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Analysis of a Forest Fire: Mezitler Forest Fire

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ABSTRACT

The fire being object for investigation, inside the boundaries of Kepsut Forest Territorial Division connected with Balıkesir Forest Enterprise, Balıkesir Regional Forest Directorate, is located at 28°16'35" East longitude and 39°33'18" North latitude, recorded as Mezitler Fire. The fire initiated in 02.08.2005 and extinguished in 08.08.2005, has continued 140 hours 15 minutes and 200 ha of forest field have burned. Total cost of fire by 2005 was 932837.87 YTL. Forest safety roads (firebreak) played essential role as defense lines against fire, arrival, and at same time, backfire application place. Magnitude of Mezitler fire is 5. Class. Mezitler fire has got E class (between 50.1-200.0 ha) forest fire character according to largeness classification.

Keywords: Balıkesir, damage, fire analyses, forest fire, Mezitler.

INTRODUCTION

Forest fire is a fire that tends to be freely spread and can burn and destroy all flammable things including live and lifeless matters in a forest. The main characteristic of a forest fire is that its surrounding is clear and it tends to be spread.

Turkey's forest asset is around 20.7 million ha and 35% of it is located in first degree sensitive, 23% in second degree sensitive, 22% in third degree sensitive, 15% of it fourth degree sensitive and 5% in fifth degree sensitive regions in terms of fire. Especially, regions having a hot and dry climate in summers (Aegean, Mediterranean etc.) are the ones including the most of first degree sensitive areas. There have been many forest fires in such regions and thousands hectares of forest area has been demolished in a short time [1]. A total of 1.549.506 ha of forest area burned between 1937 in which first statistical records were taken and 2007 and the annual average is 24.27 ha between those years. Average number of forest fire per year between these years is 1143 and burned area per fire is 19.64 ha [2].

The main reasons of fire are humans and lightning. 97% of forest fires in our country are human-initiated. Remaining 3% is caused by lightning and unknown reasons [3] (Table 1). The majority of fires are often caused by people through sheer inadvertence or accident. These types of fires usually occur in and around recreation areas and camp sites, at wild land/urban interface or along major highways. Arson fires are set for several reasons. About 8.8 million people live in 17.445 villages in or near forests. Socio-economic life standards of most of these people are well below the national average. People with low income and low life standards see the forests as an earning ground for their sustenance. So, people set fire in the forests to create jobs that will earn them some provision or manipulate vegetation to improve and produce useful plants for their animals to graze. Personal conflicts between people and forestry officials or between shepherds or different villagers have also been reported to be a cause for fires [4].

General Directorate of Forestry is conducting forest fire fighting activities in Turkey. A powerful organization system has been established in order to facilitate efficient forest fire fighting. Observation and communication are the most important core elements of forest fire fighting. 745 lookout towers have been erected with observational purposes [5].

Forest fires can cause the destruction of a large number of trees, also the death or displacement of wild animals. Strong combustion not only burns forest and plants on the ground, but also changes forestry structure, forest biology, climate and soil performance. So the forest function of preventing water and soil from being washed away and that of regulating weather both decrease. So, the earth's surface becomes bare, and soil temperature increases. Then soil organisms are destroyed and the former forest area becomes wasteland [6].

The occurrence and behavior of fires mostly depends on social and cultural situation of the people living near the forests, the topographical structure of the area, flammable material characteristics and climate. So, the determination of the effects of these aforementioned factors on occurrence and behavior of fires regionally is quite important for making plans related to fires.

Table 1. Primary and secondary reasons of fires.

Primary Reasons	Lightning	Intent			Accident			Inattention and Carelessness							Unknown
Secondary Reasons		Terrorism	Fire Raising	Creating Field	Electricity Lines	Traffic	Train and others	Stubble Burning	Picnic Fire	Hunting	Sheppard fire	Cigarette	Garbage	Garden ad field Cleaning	Unknown reason

Extinguishing fires with minimum loss and increasing the effectiveness of operations against fires is possible primarily by proper analysis of the fires and the integration of the obtained results with fire management plans. The proper analysis of forest fires from all aspects is also very important for the effectiveness of the fire extinguishing operations [7].

