ENGLISH NATURE

Impact, use and control of fire

A joint workshop organised by
English Nature and The National Trust

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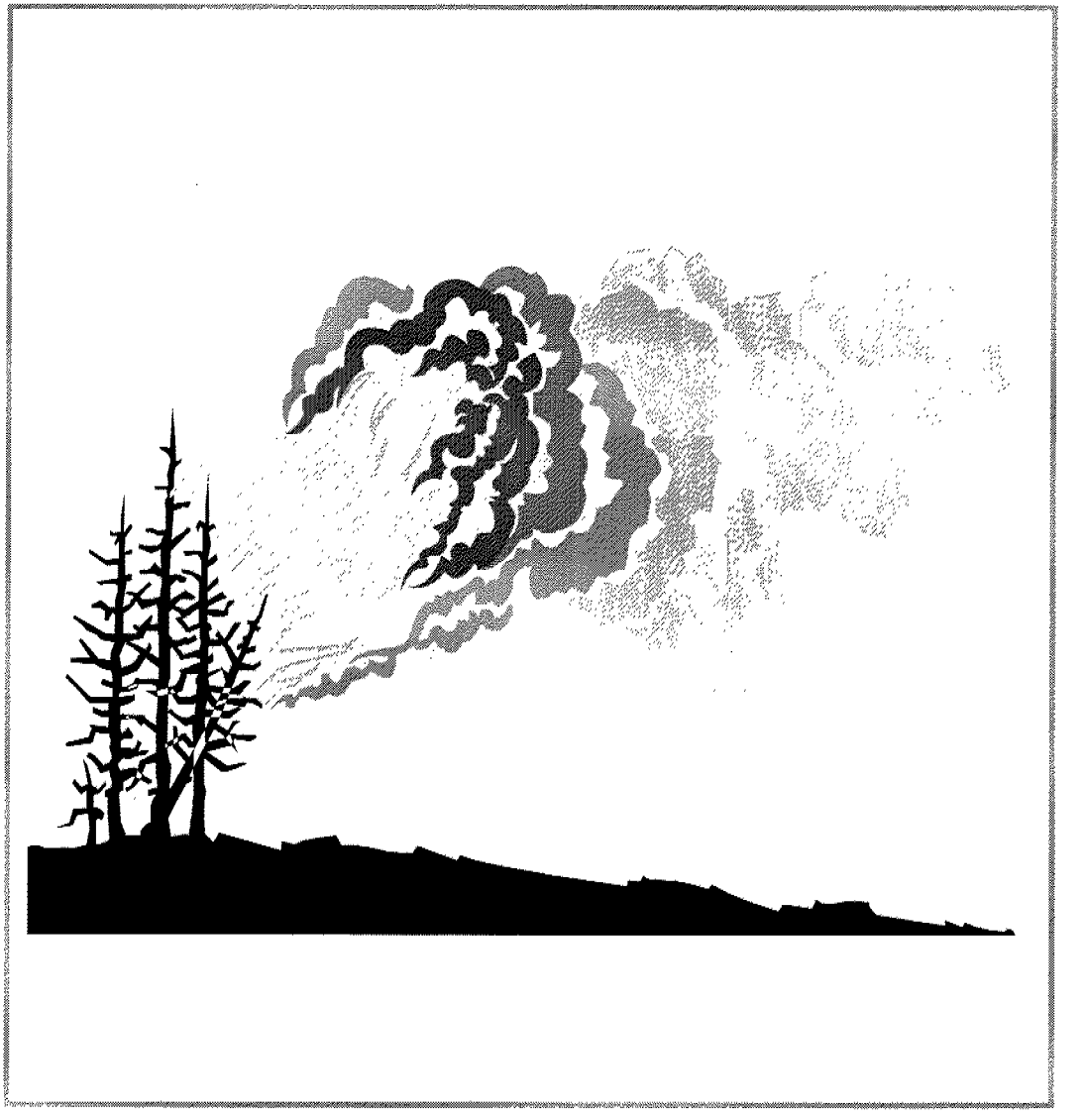

working today
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English Nature Research Reports

