



Saving Joshua Tree's Species

Dr. Cameron Barrows and Dr. Lynn Sweet

2019 Annual Field Report



LETTER TO VOLUNTEERS

Fall 2019 marked the end of our 5th year of Earthwatch expeditions. Every year is different and this one was no exception. The spring flowers were better than any of us desert rats can remember, and this is the first year that we fielded teams in the fall, an experiment that was successful, though perhaps we will need to tweak the dates to be earlier in November or late October to give us a bit more reptile diversity to work with. We also shifted our base of operations this fall, moving away from the Fire Station dorms to the Lucky Center, a historic residence tucked into the southern edge of the National Park. By all accounts that was a successful change as well, and so we will return there for all our expeditions in 2020. Of course, there some things we can depend on every year. Ray and Helga returned for their 11th (!!!) expedition with us. As Ray always quips, “they will keep coming until they get it right”. And many of our other alumni returned as well, Mary, Micheline, Judy and David all rejoined us for their 2nd, 3rd or 4th time. Another constant was the exceptional new volunteers, new friends, that joined us this year. Your energy and enthusiasm were infectious, keeping us all motivated to do the best we can. We couldn’t do this research without you all. Thank you so very much.

Cheers,

Cameron Barrows

SUMMARY

We hit an important milestone by the end of the last expedition of 2019: we finally completed all vegetation surveys on all our 27 monitoring plots. Going forward, all vegetation surveys will measure whether there have been significant changes since those baseline surveys were conducted. Finishing the “demographic sweeps” for all our focal plants is particularly notable, both because of the work it took to complete them, and for the insights they will provide into how these iconic desert species are handling the prevailing warmer and more arid conditions. Finishing the “sweeps” for Joshua trees allowed us to validate modeled projections for where this species is likely to find cooler refuges within the park. These “Empirical Data” data were a critical addition to our publication that came out this year:

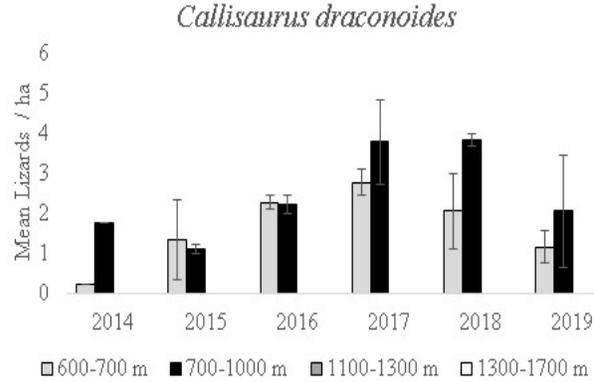
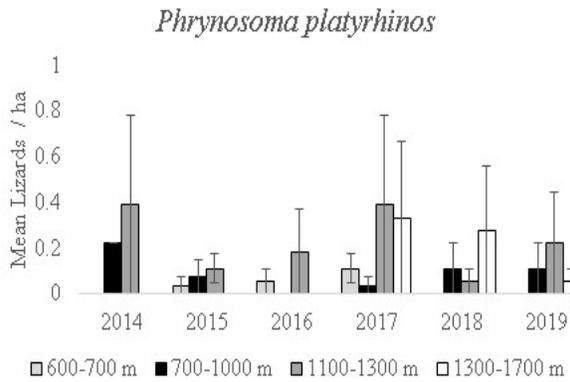
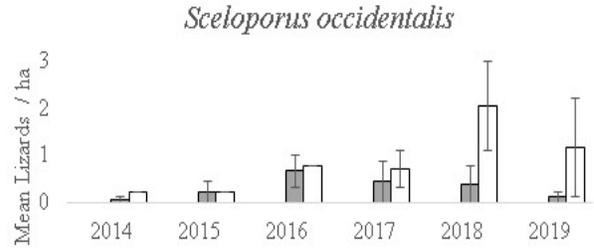
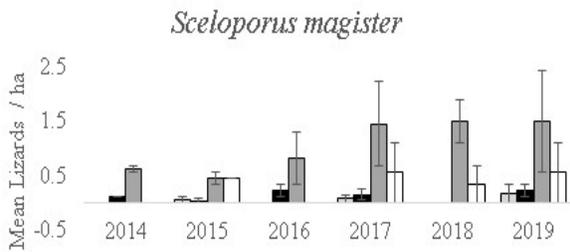
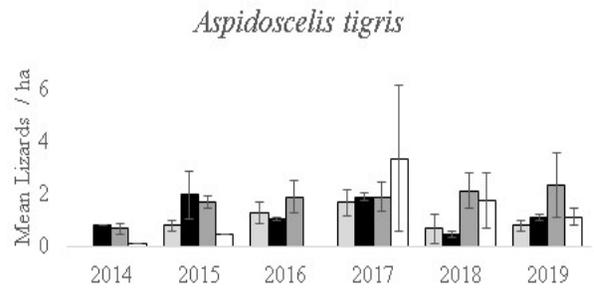
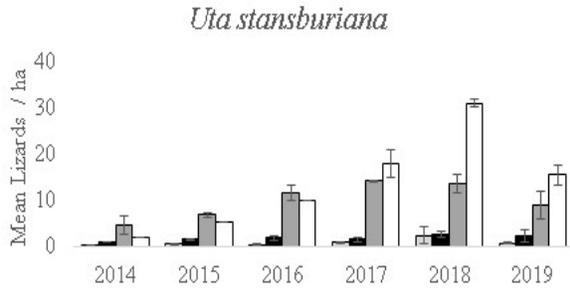
- Sweet, L. C., T. Green, J. Heintz, N. Frakes, N. Graver, J. Rangitsch, J. Rodgers, S. Heacox, C. W. Barrows. 2019. “Congruence between Future Distribution Models and Empirical Data for an Iconic Species at Joshua Tree National Park.” *Ecosphere*, DOI:10.1002/ecs2.2763

