

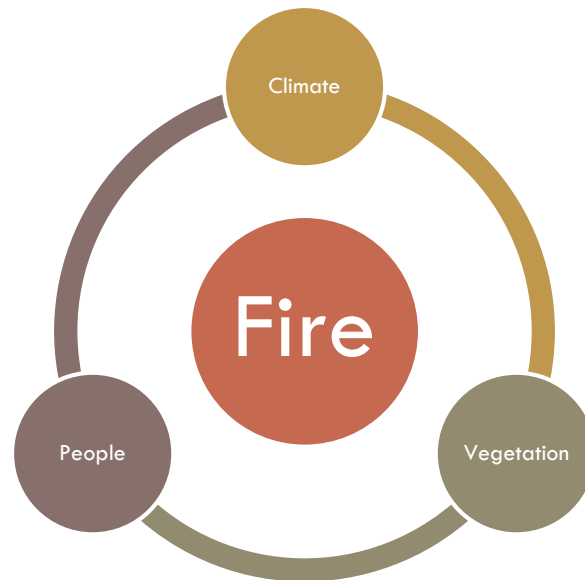
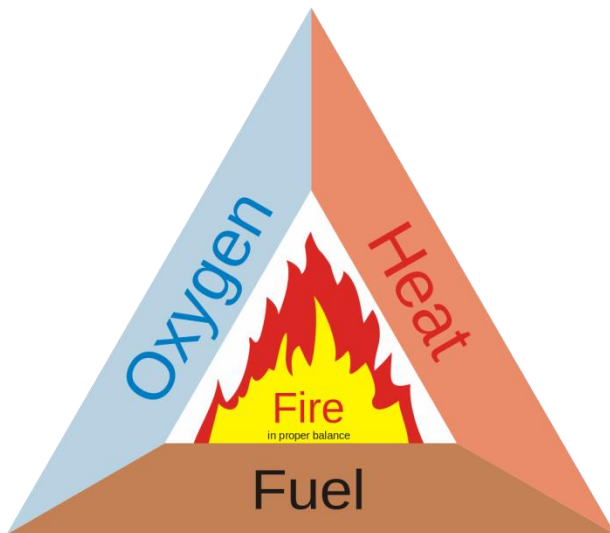


# WILDFIRES AND LAND MANAGEMENT

Dr Gareth Clay, University of Manchester  
BogFest17, 23 Sep 2017

# Fire is an interdisciplinary issue

- Fire as part of the Earth system
  - ▣ Coupled with climate and biogeochemistry



*Fire behaviour triangle*

- Fire is also a socio-ecological system
  - ▣ Hard to uncouple people from fire

# What are wildfires?

- a.k.a wildland fires, bushfires, scrubland fires
- Any unplanned and/or uncontrolled vegetation fire which may require suppression, regardless of cause

Moorland fire in Northumberland National Park



Canyon fire in Mediterranean vegetation

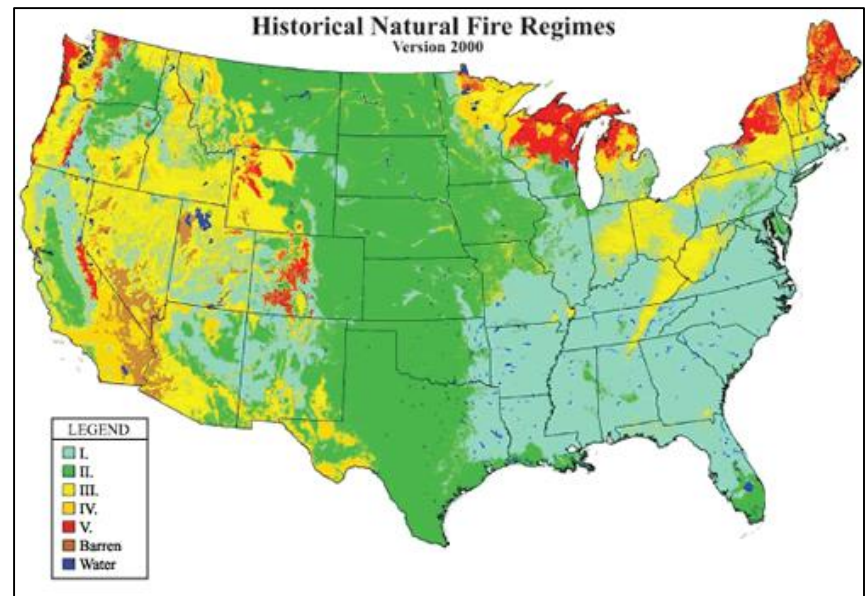


# What are wildfires?

- *“Any uncontrolled vegetation fire which requires a decision, or action, regarding suppression”* (Scottish Government, 2013)
- Wild used to refer to wildland location e.g. Great plains, Canada,
- Now tends to refer to out of control behaviour – negative view, threat

# Fire regime

- Characteristics of an area's fire history
  
- WHAT
  - **Causes** – human/natural
  - **Type** – surface, crown, soil
  - **Size** – burnt area
  
- WHERE
  - **Fuel type**
  - **Spatial location**
  
- WHEN
  - **Fire season** - which month
  - **Frequency** of occurrence (number / year)
  - **Return period** (e.g. 1 in 50 year event)



Source: USDA Fire Science Laboratory,  
Rocky Mountain Research Station

# What controls fire regime?

## □ Climate

### ▣ Principal control

- Direct control on fire weather
- Indirectly via fuel (i.e. vegetation)

### ▣ Temporal variation to consider

- Daily, seasonal, decadal

## □ Humans

### ▣ Direct via ignition sources

### ▣ Indirect via fuel (management, fire suppression)

- Management fires for ecological or other reasons
- Over-suppression, can allow fuel to accumulate → mega-fires

# Fire regime

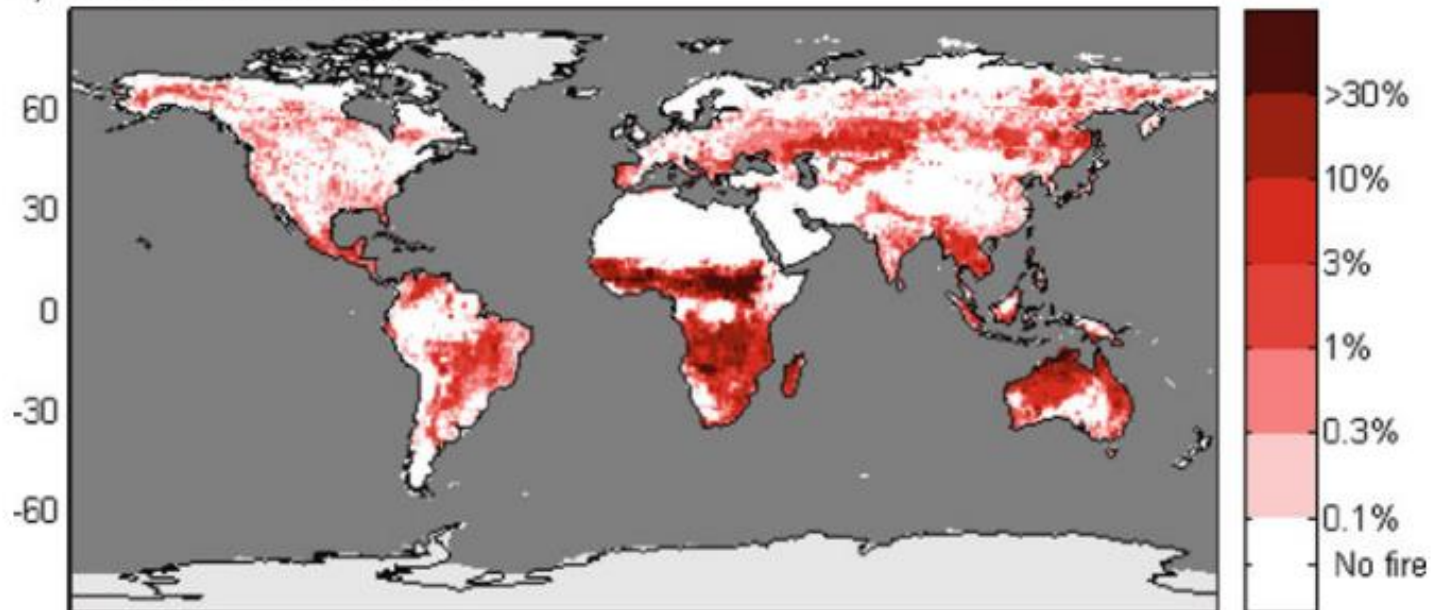
- Fire size is inversely related to fire frequency
  - ▣ Smaller, less damaging fire more common
- Use as a management strategy?
  - ▣ Over suppression → larger fires more likely = *fire paradox*
- Fire regimes are dynamic and change with climate and land management:
  - ▣ “Fire’s removal in places that have long known it may be as ecologically damaging as its introduction to places to which it is alien”  
Pyne (2012)



