Vegetation Habitat Mapping of Mammoth Cave National Park

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Abstract:
An up-to-date and detailed vegetation habitat map provides critical information for habitat management. In addition, a vegetation habitat map is necessary for the Park's Fire Management, for classification of fuel types, and for delineation of fire management units. The main objective of the project is to produce a vegetation habitat map of Mammoth Cave National Park. According to the Park Ecologists, slope, aspect and bedrock geology are the main controls of vegetation habitats in the park. Therefore, a combination of slope, aspect and bedrock geology determines the habitat types. Slope and aspect are calculated from LiDAR derived DEM dataset.

Introduction
Vegetation has considerable impacts on almost all land surface energy exchange process, acting as an interface between land and atmosphere (Arora, 2002; Douville et al., 2002). It not only forms essential habitat for plant and animal species but also a prerequisite for ecosystem function. (Hölzel et al., 2012). Different vegetation represent different stages in vegetation restoration and succession (Jiao et al., 2008). For a given climate, bedrock geology largely determines soil types, and whether surface or subsurface (karst) drainage prevail. Due to the tendency for subsurface drainage to develop in calcareous bedrock such as limestone, these sites will be more xeric (dry) than an equivalent situation underlain by sandstone or shale. The magnitude of this general difference appears to be minimized on the steepest exposures due to rapid surface drainage. Aspect, the direction of a slope faces, is a strong determinant of localized conditions.

Data:
1. Airborne Light Detection and Ranging (LiDAR) dataset, with derived digital elevation model (DEM) of 1m spatial resolution
2. Bedrock geology dataset obtained from Mammoth Cave National Park

Method:
- Extract slope and aspect information from derived DEM
- Reclassify slope and aspect data into categories according to the classification scheme provided by Park Ecologists
- Categorize bedrock geology dataset using the simplified geology units
- Convert bedrock geology shapefile data into raster file data
- Combine reclassified slope data, reclassified aspect and, reclassified bedrock geology raster file
- Reclassify the resultant image from the previous step

Bedrock Geology Classification Scheme

Alluvium Units	Main Cave Limestones Units	Caprock Clastics Units	Caprock Limestone Units
Alluvium Alluvium Younger Alluvium Older	WarsawLimestone Vienna Limestone Salem and Warsaw Limestone St. Louis Limestone St. Genevieve Limestone Girkin Limestone Girken Limestone Fort Payne Limestone	Big Clifty Member Caseyville Member Hardinsburg Limestone Leitchfield Formation Tar Springs Sandstone Tradewater and Caseyville Formation	Haney Member Glen Dean

Types of Bedrock Geology	Habitat Category
Alluvium	Alluvium
Main cave Limestones	Calcareous
Caprock Clastics	Acid
Caprock Limestone	Calcareous Sub-mesic

"Alluvium" refers to river lain sediment. "Calcareous" refers to carbonate bedrock, which results in more alkaline soil. "Acid" refers to non-carbonate bedrock, which results in acid soil. Mesic conditions are moderately moist. Sub-mesic conditions are less moisture compared to mesic.

Slope Classification Scheme: The categories of slope are divided into flat (0-4.9 degree), moderate (5-22.9 degree), and steep (23-90 degree), as suggested by Park management based on their field observation and experience.
Aspect Classification Scheme: The 360 degrees of aspect are grouped into 16 wedges of 22.5 degrees each

