



## Forest Fire Management in Cyprus

### Introduction

Cyprus is the third largest island in Mediterranean with an area of 9251 km<sup>2</sup> (925,148 ha) and is situated at the northeastern end of the Mediterranean Basin. It is mostly a mountainous country with a typical intense Mediterranean climate that is characterized by hot, dry summers that last from May until October.

Most of the Cyprus forests are natural although some of the burned areas and bare lands were artificially reforested. Natural vegetation covers the 41.67% of the total area of Cyprus of which, 18.55% is high forest mainly composed of coniferous species, 13.63% is maquis vegetation (shrubs) and 9.49% is *garrigue* vegetation.

### Fire Hazard

Fire in Cyprus, as in all Mediterranean countries, is by far the most destructive single agent threatening our forests. The fire hazard in our island is pretty high, especially during the summer period. This is because of the nature of the forests, the prevailing climatic conditions and the topographic conditions. Normally the fire season starts in May and ends in October, but occasionally it starts in April and is extended up to November.

### The Nature of our Forests

The natural forests of Cyprus, as well as the newly established plantations, consist of thousands of hectares of resinous pine trees like the Calabrian pine (*Pinus brutia*), the Black pine (*Pinus nigra*), the Cedar (*Cedrus brevifolia*) and the Cypress (*Cupressus sempervirens*). The forests of Cyprus are characterised by open stands that enhances the formation of rich understory with shrubs and grasses, which during summer period dry quickly. The volume of the fuel is further increased by the accumulation of pine needles, deadwood etc. The quantity and continuity of the forest fuels enhances the rapid spreading of fires.

Even though extractives like gums, waxes, oils, and alcohol constitute a small fraction of the tree weight, they have special properties. Their high heat of combustion and volatility influence the way that the fuel burns. The pine over-story is always associated with under-story vegetation of bush species and other herbaceous plants, which dry out during the summer period.

### Climatic Conditions

Various climatic agents like temperature, relative humidity, and precipitation affect fuel moisture. The long, hot and dry summers that last from May until October convert the pine under-story into a continuous sheet of dry and highly inflammable fuel mass. During the fire season the temperature fluctuates from 30° to 44°C increasing the risk of ignition to very high levels. The relative humidity, which affects considerably the fire environment, ranges between 30-65%. Rainfall during the fire season is very low and ranges between 0-50mm. Wind is a dominant factor of fire behaviour. It is one of the hardest elements to predict due to variability of wind speed and direction and the influences of topography, vegetation, and local conditions. Winds during the fire season are mostly northwesterly or northerly.

## Topography

The principle geomorphologic features of Cyprus are the two main mountain ranges of Troodos and Pentadaktylos separated by a broad sedimentary plain of fertile agricultural land, the Mesaoria. The highest peak of the Troodos mountain range is 1952 meters a.s.l., whilst the Pentadaktylos mountain range highest peak is 1024 meters a.s.l.

Very steep slopes, vertical cliffs, deep gorges, narrow streams and long mountain ridges characterize the central core. The foothills are characterized by rounded or conical hills, usually with steep lateral slopes. These geomorphologic features contribute to rapid fire spread and to difficulties during fire suppression efforts. The steep slopes have a direct effect on flame length and rate of spread of a surface fire. When a fire burns up a steep slope it moves faster having higher scorch than when it burns at a level site. Also a steep gully gives a chimney effect to a fire. Moreover, the steep terrain reduces the effectiveness of forest roads and fire traces to stop fires.

## Legal Responsibility

The Forestry Department is the agency responsible for the prevention and control of fires in the state forests or within a radius of 1km from the boundaries of the state forests. The Forestry Department is responsible for the following measures:

- fire prevention
- rapid fire detection, and
- the rapid intervention and effective control of forest fires.

