‘CLIMATE CHANGE AND THE VISITOR ECONOMY’

Risk workshop: Moorland Wildfires in the Peak District

28th January 2005

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1. The CCVE research project

CCVE is the pilot project for the DEFRA-funded cross-regional climate change adaptation programme. It is also part-funded by the North West Development Agenda and the Environment Agency. The focus of the research project is the threats and opportunities posed by climate change to the visitor economy of the North West region of England.

The central question to be addressed by the study is:

How can the Northwest visitor economy realise the opportunities presented by climate change, whilst ensuring that the resource base is sustained under growing visitor demand and climate related reductions in environmental capacity?

As part of the overall work programme, the research is examining the influence of climate change on the environmental capacity of key locations. There will are two scales of investigation relating to the issue of carrying capacity: regional and landscape. At the regional scale, a synoptic view of the region is exploring both physical and ecological capacity. More detailed landscape scale analysis is taking place for four case studies, with further work involving economic and perceptual capacity assessments for one of the cases studies:

- Footpath erosion in the Lake District;
- Moorland wildfires in the Peak District;
- Climate change impacts on the Sefton Dune system;
- Urban greenspace in Greater Manchester.

2. Introduction to the Peak District risk workshop

This risk workshop on *Moorland Wildfires in the Peak District* was held at Sustainability North West on the 28th January 2005. It provided an opportunity for members of the research team to engage with interested experts and stakeholders to help scope out the key issues for the study, that is, those climate-related impacts of most concern to experts and stakeholders. A total of 17 people attended the meeting, including 10 invited stakeholders. Details are shown under the 'structure of the workshop' section. The workshop was considered extremely successful and has provided an excellent input into the research process for this case study.

The Pennine moors are vulnerable to wildfires[1], especially during prolonged periods of dry weather in spring and summer. These wildfires are difficult and expensive to control; they impact on landscape and biodiversity and can result in long-term damage to the moorland ecosystem. Climate change may well exacerbate this problem and necessitate more frequent access restrictions / closures – a preventative measure at times of high fire risk. This case study, in association with Moors for the Future (MftF[2]), will seek to quantify climate change impacts and explore the feasibility and desirability of different adaptive responses.

[1] Wildfires are defined here as fires started accidentally or maliciously, or managed fires that get out of control. Operationally, they are the fires reported in the Rangers Fire Log.
[2] http://www.moorsforthefuture.org.uk/mftf/main/Home.htm

The case study

The study area considered in this work is located within the Peak District National Park (PDNP). The park itself was established in 1951 and is the oldest National Park in the UK. In its entirety, it covers an area of 1438 km^2 in the southern part of the Pennines and comprises three areas of distinctive landscape character (Figure 1): [3]:

- the White Peak (limestone plateaus with steep-sided valleys and broadleaved woodlands characterised by meadows, dry stone walls and dairy farming);
- the Dark Peak (sparsely populated, associated with extensive exposed gritstone plateaus with heather moorland and blanket bog, deep sheltered valleys and important reservoirs with coniferous woodland); and
- the South West peak (a mixed landscape of upland heather moorland with occasional gritstone ridges and valley pastures)

Figure 1: The Peak District National Park (source: Peak District National Park website)

The Peak District environment is one which is heavily managed to retain these distinct characteristics. Indeed, fire is an important component of this management regime. Nevertheless, in drier years the Peak District is threatened by wildfires, both as a result of managed fires which get out of control and those which result from natural and human-induced causes, especially the latter, which can be malicious in intent. Figure 2 shows a photograph of the extent of damage that can occur through wildfires in the area.

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[3] http://www.peakdistrict.org/

Some 354 fires have been recorded by PDNP Rangers in the Park since 1976. This is the context for the need to study the potential impacts of climate change in the Peak District.

Figure 2: The consequences of wildfires in the Peak District: the photograph shows part of the area destroyed by the Bleaklow wildfire which occurred in April 2003.[4]

Climate change impacts are likely to have a range of effects in the study area and the National Park more widely. Some of these impacts may increase the *hazard* – the likelihood of fire occurring - such as through increasing potential visitors numbers in the area. Furthermore, climate change has the potential to increase the inherent *vulnerability* of the moors to fire, for example, through desiccating soil and vegetation. Consequently, the combination of increased hazard and increased vulnerability will result in higher *fire risk* in exposed areas.

The current United Kingdom Climate Impacts Programme (UKCIP) 2002 scenarios for the 2020s, 2050s and 2080s suggest that the Peak District is likely to experience a number of important changes. The nature of these changes and their anticipated impacts can be summarised as follows:

Hotter, drier summers mean greater fire risk and hazard, due to:

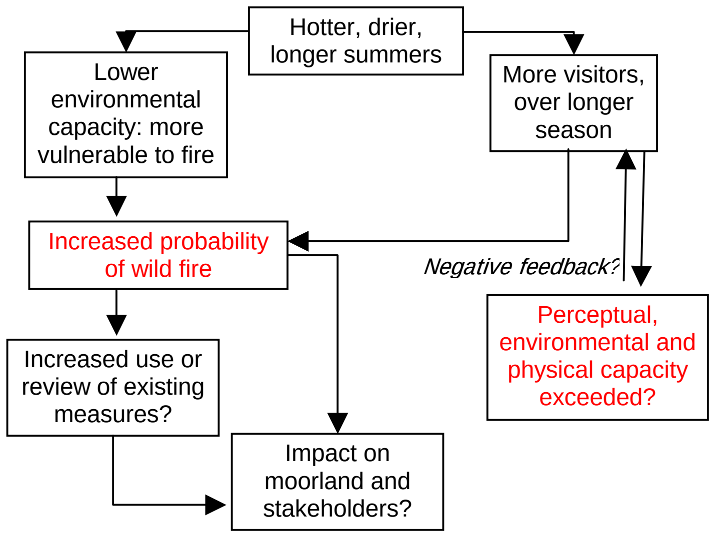
- Increased visitor numbers;
- Decreased environmental capacity to resist fire;
    - Soil and vegetation become more flammable so that fires ignite and spread more easily
    - Reduced water supply in appropriate locations on the high moorlands to extinguish fires.