# Global distribution of wildfires

- Most fires in seasonally wet-dry climates: seasonally dry tropical forests, savannas, dry woodlands
- Followed by grassland and scrubland, then temperate and boreal forests

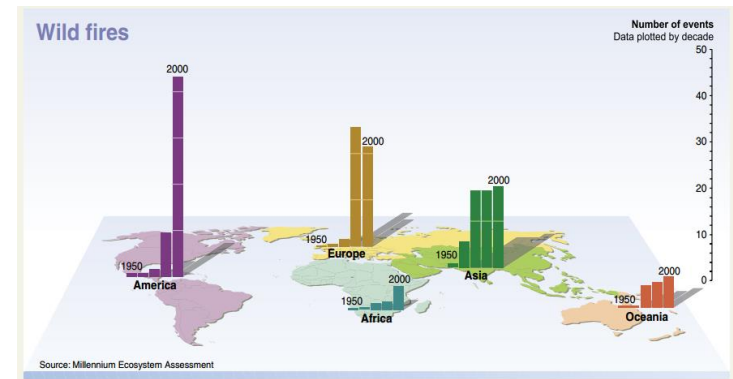
a) Annual Fractional Burnt Area



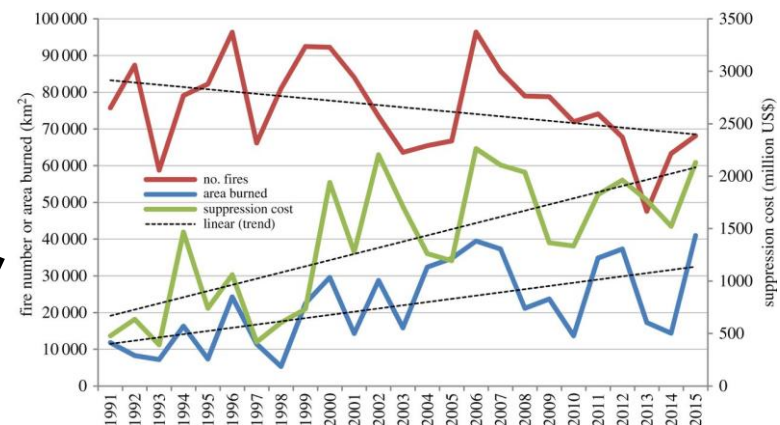


# Recent trends: Global

- Are there any clear global trends?
  - ▣ It depends on scale and timeframe
- Up to 2000, increases seen around the world (MEA, 2005)
  - ▣ Recent syntheses suggest this may not be so simple
- Data from USA suggest number of fires has decreased, but area burned (and cost associated with suppression) have increased



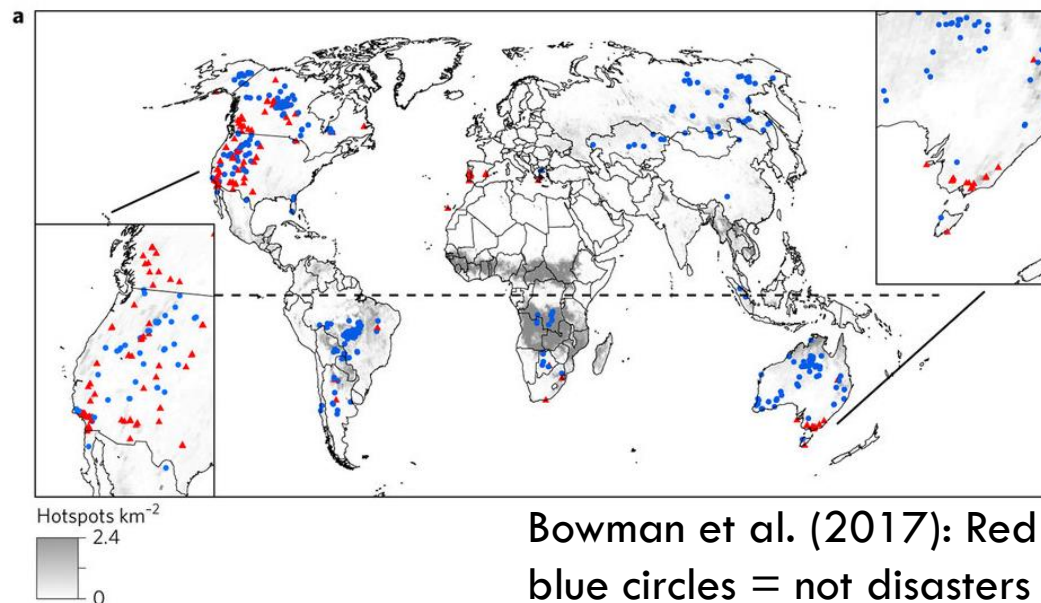
Millennium Ecosystem Assessment (2005)



Doerr and Santin (2016)

# Global mega-fires

- Recent analysis of 478 extreme wildfires, 2002 - 2013
  - 114 economically or socially disastrous
  - Suburban (wildland-urban interface) in western USA and SE Australia