## Causes of Forest Fires

Most of the forest fires in Cyprus start outside the forests or near their boundaries and less frequently within the forests. Analysing the fire incidents for the period 2000 – 2003 indicates that the biggest percentage of forest fires in Cyprus and especially the most destructive ones are of human origin, attributed to:

1. Agricultural activities: Fires set by villagers in their own lands to burn grass, gorse or stubble without taking the necessary precautionary measures
2. Recreation: Fires caused by visitors, campers and picnickers who are careless with cooking and grilling fires, burning cigarette butts and matches, etc.
3. Military activities: Troops exercising with ammunition or explosives of any kind
4. Burning of rubbish: Fires escaping from non-organised rubbish dumps
5. Forestry operations: Fires caused by people or machines engaged in any activity associated with forest engineering and forest production,
6. Residence: The rise of the number of the country residences, compose a new cause of forest fires.
7. Arson
8. Other causes: These include e.g. hunting during the summer period, use of different tools and machinery, etc.

The percentage of causes of forest fires is provided in Figure 1.

## Impacts of Forest Fires

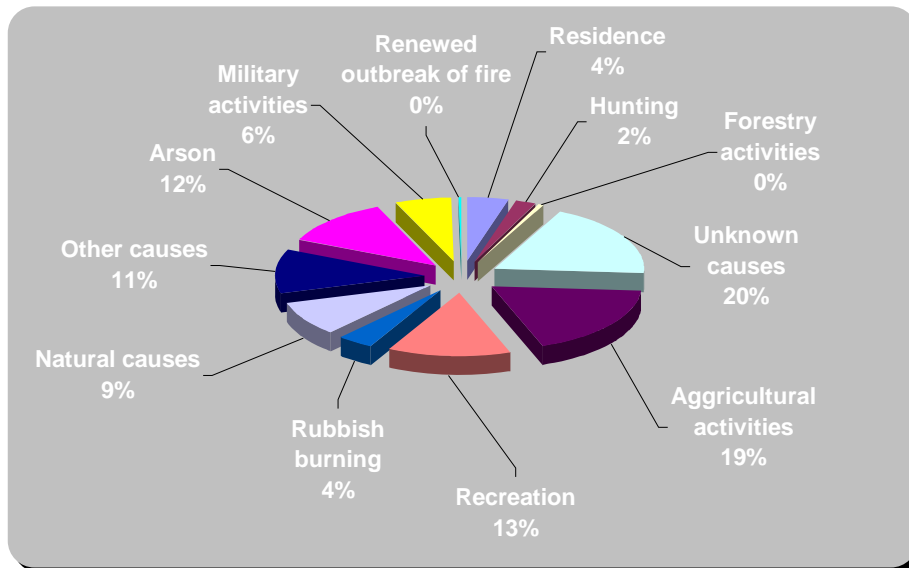
Fire is by far the most destructive single agent, threatening the forests of Cyprus. Fires have many negative consequences the most important of which are:

- Endangering the safety of people and property
- Excessive soil erosion and – in some cases – subsequent flooding
- Serious economic losses, especially to the farmers
- Ecosystem degradation and loss of biodiversity
- Impairment of the aesthetic value of forests
- Damage of historical and cultural values

## Forest Fire Management

The policy of the Forestry Department is to realize adequate protection of forests against fires and minimize the area burnt in case of a fire incident. For the reduction of the fire risk and the prevention of a fire outbreak, a series of separated but integrated programs are undertaken. These are:

- A. Fire prevention and preparedness programme
- B. Fuel management programme
- C. Pre-suppression and suppression



**Figure 1.** Causes of forest fires in Cyprus (2000-2003)

### **A. Fire prevention and preparedness programme**

The prevention of forest fires is always preferable to the control. In order to reduce the risk of fire outbreaks a number of preventing measures are taken though:

1. Law enforcement
2. Education and public awareness
3. Provision of picnic and camping sites
4. Fire protection plans
5. Fire detection

#### *Law Enforcement*

The Cyprus forest Law prohibits the lighting of any fire in the forest or within a distance of 1km from the boundaries of the state forests. Any person who causes a forest fire shall be liable, in case of conviction, to imprisonment for a term not exceeding five years or to a fine not exceeding five thousand pounds (8500 euro), or to both such sentences.

