

Climate Change and UK Wildfire



Wildfire is any uncontrolled vegetation fire that requires a decision, or action, to suppress it.¹ This POSTnote summarises management of wildfires in the UK, how projected climate changes may affect UK wildfire behaviour, and the environmental, economic, and health impacts of this. It also outlines policy options for increasing the UK's resilience to wildfires.

Background

Fire is a natural and essential process in some global ecosystems.²⁻⁵ Fire regimes are defined by their intensity (energy output from the fire), severity (organic matter consumption), frequency, seasonality, and size of wildfires in an area.^{6,7} These regimes change through time according to atmospheric conditions, climate, and vegetation.² Weather is a key factor in determining whether wildfire risk is elevated or not.⁴ Humans have altered fire regimes for millennia through deforestation and agriculture. This has led to changes in fuels (vegetation) that underpin natural fires, changed ignition rates, and shifted the seasonality (timing) of fires.⁸⁻¹¹

UK wildfires are not on the scale of some other countries (Box 1). For example, in the US in 2017, over 40,000km² of area was burnt.¹² However, between 2009 and 2017, the Forestry Commission classified 258,867 events that the fire and rescue services (FRS) attended in the UK as wildfires.¹³ Satellites recorded an area burnt of over 180km² in 2018, and already over 290km² so far in 2019.¹⁴ Significant wildfires do occur in the UK and even small fires can have major impacts since location is key.^{15,16} Notable wildfires in 2018 included Stalybridge Moor and Winter Hill Moor which covered over 19 km².^{17,18} UK climate projections indicate

Overview

- Wildfire is a natural and essential part of some ecosystems.
- Recently, there has been a global surge of large wildfires and prolonged fire seasons, associated with a complex mix of climate change, changing land management practices and human behaviour.
- UK climate projections indicate that climatic factors conducive to elevated wildfire conditions will increase.
- The UK Climate Change Risk Assessment and National Adaptation Programme identified wildfire as a climate change risk.
- The Home Office has responsibility for wildfire risk and focuses on extinguishing fires with other management responsibilities split between government departments.
- Better wildfire prevention in the UK could be achieved through landscape management.

more climatic factors conducive to wildfire but there is a lack of recorded evidence on the environmental, economic, and health impacts of wildfire events.¹⁹

Effects of Climate Change on Wildfires Globally

Under all emissions scenarios for climate change projections, global surface temperature will rise over the 21st century, with extreme precipitation events and more frequent and longer lasting heatwaves becoming more likely (PN594).²⁰ The danger of wildfires in the Mediterranean

Box 1: Global Surge in Wildfires

In the last few decades, there has been a global surge of large wildfires and prolonged fire seasons, with extensive environmental, economic and social costs.^{21,22} In Europe, there has been a change in fire rate of spread (total perimeter),²³ and intensity.²⁴ Recent wildfires in Portugal, Spain, the US, New Zealand, and Tasmania have been widely reported, and areas of peat in Southeast Asia burn for months at a time.²⁵ A large majority of fires in the US and across many European countries are human-caused,^{26,27} and many in Southeast Asia are intentional.²⁵ Over-suppression (extinguishing) in some areas has led to fuel accumulation and less frequent but more intense fires.²⁸⁻³¹ There has been a loss of indigenous techniques to control fire and to use it to manage the landscape.^{22,32} These changes to the fire regimes are associated with climate change, but also with changing land management practices and human behaviour.^{24,27,33-36}

region will increase, with areas at moderate danger from fire being further north in Europe than today.³⁷ Climate change has increased global fire occurrence and area burnt, as well as lengthening the fire season in some countries.^{4,38,39} Increasing production of vegetation, through both warming and higher precipitation, will yield higher fuel loads. This is linked to land abandonment and lack of appropriate management, potentially enhanced by increased tree mortality due to rapid warming, pests and disease.^{38,40,41} Projected increases of extreme conditions, such as drought and lightning, may increase fire activity.^{42–44} Records show that rapid climate changes between 10–15 thousand years ago in North America were associated with large increases in fire activity.⁴⁵ However, wildfire risks are not just linked to climate change, but to a complex mix of changing land management practices and human behaviour.^{24,27,33–36}

