

The Analysis of Relationship between Forest Fire Distribution and Topographic, Geographic, and Climatic Factors

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Abstract

Most of the forest in Korea is composed of pure stands with high density. Because of this forest condition, forest fire in Korea tends to be diffused rapidly and widely. Therefore, endeavors to predict and cope with forest fire are critical. To predict forest fire, it is important to understand the relationship between forest fire and other factors that influence on the events. In this study, the points where forest fire had occurred from 1991 to 2006 were acquired to compare with topographic, geographic and climatic factors. With topographic information such as different altitude, aspect, and slope located by each point, the occurrence frequency of forest fires was analyzed. With geographic information, we analyzed accessibility from the occurrence position of forest fire to the roads where the fire originated and population density. We also analyzed relationship between climatic factors and forest fire frequency. As a result, area of 1km × 1km susceptible to forest fire was derived according to the impact from each factor causing forest fire. Especially, easily accessible point of height from less than 200m showed 67% more forest fire. The human approach in highly populated areas and roads are a strong regional factor in frequent occurrences of forest fire. Forest fire was occurred most frequently from late March to mid-April. In this study, each of the factors causing forest fire was analyzed separately. However, the relationships between those factors were limited in this study. Further research and analysis about the relations between each factors and more specific causation between the factor and forest fire are needed.

Key words: forest fire, wildfire, topographic, geographic, climatic

1. Introduction

In South Korea, 70% of the land is forest area. Therefore, if forest fire occurs, it may be possible for forest fire to be diffused rapidly and widely. Therefore, endeavors to predict and cope with forest fire are critical. For predicting forest fire, it is important to understand the relationship between forest fire and the factors such as topographic, geographic and climatic conditions. Forest fire was occurred by combined factor such as fuel condition (just like species of trees, density, and array), climatic factor (just like humidity, temperature, and wind velocity), and topographic factor (aspect, slope, altitude) (Davis et al., 1959). Especially, most forest fire occurred by the human impact. The most common cause of forest fires is mountain climbers' carelessness in South Korea. The natural ignition never reported in the last 30 years in South Korea. Humans are closely related to forest fires (Lee et al., 2006). In this study, the database for forest fire in South Korea was built and analyzed for the relationship with such factors.

2. Methods

Study area was South Korea located in 33°07' ~ 38°37'N, 124°55' ~ 130°42'E. Situated from 1 to 1950m above sea level, the western part of South Korea is low-elevated area and the eastern is high-elevated area with by steep hills. Most of the forest is homogeneous stands and has high tree density. Data for forest fire occurrence from 1991 to 2006 was obtained. The data were composed of the occurred date, time, damage area, control time, city, possession, species of trees, origin. The Digital Elevation Model (DEM) was derived from contour of 1:25,000 digital maps. Altitude, slope and aspect was extracted from DEM. Roads was also extracted from digital maps. Using Euclidean distance method introduced in Arcinfo's spatial analyst tools, the distance from forest fire occurrence positions to the nearest roads was calculated on 1km × 1km grid. The population density, which was provided by the National Statistical Office, was used to convert into raster data using Inverse Distance Weighted (IDW) interpolation method. 76 points of weather data acquired from observatory used to generate raster data taking advantage of Inverse Distance Squared Weighted (IDSW) interpolation method.

3. Result

A total of 9684 forest fires had occurred during 16 years from 1991 to 2006 in South Korea. Fig. 1 represented the statistics of forest fire occurred by year. Approximately 42% of total number of forest fire was at three years (1997, 2000 and 2001). Fig. 2 represents the statistics of forest fire occurred by month. Approximately 75% of all forest fire occurred from February to April in each year.

