

Problem Statement

The Arabuko-Sokoke Forest (ASF), designated as a UNESCO Man and Biosphere Reserve and recognized as a biodiversity hotspot, faces persistent threats from illegal poaching and logging activities. These threats are exacerbated by the significant demand for forest products from nearby urban centers, including Malindi, Watamu, Kilifi, and Mombasa. Additionally, the presence of over 200,000 people residing at the forest boundary further intensifies these challenges, endangering the forest ecosystem's integrity, biodiversity, and the livelihoods of local communities. Effective strategies are imperative to combat the illegal exploitation of forest resources and to safeguard the ecological and socioeconomic value of ASF.



Objectives

General Objectives:

To leverage machine learning techniques for combating illegal poaching and logging activities in the Arabuko-Sokoke Forest (ASF) by analyzing historical data to develop predictive models that guide conservation interventions and law enforcement strategies.





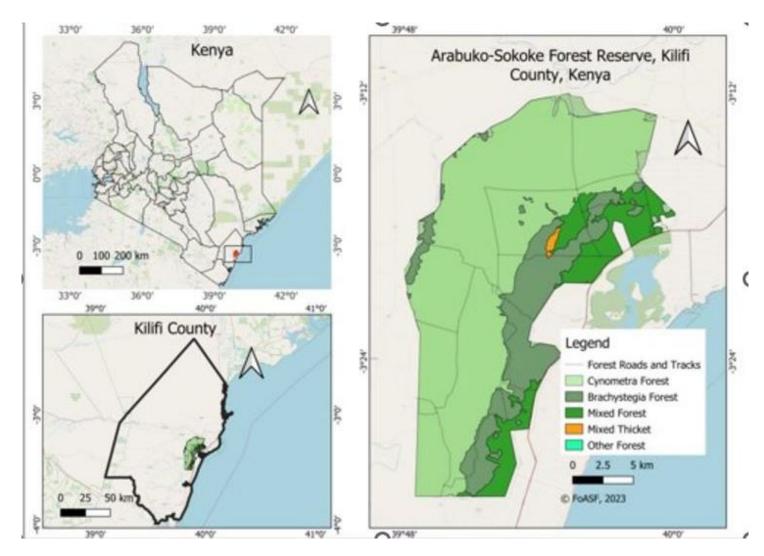
Fifty-two and 91 different snares were collected by Friends of Arabuko-Sokoke Forest community scouts during 2-day patrol in the Nature Reserve, and Ngerenya area respectively, Arabuko-Sokoke Forest, September 2023.

Specific Objectives:

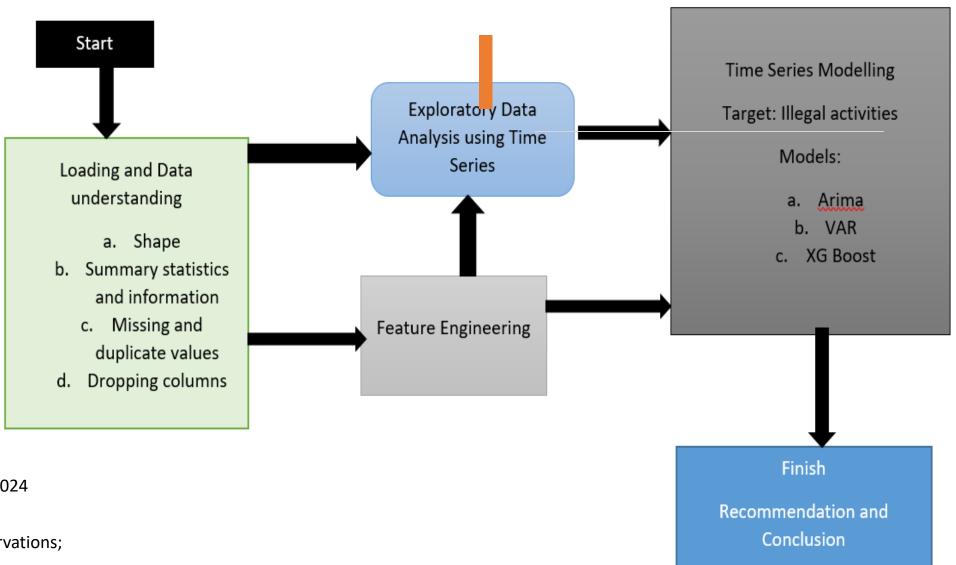
- Utilize time series analysis techniques, including ARIMA, VAR, and XGBoost, to develop predictive models for forecasting illegal logging and bushmeat poaching activities in ASF.
- Identify trends and patterns of illegal logging and poaching activities in ASF through comprehensive analysis
 of historical data.
- Compare the performance of different machine learning algorithms, including ARIMA, VAR, and XGBoost, in predicting and understanding illegal logging and poaching patterns in ASF.
- Evaluate the practical implications of the predictive models in informing conservation strategies and policy decisions aimed at safeguarding ASF's ecological integrity and supporting local communities.