The objective of this study was to investigate a forest fire and its damages in Mezitler. Mezitler fire which was not considered as arson but, it was started and spread in a very sensitive area very rapidly and caused the burning of 200 ha forest area.

MATERIAL AND METHOD

MATERIAL

Main materials of the study are Balıkesir Regional Forest Directorate, Kepsut Forest Territorial Division connected with Balıkesir Forest Enterprise, and Mezitler forest fire occurred in 2005. References, records and statistical information related to the forest fire have been tried to be obtained from the Turkish Ministry of Environment and Forestry General Directorate of Forestry Service. The reasons for choosing Kepsut Forest Territorial Division are that it is in first degree fire sensitive region and there have been big fires in the past. Kepsut Forest Territorial Division is composed of two Working Section, as A-Calabrian pine Working Section and B-Black pine-Oak Working Section. Forest border of Kepsut Forest Territorial Division is in Kepsut County and it contains 33 villages. 19 of them are the 31th article of a law village and 14 of them are the 32th article of a law village. Territorial Division operates guarding activities to prevent illegal interventions with three joint guarding centers and one guarding center. Furthermore, there is a final depot within the Territorial Division. Kepsut Forest Territorial Division serves with one forest management chief, one depot officer, three forest guarding officer, four workers, 10 fire monitoring workers (fire watcher) who are employed in fire season, one communication worker, 10 workers for initial attack and a sprinkler team composed of 8 people [8].

Geographical Location and Topographic Structure

Study area is forest fire recorded as Mezitler Fire in 02.08.2005 and it is located at 28°16'35" E and 39°33'18" N. The area is 26 km far from Kepsut district and initial attack team, and it stays within the border of Mezitler village. Alaçam Forest Enterprise and Kireç Forest Territorial Division are located at the east of the area and Bigadiç Forest Enterprise and Bigadiç Forest Territorial Division are located at the south. Ankara-İzmir railway is located along Kille Stream Valley at the burned region. The slope changes in between 20% and 60% at the region and there are steep rocks and natural roughness which is not suitable for transportation and road construction activities. In this region, relative humidity is 30%, wind speed is 20 km/sn, highest temperature is 34^{o}C.

Main hills are Tuzlanca Hill, Kale Hill, Alikaya Hill and Baglankaya Hill. Average elevation is 300 meters. Most part of the fire area stays at north aspect [9].

Tree Species

Limestone is the dominant rock at the fire area. In addition, it is composed of two different aspects. At south aspect, there are pure Calabrian pines, and at north aspect after the elevation of 500 meters mix of Calabrian and Black pines is abundant and in higher parts the tundra turns into pure Black Pines. There are *Pinus brutia* Ten. and *Pinus nigra* Arnold. trees at where the soil is deep and intermediately deep, and there are chaparral formations in rocky and stony parts. Stand characteristics are: Çza (average diameter: 1-2 cm, thinned out 1500 numbers.ha^{-1}sapling), Çzab3 (main diameter at breast is 8-10cm, 950 numbers.ha^{-1} young tree), Çzb3 (main diameter at breast is 14 cm, 600 numbers.ha^{-1} young tree, crown closure: 3), Çkc2 (main diameter at breast is 24 cm, 243 numbers.ha^{-1} tree, crown closure: 2), Çzc3 (main diameter at breast is 26 cm, 570 numbers.ha^{-1} young tree, crown closure: 3), ÇzÇkc3 (main diameter at breast is 26 cm, 450 numbers.ha^{-1} young tree, crown closure: 3), BÇz (main diameter at breast is 30 cm, 100-150 numbers.ha^{-1} young tree, no crown closure), BM, BDy (no crown closure). There were found fuel materials in this region such as: ground vegetation (*Arbutus* sp. and *Quercus* sp.), ground litter (needle leaf litter, weed, logging waste, slash).

At the undergrowth, there are plants like eastern strawberry tree, evergreen oak, jasmine box and juniper. All these plants behave differently in case of a fire [9].

