Increasing water supplies for fighting moorland fires in the Peak District

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Dan Boys, Moors for the Future & Steve Trotter, National Trust (Eds)

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Moors for the Future
Castleton Visitor Centre
Buxton Road
Castleton
Derbyshire S33 8WP
Tel/Fax: 01433 621656
email : moors@peakdistrict.org.uk
website: www.moorsforthefuture.org.uk

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1.Fire Risk Mapping - The results so far

1.1.Introduction

Accidental fires pose one of the biggest threats to the moorland habitat. Unlike `managed` burning which takes place between 1st October and 15 April, summer fires may often be caused by carelessness, arson and/or vandalism. Accidental fires can take hold very quickly during dry conditions and can have catastrophic consequences. With predicted climate change and an increase in summer temperature of up to 5°c by 2080 across the Peak District, accidental fires may become more frequent and intense (SNW CURE, University of Manchester 2004).

Besides the obvious and immediate aesthetic damage caused by fire, upland catchments provide a valuable habitat for breeding birds such as red grouse, golden plover, ring ouzel and twite and a loss of their habitat may result in further declines of these species. Upland habitats also support the southern-most viable populations of many moorland breeding birds, plants and are a refuge for endangered small mammals such as the water vole and mountain hare and are therefore more sensitive to any climate change that may occur (Figs 1 & 2).

Deep burning can result in the sterilisation of the peat and prevent the regeneration of vegetation. The pH of bare peat exposed by fire rapidly increases in acidity and inhibits plant root growth. It is also likely to accelerate the drying of the bog and increase respiration by micro-organisms. This in turn will accelerate erosion, run-off and discolour water supplies. An increase in erosion will also lead to a greater release of chemicals such as nitrogen, phosphorus, lead and carbon into watercourses and the atmosphere.

Peat also represents about a third to a half of the global soil carbon pool therefore the size and function of these landscapes are potentially important to past and future climate change. Over thousands of years, carbon accumulation in peat 'sinks' have removed significant quantities of CO_2 from the atmosphere. If degradation and drying of the peat occurs, carbon release directly to the atmosphere and watercourses (and again eventually into the atmosphere) will be accelerated (Charman 2002).

1.2.Purpose of the study

The moorland area of the Peak District National Park covers an area of approximately 550km^2 and as much of it is remote and inaccessible, fire fighting is difficult and expensive. As a result, the Moors for the Future project and partners like United Utilities and the National Trust have been carrying out work to identify areas most at risk from moorland fires in the Peak District and investigate how fire-fighting methods can be improved.

In particular, the partners aim to identify secure water supplies in remote locations that will hopefully improve the effectiveness and speed of fire-fighting whilst also reducing costs by getting water to site more efficiently.

1.3.Methods

[1] Using available data, we have been able to map those areas and identify where increased water supplies could be beneficial to tackle any future fires.

[2] In the last 28 years there have been 345 reported accidental summer fires in the Peak District and as a result 6.5km2 of moorland were devoid of vegetation in 2003 (Fig 3).

[3] In order to ascertain those areas most at risk from future fires, a buffer zone was placed around each fire. An area within 1km of a fire incident was categorised as high risk, between 1-3km a medium risk and 3-8km a low risk (Fig 4).

[4] Figure 5 illustrates Defra's ESA vegetation map for the north area of the Park overlaid with fire incidents from the last 28 years.

[5] This map was then simplified according to the flammable nature of the vegetation to highlight those areas most at risk from future fires (fig 6).

[6] In August 2004, Moors for the Future undertook a visitor survey over three days (Saturday, Sunday and Wednesday) at fourteen key moorland sites. Figure 7 illustrates those sites surveyed and the routes taken by visitors on those days.

[7] When the fire incidents were mapped with the Public Rights of Way (PROW) (fig 8) there was a strong correlation with the Pennine Way, therefore a buffer zone was created around the 45km of this path that runs through the Park and was determined as follows: High risk – 0-100m, medium risk – 100-500m and low risk 500m-1km (fig 9).

[8] The final map illustrates the existing major water supplies and off-road routes onto the moors (fig 10) and was taken from the PDNPA's Fire Plan. Large catchments not only supply water for fighting fires but also act as a firebreak.

