Habitat Fragmentation in Kenya
The Impact on Nubian Giraffes

Kenya's Agricultural Growth

Over the past twenty-five years, Kenya has experienced a significant population boom, with the country almost doubling their total population as a result of changing demographics favoring those of childbearing age. With a rise in population, increases in food production and urban spread continued in order to provide the necessary resources such as food, water, and shelter to new members of the population. Expansion of agriculture continues to expand all throughout Kenya and has now become one of the main economic activities in the country besides tourism. The major crops grown in Kenya include maize, coffee, tea, sugarcane, and wheat, all of which require extensive amounts of land to grow as well as proper amounts of rain.

As agriculture has continued to expand across Kenya, the conversion of land to open fields has resulted in increased amounts of habitat loss and fragmentation, the two main drivers of species extinction around the world that reduce biodiversity and destroy ecosystems. Habitat fragmentation is a significant problem for giraffes as populations often become separated from each other and are not able to access resources they previously were able to such as watering holes or acacia trees, a staple part of their diet. With populations of giraffes not able to access each other to interact and breed, overall genetic diversity will be reduced, a problem that could lead to increased amounts of inbreeding and less resistance to diseases with potential to wipe out the species. Over the past thirty years, giraffe populations have declined by approximately 40%, a process known as the silent extinction. Understanding the mechanisms behind the giraffe's decline, particularly the critically endangered Nubian giraffe subspecies, is becoming increasingly critical for the health and safety of the species to ensure they do not go extinct. The aim of this project is to determine how the amount of habitat fragmentation and means by which land was converted has changed over time across the Nubian giraffe's range in central parts of Kenya.

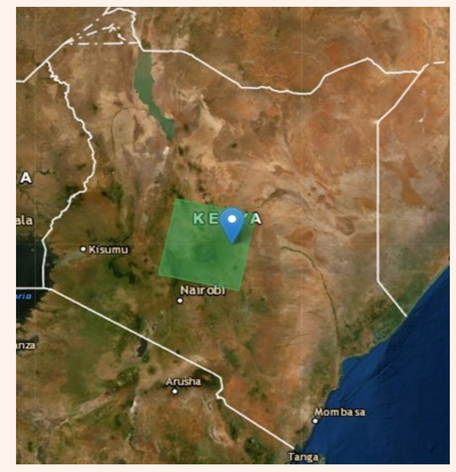


Figure 1: Study site location within Kenya as shown by green opaque square.

Study Sites

Two images (one from 1995 and one from 2016) were downloaded from Earth Explorer. The images were taken using Landsat 5 and 8, both Level 1, during the month of May to reduce seasonal variability. The original images were resized to include a smaller study area and displayed as false color composites to better visualize changes in the landscape as shown in Figs. 2a and 2b.

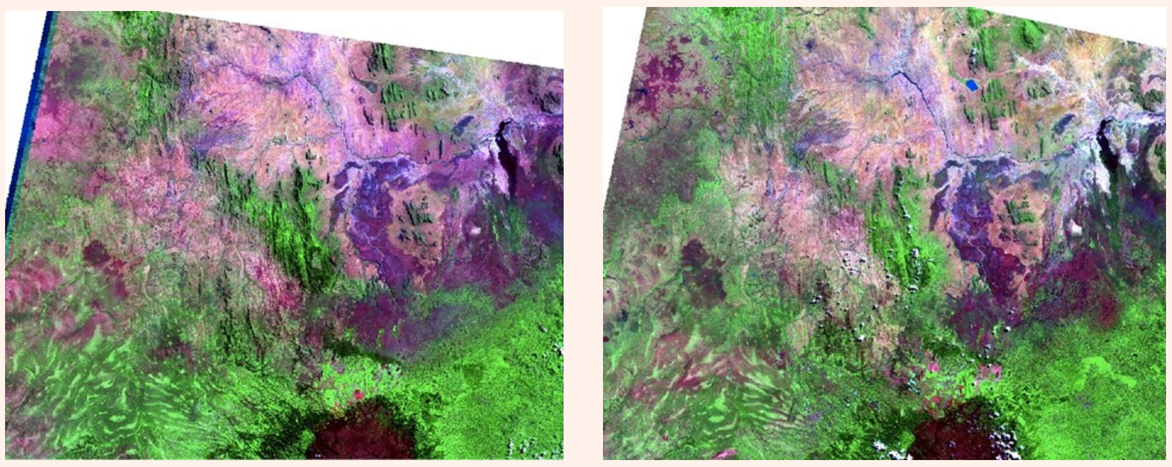

(a) (b)