This is likely to result in:

- Increased likelihood of moor closures and possible conflicts with public access;
- Greater loss of carbon to the atmosphere.

[4] http://bleaklow.com/blog/archive/000021.html)

Figure 3: Hypothesised impact of hotter, drier summers on fire risk



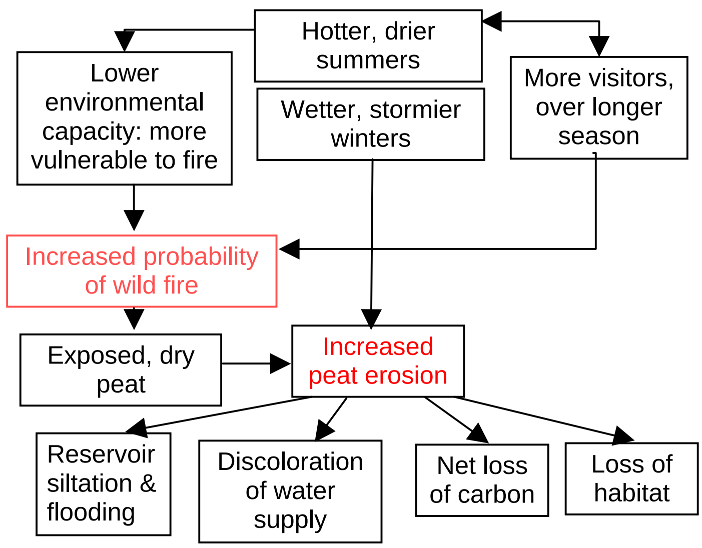
Wetter, stormier winters mean:

- Higher intensity and amount of rainfall;
- Erosion of bare peat exposed by summer fires.

This is likely to result in:

- Net loss of carbon as dissolved organic carbon and particulate carbon in steams and reservoirs;
- Associated siltation and flooding;
- Associated water discolouration;
- Loss of moorland habitat.

Figure 4: Hypothesised impact of stormier winters



The research will explore the implications of climate change for wildfire management aiming to address the main research question:

How will climate change, and anticipated changes in visitor behaviour, affect wildfire risk and its management in the Peak District National Park?

In addressing this question, the workshop also considered the following questions:

To what extent are moorland wildfires related to weather and non-climate variables?

Is it possible to develop a model to predict the probability of fire occurrence?

How will climate change affect fire risk and its management?

Structure of the workshop

The workshop took place in two stages. Firstly, there were three introductory presentations to set the scene for structured discussion:

1. Climate change scenarios for the NW region (Gina Cavan)
2. The UKCIP risk framework (Darryn McEvoy)
3. Climate change, visitors and environmental capacity: the Moorland wildfire case study (Julia McMorrow)

The second stage was an interactive session aiming to explore the issues in more depth, following the UKCIP risk management framework[5].

The attendees were as follows

	Name	**Organisation**
	Penny Anderson	Penny Anderson Associated Ltd.
	Catherine Flitcroft	Moors for the Future
	Ian Condliffe	DEFRA Rural Development Service
	Steve Trotter	National Trust
	Ian Hurst	Peak District National Park Authority
	John Malley	National Trust
	John Atkinson	National Trust
	Steve Swallow	Greater Manchester Fire Service
	Simon Hopes	Greater Manchester Fire Service
	Richard Fox	Lake District National Park Authority
	John Handley	University of Manchester (research team)
	Darryn McEvoy	University of Manchester (research team)
	Gina Cavan	University of Manchester (research team)
	Julia McMorrow	University of Manchester (research team)
	Jonathan Aylen	University of Manchester (research team)
	Kevin Albertson	University of Manchester (research team)
	Sarah Lindley	University of Manchester (research team)
	Steven Glynn	Sustainability North West

[5] http://www.ukcip.org.uk/resources/publications/pub_dets.asp?ID=4

Climate change scenarios for the Northwest region

The predicted climate changes for the Peak District National Park under UKCIP scenarios are summarised in Table 1. Of the four UKCIP emissions scenarios, the high (H) and low (L) scenarios are chosen to reflect the uncertainties about future greenhouse gas emissions and to account for fullest range of change. Predictions are made for the 2020s, 2050s and 2080s. There is little difference between 2020s high and low scenarios, as the emissions levels have largely been determined by the 50 years of emissions already in the system since the 1950s. Slow-down of Gulf Stream activity is accounted for in the models.

Table 1: Predicted climate change for the PDNP under UKCIP high and low emission scenarios

Variable	**1961-1990 average**	**2020s**	**2080s**	**Max change**
Average summer maximum temperature (ºC)	17.5	19.0 (L and H)	20.5 (L) 23.0 (H)	5.5 warmer
Winter minimum temperature (ºC)	0	1.0 (L and H)	1.8 (L) 3.3 (H)	3.3 warmer
Average summer rainfall (mm)	246	-9% (L) -11% (H)	-23% (L) -45% (H)	45% drier
Average winter rainfall (mm)	315	5% (L) 6% (H)	12% (L) 23% (H)	23% wetter

- Hot summers, such as that of 1976, would become the norm, even under the low emissions scenario. The probability of temperatures over 31 ºC will rise from 1% to 11%, equivalent to a rise from 1 to 11 days per summer under the 2080 medium-high emissions scenario. There is a predicted 1% chance that the temperature will reach 39°C, equivalent to 1 day per summer by the 2080s under the medium-high scenario.
- Greater contrast in seasonal distribution of rainfall: greater contrast between summer and winter precipitation.
- Increased probability of intense rainfall events in winter, reduced probability in summer.
- Significant reduction in snowfall – between 50 and 90% reduction by the 2080s.

