



A risk assessment of the Peak District moorland

Wildfire is inevitable.
It's not if, but when.

In association with:
Natural England, Peak District National Park Authority,
Fitzwilliam Wentworth Estate and Incendium Group

“This report is a real game changer in how we think about and mitigate fire risk on upland moorlands by using data to strategically assess risk, fire behaviours and pathways. While such a strategic approach is commonly used to manage fire risk to major infrastructure and to manage flood risk, it has not been developed for moorland fire risk – until now.”

Sarah Fowler

Former CEO, Peak District National Park Authority

Current CEO, WWT - Wildfowl & Wetlands Trust

Andrew McCloy

Chairman of Peak District National Park Authority



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For the
full report please visit:
peakdistrictwildfire.co.uk



Spreading like wildfire...



243
wildfires
from January
to April in 2022,
compared with 237
for all of 2021 in
England and
Wales

The natural capital of the Peak District National Park (PDNP) is enjoyed by 13 million visitors annually. Managed by generations of custodians, its dramatic moorland scenery has been delivering ecosystem services for millennia. As well as harbouring a wealth of biodiversity, it forms part of the UK's largest carbon store. Helping to deliver the ambitions of the nation's Nature Recovery and Net Zero strategies, the green economy will increasingly replace conventional land management practices.

However, this outlook has a significant vulnerability. Wildfire, to quote Professor Rob Marrs, President of The Heather Trust (speaking 2019), “**is inevitable, it's not if, but when**”.

With the effects of climate change, high levels of public access and evolution of management practices, it is easy to understand why the threat posed by wildfire is increasing.

It is an expectation that the Fire and Rescue Service (FRS) will respond to any wildfire event, but the success of any response is hindered by fire behaviour and lack of opportunities for successful suppression.

There were 243 wildfires from January to April 2022, compared to 237 for the whole of 2021 according to figures logged on the National Fire Chiefs' Councils National Resilience Reporting tool.

This 'taster' document gives a brief overview of the approach that has been developed to assess the risk of wildfire in the PDNP, and ways in which resulting evidence can be used to develop a landscape-scale mitigation strategy. The approach has been piloted on an area of

Even marshland burns putting property and lives at risk. Merseyside marshland at Parkgate.

continuous moorland in multiple ownerships (extending to approximately 38,000 acres) centred on the Derwent valley.

For more detailed information, please refer to the 'practitioner' (short-form) and 'academic' (long-form) versions of the assessment which can be found at www.peakdistrictwildfire.co.uk

We must act now. Land managers and policy makers must work together to help save valuable habitats and vulnerable species.

Working together, we can make a difference.

"This report provides a comprehensive regional wildfire risk assessment. The assessment is undoubtedly the most detailed undertaken for a UK landscape. Given recent warnings about increased fire risk associated with climate change in the UK's 2021 Independent Assessment of UK Climate Risk (CCRA3), the report is both timely and important."

Thomas EL Smith,
Associate Professor in Environmental Geography
London School of Economics & Political Science



What's at stake?

Wildfires cause more than just surface damage.

With an estimated 20 million people living within one hour's journey, The Peak District is one of the most visited national parks in the UK, delivering green space and nature to people who live in surrounding areas. Closing it because the wildfire risk is too high, is inconceivable.

The wild and open characteristics of the uplands, with its abundance of heathland and bog vegetation, are the last refuge for nationally threatened wildlife – particularly ground nesting birds. The moors are highly recognised and protected for specially adapted wildlife that survive within these unique habitats.

Wildfires often strike in the nesting season, when the amount of young that fledge the nest is key to long term survival of species.

Each day, around 450 million litres of clean drinking water is supplied to northern England's major cities, taken from the reservoirs in the Peak District which are fed by the same moorland catchments (Moors for the Future, 2021). Healthy moorlands filter drinking water. Wildfire damages that capability and releases chemicals and metals that have been locked away in the soil since the industrial revolution.

Furthermore, the capacity of moorlands to absorb water helps safeguard hard-surfaced urban areas from flooding downstream.

Peatland across the UK stores vast amounts of carbon, in fact they hold more than 3 billion tonnes (Office of National Statistics 2019). Healthy peatlands can lock up even more carbon as time goes on making a significant contribution to the UK's Net Zero targets.

Moorland wildfires over peatlands can emit vast amounts of CO₂ previously locked up in the soil. For example, the wildfire on Saddleworth Moor in 2018 affected 2,400 acres with a loss of some 40,000 tonnes of CO₂. It will take 2 million mature trees to grow for one year to lock up the equivalent amount of CO₂.

In recent wildfire events, 2% of the carbon lost was found to come from the surface vegetation –

the other 98% was lost from the underlying peat. Calculations on an area of PDNP moorland using Natural England biodiversity metric 2.0, suggest habitat scores of 6 biodiversity units (BU) per acre; 6 times that of lowland pasture. Using Defra indicative value of £11,000/BU there are billions in biodiversity value at stake across the PDNP moorland.