[9] The buffer zone maps (figs 4,6,7 & 9) plus the firebreak map (fig 10) form layers of what will create the definitive fire risk map for the Peak District moorlands. Once generated, this map can be used to identify areas of high fire risk and therefore highlight areas where additional water supplies could be sited. However, further information is needed to create this map:

- Hydrogeology data
- Soil data
- Topography data
- Helicopter flight statistics

[10] In addition, the following data could be refined to provide more accurate mapping:

- Fire incident map should illustrate risks with regards to number of fires at one site (no differentiation between 1 and 30 fires on map)
- Visitor data could be better presented

There is a budget of approximately £42,857 to spend on increasing moorland water supplies for fire fighting on the moors. Currently, this sum is dwarfed by helicopter costs alone as the fires on Kinder and Bleaklow in April 2003 cost the National Trust and United Utilities approximately £100,000.

2.Workshop summaries

2.1.Workshop 1: How does current water supply meet our needs?

It was agreed that at present, the current water supply does not meet our needs to fight moorland fires. While there are good examples of water supply (e.g. pond at Snake Summit) it was identified that some sources are not being used. The reasons cited were twofold:

- Lack of communication
- Lack of equipment to utilise resource

It was also felt that some existing water sources were inappropriately sited:

- Water at bottom of hills
- Fires at top of hills

In addition, some water sources have been drained over the last few years (e.g. reservoirs on Eastern Edges), as a result of the new Reservoirs Act which makes the owner of such features more liable for drowning etc.

2.1.1.Distribution of water sources in relation to risk map

The higher moors in the Dark peak are poorly supplied with water and the consensus was that priority should be given to these areas rather than the Eastern moors and South West Peak where there is generally good vehicle access.

2.1.2.Risk Mapping – what further mapping needs are there?

- Has there been a historical shift in the balance of fires? This should be identified by illustrating fire incidences over certain periods (e.g. fire incidents maps between the years 1976-85, 86-95, 96-05).
    - Are there fewer smoking related incidences in the last decade as awareness has increased?
- Information that highlights the ease with which fires were put out
- Investigate Hydrogeology of moorlands for potential bore holes (particularly summer water flows)
- All fire plan information overlaid on Fire Risk Map
- Do fires start more readily on different vegetation types at different times of the year?
- Investigate whether there are other fires during the last 28 years that are not on the fire log, to make the incidence map comprehensive.

2.2. Workshop 2: What are the Requirements for moorland fire fighting?

This question is dependant on a number of factors:

- Time of year
- Size of fire
- Location
- Vegetation type (or lack of)

During spring there is often a fairly high moisture content below the surface of the peat and damage is restricted to surface burns. At this time of year beaters can be used to put out small fires. However, during summer/autumn the peat is dry and deep-seated burns can occur, therefore water is fundamental to extinguishing these fires.

The requirements are also dependant on where the fire is; those on difficult or remote terrain may be inaccessible using particular equipment etc.

It must also be noted that much valuable fire-fighting work is already being undertaken on the Peak District moors and these successful partnerships must be maintained and built upon.

2.2.1 What are the preferred systems?

In an ideal world, the best solution would be to have an `on-call` retained moorland helicopter fire service that would be ready (e.g. in ten minutes) to tackle any reported fires. However, this is an expensive option that is not in the realms of this project. This issue has been raised at the House of Commons by Derbyshire Fire and Rescue Service to seek Government funding, but has so far been unsuccessful.

At present a number of helicopter companies do assist in moorland fire fighting however, there is not the guarantee that they will always be available. The provision therefore, needs to be made for fighting fires with All Terrain Vehicles (ATVs) and ground equipment e.g. pumps, backpack sprayers etc. To enable easier access, barriers need to be removed (sympathetically and with minimum ground works) that may hinder vehicles getting on to and around the moors.

One concern raised was the issue of how to actually extinguish fires. Understanding how fires behave varies (over different vegetation, weather conditions and topography) and takes many years of experience that can only be learnt “in the field”. As a result, suggestions were made that a resident fire fighting team could be formed (how many? where? how long?), while a dedicated team could be sent out at the onset of a fire to locate water supplies in that area.