Transportation

There is Akçakertil-Mezitler Village road around the fire area, and forest roads and forest safety roads (fire break) at the north and south of fire area. Roading in burnt region is 18.5 m.ha^{-1}. At the rocky parts no road has been constructed. Closest bridge that connects north and south of the valley is 5 km away from fire area. Kille Stream was used for sprinklers and Akbaslar Watering Pond, which is 24 km away from fire area, was used for planes as water supply [9].

METHOD

It has been performed as two-stage.

Collecting Information about Fires and Mezitler Fire

Firstly, books and published articles have been investigated for this purpose. For the investigation of Mezitler forest fire initiated within the border of Kepsut Forest Territorial Division in 02.08.2005; Management Plan of Kepsut Forest Territorial Division, Management and Contour Maps, Forest Fire Struggling Action-Plan for 2005 year of Balıkesir Regional Forest Directorate, Road Network Plan of Kepsut Forest Territorial Division, Official Statement No: 285 of Ministry of Forest which is Application Principles in Prevention and Extinguishing of Forest Fires, Fire Evaluation Report, Fire Record Card, Fire Damage Reports and Registry Books of Kepsut Forest Territorial Division have been used [10].

Meetings and Investigations

For the investigation of Mezitler forest fire, meetings with Kepsut and Kireç Forest Enterprise Chiefs have been established and detailed information has been obtained. Furthermore, villagers and laborers working in production and silvicultural works have been contacted and their opinions, recommendations and observations about this forest fire have been recorded.

RESULTS

General Findings

Table 2. Burned forest areas and properties, between 2000 and 2005 [8].

Date	Time	Fire Period	Burned Area (ha)	Cause of Fire	Types of Fire
15.04.2000	16:10	5 hours 30 minutes	1,5	Inattention	Crown Fire
19.06.2000	16:50	17 hours 10 minutes	2,0	Inattention	Crown Fire
29.10.2001	11:50	6 hours	0,3	Inattention	Crown Fire
08.08.2002	13.20	24 hours	4,0	Accident (DDY)	Crown Fire
12.08.2002	12:20	239 hours 10 minutes	2978,0	Accident (Electric Line)	Crown Fire
24.07.2003	17.30	9 hours 30 minutes	1,5	Inattention	Crown Fire
27.08.2003	12:00	13 hours	0.7	Inattention	Crown Fire
06.08.2003	15:30	1 hours	0,1	Inattention	Crown Fire
31.08.2004	14:30	16 hours 30 minutes	5,5	Inattention	Crown Fire
29.08.2004	16:20	8 hours 40 minutes	3,0	Unknown reason	Crown Fire
02.08.2005	13:45	140 hours 15 minutes	115,0	Accident (Train)	Crown Fire
03.09.2005	14:00	42 hours	12.0	Accident (Electric Line)	Crown Fire
14.09.2005	14.50	7 hours 10 minutes	0,5	Inattention	Surface Fire

Kepsut region, where Mezitler Fire was initiated, as a first degree fire sensitive region and there have been big fires in the past (Table 2). Between 2000 and 2005 a total of 3118.6 ha of forest area burned [8].

The other forest fires and their costs in Balikesir Regional Forest Directorate in 2005 are given in Table 3.

Number and Types of Forest Fires of Forest Enterprises in Balikesir Regional Forest Directorate in 2005 are given in below (Table 4).

Fire Development

Mezitler fire initiated at a point at north of Balıkesir-Ankara railway passing from the south of compartment No: 419 of Kepsut Forest Territorial Division in 02.08.2005 Tuesday at 13:45 according to the fire warning by Akcakertil Fire Monitoring Tower. Inaccessible steep and stony parts, place where counter fire has employed, fire initiation point, fire line, place where fire got under control are given in Figure 1.