#### *Education and public awareness*

Since the majority of forest fires in Cyprus are of human origin, the Forestry Department makes every effort to gain the support and co-operation of the general public through a well planned and directed publicity and educational programme, including:

- ◆ Talks and interviews of forest officials through the mass media
- ◆ Special programmes through the radio and TV services
- ◆ Publication of texts and articles in the press and magazines

- ◆ Lectures and film projection at schools, the police, army, clubs and other organised groups
- ◆ Visits and education of the farmers owing land at the delimitation line of the forest
- ◆ Production and distribution to the public of relative leaflets and stickers
- ◆ The degree of fire hazard is broadcasted through the radio and the TV several times a day and preferably immediately after the news and the weather broadcast. It is also indicated in special sign posts located at the main forest stations and warn the visitors of the forests
- ◆ Posters and signposts, which warn the public about the danger of forest fires, are placed at conspicuous places of roads, picnic and camping sites and villages
- ◆ Production and distribution to elementary and secondary schools of special leaflets and
- ◆ The “Save our Forest Week” is celebrated every year. A “Save the Forest Day” is also celebrated in all schools in co-operation with Ministry of Education.

#### *Provision of picnic places*

To reduce the danger and incidents of forest fires coming from picnickers and forest visitors, picnic places in the forest have been established, where picnickers are concentrated instead of being scattered out without any supervision. These sites attract people by providing them a number of facilities such as fire places (where they can safely build a fire for cooking purposes), benches and tables, potable water, playgrounds etc.

#### *Fire protection plans*

For more effective fire management in the countryside, a National Fire Protection Plan was prepared by the Forestry Department in co-operation with the Police Fire Service. The existing fire prevention measures and proposals for construction of new, supplementary infrastructure are the main elements of this Plan. The project started in 2001 and is expected to be completed in 2006. In addition, the implementation of the Rural Development Program 2004-2006 will improve considerably the protection measures taken in the countryside.

#### *Fire Detection*

- ◆ Fire lookout stations

Today, 13 lookout stations are found in panoramic places at peaks of mountains ensuring maximum coverage of the forest. All lookout stations are linked to the existing telephone and radiotelephone network of the Forestry Department. During the fire season, these are manned on a 24-hour basis. The watchers come from various forest villages and they are familiar with the forest. Thus, in case of a fire, they can locate it accurately and guide the firemen to get to the fire as rapid as possible. Furthermore, 16 temporary lookout stations (fire engines) are stationed at various areas of high danger that are hidden and cannot be viewed from the permanent lookout stations.

Apart from the look out stations, arrangements are made for reporting of forest fires by the civil aviation, Army Air Force and other services. Reporting of fires is also done by the public using the number 1407. All calls made by the public for this purpose are free of charge.

- ◆ Ground Patrols

Ground patrol is an old but effective form of detection and intervention relying on systematic patrol. During the fire season regular patrolling is done especially along the delimitation line where most of the forest fires starts. All patrols have threefold missions these being policing and public information, detection of forest fires and fire suppression. Most of these patrols are using light brigades and in case of a fire they intervene rapidly. Each patrol has its own sector and route, which is planned in advance. The patrols are constantly in touch with the look out stations and other patrolling units and with the headquarters of the Division.

- ◆ Telecommunication System

For communication purposes the Forest Department maintains its own telephone and radiotelephone system. All forest stations and lookout stations are linked to it. All vehicles are equipped with mobile radiotelephones and each forester has his own portable radiotelephone. Within the forest, at strategic points, there are emergency telephones, which are also linked to this system. This system plays an important role in the coordination of activities regarding forest fire protection.

Today, Cyprus is introducing the state of the art technology of the Automatic Fire Detection Systems. In 2004, one such a system was installed at the Akamas forest – a high valued forest area to be declared as National Forest Park. With the assistance of this system it will be feasible to further minimize the time from the outbreak of a fire to its detection and the first alert, which is critical for the management of the suppression process.

The project was supported by FAO technical assistance and is co-financed by European Union through pre-accession aid.

## **B. Fuel management programme**

The Forestry Department proceeds on a regular basis on various vegetation treatments with the aim to reduce the risk of ignition and the spreading rate of forest fires. Some of these treatments include pruning, cleanings, removal of both herbaceous and woody vegetation along roads, planting fire resistant species, prescribed burnings, controlled grazing, mixing of conifers and broadleaves and seeding of species with low biomass.