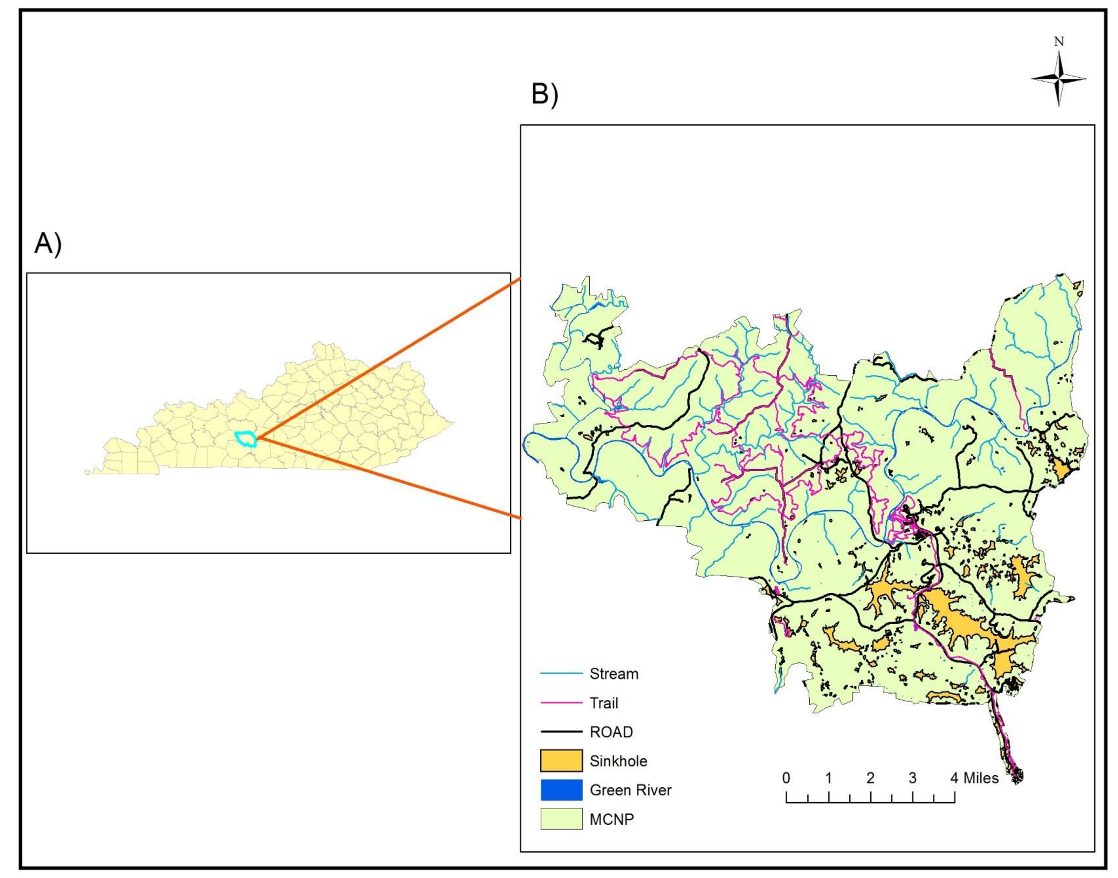

Fig1: A) The geographic location of the Mammoth Cave National Park
B) The geographic features of Mammoth Cave National Park

