope to identify species' resilience or sensitivities to change, and then identify places where those species are most secure. Through those analyses, we have determined that pitfalls and Sherman trapping have not provided added insights equal to the effort required. Therefore, we have no longer included those tasks in our protocol. We do realize that task was a citizen science favorite, since it allowed folks to get up close and personal with many different critters. Here we present results to date.





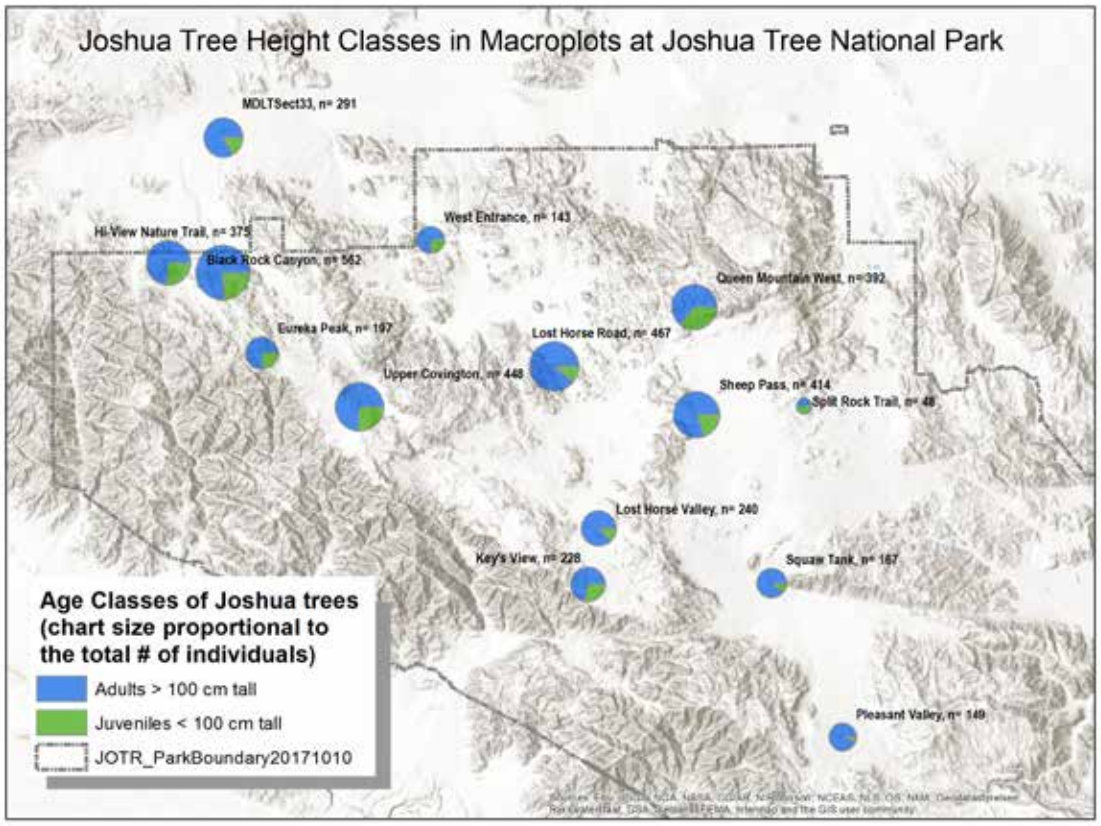




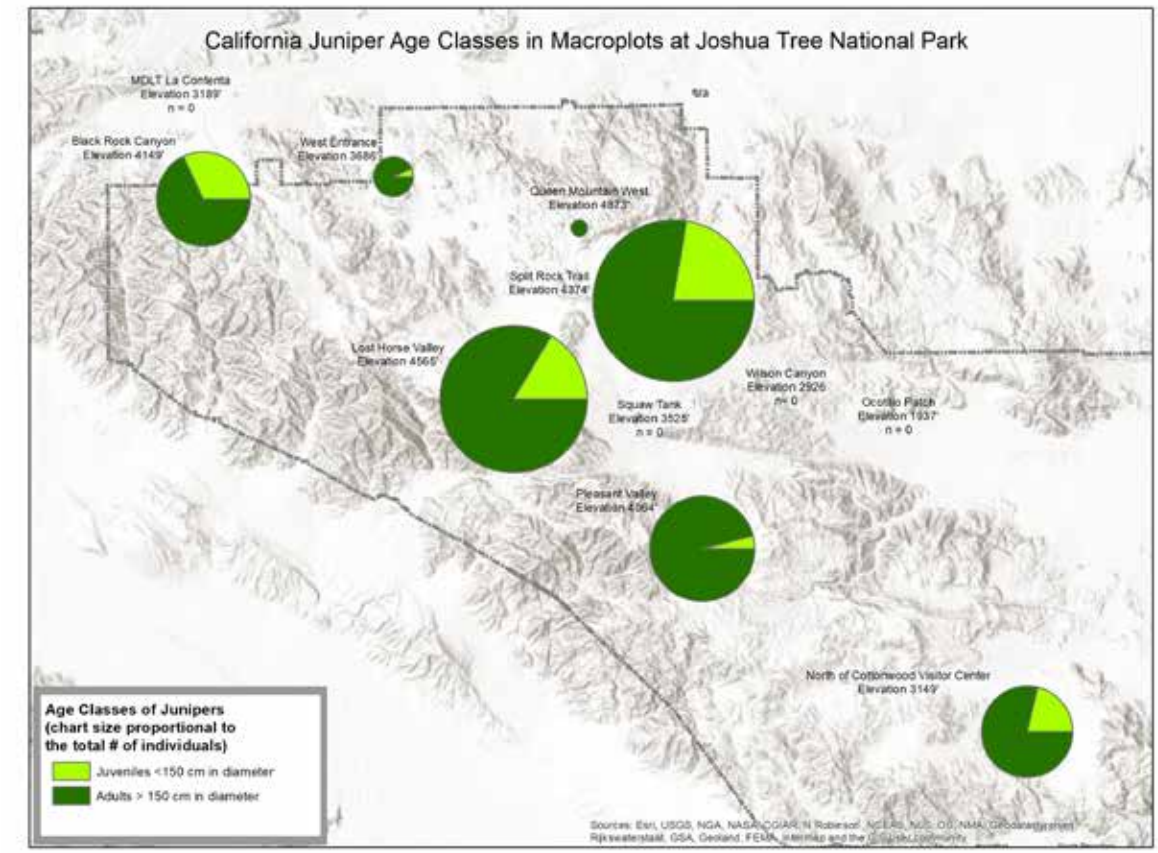
The figure above illustrates the influence of rainfall on the abundance of lizards. The peak abundances for all species were in 2017, corresponding with the higher rainfall that year, however while both side-blotched and zebra-tailed lizards sustained those population levels into 2018 (even increasing for side-blotched lizards at the highest elevations), both western whiptails and desert night lizard populations declined in 2018. We believe that these declines are associated with drying soil—due to both increased temperatures and low rainfall. Both of these lizards' preferred prey are termites, and drier soils will keep termites deeper, tracking what little moisture they can find, but making them unavailable to these lizards for food. For both zebra-tails and side-blotched lizards, termites are not on their menu; rather they eat other insects. Those other insect populations may still be quite high, benefiting from last years' abundant seed production. This points to a new, future direction in our research—tracking these food resources and soil moisture.

Field team fills out their datasheet at a plot in Black Rock Canyon, Joshua Tree National Park. Photo credit: Lynn C. Sweet

