The June 4, 2001 fire in the wildland urban interface areas of Northern Attica: Evolution, firefighting problems and damages.

G. Xanthopoulos[1], C. Labris[2], and C. Golfinos[2]

[1]National Agricultural Research Foundation
Institute of Mediterranean Forest Ecosystems and Forest Products Technology
Terma Alkmanos, Ilisia, 115 28 Athens, Greece
Phone: ++30 210 7793142, Fax: ++30 210 7784602, e-mail: gxnrtc@fria.gr
[2]Fire Corps Headquarters
Direction of Forest Fire Fighting
4 Mourouzi str., 10554 Athens, Greece

Keywords: wildland-urban interface, fire fighting, fire damage

Abstract

One of the most recent significant wildfires in a wildland-urban interface in Greece occurred in Northern Attica, north of Athens, Greece, that includes the towns of Sikaminos, Milesi, Oropos, Markopoulo, and Kalamos. The fire erupted in the afternoon of June 4, 2001 under strong winds associated with the passage of a cold front. It burned in a similar pattern to previous fires in the same area, in many parts burning Pinus halepensis forest under regeneration, while olive groves and other agricultural cultivations were also found in its path. Its fast rate of spread in combination with the need to protect homes, which absorbed a lot of firefighting effort, increased the burned area quickly. The fire slowed down with the onset of the night as the wind speed decreased and the fuels started picking-up moisture. It was controlled completely in the morning of the next day under favorable conditions by the strong firefighting forces that in the meantime had arrived in the area.

In this paper the behavior of the fire and the firefighting efforts are described, discussed and compared to past similar fires in the same area. Special difficulties encountered in firefighting due to the extensive wildland-urban interface are also pointed-out and discussed with the help of images that show the landscape where the fire spread. An IKONOS satellite image from the year 2000 is used, among others, for this purpose. The extent and nature of damages to structures are documented and presented. Finally, there is a short discussion about the post-fire problems that followed.

Introduction

The forest fire season in Greece officially starts on May 1st and finishes at the end of October. However, serious fires are not expected, as a rule, before the end of June. As a result, a fire that erupted in Northern Attica, on June 4, 2001, and quickly got out of control, caught most people by surprise. It became one of the most significant wildland-

urban interface fires in Greece of the last decade, and certainly one that justifies a closer look in regard to its evolution, the fire fighting difficulties it presented and the damages it caused. This is the objective of this paper.

Wildland-urban interface fires in Greece

In order to put the specific Northern Attica fire in context, it is needed to develop an understanding of the evolution of the wildland-urban interface fire problem in Greece.

Greece has a typical Mediterranean environment. Forest fires are a natural force in this environment, burning historically more than 0,2% of the country's forest land each year. However, until the early 1970s, although a firefighting infrastructure was nearly non-existent, fire damages to houses were uncommon and limited. The same was true for loss of life (Xanthopoulos 1988).

The development of urban-wildland interface areas, either due to the expansion of large cities and due to the development of summer housing, started in the mid 1970s. This trend chronologically coincides with an increase in the number of forest fires and the yearly burned area, as well as with the beginning of significant losses in life and property. Loss of property, for a time, was surprisingly low, even during fierce wildfires (Xanthopoulos 1988). This was due to the traditional use of non-combustible materials for building of houses in Greece (concrete, bricks, stone, clay roof tiles etc.). Wood is seldom used for building of houses, except for certain specific uses (roof support frames, doors, window frames. etc.). However, as the number of houses grew it became impossible for the firefighting forces to defend all of them (Xanthopoulos 2000a). As a result, damages to property started rising sharply (Xanthopoulos 2000b). For example, a fierce 1981 fire in the north suburbs of Athens resulted in the complete destruction of at least two houses and partial damage to many others. These losses are surprisingly low, in view of the fact that this fire burned approximately 1120 ha of a wildland-urban interface area in addition to 550 ha of Pinus halepensis forest. Fifteen years later, a large fire in July 1995, on Penteli mountain near Athens, burned 6500 ha and also burned about 100 buildings, many of them homes. A second large fire on Penteli, in August 1998, burned 7500 ha, re-burning most of the area that burned in 1995, and resulted in the destruction of even more houses and the death of one civilian (Xanthopoulos 2002).
.
Damage to property due to wildfires is not limited to buildings. Significant economic losses each year result from forest fires that burn agricultural lands adjacent to forests. Especially important are tree orchards which can be destroyed completely. Production loss of this type expands to the length of time necessary for reestablishment of each burned orchard. Olive (Olea europaea) tree orchards in particular are especially susceptible to complete damage because they are very flammable.

