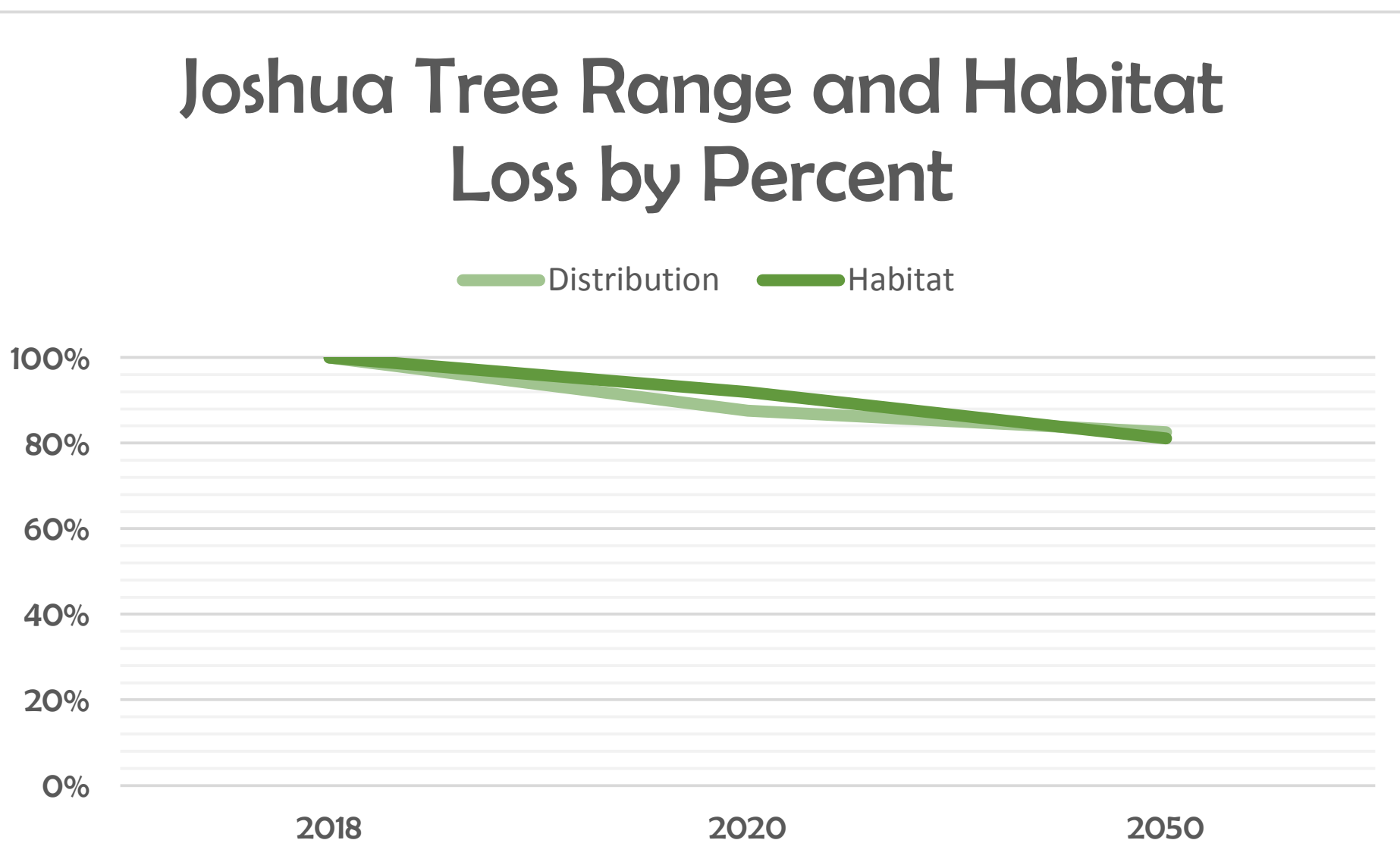


Effects of Climate Change and Urbanization on Joshua Trees

By Shelly Hill, Moriah Mason, and Christine Pang - ENV S 154

Background

Yucca brevifolia, more commonly known as the Joshua tree, is a giant yucca endemic to the desert grasslands and shrublands of the Mojave Desert. This species is an important source of food and habitat for small mammals, birds, reptiles, insects, and spiders. However, the Joshua tree is restricted to locations with cold winters, hot summers, and little precipitation, resulting in a small inhabited range^[1]. This limited habitat distribution is likely to be affected by factors such as urbanization and climate change^[6]. With changes in the Joshua tree's distribution, there will be subsequent effects on the many organisms that depend on *Yucca brevifolia* as well. With these factors in mind, we hope to visually quantify the negative impacts the factors of urbanization and climate change will have on this species.