Bowman et al. (2017): Red triangles = disaster, blue circles = not disasters

# UK Fire regime

## □ Seasonal cycles

### ▣ Two seasons

■ April/May

■ July/August

### ▣ Combination of climate, vegetation and human activity

■ Bank Holidays

■ School Holidays

■ Day of the week

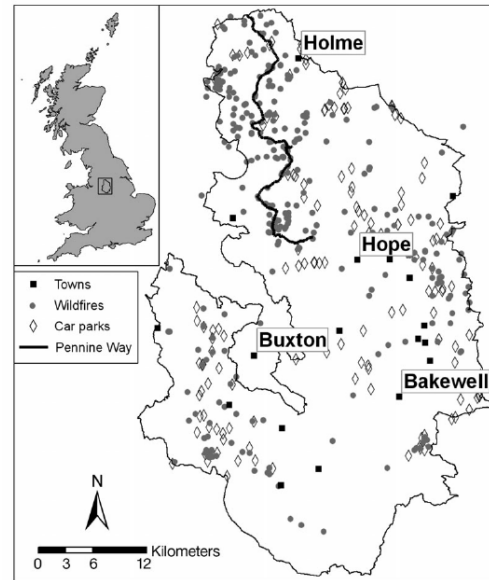


Fig. 1. Peak District wildfired, 1976–2006

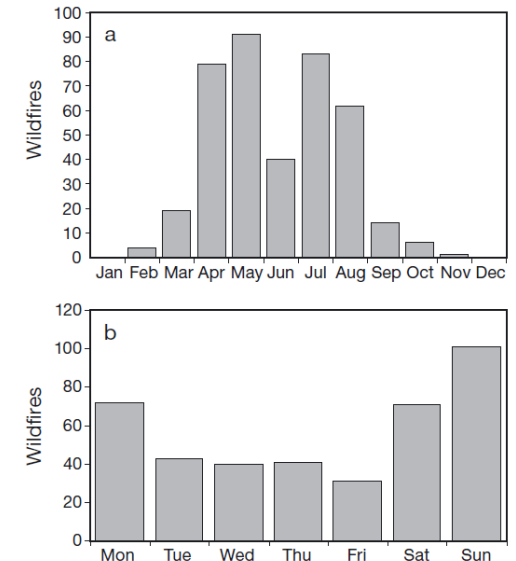


Fig. 2. Total number of wildfired in the Peak District National Park recorded by (a) month (June 1976 to December 2008) and (b) day of the week (June 1976 to December 2008)

Albertson et al. (2010)

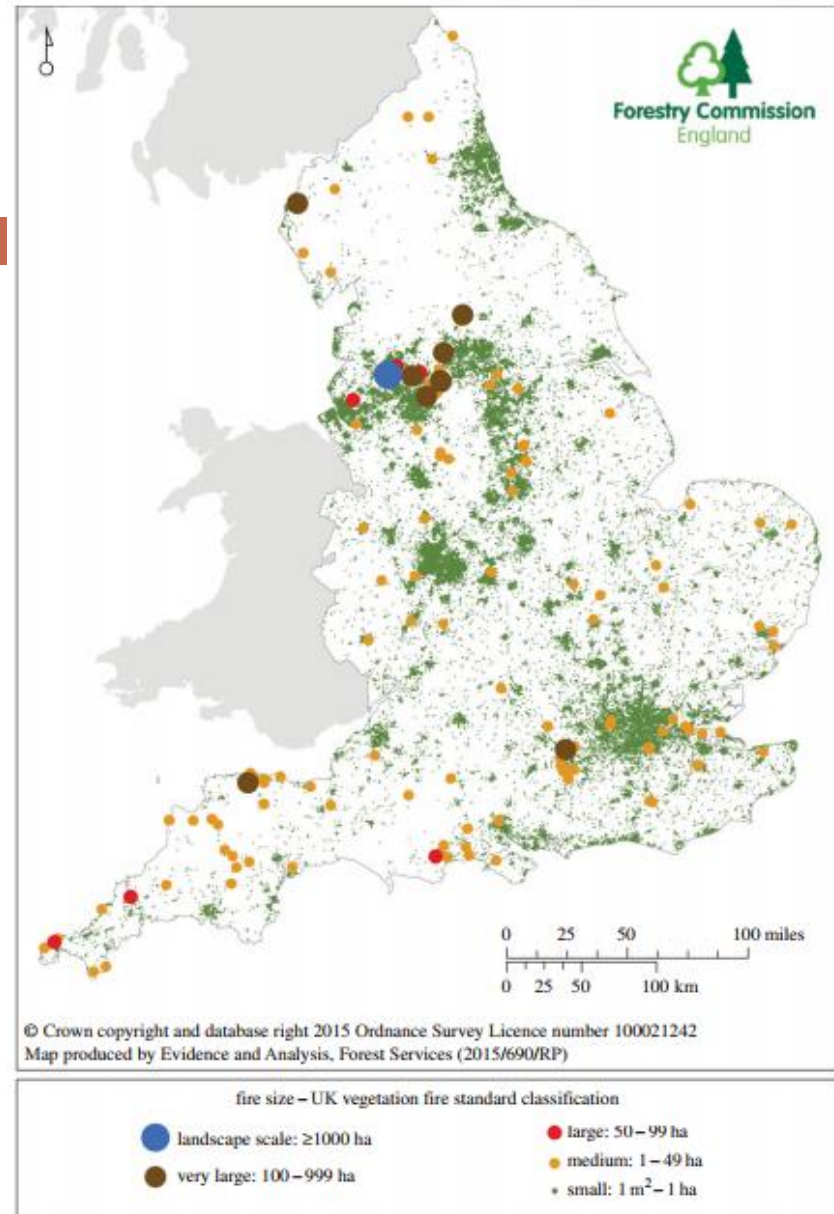
## □ Spatial patterns

### ▣ Towns

### ▣ Footpaths, car parks

# UK Fire regime

- Between 2009/10 and 2012/13
  - ▣ 210,000 vegetation fire incidents recorded by FRS
- Rural-urban interface
- Nearly 50% are  $<5m^2$
- Large fires are few, but cover large areas
  - ▣ Resources
  - ▣ Environmental and social impact



English vegetation fires for one year, FY 2011/12. From Gazzard et al. (2016)