3. Workshop Session

Facilitators: Julia McMorrow and Sarah Lindley
Rapporteur: Steven Glynn

The third presentation had introduced the main problems associated with the Peak District case study. Stage 1 of the decision-making framework continued this discussion. A number of specific questions were posed under Stages 1 to 5 of the UKCIP risk assessment framework, which helped to structure the discussion that followed. All questions were circulated prior to the workshop and attendees were invited to continue to submit any additional information and ideas in the weeks following the main workshop event.

Stage 1: Identify problems and objectives

Specific questions posed

- How important is climate change to fire risk and its management?
- What are the main drivers behind current fire risk management in the PDNP?
- What are the consequences of increased fire risk?
- What would suffer (habitats, access, economy, etc.)?
- Which stakeholders would suffer?
- Would there be any benefits?
- Are there other climate or non-climate variables affecting fire risk which should be included?
- Are there any variables we could omit?

Structured Workshop responses

Policy drivers, key stakeholders and consequences

- The driver of current fire risk management is the need to minimise moorland fires for the numerous stakeholders.
- Groups experiencing direct and indirect impacts and, therefore, with vested interests in this area include:
    - The National Trust, as landowners and managers;
    - Water companies; in particular Severn Trent (Derwent), United Utilities, Yorkshire Water. These represent some of the biggest landowners in the area.
    - Farmers and other landowners; this includes a range of stakeholders whose interests may sometimes be in conflict; such as sheep grazing and grouse moor management. The Moorland Association and the Peak Park Moorland Owners & Tenants Association are two organisations representing some of these interests.
    - The general public, for recreational uses.
    - Local residents, local accommodation providers, outdoor centres, shops, local education authorities.
    - Forestry Commission – also landowners.

- National Society for the Protection of Birds and other specific wildlife groups.
- English Nature, for example, relating to the Sites of Special Scientific Interest (SSSIs) in the area and local Biodiversity Action Plans.
- The Countryside Agency.
- The Peak District National Park Authority.
- Fire Managers, including the Greater Manchester Fire Service (GMFS), Derbyshire and other regional Fire Services.
- There is also a range of public safety issues to consider which may involve other groups. For example, past moorland fires have necessitated the closure of the M62 and the rerouting of flights to Manchester Airport for short periods at considerable cost. The list of stakeholders must therefore also include transport authorities and Manchester Airport.

Conceptualising fire risk: perceived importance of climate change and its consequences

- The information given in the presentation outlined the extent of the anticipated problem and demonstrated some of the likely impacts.
- The group confirmed a high level of concern about the likely consequences of the climate change scenarios on fire risk. Their concerns were associated with the likely increased costs of management, the likelihood of increasing damage, other associated impacts on environmental resources, and the impacts on the current users of the moors.
- The issue of climate change had been raised at meetings of the Fire Advisory Panel (FAP) and Fire Operations Group (FOG) but there has, so far, been little discussion.
- The implementation of strategic management is helping to reduce the problem over time. The number of large fires had reduced up to 1998[6], which may be due to weather trends or better fire management.
- The overall number of fires is less important than the nature of fires; their intensity/heat, size and damage. Hot, deep fires which burn the peat substrate cause too much damage. This back burning creates bare ground scars that are believed to have persisted for over a hundred years. It destroys plant roots, encourages peat erosion by preventing re-growth, and makes restoration difficult. The intensity of the fire cannot be estimated from the Rangers fire log; some entries give duration of the fire, but this information is sparse. It would be interesting to see if duration of fire related to wind speed or direction.
- Fire characteristics alter with the time of year: late February to Easter tend to be associated with surface burns and the late summer period with more intensive (hot), extensive and longer-lasting events, which burn the underlying peat. Such fires can remain undetected and are more difficult to extinguish than surface fires. The type of fire is also related to seasonal variations in the degree of visitor pressure. Changes to seasonality of the climate will, therefore, change the fire risk.

6 Anderson, P.A., Tallis, J.H. and Yalden, D.W. (1997) Restoring Moorlands: The Moorland Management Project Phase 3 Report, Bakewell: Peak Park Joint Planning Board, 153pp.

- The area of some fires is recorded in the Rangers fire log. If the number of fires with area data is sufficient, it may be possible to investigate the relationship between size of fire and weather variables, or size of fire and MORECS[7] values.
- The impacts of fires can be both direct and indirect. Direct impacts include smoke nuisance and pollution, road closures for public safety and also due to the presence of fire engine units themselves. Indirect effects include peat erosion from persistent fire scars.
- Although the study area itself is sparsely populated and few properties are directly threatened by fire at present, the views of local communities (and associated tenants associations) can also be important especially since areas towards the southern part of the area may become increasingly affected in the future. The impact of smoke from fires impacts much wider areas and more heavily populated zones.
- A 'do nothing' response was deemed not appropriate and there is a need to develop additional measures for fire risk management in order to respond to climate change impacts. This is explored further in Stages 4 and 5.