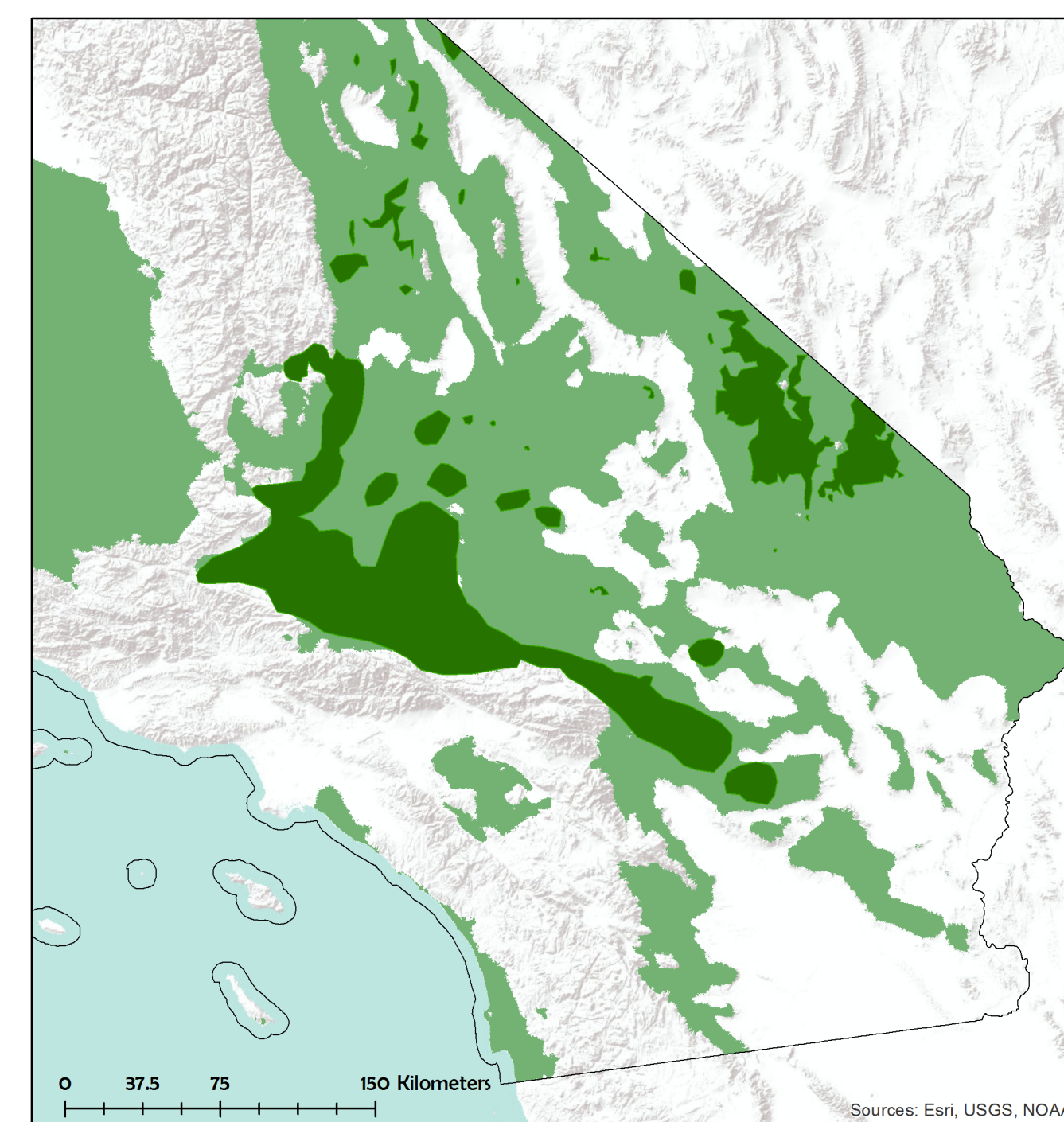


Methods

We determined that the Joshua tree can potentially inhabit regions where annual precipitation falls between 110 and 300 millimeters per year^[2]. We used the Community Climate System Model RCP 8.5, which shows a scenario of high greenhouse gas emissions and few new regulations, to show a worst-case scenario^{[3][4]}. Using the model data, we determined locations with precipitation within the survivable range historically as well as predicted over the next fifty years. We removed the areas where predicted urbanization models for appropriate time periods intersected these ranges to determine potential current and future habitat. We then intersected potential habitat ranges with current known Joshua tree distribution to determine future distribution.