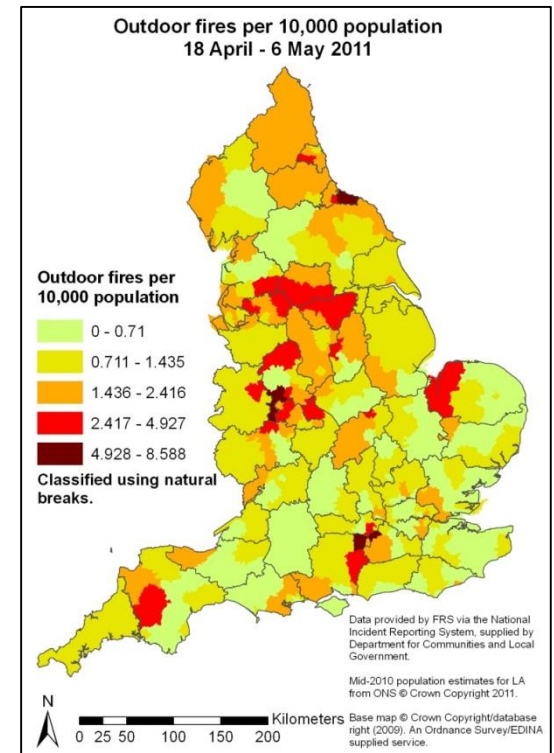
# Case Study: Spring Fires 2011



Source: BBC

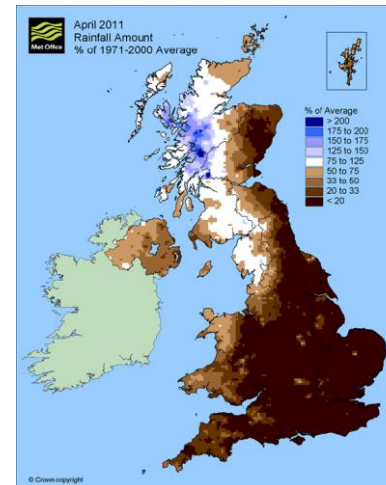
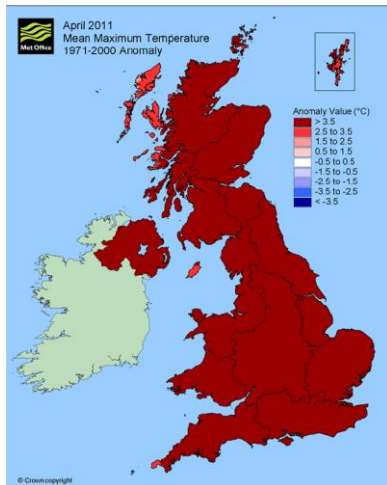
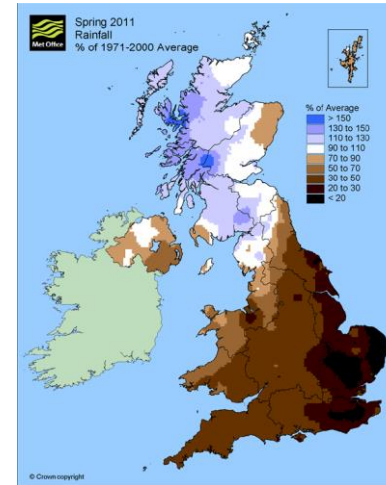
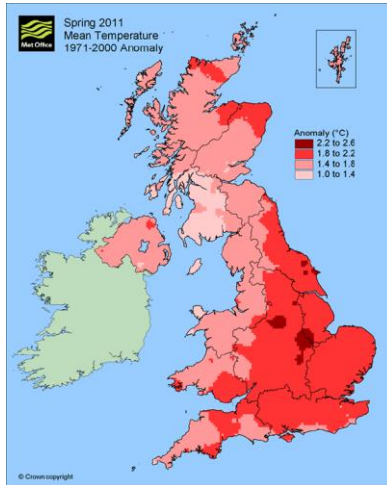


Source: MODIS



Courtesy of Julia McMorrow

# Exceptional conditions



# Spring 2011 – Swinley Forest

- Mon 2<sup>nd</sup> May
- High temp, wind, low humidity
- Fire escalated quickly
  - ▣ Multiple fire fronts
  - ▣ Moved quickly – 7 ha in 20 minutes
  - ▣ Jumped fire breaks
- 12 day incident led by RBFRS and Forestry Commission
  - ▣ 300 + fire fighters from multiple FRS
- One of largest fire incidents since WWII



Courtesy of Rob Gazzard  
(Forestry Commission)