Potential benefits

- The group felt that there were few, if any, benefits. Climate change was likely to increase fire risk, and any increase in moorland wildfire frequency or severity would bring no obvious benefits.
- However, whilst wind is normally a problem in spreading fires, it could tend to result in less intensive firing at a single location, which, ultimately, may cause less long-term damage.

Climate drivers and thresholds

- The group confirmed that climate changes variable used by the UKCIP scenarios (identified in the climate change scenario presentation) were of relevance to fire risk.
- Wind was highlighted as a particular problem, leading to large events and by contributing to the number of managed fires that get out of control. It does not require strong winds to spread fire; even a relatively gentle wind can fan a fire. It was noted that wind is a difficult variable to predict with current climate models.
- Lag periods, or the period of preceding rainfall deficit and high temperatures, are important. However, so are relatively rapid changes in MORECS, such as over a 3-4 day period as in April 2003.
- It is the occurrence of a re-wetting event that is important in reducing fire risk. The amount and nature of rainfall needed to re-wet the peat is an important control on the probability of fire occurrence. Low intensity rainfall over a prolonged period, which gives the peat a good drenching, is likely to be more important than short high intensity rainfall. Intense short showers (c30 minutes) may result in more runoff and less infiltration especially following an extended dry period. Ideal rainfall is less intense and for a longer duration (c24 hours).

[7] MORECS Met. Office Rainfall and Evaporation Calculation System, http://www.meto.gov.uk/environment/morecs.html

This is an important consideration for rainfall thresholds used in modelling fire risk from climate variables.

- Reduction in mean annual rainfall means that peat bogs will be under threat, since over 1 metre of rain per annum is required to maintain them.

Other (non-climate) factors affecting fire risk and their consequences

- The problems are likely to be different in different parts of the moor, varying with land cover.
- The feedback between fire risk and vegetation is important. A question was raised about whether the existence of a fire in the past is likely to make an area more or less susceptible to future fire. The frequency of fire in the same location could be investigated by studying the location of reported fires from the point data in the Rangers fire log and mapping of fire scars, available from MftF (mapping from aerial photography and GPS of recent fires such as the April 2003 fire at Bleaklow).
- Blanket peat and cotton grass areas are most severely affected by fire because they are least likely to be able to recover. Bilberry, heather and crowberry are generally more able to recover. Heather on podsol also tends to recover. The persistence of fire scars over time could be studied from a time series of aerial photographs to see the extent to which they re-vegetate and with which communities.
- Damage is particularly marked where fires can establish underground, sometimes burning the peat itself. Completely bare peat rarely catches fire; it needs adjacent vegetation to ignite, but as little as a 10% vegetation cover can still lead to peat burning (however, it was also argued that bare peat, particularly very dry/dusty peat will ignite, particularly from cigarette ends being discarded).
- Peat quality can affect fire risk and be affected by it (*e.g.* formation of a burned crust)
- Any climate-induced or legislation-induced changes in land-uses will be influential.
- The feedback between climate change and vegetation is also important. Climate change is likely to influence the distribution of species in the future, which, in turn, has an effect of overall fire risk, as plant communities vary in their susceptibility to fire. For example, intact cotton grass bog is likely to generate less intensive fires due to the lack of woody growth. However, climate change is likely to reduce cotton grass in favour of dwarf shrub communities which have a higher biomass and, therefore, are potentially more flammable. Mixed non-heather dwarf shrub areas (bilberry and, especially, crowberry) are more flammable and are also more likely to generate hotter fires. This, in turn, can lead to more damage - more vegetation loss, the creation of areas of bare ground followed associated erosion.
- It is important to recognise that fire is natural part of the moorland semi-natural ecosystem. Burning remains an important management tool. Fires may affect magnetic susceptibility, so that the history of burning is recorded in a peat core (a current Moors for the Future project by Dan Yallop is looking into this the relationship between peat structure and historical fire).

- Controlled burns can legally take place from 1st October to 15th April, with most activity in February and March, due to the greater likelihood of wet ground and dry vegetation, which is considered optimal for managed fires. There is some pressure from nature conservationists to shorten this period to 1st March to limit disturbance to nesting birds. Less burning is also thought to result in improvements in water quality, which may be required through the Water Framework Directive. There is currently no pressure make the autumn start date earlier.
- Any increase in the amount of woody biomass will generate more material to burn. However, an increase in *managed* heather moor would reduce fire risk, as management is geared to reducing *wildfire* risk in order to maintain a mosaic of different-aged heather for grouse.
- Partnership approaches can reduce fire risk. There had been a reduction in large fires on Dartmoor since the establishment of a farmers' group to make decisions about grass moor burning.
- There are some important economic drivers of land use change, which could impact on fire risk, including the changes to the Common Agricultural Policy. A reduction in grazing, through agricultural policy or climate change would lead to increased biomass and reduction of *Nardus* grass.
- Changes in nitrogen pollution may also be an issue through its influence on species composition and rate of growth. Other air quality-related issues include the current *Sphagnum* moss recovery in the Longdendale area (a new Moors for the Future project will investigate current sphagnum moss extent).
- English Nature and MftF gully-blocking programme[8] is attempting to reduce erosion. The aim is to re-vegetate areas of bare peat by blocking gullies, which raises the water table, encourages deposition of suspended sediment in the run-off and allows plants like cotton grass to invade.
- Speed of response of the Fire Service is a non-climate factor in the risk of fires spreading, especially since the Fire Service doesn't consider moorland in its costed risk assessments. The Greater Manchester Fire Service representatives at the workshop expressed concern at the budget implication of fighting more moorland fires. It will put additional pressure on the service, and they may have to start costing this in.
- Changes to visitor numbers, patterns and uses are covered in detail below.