Managing Fires in the UK Environment

There is evidence of burning in the British Isles from around 8000 years ago, both by wildfire and by humans for landscape management (Box 2).⁴⁶ Today, wildfires occur episodically across the country,⁴⁷ with most being started accidentally or deliberately by humans and rarely by lightning strikes.⁴⁸ Most wildfires occur in the spring and summer,⁴⁹ with climatic factors including heat, lack of moisture, and wind, influencing fire ignition and spread.⁵⁰ In particular, strong easterly winds and low humidity, often seen in the springtime, can elevate fire risk fuelled by dead vegetation.⁵¹ Extended summer droughts produce wildfire fuel in the form of dry ground vegetation and soil,⁵² with some species being particularly flammable.⁵³ Wildfires occur across different habitats; between 2009 and 2017 over 70% of the area burned annually in England was open habitats such as arable, improved grassland, and semi-natural grassland, with woodland accounting for 1%–5% during most years.¹³

Dealing with Wildfire

Wildfire is a cross-sector risk in the UK involving several government departments, groups, services, landowners, and the public. Approaches and responses to wildfire evolved from the bottom-up, with local solutions feeding in to legislation.⁵⁴ The following describes the structure and responsibilities of various UK stakeholders in wildfire:

- **Home Office:** Defined as the lead government department for major wildfire response due to their

Box 2: Controlled Fires – Management Burning

Controlled fire (management burning) is used to manage vegetation across the UK,⁴⁹ notably in upland areas that include large areas of heathland, peatland, and grassland.⁵⁵ It is used to promote a diverse heather environment for grouse shooting and improve grazing for sheep.⁵⁶ Fire as a landscape management tool can be used well or poorly, and is not suitable for all situations.⁵⁵ Regulations and good practice guidance is provided for some habitats to minimise ecological impacts and the chance of escaped fires.^{57–59} Burning requires detailed local knowledge, and an understanding of fire, and should not be carried out on peat bog and wet heathland.^{56–60} Management burning of peat bog is linked to changes in its carbon cycle and vegetation, and sphagnum moss damage.^{61–66} The effects of management burns and wildfires are likely to be different, as wildfires tend to burn more intensely,⁶⁷ although burn severity varies greatly across a wildfire.⁶⁸

oversight of the FRS (Box 3). They produced the Fire and Rescue National Framework for England,⁶⁹ which provides overall strategic direction for fire and rescue authorities.

- **Defra and MHCLG:** Defra, working closely with the devolved administrations, is responsible for regulating and incentivising land management that affects wildfire fuel, and climate change adaptation. Defra is currently undertaking a review of wildfire in England.⁷⁰ MHCLG is responsible for planning policy and support local resilience forums.
- **Wildfire Groups:** Formed regionally in response to wildfire risks and made up of land managers (e.g. National Parks, Forestry Commission), water companies, environmental groups, local FRS, and other local stakeholders. They raise wildfire awareness, develop wildfire skills and emergency response.⁵⁴
- **England and Wales Wildfire Forum and Scottish Wildfire Forum:** Knowledge exchange bodies formed in response to recent severe fire seasons.⁵⁴ They are non-statutory cross-sector groups of private, public, and third-sector stakeholders that lobby for change and promote good practice in wildfire management.

Wildfires were first officially recognised as a risk in the Civil Contingencies Act 2004.⁷¹ However, the Regulatory Reform (Fire Safety) Order 2005 excludes forests and fields.⁷² Severe wildfire is listed in the National Risk Assessment (NRA) and National Risk Register ([POSTbrief 31](#)), produced by the Cabinet Office since 2013, who are responsible for resilience planning.^{15,73,74} Information from the NRA is given to local resilience forums and FRS, who produce a Community Risk Register detailing local risks including wildfire where relevant.⁷⁵ To date, most wildfire management involves attending, controlling and suppressing wildfires.⁵⁴ According to the National Risk Register,⁷⁴ wildfire does not pose as great a concern as other natural hazards such as flooding.