## **C. Pre-suppression and suppression**

The main measures in pre- suppression and suppression used in Cyprus are the following:

### *Construction of roads*

For efficient forest management in general and especially for fire protection the Forestry Department maintains a good road network.

Forest areas that were inaccessible in the past are now accessible by the construction of new roads. These roads are planned in such a way to give quick access to all parts of the forest especially during a fire incident.

### *Construction of firebreaks*

Firebreaks are usually constructed on ridges and other natural features. Their width ranges from 6 to 30 meters depending on the nature of vegetation and adjacent crown of standing trees. Priority is given to the construction of firebreaks on gentle ridges along which vehicles and fire brigades can travel in the event of a fire.

### *Fire fighting task force*

During the fire season, 180 persons (labourers) are recruited and form the fire fighting body. This body is split into groups of 10 to 15 men and are distributed in various strategic points in the forest. Each group is provided with off-road vehicles and at least with one fire brigade and other necessary equipment for fire fighting. These crews carry out various forestry operations near roads and points where communication is possible at any time. When a fire breaks out, they are the first to go.

### *Forestry Staff*

Apart from the fire fighting squads, an adequate number of foresters remains stand-by on a 24 hours basis at all forest stations during the fire season. In case of a fire, these forest officials along with the local fire fighters are the first to reach the fire, until new forces arrive.

During the summer, forestry works are organized in such a way so that the officers and labourers are found at various strategic points in the forest. The foresters in charge of these operations are continuously in contact with the divisional headquarters and since they are equipped with the necessary tools, they can move to the fire without delay. In this way, the time of intervention and the area burnt is significantly reduced.

### *Training*

Fighting of forest fires is a joint task for forest officials and fire fighters. Local training is organised at the Cyprus Forestry College through lectures, demonstrations and film projections, and includes:

- Judging of fire situations and deciding where to attack the fire
- Fire suppression in groups
- Training on modern fire engines
- Construction of firebreaks, etc.

Training abroad is organised through fellowships and study tours for training on new fire fighting equipment and techniques.

#### *Fire fighting equipment*

Fire fighting is a difficult and complicated job and requires the combination of both manual and mechanical means. Some years ago, fire fighting in Cyprus was done mainly using manual means and methods. Most fire fighting today in Cyprus is done with the use of water. A good number of fire engines with a capacity ranging between 1000 and 12,000 litres of water are maintained. Most of these brigades are equipped with low and high-pressure pumps. Using high pressure the amount of water needed to extinguish a fire is significantly reduced.

Apart from fire brigades, a number of crawler tractors are also maintained. These tractors, during the fire season, are removed from other works and are used for construction of roads and fire breaks. During weekends, these bulldozers are moved to loading points, so that in case of a fire can be loaded and transported to the fire immediately.

Availability of water for fire fighting is achieved through the construction of concrete water tanks at strategic points along forest roads where springs are found. Each tank has a capacity of 90 m<sup>3</sup> water for fire fighting can also be supplied through hydrants, which are fixed on pipelines carrying water from the forest to the villages. Water can also be taken from the existing dams found within or near the forest and from small pools, which are created along perennial streams by constructing access roots.

Fire fighting from the air has been practiced in the recent years in Cyprus with excellent results. Helicopters are the most suitable means of transport for rapidly overcoming altitudes and distances. For this purpose, two medium-size helicopters of a payload of 5 tons each are hired every summer. Army and police helicopters are also used when needed for transportation of men and equipment and for co-ordinating fire fighting from the air.

#### **Conclusions**

As a result of the measures mentioned above we managed to reduce both the time of intervention and the area burnt each year. The average time of response during fire incidents for the period 2000 - 2003 was only 12.5 minutes.

Despite the great efforts and the good results of recent years, the problem of fires still exists and will always constitute a permanent threat for the forests of Cyprus. For this reason and in order to reduce the fire danger to the minimum possible, the continues vigilance as well as the persistent upgrading both of infrastructure and personnel training, following the evolution of the technology and its capabilities, are a top priority matter of the Department of Forests.

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