GOALS, OBJECTIVES, AND RESULTS

Our goal for this research is to document the responses of plants and animals to a warming and increasingly drier landscape within Joshua Tree National Park. Our objective is then, through our partnership with the National Park, is to have this information incorporated into management strategies that provided additional protection for the park’s biodiversity. One realization of that objective was that in 2019, the National Park began a program of creating fuel breaks around the climate refugia we have identified through our research with Earthwatch volunteers. This will help protect those refugia from devastating wildfires that have been increasing in the park over the past few decades.

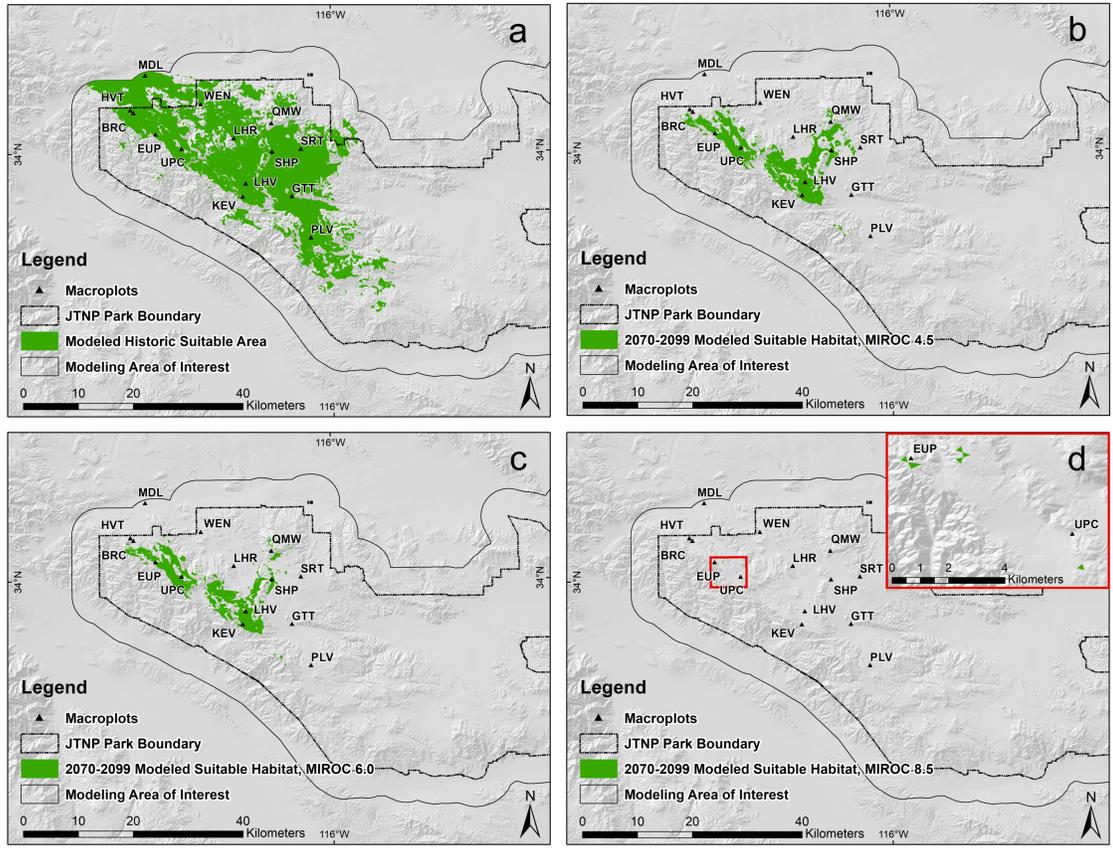
To reach our goal of documenting change in the biodiversity within the park, we have two approaches. One is to track how the abundance of these species is changing - or not changing – across the gradient of elevations within the park. A second option, when it is available, is to compare historical distributions to current ones. This approach requires that someone had the foresight before the shifts to a warmer and more arid desert had begun. Such data are rare, however, at least for lizards we do have access to distribution records dating back to the 1960s. Comparing those historical data to those we have collected recently (first figure) we can see that no species is missing (locally extinct), but we can see a general trend of most of these lizards’ distributions “leaning upslope”, with some seemingly occupying new higher elevations.