Types of visits and the effects of visitors

- The Peak District is recognised as the most visited in the UK, with peak visitor usage occurring from late February through to Easter (especially Easter) and then peaking in May (though usage is very much linked to good weather and therefore fluctuates). In the Lake District, visitors peak in May; in the summer, holidays are taken further afield.
- The majority of visits are short (day) visits.
- They tend to be influenced by day-to-day weather conditions; nice weather on a particular day or a good weather forecast.

[8] http://www.moorsforthefuture.org.uk/mftf/research/Landscape.htm

- Hot weather does not automatically mean an increase in visitors to the moors. ST (NT High Peak Estate) felt that the summer of 2003 was so hot that people tended to go to the coast instead.
- Visitors may come from a wider area when there is a longer-term good weather forecast and may stay for longer, for example through more camping. What is the influence of campsite location on fire distribution?
- Peak fire times are observed when visitor numbers (and numbers of children) are high and the conditions are dry. Anecdotal evidence suggests that the wetter summer of 2002 was associated with fewer fires, due to both less suitable conditions (lower vulnerability) and also fewer visitors.
- Visitors are a major fire source, particularly walkers leaving litter and cigarette butts. Some people suggested the act of stubbing out cigarettes into the ground cause fires. The Greater Manchester Fire Service (GMFS) felt that there usually needed to be a specific source of ignition and that cigarette ends in themselves would not be enough, though this was a matter of disagreement as others felt that cigarettes could be the source of ignition.
- Members of the FAP and FOG reported that there is a strong relationship which is clearly evidenced between well used moorland routes (e.g. Pennine Way and other access/egress routes from the high moorland areas) and increased likelihood of fire, especially small fires.
- JA noted that, preliminary analysis showed no statistically significant relationship between school holidays and numbers of fires. But the GMFS reported that most of the grassland fires at the edge of moor are in the school holidays and during fine weather.
- A number of fires are the result of deliberate arson. Indeed, in the Yorkshire Dales National Park, fire risk signs were actually removed since this was believed to be encouraging fire setting. There is also anecdotal evidence of that occurring in the Peak District. This poses a dilemma when raising awareness to users etc.

Stage 2: Establish decision making criteria

Specific questions posed

- What criteria are used to judge the success of fire risk management measures? *e.g.* number of fires per year, area burnt, duration of fire, cost incurred, and public acceptability?
- Are there any current or forthcoming legislative requirements?
- What data are available to help make decisions?
- How do decisions impact on other stakeholders?
  - Could decisions constrain other groups’ ability to respond to climate change problems?
  - Could decisions make it easier for other groups to take advantage of climate change opportunities?

Structured Workshop responses

Criteria for successful management

- Ultimately, the success of fire risk management can be measured through a reduction in the number of fires.
- Other criteria include:
    - Reductions in the time taken to extinguish a fire
    - Reductions of the physical extent of the area burnt.
    - Reductions in the number of complaints about smoke problems
    - Reductions of road closures.
- No criteria related to public perception were identified. Some management strategies such as closure of the moors are perceived by the public to be less acceptable than the visual appearance of burnt land itself, but this has not been a criterion for judging successful management.

Links to legislation

- A number of legislative links were mentioned such as the Water Framework Directive and a range of legislative measures in relation to the protection of biodiversity, including the Habitats Directive.
- The Countryside and Rights of Way (CROW) Act[9] may be a negative influence on fire risk, since this encourages further access by the general public and there are new areas open to the public. The contrary view is that more people are available to spot fires early before they get out of control.
    - The Habitats Directive[10] requires that blanket bog in SSSIs is brought into 'favourable condition' with a higher water table, so this legislation should serve to reduce fire risk.
- Moorland areas are currently exempt from fire and workplace safety legislation, there is no a legal requirement to extinguish moorland fires, but reform of the legislation is due next year.

Data available to make decisions: MORECS and its replacement

- Until September 2004, MORECS was used to determine fire risk for the PDNP. The index is a measure of soil moisture deficit. MORECS used four levels of fire risk (zero, low, medium, high and extreme). It is calculated for 40 km grid squares and based on a single meteorological station in each square. Members of the FAP felt that there was a good match between fire occurrence and MORECS index. The data are available in digital form from the supplier (Met. Office).
- MORECS has now been withdrawn, because open access rights under the CROW Act will require a nationally available Fire Risk Index (originally to be called MOSES). The Fire Risk Index will be produced by the Met Office, centrally managed by the Countryside Agency (CA) and made available to mangers and the public via CA website.

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[9] http://cms.countrysideaccess.gov.uk/places_to_go/open_access/ and http://www.hmso.gov.uk/acts/acts2000/20000037.htm

[10] http://www.jncc.gov.uk/page-1374

- When the index indicates exceptional conditions, the process of access restrictions begins and can culminate in a Fire Prevention Direction. The specific thresholds for exceptional conditions are not yet known.