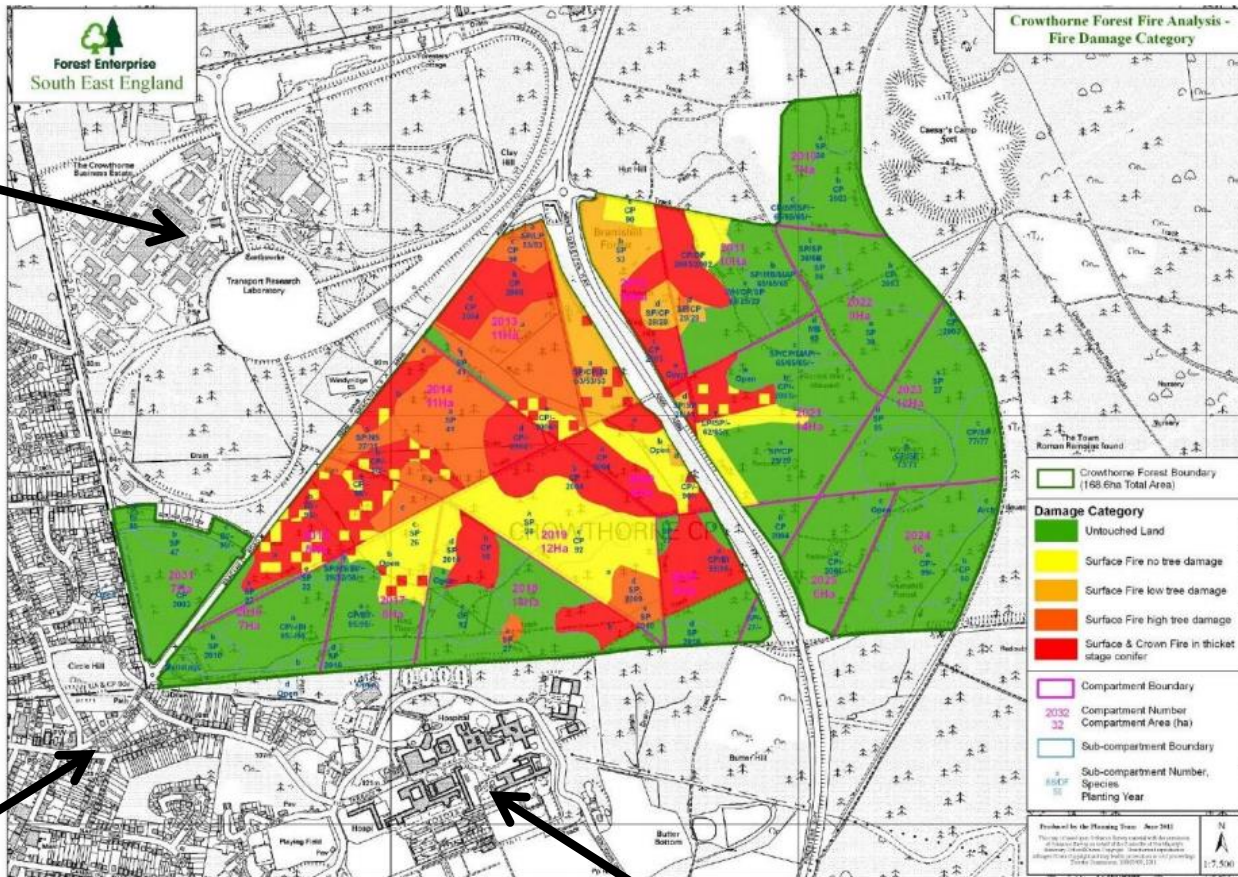
# Impact

## Fire Affected Areas

Transport  
Research  
Laboratory

Crowthorne  
village

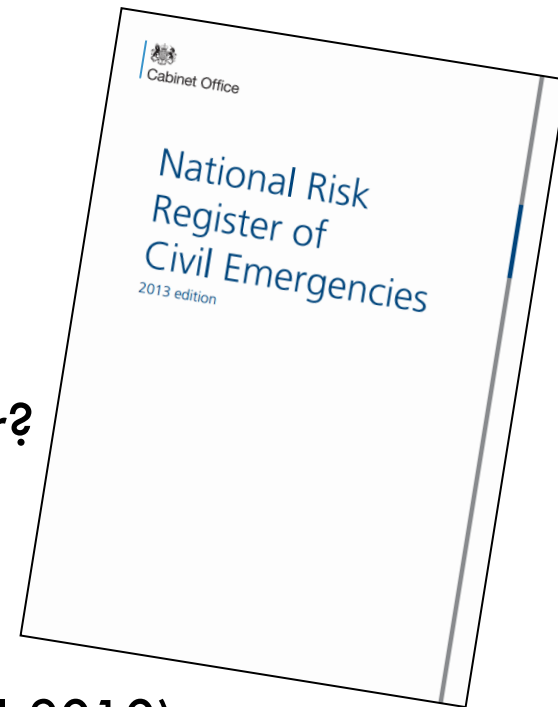
Broadmoor High Security Hospital





# Risk register

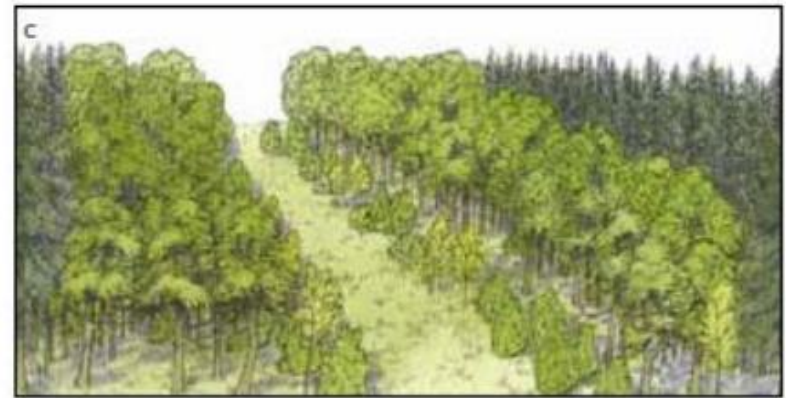
- Preparation for civil emergencies
  - ▣ Damage to human welfare
  - ▣ Damage to environment
  - ▣ War or terrorism affecting security of UK
  
- What other hazards are on the risk register?
  - ▣ Pandemic influenza
  - ▣ Coastal flooding
  - ▣ Terrorist attacks
  - ▣ Volcanic eruptions abroad (e.g. Eyjafjallajökull 2010)
  
- In 2013, '**severe wildfire**' was added to the register



# Wildfire management

# Fuel management

- Amount: biomass
  - ▣ Manage with fire, grazing, cutting
- Type: size, especially fine fuels e.g. grass or those with volatile biochemistry e.g. gorse
  - ▣ Manage species composition
- Continuity
  - ▣ Horizontal: fire breaks
  - ▣ Vertical: thin out ladder fuels

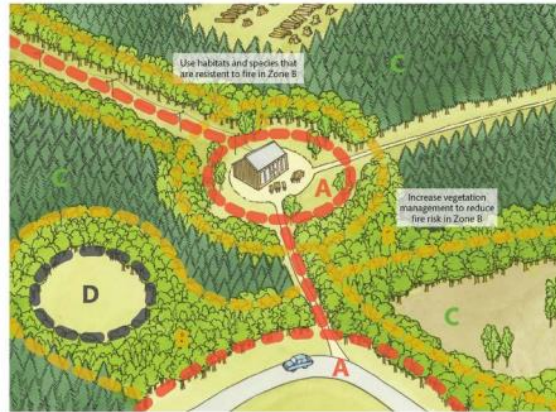


# Forestry commission practical guide

## Forest management plans

**Zone A** is the asset zone, where health and safety and important assets and infrastructure must be protected from wildfire. This zone requires a high level of fire prevention such as fuel management. To achieve this Zone A can be broken up into smaller zones with appropriate vegetation management regimes (see diagram overleaf).

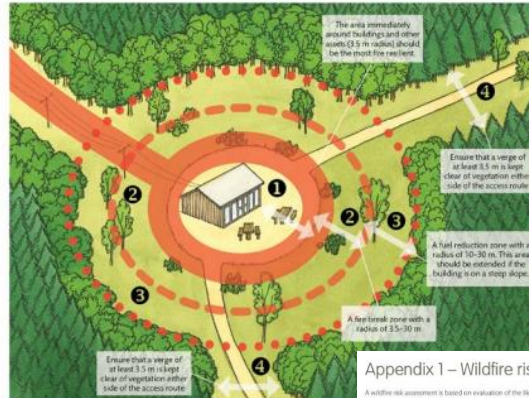
**Zone B** is the buffer zone, where increased fuel management is carried out in areas at a high risk of wildfire to protect Zone A. The aim should be to reduce the rate of spread and intensity of a fire. The width of Zone B should be proportionate to the level of risk and the potential impact of radiant heat, smoke and spot fires on Zone A. In low-risk areas of forest it may be as narrow as a fire belt. In higher-risk landscapes, the width will be increased.



Landscape scale

1 Keep vegetation sparse and well irrigated and use fire resistant species. Carry out annual maintenance before the start of the fire season. Do not burn cleared vegetation in this area - cut, chip and remove. Regularly clear the area of deadwood and remove leaves and needles from rooftops and gutters.

2 Trees and shrubs in this area should be comprised of fire resistant species and kept at a low density. Larger areas of forest or woodland should be fragmented to increase resilience and trees thinned or pruned to minimise ladder fuels. Areas of grassy open space should be increased and deadwood kept to a minimum.



3 Larger areas of forest or woodland should be fragmented in this outer area. Plant fire belts of fire-resistant tree species and manage the undergrowth so that it remains suppressed. Bonfires and prescribed burning (with appropriate control measures) take place here outside of the fire season.

4 Trees and shrub residues and all veg All ladder fuels the vegetation does

### Appendix 1 – Wildfire risk assessment

A wildfire risk assessment is based on evaluation of the likelihood of a wildfire starting and the severity of damage it might cause. Use the formula:

Wildfire risk = Likelihood x severity

Details of the risk assessment should be recorded using the Wildfire risk assessment template (see overleaf) and kept with the forest management plan (see below).

Scale	Severity	Chance (%)	Description
1	Very unlikely	0-20	Event may occur only in exceptional circumstances.
2	Unlikely	21-40	Event could occur at some time.
3	Moderate	41-60	Event will occur at some time.
4	Likely	61-80	Event could occur in most circumstances.
5	Very likely	81-100	Event will occur in most circumstances.

Scale	Severity	Chance (%)	Description
1	Negligible	0.005	Life: Minor local fire and treatment (e.g. minor calculations) Property/business: No financial loss or damage Environment: Local damage. Habitats and species will recover in less a year.
2	Minor	0.05	Life: Heavy requiring first aid and treatment Property/business: Minor financial losses (up to 1% of profit), disruption or damage Environment: Minor damage. Habitats and species will recover in 1-2 years.
3	Serious	0.5	Life: Medical treatment required Property/business: Serious financial losses (up to 25% of profit), disruption or damage Environment: Serious damage. Habitats and species will recover in 5-10 years.
4	Major	5	Life: Recovery or life-changing injuries Property/business: Major financial losses (up to 75% of profit), disruption or damage Environment: Major damage. Habitats and species will recover in 10-20 years.
5	Catastrophic	50	Life: Single or multiple deaths Property/business: Destruction of the property (total loss) or business Environment: Irreversible impact on habitats or species.

Calculate the wildfire risk and assess whether the risk is Low, Moderate, High or Unacceptable by using the matrix below. A Moderate, High and Unacceptable risk rating will require the use of control measures to reduce the risk rating to Low.

