Forest Fire Management in Turkey 2021

"Computers don't put out fires"

"The most inexpensive tool in the world is a box of matches"

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Version 5

Contents

REPORT OUTLINE

The following matters are discussed in detail within this report, which is presented in 4 sections.

Section 1 provides a consolidated, but brief, summary of potential interventions for consideration by the General Directorate of Forestry in response to the fires of July and early August 2021.

Section 2 provides a very rapid analysis of the Jul/Aug 2021 fires in Turkey, with estimates of area burnt and losses, including loss of life. It also contrasts the occurrence of fire statistics, principally the annual number of fires and area burnt between 1937 and 2018, less several 2-year periods in 2008/09 and 2019/20.

Section 3 provides relevant background discussion to identify and explain some of the important and commonly utilized areas of forest fire management. This will enable readers not familiar with some of the technical aspects of forest fire management to better appreciate the important elements.

Section 4 provides a more detailed analysis of proposed interventions, together with recommendations for potential activities. A summary of this section constitutes Section 1.

SECTION 1 SCHEDULE OF PROPOSED INTERVENTIONS IN TURKEY FOREST FIRE MANAGEMENT

The whole suite of fire management activities is often divided into four pillars, being Prevention, Preparedness, Response and Recovery, frequently abbreviated to PPRR. The proposed interventions are similarly divided. A brief summary of interventions is described in the table below, for each pillar. These potential interventions are described in greater detail in Section 4.

PREVENTION	PREPAREDNESS	RESPONSE	RECOVERY
Fuel load management o Prescribed fire o Grazing o Removal of fuel	Incident Management Structure - Cross agency	Provision of plant and equipment o Communities o OGM o Municipalities	Rehabilitate burnt areas o Same species o Species change o Watershed management
Community Interaction o Training o Education	Fire Danger Rating System		Fire cause investigation
	Early Warning System		Post-fire reviews and debriefs
	Legislation review		
	Roads and trail maintenance and construction		
	Water supplies		
	Community fire strips		

SECTION 2 CURRENT SITUATION

Responsibility for forest fire management

Forest fire management in Turkey is the responsibility of the Turkish General Directorate of Forestry (Orman Genel Müdürlüğü, OGM), under Ministry of Agriculture and Forestry (https://www.ogm.gov.tr/tr). All land classified as forest in Turkey is managed by OGM

Context of the 2021 Fires

In common with many other Mediterranean countries, Turkey experienced very severe forest fire activity, during late July/August 2021. Adverse weather occurred on and from 28 July 2021. Almost 300 fires burnt across a two-week period from that date. All fires were reported under control by 13 August 2021[1].

As early as July 31, reports of 58 fires erupting during the previous week emerged. According to news reports the Agriculture and Forestry Minister indicated that 3x aircraft, 38 helicopters and 4000 firefighters had been deployed. Early reports about the weather stated that temperatures approached 40 degrees Celsius with winds about 50 km/hr (World news - catastrophic wildfires)[2].

At the time of publication, the causes of these fires were not accurately known but were being investigated. Turkey typically experiences about 10% of its wildland fires caused by lighting with the balance being caused directly or indirectly by people.

Losses

Fatalities: Unfortunately, at least seventeen (17) lives were lost. Nine (9) of these were directly associated with fires, but it is unknown whether these fatalities were fire overruns, accidental events or other incidents on active firegrounds. An additional eight (8) personnel were killed when a Russian owned firefighting aircraft crashed just prior to landing, killing all persons on board, (five (5) crew members and three (3) Turkish observers). Based on video footage it appears the aircraft had very recently executed a water drop just prior to the accident.

Area burnt: Fire area was one of largest, if not the largest, ever recorded in Turkey in a single fire season and impacted on many communities. An estimated 170,000 hectares (1700 sq, km.) were burnt. Subsequent estimates using data from the European Forest Fire Information System estimated the area burnt at 177,000 ha, on 13 August 2021. It is assumed that this total of area burnt includes private non-forest land adjacent to forest areas.

To put an area of this magnitude into context, during the 70-year period between 1937 and 2007, raw statistics reveal that each year, approximately 1200 fires burnt about 22,000 ha. Ealy during that period, the annual area burnt was very significant but fire numbers were very low. As time progressed, the number of fires increased substantially, peculiarly matched by an equally substantial decline in area burnt. For example, in the 2-year period 1945 and 1946 area burnt was about 160,000 – 170,000 ha in 1945 and 130,000 ha in 1946. These two years represented about 18% of the total burnt during that 70-year period. By 2007, annual fire

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[1] Information Bulletin. Turkey Wildfires 13.08.21. Turkish Red Crescent
[2] https://www.digpu.com/world-news/catastrophic-wildfires-create-havoc-in-southern-turkey

numbers were approaching 2,500 – 3,000, but annual area burnt had reduced to about 3000 – 5000 ha. Areas burnt and statistics about annual fire numbers since 2007 are examined below.

An excerpt from International Forest Fire News, quoting statistics provided by OGM illustrates the increasing pattern of fire numbers and the decreasing area burnt in the relevant fire period, IFFN No. 37[3]
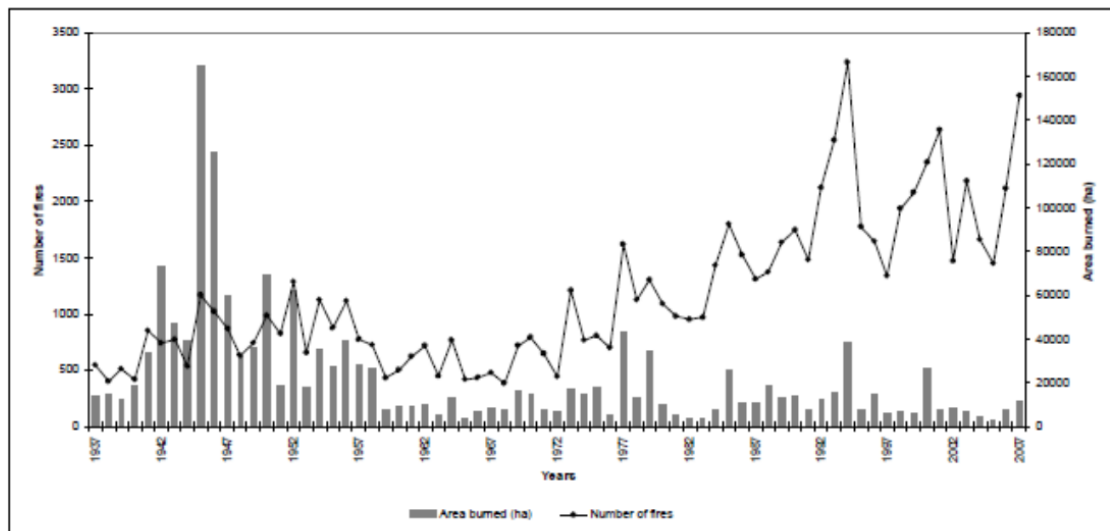

Figure 1. Forest fires in Turkey between 1937 and 2007 (Source: OGM 2007)

The General Directorate of Forestry presents a short history about the forest fires between 2010 and 2018[4]. During that period the average number of wildfires was about 2,421 per annum with an average annual area burnt of 6,814 hectares. These figures show a similar position as the earlier data, insofar as annual number of fires continues to remain at about 2400, although the annual area burnt has increased from below 2000 ha to 6,800, but very significantly below the norm in the 1930s and 1940s.

So, apart from several small gaps in 2008/09 and again in 2019/2020, the statistics do reveal the Turkey has undergone a transformation in its fire history between 1937 and 2018. The two significant elements are that the number of fires has increased substantially from about 1000 events per annum during the 1940s to about 2500 per annum in 2018. Area burnt has followed an opposite trend with very substantial areas being burnt in the 1940s and into the mid-1950s, followed by a substantial decline in the early 2000s, generally to about 2000 ha per annum, with occasional years, reaching 3-4,000 ha. Since 2008, annual fire numbers have remained more or less stable but in that short period, area burnt has increased to about 7,000 ha per annum, excluding 2021.

The Fires of 2021

All fires in late July to mid-August 2021, burnt through 170,000 ha, but just 5 fires appear to have burnt a total area of about 112,000 ha[5]. One of those, the fire labelled as 7 Aug 2021 in

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[3] International Forest Fire News University of Freiburg IFFN No 37 January -December 2008 pp 73-77 ISSN 1028-0864 (web)
[4] General Directorate of Forestry Strategic Plan 2019-2023
[5] Fire area data extracted from the European Forest Fire Information System (EFFIS)

Antalya Province burnt almost 55,000 ha, much more than the recent annual average fire area for all of Turkey in recent years:

Antalya: 07 Aug 21 – 54,769 ha

               10 Aug 21- 15,860 ha

Mugla: 08 Aug 21 - 6,157 ha

               08 Aug 21- 15,312 ha

               12 Aug 21- 10,366 ha

It is assumed that areas quoted by date are the final areas burnt when the fires were classified as "out". Generally, the areas quoted in press articles refer to the "forest area" burnt, but it is likely the areas quoted include all land tenures within the fire footprints.

