Report on: *Cucurbita Palmata s. Wats*

Present and future distribution

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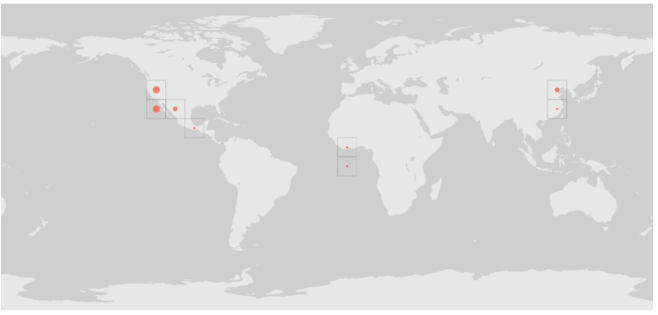
Introduction

Cucurbita Palmata s Wats, also called ‘coyote melon’, was first identified by Sereno Watson (Nee, 1990). The flowering plant bears unedible squash fruits, shown in figure 1 below, and is a wild type species of the genus Cucurbita. Cucurbita consists of a wild variation of (domesticated) pumpkins, gourds and squashes. *Palmata’s* placement in the phylogenetic tree of *Cucurbita* is in one of the basal-most clades, this clade was split off in early evolution (Zheng et al., 2013). While the rest of the clades are domesticated species, the Cucurbita Palmata is one of the few wild type species. Moreover the *Cucurbita palmata* is a xerophytic plant species, meaning that they are adapted to extreme water conditions. In this case that would be water limitations, since the plants occur in the desert of Southwest America, North Mexico, Africa and China, according to Gbif, represented in figure 2.



Left / Figure 1: Cucurbita Palmata growing in Joshua tree natural park https://www.inaturalist.org/photos/8797149
Right / Figure 2: Occurences of Cucurbita Palmata https://www.gbif.org/occurrence/map?taxon_key=2874513

Methodology

To look into present and future distribution of *Cucurbita palmata* data from github, climate layers from worldClim, and the programs R and MAXENT were used.

The rcp85 in 2070 from worlClim was chosen as a layer for future conditions because I wanted to see the worst case scenario. Supposedly this would give a real wake up call for the consequences of climate change, and show that this would at least be a scenario to avoid.

The variables that were selected were 1, 4, 15 and 17. Reasoning on why these are chosen is given below.

1. **Annual mean temperature**. Since this would be of importance for every plant species, and because *palmata* occurs in mainly desertlike areas.

4. Temperature seasonality. Again, because this species occurs in the desert and close to the equator I was interested in fluctuation in temperature.
15. Precipitation seasonality. Because *Cucurbita palmata* is a xerophyte species, they are adapted to water availability. Especially in the SouthWestern american desert, where it's normally dry but periods of high rainfall do take place (Krochmal, Paur and Duisberg, 1954) I thought it was also of importance to check the influence of variability in precipitation.
17. Precipitation of driest Quarter. Again, *Cucurbita palmata* is a xerophyte, so looking at the driest quarter couldn't be skipped.

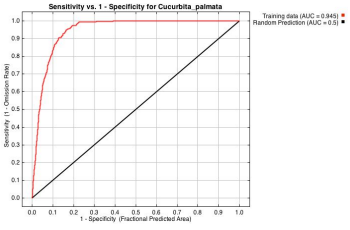
Other variables of interest correlated with these 4 variables.

The response curves of this report were created with MAXENT and the settings of this program were established using the instructions of 'Exercise: Model your chosen species' habitat suitability under present and future climate conditions'. Meaning that the random test percentage was set to zero, and the maximum number of background points was set to 10.000. Furthermore duplicated presence records were removed.

Results

The AUC value was 0.945 (figure 3), meaning that the model performed well enough to trust the results.

The most important variables were 17 and 1, respectively mean temperature and precipitation of driest quarter. 15 and 4, regarding variances in temperature and precipitation are less important for the *Cucurbita palmata.* Since it's a xerophyte plant species it's very logical that 'precipitation of driest quarter' is the most important variable.