Number 297

The Impact, use and control of fire: A joint workshop organised by English Nature and the National Trust

Dartmoor National Park Authority
Bovey Tracey
Devon

March 1998

Papers compiled and edited by
David J Bullock (National Trust) and
Sharon Gunn (English Nature)

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Contents

Introduction

English Nature and the National Trust signed a Statement of Intent on 18 December, 1991. One of the ways by which these organisations agreed to work more closely together is to arrange workshops of mutual interest. The suggestion for a workshop on the sue and management of fire in the countryside came from the National Trust, whose advisers felt a need to update their knowledge of management by fire for nature conservation and other purposes.

The objectives were twofold:

1. To review and pool experience on the impact, use and control of fire on heathland, grassland and wooded habitats.

2. To produce and disseminate a report of the meeting in which examples of good practice and guidelines are presented.

The programme (see page 3), organised by Leo Batten and David Bullock, was designed to stimulate discussion on the positions held by English Nature, and Dartmoor and Exmoor National Park Authorities on the use of fire to manage heathland and culm grassland.

We are grateful to Sue Goodfellow (Head of Ecology and Wildlife Conservation) and her staff, of the Dartmoor National Park Authority, for placing their facilities at our disposal and for their contributions on the day. Tess Walker (DNPA) demonstrated the use of MapInfo and, in particular, the "front end" developed in-house called "AGMapper". This performs GIS work including fire maps and fire plans. Phil Page and Rob Wolton (English Nature) arranged, and ably guided us around, our site visits to Yarner Wood NNR and Trendlebere Down in the afternoon.

We thank all the contributors for their presentations. The written versions, which have been lightly edited, are reproduced here. The discussions throughout the day but especially those in the afternoon in the field and back at The Parke focussed on whether there were primary reasons for prescribing fire to maintain and enhance nature conservation interests. That no firm conclusions were reached (partly because of the complexity of the issue) did not detract from an enjoyable and stimulating day.

David J. Bullock, Nature Conservation Adviser, The National Trust.

Sharon Gunn, Relationship Manager, English Nature

Programme

0945	Assemble and coffee	
1000	Introduction and domestic arrangements	
1015	The use, impact and control of fire on Dartmoor: An overview	Sue Goodfellow (DNPA)
1045	Culm grassland management and fire	Rob Wolton
1100	Improvements to fire management equipment	Tim Braund and Bill Gurnett
1130	Fire - an Australian perspective	Andy Miller
1200	English Nature's policy on fire in the uplands: A discussion paper	Joanne Backshall
1230	Lunch	
1315	Afternoon field visit led by Phil Page (EN Site Manager) and Rob Wolton	

1. Yarner Wood NNR to see heathland management by controlled burning in rotation
2. Trendlebere Down to discuss future management following the severe fire

1545	Tea and discussion of issues arise	
1630	Close	

Participants

English Nature:	David Appleton Joanne Backshall Leo Batten Sharon Gunn Albert Knott Phil Page Rob Wolton
English Nature/MoD	John Breeds Jon Brooks
National Trust	David Bullock John Harvey Katherine Hearn Matthew Oates Tony Tutton
Dartmoor National Park Authority	Sue Goodfellow Rob Stimpson
Exmoor National Park Authority	Tim Braund Bill Gurnett
Somerset County Council (Quantock Hills Ranger's Office)	Andy Miller

The use, impact and control of fire on Dartmoor: An overview

Suzanne Goodfellow, Head of Ecology and Wildlife Conservation, Dartmoor National Park Authority, Parke, Bovey Tracey, Newton Abbot, Devon, TQ13 9JQ.

Historical context

Fire has been sued as a tool to manage vegetation on Dartmoor for thousands of years. The open moorland that we see today was originally created by fire with the earliest settlers setting fire to hazel dominated woodland around 8000 years ago. We know this because fortunately on Dartmoor, due to the lack of recent disturbance, it is possible to analyse and date pollen samples from the blanket bog. These show a remarkable consistency with a continuous record for microscopic charcoal between 7700 BP and 6300 BP, parallelled by gradual reduction in arboreal pollen and the expansion of peat forming plants, heathers and grasses. This has been interpreted as reflecting Mesolithic use of fire at the woodland edge, probably as part of a strategy for hunting game.