An update from the European Forest Fire Information System, (EFFIS), on 13 August 2021, placed the total area burnt in Turkey at 177,000 ha.

> **https://effis.jrc.ec.europa.eu/apps/effis.statistics.portal/seasonal-trend/NOTEU/TR**
>
> According to the latest European Forest Fire Information System (EFFIS), the area burnt is now up to 177,000 ha, but the fires now seem to have stabilised. This clearly is way above the recent average.

Other Losses

Apart from the area of forest burnt and loss of life, information on other losses is not known at this stage. The nature and extent of those losses may have been investigated and quantified, but details are not yet known. Undoubtedly, many communities adjoining burnt forest areas suffered significant losses with houses, other assets including farm buildings, plant and equipment, orchards, crops, stock animals and fences destroyed or damaged.by fire. Loss of private assets on lands adjoining state owned/controlled forest was likely very high, witness the nature of criticism about the fire management effort from members of the public and members of the Government opposition.

Criticism of the Government effort in response

There has been significant criticism reported in the media, especially from community members and the Opposition party. A brief selection of matters is below:

31 July 2021. The President visited Manavgat.

Considerable criticism for handling of the disaster. President Erdogan said the number of planes had been increased from 6 to 13. Thousands of personnel as well as dozens of helicopters were assisting the firefighting effort he stated.

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1 August 2021

QR Code for Atalayar article

If you wish to review this article you can access it via the QR code. May need to enlarge the QR code by expanding the 'box'.

Turkey devastated by bad weather amid criticism of government's handling of disasters

Droughts, severe forest fires and floods have been ravaging the country as Recep Tayyip Erdogan's government faces negative comments about its performance in the face of these disasters

Raúl Redondo

Turkish authorities have been accused of being unprepared to combat the threat of the blaze, which has caused at least the ten deaths.

Turkish leaders battling the worst forest fires in history have been singled out for failing to stop the threat after official data showed they spent only a fraction of the already reduced funds budgeted to prevent forest fires this year.

03 August 2021

Leader of CHO Criticism (Opposition)

Main Opposition Republican Peoples Party (CHP) criticizes Turkey government for being "unprepared" for the fires

4 August 2021: President Erdogan: "Opposition information undermining firefighting effort. A total of 172 out of 182 fires that broke out in the past 8 days have been brought under control. Turkey is using 20 planes, 51 helicopters and nine UAV." (This article also references EFFIS, see below under Fire Danger Forecasting):

Comment

Review of images accompanying these articles suggest very strongly that these fires were too intense to defeat by available technology unless they could be attacked almost immediately after ignition – not within 2 or 3 hours or a day, but within 5-10 minutes. When the temperature is 40º C and wind is 50 km/hr, that is the time that is available, before the fire begins to rapidly spread out of control.

Under such weather conditions, aircraft maybe can knock down fires but they can never guarantee to completely extinguish them and very rapid ground based follow up is necessary to locate and extinguish any remaining small pockets of fire under logs, behind trees and in deep litter.

Unfortunately, the public image of aircraft is that they look impressive so they "*must be doing some good*". Reality is that on many occasions water drops miss the fire edge, even if the water reaches the ground.

The only 'solutions' are to have fewer fires under the weather conditions that prevailed, and to implement effective fuel load management to lessen fire intensity. Areas so treated will still burn under very adverse fire conditions but the time available for effective initial attack is lengthened. The only way to achieve reduction in fire numbers is to engage in very carefully targeted community involvement so that the community becomes a part of the solution, rather than a part of the problem as regards levels of fire incidence.

The frequency and severity of disaster type natural events is increasing. For example, USA is facing more frequent and extreme fires occurring over greater areas, smoke from wildfires in Siberia has reached the North Pole for the first time ever recorded, Turkey itself suffered its greatest ever recorded fire area (in just a little over 2 weeks of the fire season) so only a supreme optimist would assign this as a chance occurrence. There is very good evidence globally to indicate that more severe weather, induced by climate change is generating more extensive forest fire. (Wildfires: How are they linked to climate change?)[6]

SECTION3 - BACKGROUND DISCUSSION POINTS

Fire Danger Forecasting – Fire Danger Rating System

Fire danger forecasting is an essential component of readiness and actual fire suppression. Fire managers or Incident Controllers, ideally need to understand the nature of impending fire weather and how individual fires are expected to behave. For this purpose, a Fire Danger Rating System (FDRS), that amalgamates actual or forecast weather conditions to provide a measure of the relative degree of fire danger is utilized. This information is necessary in order to develop and implement safe suppression strategies – managers/controllers need to be satisfied that fire behavior and intensity expected will not exceed the capacity of resources allocated for suppression, or else firefighters may be placed in life threatening situations. It is also used to provide warnings and alerts to threatened communities.

A description of fire behavior attributes is attached as Appendix 1.

There is a Europe-wide fire information system that can provide this type of information. It is the European Forest Fire Information System (EFFIS). It has been designed to provide relevant and timely information to forest services and wildland fire management services across Europe and neighboring countries. EFFIS is managed by a "*co-operative wildland fire expert group*" on which Turkey holds one observer position[7].

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[6] www.bbc.com/news/58159451
[7] https://effis.jrc.ec.europa.eu/partners

It is a most extensive system that gathers huge quantities of data about fire occurrence and spread, weather information and forecasts, fuels, ignition potential, topography, community development, in short almost any aspect of wildland fire management that a fire manager needs, or ought to be aware of. It can provide a detailed picture of a geographic area, complete with forest areas, cleared/agricultural lands and towns/villages, with the ability to interrogate for data on very broad areas, such as an entire country, to smaller subdivisions (council, province) and right down to very detailed local areas of just a few hectares.

It is a multifaceted system that draws input from many sources. Originally, it was based on the Canadian Forest Fire Danger Rating System, it has been modified to incorporate elements of the US National Fire Danger Rating System (NFDRS), the Keetch-Byram Drought Index (KBDI) and the McArthur Mk V fire danger meter. Users are able to select whichever elements they feel are the most appropriate for their circumstances. EFFIS should be suitable for Turkey because it covers the Mediterranean zone as well more elevated lands inland, so Turkey could well use the McArthur Mk V for Mediterranean environs and either of the other two systems for the higher elevation inland forests. These observations notwithstanding, it is understood that Turkey does not make extensive use of EFFIS.

Turkey's principal information about impending fire danger is provided by the Turkish State Meteorological Service[8] (MGM), but the nature of the content and the variables for which forecasts are provided has not been researched in this diagnostic. Very obviously, the MGM would provide forecast data for salient meteorological parameters such as temperature, wind speed, relative humidity and dew point, given that it maintains an extensive network of 1300-1400 automatic weather stations across the country, but it is not known what the nature of any specific advice is about expected fire behavior, provided by MGM.

It is further noted that OGM has indicated, in the Strategic Plan 2019-2023, that there is an intention to develop a "Turkey specific" fire danger forecasting system, (FDRS) perhaps indicating that by developing its own local system, that it will bypass EFFIS. This development of a local FDRS is a major undertaking that will require lengthy research and analysis, which could extend over many years to develop a robust system. It would be worthwhile OGM working with MGM to analyze the utility of the fire danger rating systems included within EFFIS. These are briefly discussed below.

Major Global Fire Danger Rating Systems

Across the globe there are three major fire danger rating systems, (being the three systems incorporated into EFFIS) – namely the Canadian Forest Fire Danger Rating System, National Fire Danger Rating System (USA) and the McArthur Forest Fire Danger Meter (Australia).

These three systems are comprehensive and take many factors into account – long and short-term drought, forecast weather conditions, topography, forest types, fuel quantity, its condition/moisture content and degree of curing or dryness. In one form or another, these three systems, or parts of them are used in many other countries. They provide users with the ability to forecast fire danger indices which show the relative degree of fire danger. Importantly users can predict fire intensity using their own inputs for available fine fuel, slope of the terrain and forecast temperature, relative humidity and windspeed.

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[8] https://www.mgm.gov.tr/arastirma/dogal-afetler.aspx?s=ormanyangin

It is not always a simple matter of importing one or other of these systems and commencing to use it. Each system was developed by fire researchers in their respective countries and the systems cater for the key vegetation types and rainfall patterns and those factors don't necessarily translate to a different country at different latitudes with very different vegetation and rainfall patterns.