2.2.2. How much water is required?

Dependent on fire

2.2.3.What supply rates?

- A helicopter slung `bambi` bucket can carry 80 gallons of water. On a two-minute turnaround (30 loads per hour) this can deliver 2,400 gallons to site. By doubling the distance the helicopter has to travel, you effectively halve the amount of water that can be supplied. It was noted that a 4-minute+ turnaround was too long to efficiently fight a fire. (hence the need for a network of ponds / helicopter water collection points at strategic locations near or within high risk zones)

- A light portable pump can deliver 1,000 litres per minute

- A 50mm pump can deliver a varying flow which is dependent upon the optimum pump pressure (the discharge (in litres) = 2/3 x diameter^2 (in mm) x times the square root of the pressure (in bars)).

- For every metre lift of hose an extra 0.1 bar is needed

- For every 25 metre length of 70mm hose an extra 0.2 bar is required

2.3.Workshop 3: How to supply requirements?

There are different phases of moorland fires (e.g. initial, established etc) and they need to be tackled in different ways with varying equipment. In addition, the type of vegetation will also have an impact on the fire. Therefore, we need to identify what type of fire we are providing water for:

- Small quantities to “nip fires in the bud” in the initial stages of a fire
- Large quantities to tackle established fires

2.3.1Types of Supply

2.3.1.1Permanent features

There are two types of site-based water supply that can be utilised:

- ‘Open’ sources such as ponds allow personnel and helicopters to `tap` into them immediately. However, there is the issue of legal responsibility if someone falls in and e.g. drowns. The installation of such ponds could damage the habitat, unless sited in degraded moorland. But these could be very beneficial to wildlife in the long-term as a habitat feature?
- ‘Closed’ - sources such as tanks do not suffer from evaporation and therefore will not dry up during summer, however there are aesthetic and conservation issues because the tanks will either sit on top of the peat or be dug into the peat to create an underground supply – and may not be easy to find.

Large, open and naturally replenishing ponds would enable a helicopter to plunge a bucket into them without the need of any support from other personnel at the outset. This could reduce the response time between the initial report and action being taken and this greater efficiency could therefore prevent a larger fire from establishing. Lidar data could be utilised to highlight when such ponds could be located.

For an open pond to be suitable for helicopter using a bucket, it needs to be long enough to enable water to be scooped into the bucket (e.g. at least $7m^2$) and have a depth of between1.2-2.5 metres (dependant on size of aircraft). However, buckets are now being marketed that can fill up from a supply only 30cm deep using a built in pump. These are quick to fill but as yet are not available in the UK.

In addition, there is a need for small water sources all over the high-risk moorland areas to be accessed initially to react quickly to the onset of a fire. In essence, it was thought that one way to do this could be through gully blocking. This method is already being undertaken and potential water sources already exist. Of concern was the quality of water (for use in e.g. fogging machines) and the type of material currently used for blocking is biodegradable in many areas, which would have an effect on the long-term usage:

- Plastic pilings are impermeable and therefore trap water as well as sediment
- Wood, stone, coir and heather/wool bales are permeable and therefore less water is trapped behind.

2.3.1.2.Temporary features

The use of temporary damming during times of high risk could complement the gully blocking. Using the Fire Severity Index (FSI) as a guide, tarpaulins / posts and/or sand bags (or similar) could be taken onto the moors at FRI 3 in readiness for any higher threat. At FRI 4, damming of cloughs/tributaries with good summer and therefore all year round flows (e.g. Hern Clough), could take place so additional water sources are available to fight fires. This would also have the additional benefit of further raising the water table that will help against fires starting in the first place.

Temporary ponds/tanks could also be constructed in times of high risk. Tanks could be located at key sites at the start of summer in readiness for any perceived threat. While they would detract from the landscape they would drastically increase any fire fighting effort. During times of fire, further smaller temporary dams could also be constructed. All of this needs to be planned and implemented.