Since then, the moor has been densely settled, used for growing crops, abandoned when the climate worsened during the Iron Age, and for most of the last 500 years has been used extensively for rearing livestock. Throughout this time fire has been used for one main purpose - to maintain and improve grazing for sheep, cattle and ponies. There has never been a tradition of small carefully planned regular burns as in most other upland areas where grouse are an economic crop. Instead the moorland, both commons and newtakes (moorland which was enclosed from the common a few hundred years ago), have been burnt with as little effort as possible to achieve a flush of summer growth. Burning, or swaling as it is known locally, has been carried out over large areas with few people - and as often as a fire will run through it. An old man who worked as an agister for the Eastern Quarter commons at the end of the last century told me a few years ago that they would set fire to an area with one match when the heather was about a foot high and let it burn itself out. Sometimes it burnt for a fortnight.

I quote from an article in the *Western Morning News* published on 7 May 1927: *"Beginning on Easter Sunday"* (17 April that year) *"there has been a reign of fire on Dartmoor and we have come to dread the sight of sunshine and tremble at the sound of wind. On Easter Sunday when the weather finally cleared, I realised that we were in for a time of horror ... On Easter Monday, long before noon our sun was put out by smoke. At 2.30 I went to the top of Widecombe Hill, and for an hour and a half watched men, women and children setting fire to the moor with petrol. Peaceful holiday makers who had brought lunch and were trying to picnic were invisible in clouds of smoke ... On Wednesday morning I was so uneasy that I sent out by hand to Devon Constabulary Headquarters, and received a reply by 5 pm saying a squad of plain clothes men on motor cycles would be detailed to make detections. Next morning occurred the disastrous fire at Yarner ... Not acres but miles were burnt. Three men were seen in the middle of the common firing but were unfortunately not caught."*

Present day situation

Things have not changed much today. All types of moorland vegetation are burnt regularly including heather, gorse, purple more grass (*Molinia caerulea*) and bracken. *Molinia* and bracken are burnt most regularly every three years or so, with gorse and heather about every seven years when the vegetation is dormant and dry and there are usually drying winds from the east or north-east. In the newtakes the tenants are controlled to some extent by their landlords (usually the Duchy of Cornwall) and by management agreements with the DNPA. Swaling here is generally carried out carefully and in rotation, with conservation aims as well as agricultural ones. However on the commons (covering the SSS and proposed Dartmoor SAC) the situation is more varied. Burning is often a social occasion organised by Commoners Associations. Some Associations are careful and considered in their burning, others are more cavalier, burning large areas repeatedly and with little control or forethought. And of course there are individuals (often also commoners) who behave in a totally anarchic way, setting fire to anything which might burn year after year.

The public are also to blame for lighting fires but these are thankfully few and far between nowadays. They are usually in summer when barbecues get out of control and picnickers are out and about and can cause severe damage as happened in 1984 when the peat burned for weeks on the Northern moor. And of course we have a few local individual arsonists who start copy-cat fires in spring as at Trendlebere Down. Fires are also occasionally accidentally started during military training exercises although these are usually put out promptly.

However the majority of fires on Dartmoor are still started by farmers for agricultural purposes as they have been for centuries. A major challenge for nature conservation is to ensure that these fires at the very least don't damage the conservation interest and, at best, are used to enhance biodiversity by encouraging vigorous, structurally varied moorland vegetation communities.

Fires of Spring 1997

The size of this challenge becomes all too apparent in dry springs! Last spring, huge fires swept across both the Northern and Southern moor. They caused much short-term damage and some long-term damage. During the workshop we will see how extensive those fires were and how they relate to the nature conservation designations in our GIS demonstration. On the site visits we will look at some of the damage and recovery at Trendlebere Down.

