Forest Fires in Alberta, Canada (2006–2023): Impacts, Analysis, and Management

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Introduction

Wildland fires in Alberta, Canada, are a significant natural disaster with widespread environmental, economic, and social impacts. Between 2006 and 2023, Alberta experienced a notable increase in wildfire size and frequency, culminating in severe incidents like the 2024 Jasper wildfire. This study analyzes historical wildfire data to uncover key trends, influencing factors, and mitigation opportunities. By identifying correlations between wildfire behavior and environmental variables such as temperature and humidity, this research highlights the challenges and opportunities for improving wildfire management and reducing their long-term impacts.

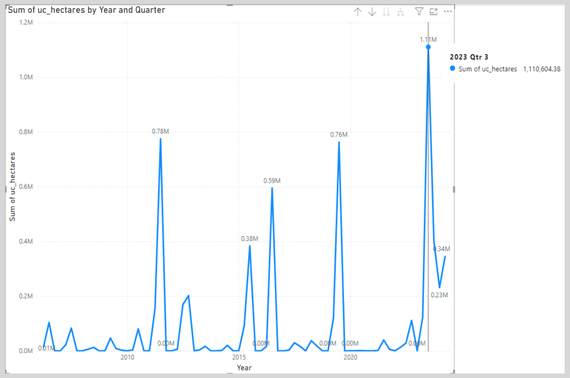
Objective

Analyze the size, frequency, and distribution of wildfires in Alberta between 2006 and 2023.
Identify key environmental and human factors influencing wildfire size and behavior.
Develop predictive models to improve understanding and management of wildfire risks.
Propose strategies to mitigate wildfire impacts on Alberta's environment, economy, and communities.

Materials & Methods

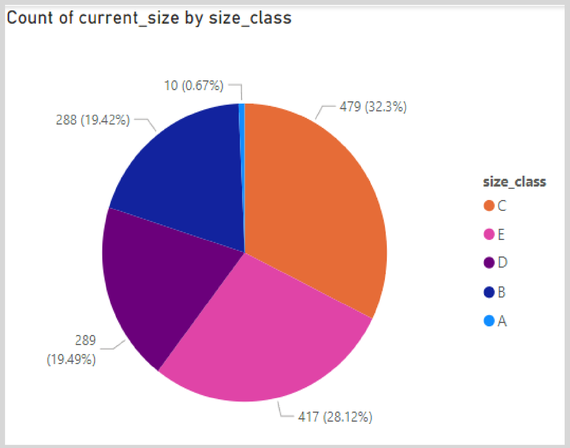
Data Collection: Over 25,000 wildfire records from Alberta Forestry and Parks (2006–2023).
Data Preprocessing: Cleaned and filtered data, selected key variables: temperature, humidity, wind speed, and proximity to water.
Analysis: Descriptive statistics for trends, and Decision Tree Classifier for predicting wildfire size classes.
Visualization: Charts and maps to illustrate rends, size classes, and geographic patterns.

Results



Trends:

- Wildfire-affected areas grew by 2,481.82% from 2006 to 2023.
- Significant growth occurred after 2022, reflecting climate and vegetation changes.

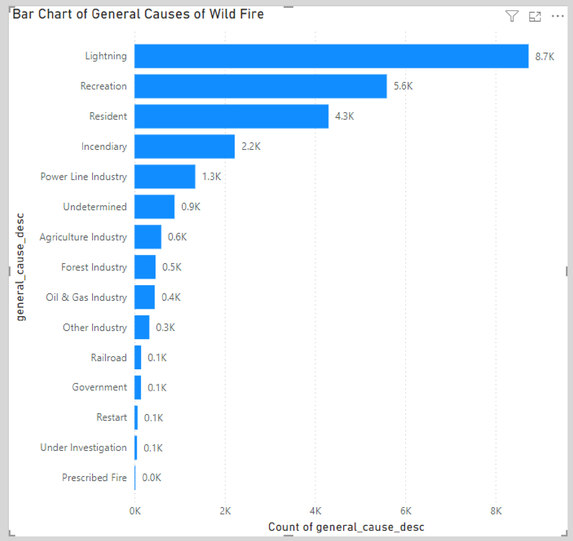


Size Classes: Most incidents fall in medium (C: 32.3%) and large (E: 28.12%) categories.

Key Factors:

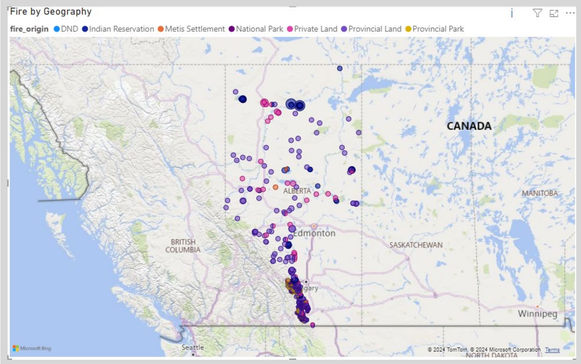
- High temperatures and low humidity strongly correlate with larger fires.
- Lightning is the leading cause (34.49% of all incidents).

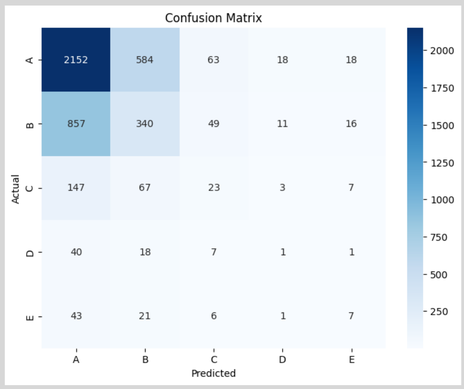
Results



Geography:

- Provincial lands see 71.25% of all wildfires





Model Performance: Decision Tree achieved 60% accuracy, excelling with smaller fire classes.

Challenges

Class imbalance and limited features affected model performance.
Increasing wildfire in sizes and amount highlights the need for better management.

Discussions/Conclusions

Conclusions:
•Climate conditions and human activities are major drivers of wildfire behavior.
•Rising fire intensity calls for enhanced strategies and policies.
Recommendations:
•Stricter fire season regulations and targeted public education.
•Improved resource allocation and long-term climate adaptation measures.
Future Work:
•Incorporate more variables (e.g., terrain, fuel type).
•Explore advanced models for better predictions.

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