2.3.2.Supplying additional water to permanent/temporary features

There will be circumstances where additional water will have to be pumped to permanent features to boost supplies, these are:

- where they cannot be filled by naturally occurring springs etc
- when the supply has been exhausted during fire-fighting

In these circumstances the water will have to be pumped from larger reserves (e.g. reservoirs, groundwater etc). This can be done either via:

- permanent pipelines (under or over ground)
- temporary hoses during fire incidents

Permanent features whether they are ponds or pipelines incur maintenance costs (e.g. de-silting, repairs from freezing, vandalism etc), and good water quality must be ensured particularly for the use with backpacks and fogging machines. As previously mentioned there is also the impact of initial installation on the fragile habitat.

Permanent pipelines also have the disadvantage of not being flexible and thorough research should be undertaken to justify their installation and possible impact. However, because they are *in situ* they can deliver a continuous supply of water immediately. Pipelines were suggested at West End, Sandy Heys and Kinder Low End.

The use of boreholes could also be utilised where the underlying geology warrants/allows it. However, the issue of drilling would need to be addressed, as heavy plant machinery is needed to undertake this work. In addition, pumps would have to be flown in where bore holes had little/no pressure.

There is therefore a need for a mobile, easily set-up pumping system for water transfer from sustainable sources. Temporary hoses offer the flexibility of getting the water to exactly where you want it, but there is a delay in replenishing permanent features through this method (Times for rolling out etc). In addition there are the logistics of retrieving these hoses after the event.

One method of reducing the time to set up a temporary system would be to have locked `tool kits` placed in strategic locations on the moors (e.g. Kinder and Bleaklow Summit) during times of high risk. These kits would be flown up by helicopter and would consist of hoses, pumps, backpack sprayers etc. Being located on site they could be moved, in a short space of time, to strategic locations when fires start.

Both Derbyshire and Greater Manchester Fire & Rescue Service have taken stock of a High Volume Pumping (HVP) Unit provided by the Office of the Deputy Prime Minister, primarily for use with future terrorist attacks to supply water during times of emergency. The HVP, which weighs 26.5 tons and is restricted to strengthened / metalled roads, delivers 8,000 litres per minute. Each machine has 3km of hose that takes approximately 30 minutes to pay out and this could be utilised to supply site-based supplies (adjacent to roads) with a continuous supply of water during fires. In addition, the hose can be manifolded to supply smaller dimension hoses that can be rolled out over the moors to more remote locations.

Because of the weight of the machine, the vehicle needs to be within 26 metres of a water source to be able to utilise it. Therefore, if this machine is to be used an assessment of the suitable reservoirs needs to be made. Where the water supply is more than 26 metres from a road, a feasibility study may be needed to identify where slip roads etc could be built.

Other methods of paying out hose were discussed. Hose slung from beneath a helicopter enables water supplies to be directed to remote locations very quickly (as used in the Grampians), but retrieval is difficult. It was suggested a method could be designed for paying out hose from an ATV.

2.3.3.Alternative methods of extinguishing fires

The most frequently used fire-fighting medium is still water. The extinguishing properties of water are based primarily on its cooling effect. Water additives have been developed that use less water more efficiently and these could be utilised for moorland fire fighting. They claim to pose no threat to the environment and because they reduce emissions of contaminants there is both a reduction in the level of contaminants in fire-fighting water and ultimately ground water.

3.Next Steps & Priorities

In conclusion, it was felt that the biggest priority was to **establish further permanent water supplies at key sites on the moors.** These priority areas were identified as the high ground between **Marsden to the north and Kinder to the south** and the pond at Snake Summit was cited as a good example of this. Therefore, the following work is needed to identify suitable sites:

Action	By whom
Complete Fire Risk Map	MFF
Establish installation costs of new ponds	FOG
Establish minimum requirements for new ponds (sizes, water quality) and maintenance costs	FOG
Highlight key areas for permanent water supply	MFF
Use hydrogeology data to locate sites where permanent features would: • be naturally replenishing (preferable) • need artificial refilling	UU
Undertake site surveys of new ponds locations	NT, EN

In addition, the following was also recognised as important work that needs to be undertaken:

- Put in place a ‘fire watch’ during times of high risk to speed up the initial reaction times and raise awareness with visitors (PDNPA & MFF)
- Public Awareness – more signage on Pennine Way (PDNPA)
- How long would it take to supply water in different scenarios (Fire Services)
- Pursue use of additives (FOG)
- Evaluate HVP and where it can be used (map) (DFRS)
- Investigate best practise elsewhere (e.g. Grampian) (FOG)
- Portable tool kits (FOG)
- Disseminating information on how to actually put out fires – best practise (FOG)
- Feasibility study of existing tanks (NT)
- Investigate the possibility of closing roads, PROWs and sensitive areas during fires (PDNPA)

As a final point, it was decided that future discussions of this issue would be conducted through the Fire Operations Group (FOG)

4.References

Charman, D (2002) Peatlands and Environmental Change, John Wiley & Sons Ltd

Sustainability North West (2005) Climate Change and the Visitor Economy in England’s North West, University of Manchester

Appendix 1 List of Figures

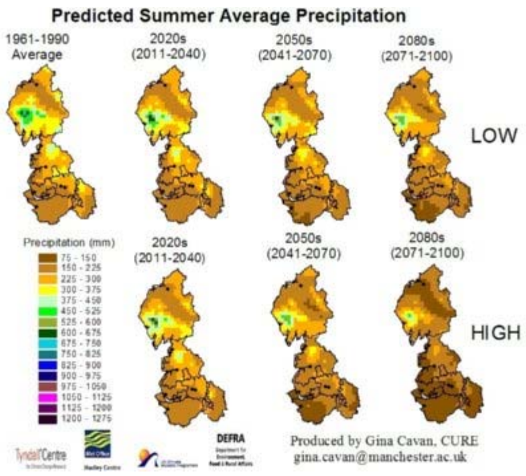

Fig 1 Predicted Average Summer Precipitation

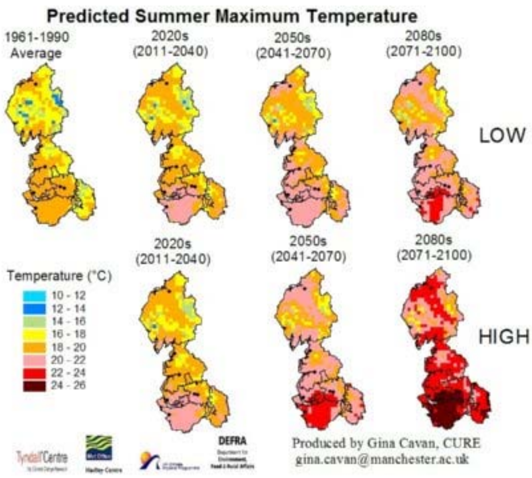

Fig 2 Predicted Summer Max Temperature

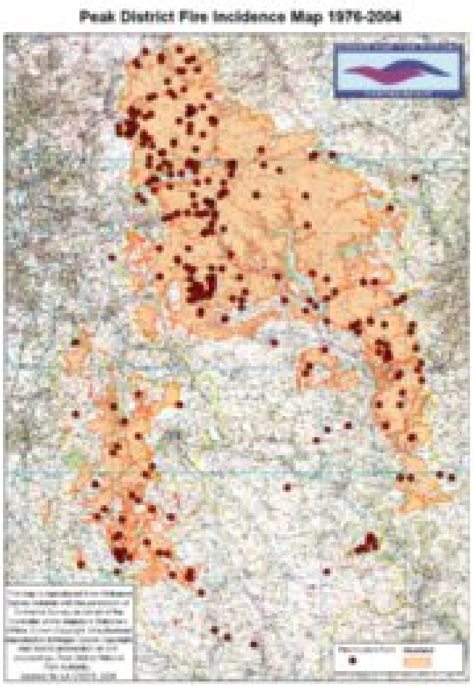

Fig 3 Peak District moorland fires 1976-2004

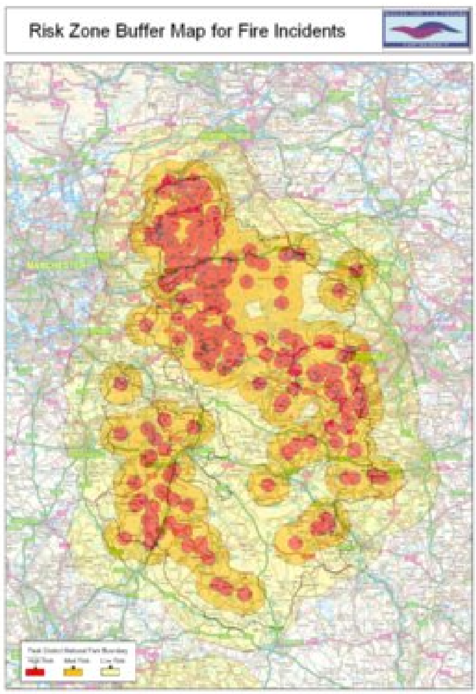

Fig 4 Fire Incidents Buffer Map

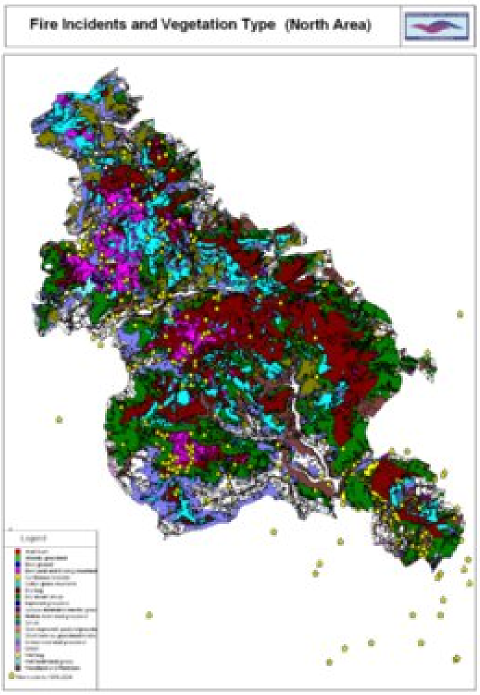

Fig 5 defra Vegetation Map and moorland fires

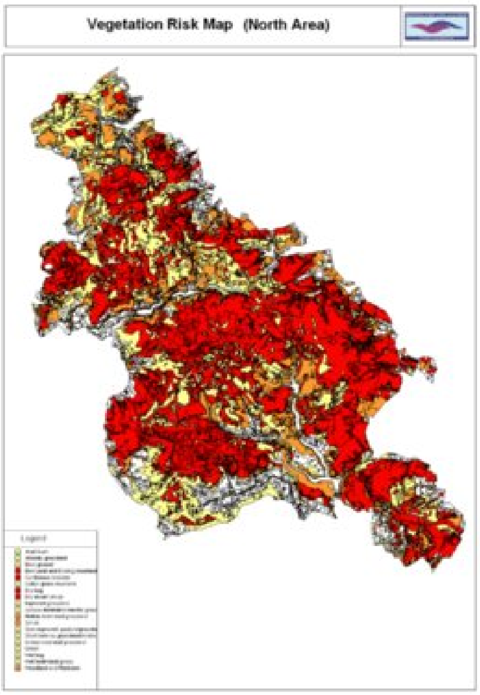

Fig 6 Vegetation Risk Map

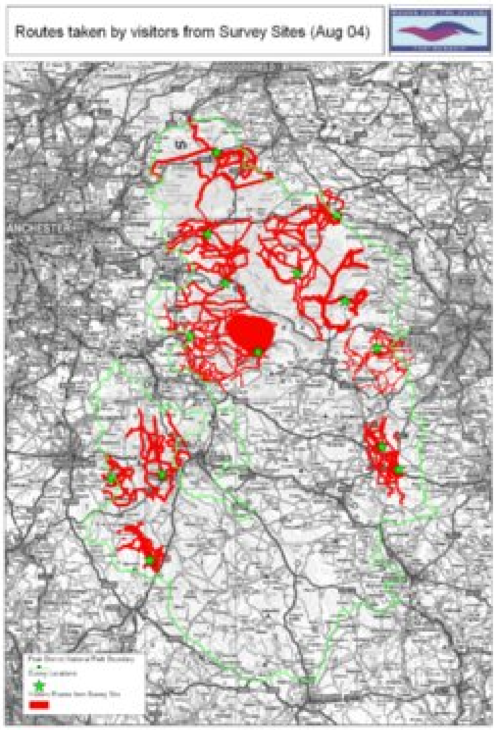

Fig 7 Visitor Routes

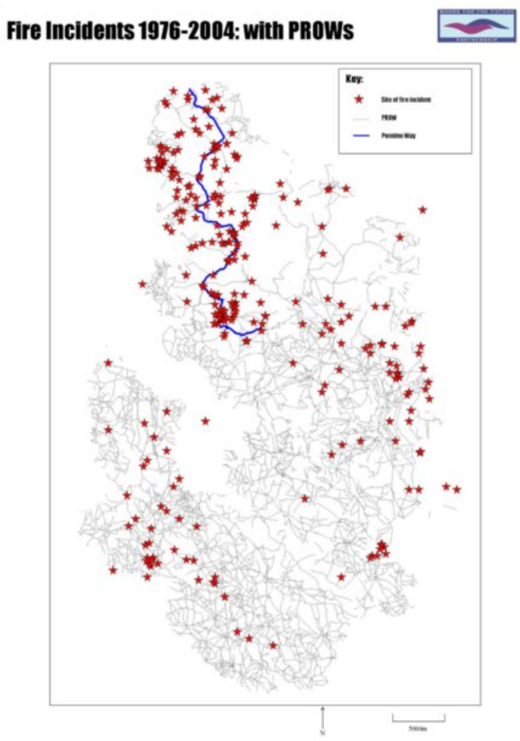

Fig 8 Fire Incidents in relation to PROWs