There was political uproar. Screaming headlines in national papers, prime time television coverage and telephones constantly ringing with anxious queries from the public. We had had similar springs in the past - but not this level of public concern. The reasons were complex. Increased environmental awareness, public spending cuts which made the burden on the fire service much more acute, a few near human escapes, the unpopularity of farmers and a fairly bullish attitude from the DNPA all contributed.

Outcome

Surprisingly perhaps the Dartmoor Commoners Council have accepted a share of the blame and were willing to meet with the major players in May of last year to tackle the problem (the first time it had been seen as a problem). The Devon Fire and Rescue Service, MoD, MAFF/FRCA, Duchy, Common Owners Association and of course EN and DNPA were all represented.

At that meeting it was decided that fire plans should be drawn up for each common with a five year rotation in mind and that the Northern Quarter should be tackled first. This consists of some six 'home commons' and a major portion of the Dartmoor Forest. The onus was placed firmly on the commoners although technical help was offered by the DNPA - we provided maps, Codes of Guidance, etc. The Swaling checklist has been very well received (see page 8). A few meetings further down the line, we now have some fire plans which we will display on the GIS in this workshop. They may not be ideal but the commoners have thought about where they wish to burn and when. For many commons this is a real advance on past practises! The Fire Service have given technical advice and offered to provide labour at all swales if possible and the DNPA will help where it can. EN are now in the process of approving notifications under the SSSI legislation.

Of course the whole thing could be scuppered by one individual commoner (or arsonist) but it is likely that such a person would be subject to peer pressure and hopefully will not light the fire int he first place (most commoners know who lights the fires - it is obvious from which leer they start on). There is a great sense that the public are watching and this is a chance to show that responsible swaling is not damaging and is indeed necessary for conservation as well as agriculture.

The way ahead

We hope for a dampish Spring! However, more certainly we intend to develop the concept of fire plans extending the detail and helping the Dartmoor Commoners Council to draw them up for other Quarters. We intend to have fire plans for our own moorland and we have arranged a 'mop-up' meeting in May to review the Spring of 1998 and take matters forward. The most important lesson we have learnt is that all the key players must keep talking - we must share our aspirations, techniques and frustrations, and thereby reduce suspicion and promote good practice tailored to Dartmoor.

Swaling checklist

Before burning you must telephone:

1. **Police 0990 777444**
   Ask for the Control Room

2. **Devon Fire and Rescue Service 01392 872200**
   Ask for the Control Room

3. **English Nature 01837 55045**
   If the burn is to take place in a Site of Special Scientific Interest

4. **Dartmoor National Park Authority 01626 832093**

Making these phone calls will help to ensure that no officers are sent to put your fire out.

The legal requirements

The burning, not only of heather and grass, but also gorse, bracken and *Vaccinium*, is controlled by the *Heather and Grass etc (Burning) Regulations 1986.*

- Burning is allowed only between:

  1 October - 15 April in upland areas
  The National Park Authority recommends no burning after 31 March to prevent harm to nesting birds.

- Outside these dates burning is allowed only under licence issued by the Ministry of Agriculture, Fisheries and Food (MAFF).

- You must give 24-72 ourse written notice to neighbours of intent to burn.

- You must not start burning heather, grass, gorse, bracken or *Vaccinium* between sunset and sunrise.

- You must ensure that sufficient people and equipment are on hand to control the burn.

- You must take all reasonable precautions to prevent injury or damage.

- You must not cause a nuisance through the creation of smoke. This is an offence under the *Clean Air Act 1956.*

- You must contact English Nature if burning on a Site on Special Scientific Interest.

- Under the Dartmoor Commoners' Council's Regulations, arising from the *Dartmoor Commons Act 1985*, no person or local Commoners' Association shall burn moorland where heather is present on the commons exceeding an area of 9,000 square metres at intervals of less than 12 years, nor where the distance between burns in any one year is less than 150 metres. No person or local Commoners' Association shall burn moorland

where dead grass is present on any common land unit over an area exceeding 50 acres (20 hectares) or 25% of the area of that common land unit whichever shall be the less and such burning shall take place at intervals of no less than three years.