For example, the Canadian system is suited to boreal forest types with a deep duff layer, (the layer of decomposed vegetative material that is sandwiched between the mineral soil and the litter layer). Mediterranean forest and tropical rainforest essentially do not have a significant duff layer, if at all, so the direct import of say the Canadian system may not function adequately. Similar comment may apply to the other two systems and experience around the globe suggests that direct transplantation of one or other of these systems is unlikely to work well. It is almost always the case that some modification is necessary.

South Africa embarked on a program to select a FDRS more suited to its conditions than the local system in use. In brief, the South African exercise began at a base level, at which the fire services enumerated the elements of a fire danger rating system that they wished to utilize. They then considered a number of different systems, discarding several and further evaluating several others before deciding which system best served their needs.

A paper by the South African agencies (Appendix 2), a discussion paper briefly describing fire danger ratings systems (Appendix 3) and a paper from New Zealand (NZ), describing the process of "adoption or adaptation" of a Fire Danger Rating System (Appendix 4) are attached.

There are other fire danger rating systems such as the Swedish Angstrom Index and the Russian Nesterov Ignition Index. The Angstrom Index relies solely upon relative humidity and temperature and the Nesterov Index is the relationship between the current day's maximum temperature and minimum dew point, with amendments for recent rainfall. These systems both rely only on a measure of humidity, (which in turn determines fine fuel moisture content). Neither takes wind conditions or other factors such as fuel type and quantity into account, so they are essentially an indication of the likelihood of fires starting (ignition index), but not of subsequent behavior.

If Turkey is determined to develop its own fire danger rating system, an interim step would be to make use of the EFFIS facility, in conjunction with the Turkey Meteorological System, to assess and determine the applicability of any specific elements from the three major global systems in use.

Early Warning Systems

An Early Warning System (EWS) is an essential component of readiness for forest fire management. An effective EWS relies upon an evaluation of fuel dryness couple with weather outlook to determine the likely potential for fire ignition and fire behavior at some point in the future.

The OGM has established what is referred to as an Early Warning and Management System (Elvan et al 2021[9]). It is reported by OGM[10] … that "*an early warning system for forest fire*

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[9] Elvan Reported in Forest Fire and Law: An analysis of Turkish forest fire legislation based on Food and Agriculture Organization criteria
[10] Strategic Plan for Climate Change Adaptation of Forestry   www.ogm.gov.tr

has been established" to meet the goal of "*UO2.8.3 Increasing preventative measures in combating forest fires, improving existing early warning systems.*" The system, reported by Elvan, relies upon lookout observers locating smoke within a very short time period (15 seconds after ignition is quoted). As soon as data is collected, it is forwarded to the relevant Fire Operations Center. Response teams then consider the physical factors affecting the fire (topography, weather, fuel type, location) to decide whether to attempt to control the fire by direct attack with ground forces, use of aerial appliances or a combination of both.

Elvan's paper also describes the commencement of active detection when conditions are such that fire management authorities need to be able to detect fire ignitions as quickly as possible in order to ensure timely and adequate suppression action can begin. So, this "EWS" falls more into the "detection" category, which of course is the immediate precursor to suppression action.

The application and use of an 'early warning system' should incorporate information to be collected <u>some time prior to the onset of active fires,</u> i.e., it should serve as a warning to fire management authorities, and to communities, per medium of the fire management agencies that adverse fire occurrence may be imminent (perhaps within several weeks or so), and should act as a 'trigger' for the relevant fire management agency to ensure that all aspects of readiness are in place, including matters such as community warnings and alerts, plant and equipment preparation, resource arrangements, inter-agency coordination - all clearly identified. In short, it is the trigger to make sure that everything is ready for the onset of fire. Obviously, such a warning also alerts fire authorities when it is appropriate to initiate detection mechanisms – fixed fire lookouts, ground patrols or aerial patrols, including UAV.

An example of such an early warning system, including a measure of drought is the Keetch-Byram Drought Index[11]. This is a reflection of antecedent rainfall and evapotranspiration, so in essence it is a measure of long term-drought. When allied with recent rainfall and temperature, it provides a good measure of fine fuel dryness, degree of curing of fine annual fuel such as crops and grasses or leaf litter and ability for that fuel to be ignited and the rate and vigor (intensity) with which it is likely to burn.

Whereas short term drought is easy to represent by the period that has elapsed since recent rainfall, long term drought is a measure of the severity of seasonal and longer-term drought. The Keetch-Byram Drought Index provides such a measure.

In the USA, where the KBDI was developed, its range is 0-800 and each unit represents 1 point (1/100") of rainfall required to bring upper soil levels to field saturation levels. In countries using metric systems, KBDI range is 0-200 and each unit represents approximately 1 mm of rainfall (200 mm of rain to restore field saturation levels. Two different ranges but the same end result.

KBDI is simple to maintain and requires only rainfall and maximum temperature, recorded on a daily basis, to adjust the index day by day. If rainfall in excess of 5mm occurs, the index will decline but if no rainfall occurs, the index will increase. It is represented by 4 ranges:

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[11] https://twc.tamu.edu/kbdi

Metric:

0-24	Mild drought
25-62	Average drought
63-100	Serious drought
101-200	Severe drought

From a fire management perspective, the current value of KBDI provides a broad indication of the propensity for fine fuels to burn and it can serve as a useful early warning system that underlying soil and fuel moisture is low and any adverse change in meteorological conditions could rapidly lead to deteriorating fire conditions. E.g., at the mild range of 0-25 there would be little expectation of imminent adverse fire behavior, (probably only 50-60% of the fine fuel on exposed aspects would be at a moisture content low enough to burn) but at the highest level, even a slight change in conditions, especially the development of strong wind conditions could easily lead to high intensity fire behavior, as the whole fuel profile would be available to burn, irrespective of its aspect or position in the topography.

In other parts of the world, other well-known meteorological conditions often herald adverse fire conditions e.g., a strongly negative and declining value for the El Nino Southern Oscillation Index (ENSO) is often a clear sign that countries in SE Asia/Australia, may be heading towards a very adverse fire season, so it is appropriate to commence readiness activities whenever decreasing values of ENSO reach predetermined negative values.

The EFFIS system incorporates KBDI and also indicates existing and forecast temperature anomalies (out as far as 4 or 5 weeks), a signal for likely low measures of relative humidity.

The key principle behind an Early Warning System is that it kicks in <u>before</u> fires start and alerts fire authorities to 'get ready', if they have not already done so.   There is rapidly escalating evidence to support the notion that '*traditional fire seasons*' in many areas globally, are occurring much earlier than has been the norm, are persisting for a longer time span than usual and are impacting very significantly greater areas than is usual.

The value of an EWS is that fire and forest agencies who may assume that fire seasons will develop in accord with historical patterns about the likely onset of fire, have been caught out by being in a state of less than optimum preparedness when the 'traditional' fire season develops earlier than expected.

Importance of fire intensity

It is widely accepted by many fire management agencies that less than 5% of wildfires cause more than 95% of the damage. It is no surprise either that unless the first responders are almost at the very site of a fire when it first starts under very adverse weather conditions, that such fires will rapidly burn out of control defying all efforts to bring them under control. Sometimes, there is as little as 5-10 minutes available to mount resolute initial attack successfully before a fire is off and away.

Once fire intensity exceeds about 3000-4000 kw/m there is no technology capable of control by direct attack - no amount of fire firefighters, bulldozers, fire trucks or aircraft serve any practical purpose in forests.   Fast moving fires spreading uphill in high fuel loads with a tail

wind and burning under conditions of low humidity rapidly exceed nominal control levels and do not lend themselves to suppression unless something significant alters – the weather moderates, fuel conditions alter to very low levels of fuel insufficient to sustain spreading fire, e.g., fire runs into a very low fuel or no fuel areas that are substantial in size, significant rainfall occurs.

Given the levels of weather that prevailed in late July-mid August in Turkey, any fire not quickly suppressed would rapidly burn beyond the limit of suppression capability. I estimate that under the prevailing meteorological conditions, with a relative humidity of about 10%, these fires could probably have burnt with intensities of 5000 kW/m in fuel loads of 10 tonnes per ha, 11000 kW/m in fuel loads of 15 tph) and 21,000 kw/m in heavier fuels, say 20+ tph, all burning on level terrain.   Any significant slope in the terrain, or elevation of weather parameters, would cause the fires to spread at an increased rate with substantial increases in fire intensities. E.g., a 5-degree slope would cause a doubling of the above intensities to 10,000, 22,000 and 42,000 kw/m, all way outside the envelope for direct attack. Fires burning on a 10-degree upslope would see those intensities quadrupled.