Wildfire Prediction

The web-based Fire Severity Index (FSI) daily rating service is funded by Natural England and Natural Resources Wales

Box 3: Fire Services and Wildfire Risks

- **FRS:** Under the Fire and Rescue Services Act 2004⁷⁶ and the Civil Contingencies Act (2004),⁷¹ the 52 FRS across the UK have a statutory responsibility to manage wildfire.⁷⁷ The services are devolved and operate locally to reduce fire risk, and are required to 'Identify and Assess', 'Prevent and Protect', and 'Respond'. Local FRS Integrated Risk Management Plans determine if wildfire training is required.⁶⁹ There is a strong collaborative approach and international knowledge sharing.⁷⁸
- **National Fire Chiefs Council:** Responsible for improving the fire sector's approach to wildfire preparedness.⁷⁹ They are increasing the number of specialist tactical wildfire advisors across the country from 23 to 35, and are developing a wildfire asset register. The National Chief Fire Officer Association Wildfire Forum raises wildfire awareness and develops national standards for wildfire training and techniques. They offer advice to FRS for wildfire pre-planning, prevention, and response.⁸⁰
- **Fire and Rescue Authorities:** Each is required to produce a publicly available three year Integrated Risk Management Plan, and should engage with research and development programmes.⁷⁶

and is contracted for delivery by the Met Office.⁸¹ It predicts how dangerous a fire would be if it ignited given certain weather and fuel conditions, informing when to exclude access from land under the Countryside Rights of Way Act in England and Wales to limit ignitions.⁸² The model is not 'tuned' to UK-specific fuel types and loads, and significant investment would be required to address this. It is used to help inform the Natural Hazard Partnership's Daily Hazard Assessment of elevated wildfire conditions,⁸³ which provides a basic and generalised view of conditions across the UK. The Joint Research Council's European Forest Fire Information System also provides data for the UK.⁸⁴ A more advanced Fire Danger Rating System is being redeveloped for Scotland.⁸⁵

Wildfire Recording and Reporting

An Incident Recording System was deployed in 2009 to record accurate and consistent data on UK wildfires.⁸⁶ The system is limited by the accuracy of input by the fire services. It excludes fires not attended by FRS, including some management burns (Box 2), and it does not record fire perimeter.⁵⁴ Wildfires that damage infrastructure and buildings, such as the Little Marlow fire,⁸⁷ may not be recorded as wildfires. The Forestry Commission provides reports on wildfire in England.¹³

Impacts of Changing Fire Behaviour

As UK wildfire records only began in 2009, they cannot indicate whether it is responding to climate change.¹³ The effect of climate change will be complex,^{88,89} but weather is a key variable in wildfire behaviour.^{4,37,90} The UK Climate Projections 2018 indicate that weather conducive to wildfire ignition will increase and the wildfire season will extend.⁹¹ Warmer, wetter winters could increase fuel load; and longer, drier summers may increase the risk of fire,⁹² with summers more hazardous than spring for wildfire by the end of the century.⁹³ Climate variability and weather extremes may be of more concern than gradual changes.⁹⁴ Periods of drought in 2010, 2011, and 2012 were associated with increased wildfires and area burnt.¹³ Ignitions could increase: if dry lightning strikes become more regular;⁹³ if accidental or deliberate ignitions become more frequent as people spend more time outside;⁹⁵ and if vegetation species distribution changes altering fuel loads and landscape fire resilience.⁹⁶

Potential Risks and Impacts

Environmental

Effects of fires on ecosystems and ecosystem services in the UK are complex and varied,⁹⁷ but there is a lack of relevant studies. Most research focuses on single wildfires and their effects rather than fire regimes, the impacts of which depend on a number of factors.⁹⁵ Large wildfires could damage important habitats, including protected areas such as National Parks, Areas of Outstanding Natural Beauty, ancient woodland, Sites of Special Scientific Interest (SSSIs), and peatlands.⁹⁸ For example, the 2019 Marsden Moor wildfire area was an SSSI, a Special Protection Area and a Special Area of Conservation.⁹⁹