Points to remember

Planning	• Plan according to a long-term agricultural or environmental objective. • Draw up a programme of essential burning on a sound rotation basis and include the creation of fire breaks where necessary. • Plan to complete all essential burning outside the licensing and bird nesting periods. • Plan individual burns sensibly by relating size of area to manpower availability, safety requirements and forecasted weather conditions.
Timing	• Burn when there is a gentle breeze. • Make an early start. • Stop and re-assess if conditions change.
Place	• Choose with care the best spot to start the fire. • Burn small areas at a time, paying particular attention to the optimum width of the burn.
Firebreaks	• Use firebreaks, choosing natural boundaries for the burn wherever possible.
Control	• Have sufficient manpower and equipment. • Appoint someone to be in charge.
Landscape and wildlife	• Appoint someone to be in charge. • Avoid spoiling the landscape and environment, especially woodland.
Neighbours	• Keep them informed and take account of their property and interests.
Public Safety	• Avoid creating hazards to road users and the public.
Prosecution and penalties	• A breach of the *Heather and Grass etc (Burning Regulations 1986* may on conviction result in a fine of up to £400

Culm grassland management and fire

Robert Wolton, English Nature, Devon, Cornwall and Isles of Scilly Team, The Old Mill House, 37 North Street, Okehampton, Devon, EX20 1AR

Culm grassland is the local name given to species-rich purple moor (*Molinia caerulea*) grass and rush pastures in northern Devon and north-east Cornwall. Known too as Rhôs pasture, the habitat also has major concentrations in the UK in southern Wales, south-west Scotland and Northern Ireland. In Devon, as well as occurring within the Culm Natural Area, numerous sites are found around the edge of Dartmoor. A lowland habitat, Rhôs pasture grows on poorly drained acidic soils in areas of high rainfall. The vegetation is characterised by abundant purple moor grass or by rushes, especially sharp-flowered rush (*Juncus acutiflorus*). Its species-richness distinguishes it from communities dominated by these plants in upland areas, and has important implications for management.

Summer grazing by cattle has traditionally been the main use to which Culm grassland has been put by farmers. This grazing is supplemented by winter burning or summer mowing as necessary. Where sites are no longer grazed, as is often the case today, burning or mowing is essential to prevent the accumulation of smothering leaf litter and scrub encroachment. Ungrazed fields are, however, never as species-rich as grazed ones even if regularly burnt. Where *Molinia* is the dominant plant mowing is seldom practical or indeed desirable (it produces uniform and species-poor swards), so this practice is applicable only to rush dominated pastures - these are not flammable. A few farmers still cut rushes in the autumn and bale them for use as bedding.

Culm grassland often contains a substantial ericaceous component. However, unlike in the uplands, the conservation objective is nearly always to promote a species-rich sward, not mature heathland. As a consequence, frequent burning is acceptable where it would not be on upland heaths or moors dominated by *Molinia*. It is interesting to note that even on Culm sites burnt nearly every year, heather (*Calluna vulgaris*) and cross-leaved heath (*Erica tetralix*) persist, sometimes in abundance.

The effects of winter burns on marsh fritillary (*Eurodryas aurinia*) butterflies, which are present on many Culm grassland sites, need to be considered carefully. The butterfly overwinters as a caterpillar and on sunny days in March, when conditions are often best for burning, they sun themselves on top of the grass. Some drop off into deep damp vegetation in front of advancing flames, but observation suggest that most get burnt. Despite this some sites which have been burnt year after year for decades still have strong colonies, so obviously the species can cope with such management. Indeed, in the long-term, fire may be essential to maintain the habitat, and the larval food plant devil's-bit scabious (*Succisa pratensis*), in suitable condition for the butterfly. Nevertheless, marsh fritillaries often seem to favour just one small part of a field in which to breed and if this can be located through searching for the larval webs in September and kept safe from fire, so much the better.