The 2018 Saddleworth Moor wildfire affected 2,400 acres with a loss of some 40,000 tonnes of CO₂

It will take 2 million mature trees to grow for one year to lock up the equivalent amount of CO₂

Extrapolating the impact of the Saddleworth Moor fire in 2018, conservative estimates indicate costs of £3650/acre, equating to £8.76m across the 2,400 acres affected, including the loss of carbon, and the cost of land manager and FRS efforts. The moorland area in the Peak District alone could incur costs of £478m if it burnt under the same severity.

The April 2019 wildfire on Marsden Moor destroyed 700 hectares of habitat and put lives at risk. Marsden Moor burned again in April 2021, requiring a response from 100 fire-fighters and again in March 2022. Already, in 2022, fires on Arnfield Moor and Tintwistle have burnt about 1,000 acres.

The PDNP is highly designated for wildlife and habitats and is an essential part of the nature recovery network.



What's being done right now?

There are widespread programmes of habitat restoration, helping to improve the resilience of the moorland landscape to climate change and other potential threats, these include re-wetting (raising the water table), re-vegetation of bare peat and planting of sphagnum moss.

Thanks to funding provided by UK Government and others, project management provided by the likes of Moors for the Future Partnership and facilitation from landowners, £50 million has already been invested in moorland restoration schemes across the Peak District.

In iconic locations such as Kinder and Bleaklow, £15 million provided by the Lottery and EU Life fund has been invested in:

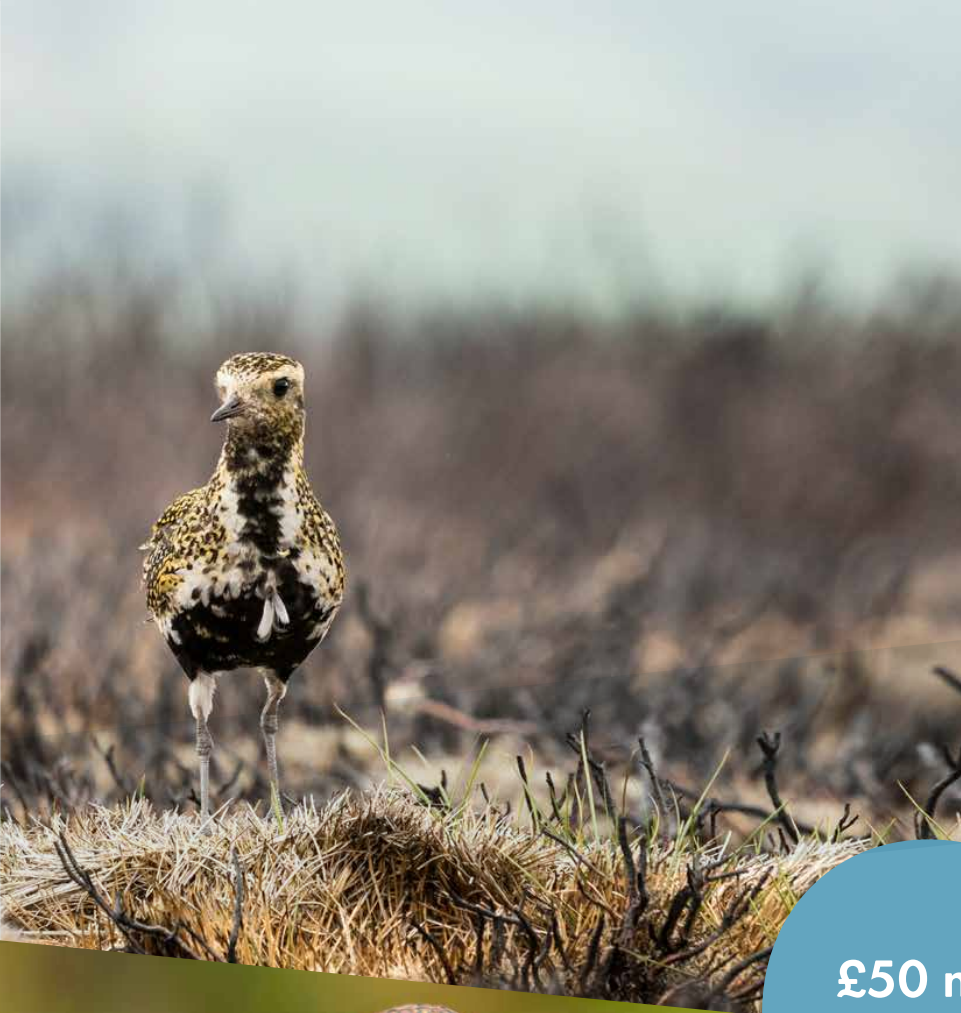
- 33 miles of geotextiles to stabilise eroded peat
- 4,000 mini dams to retain water
- 150,000 moorland plants
- The broadcast of 807 million sphagnum moss fragments
- 22 tonnes of grass and heather seed have been sown

In normal weather conditions, re-wetting can help protect valuable sub-surface peat from the consequences of wildfire but underlying peat is still vulnerable in increasingly frequent extreme weather conditions.

Without the implementation of suitable protective measures, wildfire poses a serious threat to these nature preserving and climate mitigating investments.

