Name: Gabriel Guzman

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**Period Change Analysis on Abandoned Hobet Mine (West Virginia)**

**Introduction**

The North America has experienced extremely high rates of economic development in the last half century, bringing prosperity and an increased standard of living for most Americans. This incredibly industry development has been fueled by an immense amount of energy production and extraction of natural resources from the land One such resource in the United States has been coal this is an abundant resource in the Appalachian geological region. Coal mining in Appalachia used to be comprised of room-and-pillar mining. During the 20th, a switch to mechanized mining and larger operations took place in the mining in this area (Department of Environmental Protection, 2019). Mountain top removal is one of these methods, providing efficient extraction of the resource along with great environmental consequences Landform alteration is one of the biggest environmental issues related to this kind of mining (Maxwell & Strager, 2013). This landform alteration has been linked to cause negative ecological changes to wildlife from salamander populations being brought to the brink of extinction (Price, Muncy, Bonner, Drayer, & Barton, 2015) to the health of fish populations being negatively impacted by chemical discharge from these coal mines (Ferreri, Stauffer & Stecko, 2004).

Remote sensing is being used across the world to improve our understanding of the extent of the landform changes caused by mountain top removal (Bower, Shobe, Maxwell, & Campforts, 2024). This study attempts to better understand the landform changes experienced by the Hobet mine in West Virginia and surrounding areas. Improving our understanding of how the landscape has been changed is useful information that may help restoration efforts (DeLancey, 2019). We wish to better understand how much the landscape has changed over time.

**Methods**

For this project, we used Landsat 7, 8 and 9 imageries. The date range used spans from 1985 to 2020. Landsat was the best imagery source for this project because it provided high spatial resolution as well as vast past data, which was essential for this project.

Start: 1985-01-01 → 2005-12-31

End: 2014-01-01 → 2020-12-31

**Annual Time Series Graph**

An annual time series graph was generated in order to understand the difference between bands values over time. The year chosen for this annual time series graph was 2019-2020.

**False Color Image Composite**

A false image color composite of the ‘before’ (1986-07-05) and ‘after’ (2020-12-09) were generated to better understand the change in the major features of the study area. LS5 and LS8 were used for these composites (Path = 19; Row = 34). An infrared (CIS) false image composite was chosen to be the

**Two Period Change Analysis (with unsupervised classification)**

We had to reclassify spectral classes generated by the unsupervised classification model into informational classes (Forest1 = 100, Forest2 = 101 and Mine = 102). Once this was done. The informational classes Forest1 and Forest2 were merged. The area of these informational classes (Forest and Mine) for the ‘before’ and ‘after’ of the two-period change analysis. These area values can be found in Table 1. The map denoting the change between the ‘Start’ and ‘End’ can be found in Figure 5.

**Results**

Annual time series analysis of study area (Figure 2) shows that the vegetation and the mine do not overlap in terms of NDVI. The false color composite (Figure 3). Shows little change in the study site.

**Discussion**

Table 2 suggests that after the abandonment of the Hobet mine the area of the mine decreased by 13.3 % in area. Over time, nature has slowly taken the mine back.

We believe exploring the literature on the past ecology of the area and accounts of the changes that may have taken place over the operation of the miens and conducting new ecological surveys might lead us to better understand how reduction of habitat for certain species might affect their populations.

Better understanding the change in the landscape of the Hobet mine is imperative to decide if restoration of the area is needed and it might lead to which approaches might be best. Due to the high costs of restoration and the reduced impact of the former mine to the landscape every year, it may not be a site of interest for immediate restoration, however, understanding other variables such as chemical contamination might change this conclusion. GIS is not the whole picture of this site.

**Figures**

**A aerial view of a green area

Description automatically generated**

**Figure 1:** *Maps of the Hobet Mine in West Virignia. Images from 1995 (left) and 2020 (right).*

*A graph with red and green dots

Description automatically generated*

**Figure 2:** *Annual time series graph of the Hobet Mine (West Viginia).*

*A green surface with many lines

Description automatically generated with medium confidenceA close-up of a red surface

Description automatically generated*

*1986-07-05 2020-12-09*

**Figure 3:** *False color image composite of before (left) and after (right).*

**A close-up of a satellite image

Description automatically generated**

**Figure 4:** *Map**of Normalized Difference Vegetation Index (NDVI) Hobet Mine (West Viginia).*

**A satellite view of a green area

Description automatically generated**

|  |  |
| --- | --- |
| **Color** | **Feature (Class)** |
|  | Forest |
|  | Mine |

**Figure 5:** *Classified map of change. Legend indicates the color of the different features.*

**Tables**

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**Table 1:** *Confusion matrix derived from a supervised classification of forested and mine areas in the Hobet mine (West Virginia).. User’s accuracy for all classes is highlighted in orange. Producer’s accuracy for all classes is highlighted in blue. Total accuracy was \_\_%.*

|  |  |
| --- | --- |
| **Class** | **Area Cover** |
| **Forest (Before)** | 89.40% |
| **Forest (After)** | 92.70% |
| **Mine (Before)** | 10.60% |
| **Mine (After)** | 7.30% |
| **Forest Change** | -6.70% |
| **Mine Change** | -13.30% |

**Table 2:** *Percentage cover of each class (‘Forest1’ and ‘Forest’2 merged into ‘Forest’)*

**Works Cited**

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Cravotta, C. A. (2008). Dissolved metals and associated constituents in abandoned coal-mine discharges, Pennsylvania, USA. Part 1: Constituent quantities and correlations. \*Applied Geochemistry, 23(2)\*, 166–202. https://doi.org/10.1016/j.apgeochem.2007.10.011

**Honor Code**

I affirm that I have upheld the highest principles of honesty and integrity in my academic work and have not witnessed a violation of the Honor Code.

**Links to Scripts**

[Two Period Analysis (unsupervised)](https://code.earthengine.google.com/74443652cf4ac9345ce0210b9d4ddf1c)

[Unsupervised Classification](https://code.earthengine.google.com/58bf88ef96ac2c8fd8b10d25e4c29dce)