Once the decision has been made to burn, the next step as always is to plan carefully so as to be prepared when the day arrives when conditions are right. The grass itself is usually very easy to light. Opinion differs as to whether to burn with the wind or against it. Burning against the wind usually produces hotter fires, taking away more leaf litter, and such fires are far easier to control. However, old hands often burn with the wind where there is only one or two years growth to deal with, and there is no danger to adjacent property, forestry plantations or the like. Such relatively

cool fires fortunately tend to fizzle out quickly when they meet areas of rushes or hedges. Be aware though that grass fires can travel very quickly, certainly faster than a person can run, so if in doubt back burn from one natural fire break to another.

Box 1. Rules for deciding when and how often to burn Culm grassland

1. Do not burn sites if there is no previous history of burning. On such sites there may well be some species, especially invertebrates, which will be wiped out by fire. If a site has been burnt regularly before, the chances are that only species with populations that can survive fire will still be present.

2. Burn only if grazing during the previous summer has been insufficient to create a sward that is, on average, about 15 cm high at the end of the season. On very wet sites, or in wet years, it is often not possible to graze sites sufficiently without causing extensive poaching damage.

3. Do not burn more than half of a site (one or more adjacent fields) in any one year, and never try to burnt he whole of any one field completely. Leaving substantial areas unburnt will protect refugia from which mobile species can recolonise the whole site or field.

4. Do not attempt to burn areas where there is deep peat, especially not areas with a cover of bog mosses *Sphagnum* spp; if these catch fire, substantial long term damage will result. Also, try to avoid burning very swampy areas and right up to the base of hedges.

5. Do not leave a site that needs burning for more than two winters. After this, the build up of dead grass will be such that the fire will be much hotter, causing more damage to the soil surface and any wildlife that may be sheltering close to the ground. On the other hand, biennial burns will be relatively cool and just take away the dead grass.

6. Plan burns carefully, and always follow the Heather and Grass Burning Code. Burn preferably during January or February, and not after 15 March - after this time, there can be much invertebrate and bird activity, especially on the sunny, windless days that are best for burning.

Improvements to fire management equipment

Tim Braund and Bill Gurnett, Exmoor National Park Authority, Exmoor House, Dulverton, Somerset TA22 9HL

In this presentation I will cover improvements to fire management equipment/systems with reference to Exmoor National Park. The experience there is, however, easily applied elsewhere.

1. Vision statement

- The delivery of a proactive conservation burning programme that is scientifically based and well resourced.

2. Goal and objectives

- Efficient delivery of ENPA burning programme (25 fires/yr).
- Assist others in the delivery of their burning (up to 10 fires).
- Develop the science of burn management (measure and predict).
- Demonstrate good practice.
- **Dispel the anti-burn myth.**

3. Today's situation

- No prediction of fire behaviour/risk.
- No/very little pre-burn management.
- Poor equipment/badly resourced.
- Many other land managers ignore regulations.
- **Result - many fires out of control (1997 - 75 fires).**

4. How did we get here?

- Conservation agencies purchase of land.
- New role.
- Traditional attitude to burning - "It's good for it".
- Declining resource - loss of heathland.
- Public opinion.

5. Available options to improve existing fire systems

- Develop systems of fire prediction.
- Improve preburn management.
- Improve equipment for burning.

6 Fire prediction

- The use of Met Office Data to predict fire risk and behaviour - MORECS (soil moisture and crop stress).
- Benefits - Prediction of opportunities to:
  - ❑ burn (only 12-14/year)
  - ❑ Predict summer risk periods
  - ❑ Develop fire prediction wheels

- Costs - About £500/year.

7. Pre-burn management

- Plan ahead - get consents early - be ready in autumn.
- Prepare boundaries in autumn - cut, rake, harrow.
- On the day, wheel track the perimeter to bring up moisture.
- Any time invested pre-burn will be paid back three fold on the day of the burn.
- Train staff.

8. Improved equipment for fire management

- Delivery of water-based fire control would greatly improve efficiency.
- Easy to adapt existing equipment.
- Specialist low ground pressure equipment available.
- Can adapt to take advantage of foam technology to multiply water volume.
- Reduce exposure of staff to hazard.
- Cost £600-£15000.

