

Remote Sensing for Forest Recovery: Proposal

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1 Abstract

This is the abstract. Zeng et al. (2022) did a study on vegetation indices.

2 Introduction

3 Data Description

4 Data Description

The dataset used in this study includes field-measured survival rates of afforested sites collected by Forest Ontario, as well as satellite data products from the Harmonized Landsat Sentinel-2 (HLS) project.

4.1 Site Features

	Description
ID	Site ID
PixelID	Pixel ID
Area_ha	Area of Site
Season	Planting Year
PlantDt	Planting Date
prevUse	Previous Land Use of Site
Planted	Number of Trees Planted
SpcsCmp	Species Composition of Site
Type	Species Type of Site
SrvvR_1, ..., SrvvR_7	Field Measured Survival Rate at Year 1-7 (Target)
AsssD_1, ..., AssD_7	Date of Field Survival Rate Measurement
NmbrPIO	Number of Trees Originally Planted
NmbrPIR	Number of Trees Replanted
NmbrPIT	Total Number of Trees Planted
ImgDate	Image Date of the Remote Sensing Data
Year	Image Year of Remote Sensing Data
DOY	Day of Year of the Remote Sensing Data

4.2 Spectral Indices

Index	Description
NDVI	Normalized Difference Vegetation Index
SAVI	Soil-Adjusted Vegetation Index
MSAVI	Modified Soil-Adjusted Vegetation Index
EVI	Enhanced Vegetation Index
EVI2	Two-band Enhanced Vegetation Index
NDWI	Normalized Difference Water Index
NBR	Normalized Burn Ratio
TCB	Tasseled Cap Brightness
TCG	Tasseled Cap Greenness
TCW	Tasseled Cap Wetness

4.3 Out-of-range Values

During EDA, we noticed that there are out-of-range values in the vegetation indices and survival rates. With the exception of TCB, TCW and TCG, the vegetation indices should range between -1 to 1 (2018, n.d.a, 2025, 2023, n.d.b; Sinergise, n.d.; Mondal 2011). The survival rates should not exceed 100. We will be removing these out-of-range records from the dataset.

4.4 Previous Land Use and Species Composition

Class imbalance was observed in 'SpcsCmp' column. Given that there are over 300 categories in 'SpcsCmp', it would not be practical for us to use this column as a predictor for our model.

Severe class imbalance are also observed in the 'prevUse' column, as such, we would also not be using 'prevUse' as a predictor for our model.

4.5 Species Type

From 'SpcsCmp', we are able to impute the species type. Sites are classified as Conifer(Deciduous) if the proportion of softwood(hardwood) species $\geq 80\%$, else, they would be classified as mixed.

Figure 1 shows that survival rates and spectral indices differs by species type, suggesting that 'Type' would be a viable feature to use as predictor for our model.