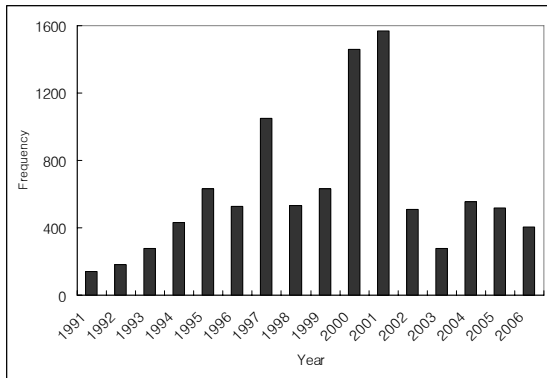


Fig. 1 Forest fire occurrence by Year

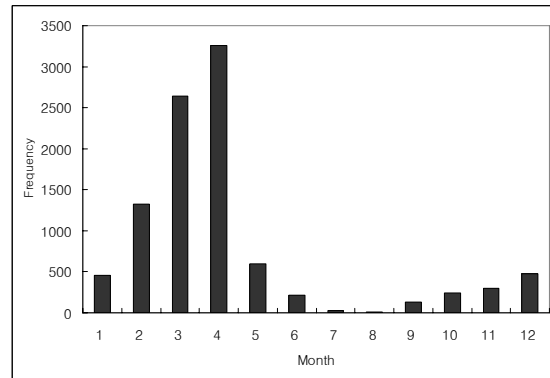


Fig. 2 Forest fire occurrence by Month

Fig. 3 represented the frequency of the forest fire occurred by day. Mean frequency of forest fire occurrence during a day was approximately 310. The 5th day of months has twice frequency. In South Korea, April 5th is Arbor Day. When many people often go to forested area for planting saplings, the forest fire is caused by the carelessness of the people. Forest fires are most often caused from 2 p.m. to 8 p.m. because people are most active at that time.

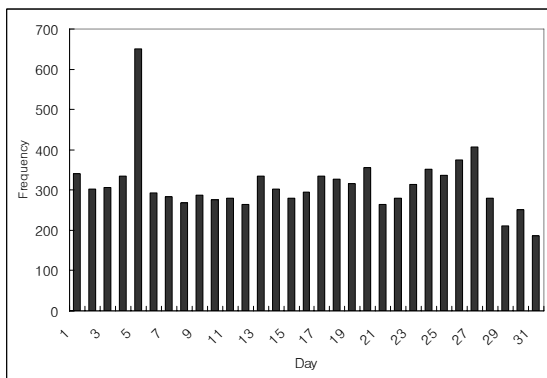


Fig. 3 Forest fire occurrence by Day

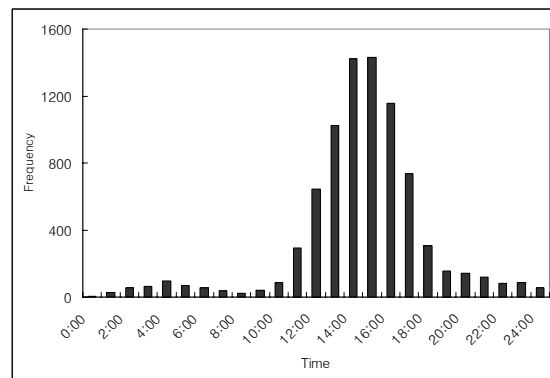


Fig. 4 Forest fire occurrence by Time

The forest fire occurred on weekend was more than that on weekday. The damaged area by forest fire is usually less than 10ha.