Calculating the wildfire risk rating		Likelihood					Risk rating	Severity
		1	2	3	4	5		
Severity	1	1	2	3	4	5	1-5 Risk rating 1 Low	
	2	2	4	6	8	10	6-10 Risk rating 2 Moderate	
	3	3	6	9	12	15	12-16 Risk rating 3 High	
	4	4	8	12	16	20	18-24 Risk rating 4 Unacceptable	
	5	5	10	15	20	25		



Practice Guide

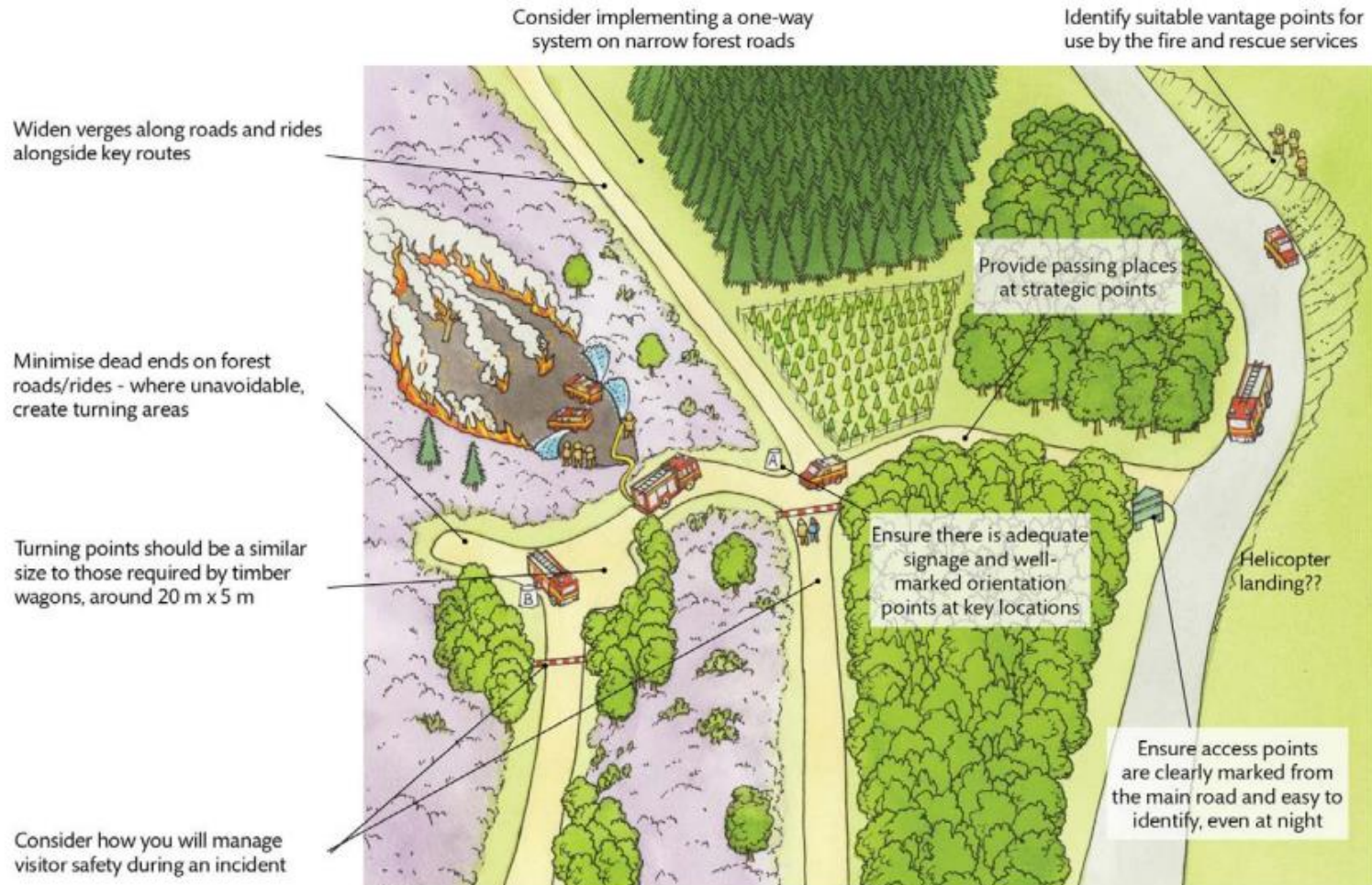
## Building wildfire resilience into forest management planning

### Wildfire risk assessment template with worked example

Worked example name	Worked example location	Worked example description	Worked example asset	Worked example severity	Worked example chance (%)	Worked example risk rating	Worked example control measures	Worked example risk rating after control measures
Pre approval from Natural Health 2025 and Landmark Wood	London, Thornton, SE England	General public fire risk	First Striking at year 20	4	4	16	Implement fire belts around high risk sub compartments	3
Completed by: J. G. G. G.	Date of assessment: 1/10/2019	Version: 1.0/2019						

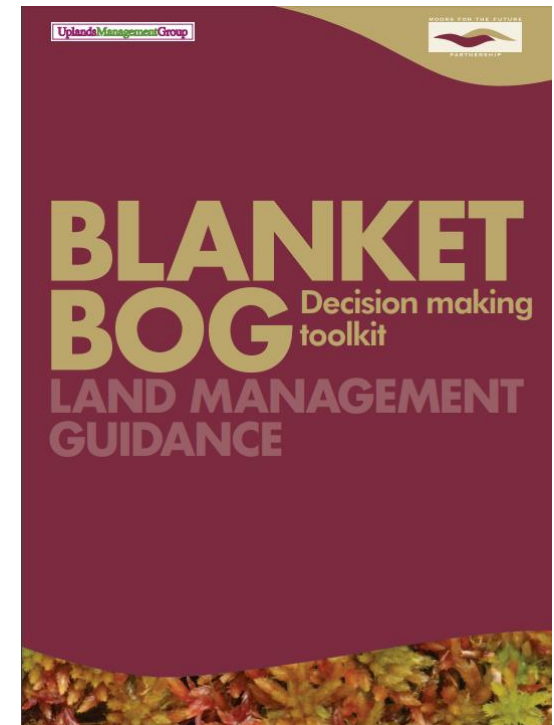
# Forestry commission practical guide

Figure 22 Planning to facilitate an incident response. All such features should be marked on the Wildfire response plan.



# Land management guidance

- Consider risk of wildfire, in particular:
  - ▣ Is there a history of wildfire in the area?
  - ▣ Is there vegetation with high fuel loads adjacent to the restoration site?
- Draw up a wildfire management plan
- Monitor changing fuel load



# International examples

- City of Hobart, Tasmania
  - ▣ Over 100 urban fuel breaks
  - ▣ Periodically assessed and updated
  - ▣ Included as part of planning process for new houses



City of **HOBART**

- Canada
  - ▣ Forest Fire Danger Rating System
  - ▣ Fire modelling
  - ▣ Prescribed burning



Natural Resources  
Canada

Ressources naturelles  
Canada

Canada

# Ignition management

- Fire risk warnings
  - ▣ Public access, CRow
- Education programmes
  - ▣ School-aged children
- Planning system
  - ▣ Rural-urban house building

**H I G H R I S K**

**FIRE**

**FIRE**

**NO SMOKING or NAKED FLAMES**

**Emergency!**  
If you see any smoke or fire on the moors, please report it immediately to the Fire Service. Call 999

**The Peak District Fire Operations Group**  
The Fire Operations Group aims to prevent and fight moorland wildfires in the Peak District through the use of moorland fire action plans, incorporating partnership working, joint training and standardised equipment procurement. The group is made up of representatives from the organisations listed below.