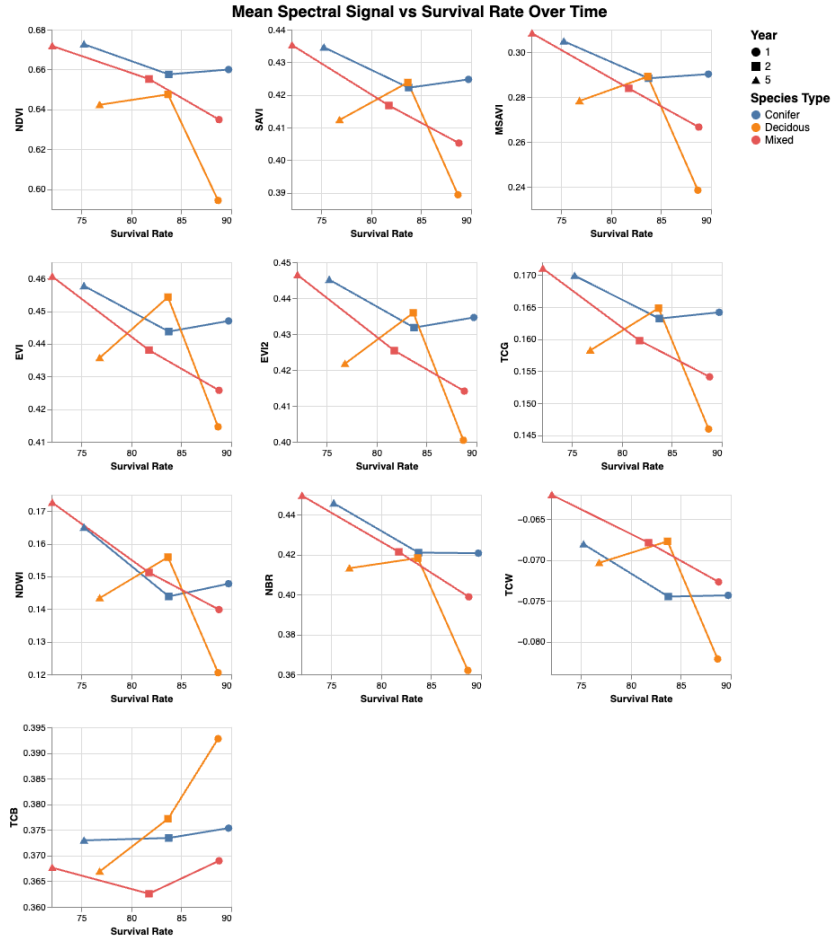


Figure 1: Plot showing mean survival rate and vegetation index signals for different species type in Year 1, 2 and 5. There is significant difference in the relationship between survival rate and VI signals for different species type. Conifers has a smaller signal response to change in survival rate. Deciduous shows the strongest response in the first two years. Mixed type shows a linear relationship between survival rate the spectral signal.

4.6 Trends and Seasonality

Clear seasonality was observed in the spectral indices, where the signals peaked during the summer and dropped during winter months (Figure 2). This would be something that we need to address in our model.

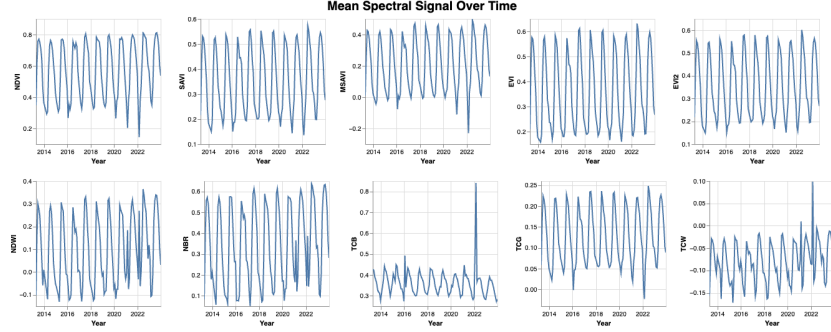


Figure 2: Plot showing seasonality in vegetation indices.

Figure 3 also shows a positive relationship between vegetation indices and tree age. Minimal change in vegetation indices was observed between age 1 to age 4. Indicating potential difficulties in survival rate prediction for earlier years.

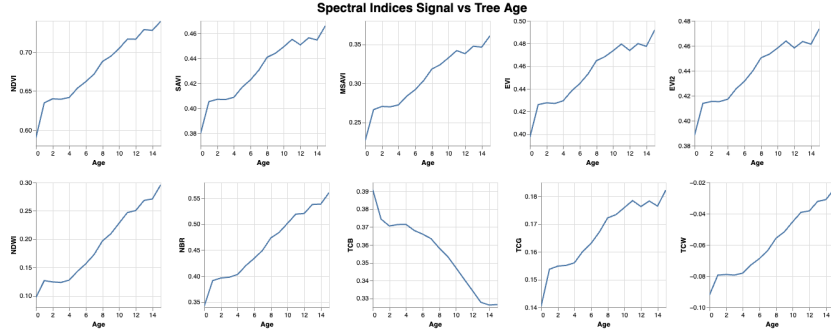


Figure 3: Plot showing mean spectral signal by tree age. With the exception of TCB, spectral signal increases as tree matures. A negative relationship was observed for TCB due to decreasing surface brightness as canopy cover increases.

4.7 Collinearity

From Figure 4, we observed strong collinearity between vegetation indices except for TCB. The strongest correlation between survival rate and vegetation indices is observed in Year 7.

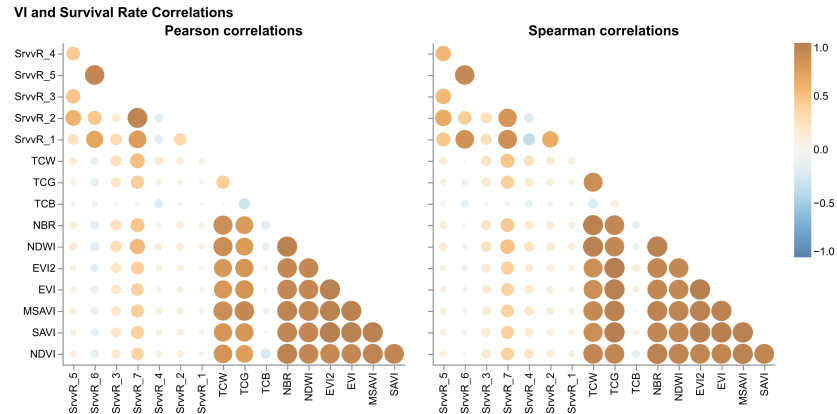


Figure 4: Correlation plot showing strong collinearity between vegetation indices.

5 Data Engineering

6 Modelling Techniques

7 Success Criteria

8 Timeline

9 Conclusion

References

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