These trends are intriguing, but it is important to validate these data. Here we can take advantage of the “gradient” approach using the data collected with our Earthwatch volunteers. The second figure illustrates those results.



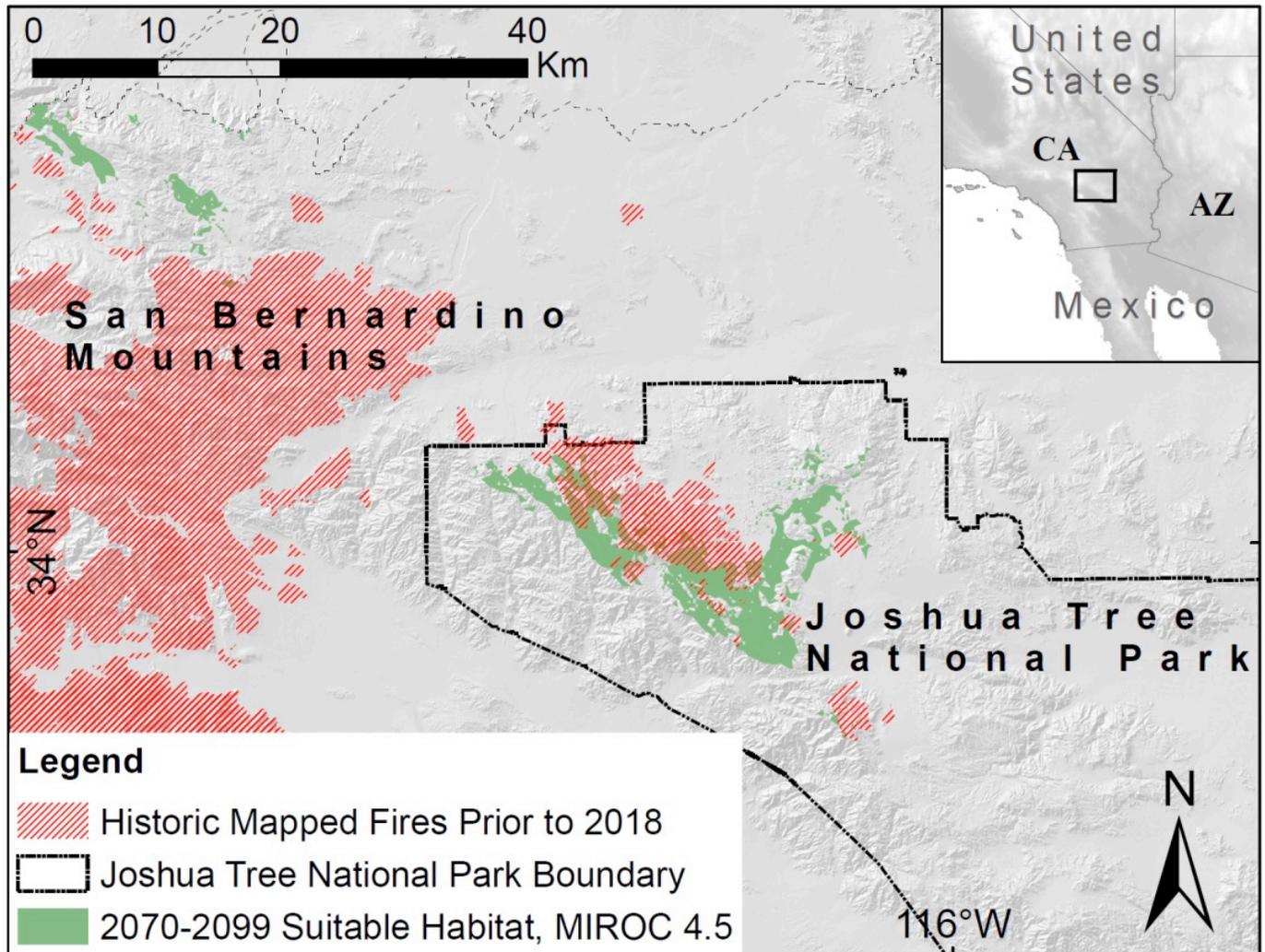
Here we see that many of these lizards are most abundant at the higher reaches of their distributions, a result consistent with the first figure. At least so far, these lizards are adjusting their distributions within the park as a means of adapting to a changing climate.

