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EES 391 – Report 3 – 2/28/19

Tasks: Readings of "Climate Tolerances / Habitat Requirements" paper, *Python Scripting* Chapter 5 (with exercise), and *Saving a Million Species* chapter 5 & 6

READINGS AND EXERCISES

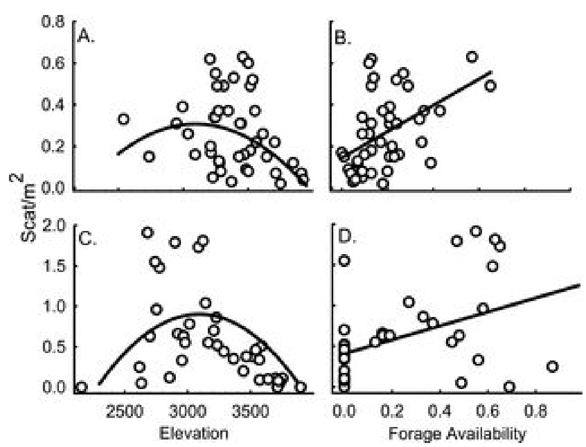
Climate Tolerances and Habitat Requirements of Pika – Yandow et al 2015 -
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0131082#pone-0131082-g003

Description of text:

This is another study focusing on the limiting factors of pika distribution. Three main factors were assessed in regards to their impact on pika abundance: summer heat, winter snowpack, and forage availability. Pika habitat is primarily alpine, and with alpine habitats being extremely vulnerable to climate change, the pika is again being used as an example species for understanding how climate change will affect mountain ecosystems. The authors made note of the current divide between scientific expectation and actual results for mountain-species range shifts in warming climates, referencing a study where species actually migrated downslope. While the elevation-temperature relationship seems straightforward, this study makes it clear that other factors shouldn't be overlooked, and can greatly influence species range.

Hot, dry, and low areas are obviously becoming unsuitable for pikas, so the study mainly focuses on the limiting factors in high elevation, mostly northern sites. Three hypothesis were tested in total. The summer heat hypothesis, which last week's article endorsed, says that summer temperatures limit pika distribution due to limiting forage time and increased heat stress. The winter snowpack hypothesis says that loss of snowpack limits pikas by damaging their food stores and leaving them overexposed to the cold and predation. Lastly, the food availability hypothesis says that pikas are limited by how much food can grow in their habitats. Forage availability data was collected by measuring the size of vegetation patches near pika dens and talus piles. Climate data was also collected manually, using sensors. Temperature data was also as a factor in the forage hypothesis, since climate has primary influence over the growing season of foragable plants. Pika presence was measured through observing scat density.

Forage area and scat density ended up showing a strong, positive linear relationship. Scat density also increased with elevation, up to an apex of 3600m (shown on figure to the right). Of the many climate variables tested, the one with the highest correlation was days below -5 Celsius, where scat density was positively correlated up to 120 days. The results of the study endorsed both the forage availability hypothesis and the snowpack hypothesis for the tested area (high elevation Rocky Mountains).



Applications for study:

While last week's article outlined summer temperatures as a main limiting factor in pika distribution, it's important to note that there are other factors at play, such as snowpack and food availability. Like I said last week, it's important to know the limiting factors of pika distribution, and to understand that many variables contribute to climate-species reactions.

Saving a Million Species Chapter 5 & 6

Chapter 5:

This chapter focuses on how species area relationships are used (and misused) in predicting climate caused extinctions. There are two main types of SARs: "nested" SARs and "island" SARs. Nested SARs are used when a habitat is shrinking (it is "nested" / is a subset of its original size) and island SARs are used when species are migrating to entirely new areas. This follows the all or nothing approach outlined in previous chapters, where a species is either assumed to be unable to migrate or assumed to have unlimited capability to migrate. This is done to make modeling easier. In reality, both systems are flawed, since new habitat will usually be an offset subplot of the original rather than a completely new area or a completely contained subset. SARs also have trouble dealing with multiple communities of a species at once, since it treats the species as a lump sum by default and doesn't factor in how separate populations will react differently to changes. The author stresses that better prediction methods than SAR are needed for fragmented habitats, which are becoming increasingly more common with climate change and habitat destruction.

Chapter 6:

This chapter details the extinction of the Golden Toad. The disappearance of the Golden Toad from Costa Rica in 1989 was one of the first species losses connected to climate change. The main hypothesis for the loss of the once common Golden Toad was dry conditions caused by the southern El Nino, which impacted rain forest mist conditions crucial to amphibian health. Eventually, researchers discovered that the fungus chytridiomycosis was infecting and killing off large populations of amphibians, and that the dry conditions likely enabled its spread among the Golden Toad population. The loss of the Golden Toad was just the beginning, as dry conditions and chytrid have worked together to decimate 70% of South American frogs within just a few decades. Chytrid is the main factor driving amphibian extinction globally, but its association with climate change, and how much temperature enables the fungus, is hotly debated to this day.

Python Scripting Chapter 5 / Pika Data Collection

- I skipped chapter 4, since it was focused on Python syntax
- Chapter 5 goes deeper into using Python as a geoprocessing tool
    - I went through clipping and buffering from the python command prompt
    - Went through dissolving a buffer by adding extra parameters to the buffer command
    - Learned how to deal with empty parameters
    - Learned how setting up variables for files can make things easier to type out, and how setting up a default environment (disk location) to work from means not having to type out the entire file path every time you want to save something
    - Learned how to set the spatial reference of a layer using a reference layer
    - Learned how to adjust settings from the command line and how to get messages regarding the progress of running tools

- This week I used the python method I outlined in last week's report to turn eight summer temperature rasters from float value to int so that they could be changed into shapefiles. This allowed for easier selections and data comparisons, and will hopefully allow me to join the data spatially with my pika habitat layer. Screenshots regarding this are on the google slides.
- This week I heard back from Aaron Johnston, a wildlife specialist from the USGS who I asked for advice from last month. He gave me some good resources to look into:

"I think GBIF has several thousand pika records (https://www.gbif.org/). Additional records can be found in archives of each state's Natural Heritage Program. Daymet would probably be your best bet for high resolution (daily at 1 km) climate data that is free. Alternatives are PRISM (4km), WorldClim, TopoWX, SNOWDAS). Pikas are famously sensitive to heat stress but their distributions can be limited by cold stress, moisture, snowpack, and precipitation."