Figure 2: (a) False color composite of resized image from 1995 displayed in 7, 4, 2. (b) false color composite of resized image from 2016 displayed in SWIR 2, near infrared, and green.

Supervised Classification

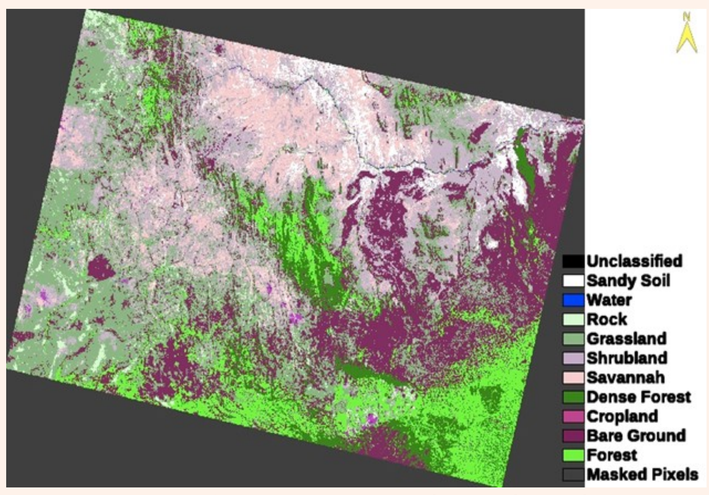


Figure 3: Minimum distance supervised classification of image from 1995.

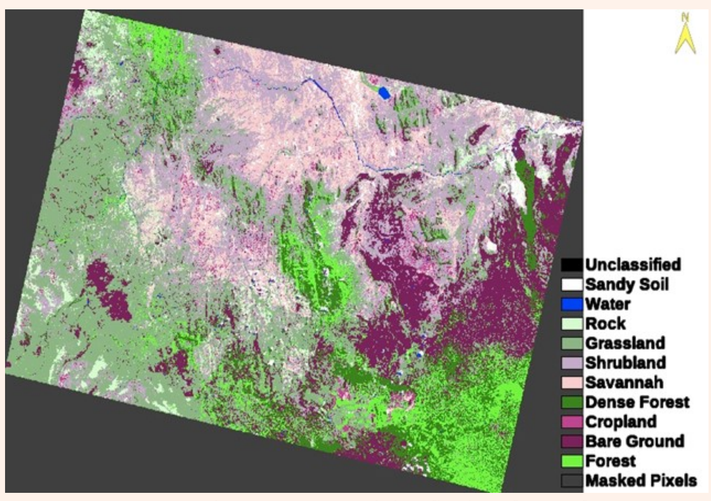


Figure 4: Minimum distance supervised classification of image from 2016.

An unsupervised classification was first ran to better understand the data and to help inform the supervised classification. Training sites for the supervised classification were then created using the ROI tool to represent the ten land cover types being classified as shown in Figs. 3 and 4. Ground truthing was conducted using Google Earth. When running the supervised classification, a mask was used to narrow down the overall study area. The resulting outputs displayed large amounts of deforestation occurring from 1995 to 2016, primarily in the bottom right corner of the images. Parts of the study area were also converted from savannah or shrubland to grassland, indicating additional deforestation. The results were consistent with predictions based off observing the false color composites and conducting a visual comparison. A confusion matrix was run for both years to determine accuracy of training sites. The Kappa coefficient for the 1995 image was 0.5471 and the Kappa coefficient for the 2016 image was 0.7110.