These levels of intensity are sufficient to defeat any level of attack and unless fires are controlled within a very short time from ignition, initial attack is likely to fail and an extended fire fight will almost certainly ensue.

On a day-to-day basis, EFFIS has sufficient information on weather forecasts to enable fire managers to be able to assess the likely fire conditions, provided they have information about fuel type and quantity.

Prevention is better than the cure – community involvement is critical

Given that Turkey is one of the oldest permanently settled region in the world, there is clearly a very close association between people living in the settled areas and forests.   Their actions adjacent to and sometimes within the boundaries of forests, are critical in determining whether fires start on very adverse fire days and where they start. This naturally leads to the matter of "Community Involvement" and building local communities into the overall fire management structure. This matter is further examined later in this report.

Community involvement:

The above concept is central to any attempts to improve fire management and the main focus must be on reduction of ignitions. It is known very clearly, that on the most adverse fire days when fires burn with very high intensity and spread rapidly, that fire intensity is too great for any of the accepted methods of suppression to be effective. It is also known that in any given community there is a very high likelihood that fire ignitions in and near that community stem from the actions of people who live and work there.

There must be very close and interactive contact with those communities in fire prone areas, *before* the onset of adverse fire conditions. Hence the value of an Early Warning System that heralds the onset of 'worse-than-normal', right through to 'very adverse' fire conditions in the near future. Residents in and near to fire areas and/or their activities or equipment are likely to start by far the greatest proportion of wildland fires. Long term statistics reveal that lightning in Turkey comprises about 10% of all fire ignitions, with the remainder being related directly to people, e.g., farmers burning unwanted crop residues or indirectly e.g., faulty power transmission lines. It is evident from the literature dealing with fire causes, there is always a

significant element, as high as 60% of all fires where the cause is ascribed as "unknown". This indicates that there is likely not a dedicated fire investigation capability.

This raises the question of communities being equipped and trained to deal with initial attack on fires whilst they are in their initial stages and amenable to direct suppression action. Even on the worst days, fires igniting from a point source require some time to reach the stage where they begin to run at high rates of spread. On very low-risk days, fires burn at low intensity and are easier to control and suppress and can remain in that state for some hours, but on very high-risk days, in even moderate fuel loads, a point ignition can reach the state where it is not amenable to attack, within the first quarter hour, maybe even less, depending on wind and topography. Hence, rapid initial attack is vital. Local residents are often much closer and can access the fire far more quickly than resources dispatched from some distance – and their local knowledge is often unsurpassed.

Community members, who often derive some income by way of non-timber forest products from adjacent forests, are expected to participate in suppression activities in Turkey. They are often referred to as 'volunteers' but there does not seem to be any structure to determine how they operate, and who, if anyone or any agency provides them with equipment. It may be worthwhile to consider formally recognized, trained and equipped "community-based fire units" to act in initial attack – after all, the great bulk of the fires emanate from within communities or those communities' residents!

By way of comparison, many other countries operate with very substantial community based "volunteer brigades". In one state in Australia, NSW, with an area similar to Turkey (NSW 810,000 km^2, Turkey 783,400 km^2, but very different population size (NSW 8.2 million, Turkey 85.3 million), the Rural Fire Service comprises about 72,000 volunteer firefighters across about 2000 rural brigades, who provide the bulk of wildland fire management on about 90% of the state. The fire service is managed by a full-time staff of about 800 and is fully funded and equipped by the State Government with mandatory funding contributions from the State Government, Insurance Companies and Local (Municipal) Government.

Similar arrangements also apply in all other Australian states, where volunteers provide the backbone of on ground fire management in wildland fires (bushfires).

The journey to get there is not easy and requires a very strong sense of '*wanting to be involved*' or of '*needing to be involved*' by the rural community and that is not always evident, so creating a volunteer-based service is not something that can be imposed by Government decree, but it seems that if there exists a mandate for community members to be involved and available for fire management activities then a critical appraisal of that situation may well conclude that those community members should be equipped with the wherewithal to be effective.

Community Education and Interaction

This area is one where there is a need to get suitable mechanisms established as soon as practicable, (and it may be a forerunner to establishment of volunteer-based "community fire units"). There are several key elements to consider:

- Suppression activities are only effective at the bottom end of the fire intensity scale. Once fires start to spread rapidly, there is no technology capable of stopping them – no amount of firefighters, fire trucks, bulldozers or aircraft.

Fire Intensity levels kW/m - limits for methods of successful attack

Method Author	Ground crews	Bulldozers	Heavy tankers	Large aircraft
Cheney[12]	1000	2000	2000-3000/3500	2500
Alexander[13]	<500	2000	2000	2000-4000[14]
Loane & Gould[15]				3000 airtankers 1000 small aircraft

- A vast majority of fires are started by the activities of people (usually those who live in the same communities that are affected by the fires!)
- Activities of communities can have a large impact on the availability of fuel to carry fire under adverse conditions – fuel availability is central because the fine fuel quantity (tonnes per ha), allied with extant weather conditions and topography are the key determinants of fire intensity.
- Communities close to or within forest boundaries are often the best placed person to be able to get to the site of an ignition quickly (but to be effective, they need appropriate equipment.)

Hence the most important issue is to undertake those actions that can reduce community fire ignitions, restrict their fire use to "safe" periods and ensure the community understands what to do to ensure their own safety when conditions are right up at the wrong end of the scale.

Community interaction is not about scaring residents but to carry the community along and actively involve them in the fire management process, aiming to achieve a state whereby local communities are aware of and really understand the necessity to be ultra-cautious with their use of fire, when risk conditions so dictate, to be able to recognize when such conditions prevail, and to be able to clearly understand and respond appropriately to warnings and alerts about imminent fire threat.

One of the key findings in a study (Elvan et al, 2021)[16] was that: "*areas that need to be improved have been determined to be definitions, **participatory community-based approaches to fire management….. a focus on public participation and social approach is needed**.*"

It should never be the case that all fire use is forever forbidden because that, quite simply, doesn't work – there are many countries who have legislated to ban use of fire during defined periods and defined areas, all to no avail e.g., some years ago, Bulgaria banned the use of fire

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[12] Cheney, N. P. The Safety of Bushfire Fighters CSIRO Forestry and Forest Products (undated) and a further paper, "Bushfire Fighting and Occupational Health and Safety" presented at the Worksafe Australia Professional Education Program in June 1994, Sydney.

[13] Fire behaviour as a factor in forest and rural fire suppression. Alexander, M.E. (2000). Forest Research, Rotorua, in association with the National Rural Fire Authority, Wellington. Forest Research Bulletin No. 197, Forest and Rural Fire Scientific and Technical Series, Report No. 5. 30 pp.

[14]Alexander also says in his paper that: "At intensity levels above 4000 kW/m: "*Very difficult if not impossible to control*".

[15] Aerial Suppression of Bushfires Cost-Benefit Study for Victoria. I.T. Loane and J.S. Gould. National Bush Fire Research Unit CSIRO Division of Forest Research Canberra ACT 1985

[16] Elvan O, Birben Ű, Özkan Y, Yildirim H, and Turker Y, 2021, Forest Fire and law; an analysis of Turkish forest fire legislation based on Food and Agriculture Organization criteria. Cited as *Elvan et al Fire Ecology (2021) 17-12*

for burning wheat stubble because of high levels of smoke pollution. Farmers burnt their crop residues annually in a bid to reduce pathogens harboring in the stubble. Because individuals who burnt their stubble during daylight hours could be easily observed, many farmers resorted to firing their crop residue at night. If questioned, shrug their shoulders and suggest that "*they were not aware and somebody else*" must have lit the stubble.

The outcome of this edict was that the majority of stubble was burnt at night, when meteorological conditions where cooler with higher humidity. The crop residue did not burn as cleanly as it did in daylight hours, under warmer and dryer conditions, much greater volumes of smoke were produced and smoke pollution was worse. The no-burn initiative was a complete failure and had the reverse impact to that intended.

At one point Indonesia banned the use of fire for land clearing, with several minor exceptions for small holders who relied solely on their land for livelihood. No impact and no reduction in widespread fire use.

Croatia had bans on use of fire during specified times of the year. Not very successful except on one major island where the principal activity was grazing sheep for specialist cheese production. Any fire during summer months adversely impacted the sheep herders' bottom line, so the local residents imposed and policed **their own** fire use criteria which were tougher than those imposed by the national government. The local restrictions were very effective because the local communities had complete ownership and were fully involved.

The most inexpensive land management tool available in the world is a box of matches and the real challenge is to ensure that communities understand the grave threat posed by uncontrolled fire to themselves and their assets as well as community owned assets (the forests), to use their matches wisely and to have them understand that their own actions can be instrumental in determining whether their community, its members and their assets, can enjoy freedom from the damaging effects of catastrophic fires.