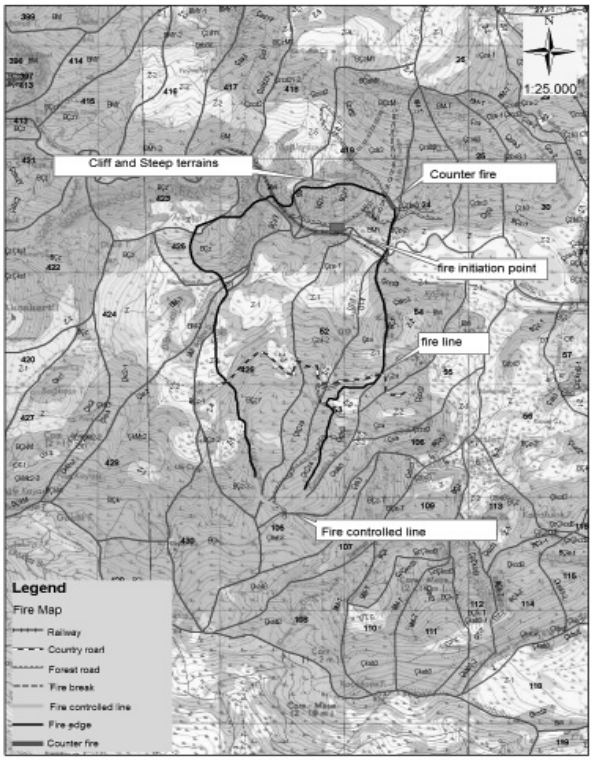

Figure 1. Fire initiation point and direction of progression [2].

Kireç Forest Territorial Division reached first to the fire area with sprinkler no: 805 at 14:00 and they directly tried to get the fire under control with an officer and 5 laborers from the south of Tuzlanca Hill.

Since fire progressed towards Northeast and North line of fire was empty; Kepsut Forest Management Branch no: 265 sprinkler and Dursunbey Forest Management no: 802 sprinklers were deployed to Tuzlanca Hill. At this point a dozer joined the works and fire lanes (cat lines) were opened and then northern line of the fire was got under control by supplying counter-fire from existing safety lane at 18:30.

Since there was no roadway to southern part of the fire, the area is steep and rocky, the distance between sprinkler and fire was long and the sprinklers no: 912, 119 and 667 were not be able to sent, Balıkesir Forest Enterprise and Dursunbey Forest Enterprise land teams were sent to the fire area. Fighting against the fire from air could not be performed to steep and stony places

Table 3. The other forest fires and their costs in Balikesir Regional Forest Directorate in 2005.

NAME OF FOREST ENTERPRISE	Burned timber crop	DAMAGE OF FOREST CROP										Reforestation Costs		Other e.c.	Sum Total Cost
		Completely burned forest crop			Damage of decreasing forest crop value						Total damage of forest crop				
		Quantity	Unit price	Amount	Amount		Diminishing Value Unit Price		Amount						
	m^3	m^3	m^3	Timber	m^3	Ster	m^3	Ster	Timber	Fuelwood		Hectare	Amount		
Alaçam	7304				3292	1716	8,38	2,1	27573	3604	31177	85	105314	3846	140337
Balikesir	5515	5515	11	60665							60665	139,8	263856	15056	339577
Bandirma												9,9	10402	29059	39461
Bigadiç															
Dursunbey					33	8	15	8	982	141	1123	13,45	34182	22076	57381
Edremit	345											8,94	9315	13574	22889
Sindirgi												2,27	945	1601	2546
TOTAL	13164	5515	11	60665	3325	1724	23,38	10,1	28,555	3745	92965	259,36	424014	85212	602191

Unit price = Amount = Million TL.
Other e.c. = other extinguishing costs (foods + fuels + lost hand tools)

since helicopter of Balıkesir was recruited to Antalya Regional Forest Directorate and then the fire jumped to the southern side of Kille Stream and it turned into a crown fire.

As a result of relative humidity of 30% and reaching of maximum temperature to 34°C along with changing of wind direction to south form north (speed of wind is 20 $km.h^{-1}$) and thus as a result of progression of fire as a crown fire at the southern part of railway located in the active point of fire; the fire headed towards Kale Hill. The sprinklers which were not active at Tuzlanca Hill region could reach Kale Hill by taking 10 km distance.