Visualizing Change

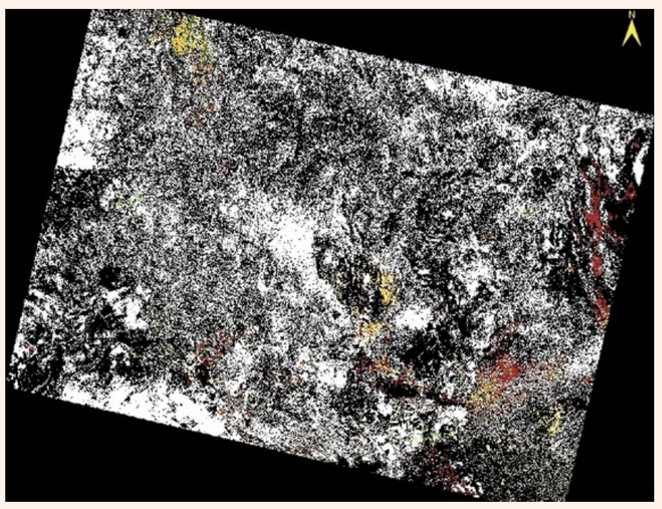


Figure 5: Thematic change map showing land cover types change from 1995 to 2016.

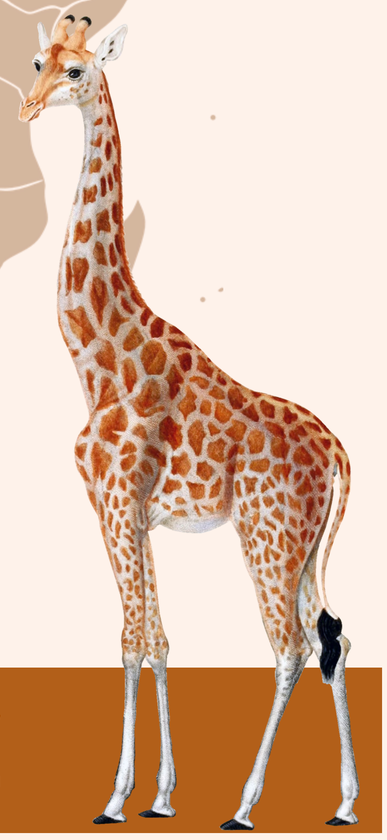
To determine the amount of change in the landscape across central Kenya between 1995 and 2016, the thematic change tool was run to conduct the final analysis. The final image resulting from the thematic change tool showed a large amount of change occurring between the 1995 and 2016 (Fig 5). As the tool creates a large output in the legend showing which land cover changed to which, only changes that were from forest or dense forest to any other land cover types were displayed to simplify the output as shown in Figure 5.

Looking Forward

After conducting additional research on the environmental influences of Kenya through the literature, the results of this project closely resemble the state of affairs Kenya is currently in. Recently, Kenya has been experiencing large amounts of desertification and land degradation primarily due to climate change reducing the amount of rainfall each year. Desertification is becoming a major environmental problem all throughout Kenya, impacting approximately 80% of the country. Temperatures around the world are rising and rainfall is becoming more sporadic throughout the year, changing typical weather patterns that have been experienced for decades. Without adequate rainfall, many Kenyans are unable to grow their crops in areas once capable of supporting them. As a result, many individuals and communities are deciding to move around to other parts of Kenya with hopes the other areas will provide more rainfall for growing crops.

Deforestation in these areas has continued to increase as people need to prepare the land for agriculture when moving to a new area. Many forested areas are then converted to cropland. The main problem with deforestation is that it impacts not only where there was previously forest, but also the surrounding ecosystem as losing forests can increase the amount of erosion occurring, continuing the process of land degradation across the Kenyan landscape. Additionally, the lack of water also impacts raising livestock as individuals are not able to provide the animals with crops for food. As a result, many members of the community turn to hunting giraffes as food for their family, further reducing giraffe population numbers.

Through the use of remote sensing, land cover change over a twenty-one year time period was visualized and can then be used to inform future management policies and actions to better inform conservation efforts. Incorporating ways to preserve giraffes as well as the agricultural practices of the local communities will be key to ensuring lasting impact throughout the country.



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