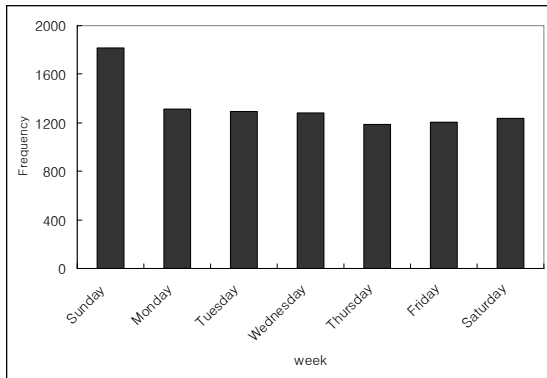


Fig. 5 Forest fire occurrence by Week

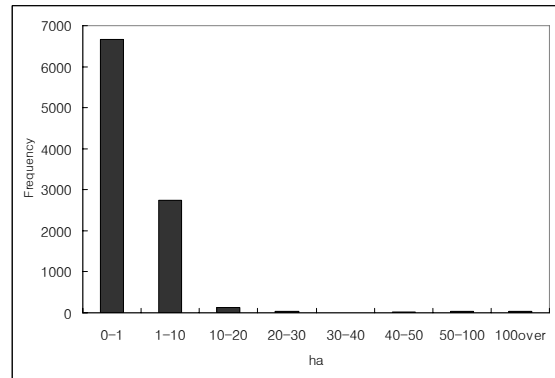


Fig. 6 Affected area by forest fire

As shown in Fig. 7, forest fire frequently occurred around urban. The faults of human in forest area caused forest fire, especially by burning and a careless.

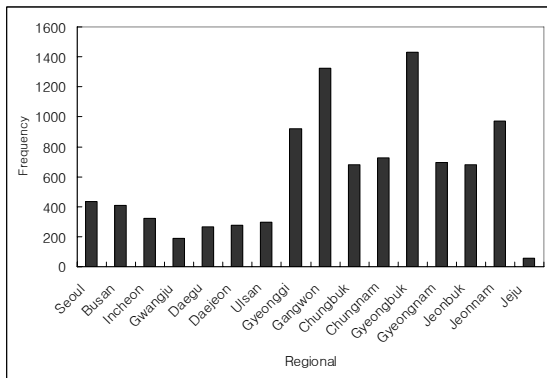


Fig. 7 Forest fire occurrence by Region

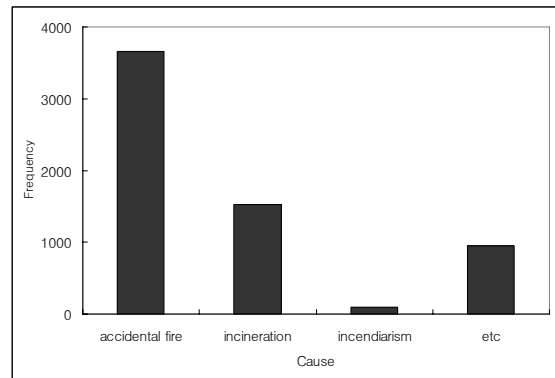


Fig. 8 Forest fire occurrence by Cause

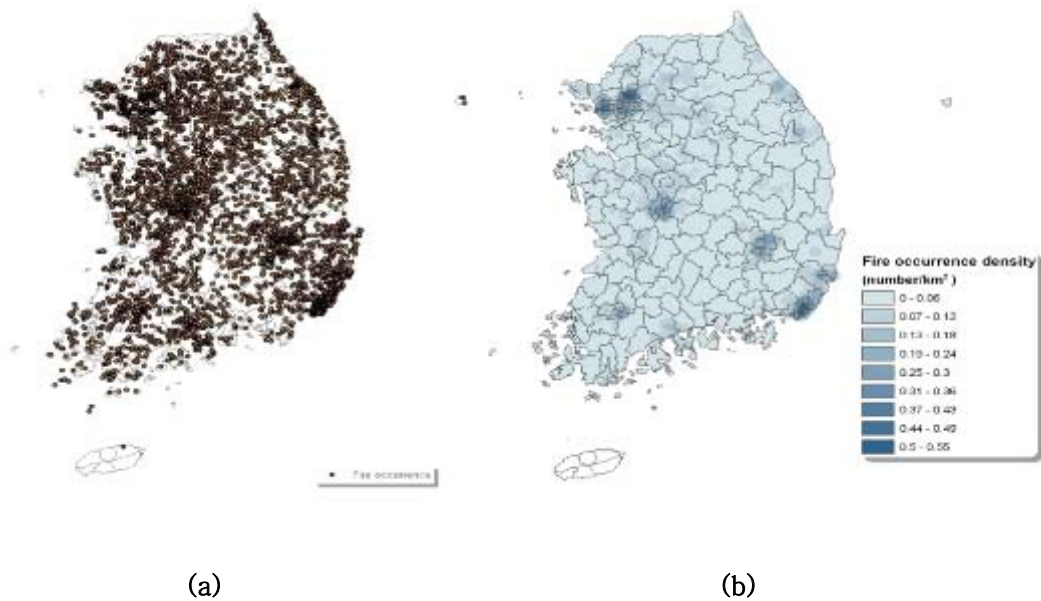


Fig. 9 Forest fire occurrence point (a) and Forest fire occurrence density (b)

As shown in Fig. 10 and 11, forest fire was occurred mainly less than 200 meters elevation and 25° slope.