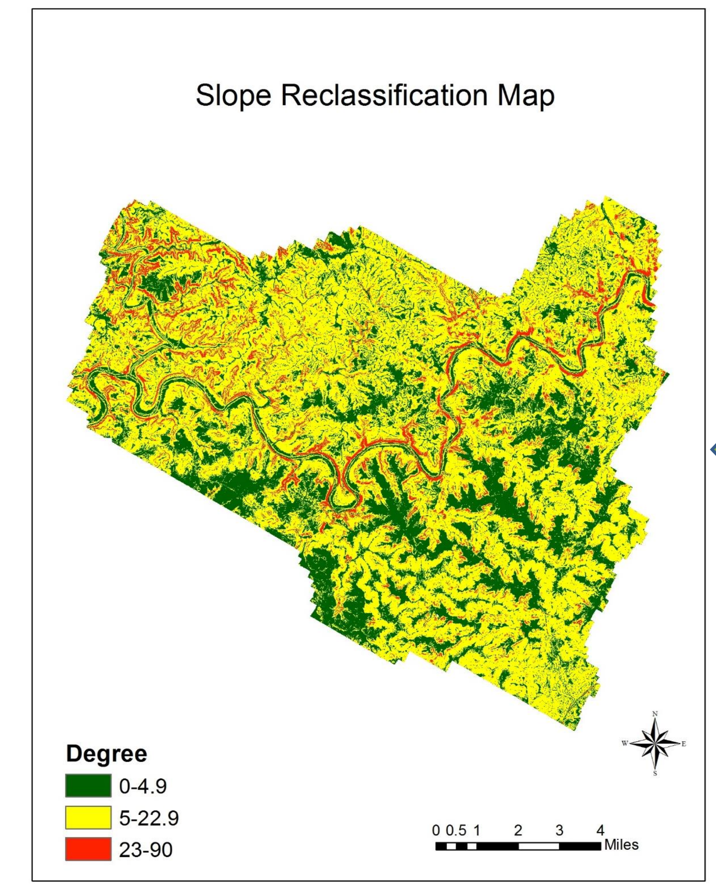

Fig2: Slope Reclassification Map

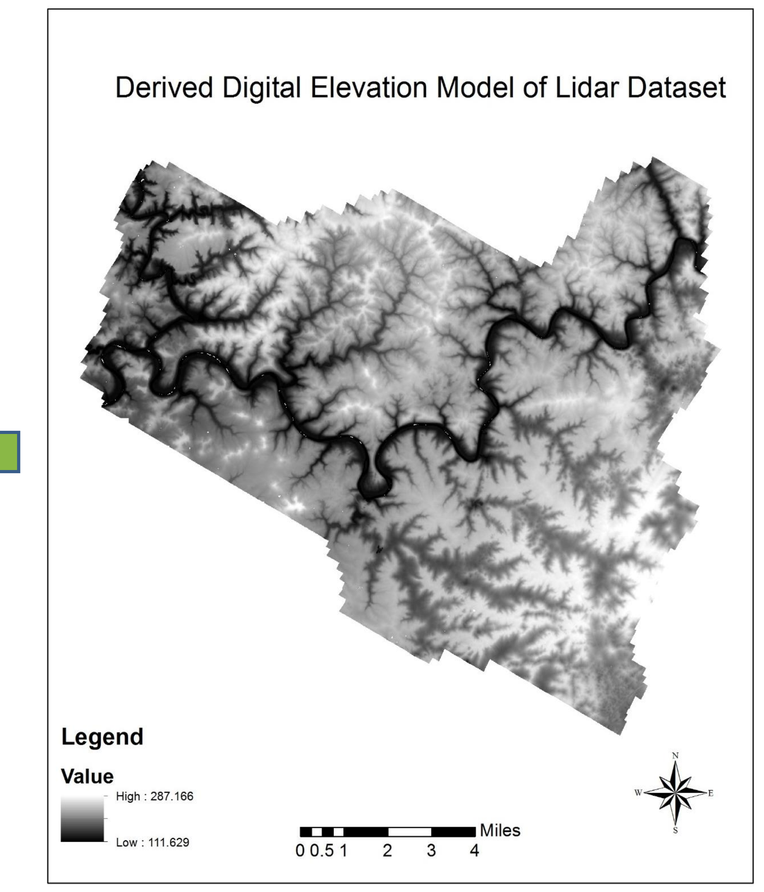

Fig3: LiDAR Derived DEM Map

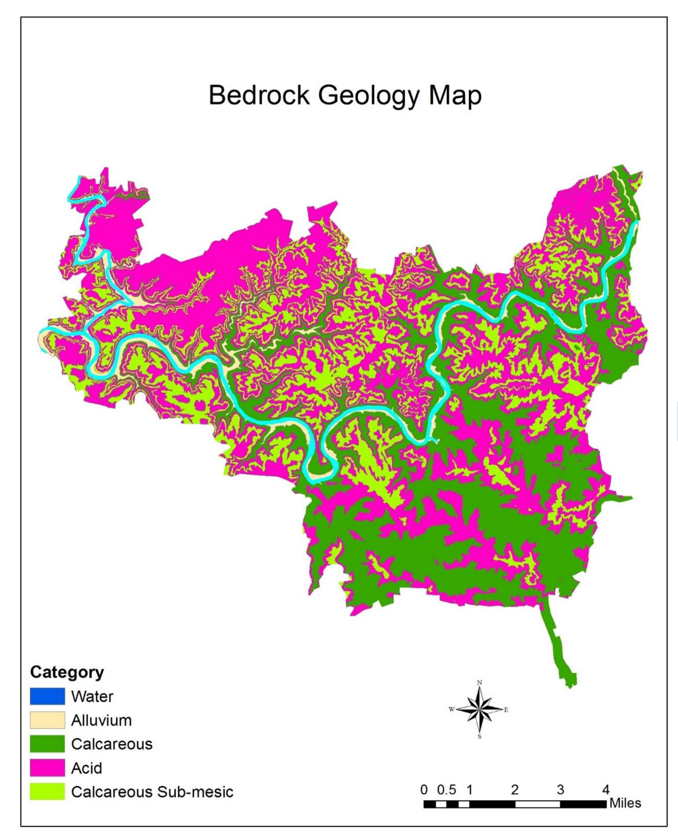

Fig 4. Bedrock geology vector dataset

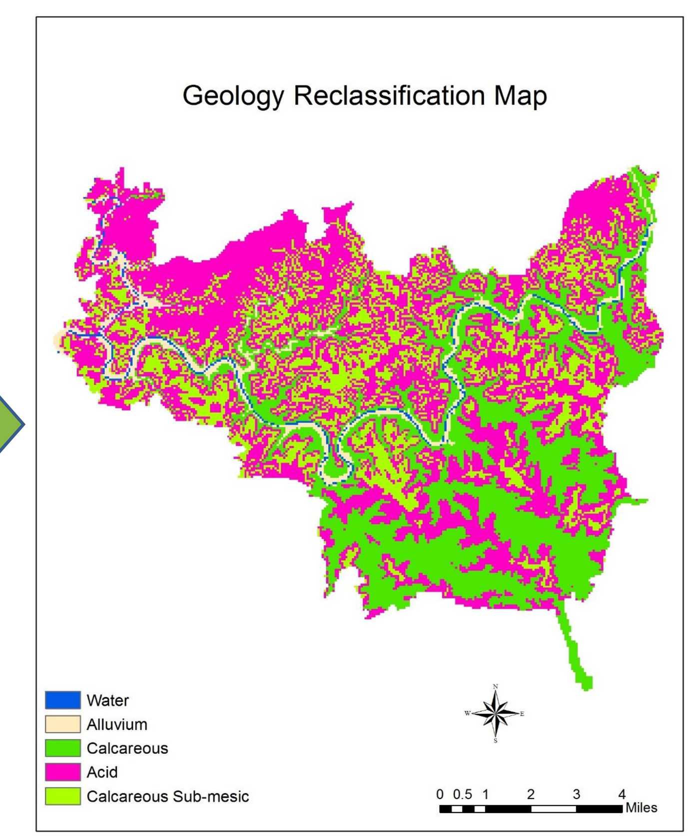

Fig 5. Bedrock geology raster dataset

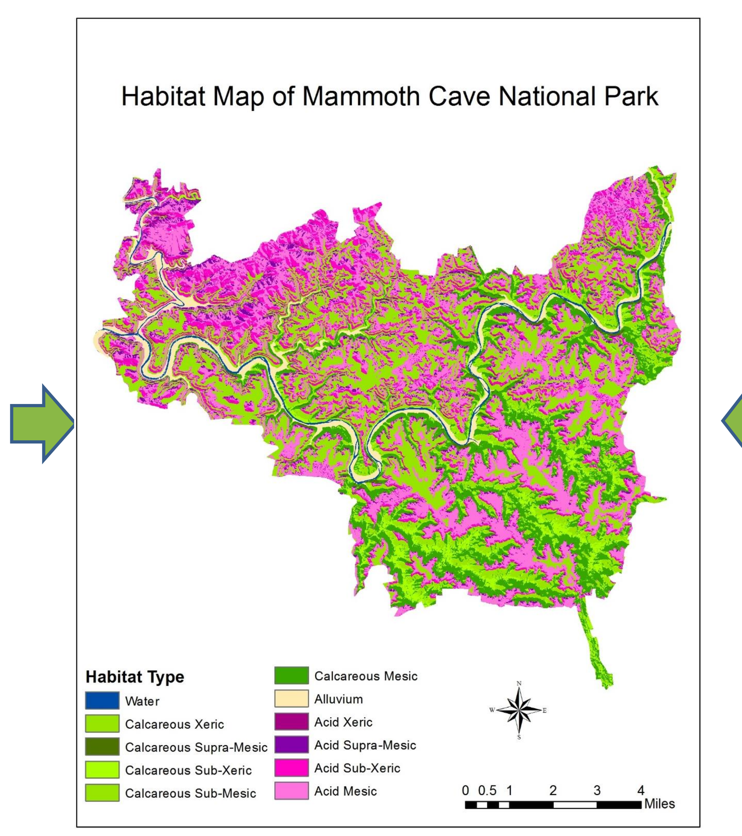

Fig6: Habitat physical attributes map based on geology, slope, and aspect

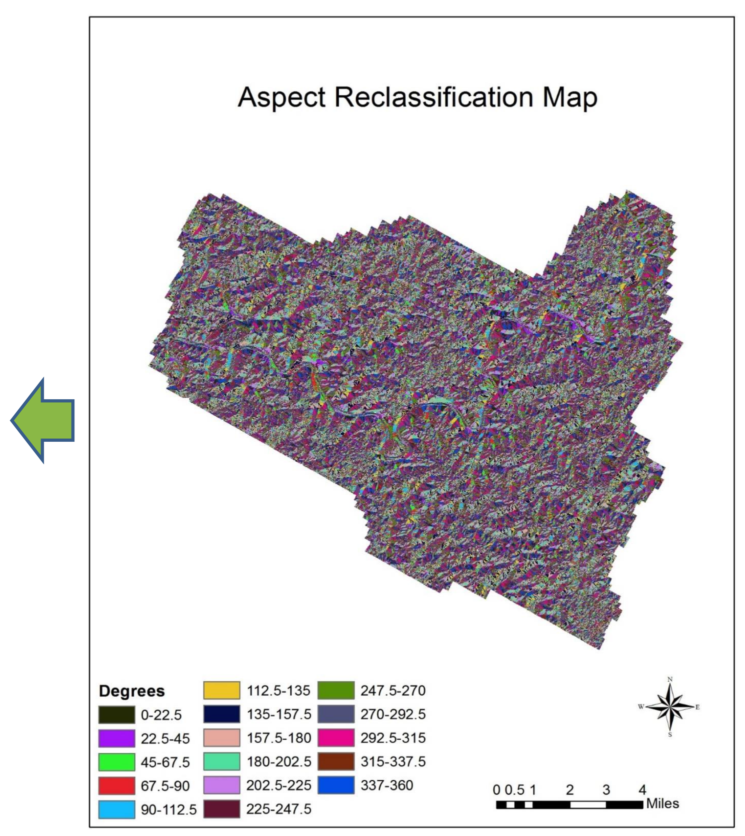

Fig7: Aspect Reclassification Map

Conclusion:
- Habitat types are controlled by a combination of bedrock geology, slope and aspect
- Bedrock geology largely determines the habitat type
- Calcareous and Acid are the main habitat types of the park

Future Work:
- Utilize Landsat-8 OIL imagery to generate vegetation types
- Combine vegetation types and habitat types to produce vegetation community map
- Use LiDAR dataset to identify vegetation species within a small area of the park

Reference:
Arora, V, 2002. Modeling vegetation as a dynamic component in soil-vegetation-atmosphere transfer schemes and hydrological models. Rev. Geophys., 40, 1-25.
Douville H, Planton S, Royer JF, Stephenson DB, Tyteca S, Kergoat L, Lafont S, Betts RA, 2000. Importance of vegetation feedbacks in doubled-CO2 climate experiments. J Geophys Res 105(D11): 14841–14861. doi:10.1029/1999JD901086.
Hölzel, N., Buisson, E., and Dutoit, T., 2012. Species introduction—a major topic in vegetation restoration. Applied Vegetation Science, 15, 161–165.