# Fires in the Mediterranean Ecosystem (Turkey) in July 2021

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# Abstract

Turkey has an ecologically rich ecology, including three main climate zones and three transition zones. Main climate zones; Black Sea, Mediterranean and Continental climate zones, and transition zones are Marmara, Mediterranean and Southeastern Anatolia regions. Of these ecological regions, a large area was damaged by the fire that broke out in July 2021 in the Mediterranean region in the south of Turkey and the Aegean region in the west (Mediterranean climate zone). The fire first started in Manavgat and Gündoğmuş districts of Antalya, and then broke out in various parts of Adana, Osmaniye and Muğla provinces. The fires that occurred in Adana took place in a wide area in the north of Adana, within the borders of four districts. In Osmaniye, fires occurred in the central district and Kadirli. These fires, which occurred in Osmaniye and Adana, took place in the forest area at an altitude of 500–1000 m. Since the fires that occurred in Antalya and Mersin were effective in the altitude zone starting from the coast and up to 1500 m, the mountain belt forest as well as the climax vegetation of the Mediterranean were burned. The fires that occurred in Muğla reached up to 2000 m and damaged a wide forest ecosystem. Due to the fire being at different altitude levels, Pinus brutia within the orobiome, Pinus nigra, Cedrus libani and Cedrus cilicia, which are mountain forests, and the understory were damaged. The fire also destroyed underground and aboveground fauna within the forest ecosystem, which could not be recorded statistically.

# Method

in successive fires in July 2021 in Turkey. For this reason, the method of preparing and comparing the maps of the areas exposed to the fire before and after the fire was used. In the preparation of maps, a 30-meter digital elevation model (DEM data) with pixel size was prepared using the Arcgis program as a base for the elevation map. The slope map was prepared using the Arcgis program using the same brew data. Multispectral camera recordings were used to detect the burned areas. Plants use the chlorophyll in their leaves and sunlight to produce organic matter from inorganic matter. During this process, called photosynthesis, the part of the electromagnetic energy coming from the sun with a wavelength of 0.63 µm – 0.69 µm and corresponding to red light is used. Therefore, a Multispectral camera measuring the reflectance of red light will have low numerical values in areas with dense live vegetation. On the other hand, plants do not absorb electromagnetic energy with a wavelength of 0.7 µm and higher, but reflect it back. Therefore, areas with dense vegetation will have high numerical values in a Multispectral camera image that measures the reflection of near infrared (NIR) electromagnetic energy. Therefore, fire areas With Landsat 8 satellite images, remote sensing methods in the Arcgis program, two maps were prepared as before and after the fire, and the fire areas were determined (https://earthexplorer.usgs.gov/). Accordingly, multispectral bands were used in the detection of fire areas, and while the red colored areas showed plant vitality (before the fire), the areal evaluation of the burned areas was made with the decrease of red colors in the same areas after the fire .

# Login

The natural features or ecology of any environment; determines climate, soil, parent material, topography and biotic (living) components. This success is divided into two parts: animate and inanimate. The living elements of the environment are soil, flora (plants) and fauna (animals). Non-living elements consist of climate, topography and parent materials. The relationships between living and non-living elements in the environment are in balance under natural conditions. While natural tissues in balance do not lose the natural feature of one of the living and non-living factors, it causes the relationships of all parts, especially the plant, to be divided (ATALAY, İ. 2002). Turkey's residential location, diverse climate and topography, especially spacing and aspect conditions, make it one of the countries with the richest vegetation cover or biological richness in the world after the equatorial and subequatorial regions. In Turkey, where the main regions of European-Siberian, Mediterranean and Iran-Turanian plant geography are located, the entire population, excluding equatorial, subequatorial regions and tundra regions, includes a large part (ATALAY, İ. 2015). The northern region of Turkey as a whole falls into the European-Siberian Region. The northern coasts of the Marmara Region and the Aegean and Mediterranean regions include the Eastern Mediterranean flora. Central and Eastern Anatolia regions fall into the Turan-Near Asia or Iran-Turan Flora Region, and the steppe areas of Southeastern Anatolia fall into the Iran-Turanian cooled Mesopotamian Flora Region (ATALAY, İ. EFE, R. 2015). Accordingly, the frequent changes in altitude and aspect conditions in Turkey make it difficult to draw the exact boundaries of the flora regions and are an important factor in increasing the floristic richness. The interaction/relationship of the natural environment with living things is important in the development of sustainable policies. However, the increase in the human population and the use of natural environmental conditions in a way that disrupts the ecological balance or a chain of neglect causes deterioration in the ecosystem. This situation causes deterioration in the ecosystem by repeating human negativities that do not give nature the opportunity to repair itself or that exceed the speed of repair. Along the Black Sea and Mediterranean coasts of Turkey, there are mountain ranges (located in the Alpine-Himalayan belt) with altitudes exceeding 2000 m and sometimes exceeding 3000 m.

