

# AN OVERVIEW OF THE PROCESSES INVOLVED IN THE INVESTIGATION OF WILDFIRES

*(Tinjauan Proses Investigasi Kebakaran Hutan dan Lahan)*

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**(Received 2 October 2021 / Accepted 4 February 2022)**

## ABSTRACT

A pro-active investigation of wildfires provides forestry, fire and law enforcement managers with a greater understanding of their wildfire cause trends, allowing for prevention targeted campaigns, to address arson activity and changes in land management practices. Without accurately determining the cause of wildfire events, the logical move is to increase the capability of suppression and assume the cause, without any solid evidence. The enhancement of the suppression capability adds great cost to the community and increases the risk to firefighter safety in having to attend to unplanned wildfires. The community also loses through increasing rates of damage and destruction of crops, assets and property. However, it does not deal with the core issue, being the cause of the wildfires. In the absence of accurate wildfire cause determination, firefighters are not identified or deterred from their fire lighting practices knowing they will not be identified or prosecuted. By agencies having available a trained and confident wildfire investigation capability, a greater understanding of the size and nature of the problem can be identified and addressed more effectively.

Keywords: Wildfires, investigation, community, firefighters

## ABSTRAK

*Investigasi kebakaran hutan secara proaktif memberikan pemahaman yang lebih baik kepada manajer kehutanan, kebakaran, dan penegak hukum tentang kecenderungan penyebab kebakaran hutan, memudahkan pelaksanaan kampanye pencegahan yang ditargetkan, untuk mengatasi aktivitas pembakaran dan praktik perubahan lahan. Tanpa penentuan penyebab kebakaran hutan secara akurat, langkah logis berikutnya yang harus dilakukan adalah dengan meningkatkan kemampuan pemadaman dan asumsi penyebabnya walaupun tanpa adanya bukti yang kuat. Peningkatan kemampuan pemadaman akan menambah biaya besar bagi masyarakat dan meningkatkan risiko keselamatan petugas pemadam kebakaran jika harus berhadapan dengan kebakaran hutan yang tidak terkendali. Masyarakat juga dirugikan akibat peningkatan tingkat kerusakan dan kehancuran tanaman, aset dan harta benda. Namun demikian, hal ini tidak terkait dengan inti permasalahan, yaitu penyebab terjadinya kebakaran hutan. Tidak akuranya penentuan penyebab kebakaran hutan akan menyebabkan para pembakar akan tidak teridentifikasi atau merasa bebas melakukan praktik pembakaran karena mereka mengetahui bahwa mereka tidak akan dapat diidentifikasi atau dituntut. Jika setiap lembaga memiliki kemampuan investigasi kebakaran yang terlatih dan terpercaya, pemahaman yang lebih besar pada akar masalah penyebab kebakaran akan dapat teridentifikasi dengan baik dan dengan demikian akan dapat ditangani dengan lebih efektif.*

*Kata kunci: Kebakaran hutan, investigasi, masyarakat, pemadam kebakaran*

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## INTRODUCTION

The repercussions of unplanned wildfires impact heavily on communities. In recent years, many countries around the world have suffered from the impact severe events have caused. The risk to lives, the destruction of property and the environment, to the loss of income through destruction of crops and livestock, all can result from an uncontrolled fire. The health of people has also been placed at risk after being exposed to heavy and prolonged wildfire generated smoke, often great distances from the wildfire event. The cost of managing and suppressing unplanned wildfires is also increasing for agencies, along with posing risk to lives of the emergency response crews.

A key solution to dealing with this increasing risk is prevention of unplanned ignitions.

This paper will summarise key aspects of wildfire investigation and the value it has in being adopted as a prevention strategy in wildfire at risk countries. It is in no way fully complete as the details of Wildfire Investigation are very involved, but the intent is to provide the reader with aspects of the Wildfire Investigation process and some of the benefits of accurately determining cause.

The techniques and terminology referred to in this paper is based on the National Wildfire Co-ordinating Group (NWCG) 'FI 210 Wildland Fire Origin and Cause Determination' training course and the 2016 NWCG 'Guide to Wildland Fire Origin and Cause Determination' handbook, both of which the author has contributed to in their development.

To accurately and confidently investigate the cause of a wildfire, it is highly recommended to undertake formal training in this specialist area. The variables that affect a wildfire cause can make the task of investigation very challenging. Normally delivered over a one-week period, this training is key to an investigator gaining the confidence to undertake a successful wildfire Investigation.

### Why investigate Wildfire cause?

Accurate identification of the cause of a wildfire plays a critical role when it comes to the successful prosecution of firefighters and the presentation of evidence of an ignition sequence and cause. It is also vital to gain an accurate picture of the cause of Wildfires in an



Figure 1 Wildfire investigation

area. There are many other benefits that can be gained from the wildfire Investigation process, such as creating a strong deterrence and to provide strong evidence to change legislation or restrict the use of fire during peak risk times of the year.