The fire which jumped over Mezitler-Akcakertil country road and headed towards the south got under control in 03.08.2005 Wednesday at 17:00 thanks to:

- Effective efforts of a plane and 5 helicopters,
- Decreasing wind speed,
- Effective efforts of Bigadiç Forest Enterprise first-intervention team from Kırantarla and Düzdavutkırı ridges,
- And since fire stays within Kepsut Forest Territorial Division no:426 and Kireç Forest Territorial Division no: 261 and 262 Blackpine-Oak mixed forest,

Equipment (13 dozers and a grader) supplied sprinklers to enter the area by opening a fire line [8].

Table 4. Number and Types of Forest Fires of Forest Enterprises in Balikesir Regional Forest Directorate in 2005.

NAME OF FOREST ENTERPRISE	Number of Fire	Total area (ha)	Types of Forest Fires		Fire Attendance Time (hour)
			Ground Fire (ha)	Crown Fire (ha)	
ALAÇAM	1	85		85	140
BALIKESİR	14	139.8	6.8	133	310.05
BANDIRMA	9	10.1	3.65	6.45	61.5
BİGADİÇ					
DURSUNBEY	8	13.5	11.4	2.1	74.28
EDREMİT	11	8.94	8.18	0.76	88.45
SINDIRGI	9	2.27	2.17	0.1	69.05
TOPLAM	52	259.61	32.20	227.4	

Table 5. The forest and fire conditions of Kepsut Forest Territorial Division [8].

Regional Forest Directorate	Balıkesir	
Forest Enterprise	Balıkesir	Alaçam
Territorial Division	Kepsut	Kireç
Division No	419,425,426	233,261,262
Stand Type	Çzb3,BÇz,BM	Çza, Çzb3, Çzab3, ÇzÇkc3,Çkc2,BÇz
Date of Fire	02.08.2005	
Time of Fire Occurence	13:45	
Time of First Intervention	14:00	
Date of Under Control	03.08.2005	
Time of Under Control	17:00	
Date of Fire Extinguishing	08.08.2005	
Time of Fire Extinguishing	10:00	

Properties of Burned Areas

The fire has started at Kepsut Forest Territorial Division and jumped to Alaçam Forest Enterprise Kireç Forest Territorial Division. Table 5 shows the forest and fire conditions.

Mezitler Fire has occurred as crown fire at Kepsut Forest Territorial Division, compartments no: 419, 425 and 426 which has a total area of 115 ha and Kireç Forest Territorial Division, compartments no: 233, 261 and 262 having a total area of 85 ha.

High wind speed and temperature, low relative humidity, broken structure of geology at progression direction and lack of means of access to area has caused fire to expand quickly. 10 ha of high forest, 105 ha of degraded high forest at Kepsut Forest Territorial Division and 65 ha of high forest and 20 ha of degraded high forest at Kireç Forest Territorial Division, totally 200 ha woody area have been burned (Figure 2) [8].

Fire Suppression Squad and Vehicles

General Manager of Forests, Head of Guarding Department, Regional Forest Director of Balıkesir, Forest Supervisor of Balıkesir, Forest Supervisor of Alaçam, Chief of Kepsut Forest Territorial Division, Chief of Kireç Forest Territorial Division, 30 technical staff, 20 officers and 385 fire extinguishing laborer has been included actively in extinguishing works (Figure 3) [8].

1 plane, 5 helicopters, 63 sprinklers, 13 dozers, 13 trailers, 1 grader, 7 midibus, 20 pick-ups, 5 buses and 2 ambulances has been used in control of the fire [8].

Figure 2. A photograph of burned area taken from plane (Balıkesir Regional Forest Directorate).

Figure 3. A fire extinguishing laborer (Balıkesir Regional Forest Directorate).

Table 6. Fire Records [8].