There is clearly a role for regulated use of fire during defined periods, including a complete ban on fire use on certain days when fire conditions are forecast to be very adverse, but that must be very closely tied to community involvement – if the general population understands why, and what the potential impact on them may be, then they are far more likely to acquiesce to whatever restrictions and conditions might be imposed.

An appropriate restriction may be a "restricted period" during which open air fires are effectively banned, except that a "permit" can be issued to specific landholders, upon application to an identified **local** authority or person, for approval to use fire at a defined time and under defined conditions.

Research into Community attitudes, wants and needs to drive appropriate behavior in critical fire situations

From the perspective of a seasoned fire practitioner, it may seem very simple to assess what communities need to know in times of fire stress – "*you just tell them what they need to know*". The reality is that such fire practitioners may never really know, unless they actually inquire of affected people. Following severe fires, there is often much discussion about the impact on involved communities and how such impacts can be avoided or ameliorated in future. The core element in this is the community and its members – it is folly to assume what the community actually knows vs what it does know and to further assume that all community members fully

understand and will react appropriately. Targeted research is critical to ascertain what the members in communities really need to know and how well their needs have been met by the fire or emergency service.

There is a very good opportunity now, following this fire event, to undertake such research, based on actual scenarios because people experienced severe fire first hand and reacted to it in certain ways perhaps relying upon any advice received, or maybe looking for advice that they did not receive by way of warnings and alerts about impending high intensity fire. Many of them lost assets or were impacted by the fires in other ways and will have a clear message to relay

Warnings are a critical component to alert communities to impending natural disasters, including fires but the manner in which they are prepared, delivered and understood evolves over a period of time. It is critical, for the success of a community advice strategy to understand that some warning strategies are more successful than others. Similar comments can apply to the method of delivery, e.g., TV, radio, direct telephone call, mobile phone app or fixed warning signs, because a single method of delivery may not reach the whole community and critical above all else is how well the community understands what the message is about and how to react.

This type of study is probably central to any other actions to develop a sound community focus on fire. Cosgun and Gonzalez-Cában[17] foster such a concept as does the paper by Elvan et al.

Following severe fires in New South Wales (NSW) in 2019/20 that burnt 5.5 million ha and impacted many communities, the NSW Rural Fire Service commissioned an independent review of the effectiveness of education and warning/alert campaigns. See: www.bnhcrc.com.au/publications/black-summer-nsw-community A PDF copy of this report is attached as Appendix 5.

To date one municipality, Bodrum (there may be others), has undertaken and reported a post-fire review, but how involved community members were in the review process, especially in relation to what they knew or were warned about in weeks and days leading up to the fires, and also during the fires is not reported There is much focus on post-fire recovery, and given the level of losses, that is to be expected. It may have been useful too, if the community members who participated in the review had the opportunity to indicate how much, and what type of information, they were provided with about the potential for very adverse fires in the lead up to the events and what sort of information they were provided with or the types of information they would have welcomed during the fires but were not provided with.

The Bodrum review traces the development and spread of 4 major fires, collectively burning about 8500 ha and lists the resources allocated. Included in the resources used are 891 public staff and 123 volunteer and private employees. Not clear is whether the volunteer staff were "fire" volunteers who maintain some sort of training and readiness to attend fires or good Samaritans who just turned up on the day to help (a noble gesture, but perhaps raises the question of untrained firefighters on active and dangerous firegrounds).

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[17] Factors explaining forest fires in the Serik and Tasagil forest provinces

The largest of these fires (7,573 ha) appears to have been driven by wind, from the ignition point direct to the coastline, when its forward spread ceased. Perhaps the spread rate was too rapid for aircraft, as none were listed in the schedule of equipment.

As part of the process, the Review Team visited 352 households and interviewed 780 people. Not stated but deduced from other data provided, it seems that this initiative was by the relevant municipalities and directly targeted restoration and recovery activities, for which the local communities are no doubt grateful. Not a big step to the next level to ascertain from the communities what information they had about impending fire danger, what alerts were provided and whether or not they were understood and how well prepared the community was and whether or not they had adequate and appropriate information.

Community Firebreaks or "asset protection strips"

It is desirable, mandated even, that community lands be separated from forest lands by a zone of sufficient width to act as a firebreak. For these zones to be effective, fuels on them should be removed prior to the onset of the fire season – not later than the time an effective Early Warning System suggests that the fire season is approaching.

Such zones are multi-functional. They can serve to halt the spread of fire from private lands to adjacent forest or in reverse, serve to halt spread of fire from forest into private lands. They can also serve as a very effective anchor point from which to which to mount suppression action against approaching fire. These features are only effective when the strips actually do exist and have been prepared by removal of all or most of the fuel on them.

Typically, they may exhibit a covering of grass or small shrubs which can be removed prior to the onset of the fire season by using low intensity fire, intense grazing when stock can be confined to the protection strip, by cultivation intending to leave the strip in a fallow condition through the fire season or by mechanical means such as mowing.

Although such separation strips ought to be established where terrain permits, in some instances such strips have either not been created or not adequately maintained, thereby allowing easy transfer of fire between forested areas and community land.

Roads and fire tracks

Layout - Roads and access tracks are an essential component of fire management to enable initial attack and later on for other suppression resources to gain access to fire areas. As a general rule of thumb, roads and access trails should be '*tenure blind*' and should never stop in a "dead end" at a boundary between separate tenures. Roads and trails that traverse the forest and then simply end and do not link into the overall network at that 'dead-end', can be very dangerous in severe fires when fire crews, who believe they are retreating to safety are not aware that the road or fire track they are travelling on does not link into the roading network, in the direction they are proceeding, but will simply terminate.

Roadside Maintenance

There are indications that some roads were not well maintained with regard to clearance along the edges of the roads. Over time, trees encroach closer to the road edge as natural regeneration occurs and eventually the branches and canopy begin to overlap the road. One suggestion was that there is a need to remove a narrow strip of trees from the roadsides, perhaps by use of forest harvesting machines.

Fuel load management by Preventative burning

In forest areas, preventative burning, variously described as 'prescribed burning', 'control burning', 'burning off' or like terms, is used in many parts of the world to reduce the amount of litter fuels on the forest floor and suspended in shrub layers. The objective of preventative burning is to ultimately reduce subsequent fire intensity in the event of a wildfire.

The views on this deliberate burning are very polarized, but there is a growing acceptance that several episodes of carefully implemented, low intensity prescribed burning is far more beneficial to the health of ecosystems and their constituent flora and fauna than less frequent but very high intensity fires. Careful consideration of the deliberate application of fire and assists in understanding that many parts of the world were exposed to deliberate fire use by indigenous peoples for many thousands of years and their application of fire was not random - they had real purposes behind their activity, using wisdom gathered over lengthy periods up to 60,000 years.

Australia is probably one of the most recently settled countries in the world. Settled by "new settlers" that is – there was already a population of indigenous nations who had been there for up to 60,000 years before European settlement. Those First Nations peoples used fire prolifically and with great skill, for a number of purposes, including protection of medicinal plants and herbs, to attract grazing animals and to limit the spread of invasive forest types such as rainforest, into woodland and grassland areas, where valuable and culturally significant plants occurred.

When European settlers arrived, they were greeted with abundant fauna and an array of grasslands, woodlands, tall wet and dry sclerophyll forest and extensive belts of rainforest, so the husbandry afforded by the First Nations over thousands of years, very clearly enabled such a situation to prevail. Among the first actions by the newcomers was cessation of indigenous style burning.   Following very severe fires in 2009 (173 fatalities on one day) and 2019/20 (5.5 million ha in NSW), there are concerted efforts now being made in some quarters to reinstate the skillful burning practiced by the first inhabitants.

Likewise, in USA, many years of swift and resolute initial attack on forest fires and very substantial suppression activity, whenever possible, has helped to create a situation whereby forest fuels in many forested areas continued to rise. This has been recognized and USA is increasingly applying prescribed burning as a management tool to reduce fire intensity and forest damage in subsequent wildfires.

By itself, preventative burning does not stop fires from igniting. If conducted in accord with guiding principles about the intensity of the prescribed fire, and careful identification of the zones targeted for prescribed fire, it does mean that any subsequent wildfire that ignites within the area of concern will burn at a reduced intensity and may be amenable to control.

Reducing the fine fuel load serves to restrict the spread of the fire and gives firefighters more time to access unintended fires. It also means that when firefighters do reach a fire, burning the actual fire intensity will be lower and there is a much greater chance that initial attack efforts will be successful. If suppression action is not successful, a wildfire may burn through the area but at a much lesser intensity because of the significant reduction in available fuel, perhaps as much as 70% of the original fuel load removed.