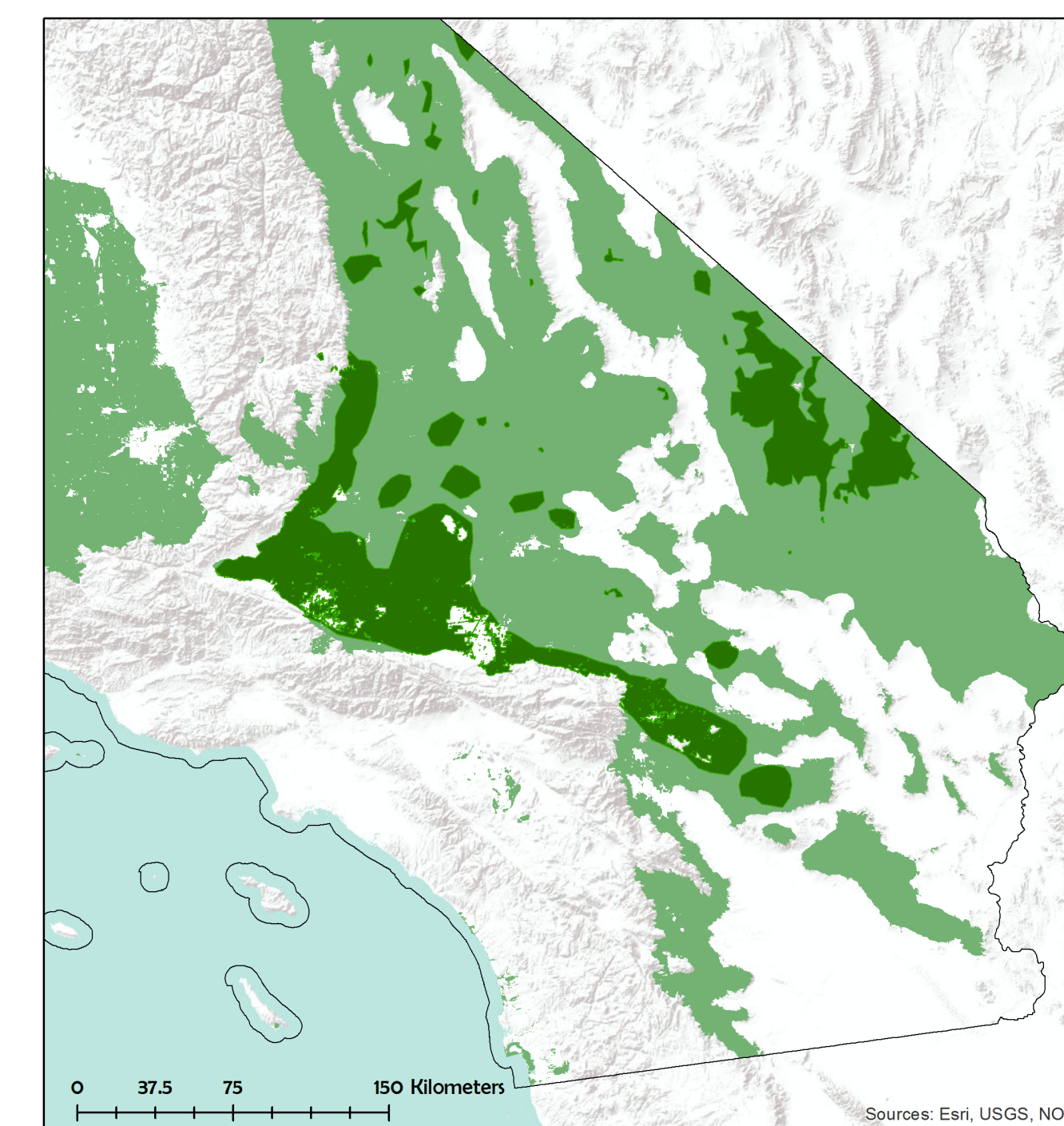
Results

The current distribution of Joshua trees covers an area of 23,417.60 square kilometers^[5]. Our predicted distribution for 2020 shows a decrease in area to 20,507.09 square kilometers, and in 2050 to 19,328.82 square kilometers. This is a decrease in overall range of 12.43% by 2020 and 17.46% by 2050. We determined current potential habitat to cover an area of 111,997.88 square kilometers. This area is decreased to 102,966.82 square kilometers in 2020 and 99,784.82 square kilometers in 2050. This is a decrease of 8.06% by 2020 and 10.90% by 2050.