Fig 9 Pennine Way
Buffer Map

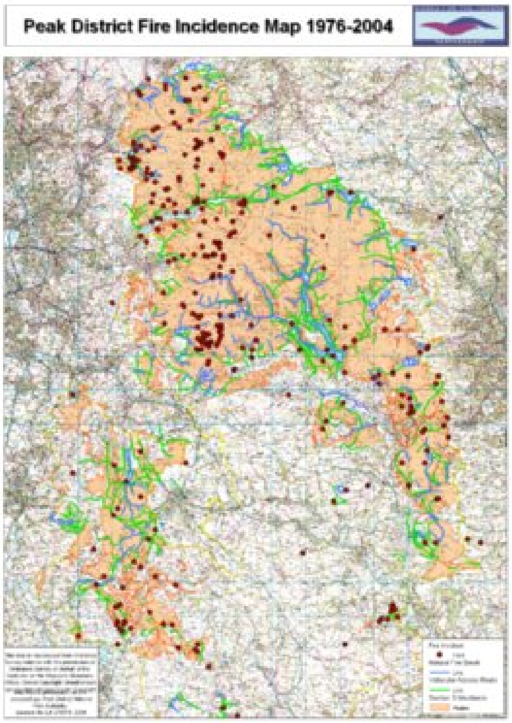

Fig 10 Fire Incidents and
Fire Breaks

Appendix 2 Participants List

Peter Arnfield	Derbyshire Fire & Rescue Service
Dan Boys	Moors for the Future
Andrew Chadwick	Moorland Keeper
Ian Copstick	Derbyshire Fire & Rescue Service
Chris Dean	Moors for the Future
Richard Drabble	Derbyshire Fire & Rescue Service
Fiona Draisey	PDNPA
Catherine Flitcroft	MFF
Gina Gavan	Manchester University
Bill Haymer	NT
Tony Hood	PDNPA
Ian Hurst	PDNPA
Sophie Milner	National Trust
Fred Mitchinson	Moorland Keeper
Richard Pollitt	English Nature
Tricia Rice	English Nature
Luke Ring	Helilift Helicopters
Stuart Ring	Helilift Helicopters
Chris Ruddy	Pennine Helicopters
Andy Shaw	National Trust
Steve Swallow	Greater Manchester Fire Service
Steve Trotter	National Trust
Simon Wright	National Trust