Under very severe conditions, areas that have been "hazard reduced" or subjected to prescription burning will still burn. As a general rule the "prescription" for any burning should et a number of parameters that apply to a specific burn: desirable temperature, relative humidity, wind speed and fuel moisture content. It is rarely the case that attempts are made to remove all of the ground litter and shrub fuel, and a sound target is to attempt removal of about 70% of the fine litter, without causing any significant scorch to tree crowns.

Fuel load management by grazing

Another fuel load management technique is to graze selected areas with domestic stock. It is preferable that stock can be contained to a defined area. The stocking rate determines how effective this is for reducing fuel loads comprising grasses, herbs and other edible plants. Trampling by the stock as they move about in the forest can also serve to ensure that litter suspended in shrub layers may be displaced onto the ground, providing less aeration to the fuel load.

Physical removal of fire fuel

This is a practice sometimes employed where forests carry heavy fuel loads adjacent to housing and other valuable assets, whereby the ground fuel is collected and moved off site. It is obviously very labor and plant intensive and there is a need to subsequently dispose of any material collected. It is not generally applicable to broad areas and is often confined to narrow strips of forest adjacent to 'at risk' assets.

These matters are very worthy of consideration by the General Directorate of Forestry (OGM).

Water supplies

There is need for static water supplies from which to replenish fire tankers when they exhaust their supply. The optimum outcome occurs when fire tankers do not need to leave the fireground for a lengthy time period and travel long distances to refill with water.

Field water supplies must be accessible by a road or track that can be traversed fire-fighting vehicles and experience has shown that the more depth in a water supply, the more reliable it will be.

For static water supplies that may be used for water bucketing by helicopters, there are, or should be, defined clearance zones from which all aerial hazards have been removed.

Running streams with suitable ponds are adequate to fill water tankers but as terrain steepens

Fire investigation

Generally, fire statistics for Turkey show overall fire causes are about 10% from lightning and 90% anthropogenic. These figures obviously vary from year to year, but they are the long-term averages. The human caused fires are generally not described in detail, and often there is as much as 60% of the total number of fires classified as cause "unknown". For example, the fire plan for 2021 indicated that 10% of all fires were caused by hunters, stubble burning and farming and that community education, information and training would target those specific categories. However, there were probably another 50% of fires where the cause was not categorized. As a consequence, a large section of the communities that may have contributed to those fires may not have been targeted.

The lack of data about further subdividing the human caused fires into more specific categories suggests very strongly that there is perhaps limited fire investigation conducted. There is a very strong perception globally, and it is certainly a proposition that is gaining traction with forest and fire management agencies, that effective fire management begins with preparation and preparedness measures, one of the key foundations of which is community awareness and education.

The corollary is that without a detailed understanding of what precisely is the cause of fires, how then does one target effective prevention and community education? As a general principle unless prevention activities are closely and specifically targeted, community members often rapidly conclude that the message is aimed at somebody else and not them! The simple message is: *If you do not know precisely what is causing fires, how then can you effectively target community education and reduction programs?*

Some form of formal fire investigation to establish cause and to assess outcomes on an ongoing basis is indicated.

Forest Fire Legislation

There are individual pieces of fire related legislation that seem to be somewhat disjointed, insofar as whenever an event was worthy of description or provisions in legislation, it was either added to an existing piece of legislation or a separate Regulation or other new piece of legislation was drafted. The outcome is that there is a large number of separate pieces of Legislation or Regulations that perhaps could be logically arranged in a single piece of fire legislation/regulation for clarity and accuracy in both understanding and implementing the relevant elements.

Elvan et al[18] also examined "fire law" from the perspective of how well it followed FAO guidelines. Whilst not recommending a full re-write of the relevant legislation, this paper points up areas that need to be strengthened – for example, there is no definition of what constitutes a "forest fire".

It appears that there may be benefits from a consolidated legislative package that clarifies fire management insofar as wildland fires are concerned, i.e., those fires that occur on forests, conservation reserves, agricultural and farming land - essentially all fires outside urban areas.

In NSW, 25 years ago, there were a number of separate pieces of legislation that dealt with fires: a Bush Fires Act that principally dealt with rural fire external to Forests and National Parks and separate fire provisions within the Forestry Act and National Parks and Wildlife Act. Each Act also had an accompanying set of Regulations that were modified and updated more frequently than the parent Act.

Following severe fires in 1993/4 this legislation was reviewed and re-written to provide a single piece of legislation (**Rural Fires Act 1997** and accompanying Regulation) to set the framework for management of all wildland fires (essentially any fire outside of urban areas where the principal focus is usually on structural fires, managed by a full-time urban fire service).

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[18] Elvan O, Birben Ű, Özkan Y, Yildirim H, and Turker Y, 2021, Forest Fire and law; an analysis of Turkish forest fire legislation based on Food and Agriculture Organization criteria. Cited as *Elvan et al Fire Ecology (2021) 17-12*

Turkey could undertake a similar exercise to bring its fire legislation into a single coordinated set of Laws and Regulation dependent upon its processes and systems for legislation. As a part of this process, it seems desirable to very clearly enunciate the responsibilities for rural fire management that attach to National, Provincial and Municipal entities as well as to communities and villages adjoining, or located within, forest areas.

Incident Management

Responding to a major hazardous event nearly always involves multiple agencies and responders, irrespective of whether it is fire, flood, earthquake or some other natural disaster. When an event like these recent fires occurs, there must be a dedicated and well understood process to manage the situation and to bring together and coordinate the activities of all the involved agencies.

How these many discrete agencies operate as a cohesive unit is critical to the success or otherwise of the response. There have been many comments about 'lack of coordination' during this fire episode.

In USA, the fire agencies (principally the US Forest Service) developed what was originally termed an **Incident Control System** that set out a number of key principles in managing an event, following disastrous fires in 1970. Because of the number of different agencies that may be involved, this system became the National Inter-Agency Incident Management System (NIIMS) which sets out how multi-agency teams should operate, even down to identifying common terminology. The system rapidly evolved from a system to manage forest fires to one capable of managing any major activity involving multiple agencies. A detailed description of this system is attached at Appendix 6.

Many other countries have adopted the principles behind this system and use it as a management system to formulate and operate multi-agency responses to a wide range of events – fires, floods, earthquakes, hurricanes, pests/diseases. Although this process commenced in USA, many other countries have adopted the concept and now there are good examples of international exchange of fire management resources between USA-Canada -Australia - New Zealand, where resources from one country can rapidly transit to another country and all personnel are in the same wheelhouse when it comes to how the incident will be managed and who calls the important moves.

Whilst this is a good example of international co-operation, the situation remains that the prime use of such a system is "at-home" when multiple agencies and resources come together locally. It is extremely important that all agencies and personnel involved understand the process to avoid duplication of effort and/or issue of contradictory instructions. It is also critical that everybody involved understands the terminology so instructions and decisions can be accurately implemented. It does entail considerable planning and actual plan preparation on a top-down basis from National to Provincial to Municipality to Local levels.

The system was soon introduced to Canada, a logical step. In 1986, Australian forestry services began to adopt the system, following a Fire Management Study to USA/Canada in 1985, by a Forest Fire team from Australia. This was part of an ongoing exchange that has been operating every 3 or 4 years, with the host country alternating for each study. Initially, it was a regular exchange between USA and Australia, but was later expanded to include New Zealand and Canada.

It is appropriate here to also draw an analogy with the Sendai Framework for Disaster Risk Reduction 2015-2030, developed by the United Nations. This framework very clearly supports a concept of disaster management, not by a single agency, or a lead agency, but by the totality of separate agencies, that of necessity or choice, become involved in responding to disaster events. Each separate event will have its own suite of participating agencies that is not necessarily identical.

Very clear within the Sendai Framework is the very real contribution to the apparent increasing frequency of very severe events that are driven by weather, which in turn is being driven by climate change. The very clear message in it is that the globe should prepare for an increasing occurrence of disaster type events brought on by increasingly severe and unstable weather – preparation and ability for all parties involved to function in a cohesive partnership is central to successful outcomes.

Below is a direct quote from the Sendai Framework, which resonates very well with the principles enunciated in the USA National Inter-Agency Incident Management System.

> Disaster risk reduction and management depends on coordination mechanisms within and across sectors and with relevant stakeholders at all levels, and it requires the full engagement of all State institutions of an executive and legislative nature at national and local levels and a clear articulation of responsibilities across public and private stakeholders, including business and academia, to ensure mutual outreach, partnership, complementarity in roles and accountability and follow-up;

During the recent fires in Turkey, there were many reports suggesting that co-ordination between different agencies and organizations was either very low-key, and in some cases non-existent. People assisting at fires were unaware of who was in charge, what the important strategies were, who was supposed to implement them, where the incident control center was and who was in charge of the operation. Fires of this nature involve the whole landscape over broad areas e.g., one of the fires at Antalya burnt in excess of 54,000 ha, so it impacted many entire communities and agencies with responsibilities within that area.