Research Questions

- How effectively can time series analysis techniques, such as ARIMA, VAR, and XGBoost, forecast illegal logging and bushmeat poaching activities in ASF based on historical data?
- What are the trends and patterns illegal logging and poaching activities in ASF, as revealed by the analysis?
- Among the utilized machine learning algorithms, namely ARIMA, VAR, and XGBoost, which demonstrate the highest efficacy in predicting and understanding illegal logging and poaching patterns in ASF?
- How can the actionable insights derived from these predictive models contribute to the development and implementation of effective conservation strategies and policies for ASF, considering ecological preservation and community livelihoods?



Methodology



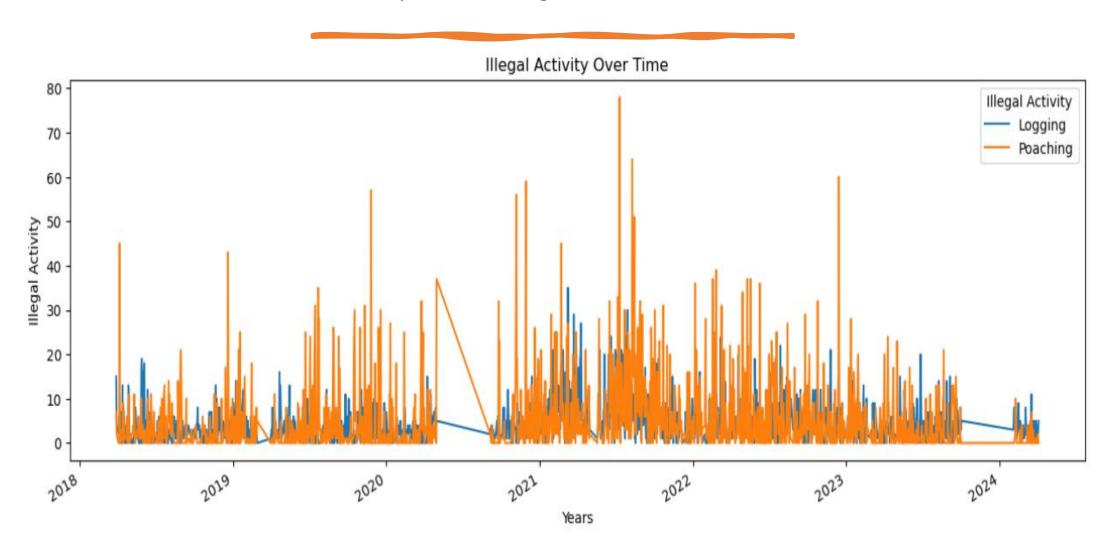
- Source of data: Survey 2018-2024
- Tool used: SMART tech
- Data description: 18761 observations;

total 28 columns)