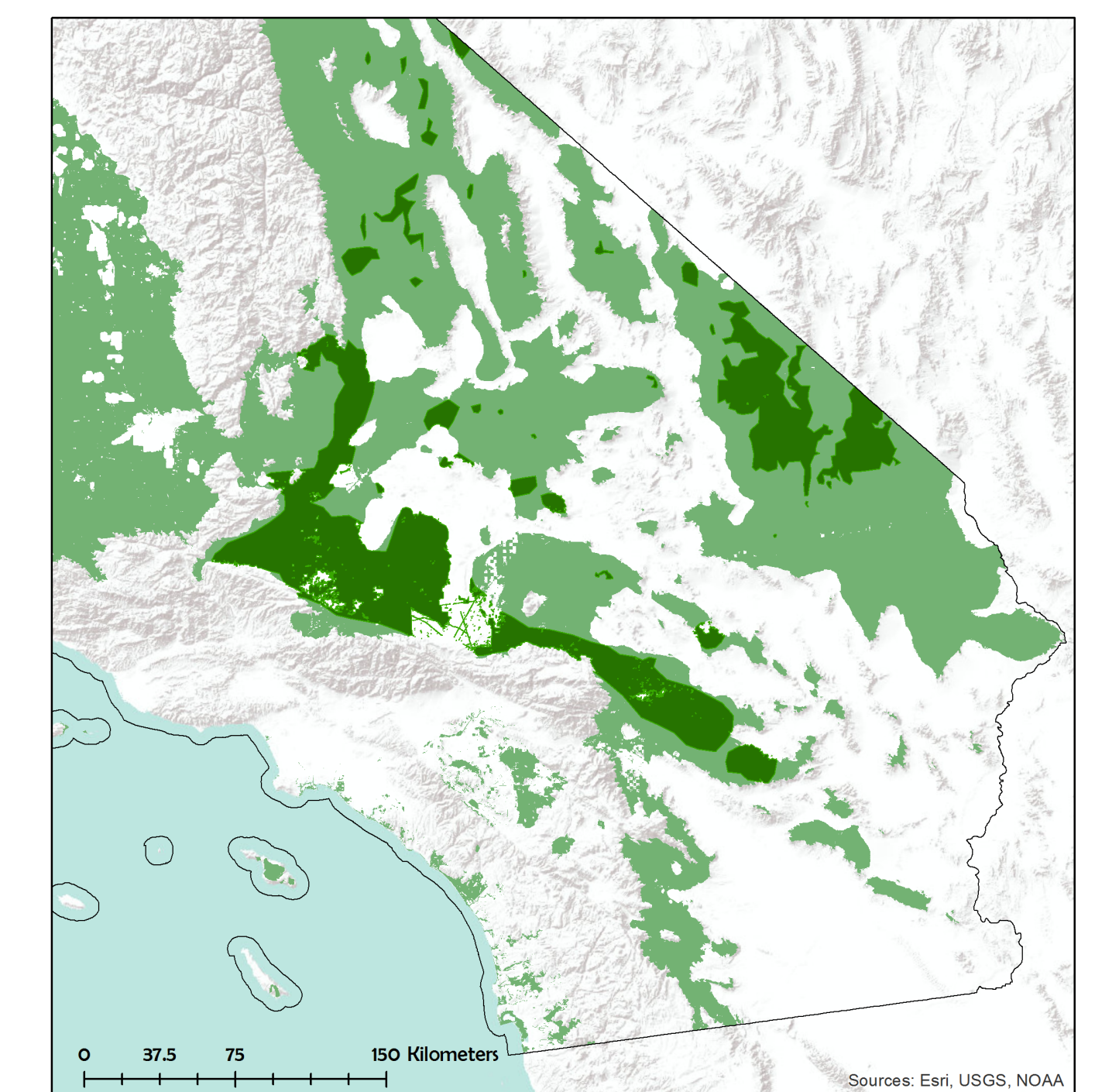
Joshua Tree Distribution, Present

Joshua Tree Distribution
Potential Habitat



Joshua Tree Distribution, Approx. 2020

Joshua Tree Distribution
Potential Habitat

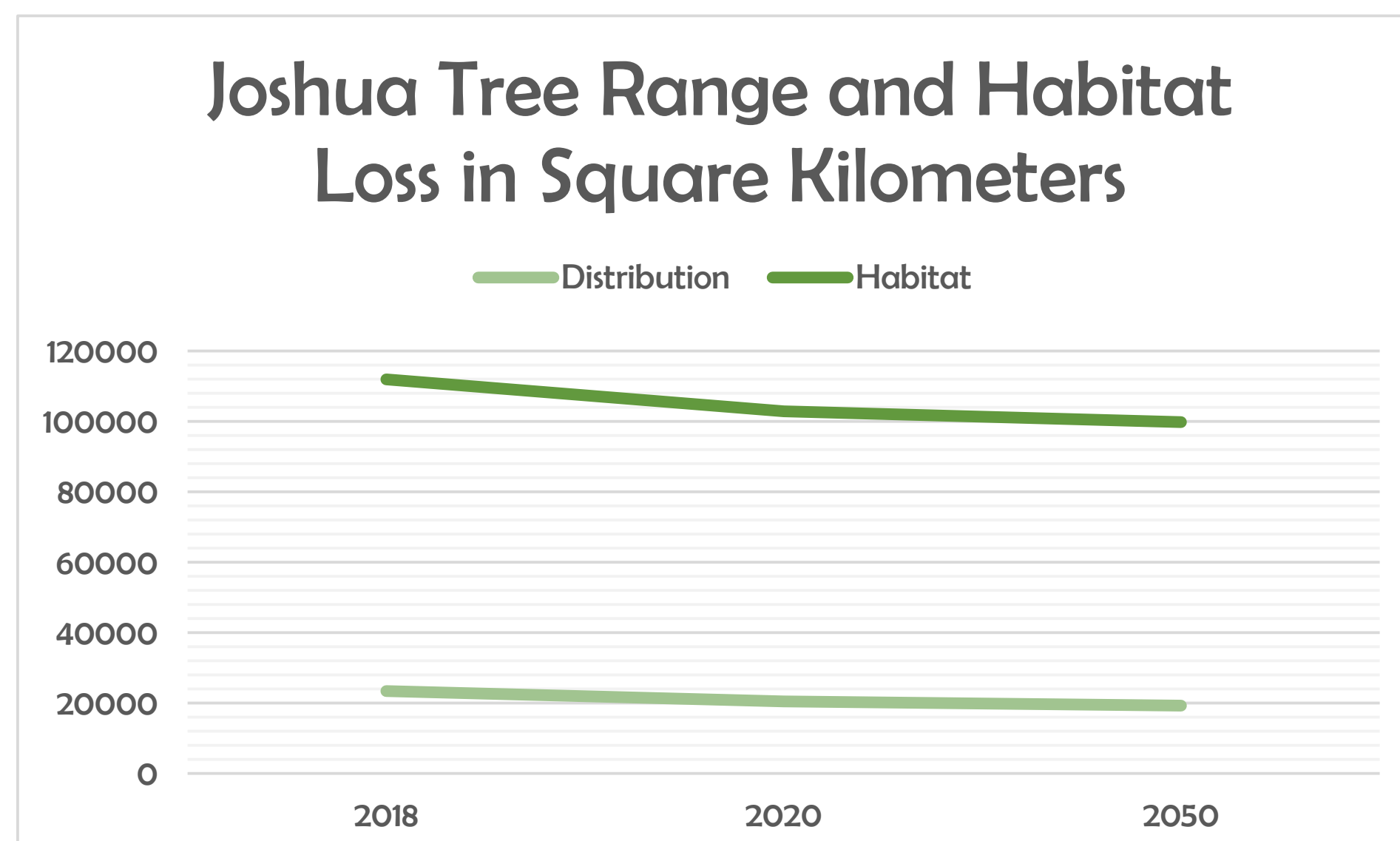


Joshua Tree Distribution, Approx. 2050

Joshua Tree Distribution
Potential Habitat

Conclusions

Lowered precipitation caused by climate change and increased urbanization are likely to severely affect the habitat and range of Joshua trees. The tree's current range may decrease by as much as 17.46% in the next thirty-two years. Negative factors are likely to affect populations unevenly. Though some inland desert regions, like Joshua Tree National Park, will be protected from urbanization, they're more likely to be impacted by increasing drought. Likewise, coastal regions face less danger from lack of water, but due to their proximity to Los Angeles are more impacted by urbanization. Potential habitat is likely to decrease by 10.90% by 2050. However, real potential habitat is likely much smaller than our data suggest. We analyzed all of California, and so our potential habitat includes regions in locations such as the Bay Area and the Channel Islands. While the Joshua tree could survive there, the plant has a limited seed dispersal, meaning it would not be able to reach that habitat. Though there is little concrete data on immature Joshua trees, studies suggest that they are much more affected by droughts than their mature forms^[7]. Therefore, it's reasonable to believe that climate change and urbanization will impact Joshua trees even more than our research suggests.



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