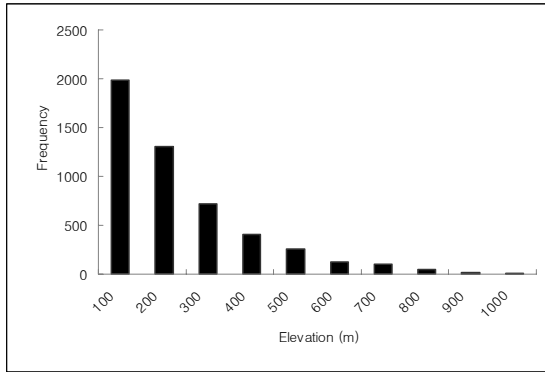


Fig. 10 Forest fire occurrence by elevation

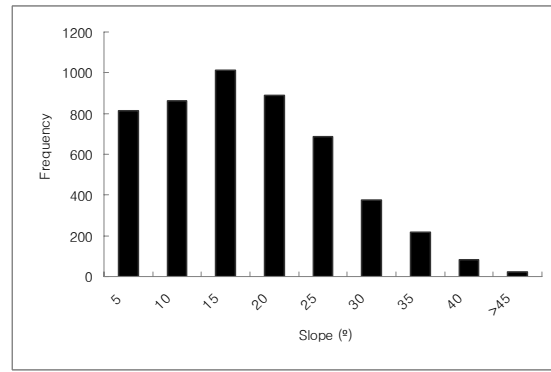


Fig. 11 Forest fire occurrence by slope

Forest fire was occurred mainly to the south direction and in the area with population density being less than 500.

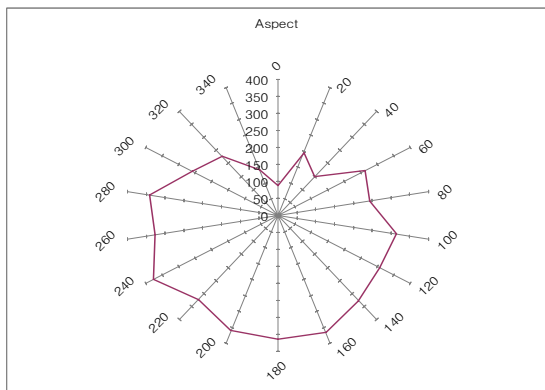


Fig. 12 Forest fire occurrence by aspect

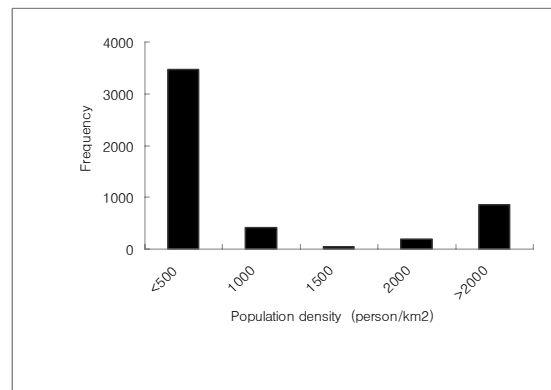


Fig. 13 Forest fire occurrence by population density

The farther distance from roads, the lower probability of forest fire.