This year, we focused on finishing up our line and intercept transects from last year, as well as Joshua tree, ocotillo and ironwood demographic sweeps (total counts and measurements) within macroplots. In addition, we began demographic sweeps for California juniper and pinon pine, two other species of high importance to the community food web. The valuable, but complex transect data will be analyzed soon as part of the community analysis. From the much more simply recorded but rich demographic sweep data, looking at the distribution of Joshua trees on the landscape within our macroplots, there is a trend towards younger individuals, those <60 cm to be found at higher and cooler locations on the landscape. Some of our lower elevation plots show little to no recruitment of new seedlings. We will continue working towards a more complete picture of Joshua tree demography by repeating our measurements at long intervals as well as recording dead individuals.



The California juniper study produced similar results, showing a tendency towards young individuals occupying higher and cooler habitats than previous cohorts. This dataset may be bolstered by gathering data from more of our macroplots in the future.



Project Impacts

1. Increasing Scientific Knowledge

Total citizen science research hours

Provide an estimate for the number of hours per day that volunteers spent collecting data, being trained to collect data in the field, and performing data entry. Include in this estimate transportation from housing site to the field site, and all sorts of activity for which you would typically pay a technician.

The volunteers typically contributed an 8-hour day, with 10 minutes to 2.5 hours spent commuting to field sites, 30-40 minutes prepping gear and unloading, and the rest of the day spent collecting data. In all, they contributed 1,000 hours to our project this year.