Peatlands are nationally and internationally protected habitats, which contain large quantities of carbon (Box 4). The risk of peat soil igniting is controlled by its moisture content,^{100,101} with climatic and human-caused drying of

peatlands increasing the vulnerability of peat to burning.¹⁰² The resilience of degraded dry peat to fire can be enhanced through restoration.¹⁰³ Once alight, the peat itself can smoulder (slow, low temperature, flameless burning) for months, burning downwards and outwards. This is difficult to extinguish regardless of changes in weather or firefighting efforts,^{102,104} produces toxic smoke,²⁵ and can release large quantities of carbon dioxide.^{105,106} Even on a very wet bog with a high water table (the depth where the peat is saturated with water), vegetation can burn, which can affect the hydrology (movement of water), chemistry, physical properties of peatlands, and subsequently river water chemistry, and river flora and fauna.^{107,108}

Economic

There is a lack of evidence and holistic economic analysis of wildfire damage in terms of preparation, prevention, response, and recovery.¹⁰⁹ According to the Forestry Commission, between 2009 and 2017 the FRS responded to 258,867 wildfires, with the highest number (49,847) in 2011.¹³ One fire in 2006 took 31 days to suppress at a cost of around £1 million, and costs of restoring landscapes following a fire can also be extensive.⁹⁵ Carbon emissions from burning woodland and peatland could impact UK greenhouse house gas emissions.^{106,110,111} They can be detrimental to ecosystem services.⁹⁷ Burning of moorland may affect water colour and dissolved organic carbon concentration as well as eroding peat into river catchments, increasing costs for water companies.^{112,113} Wildfire could also damage heathland managed for grouse shooting, an industry which supports local economies.¹¹⁴ Wildfires often start in the rural-urban interface, putting major infrastructure at risk, including transport networks, communications, power, gas, rights of way, and buildings.⁴⁸ Agriculture and forestry could be at risk, but evidence so far is lacking.⁹²

Health

Globally wildfires have caused loss of life, injury, and respiratory distress, exacerbating chronic conditions and causing long-lasting psychological effects.^{115–121} There is no evidence of this in the UK as yet, but the risk and threat to life is increased by the UK's high population density.¹²² Smouldering peat fires have greater impacts on air quality than vegetation fires. They emit toxic compounds and high levels of small particulates, which may pose health risks.^{25,133} Studies are lacking on whether the burning of peatlands containing atmospherically-deposited pollutants mobilises heavy metals into water and/or smoke.¹³⁴

Box 4: UK Peatlands

- Peatlands (blanket bog, lowland raised bogs and fen peats) cover 10% of the UK's land area. They perform valuable ecosystem services (processes which benefit humans),^{123,124} and across Great Britain contain an estimated 5.1 bn tonnes of carbon.¹²⁵
- 80% of UK peatlands are degraded, mostly due to drainage, burning, grazing practices,¹²⁶ and industrial pollution.¹²⁷
- Some peatlands are protected under EU legislation and are identified as an Annex 1 habitat of EU 'community interest' under the EU Habitats Directive.^{128,129} Blanket bog is a priority habitat and Defra's 25 Year Environment Plan has an ambitious peat restoration project.^{130,131}
- Natural England is working with landowners and managers to restore upland blanket bog.¹³²

Options for Increasing UK Fire Resilience

In general, current policy focuses on suppressing wildfires through the fire services, and less on wildfire prevention. Both issues have to be addressed to reduce the risk of wildfires, which require fuel and ignition,⁵⁴ but such an integrated, multi-agency approach is challenging.^{22,135} The effectiveness of different national fire management policies are debated,¹³⁶ but there is potential for learning from other countries that have legislation to reduce fire risk, such as New Zealand that still experiences severe wildfires.^{137–139}

Climate Change and Adaptation to Wildfire

Efforts are being made to limit climate change effects through adaptation plans and emissions reduction.¹⁴⁰ The UK Climate Change Risk Assessments (CCRA) in 2012 and 2017 and the National Adaptation Programmes (NAP) in 2013 and 2018 identified wildfire as a climate change risk.^{52,92,141,142} Recommendations to improve landscape resilience to address risk have been made by the National Fire Chiefs Council and Natural England.^{143,144} However, in South East England, none of the FRS Integrated Risk Management Plans considered the impact of climate change or provided mitigation or adaptation to wildfire.¹⁴⁵ The 2018 NAP recommends sustaining current action plans and lays out actions only for forestry to increase resilience to wildfire. These include:

- prevention training for FRS and land managers;
- developing a forestland wildfire risk and fuel map; and,
- enhancing prediction systems for forest land.