Successfully preventing the unplanned ignition of Wildfires is reliant on three key areas;

- **Engineering** (or that of appropriate legislation governing the use of fire in the open and adequate penalties, authority to investigate fires etc.);
- **Education** (of the community and Wildfire Management staff in Wildfire ignition prevention and reporting of suspicious activity relating to the cause of a Wildfire) and;
- **Enforcement** (pro-active investigation of Wildfires and follow-up prosecutions).

Should any of the above components being ignored, the risk of human caused wildfires will continue to occur.

Critical to the Enforcement stage is that of wildfire cause investigation and the examination of the fire scene to locate evidence of an ignition source, enabling the item of evidence to be linked to an arsonist, linked to farming practices, or a negligent act. Enforcement also acts as a significant deterrent to the community knowing agencies take a pro-active stance in enforcing laws.

The investigation of the cause of wildfires is a specialist task that is significantly different to that of structure fire investigation. Even before the smoke clears, the clinical process begins and like any investigation, it requires expertise to accurately interpret what occurred out of the ash and blackened vegetation that remains.

Importantly, there is an increasing expectation in many wildfires at risk countries to identify and successfully prosecute deliberate firefighters. A significant reliance is for the work of wildfire Investigators to combine their skills with their law enforcement colleagues to comprehensively represent these cases for prosecution.

### Key skills are necessary to investigate Wildfires

Many countries that are at risk of wildfire empower land management and fire service officers to pro-actively manage wildfire and to prevent them from occurring. This can be a significant task when it also involves smaller jurisdictional areas that may be the source of the ignition of the wildfire events.

Wildfire investigation is a combination of law enforcement and wildfire management skills. Ideally, officers who are trained in Wildfire Investigation should come from a variety of the agencies responsible for wildfire prevention and suppression. This combined approach can be very beneficial to operate as a team when investigating the cause of a wildfire, as the process can be very time consuming and should be undertaken by two or more officers. The combination of these skilled team reduces the workload and allows for the combining of skills in a scene examination process. The officers targeted for this training certainly need to have a background in wildfire suppression and management. Ideally, others with law enforcement experience can be valuable to the team.

### So, how do you accurately determine the cause of a Wildfire?

A proven method of applying an internationally accepted methodology to a scene examination is needed to accurately locate the origin and link evidence of the ignition source.

The examination of the fire scene is a clinical process which must be carefully applied. It is here where an extensive level of investigation experience and understanding of Wildfire is essential. And like any investigation process, the level of confidence in the cause determination is linked to the level of experience and training of the investigator.

The first phase of the fire scene examination is ensuring the attending fire crews preserve the General Origin Area (the area first observed by them as burning on their arrival). Similar to the need to preserve a structure fire for examination, targeted scene management training of fire crews is vital to prevent evidence being washed away, walked into the ground or driven over by vehicles - a challenging task in the open environment of a Wildfire. These crews need to be trained in the preservation of the Wildfire Scene and importantly to also record their observations at the scene and to report on their opinion of the fire cause. International fire service targeted courses are available specifically to address this phase and these personnel.

The follow-up phase involves the Wildfire Investigator. This General Origin Area becomes the crucial focus for the scene examination by these officers to interpret 'Fire Pattern Indicators', to reconstruct the overall Fire Pattern and accurately identify the 'Specific Origin Area' and ultimately the 'Origin/Ignition Area'.

Commencing at the 'hottest' part of the wildfire, or the 'Advancing' Vector, investigators identify and interpret Fire Pattern Indicators to determine the direction a wildfire travelled. These occur as a result of physical objects such as vegetation, rocks and discarded rubbish, displaying changes from exposure to heat, flame and combustion by-products. They display different

qualities depending on the location in respect of the wildfire progression. They are defined as;

- *Protection;*
- *Grass Stem;*
- *Foliage Freeze;*
- *Angle of Char;*
- *Spalling;*
- *Curling;*
- *Sooting;*
- *Staining;*
- *Ash Deposits;*
- *Cupping;*
- *V-Patterns.*

The following images are examples of some of the above Fire Pattern Indicators.

Fire Pattern Indicators also can display different qualities depending on the related intensity of the wildfire and in respect of their location in proximity to the origin. 'Macro-scale' Indicators are found where the fire has gained enough intensity to be clearly visible from a distance; 'Micro-scale' Indicators are located where the intensity of the fire is low and generally need to be viewed up-close. These are typically located near where the fire ignited before gaining intensity and a more rapid rate of spread. Identifying and interpreting these Fire Pattern Indicators allows the investigator to accurately reconstruct the path the fire took and to allow the identification of the Origin/Ignition Area within the 'Specific Origin Area'. This process is demonstrated in the green lines in the diagram below.

The Specific Origin Area is where a careful and methodical process is applied to search for evidence of the Ignition Factor by sifting through the ash and debris. The locating of evidence of the cause at this location completes the process (be it exhaust carbon from of motor vehicle, molten metal particles from an arced powerline, or the match of an arsonist). Forensic analysis of remnant evidence then provides an essential part of the determination of the cause, more often a law enforcement role. However, a further challenge for the investigator, is evidence of the Ignition Source is not always present at



Figure 2 Protection Fire Pattern Indicator with red arrow showing impact of fire direction resulting in greater damage to the right side of the timber section



Figure 3 Foliage Freeze Fire Pattern Indicator with red arrow indicating the direction of the wind (and fire) at the time the fire impacted

wildfire origins. But by accurately determining where a wildfire ignited can be of great benefit, particularly if it is located on a private property and the landowner denies any knowledge of the cause.