Current reporting of fires – influence on datasets

- When the public or a ranger reports a fire, the priority is to put it out as quickly as possible. Once this is done, the fire will be mapped and a Fire Report is completed by the Rangers, (Appendix 1). These datasheets, and earlier forms of paper records, have been used by Dan Boys of MftF to compile the Rangers Fire Log database, being used in the CCVE project.
- Although the public may report managed fires, only accidental fires or those that get out of control are included in the Rangers Fire Log.
- The logging of these events by Rangers has changed over time, but has been standardised for the last 2-3 years. For instance, prior to this, the grid references recorded may be the location where the fire started or the point from which the fire damage was observed by the Ranger.
- The actual size of fire can be difficult to obtain, but, like all the Rangers Fire Log data, this is much more reliable for the last 2-3 years.
- Organisations are likely to carrying out their recording in different ways which makes comparison difficult. For instance, GMFS also has records (digital and paper) of the fires that they have attended, which may include fires not in the Rangers Fire Log. The GMFS process is to create an incident record when a call is received. This may be a useful back up source of information for fire duration and extent, but not all fires in the Rangers Fire Log database will have been attended by GMFS. Some will be outside their area and will have been attended by the Derbyshire or another Fire Service, who may have a different recording system. Equally, double counting between the two databases could be a problem, since it may be difficult to match the locations and time of the same fire in the two databases.
- The GMFS reports also note the cause of the fire and its start (first call) and end (tenders leave). Multiple calls to one event are given the same report reference so this minimises potential double counting. JA asked whether there might be better reporting on the urban fringe due to more people being likely to see and then report fires in these areas. This would need to be looked at to ascertain whether there was any bias but the GMFS considered that there were few fires which were not eventually reported.
- Most of the moorland fires attended by GMFS are at the edge of the moors on grassland, as this is the main moorland habitat within their area and this is where the public have easiest access.
  - The relationship between actual fire events is not currently well known – are multiple fires the result of arson or embers? The widely scattered seven fires on one day in April 2004 perhaps suggest that this is unlikely to be associated with arson.

Visitor data

- MftF surveyed 14 exit/entry points to the PDNP in August and November 2004 and have numbers of visitors at each. There are also interviews associated with these surveys covering where people have visited and why.

- PA also carried out similar surveys in the past and various reports are available, such as Recreation in the Peak District (1996), which is based on a survey by Rangers of all people that could be seen on and off paths on Access Land. The report is available from MftF and includes some predictive modelling of levels of use.
- The MftF visitor surveys in 2004 could be compared to weather records to investigate any statistical relationship between visitor numbers and weather.
- The Countryside Agency is also trying to predict patterns of visitor use and the relationship between weather, attractions and numbers.
  - The question was raised about whether the closures of moorland due to Foot and Mouth Disease (FMD) had been recorded. If so, it may be possible to see whether restricting visitors to paths, as in moor closure due to fire risk, had influenced the number of fires, regardless weather. It was felt that this information would be available through Local Authorities (Jill Millward, Derbyshire Trading Standards was suggested as a contact for this). However, it may not be that helpful because 2001 was a wet summer.

Stage 3: Assess risk

Specific questions posed

- What administrative structures exist to manage fire risk? How does decision-making work in each?
  - Difference between roles and membership of FAP and FOG?
  - Which decides if moors need to be closed?
  - Do all members have to agree when action is needed and what it should be?
  - To what extent are they representative of stakeholders?
- What technical tools are currently used to assess fire risk? e.g. MORECS, MOSES
  - What are the thresholds that trigger moor closure or other management options?
  - How do these tools perform?
  - How well will they cope with climate change?
- What other tools would you like to see developed?
  - What variables would you like us to be able to predict?

Structured Workshop responses

Administrative structures for managing fire risk

- Management of fire risk includes shorter and longer-term *strategic* (preventative) action, such as moor closure, installation of fire ponds or re-vegetation to raise the water table. This role is largely covered by the Fire Advisory Panel (FAP)[11]
  - FAP has operated since 1992/93 as a forum of stakeholders who advise on fire-related issues, such as moor closure. Its role is strategic prediction and

[11] http://www.moorsforthefuture.org.uk/mftf/downloads/FAP%20&%20FOG%20objectives.doc

management mechanisms for dealing with fire risk. It has not yet *specifically* considered the implications of climate change on future management.

- Management of fire risk also includes *tactical*, practical response in fire fighting, such as deployment of fire-fighting equipment (fire tender, helicopter, *etc*.). This is co-ordinated by the Peak District Fire Operations Group (FOG), set up five years ago with membership which includes the local Fire Services. FOG has established operational Fire Plans and a spatial database (FireGIS) to help to ensure that appropriate equipment is available and its locations are known.
  - FAP and FOG grew from the first research report on moorland fires in 1986, undertaken by PA for the PDNP. FAP and FOG represent a strategic and partnership view of fire risk management, which is reflected in the existence of Fire Plans exist for each area.
  - Historically, these initiatives allowed the burden of a closure decision to be shared and, therefore, represented an important partnership between interested parties. It also facilitated the development of complementary and compatible training, purchasing and mapping of resources (such as water sources, access points, *etc*, in the FireGIS spatial database).
  - In the light of the new access legislation changes (CROW Act), the FAP is now being disbanded while the FOG is being reviewed and may undergo some structural change.

Technical tools and their performance

- The FireGIS spatial database was designed to guide fire fighters. It is widely distributed and contains information in MapInfo format on access points, water sources, contact persons, etc.
- The move from MORECS to MOSES, and now the Fire Risk Index, essentially means a change from a local driven to an external automated system. The new index will use 10 grid squares (regardless of diversity within them, but an improvement over the 40 km squares for MORECS). It is based on:
  - Rainfall (24 hour total) measured at noon
  - Temperature at noon, degrees Celsius
  - Wind speed at noon, kilometres per hour
  - Relative humidity at noon, percent
- There has been some debate about the nature of thresholds associated with the new index. The specifics of the thresholds themselves and the process for their generation are currently not clear. The new thresholds will act as a national decision-making process for moor closure. There is no mechanism for local knowledge of the real fire risk within the 10 km areas, unlike the old FAP systems where MORECS thresholds triggered a series of local decisions (See Appendix).
- Further information about the new system should be available through the Countryside Agency, Landscape, Access and Recreation Department. Guidance notes for the Fire Risk Index are available online[12]

[12] Countryside Agency, administering access. http://www.openaccess.gov.uk/wps/portal/!ut/p/_s.7_0_A/7_0_J6/.cmd/acd/.ar/sa.link/.c/6_2_PG/.ce/7_2_12V/.p/5_2_MC?PC_7_2_12V_linkto=chapter24.jsp

Stages 4 & 5: Identify and appraise options

Specific questions posed

- What management options do you use to manage fire risk?
  - Moor closure, helicopters, bowsers, pools, reseeding, *etc*.
- Which are most robust to climate change?
  - Are there any 'no regret' or 'low regret' options?
- How successful are they against your criteria?
- Do they result in any conflicts?
- How do you think climate change might affect these strategies?
  - Are any new ones being considered?