Whilst the Sendai Framework, as its name suggests, sets out the rationale behind an all-encompassing approach, essentially the 'why' part of the framework, the NIIMS system spells out the principles behind the 'how' side of the equation.

In the next and concluding section of this report is a recommendation that Turkey undertake a study tour to a relevant country/ies to examine in-depth, the issue of inter-agency coordination, along with other topics.

SECTION 4 - POSSIBLE INTERVENTIONS FOR CONSIDERATION IN TURKEY

The whole suite of fire management activities is often divided into four pillars, being Prevention, Preparedness, Response and Recovery, frequently abbreviated to PPRR.

Often, the four separate areas follow each other in logical time sequence but they do not necessarily have to occupy any specific time slot during the passage of a given period of time. Set out below are several activities for consideration:

A- PREVENTION

Prevention is that suite of activities that can be undertaken in a bid to reduce the incidence and/or severity of fire. If ignitions can be prevented from happening, then fires will not occur to the same extent as they otherwise might. Activities in this classification include: Community education and awareness raising, management of fuel loads by activities such as prescribed fire use, grazing by domestic animals and physical removal of fuel.

Fuel Load Management

Prescribed Burning

Prescribed fire use is a very effective way of managing fuel loads in forests. This can occur under forest canopy or on 'protection zones' where the intent is to create a fuel reduced fire break. If used under canopy, the fire must be of a sufficiently low intensity to cause minimal crown scorch. Fires that are too hot will kill leaves that will be shed, thereby reducing the effectiveness of prescription fire. The intent of reducing the fuel load is to reduce the intensity and rate of spread of subsequent wildfires, perhaps enabling suppression resources to reach the fire and extinguish it before it burns out of control. A secondary intent is to reduce the amount of forest damage that is caused by the wildfire.

Critical areas adjacent to communities, and inside forests, where natural features, or lack of roads and trails may hinder rapid initial attack are good candidates for treatments. Other areas for strong consideration include those where there is an historically high incidence of ignitions.

In supporting countries to scale up their forest land restoration, the United Nations Economic Commission for Europe (UNECE) and FAO support the concept of prescribed burning to reduce the intensity of subsequent wildfire thereby reducing the overall impact on forests and watersheds (UNECE Media 27 August 2021)[19].

It is proposed modification of forest fuel loads by use of prescribed be included for examination in an international Fire Study with a view to implementing practical field trials. In the absence of a fire study to another country/ies, the topic remains worthy of serious local consideration.

Grazing by domestic animals

Grazing is a useful tool for those forest areas where there is substantial grass and herb vegetation in the forest or on the verges and within natural clearings. Provided the stocking rate can be regulated to a sufficient intensity of stock, rapid removal of grass fuels can occur.

Constraining stock to desired areas can be achieved with temporary fencing, including electric fencing or by use of 'salt licks' in strategic locations. Watering points, of course, are mandatory.

Physical removal of fuel

By its very nature, the collection and physical removal of forest litter and fine fuels is very labor intensive and is only practicable on relatively small areas. This type of fuel management is best suited to those areas where there is a high value asset nearby, for example a small

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[19] https://unece.org/media/news/359313

community which is at risk of forest fire encroaching from forest areas. As a general principle, this activity produces the best results when the assets that are being protected also implement good fire hygiene on and around the area which is the target of protection.

It is recommended that grazing by domestic animals and physical removal of forest fuels be the subject of field trials in selected areas to ascertain the potential value of such practices for fuel load modification

Training and education programs for Communities

There is a need for very strong, ongoing interaction with communities to ascertain what they understand about fire, its use and suppression, and very particularly to determine the matters that the community as a whole believes it ought to be advised on and how and when that advice should occur. There is obviously a very structured approach necessary but it must be one where the community sees itself as an equal partner in the process, with two-way dialogue.

There is need for a detailed study, by directly gathering data from communities about the content and structure of these training and education programs, in order to develop a base training/education program.

It is recommended that to initiate development of an appropriate program focused on community training and education, an independent review of selected fire affected communities from this 2021 fire event should be undertaken to determine the scope of subjects that communities wish to be advised of, as well as topics the fire service needs them to be aware of. As a reference point, such a review should also include several selected communities that were not directly affected by this series of fires.

These reviews will assist to inform a relevant community interaction program, which should subsequently be developed.

B- PREPAREDNESS

Preparedness is the process of ensuring that all processes required for effective management have been validated and are operational, or able to be operationalized with very minimal notice. Included here are Planning processes, including inter-agency planning and exercising prior to onset of fire activity, ensuring that all contractual and hiring matters have been processed, identify significant resources that may be hired under contract (whether on permanent hire or 'call-when-needed') resources arrangements made for employment and deployment of casual staff, all equipment and facilities checked and tested, supplied, replaced or serviced where required.

There is an expectation and perhaps even a legal obligation under the fire laws for communities who live on or close to the forest areas to participate in fire suppression activities. There does not appear to be any pre-determined structure that enables this process to operate effectively – in essence there is little preparation

Identification of Incident Management structures

Coordination between agencies and vertical levels of government (State-Province- Municipal/ Local) and non-government agencies is essential but appeared to be largely lacking. Perhaps the best way for Turkey to experience this is to experience how it works in practice so as to appreciate the different levels of planning and inter-agency liaison required, before, during and

after major disaster events, as well as the requirement to identify in the planning phase which facilities will be used as 'Control Centers' where key incident management personnel will be stationed.

It is recommended that Turkey initiate a "Forest Fire Study" to an appropriate country or countries, to specifically examine establishment of a multi-agency incident management system. [[Such a study could also focus on fire danger rating systems, their application and development and use of acknowledged early warning systems]].

There is a need to identify a suitable country or two countries for such an exchange and develop 'terms of reference' identifying the subjects to be investigated. The study group should comprise about 6 members. It would be appropriate to include a representative also from the Disaster Management Agency

It is recommended that two countries – perhaps one 'local' Mediterranean country and/or one country external to the local area be considered, e.g., USA. Participants in this type of venture should be those who have the ability to introduce and refine any initiatives that may be adopted.

Fire Danger Rating System and Early Warning System

Although Turkey has access to EFFIS and the FDRSs contained within it, OGM has indicated its intent to progress with development of a Turkey specific fire danger rating system. Prior to commencing this activity, it would be advantageous for fire specialists to examine the use and application of FDRS and EWS in other countries, with a view to analyzing the likely scope of the task set for local completion. These two topics are included in a proposed 'Forest Fire Study' to an appropriate country or maybe two countries, as indicated immediately above.

It is proposed that prior to commencing development of its own specific fire danger rating system, that OGM should liaise closely with the Turkey Meteorological Service (MGM) to determine whether EFFIS contains suitable parameters, e.g., KBDI, to serve as an interim Early Warning System or whether to seek a suitable indicator of long-term drought, or other meteorological parameter/s for relevant forest areas/zones from MGM.

Legislation

A review of Legislation is proposed to consolidate fire legislation. It would also be appropriate to consider legislative requirements to clearly specify the obligations on communities and villages to assist with fire management activities, also identifying responsibility for supplying such areas with appropriate equipment. This review would also be an appropriate opportunity to clearly set out those organizations, external to OGM, who are, or may be, included in fire response activities e.g. AFAD, Municipalities.

It is proposed that OGM, and other allied agencies or entities, initiate a review of fire related legislation, ensuring that it is compatible across all government agencies and other entities that may become involved in fire management activities.

Road and Trail Maintenance

Ideally, forest roads and fire trails ought to have verges free of shrub and tree vegetation to provide a more robust fire break. Untended roads develop regeneration that can eventually encroach into the verge and if left untreated, branches and overhanging canopy greatly reduce the utility of the road and verges as a suitable fire break or control line. There are indications

that some roads are at a state that requires removal of trees from the verges. One method to do this may be to use tree harvesters to cut and process any trees that require clearing. Products can be utilized if of adequate size to be processed or made available to communities, e.g., for firewood or fencing material.

It is proposed that an analysis be undertaken by OGM to identify the extent of roads and trails that require substantial amelioration and that suitable mechanisms to achieve this be identified if determined to be necessary.

Road and Trail Construction

The forests are provided with a road and fire trail network to enable access for all types of forestry operations, including fire management activities. It is critical that roads link directly into communities if those communities are legally obligated to assist in suppression – the community members so involved must be able to easily and speedily access the forest areas near them.   All roads that may be used for fire suppression activities should be 'through' roads linking into the overall road network at either end of a specific road.