Commonly recognised causes across wildfire prone countries are summarised as;

- Juvenile activity;
- Campfires;
- Smoking\*;
- Debris Burning;
- Incendiary/Deliberate;
- Equipment Use;
- Railways;
- Lightning;
- Miscellaneous causes (such as Powerlines, Firearms or Welding).

\* Smoking is often erroneously identified as the cause of many wildfires however; research suggests

it is not a reliable ignition source as certain circumstances need to align to result in a successful ignition. Particular environmental factors need to be present for a cigarette to ignite vegetation

- A finely particulated/aerated fuel bed;
- A loose/aerated arrangement of the fuel;
- The Fine Dead Fuel Moisture Content of the fuel must be low, generally less than 14%;
- The ambient air temperature needs to be at least 26°C;
- A low relative humidity;
- Ground level location needs to be exposed to wind;
- At least 30% of the glowing tip needs to be in contact with the vegetation.

In regard to all these causes, the investigation finding needs to align the circumstances of the Wildfire cause with the cause category. In some instances, the evidence of the fire cause cannot be found, however the



Figure 4 Angle of Char Fire Pattern Indicator on a tree trunk red arrow indicating the direction of the fire travel



Figure 6 Ash Deposit Fire Pattern Indicator red arrows showing remnant white ash off burning vegetation deposited on the side of the tree exposed to the advancing fire



Figure 5 Staining Fire Pattern Indicator on a rock after impact of fire vegetation oils and resins

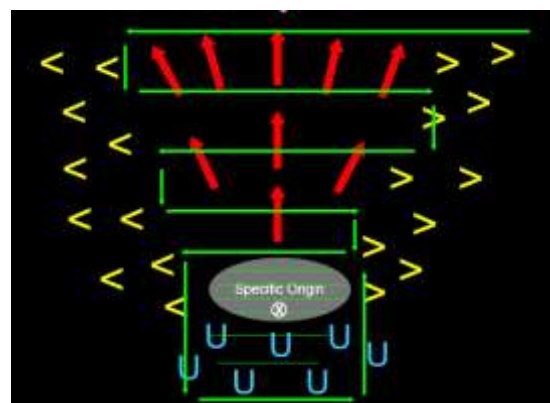


Figure 7 Recommended methodology involved in examining Wildfire to identify the Ignition Area based on the identification of Fire Pattern Indicators. (NWCG, 2016)

circumstantial evidence may point to the cause identified in relation to the located origin.

These causes are commonly used categories of wildfire cause around the world. They may have local terminology aligned to these broad references.

Again, combining the skillsets of the wildfire investigator and law enforcement in this process is critical. This has been well demonstrated across many international jurisdictions, to the point of the development of a specialist training course to foster this arrangement, modified and delivered in internationally in recent years. The final goal for the investigation team, being to accurately gather and represent all the facts surrounding the cause of the wildfire and to ensure it stands up to close analysis.

Not without its challenges, this meticulous process can be the most time consuming and if not thoroughly applied, an entire investigation runs the risk of being compromised. Crucial pieces of evidence can be overlooked along with the conclusive indication of the cause of the fire being missed or worse, incorrectly identified. However, when the methodology is applied and evidence located, the case can be solved and the cause confirmed with confidence of the investigators.

After delivering wildfire investigation awareness and training internationally over several years, the value of agencies gaining these skills was confirmed by the author. For the first time in The Netherlands, law enforcement and fire officers successfully investigated fire scenes, previously considered an impossible task. A further training course conducted in Hawaii USA to forestry and law enforcement officers also saw a similar positive outcome, (both locations not normally known for wildfires). The major benefit of the methodology of Wildfire Investigation has confirmed that it can be applied across all fuel types, across all topographies and though varying climates.

### **Training**

The investigation of wildfires is reliant on the training of personnel. This is a specialist role that can't be learnt from a reference book as the variables that influence wildfire behavior also play a key role in the

formation of Fire Pattern Indicators. These must be interpreted with a knowledge of the influence of fuel, weather and topography on the behavior of the fire. The training of investigators in Wildfire Investigation is essential to ensure the accurate determination of the cause of a wildfire. The author has experienced this skills enhancement in delivery of this training internationally, resulting in significant benefit in reducing wildfire ignitions in a number of Countries, struggling to investigate wildfire ignitions.

## **CONCLUSIONS**

Accurate identification of the cause of a wildfire plays a critical role when it comes to the successful prosecution of firefighters and the presentation of evidence of an ignition sequence and cause. Wildfire investigation is a combination of law enforcement and wildfire management skills. A proven method of applying an internationally accepted methodology to a scene examination is needed to accurately locate the origin and link evidence of the ignition source. Combining the skillsets of the wildfire investigator and law enforcement in this process is critical. By agencies having available a trained and confident wildfire investigation capability, a greater understanding of the size and nature of the problem can be identified and addressed more effectively.

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