1	Information about Place of Fire		3	Time		Date		Time					
a	Regional Forest Directorate	BALIKESİR	a	Initiation		02.08.2005		13.45					
b	Forest Enterprise	BALIKESİR-ALAÇAM	b	First Intervention		02.08.2005		14.00					
c	Territorial Division	KEPSUT-KİREÇ	c	Under Control		03.08.2005		17.00					
d	Series	KEPSUT-KİREÇ	d	Fire Extinguishing		08.08.2005		10.00					
e	Place	MEZİTLER	e	Fire Period		140 hours 15 minutes							
f	Compartment No	419,425,426,233,261,262	4	How many of Management		BLK(8-1) ALA(1-1)		How many of Branch		Kps1-Ala1			
g	City	BALIKESİR	5	Fire Comm. Name, Surname									
h	District	Kepsut-Dursunbey	6	Fire Warning		177 Phone Line							
i	Village	Mezitler-Akçakertil	7	Initiation Point		Side of Railroad							
2	Discovery of Guilty	Not found	8	Extinguishing Method		Direct Method							
9	Cause of Fire	Lightning	Unknown	Intent	Inattention-Carelessness	Accident							
						Train							
10	Meteorological Information	Relative Humidity %	Wind Speed km/s	Wind Direction	Temperature (Max)		Amount of Rainfall (mm)						
		30%	20 Km/s	South	34		-						
11	Topographic Information	Altitude	Slope	Aspect	Surface	Wide Valley	Narrow Stream	Dry Stream	Edge				
		500	60-80	N,NE,NW,S	Rough				x				
12	Initiation Material	Grass	Bush	Litter	Chip	Wood	Debris	**Timber**	Other				
		X							x				
13	Of Burned Forest	Type of Management	Ordinary High Forest	Degraded High Forest	Normal Coppice	Degraded Coppice	Macchia	Forestation	Total				
			Ha	Ha	Ha	Ha	Ha	Ha	Ha				
a		Type of Stand	Çzb3,Çkc2,Çza,Çzab3,Çzc3,ÇzÇkc3,Bçz,BM,BDy										
b		Tree Type	Çz, Çk	Çz		M							
c		Type of Fire Surface											
d		Crown	75	120		5		200					
		Total	75	120		5.00		200					
14	Number of Saplings dried in burned Forestation area (up to 7.9 cm)		17600										
15	Amount of Tree in Burned Forest Area m^3 8 cm.Y.		K.G.H.	Wood	Round Timber	Industrial Wood	Paper Wood.	Grinding Wood	Firewood				
			12819	2339	2112	1670	1555	1555	1556				
16	Percentage of Tree Loss %		-	10%	10%	10%	10%	10%	10%				
17	Total Harm of Tree Management m3												
18	Loss of Management in Fire												
a	Loss of Burned Saplings		148544,00 YTL										
b	Loss of Management because of Burned Tree		Timber :	52659,98	Grinding wood :								
			Firewood :	6644,88	Total :	59304,86							
c	Forestation Cost		244.464.00 YTL										
d	Cost of supplies	9345.91	19	Included in Fire (Piece)		20	Vehicles (Piece)						
e	Cost of Laborer	7060.90	a	Regional Administrator	5	a	Pick-up	37	i	Dozer	14		
f	Cost of Fuel	-	b	Technical Staff	30	b	Truck	-	k	Loader	-		
g	Cost of Vehicle Rent	409.19	c	Officer	20	c	Minibus	7	l	Sprinkler	63		
h	Cost of Sprinkler.	84556.00	d	Extinguishing Laborer-Laborer	385	d	Truck	-	m	Grader	2		
i	Cost of Dozer	23242.00	e	Tax-payer	50	e	Bus	1	n	Trailer	12		
k	Cost of Trailer	3552.85	f	Military	50	f	Tractor	2	o	Truck	-		
l	Cost of Jigsaw	72.52	g	Police	-	g	Other	-	p	Plane	1		
m	Cost of Plane	85776.46	h	County Police	15	h		-	r	Helicopter	6		
n	Cost of Helicopter	273618.08		Total	555		Total	47		Total	98		
d-n	Total Cost	491.321.91 YTL	21	Total Management Loss									
o	Death Compensation		a	Loss of Management from Assets				59.304.86					
p	Handicapped Compensation		b	Loss of Management from Saplings				148.544.00					
r	Damage and Loss Reparation		c	Forestation Cost				244.464.00					
o-r	Total Compensation		d	Extinguishing Cost				491.321.91 YTL					
			e	Compensations				-					
a-r	General Total	491.321.91	a-e	General Total				943.634.77					

Cost of Fire

The forest fire initiated at Kepsut Forest Territorial Division and Kireç Forest Territorial Division in 02.08.2005 at 13:45 has continued 140 hours 15 minutes and 200 ha of forest field have been burned. Total cost of fire by 2005 was 932837.87 YTL.