10. Resourcing of burn management

- Serious consideration needs to be given to the re-targeting of existing resources for improved management.
- MAFF give money for heather moorland area payments (50/ha), landowners get up to £100 for burn plans; but -
- Money needs to be targeted to the successful execution of burn plans.

11. Summary

- Plan early.
- Be prepared/well equipped.
- Predict and burn in confidence.
- Demonstrate good practice.
- Allocate sufficient money.
- **Be proactive in burn management** - dispel the myth!

The Fire Prediction Plans, as outlined in this paper, have now formed the basis of a bid for European Funding under the Exmoor Leader Project. Contact Bill Gurnett for further details.

Fire - an Australian perspective

Andy Miller, Quantock Hills Rangers Office, ANOB Team, Castle Street, Nether Stowey, Bridgwater, Somerset TA5 1LN; and Ranger in Charge, Lake Eildon National Park, Victoria, Australia

Introduction

Fires are a natural part of the Australian environment. The effects of vegetation and habitats vary depending on the frequency and intensity of the fires. In mountainous and higher rainfall areas tall wet sclerophyll eucalypt forests develop and in only very dry years are large fires likely. If fire as excluded for several hundred years it is possible that these forests would slowly change to cool temperate rainforest. In reality, however, it is impossible to exclude fire long enough for this to occur. Foothill dry sclerophyll forests present an annual fire threat with potential for very large fires. In areas that are burnt more frequently, forest gives way to woodland and if burnt even more frequently, grassland.

Fire, as a result of lightning and the hunting techniques of Aborigines, has been an integral component in the evolution of plant and animal communities. Many vegetation types have been modified by the application of fire to the environment since European settlement. Although comprehensive fire records are not available prior to 1939, the literature indicates that early settlers and Aborigines were the cause of frequent, widespread and often intense wildfires. In the early days of European settlement, extensive areas of forest were often burnt in an uncontrolled manner in operations associated with land clearing and goldmining.

Since the disastrous fires of 1939 and the ensuing Royal Commission, greater emphasis has been placed on fire protection. This has led to improved detection measures, more efficient suppression capabilities, more law enforcement and more effective fuel management programmes.

Fire protection responsibilities for public land in Victoria lie with the Department of Natural Resources and Environment (NRE). This responsibility extents to protecting life and property in communities adjacent to public land, as fires originating on public land can pose a significant threat to adjacent farm land and rural settlements.

Fire protection

Fire protection is an all encompassing term which includes:

- **Fire Prevention**, including Education and Enforcement of regulations.
- **Fire Pre-Suppression**, including Liaison, Detection, Training, Fire equipment, Communications, Fuel Reduction Burning, Fire Breaks, Access Tracks, Water Points, Air attack and Support facilities, Weather recording and Preparedness.
- **Fire Suppression**, all activities undertaken once a fire is detected.
- **Recovery**, including any actions taken to minimise damage caused by the fire and/or the suppression effort.

The Department has prepared a number of Codes of Practice and Fire Protection Plans for all areas of the State. These are used to guide staff in the proper procedures and to plan appropriate actions - both in the lead up to the fire season and in the event of a wildfire occurring - and for undertaking activities such as fuel reduction burning. As time and space are limited, it is not possible for me to go into details of all of these subjects. I will attempt to concentrate on a couple of areas which I think will be of greatest interest. For more detailed information on the other areas I would refer the reader to the reference list at the end.

Weather recording and Preparedness

Throughout the State the Department maintains daily weather records. These records can then be fed into a simple cardboard dial to predict fire behaviour. In the event of a wildfire or a planned burn, weather factors such as temperature, relative humidity, wind speed and direction can be combined with the "drought index" (a numerical index of the dryness of the fuels) to predict fire behaviour. A simple numeric figure is produced, which when combined with fuel quantity (either measured or estimated in tonnes/hectare) and slope will give accurate estimates of forward rate of spread of the fire front, and flame heights. More accurate figures can be obtained by using a "Speedie Moisture Metre" to measure fuel moisture.