Numerical and categorical data types

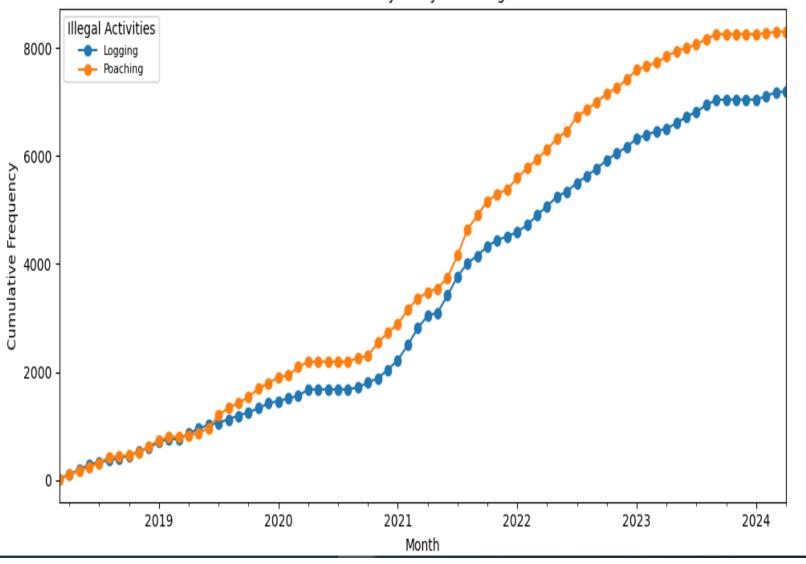
Exploratory Data Analysis

The trends and patterns in illegal activities from 2018 to 2024.

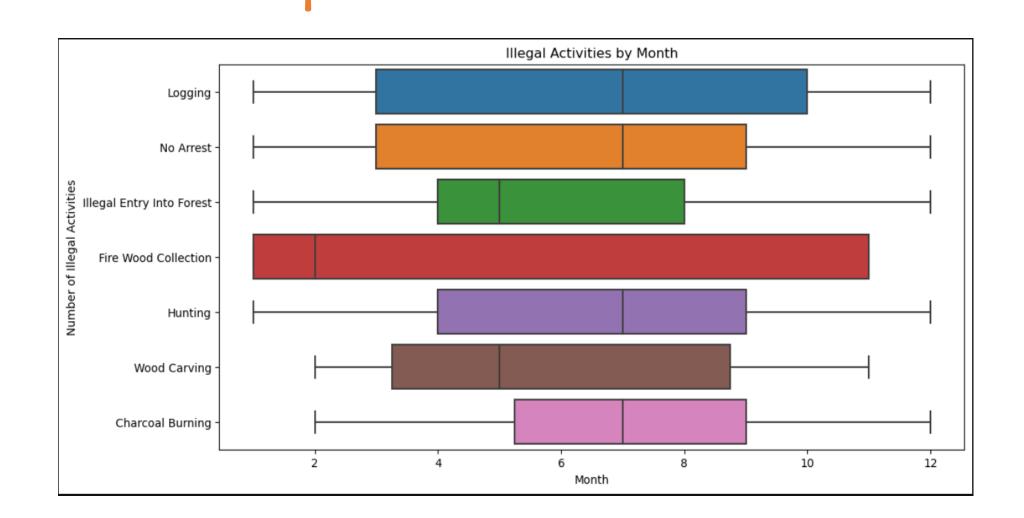


Positive trend; the illegal activities increases with time (2018 to 2024)