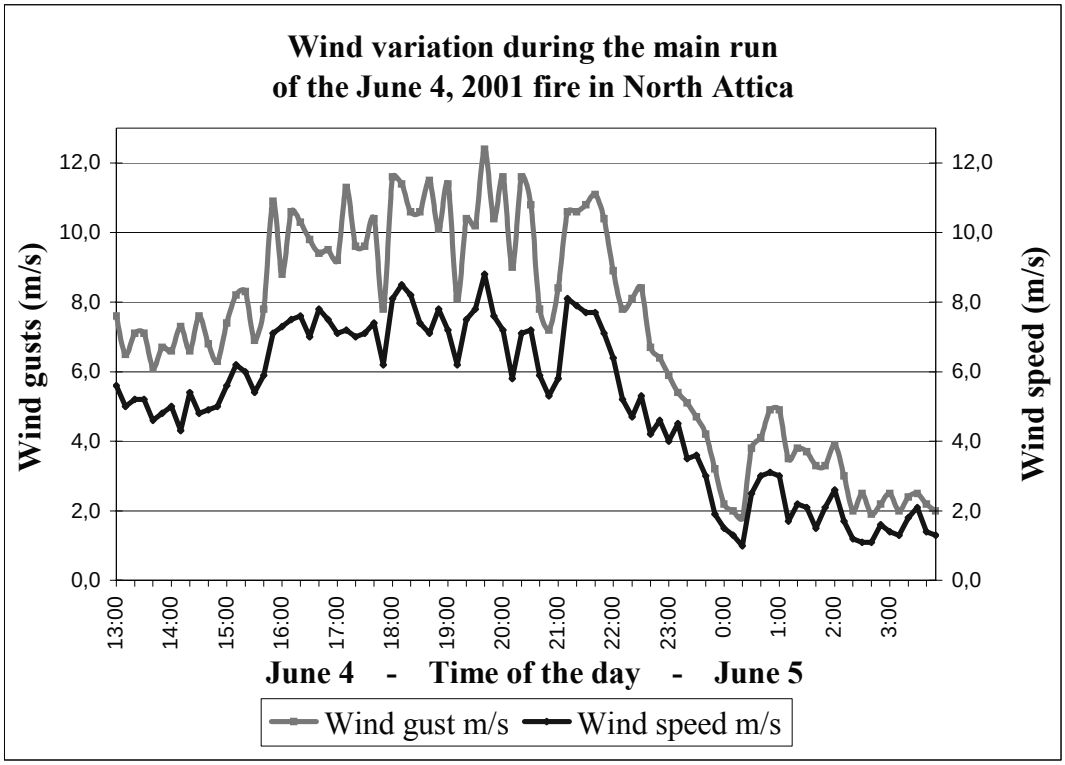
The June 4, 2001 fire in Northern Attica

Fire evolution, weather and fire behaviour

The fire started on June 4, 2001, at 13:50, in the area of the municipality of Aulona, next to the National Road 1 (Figure 1). An electric power transformer may have been the cause but this could not be proven during the investigation that followed, so the cause has been listed as "unknown". The fire was reported immediately by personnel at a toll booth that exists at the nearby intersection of the National Road (exit towards the town of Oinofita), which is less than 100 m from the origin of the fire. It initially spread in a northwest direction under the influence of a SW wind that was blowing in advance of an approaching cold front. Wind speed was recorded at about 4,5-5 m/s with gusts reaching 6,5-7,3 m/s at the weather station of the Itia Research Team of the National Technical University of Athens (NTUA), at that time. Relative humidity was at 47% (Graph 1).