# Map-1: Fire areas location

With the effect of the altitude factor, environmental conditions called orobiome have been formed in these mountains, which contribute significantly to the increase of ecological richness in Turkey. However, the fires that broke out in July 2021 caused great damage to the rich ecosystem in these mountainous areas. The fires initially started in Manavgat and then spread to many points throughout the Mediterranean ecosystem. Thus, while the plants belonging to this ecosystem were burned in very large areas, creatures belonging to the underground and aboveground fauna also perished. However, there was also deterioration in the physical and chemical properties of the soil in the burned areas. Fire areas and areal values are given in the table below.

However, while the plants belonging to this ecosystem burned in very large areas, the creatures belonging to the underground and aboveground fauna were also destroyed. In addition, there were deteriorations in

the physical and chemical properties of the soil in the burned areas. Fire areas and areal values are given in the table below.

Table-: Fire Areas and Area (ha)

| FIRE PLACE | FIRE AREA (HA) |
|---|---|
| Manavgat | 55566.9 |
| Gundogmus | 14599.5 |
| Qadirli center | 4063 |
| Karaisali Aladag Imamoglu | 4038 |
| Kozan | 2426 |
| Silifke | 3407 |
| Aydincik | 10387 |
| Koycegiz | 10795.5 |
| Marmaris | 12085.8 |
| Bodrum Milas | 16461.5 |
| Mentese Kavaklidere | 13418.9 |

Manavgat with 55566.9 hectares, Bodrum Milas with 16461.5 hectares, Gündoğmuş with 14599.5 hectares were damaged in the fire. This was followed by Menteşe Kavaklıdere and other places indicated in the table with 13418.6 ha. The ecological characteristics and spatial evaluations of these areas where fires occur are discussed below.

## AREAS WHERE FOREST FIRE OCCURRED

# 1-Fires in Adana and Osmaniye

The fires that occurred in Adana took place in a wide area in the north of Adana within the borders of four districts. These are Kozan, Karaisalı, İmamoğlu and Aladağ districts. In Osmaniye, fires occurred in the central district and Kadirli.

These fires were effective in the 500–1000 meters altitude zone (Map-2) and 4063 hectares in Osmaniye and 4038 hectares in Adana were exposed to fire. Burnt areas are areas with 2–4% and 4–6% gradients (Map-3).

Mediterranean climate is effective in areas exposed to fire in Adana and Osmaniye, and the main vegetation is *pinus. brutia* ( Map – 4). *Pinus* in this generation *the brutian* the undergrowth and *Pinus In the place where brutia* was destroyed, Quercus coccifera, Arbutus, which is in the form of a bush

dominates the environment. andrachne, Arbutus unedo, Ceratonia siliqua, Laurus nobilis mythus communis, Olea europea, Nerium oleander, Phllyrea latifolia, Styrax officinalis, Pistecia lentiscus _ _ terebinthus, Calicotoma villosa, Paliurus spina-christi, Vitex agnus Plants such as castus take place widely. Both pinus in fire Both brutia and under-forest plants in this shrub form were damaged. (Map-4).

## Map-2: Elevation step map of the fire area in Adana and Osmaniye

## Map-3: Slope map of the fire area in Adana and Osmaniye

## Map-4: Plant density map of pre-fire and post-fire multispectral camera recordings in Adana and Osmaniye

# 2-Fires in Antalya

The fires in Antalya's Manavgat and Gündoğmuş districts, where the fires of July 2021 first occurred, affected a wide area. The fires around Manavgat were effective in a wide belt from 2–4% to 20–89% (Map-6). On the south-facing slopes of the Taurus Mountains, maquis and *pinus brutia* and *pinus pinus* forming the Mediterranean montane forest above the *Brutia border nigra*, *Cedrus Libani* and *Abies Forests consisting of cilicica* trees were exposed to fire. A total area of 55566.9 hectares was burned in this fire in Manavgat.

Gündoğmuş took place at an altitude of 0-1500 meters (Map-5). In the fire, 14599.5 hectares of area were burned and *Pinus brutia Pinus* with forests *nigra, Cedrus libani andAbies The forest area consisting of Clicica* trees was damaged (Map-7).