Cumulative Monthly Analysis of Illegal Activities

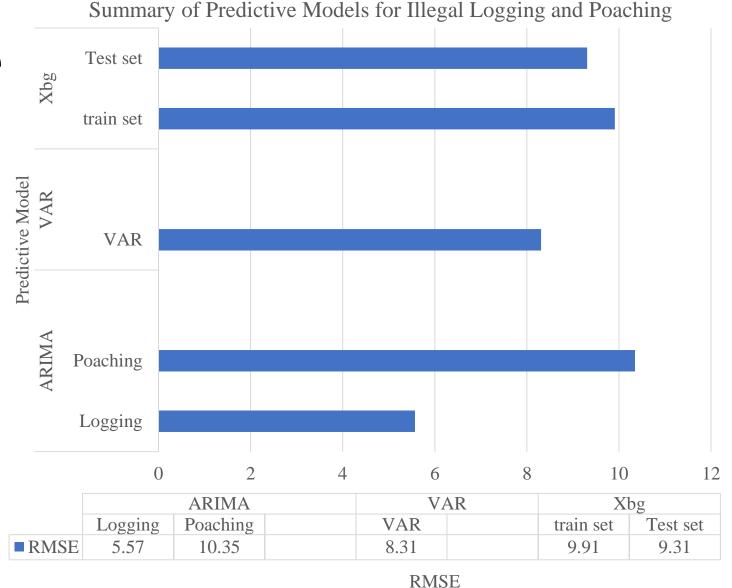


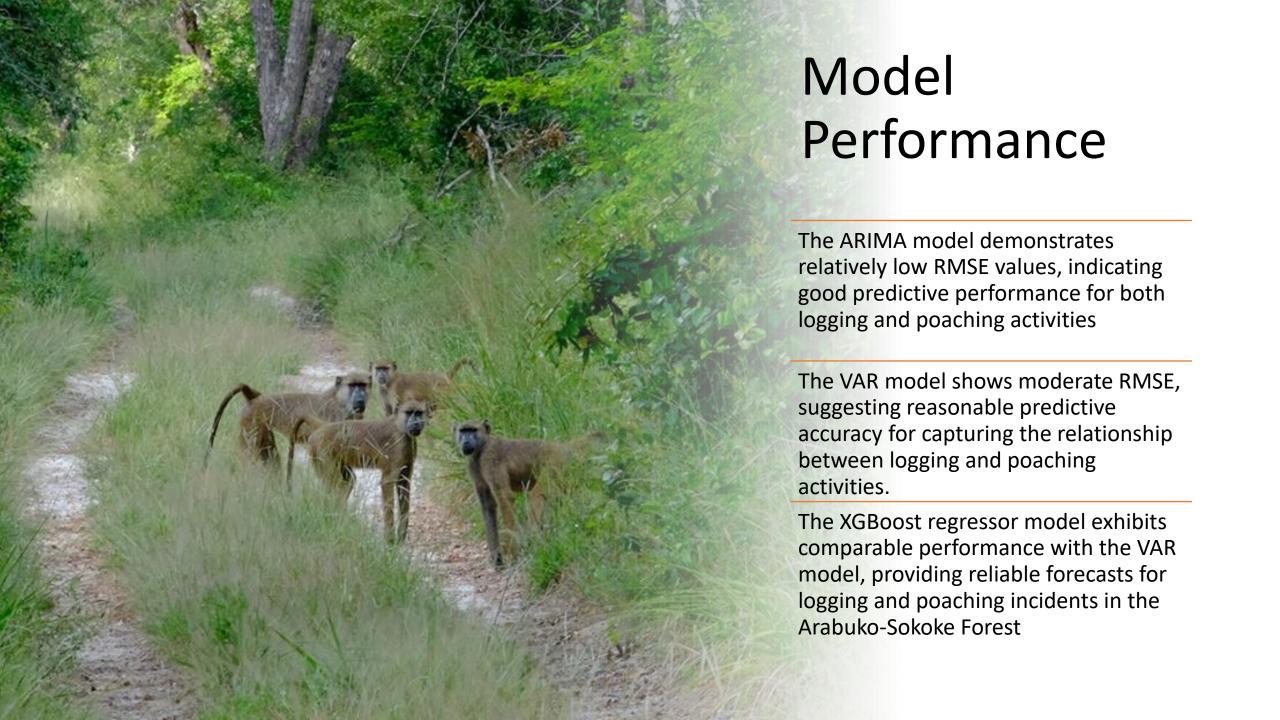
Monthly Quartiles and Median for Arrest of Illegal Poaching and Logging in Arabuko Sokoke Forest



Model Performance

- XGBoost regressor model exhibits comparable performance
- VAR model shows moderate RMSE
- and ARIMA model: relatively low RMSE







CONCLUSION

The integration of machine learning techniques into conservation planning and management offers a promising approach to combat illegal activities threatening the Arabuko-Sokoke Forest. By harnessing the power of predictive analytics, stakeholders can work towards a sustainable future for ASF, preserving its biodiversity and ecosystem services for generations to come.

"In harnessing the power of predictive analytics, we chart a course towards a sustainable future for the Arabuko-Sokoke Forest, preserving its biodiversity and ecosystem services for generations to come"

— Mlati, Philip, Stella, Ahmed, and Allan

Data Scientists

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