Presentations:

All of the following included the PI (Cameron Barrows) as the lead author and speaker and all acknowledged Earthwatch

- The Impact of climate change on the biodiversity of Joshua Tree National Park. **Keynote Speaker**. September 2017. Environmental Leadership Academy, San Marcos State University
- Using GIS-based models to forecast the impacts of climate change on southern California's biodiversity: outcomes, assumptions, and validation pitfalls. November 2017. GIS Day, UC Riverside
- Modeling Climate Change Impacts for Joshua Trees at their Southern Boundary: How Scale impacts Predictions. November 2017. Mojave Desert Ecoregion: Native Plant Materials Development and Restoration Symposium, Barstow, CA.
- Biodiversity and Climate Change: Predicting Species Responses to a Warmer Future. **Keynote Speaker**. November 2011. Eighty sixth Anniversary of the Pacific Coast Obstetrical and Gynecological Society. Palm Desert, CA.
- Managing for Uncertainty: Climate Change and Vulnerable Species. March 2018. California Habitat Conservation Planning Coalition, UC Riverside, Palm Desert, CA

Presentations by team leader Lynn Sweet (all acknowledged Earthwatch).

- Shifting Landscapes: Studying Climate Change in Diverse Plant Communities. **Keynote Speaker.** JASON Learning 2017 National Educators' Conference. June 2017. Auburn, VA
- Climate Change Citizen Science Project. Invited speaker, November 2017. Wildlife Weekend, The Wildlands Conservancy, Whitewater Canyon Preserve.

The field team checks out the geology near a field site at Joshua Tree National Park. Photo credit: Lynn C. Sweet

2. Mentoring

a) Community outreach

Provide details on how you have supported the development of environmental leaders in the community in which you work.

Name of school, organization, or group	Education level	Participants local or non-local	Details on contributions/ activities
Yucca Valley High School	High School	Local	Presented the results to date of this research to each of the biology classes
UC Master Gardener Program	Post-graduate	Local	Presented information about local ecology including description of this study
James Madison University	University	Non-local	Led them in contributing to this study for several days as part of their "Alternative Spring Break" program
California Native Plant Society	General public	Local	Presented information about local ecology including description of this study
UC Riverside Botany Department Class	University	Local	Presented information about this study to the class at the field site
Grauer School (Encinitas, CA)	High School	Non-local	Led them in contributing to this study for a day as part of their environmental education program

3. Partnerships

List your current active professional partnerships that contribute to your project and indicate the type of support these partners provide

Partner	Support Type(s)[1]	Years of Association (e.g. 2006-present)
Joshua Tree National Park	Housing, logistics, staff	2014-2018
Mojave Desert Land Trust	Property access, volunteers, field support	2014-2018
Wildlands Conservancy	Property access, volunteers, field support	2017-2018

[1.] Support type options: funding, data, logistics, permits, technical support, collaboration, academic support, cultural support, other (define)

4. Contributions to management plans or policies

Plan/Policy Name	Type[2]	Level of Impact[3]	New or Existing?	Primary goal of plan/policy[4]	Stage of plan/policy[5]	Description of Contribution
Weed Management	Management Plan	local	New	Species conservation	proposed	Focusing weed management on areas identified as climate refugia through our research

[2.] Type options: agenda, convention, development plan, management plan, policy, or other (define)

[3.] Level of impact options: local, regional, national, international

[4.] Primary goal options: cultural conservation, land conservation, species conservation, natural resource conservation, other

[5.] Stage of plan/policy options: proposed, in progress, adopted, other (define)

5. Conserving natural and sociocultural capital

a) Conservation of taxa

i. List any focal study species that you did not list in your most recent proposal

Species	Common name	IUCN Red List category	Local/regional conservation status	Local/regional conservation status source
Yucca brevifolia	Joshua tree		Proposed threatened	
Gopherus agassizii	Mojave Desert tortoise		US/CA Threatened	

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RESEARCH PLAN UPDATES

Report any changes in your research since your last proposal/annual report. For any 'yes' answers, provide details on the change in the 'Details' box. This section will not be published online.

1) Have you added a new research site or has your research site location changed? ☐**Yes** ☒**No**
2) Has the protected area status of your research site changed? ☐**Yes** ☒**No**
3) Has the conservation status of a species you study changed? ☐**Yes** ☒**No**
4) Have there been any changes in project scientists or field crew? ☒**Yes** ☐**No**

"DETAILS BOX:" Nick Graver replaced Tyler Green as a field team leader from Joshua Tree National Park. Scott Heacox replaced James Heintz as a field team leader from UC Riverside.

A field team leader locates the center of a large, old California Juniper as part of the demographic study. Credit: Lynn C. Sweet

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Volunteer Warren Stortroen measures a Mojave yucca at Black Rock Canyon, Joshua Tree National Park. Photo credit: Lynn C. Sweet

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Field team leader Nick Graver looks on as the field team measures plants at Black Rock Canyon, Joshua Tree National Park.
Photo credit: Lynn C. Sweet

The JASON Learning group learns about the native creosote bush at a Colorado Desert site within Joshua Tree National Park.

Photo credit: Scott Heacox