On the vegetation front, again we published an important paper modeling, and then validating (with Earthwatch volunteer-collected data) the existence of climate refugia that could protect Joshua trees – as long as we begin a concerted effort to stem our contributions to modern climate change. Those refuge are depicted on the figure below.



The upper left model (a) shows the current distribution of Joshua trees; upper right and lower left models (b and c) depict a future distribution, assuming we humans make a real effort to deal with carbon emissions. The lower right model (d) shows a pessimistic future where we opt to do nothing and continue with our business as usual,

Unfortunately, climate is not the only threat to the Joshua tree ecosystem; fire is also a serious threat. The figure below shows the recent past wildfire incidents and their relationship to the modeled climate refugia.



We were very pleased to see that in 2019 the National Park Service received funding to modify fuels to create fire breaks surrounding many of the identified refugia, with directions to fire fighters to do all they can to protect those refugia.



PROJECT IMPACTS

Increasing Scientific Knowledge

TOTAL CITIZEN SCIENCE RESEARCH HOURS

For all four expeditions combined, just over 2,100 hours were contributed by Earthwatch volunteers helping us conduct our research.

PEER-REVIEWED PUBLICATIONS

Sweet, L. C., T. Green, J. Heintz, N. Frakes, N. Graver, J. Rangitsch, J. Rodgers, S. Heacox, C. W. Barrows. 2019. "Congruence between Future Distribution Models and Empirical Data for an Iconic Species at Joshua Tree National Park." *Ecosphere*, DOI:10.1002/ecs2.2763 – Earthwatch Acknowledged

PRESENTATIONS:

- Invited Speaker for the UCR Wild Coachella Evening Lecture Series 2018-2019. "How will Joshua Trees Survive?" 2/6/2019. About 200+ local residents.
- Invited speaker for the Coachella Valley Economic Partnership Forum. "Climate Change and the Joshua Tree" About 30 regional business leaders. 10/9/2019
- Invited speaker for Desert Community Garden Day: "Citizens afield: Community science and conservation of the Joshua tree." About 35 local resident attendees. 10/26/19
- Invited speaker for the Rancho Santa Ana Botanic Garden Research Seminar Series. "Monitoring the impact of climate change on desert species in the Joshua Tree National Park region." About 40 students and faculty of the graduate program. 11/1/2019
- Invited speaker for National Park Service Mojave Desert Network 2019 Science Symposium. Where the Young Ones Are: Monitoring Species Across Joshua Tree National Park. About 75 National Park Service Employees from the southwestern desert parks. 11/7/2019
- Invited speaker for Black Rock Symposium: "Shifting Landscapes: Studying the Impacts of Climate Change in Joshua Tree National Park". About 150 registered local resident attendees 1/17/2020

COMMUNITY OUTREACH

| Name of school, organization, or group | Education level | Participants local or non-local | Estimated number of participants | Details on contributions/ activities |
|--|-----------------|---------------------------------|----------------------------------|--|
| Yucca Valley High School | High School | Local | 400 | |
| EdWeb/JASON Learning | HS Teachers | Non-local/national | 200 | Webinar- Climate change and Joshua trees |

CONTRIBUTIONS TO MANAGEMENT PLANS OR POLICIES

| Species | Common name | IUCN Red List category | Local/regional conservation status | Local/regional conservation status source |
|------------------|--------------|------------------------|------------------------------------|---|
| Yucca brevifolia | Joshua Trees | | | |



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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? | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| 2) Has the protected area status of your research site changed? | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| 3) Has the conservation status of a species you study changed? | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| 4) Have there been any changes in project scientists or field crew? | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |

Details – provide more information for any 'yes' answers

Housing was changed to a new location
New Field staff included Melanie Davis

LITERATURE CITED

- Sweet, L. C., T. Green, J. Heintz, N. Frakes, N. Graver, J. Rangitsch, J. Rodgers, S. Heacox, **C. W. Barrows**. 2019. "Congruence between Future Distribution Models and Empirical Data for an Iconic Species at Joshua Tree National Park." *Ecosphere*, DOI:10.1002/ecs2.2763