Figure 1. The location where the fire started, next to the National Road 1. Some burned shrubs are seen in the foreground. The electric power transformer suspected for causing the fire is visible at a distance in the middle of the photo.

About an hour later the wind started picking-up strength and changing direction to W-NW. At approximately that time the fire spotted to a location called "Agia Eleousa", more than 1 km ahead of the front. In that area it burned 2-3 houses situated within the forest. The fire front reached the village of Sikaminos, 4,5 km from its origin, around 15:20, about one and a half hour after its start, exhibiting a rate of spread of approximately 3 km/h until that point.



Graph 1. Wind speed and wind gusts during the main run of the June 4, 2001 fire, based on meteorological data from the weather station of the Itia Research Team of the National Technical University of Athens (NTUA), which is located 25 km to the south.

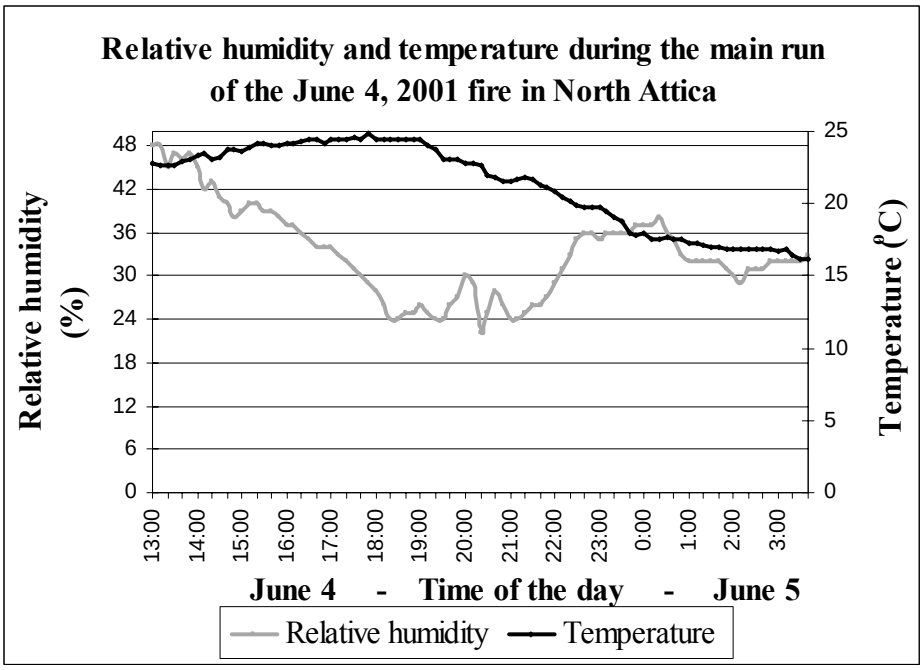
Two hours after the fire start (15:50) the wind speed had exceeded 7 m/s while gusts reached 10,9 m/s. In the meantime the relative humidity had dropped to 38% and continued dropping until it reached 24% at 19:20. It remained below 30% until 22:00 hours (Graph 2).

The fire, after passing through Sikaminos, burning grasses in the village and damaging homes, it reached, in order, the towns of Oropos, Milesi, Bafi, Neo Livissi, and Markopoulo, destroying many homes and other buildings in its path. The fire front spread practically uninhibited until it reached the town of Kalamos, while still in daylight. The few efforts to control parts of the front were weak and uncoordinated because priority was given to saving lives, homes and other property.

