

# The Analysis of Forest Fire Extension Cause through a Case Study

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## Abstract

In order to investigate causes affecting the extension of forest fire size, we studied detail factors of forest fire spread at total 31 sites, which were consisted of 16 sites of over 30 ha from large size forest fire, and 15 sites of less than 30ha from small size forest fires during recent three years(2000~2003). Being based on findings upon investigation, The detail factors observed were statistically analyzed to see if there were any difference between large size and small size forest fires. The analysis results showed statistical significance at 1% probability level for six factors, including tree type, fuel continuity, wind speed, maximum wind speed, maximum elevation, and length of slope.

In particular, the main factors of causing large forest fires are a distribution of tree species such as conifer(*Pinus densiflora Sieb.et Zucc*), a continuity of fuel arrangement, a wind speed of 5m/s over, the maximum wind speed of 9m/s over, the maximum elevation of 420m over and length of slope of 650m over. This paper focus is a need for study about spot fires and above six factors for the prevention of forest fires.

## 1. Introduction

Korea is located in continental temperate climate zones which has four distinctive seasons with relatively dry periods in spring and autumn. Therefore, periods from mid February to mid May from early November to mid December when the most forest fires occur every in

Korea. Recently, The size of forest fire in Korea is getting larger in many cases such as Kosung(3,762ha) occurred in April 1996, East Costal(23,792ha) in April 2000, and Cheongyang·Yaesan(3,095ha) in western region in 14. APR. 2002. As the large-sized forest fire over 30ha area has occurred not only in east coastal area, but also the central and west coastal district of country, the location of forest fire occurrences is expanding to cover all over the country.

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## 2. Experimental

### 2.1 Causal Analysis about an element on influence upon expansion of Forest Fire

On detailed elements of influence upon expansion of forest fire in the total of 31 regions affected by damages of forest fire among those recorded in the last 3 years (2000~2002), which include 15 regions affected by large-scaled forest fire damages of 30ha or more and 16 regions affected by small-scaled forest fire damages of less than 30ha, significance verification per each scale of damages by forest fire has been performed to display the significance level.(Figure 1.)

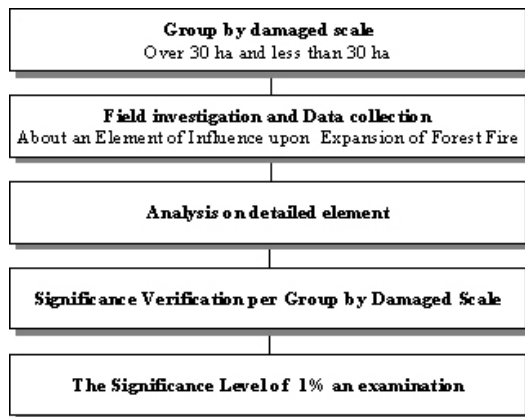


Fig 1.Causal Analysis Flowchart .

### 2.2 Causal Analysis of Magnification by Considering Characteristics of Spot Fire

The occurrence of spot fire is an important element influencing upon expansion of forest fire among other causes of forest fire magnification. Therefore, on-site investigation has been carried out on areas with spot fire occurrence in instances of forest fire, based on which the spot of fire fall and spot fire distance have been estimated, thus calculated. Figure 2, illustrates the investigation area of spot fire occurrence in Cheongyang-Yaesan region.

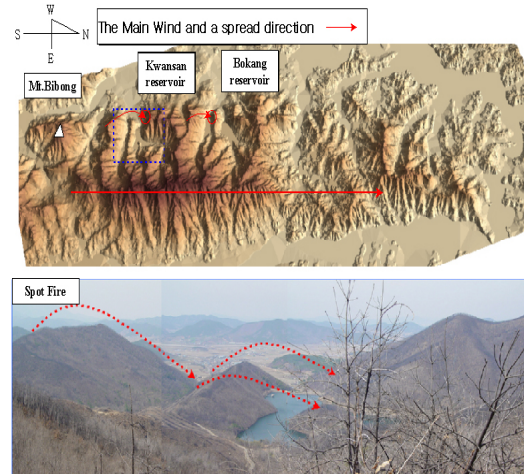


Fig 2. Spot fire occurrence in Cheongyang-Yaesan region

## 3. Results

On detailed elements of influence upon expansion of forest fire in the total of 31 regions affected by damages of forest fire among those recorded in the last 3 years (2000~2002), which include 15 regions affected by large-scaled forest fire damages of 30ha or more and 16 regions affected by small-scaled forest fire damages of less than 30ha, significance verification per each scale of damages by forest fire has been performed to display the significance level of 1% in 6 elements of tree types, fuel lasting factor, wind velocity, the maximum wind velocity, the maximum altitude and the slope length.