Structured Workshop responses

Current fire management options and strategies

- There are two elements of fire management: managing the fire risk and managing the direct and indirect consequences of fire itself. These require different strategies.
- Managing the fire risk, or fire prevention, involves reducing the likelihood of fire hazard, coupled with reducing the vulnerability of the moorland environment.
- Fire management undergoes three phases of decision-making.
  - Firstly, prevention (awareness raising)
  - Secondly, preparation (ensuring that there is accessible, suitable fire-fighting equipment, staff training and equipment maintenance). Part of this involves developing fire plans.
  - The final stage is reacting to fires when they happen; this is where fire officers themselves are involved. A flow chart based on the MORECS system was provided to illustrate this management process, flagging up actions to take at certain points (see Appendix). This has been replaced by the Fire risk Index guidelines.
- The closure of the moors is a big political decision, since it affects landowners and restricts access to public rights of way. Moor closure does not mean that the public are totally excluded; footpaths remain (open access to public rights of way (PRoW) are not restricted, however access to moorland can be restricted).

- The last moorland closure due to fire risk was 1995/6 (more specific data available from Peak District National Park Authority). Again, it is important to note that this covered access to open moor and not the footpaths themselves.
- It is felt that closure of moors may actually be counter-productive since there are then fewer people to spot fires and report them, so increasing the risk of fire spreading.
- Public awareness events include the Fire Awareness Fortnight. There is also general fire awareness raising that takes place in schools, although there is some concern that this may actually provide information for potential arsonists.

- Various fire-fighting mechanisms are used such as helicopters but these are very expensive. The landowners must cover this expense at the moment. Estimated costs of helicopters used by United Utilities during the 1997/8 Bleaklow fire were £70k.
- A risk sharing strategy is used by insuring against fire fighting costs, but this is expensive. For example, the National Trust has £5,000 - £10,000 worth of insurance cover for their High Peak Estate alone.
- There is currently lobbying of DEFRA for additional funding to help with management costs, such as helicopters.

New measures

  - It was agreed that additional measures would be needed and that the 'Do nothing' option was not viable.
  - It was noted that some of the problems are likely become similar to those currently experienced in southern Europe and there may be useful information that can be obtained on strategies for adapting current PDNP management strategies in the light of this experience.
  - Long-term measures such as gully-blocking could be seen as ways to reduce fire risk and as preventative measures against other negative effects of climate change *(e.g.* restricting humification by maintaining a wet surface, which reduces loss of carbon to the atmosphere and release of tannins and other humic acids into the water supply). There are MftF on-going research projects investigating gully blocking and it is not yet clear how effective this is as a management technique. There was also concern about robustness of gully-blocking to climate-change; would there be sufficient rainfall of 1000-2000mm per annum to sustain blanket peat bog?
  - Smoking bans on Access Land could be considered, and would be in line with current developments in public health legislation. Other management suggestions were the use of cigarette bags to prevent butts been disposed of in inappropriate ways.
  - Public awareness raising through signing, leafleting and posters is a 'No regret' option. The current Fire Awareness Fortnight framework could be extended, included work in schools and talks in car parks. It would need to be carefully managed to prevent a potential negative impact in view of the perceived arson problems.
  - Another 'no-regret' option is raising government awareness and lobbying for central funding (for instance, for helicopters costs).
  - Recycling water may be a preventative measure in extreme risk areas, as would preventative wetting dry vegetation.
  - Fire plans would need to be more climate-sensitive
  - New water storage possibilities, such as ponding need to be investigated and the funds obtained to create and manage these and other fire-fighting resources (for example through DEFRA). GIS can help in deciding locations for new ponds.
- Closure is a very big issue, as has been highlighted earlier. It is also not clear how effective closure is for preventing fires. In fact, moorland closure could actually be considered illegal. There is also the issue that PRoW cannot be closed, and although the moorlands may be closed, most fires are started near to PRoW and other popular

routes. There is also the argument that allowing public access can help to spot fires and therefore report them more quickly.

Conflicts with other users

- Creation of ponds (DEFRA-funded), pipelines and firebreaks could all be considered but some of these are likely to create conflict with other bodies such as nature conservation organisations (they would not be allowed on SSSIs). Recreation users would also find them visually intrusive.
- Firebreaks can only be cut on heather moor, as they conflict with landscape quality and nature conservation.
- The major conflict is between landowners who want to close the moors at times of high fire risk, and the needs of public open access.
- There is conflict between road users and the Fire Service when roads are blocked to attend a fire. Also between local authorities and road users, when a road is closed for safety (smoke or fire making driving dangerous). The local economy suffers when roads are closed.