At Kalamos, the fire was delayed by sparse fuels and some firefighting effort. However, it finally crossed the asphalt road that links Kalamos to Kapandriti and continued in a SE direction, in a tall pine forest, driven by the NW wind. By dusk, just after 21:00, the fire approached the monastery of “Agios Simeon”, in spite of various efforts to control the fire front. It had run 14 km from Sikaminos in approximately five and a half hours, exhibiting a rate of spread of 2,5 km/h, including the delay at Kalamos and the influence of firefighting efforts SE of Kalamos.

At 22:00 the wind speed started dropping, with gusts in the 6,5-8 m/s range and an hour later in the 3-5,5 m/s range. This change, in combination with increasing relative humidity and firefighting efforts, stopped the solid progression of the fire (Figure 2).

The wind speed remained at the level of 1-2 m/s through the night giving the opportunity to the fire fighting forces to battle and to control the fire front, except for limited spread of fingers of fire on steep slopes and draws. The fire was practically controlled by the next morning with the help of aerial support.



Graph 2. Relative humidity and temperature evolution during the main run of the June 4, 2001 fire, based on the NTUA weather data set.

Figure 2. The non-continuous fire front in the night, SE of the town of Agioi Apostoli, after the wind calmed down.

The total burned area, according to the official report and burn-map filed by the Forest Service Office (Dasarheio) of Kapandriti, reached 3.397 ha (Figure 3). This includes 994 ha of agricultural cultivations and 2.403 of forest vegetation. The latter includes 1.602 ha of regenerating forest and 235 ha of reforested forest. Only 182 ha of the forest land were private. The rest belongs to the State, as most forests in Greece.

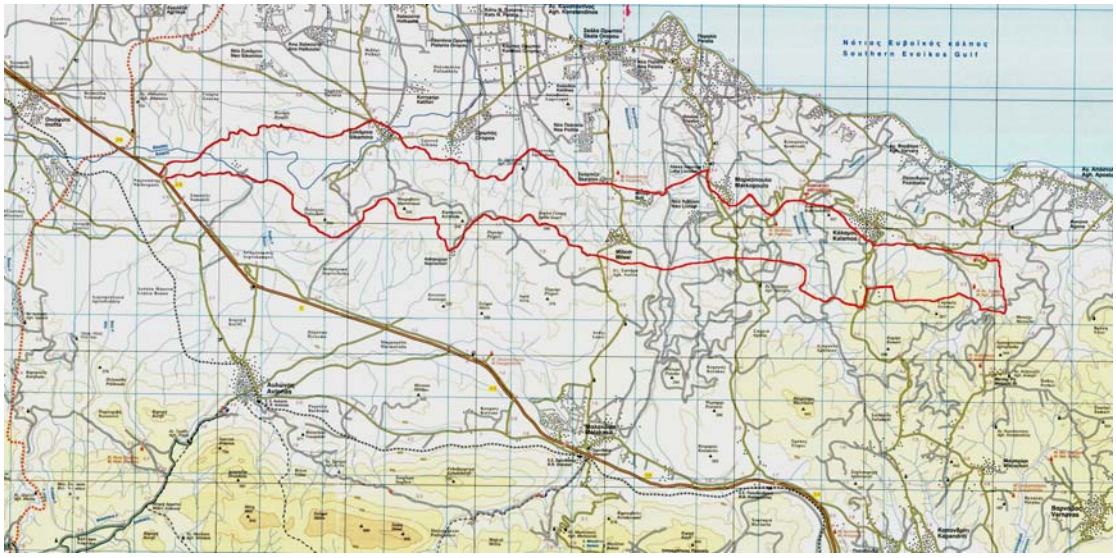


Figure 3. The final burned area of the June 4-5, 2001 fire in North Attica.

Topography, road network and fuels

The fire burned in a varying topography which ranged from near-flat to rolling hills of 20-40% slope. Slopes were steeper in only few locations and in general there were no "impossible" sites.

The area being, an extensive wildland-urban interface zone has a relatively dense road network. A good number of roads, some of them asphalt, cut across the length of the burn, while many roads running in a west-to-east direction facilitated firefighting efforts on the flanks of the fire. However, as discussed later, narrow unpaved roads leading to many homes were far from ideal for fire truck access, making defence of such homes a very difficult and dangerous task.