***Cost of Sapling Loss*:** No sapling loss has recorded at Kepsut Forest Territorial Division. However, 11 ha of sapling at Kireç, compartment no: 261, It is assumed that there is an average of 1600 Turkish Pine saplings per hectare and according to forest law article no: 112/B: 11 ha*1600=17600 saplings*4.22 YTL*2= 148544.00 YTL.

***Cost of Tree Loss*:** A total standing volume of 5515 m^3, 1861m^3 of it is *Pinus nigra* and 3654m^3 of it is *P. brutia*, in Kepsut Forest Territorial Division and a total standing volume of 7304 m^3, 3615 m^3 of it is *P. brutia* and 3689 m^3 of it is *P. nigra*, in Kireç has been marked. According to the normal production assets as log, round timber, industrial wood and fuel wood, 10% of them have been damaged; the real cost is 59304.86 YTL according to the article 112.

***Cost of Forestation*:** Total forestation work to be done in Kepsut Forest Territorial Division is 99 ha, 39 ha of which is *P. brutia* and 60 ha of which is *P. nigra*. and in Kireç Forest Territorial Division, forestation will be made in a total of 85 ha of

area, 33 ha of it is *P. brutia* and 52 ha of it is *P. nigra*. According to the 114th article, changed by law no: 2869, of Forest Law numbered as 6831, total forestation cost is 227792.00 YTL.

***Cost of Food Supplies*:** Cost of food consumption was 5117.65 YTL and 4228.26 YTL in Kepsut Forest Territorial Division and Kireç Forest Territorial Division respectively. Total cost of food consumption was 9345. 91 YTL.

***Cost of Laborer*:** 385 fire fighting laborer has worked for 7 days during the fire. Thus the total cost of laborer was 12936.00 YTL according to 49/6th article of Labor Agreement.

***Cost of Vehicle*:** 1 bus and 7 minibuses have been ridden 364 km and 2659 km respectively during the fire. 37 pick-ups have joined the fire and ridden 15802 km. Total cost of vehicles was 4097.19 YTL.

***Cost of Dozer, Loader and Grader*:** 14 dozers and 2 graders have been included in fire fighting works and they have worked for 150 hours and 48 hours respectively. Total cost of heavy construction equipment was 23242.00 YTL.

***Cost of Trailer and Truck*:** 12 trailers have been used by the total of 4362 km during fire fighting works. Total cost for trailers and trucks was 3552.85 YTL.

***Cost of Power saw*:** Total cost for power saws used in fire fighting works was 75.52 YTL.

***Cost of Extinguisher Plane*:** A C130 type extinguisher plane (air tanker) has been used for 15.58 hours. Cost of one hour rent for this plane was 3540 USD. Thus total cost of air tanker was 85776.46 YTL.

***Cost of Extinguisher Helicopter*:** 6 extinguisher helicopters (helitank) have been used during the fire and they had a 64.61 hours flying time. One hour renting cost was 2723 USD according to order no: 283 of General Forest Management. USD exchange rate of Central Bank of Republic of Turkey was 1.318 YTL according to the Official Gazette published. Therefore, the cost of fire extinguisher helicopter was 273618.08 YTL.

***Cost of Sprinkler*:** 63 sprinklers has been recruited and actively worked in fire fighting. The cost of sprinkler was 84556.00 YTL. [8] (Table 6).