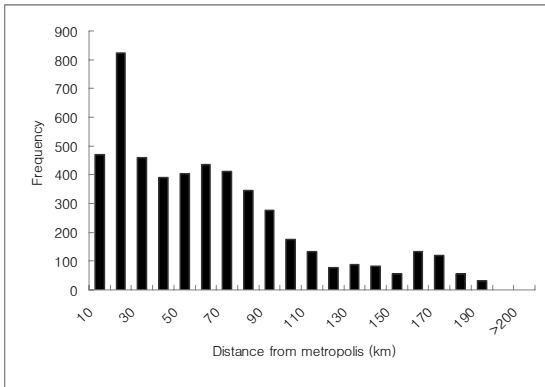


Fig. 14 Forest fire occurrence by Distance from metropolis

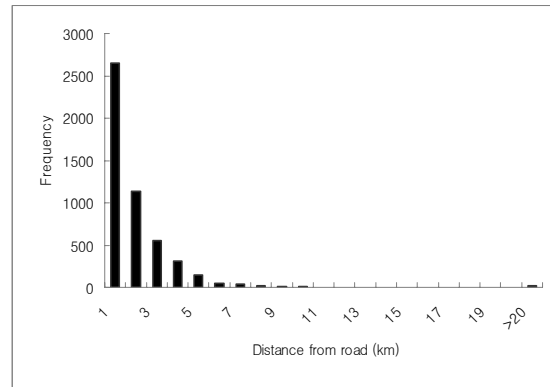


Fig. 15 Forest fire occurrence by Distance from roads

As shown in Fig. 16 and 17, forest fire was occurred mainly at 10°C temperature and 56% relative humidity.

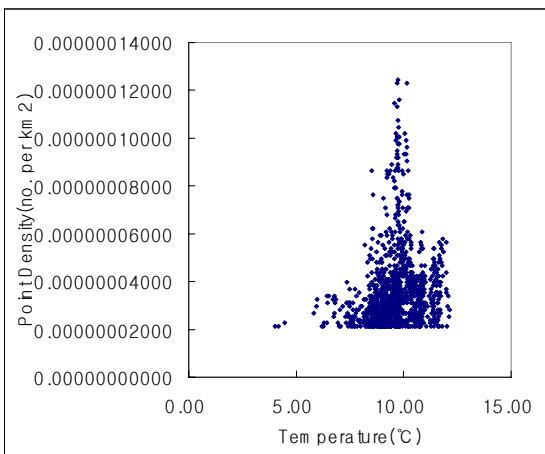


Fig. 16 Distribution of Point density and Temperature

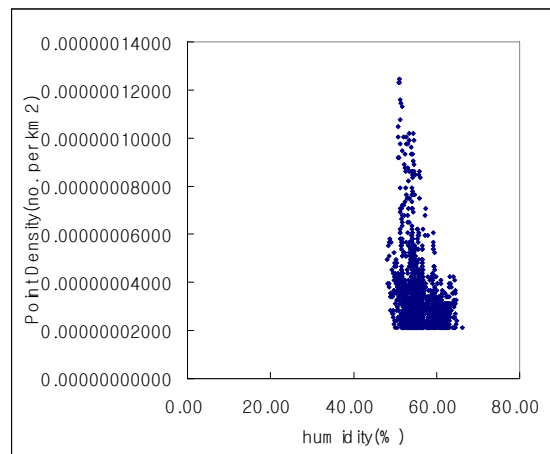


Fig. 17 Distribution of Point density and Humidity

4. Conclusion

In this study, Data for the forest fire occurred in South Korea was built. The relationship between the occurrence frequency of forest fire and some factors such as topographic, geographic and climatic conditions was analyzed by the factors. As a result, easily accessible height, less than 200m, showed 67% frequency of the total number of forest fire. The human approaches from high-populated areas are a strong regional factor leading to frequent occurrences of forest fire. Forest fire was occurred most frequently between late March and mid-April.

In this study, each of the factors causing forest fire was analyzed. However, the relationships between those factors were not analyzed for this study. After all, forest fire was closely related to human activities. It is needed that further research for relationship between each factor is considered.

5. Acknowledgment

This study was carried out with the support of 'Spatial Characteristics of Forest Fire Occurrence and Damage using GIS and RS Techniques (Project No. S120707L0901101) provided by Korea Forest Service.

6. Reference

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