## Map-5: step map of the fire area in Antalya

## Map-6: Slope map of the fire area in Antalya

## Map-7: Multispectral camera recordings before and after the fire in Antalya

# 3-Fires in Mersin

Fires occurred in Aydıncık and Silifke districts of Mersin.

*Pinus* in the 0-1500 meter altitude zone (Map-8) *Pinus* in the upper belt as well as the *brutia forest nigra, Cedrus libani* and Abies The mountain belt forest consisting of cilicica trees was also burned (Map-9). These fires, which broke out around Aydıncık and Silifke, were effective in a wide belt from 2–4% to 20–89% (Map-9)

*Pinus* was located in the 0-1000 meters altitude belt. *brutian* forests and bush formation burned. (Map-10).

# Map-8: Elevation step map of the fire area in Mersin

# Map-9: Slope map of the fire area in Mersin

# Map-10: Multispectral camera recordings before and after the fire in Mersin

# 4-Fires in Muğla

The forest fire in the Köyceğiz district of Muğla occurred on the south-facing slopes of Gölgölli Mountain. The fire was effective in a wide area at an altitude of 0-2000 meters (Map-11), and an area of 10795.5 hectares was burned. *Pinus* in this generation *brutia* forests as well as *Pinus nigra, Cedruz libani* and *Abies* Mountain belt forests consisting of *cilicica trees were also burned.*

Forest fires in Marmaris district took place in the 0-1000 meter zone. The slope of the burning belt is between 0–2% and 20–89% and a large area was exposed to fire (Map-12). 12085.8 hectares of *Pinus in this belt brutia* forest and shrub-shaped maquis were burned.

*Pinus* on an area of 16461.5 hectares in the 0-1000 meter belt around the Yaran Mountain in Bodrum and Milas districts *brutia* forest burned.

In Menteşe and Kavaklıdere districts, a fire occurred in a wide area at an altitude of 0-2000 meters. In this fire, 13418.9 hectares of area in and around Oyuklu mountain, which is an extension of Madranbaba mountain, was exposed to fire. Pinus in the belt extending up to 2000 meters Abies, a mountain belt forest as well as the brutia species cilicica larch, cedar and fir trees were also burned (Map-13).

# Map-11: Elevation step map of the fire area in Muğla

# Map-12: Slope map of the fire area in Muğla

# Map-13: Plant density map of pre-fire and post-fire multispectral camera recordings in Muğla

## CONCLUSION

A large forest area was exposed to fire in the July 2021 fires in Turkey. In this fire, a large area was burned in the south of the country, along the Taurus mountain belt, at different altitudes. A total area of 91681.3 ha was damaged in the fire. Manavgat was damaged the most by the fire with a maximum of 55566,9 ha. This was followed by Bodrum Milas with 16461.5 ha and Gündoğmuş with 14599.5 ha. Fire is rather Pinus *Pinus, the* climax plant of the Mediterranean Region, occurred in the brutia forest belt and due to the Manavgat, Gündoğmuş, Silifke, Aydıncık and Köyceğiz fires reaching levels above 1000 m. Cedrus as well as the *brutia community* libani, Abies cilicica and pinus Mediterranean mountain belt forests consisting of nigra species were also damaged.

Burnt areas are areas where coastal tourism is particularly important in Turkey. These areas contain many factors that make tourism attractive. These are in terms of human factors such as the morphological diversity of the bays, the fact that the sea water temperature covers a period of approximately 5–6 months for swimming, the diversity of plant species and the presence of forests, as well as the cultural richness of ancient ruins, being on an international yacht route. are also important fields. In other words, they are the favorite areas of Turkey in terms of natural, human and economic resources.

It takes a long time for the forest to renew itself in the burned areas. The main measures to be taken for this are:

1-First of all, the burned areas should be cleaned and taken under protection,

2- In addition to the natural regeneration of the forest, afforestation efforts should be accelerated,

3-Legal measures should be taken to prevent fire areas from being developed.

## Declarations

# Author Contribution

Fatma Kafali Yilmaz has determined the the perpespective of this search. In other Words, Fatma Kafalı Yılmaz drew the outline. And Okan Bozyurt has collected the data and commented the maps. İlyas Avcı has prepared the maps by using Geographical Information System. Finally, The comments and the comparation the maps have been analysed by Fatma Kafalı Yılmaz and Okan BOZYURT.

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INTERNET REFERENCE

1. https://earthexplorer.usgs.gov/

## Map 1 to 13

Map 1 to 13 are available in the Supplementary Files section.

## Supplementary Files

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- Map.docx