Classification of Fires According to Burned Areas

Developments of Fire Organization and new precautions taken towards forest fires have caused significant changes in either areas or number of forest fires in Turkey. As parallel to these, forest fires have been classified under 7 main groups. These are: Class A: 1,0 ha or smaller areas, Class B: between 1,1-5,0 ha areas, Class C: between 5,1-20,0 ha areas, Class D: between 20,1-50,0 ha areas, Class E: between 50,1-200,0 ha areas, Class F: between 200,1-500,0 ha areas, and Class G: Areas greater than 500,1 ha. According to this classification fires burning greater areas than 500 ha is called as "Big Fires". Small fires have two dimensions and low magnitude. There is also another vertical column called as convection column in big fires. Fires burning with high energy outcome, having three dimensions, developing a noisy convection column, having storm characteristics and initiating fires in areas far from hundred of meters are Big Fires [3, 11]. Mezitler fire has got E class forest fire character according to this classification.

Table 7. Type of fire determined according to class of fire intensity and difficulty of struggling fires [2].

Class of Fire Intensity	Fire Intensity (kw/m)	Fire Type and Struggling Difficulty
1	< 10	Self-progression of fire is difficult.
2	10-500	Ground fire with low intensity and low progression rate. Intervention is possible from head and sides. Opened corridors may be adequate to control the fire.
3	500-2000	Intermediate to high intensity Ground fire. Difficult to control the fire with corridors. Vehicles like dozers, planes and helicopters are important.
4	2000-4000	High intensity ground fire. Things to be done in head of fire may not be successful.
5	> 4000	Intermediate and active crown fire. Difficult to control. Works (for fire control) should be done at sides and indirect intervention.

Magnitude (or Intensity) of Fire

Intensity of fire is an indicator to determine the difficulty level of struggling fires (Table 7). Magnitude of Mezitler fire is fifth class because of being seen together with crown fire and surface fire.

CONCLUSIONS AND SUGGESTIONS

According to the last 5-year data supplied by Kepsut Forest Management Branch, fires usually began afternoon [8]. This is also the case for Mezitler Fire. Magnitude of Mezitler fire is fifth class because of being seen crown fire [2]. Mezitler fire has got E class forest fire character according to largeness classification [3, 11].

It is considered that the main reason for this fire which initiated in Balıkesir Forest Management Kepsut Forest Management Branch and caused burning of 200 ha of forest area was, though it is not still certain, the heat created by brake pads of trains resulted from continuous braking between Kütahya-Balıkesir, especially between Gazellidere-Nusret stations, and burn of dry grasses and flammable material around the railway. Investigations made in fire area have showed that safety road and lanes had been constructed and proper maintenance had been done before fire. Fire warning has been delivered by fire monitoring tower and the tower has actively served in fire fighting organization. Fire warning has been delivered to all centers in time. All fire fighting staff moved in 5 minutes and first fire fighting operation started 15 minutes after the deliverance of fire warning. However, no air operation was performed since helicopter of Balıkesir had been recruited to another region. Sprinklers and helicopters have lost time in reaching to water supplies. Since planes could not maneuver to lower elevations over the valley, effective fire fighting to active point of fire could not be performed while the fire is in inclined area.

Adequate number of equipment (dozers, trailers, trucks etc.) has been recruited. Indirect operation was made from lanes opened by these equipments. Fire commandant organized the fire fighting operations from the operation headquarter. Production work has been finished in time and forestation

(rejuvenation) work was started in same year. Lack of Forest Guarding Officers has been realized. Officers must be recruited for equipment and other teams coming from different regions. Water ponds must be constructed in order to supply water for helicopters and planes quickly. Different communications channels must be provided for technical staff and fire laborers to reduce the intensity in radio communication. Fighting teams should not move away the safe region and safety of lives must be provided.

Accurate and timely information on fuel properties is crucial importance in fuel management and fire control activities. Thus, the prediction of fuel load for large areas is a prerequisite for successful fire management. Assessments of crown structure and the distribution of fuels within the canopy can be very useful in assessing crown fire behavior. Recently, canopy fuel characteristics can be predicted easily with remote sensing aerial photos and satellite images, making the prediction of fuel load possible for large areas at low costs [12].

It is concluded after the investigations and determinations made the necessary interventions to fire have been done, there was no fault of technical and administrative staff in expansion of fire to such big size.

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