Recording

Including the source and point of ignition, and fire perimeter, in the recording of wildfires would broaden understanding of UK wildfire.¹⁴⁶ This would display changes in wildfire behaviour over time with climate change, and associated impacts and costs.¹⁴⁷ It would also provide robust data for analysis and improve modelling and risk assessments.⁵²

Improved Public Communication and Education

As human action is the main cause of UK wildfire ignition,⁴⁸ improving public communication and education about fire risk may reduce incidents and benefit emergency planning.⁵² This has been successfully applied in South Wales, alongside fuel reduction, and wildfire response training.¹⁴⁸ Community groups can deliver wildfire education, supported by stakeholders.¹³⁵ The success of public communication by the US Firewise Communities Programme on mitigating fire risk around homes and in communities is being explored for UK application.^{149,150}

Fire Danger Rating System (FDRS) Development

FDRS are used globally to successfully predict fire danger.¹⁵¹ Stakeholders support the development of a UK FDRS to warn when and where risk is greatest. Options to improve UK wildfire prediction have been suggested in the short and long-term.¹⁵² By incorporating UK fuel types, it could be used to guide the timing of management burning (Box 2).⁹⁵

Land Management and Spatial Planning

The extent of impact from a UK wildfire is determined primarily by its location,¹⁵ and even small fires can have

major impacts especially when several occur close together.¹⁶ Wind direction and strength can be major factors controlling spread and impact.¹⁵³ In rural-urban interface areas, construction close to wildfire fuel increases risks.⁵⁴ For example, Surrey Heath District Council have required consideration of wildfire risk for developments under the Town and Country Planning (Environmental Impact Assessment) Regulations 2017.^{154,155} The 2017 UKCCRA identified an integrated land-use risk management approach to increase resilience to wildfire.⁵² Land managers are willing to improve landscape resilience to wildfire, and active land management to reduce risk is supported by the wildfire community.¹⁵⁶

The Forestry Commission guidance on making forests more resilient to fire suggests that management should be considered at the landscape scale and be proportionate to the risk.^{49,54} A landscape scale approach has been successful in Dorset, alongside engagement with local planning authorities.¹⁵⁷ However, development of a national fuel map and wildfire hazard map would be needed for wider implementation, along with understanding of local perceptions and the uses of fire.¹⁴⁶ Defra's checklist of ecosystem services could include land management to reduce wildfire risk.^{95,158} Treating ecosystem services as a property asset, would help avoid costs of damage to services being judged against suppression costs.⁹⁵

Improving the Response to Wildfire

Commentators have suggested that the response of FRS and land managers' to wildfire could be improved through:

- Providing cross-sector wildfire suppression and prevention training (Box 5) to FRS and land managers using the Forestry Commission's Practice Guide.¹⁴²
- Improved FRS and land manager rural water access.^{49,52}
- Continuation of national and international FRS and land management wildfire knowledge sharing platforms.^{78,159}
- Using wildfire tactical advisers, local experts and researchers on-site at fires to aid FRS response and improve understanding of wildfire impacts.¹⁴⁶
- Modelling fire risk, spread and smoke to support the FRS and risk assessments,^{95,153,160} and evacuation modelling to support incident managers in tactical planning.¹²²

Box 5: Fire Suppression and Wildfire Management

- Suppression is the extinguishing of a fire.
- Fire suppression reduces area burnt,¹⁶¹ but over-suppression of fires with no other measures can increase the risk of severe fires,^{22,47} particularly under exceptional weather conditions.¹³⁶
- Wildfire resilience might be improved by tolerating a fire regime of low intensity fires by controlled burning or manual removal of vegetation, which has been successful in Australia.^{22,32,159,162}
- Burning has potential consequences for different ecosystems that have not been assessed experimentally, particularly in peatlands.^{22,146,162} Research could focus on high incidence areas identified through risk assessment and modelling.⁴⁹
- Wildfire management plans, involving risk assessments, response plans and management zones, are used in England by the Forestry Commission and by applicants for Countryside Stewardship scheme in lowland heath, grasslands and uplands.⁴⁹

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