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EES 391 – Report 4 – 3/19/19

Tasks: Readings of "Pika Low Snowpack Survival" paper, *Python Scripting* Chapter 6 (with exercise), and *Saving a Million Species* chapter 7 & 8

READINGS AND EXERCISES

Pika Survival at Low Snowpack – A.T. Smith & C.I. Millar 2018 - https://www.fs.usda.gov/treesearch/pubs/56502

Description of text:

One theory involving pikas and climate change is that low snowpack will lead to increased pika mortality. This is because pikas use the snow as insulation from extremely cold temperatures, so without it they could potentially die of exposure or excessive thermoregulation. This study tested this theory on Sierra Nevada Pikas. Many studies have related pika mortality to lack of snowfall in the past, but there isn't much solid data to back it up. This study references the Yandow et. al study I read for the last report, in which the snowfall high mortality prediction was only weakly supported.

This study looks at how pikas dealt with California's lowest ever snowfall in the winter of 2014/2015. During the season, the Sierra Nevada only received 3-17% of its usual snowfall on average, with some areas receiving no measurable snowfall at all. April snow water content levels were at a historic 5% of the historic average, making the winter 2014/2015 the driest on record. To reiterate the magnitude of this low point, the previous April record was 25% of the historic average. To test how this absurd lack of snow impacted Sierra Nevada pikas, the team compared summer 2014 and summer 2015 occupancy, with another follow up comparison in the summer of 2016. Occupancy was tested by looking for green hay piles at specific sites - meaning that a pika is actively collecting for its warm season harvest. Direct sightings and audible calls were also used as evidence for occupancy.

In the end, no evidence was found for snowfall increasing pika mortality, even in the most extreme case possible. In 2015, hay piles were found at 89.2% (33/37) of the baseline sites from 2014. Additionally, pikas were seen or heard at 78% (29/37) of summer 2014 sites and 91% (30/37) of summer 2015 sites. Overall, pika presence was found at 36/37 sites - the 2014 and 2015 results were almost identical. A follow up in 2016 looked at 33 of the sites, where 29 were found to have green hay piles.

The discussed the reasoning behind this result, chiefly the idea that high-talus environments are able to buffer temperatures enough to allow for pika survival in extremes. Another factor was that precipitation was very high in the spring of 2015 following the drought, allowing for abundant food. Temperatures for winter 2014/2015 were also higher than average, but were still very cold and far below freezing in pika habitats. Overall, the mechanisms for extreme cold survival of pikas is still unknown. This quote from the study sums up the results well -

> "*The logic behind the low snowpack–high mortality prediction with regard to American pikas makes perfect sense. But it appears that American pikas, for whatever mechanism or reason, can survive winters with low or no snowpack.*"

APPLICATIONS: Snowpack was a variable that I wanted to look into, it had seemed like a pretty concrete association, but this study is a strong refutation. Talus again seems to be an important variable here.

Saving a Million Species Chapters 7 & 8

Chapter 7: Coral Extinction

The widespread bleaching of coral reefs is described in this chapter. Corals are very sensitive to temperature changes, and even 1 °C variations can cause coral die-offs. With reefs being some of the most diverse and dense habitats on Earth (harboring up to 3 million species), the loss of coral impacts many species that rely on it for food and shelter. El Nino events in particular, which create warm ocean waters, are a major threat to reefs and have already led to documented cases of local coral extinctions. One such local extinction occurred in the Eastern Pacific in the 1980's, and involved three coral species. The species were decimated by strong El Nino events, but one species, *M. intricata*, has been able to continuously repopulate shallow waters from deep refuges that are not impacted by El Nino waters. Local extinctions are in turn leading to functional extinctions within the reef habitat. Functional extinctions occur when a species has been reduced to a point that it no longer plays a significant role in the ecosystem - it's not extinct yet but is still insignificant.

The fate of corals will depend on how well reef building corals will be able to handle increased temperatures and ocean acidification. Reef-builders are the foundation, and their loss could mean total loss of coral reefs. If just 30% of corals are destroyed, it could mean the extinction of 400,000 species. Aside from reducing emissions, genetic engineering may be a necessary step for ensuring the survival or corals into the next century.

Chapter 8: High-Latitude Extinction

This chapter discusses the risk that arctic/antarctic species face with rising temperatures. Since 1979, arctic sea ice coverage has seen a steady decline while antarctic sea ice has decreased very slightly. A few species are listed as being of particular concern - beginning with polar bears, walrus, and narwhals. These species all share a common dependence on arctic sea ice. Polar bears require sea ice for every facet of their lives - reproduction, rearing, foraging, and hunting of seals. Similarly, the Pacific walrus relies on sea ice for mating and birthing, and overall has very specialized habitat and feeding needs - which is never a good sign when it comes to adaptability. The narwhal is also specialized to cold

and deep arctic waters, but is mostly at risk due to human hunting pressure. Antarctic species are less at risk due to the antarctic being less impacted by warming oceans (since its continental).

Python Scripting Exercise 7

- This chapter focused on using cursors and SQL expressions to manipulate data
- Cursors are used to iterate over the rows in a table, and the syntax is:
    - `SYNTAX: SearchCursor(in_table, field_names, {where_clause}, {spatial_reference}, {explode_to_points}, {sql_clause})`
    - The where clause is used in SQL to extract only data that fulfill a specified condition - for example, in GIS - `STATE_NAME = 'Alabama' -` would select the features containing "Alabama" in a field named STATE_NAME
- Learned some specific syntax for using SQL expressions:
    - Shapefiles use double quotation marks (" ") — for example, "NAME"
    - Geodatabase feature classes use square brackets ([ ]) — for example, [NAME]
- Ran through examples using a file of points representing Alaskan airports, using expressions to select and print data into the python command prompt - examples shown on attached slides
- In addition to regular cursors, there are also update cursors, which are used to make changes to existing records, and insert cursors - which are used to add new records
    - Went over how to insert data into a table of a shapefile, in this case inserting the AK state abbreviation into the STATE field of the airport data, which was incomplete
        - See accompanying slides for full example
    - Inserted new airports into the data table - see slides for example
    - Learned how to validate fields to make sure none of the fields contain invalid characters

Pika Data

- Originally, I had turned my pika range raster data into a polygon shapefile to better associate the data, since more comparisons can be done with shapefiles.
    - I wanted to do a spatial join between my temperature shapefiles and range shapefiles - but I eventually realized that since the pika range data had basically no values in its attribute table, the join would not be accurate. This is because without any unique

values, the pika range raster cells were large and globby when transformed into polygons, and not the same size as the original raster cells.

- To counter this, I decided that I would build an attribute table for the pika range of unique values - there turned out to be nearly 10 million - and turn the raster cells into points that I could then associate with the underlying temperature.
- Once I had my points, I successfully tied them to one of my temperature shapefiles using the intersect tool, which seems like a better implementation of spatial join
    - It took a long time, since there were 10 million points, but it seems to have worked
- The next step would associate 7 more temperature fields (for each of my temperature shapefiles) to the pika range points which can then be analyzed
- See slides for better visual description