PH  
Peatland  
Hedgemoor Ltd

Severn Trent Water

PEAK DISTRICT  
CHATS WORTH

THE NATIONAL TRUST

PEAK DISTRICT  
NATIONAL PARK AUTHORITY

United Utilities

CHESHIRE  
FIRE & RESCUE SERVICE

Derbyshire  
Fire and Rescue Service

Greater Manchester  
Fire and Rescue Service

South Yorkshire  
Fire and Rescue Service

Leicestershire  
Fire and Rescue Service

West Yorkshire  
Fire and Rescue Service



# Targeted Public information

- Areas of high arson ignitions
  - ▣ e.g. South Wales (Jollands et al., 2011)

- Time of high risk
  - ▣ E.g. school holidays

- Press releases

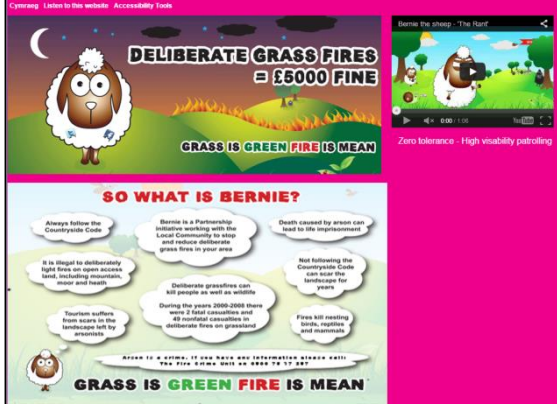
- Websites
  - ▣ Peak District “Be Fire Aware”

**Flames Aren't Games**  
29/05/2012

With half term approaching Staffordshire Fire and Rescue Service is reminding children and parents 'Flames Aren't Games' as part of its grass fire prevention campaign.

**"Starting a fire deliberately is not big, funny or clever - it's a crime and it won't be tolerated."**

Head of Risk Reduction, Glynn Luznyj



**DELIBERATE GRASS FIRES = £5000 FINE**  
**GRASS IS GREEN FIRE IS MEAN**

**SO WHAT IS BERNIE?**

- Always follow the Countryside Code
- It is illegal to deliberately light fires on open access land, including moorlands, moor and heath
- Deliberate grassfires can kill people as well as wildlife
- During the years 2000-2008 there were 7 fatal casualties and 48 non-fatal casualties in deliberate fires on grassland
- Fire kills nesting birds, reptiles and mammals
- Death caused by arson can lead to life imprisonment
- Not following the Countryside Code can cost the landowner ten years

**GRASS IS GREEN FIRE IS MEAN**

Project Bernie (South Wales)

Flames Aren't Games  
(Staffordshire Fire and Rescue Service)

**Fire Danger**  
**WELCOME**

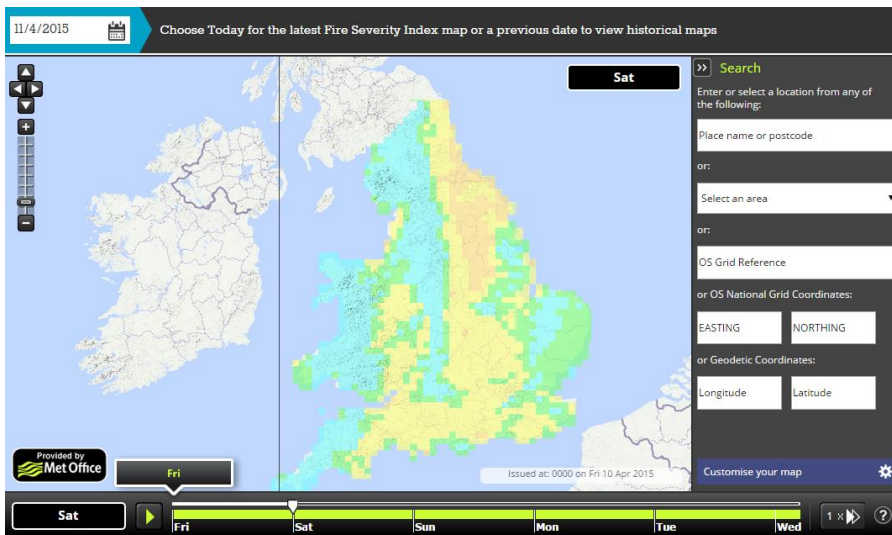
We're making a pin board to help visitors understand fire risk.

Our ranger has been out taking photos of the risks. Your mission is to help the ranger by pinning the photos to the right board.

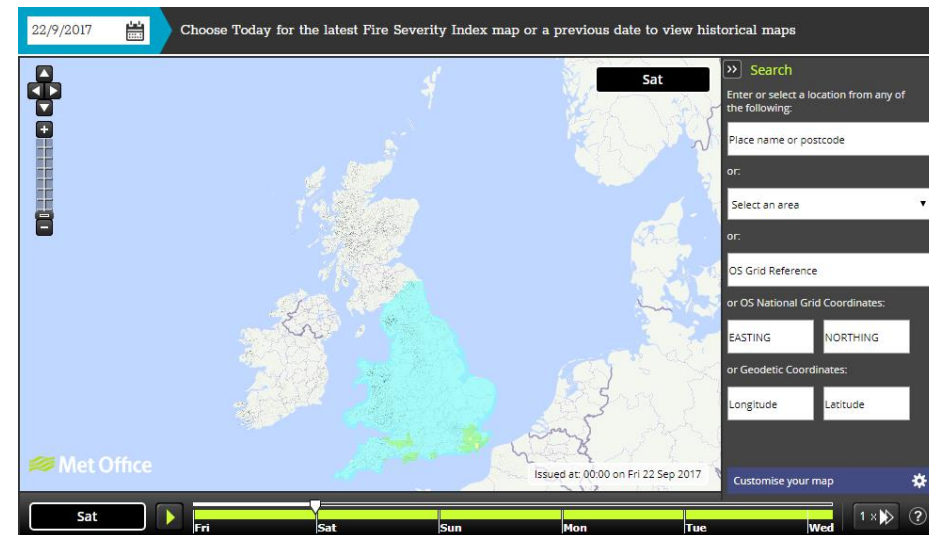
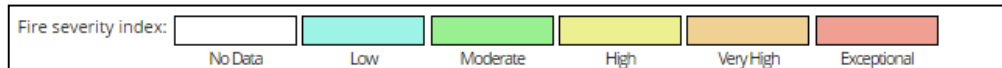
**Play the Game**

# Fire risk warnings

- Used to highlight periods of high fire risk
  - ▣ Allows for closure of open access land in extreme situations
- Met Office Fire Severity Index
  - ▣ <http://www.metoffice.gov.uk/public/weather/fire-severity-index>