Particularly, the detailed causes of forest fire magnification indicated the characteristic that when tree type distribution is of acicular trees, such as of pine tree, etc. and there exists fuel lasting factor, the wind velocity of 5m/s or more, the maximum wind velocity of 9m/s or more, the maximum altitude of 420m or more and the slope length of 650m or more have been displayed.

Table 1. Significance verification analysis about an element on influence upon expansion of forest fire (ANOVA)

Scale	Number of Plot	Fuel		Terrain					Weather				
		Species of Trees <sup>1)</sup>	DBH (cm)	Max. Altitude (m)	Min. Altitude (m)	Altitude gap (m)	Slope (°)	Slope length (m)	Wind Direction (°)	Wind Velocity (m/s)	Max. Wind Velocity (m/s)	RH (%)	Min. RH (%)
Less than 30ha	16	2.10	13.9	197	129.7	67.1	21.2	204.6	243.5	3.20	5.4	22.9	17.4
30ha Over	15	1.38	14.4	419	91.9	327.5	26.7	650.8	214.3	5.39	9.0	27.3	13.2
F-Value		7.3*	0.1	15.2**	1.6	25.5**	4.0	17.6**	1.6	4.7*	12.3**	1.0	4.2

1) Value : Conifers = 1, Deciduous = 2, Mixed trees = 3  
 \* : Significance level of 5% , \*\* : Significance level of 1%

Table 2. The characteristics of the most representative regions of spot fire

Factors		Regions		Cheongyang·Yaesan (3,095ha)		Limpeemyun, Gunsan (220ha)	Gimje·Wanju (113ha)
				Kwangsimyun	Wansanlee		
Fuel	Main Tree	Conifer		Conifer	Conifer	Conifer	Conifer
	Height of Tree (m)	8 / 7~9		8 / 7~9	8 / 7~9	8 / 6~12	6 / 3~10
	Age of tree	30~40		30~40	30~40	20~25	20~25
Weather	Max. Wind Velocity (m/s)	15.1		15.1	15.1	9.4	12.3
Terrain	Ridgelines of Crown Fire occurrence	7~8		7~8	7~8	8	8
	Slope (°)	24		24	23	22	21
	Terrain Type	B1		B1	B1	B1	B3
Terrain Type							

The characteristics of the detailed causes in the most representative regions of spot fire generation as in Table 2 produced an analysis such as that the main type of trees are consisted of pines, the meteorological environment with the maximum wind velocity of 9.4m/s or more, crown fires in the 7~8th ridgelines and topographical structure consisted in steep hills of 21° or more. In case of the

fire forest occurrence in Cheongyang·Yaesan regions, the spot fire occurrence has been marked as in Fig 1.

#### 4. Discussions

In relations to the study on causes for forest fire magnification, increased investigation is to be performed on such occurrences via spot fire. In addition, for the purpose of effective forest fire prevention, establishment of active

countermeasures would be required on the regions affected by the above 6 causes of forest fire.

## 5. Conclusion

The characteristics of causing large forest fires were summarized as followings:

- distribution of tree species such as conifer(*Pinus densiflora Sieb.et Zucc*)
- continuity of fuel arrangement
- wind velocity of 5m/s over
- maximum wind speed of 9m/s over
- maximum altitude of 420m over
- and length of slope of 650m over

The characteristics of the detailed causes in the most representative regions of spot fire generation as followings:

- Conifer
- Maximum wind velocity of 9.4m/s or more
- Crown fires in the 7~8th ridgelines
- Slope of 21° or more

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