The fire burned in a variety of fuels. They ranged from Aleppo pine (Pinus halepensis) forest to agricultural fields, to tree orchards (mainly olive groves), vineyards, and gardens around houses. Aleppo pine forests for the most part were young stands under regeneration, mixed with maquis shrubs that usually form the understory of such forests, but there were also tall stands at varying density levels. The state of live vegetation was far from water-stressed and the grasses were mostly green as it is usual at this time of the year. The high rate of spread exhibited by the fire can be attributed mainly to the strong gusty winds in combination with the low moisture content of dead fuels. In the tall stands, the Aleppo pine trees were, as a rule, less than 12 m tall, with long crowns reaching close to the ground. As a result they easily torched, producing firebrands that started new fires in vegetation and in structures. The overall intensity however, was far

less than what is common in July-August fires. For example, in the pine crowns only the finer fuels were consumed.

The Wildland-Urban Interface

The area of the burn is practically a continuous Wildland-urban interface that includes mainly two types of interface: Classic, where villages come in contact with forest fuels and mixed where isolated structures are surrounded by larger areas of vegetation (Queen 1993). Furthermore, many houses and other structures come in contact with agricultural vegetation including olive groves. Figures 3, 4 and 5, provide examples of the area after the fire

Firefighting

The fire being unusually early in the season, the reflexes of the firefighting mechanism were not at their best. The fleet of Canadair waterbombers that the Greek Air Force operates were not fully available and in high alert. The heavy firefighting helicopters which are contracted every summer since 1999 were still not in place. Finally, the seriousness of the fire was probably underestimated in the first moments, resulting in large but still inadequate dispatching of ground forces and probably in less coordinated firefighting than what was needed for the specific conditions (incoming cold front, urban-wildland interface ahead).

The first firefighting forces were dispatched one minute after fire reporting (13:56). A 12-ton fire truck returning from an earlier fire at Aliartos (an agricultural fire that threatened warehouses of the local Agricultural cooperative) arrived at the scene just a few minutes later and started direct attack on the south flank. A second truck from the town of Aulona arrived a few minutes later and continued on the same flank.

When the problem became evident the Coordinating Center of the Fire Service began a massive mobilization of ground forces. The number of fire trucks kept increasing, with forces being dispatched not only from Athens but also from Lamia 120 km to the North. The change of direction of the wind with the passage of a cold front was very similar to that on a September 1992 fire in the area that burned 2500 ha in less than six hours before the winds subsided. The northern boundary of that burn coincides in many locations with the southern boundary of the 2001 fire.

In the open areas the fire fighters controlled the flanks of the fire mainly along existing roads. They tried controlling the fire front a number of times, with the help of existing roads but they were unable to do so, in spite of the large number of fire trucks, due to the fast spread of the fire and the lack of adequate available forces. The latter problem was due to the effort put on saving homes, often under extreme pressure from the local residents. This resulted in saving many homes in some areas, mainly close to the towns, but the fire front progressed damaging other houses further down its path.

As the winds started turning from the W-NW, and while most forces were heading for the fire front, the fire trucks reaching the area through National Road 1, coming from

the North, were directed to the south flank of the fire under the command of a specific officer. This resulted in effective control of the flank and helped keep the burned area narrower compared to the 1992 burn.

In the area east of the town of Kalamos, where the fire was controlled, there are many mature Aleppo pine stands as well as children-camp installations. The camps had to be evacuated well before the arrival of the advancing front. Fortunately, the wind subsided at that time and the firefighters had the opportunity to control the spread of the fire in spite of the hazardous fuel conditions. Six Canadair waterbombers and MI-26 a helicopter helped, with the first light, in the final control efforts.

The number of fire-trucks that were involved in the fighting finally reached 66 with 200 Fire Service firefighters and 60 seasonal firefighters. Also, 120 Fire Service firefighters organized in hand-crews and 80 soldiers and officers from the Armed Forces contributed to the final control.