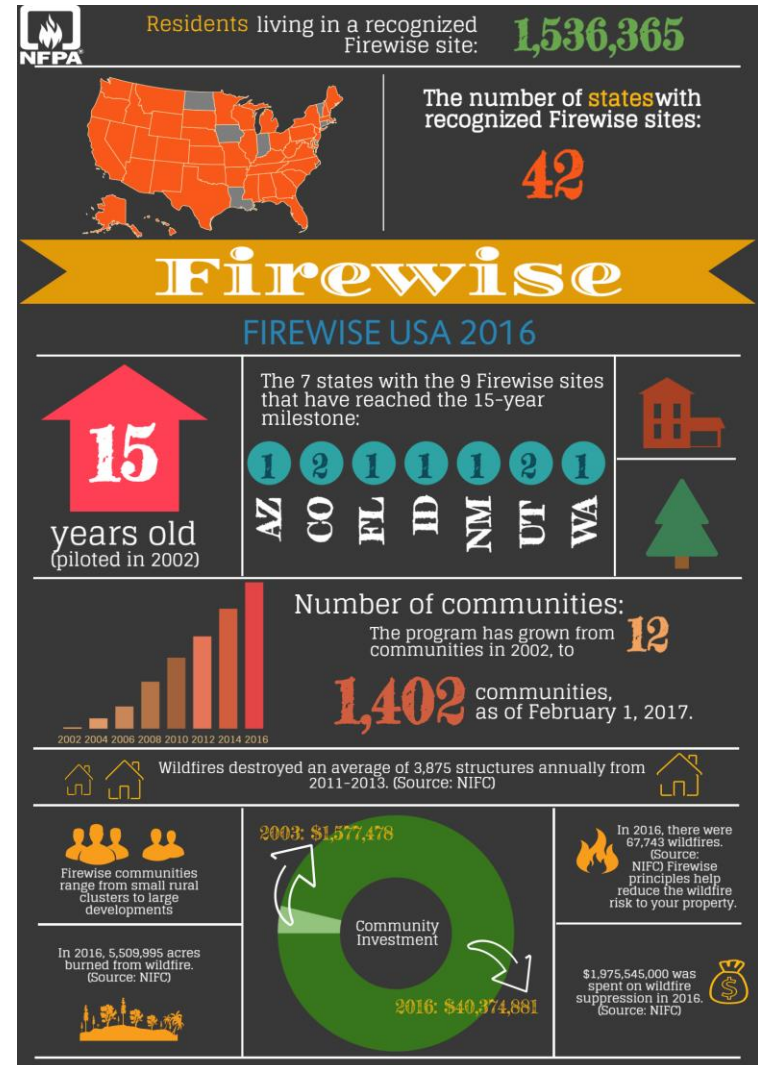
11 April 2015



22 Sep 2017

# International examples

- Firewise communities
  - ▣ Local solutions
  - ▣ Engaging homeowners to take individual responsibility
- Invest \$2/capita into action
  - ▣ Cash, time, in-kind services etc.
- First UK Firewise community launched in Thursley, Surrey in 2014



# Partnership working

- Evolution of community-based cross-sector working over last 30+ years
  - ▣ Bottom-up diffusion to national levels
- Fire groups (e.g. PDNP FOG)
  - ▣ Sharing knowledge & collaboration on equipment
  - ▣ Varied expertise across the country
    - Northumberland: back burning; PDNP: helicopter suppression
- Many different expectations for land
  - ▣ Multiple ecosystem services for multiple groups
  - ▣ Can lead to tension and disagreement
  - ▣ Wildfire prevention a uniting boundary concept

# Partnership working

- National level groups
  - ▣ Scottish Wildfire Forum (SWF)
  - ▣ England and Wales Wildfire Forum (EWWF)
  - ▣ Chief Fire Officers Association Wildfire Group



- Knowledge Exchange
  - ▣ FireBeaters
  - ▣ FIRES seminars
  - ▣ Knowledge for Wildfire (KfWf)



# Links & reading

- Knowledge for Wildfire: [www.kfwf.org.uk](http://www.kfwf.org.uk)
- EWWF:  
<http://www.northumberland.gov.uk/Fire/Wildfire.aspx>
- Gazzard et al. (2016) – Open Access

PHILOSOPHICAL  
TRANSACTIONS B

[rstb.royalsocietypublishing.org](http://rstb.royalsocietypublishing.org)

Research



**Cite this article:** Gazzard R, McMorrow J, Ayles J. 2016 Wildfire policy and management in England: an evolving response from Fire and Rescue Services, forestry and cross-sector groups. *Phil. Trans. R. Soc. B* **371**: 20150341. <http://dx.doi.org/10.1098/rstb.2015.0341>

Wildfire policy and management in England: an evolving response from Fire and Rescue Services, forestry and cross-sector groups

Rob Gazzard<sup>1</sup>, Julia McMorrow<sup>2</sup> and Jonathan Ayles<sup>3</sup>

<sup>1</sup>Forestry Commission England, Forest Services, Bucks Horn Oak, Farnham, Hampshire GU10 4LS, UK

<sup>2</sup>School of Environment, Education and Development, and <sup>3</sup>Manchester Institute of Innovation Research, University of Manchester, Oxford Road, Manchester M13 9PL, UK

RG, 0000-0002-6350-6039

Severe wildfires are an intermittent problem in England. The paper presents the first analysis of wildfire policy, showing its halting evolution over two decades. First efforts to coordinate wildfire management came from local fire operation

# Research questions and challenges

## Key research gaps

- Link between fire severity and fire history (i.e. PB and WF)
- Trade-offs between prescribed burns and wildfires (all ecosystem services)
- Some social science in UK fire science, but limited

## Opportunities

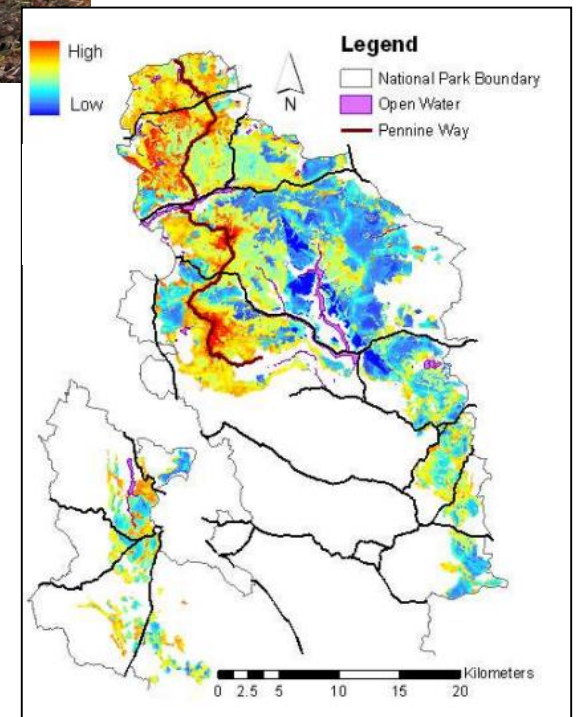
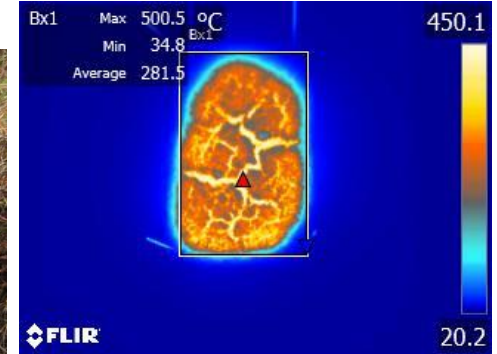
- Lots of data (IRS, National Park Rangers, Forestry Commission etc.) → need to archive and join up
- Combine data on prescribed fire and wildfire
  - ▣ Better understand the fire regime
- Practitioner science
  - ▣ Gather data to increase number, type and geographic coverage of fires recorded

Research synergies should support ‘fire resilient landscape design’

- Opportunities to build on partnership working

# Fire research at Manchester

- Ecosystem response to fires
  - ▣ Carbon dynamics
  - ▣ Water quality
  - ▣ Heavy metal release
  
- Spatial mapping of wildfires
  - ▣ Understanding their role in the UK
  
- Knowledge Exchange ([www.kfwf.org.uk](http://www.kfwf.org.uk))
  - ▣ Dialogue between academics and organisations such as the Fire and Rescue Service, local and central government, and land managers





# Wildfires 2017



- Theme: Wildfire resilience in a UK context
- 7 – 8 November
- Royal Bath Hotel in Bournemouth
- <https://www.dorsetforyou.gov.uk/uk-wildfire-conference>





Thank you

# References

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