It is proposed that OGM indicate whether additional construction works for roading and fire tails works are essential, and if so, the scale of such works.

Water Supplies

Water supplies are obviously a paramount need for fire-fighting vehicles**.** In elevated and dissected terrain, static water supplies (dams, ponds, pools) need to be constructed, with access for fire vehicles.   The more frequent these facilities, the less time is lost in traveling to the nearest water supply, to refill and return to the fire.   The matter of water supply, especially any perceived inadequacies, is likely to be raised in individual post-fire reviews, if such reviews are held.

It is proposed that OGM indicate whether additional water supply points are necessary, either on forest lands or on community lands adjacent to forests.

Community Fire Strips

Establishment and maintenance of protection strips or between forest lands and community lands is required to be in place. A pre-determined idth is specified. It is apparent that these protection strips are not universally in place. Post-fire reviews may highlight any inadequacies in these zones.

It is proposed that OGM identify any shortfalls in adequately prepared community fire strips.

C- RESPONSE

Response includes the reaction to weather forecast/s or onset of adverse weather, provisions for public announcements and warnings about fire potential generally, and for specific ongoing fires in identified geographic locations and advice/warnings to public. Response to actual fires includes dispatch of resources for initial attack, and later for sustained suppression campaigns. Obviously, there must be suitable resources available to direct to fire locations.

Provision of plant and equipment**.**

a) *Communities*: There is little, or no, appropriate firefighting equipment that enables volunteer community members to make any worthwhile and effective response to unwanted fires. In many areas, there are no firefighting vehicles or units and not even any simple hand tools such as fire rakes or knapsack spray. Information from community members at fires in the Bodrum municipality indicated that firefighting equipment was not available and for several days after the fires commenced, community members were carrying carbon dioxide charged fire extinguishers to the fires in a bid to control the fires.

b) Judging by media coverage of *'volunteers'* participating bare chested in fire-fighting activities, there is also no personal protective equipment provided to them.

The photograph below succinctly explains the lack of suitable equipment in some areas:

A woman tries to stop an advancing wildfire in Kacarlar village near the Mediterranean coastal town of Manavgat, Antalya, Turkey, Saturday, July 31, 2021 [AP]

Whilst the key focus in community interaction must be targeted towards involving communities in all aspects of fire management, with the objective of reducing the number and extent of fire ignitions, there will always be occasions when suppression becomes necessary.

Because communities can often provide the nearest personnel resources available, it is logical to provide training and equipment to them so they possess the wherewithal to mount a concerted initial attack. Under the fire behavior that occurs on extreme fire days, rapid and effective investigation and initial attack is essential. This requires adequate equipment, since tree branches, buckets and household kitchen style fire extinguishers will never succeed.

It is proposed that a number of vulnerable communities, in the Mediterranean forest zone, be identified and a needs assessment be conducted to establish the nature and quantity of equipment necessary to provide each community with the ability to respond immediately to unwanted fire, either within the community boundaries or on adjacent forest lands.

At the same time this assessment should also focus on how any such equipment would be stored or housed, with specific agreed community arrangements for its use and operation when required, by trained community members. As a minimum, mobile fire suppression equipment ought to include small units (fast initial attack capability) such as lightweight 4x4 Pick-up with a 400-liter water tank, 5 HP pump and hose, and a selection of hand tools – fire rake, knapsack sprayer and chainsaw. The equipment should also include: communication facilities, personal protective equipment for "community based" firefighters, and first aid supplies.

It is further proposed that communities provided with such equipment ought to also be provided with at least one motorcycle to enable rapid investigation of fire locations when smoke is observed by a community or a community is requested to respond to a fire in adjacent forest.

c) *Directorate of Forestry*: The absence of suitable fire response vehicles within the first few days of this fire event, indicates a potential a shortage of suitable response vehicles (or a lack of readiness). The availability of equipment operated by OGM should also be reviewed. There is little point in assembling a listing of equipment that is currently available overall or even by administrative units without an understanding of the potential needs of that unit.

It is proposed that the Directorate of Forestry review its fleet of fire-fighting apparatus to ascertain if its fleet of equipment either specially designed for firefighting e.g., fire tankers or other equipment that can be utilized for firefighting e.g., dozers, is adequate and whether additional or replacement units are necessary. Also, this review could consider whether outright purchase or leasing is the most cost-effective manner to supply high capital value items

d) *Municipalities*: Municipalities clearly have a role in fire management both in an urban and a rural context. Urban fire-fighting equipment is provided and it is apparent that some of this equipment was deployed against rural fires (no criticism intended), presumably on the basis that Municipalities generally do not maintain a cadre of equipment for suppression action against forest or other wildfires e.g., on agricultural/cropping/grazing lands, but that under the circumstances that prevailed structural firefighting equipment was better than no response.

It would be opportune to examine and clearly define municipal responsibilities in relation to wildfires, in concert with the proposed legislative review. Identification of this responsibility may require Municipalities to provide appropriate firefighting equipment for wildland fires, together with appropriate arrangements for its housing, maintenance and operation during fires.

D-RECOVERY

Recovery includes post fire restoration of burnt areas including forest regeneration, repair of damaged facilities, equipment replacement. Also included in recovery is formal analysis of

the fire/s to ascertain the level and nature of damage and fire causes. On occasions 'recovery' activities may be initiated while suppression action remains in progress.

Re-establishment of burnt forest

Fire is listed as one of the most important factors causing degradation that requires restoration in forests in a joint FAO/ UNECE study (2021[20]). Turkey holds a position not enjoyed by most other members of a group of countries identified in Eastern and South Eastern Europe. That position is that practically all forest land in Turkey is controlled by OGM, whereas other countries have a very diluted forest ownership with as much as 40% of forested lands in private ownership. Hence, any restitution actions are controlled by OGM without the need to involve other stakeholders.

Burnt areas may regenerate naturally without intervention. In that case, the vegetation pattern evident pre-fire is *likely,* but not guaranteed, to re-establish itself. There are indications that some vegetation types may alter following severe fire with the increased impact of global warming on species succession. It is important to monitor development of regeneration to ensure that unwanted species (undesirable non-local and highly invasive weed species) do not become dominant in the landscape.

Alternatively, there may be valid reasons to deliberately alter the vegetation type to different tree species, to increase the resilience of the landscape to future fire events. This would necessarily require a concerted replanting and reafforestation process.

Whatever processes are adopted, there is a need to assess each individual fire area and a standardized approach may prove useful. One such approach is "Burned Area Emergency Response[21]", being the suite of activities necessary to rehabilitate following fire.

The effort now required to regenerate burnt forest areas is far greater than at any time in Turkey's history and OGM should be invited to indicate if assistance is required and the nature and extent of such assistance to ensure that fire affected forests are restored as effectively as possible, taking into account associated impacts, e.g., watershed management that may require specific intervention, regeneration to naturally occurring species, or altering the species mix.

Fire Investigation

Without a clear knowledge of the precise mechanisms for fire causes it is difficult for community educators to effectively target communities about careful fire use. If 50-60% of fire causes are unidentified, it is unlikely that community educators can then accurately target the undesirable occurrence of fire, simply because they do not know what to target.

Fire cause should be investigated as soon as practicable, sometime even while the fireground remains active, with the rider that it must be safe to do so. Clues as to the source of ignition rapidly disappear. There is an existing program aimed at developing a long-term wildfire prevention program for Istanbul Forest Region. Two of the key elements in the program are the training of a number of people in fire prevention activities and fire investigation to enable

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[20] Forest Landscape Restoration in Eastern and South Eastern Europe 2021
[21] https://www.fs.fed.us/naturalresources/watershed/burnedareas.shtml

a capacity to interact with communities and to conduct investigations into the causes of fire. This project would be a good starting point to consider in expanding the capability for fire investigation (and community interaction.)

It is proposed that OGM adopt the concept of investigating the cause of all forest fires. This would necessarily require the training of investigators in the requisite skills so that they in turn can inform community educators

Post-fire Review

Debriefing, or post-fire review, following significant fires, is a useful method to identify and record any 'lessons learned'. It is important to identify those elements where activities did not proceed as planned, to enable actions to address any shortfalls in standard operating procedures. It is equally productive to also examine those areas where the management activities worked particularly well and to use those experiences to also reframe Standard Operating Procedures (SOPs).

The purpose of such reviews must never be to attempt to apportion 'blame', but to make a genuine effort to understand how the whole operation proceeded with a view to identifying improvements, Naturally, every person who participated in suppression events cannot participate in such event, but there should be a representative cross section of attendees from each agency involved.

It is proposed that OGM initiate "post-fire reviews" or "fire debriefs" for each significant fire.