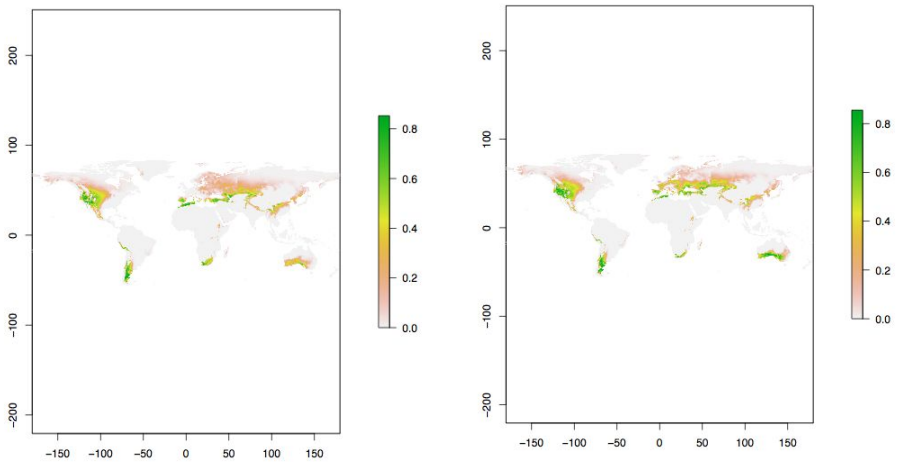


Left / figure 3: AUC value
file:///Users/maud/Desktop/MAXENT/Results/Cucurbita_palmata.html

Right / Table 1: Variable importances.

Variable	Percent contribution	Permutation importance
bio17	50.6	49.6
bio1	35.5	32.6
bio15	7	9.9
bio4	6.9	7.9

Present distribution chances (figure 4) are not entirely the same as the known distribution from Gbif. Firstly, *palmata* doesn't actually occur in the areas given by this model south from the equator, this could be due to accessibility limitations. Secondly, and the other way around, the presence of *palmata* in Africa is not represented in this model. This could mean that the model is a little bit faulty in that part or that *palmata* was introduced in that area and that it went invasive against the odds of this model.
Climate change will have a small effect on the distribution chances, as shown in figure 5, but not anything devastating. The green parts, where there is a high chance of distribution actually seems to be a little bit bigger in 2070, while the area as a whole seems to shrink.



Left / figure 4: Present distribution map
Right / Figure 5: Future distribution map

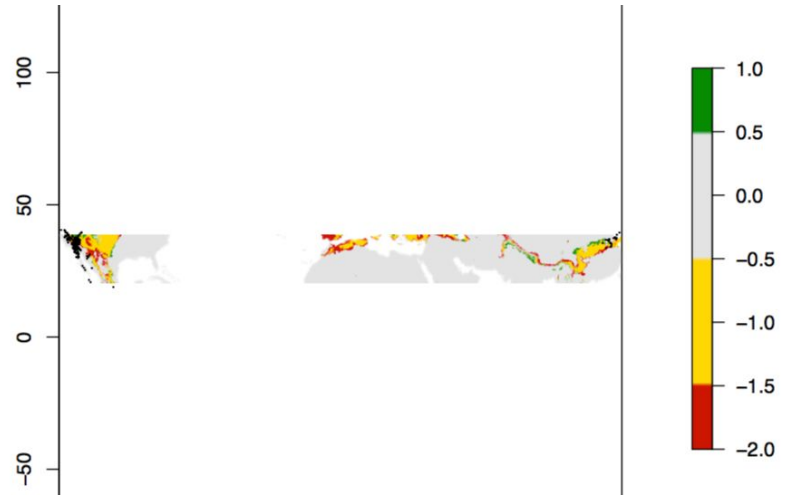


Figure 6: Future distribution change map

The future distribution change map on the left shows a much clearer how the habitat of *Cucurbita palmata* could change in 2070. My personal guess is that habitat change would have a much larger impact by that time, but we see here that climate change also has a pretty big impact. It almost seems that the habitat is shifting a little bit up north, which might be explained by a higher annual mean temperature. This means that *Cucurbita palmata* has to adapt to even drier and warmer environments.

Discussion

This model has given us more insight in the distribution of *Cucurbita palmata*. Linking the biotic variables influencing the distribution to changing conditions on earth, we gained information about what will happen to the distribution of this species in the future, and the effects of climate change thereof. Despite the fact that the model has some limitations, for instance it doesn't take the distribution of *palmata* in Africa into account, and it the only gives insight in the consequences of climate change, ignoring other influences like land use change, giving a fairly one sided view, it's still a valuable warning sign of what could happen in the future regarding the distribution of wildtype plants.

References

Krochmal, A., Paur, S., & Duisberg, P. (1954). Useful native plants in the American Southwestern deserts. *Economic Botany*, *8*(1), 3-20.

Nee, M. (1990). The domestication ofcucurbita (Cucurbitaceae). *Economic Botany*, *44*, 56-68.

Zheng, Y. H., Alverson, A. J., Wang, Q. F., & Palmer, J. D. (2013). Chloroplast phylogeny of Cucurbita: Evolution of the domesticated and wild species. *Journal of Systematics and Evolution*, *51*(3), 326-334.