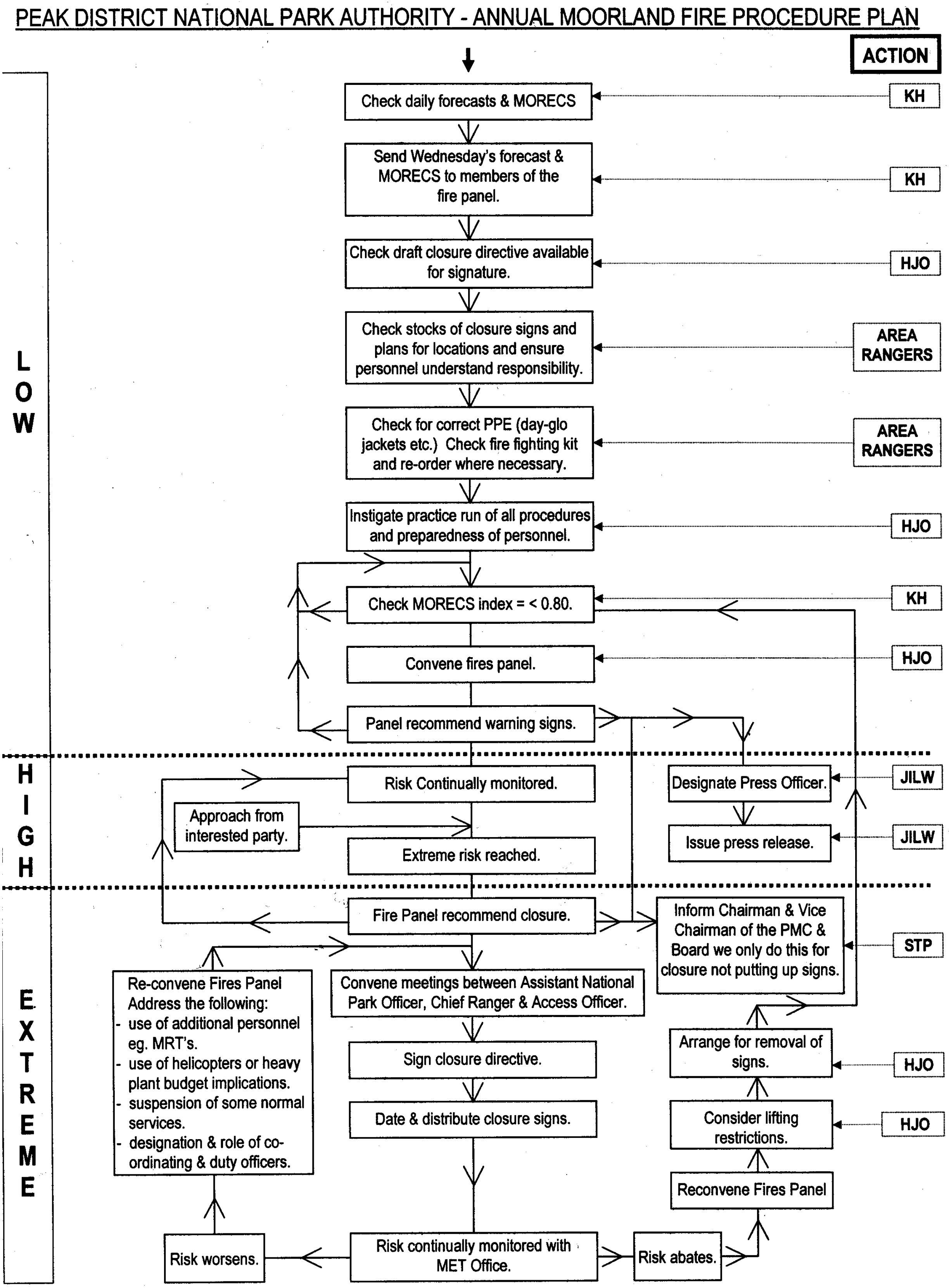
4. Other reports

Risk workshop reports (January 2005) are also available for:

- Footpath erosion in the Lake District; and
- The integrity of the Sefton coastal dune system.

5. Appendix: Fire Management procedure documentation

Former fire procedure under MORECS system



Current fire report form

FIRE REPORT

DATE REPORTED: ____________________ TIME REPORTED: ____________________

LOCATION: ____________________ GRID REF: ____________________

LANDOWNER: ____________________ ACCESS ROUTE: ____________________

SITE CONTROLLER: ____________________ RADIO CALL SIGN: ____________________

RENDEZVOUS POINT: ____________________ NEAREST ROAD HEAD: ____________________

NEAREST WATER SUPPLY: ____________________ SIZE OF FIRE FRONT (Yds): ____________________

MOORLAND INFORMATION:

SURFACE VEGETATION: [DEAD] [DRY] [GREEN] VEGETATION: [HEATHER] [GRASS] [WOODLAND]

SURFACE PEAT: [DRY] [DAMP] [WET] DEPTH OF MOISTURE: [0.5”] [1.0”] [1.5”] [2.0”]

PROTECTED STATUS: [E S A] [S S S I] [S P A] [S A M] ARE FIRE WARNING/CLOSURE SIGNS UP: [YES] [NO]

ACTION TO BE TAKEN:

POSSIBLE CAUSE OF FIRE: ____________________

CLOSE OF INCIDENT

DATE CLOSED: ____________________ TIME CLOSED: ____________________

TOTAL EXTENT (Sq Yds): ____________________ SIGNED: ____________________

Fire report form (continued)

PERSONS ATTENDING - RANGERS / ESTATE WARDENS:

1.	11.
2.	12.
3.	13.
4.	14.
5.	15.
6.	16.
7.	17.
8.	18.
9.	19.
10.	20.

FIRE STATIONS IN ATTENDANCE:

1.	4.
2.	5.
3.	6.

WAS A HELICOPTER USED?: YES NO

DE-BRIEF NOTE / RECOMMENDATIONS / ACCOUNT OF INCIDENT