These figures are used, in a wildfire situation, to plan the fire suppression and estimate the difficulty and the resources required. For a planned burn, the figures indicate whether the burn will start, and if so, how difficult it will be to control. For planned burns, precise guidelines are given in the burn permit, and the fire must not be lit if any of the readings are outside the stated parameters.

The Fire Danger Index is also used as a guide to preparedness. Each day during the fire season the index is calculated for various areas of the State and given a rating of either Low, Medium, High or Extreme. Staff movements and Preparedness are then determined by the rating.

Fire behaviour

Fire behaviour is influenced by a number of factors, each of which could justify a lengthy discussion. I will restrict myself to the briefest of notes to stimulate thought and discussion.

Three factors influence fire behaviour

1. Weather
2. Topography
3. Fuels

Weather

Wind speed and direction
Temperature
Relative humidity
Rainfall

All these factors affect fuel moisture.

Long- and short-term effects. Long term rainfall soaks heavy fuels, whereas short term rainfall only affects fine fuels.

Atmospheric stability

An unstable atmosphere produces updraughts and gusty winds, and more intense fire behaviour than a stable atmosphere.

Topography

Slope

The steeper the slope, the faster the forward rate of spread (FROS). There is a slower FROS uphill than downhill. A 5° slope increases FROS by 33%, a 10° slope increases FROS by a factor of 2 (100%), and a 20° increases FROS by a factor of 4 (400%).

Aspect

Southern and western slopes tend to be warmer and drier than northern and eastern slopes. Fuel quantities also vary according to aspect. Generally there are more fuels on moister, shaded slopes than drier, hotter slopes.

Fuel

Type	Heath, grass, woodland (deciduous and conifer).
Quantity	Generally measured in tonnes per hectare (t/ha) The greater the fuel quantity, the greater the fire behaviour.
Moisture content	Drier fuel burns best. Usually measured in percentage of dry weight of fuel.
Distribution	Compacted, or aerially distributed. Compacted fuel excludes air (oxygen) and therefore will not burn as well as aerially distributed fuels.

Lighting patterns

Can influence how the fire behaves.

Can be used to "pull" the fire edge against the prevailing wind.

Beware of the zone where two fire fronts meet. Try to have the two fronts meeting at an angle.

Proposal

I believe that there is a great scope for improved collection of weather data and personal observation of fire behaviour in the UK. This could then lead to the modification of a "Fire Wheel" (see boxes 1 and 2) which could improve the prediction of fire behaviour and an increased

confidence and professionalism when planning burning operations, and in dealing with unplanned fires. A sample recording sheet is attached for consideration. A number of agencies, including the National Park Authorities, National Trust, English Nature and AONBs are involved in fire management. A coordinated approach to data collection and possibly a research project could pave the way for much greater coordination and information exchange and improved knowledge of fire behaviour in the UK. The adaptation of the Fire Wheels (Boxes 2 and 3) is being investigated by Exmoor National Park Authorities. Contract Bill Garnett for further information.

References

Code of Practice for Fire Management on Public Land. Department of Conservation and Natural Resources, 1995. Victoria, Australia.

Alexandra Fire Protection Plan (Draft). Department of Conservation and Natural Resources, 1995. Victoria, Australia.

The Department also maintains a Web Site with extensive information on fire and other emergencies as well as other flora, fauna and park management information. Research reports and other information are also listed.

The address is: http://www.nre.vic.gov.au

Quantock Hills, AONB, Fire Protection Plan. Quantock Hills, Warden Service, unpublished draft

Box 1. An example of a fire record sheet

Fire Record Sheet

Fire name: .....

Date: ..... Time: .....

Location (attach map) ..... Grid reference .....

Temperature: Dry bulb: ..... Wet bulb: .....

Humidity: .....

Wind speed: ..... Direction: .....

Slope: ..... Aspect: .....

Fuel Type: .....

Forward rate of spread (FROS) (estimate): .....

Flame height (estimate) .....

Cause of agency of fire (known or suspected) .....

.....

Notes:
(Include unexpected or unusual fire behaviour, control difficulties etc.)

Maximum level of resources, personnel and equipment:

Final area of fire: .....

Final perimeter of fire: .....