Damages

The damages caused by the fire were quite heavy. Direct damages (complete or heavy destruction) that were officially recorded are shown in table 1. However, there is no way to estimate non-reported damages, which are usually of lesser extent, and, of course, indirect damages that involve non-material goods (aesthetics, sense of security, etc.).

Table 1. Officially recorded damages caused by the June 4-5, 2001 fire.

Type of damage	**Number**
House	57
Rural house	1
Garage	1
Monastery	1
Church	1
Mobile home	2
Warehouse	22
Stable	3
Sheep sack	4
Chicken sack	1
Greenhouse	1
Kiosk	1
Private car	4
Business car	1
Heavy professional machinery (dozer, etc.)	3
Agricultural machinery	1
Miscellaneous light machinery	3

Most damages occurred early in the spread of the fire, close to Sikaminos, Milesi, Bafi, and Markopoulo, while damages were quite limited in the area of Kalamos.

Discussion

The fire is a good example of the problems encountered in protecting WUI areas:

- Firefighting forces never seem to be enough.
- Applying a firefighting plan is difficult at best.
- Rapid fire progression makes protection of all structures practically impossible.
- The presence of public can be both positive (help, information, protection of own home) and negative (panic, pressure to firefighters, exposed to danger, unpredictable)
- The location (slope, road access) and condition of houses (materials, existence of vegetation and/or flammable materials around the house, presence of owner, simple firefighting facilities) are important for their chance of survival.

The following findings are the result of the effort to document this fire:

- Many roofs, even clay-tile ones, ignite from firebrands making seemingly well-constructed houses vulnerable. The culprit is usually the tar-paper that is put under the clay tiles.
- Wood piles are a major headache. Once ignited they produce extreme heat and can ignite neighboring structures.
- One such example is seen in figure 4. Two 12-ton water loads had to be emptied on the burning pile. In May 2003, new wood piles, consisting of scorched timber in 2001, exist in the same place.

Figure 4. A wood pile near Markopoulo at this point burned during the 2001 fire. . It was recreated in 2003 (Photo May 2003).

Following are some recommendations, based on the observations made at this fire.

- Develop good, realistic plans for all WUI areas, with cooperation of all organizations and the public.
- Put emphasis on safety of houses (construction materials, vegetation, protection infrastructure), road access (width, condition, block-free, turnarounds, signs), and firefighting infrastructures.
- Education of the public is very important as part of the prevention activities

Acknowledgements

The information presented here is mainly based on the personal experience and participation of the authors in the suppression of the fire. However, significant help and information was also provided by Mr. Frangiadakis head officer of the Local Forest Service Office (Dasarheio) of Kapandriti, and Major Ioannis Mantas head of the Fire Service Station of Oinofita.

References

Queen, P. L. 1993. Fighting fire in the wildland/urban interface. Fire Publications Inc. Bellflower, California. 119 p.

Xanthopoulos, G. 1988. Greek forest fires and property damage: A brief history. pp. 199-200. In proceedings - Symposium and Workshop on "Protecting People and Homes from Wildfire in the Interior West", October 6-8, 1987, Missoula, Montana, USA. USDA For. Serv. Gen. Tech. Rep. INT-251. 213 p.

Xanthopoulos, G. 2000a. Special difficulties in fighting fires in the urban Wildland interface. Firefighting Review (Pirosvestiki Epitheorisi). 80: 22-29 (in Greek).

Xanthopoulos, G. 2000b. Fire situation in Greece. International Forest Fire News (ECE/FAO) 23: 76-84.

Xanthopoulos, G. 2002. The forest fires of 1995 and 1998 on Penteli mountain. Pp 85-94. In proceedings of the International Workshop on “Improving Dispatching for Forest Fire Control”. December 6-8, 2001. Chania, Crete, Greece. G. Xanthopoulos, editor. Mediterranean Agronomic Institute of Chania, Chania, Crete, Greece. 162 p.