UK peatlands store 3 billion tonnes of carbon; more than in the combined forest of Britain and France





“Across the UK, FRS are facing a growing challenge to adapt to the increasing scale, scope and severity of wildfires and the recommendations within the report are as equally applicable to many FRS the length and breadth of the UK as they are to those who have responded to several significant incidents in PDNP in recent years.”

Paul Hedley,
Chief Fire Officer for Northumberland FRS
and National Fire Chiefs’ Council (NFCC)
Director

£50 million
invested in
restoration



Why do we need this research?

In 2019 a ‘call for action’ was made by the then National Park’s Chief Executive, Sarah Fowler, for “a strategic approach to the control of moorland wildfires and the provision of essential infrastructure to achieve this”.

Wildfires are started by people, either by accident or, regrettably, on purpose. Warm weather brings out visitors, often intent on having barbeques.

The motivation to carry out this work comes from the profound fear that exists amongst habitat managers such as gamekeepers and rangers each spring when dry weather often prevails. A fundamental shift in land management policy on designated land has seen a significant reduction in grazing and controlled burning and a consequential increase in volatile biomass.

Much of the UK’s weather is dominated by moist maritime air developed over the Atlantic from the west/south west. However, due to global warming we are seeing more high-pressure systems that develop over continental Europe that block the maritime air and replace it with very dry warm air. Where these fire supportive conditions might have been observed once a year at the turn of the century, this is now occurring two to three times every year, and it’s projected to increase to six times that by the end of the century (*Zhang, et al., 2020*).

Wildfire,
beyond the
capacity of FRS,
poses a threat to the
Peak District
National
Park

Increasingly fire supportive weather and combustible vegetation creates fires beyond the capability of FRS to extinguish. It is a legal expectation that FRS will respond to any wildfire event, but this response is hindered by fire behaviour and lack of opportunities for successful suppression. Continuity and connectivity of wildfire across large areas of high fuel loading, subject to prolonged periods of fire-supportive weather, mean that the FRS have limited tactical options due to:

- Limited access to water
- Lack of access to the moorland
- Delays in initial attack
- Lack of aerial support
- Limited equipment
- Limited training
- Limited specialist experience

Stakeholders are profoundly concerned.



"I applaud the work of the authors in putting forward a strategic response to wildfire threats in PDNP moorlands based on evidence and scientific analysis while paying attention to stakeholder engagement."

Prof. Guillermo Rein,
Fire Science,
Imperial College London

Where have we begun to drive change?

This project provides an assessment of the threat of potentially devastating wildfire in part of the PDNP and how development of a landscape-scale mitigation strategy is crucial to avoiding significant losses.

Approximately 131,000 acres are above the moorland line within the PDNP. This moorland habitat is a combination of internationally important upland heath and blanket bog, woodland cloughs and other habitats which support a wide variety of animal, bird and plant life.

The moorlands of the Peak District have been divided into eight areas of continuous moorland and the approach piloted on an area of 38,000 acres centred on the Derwent Valley.

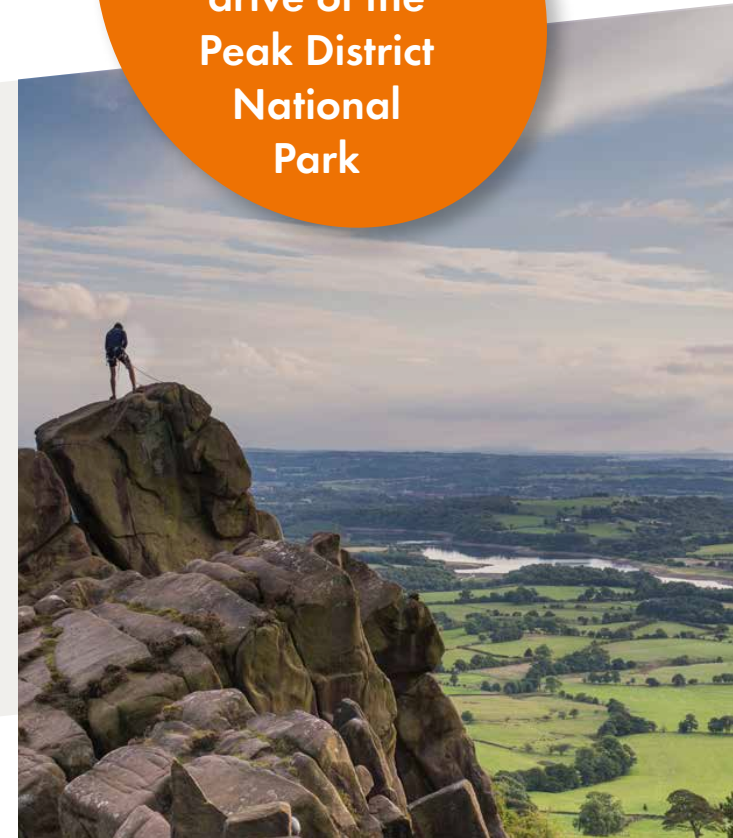


How we've done it

For the first time information from habitat managers and fire specialists has been combined to help assess the threat.

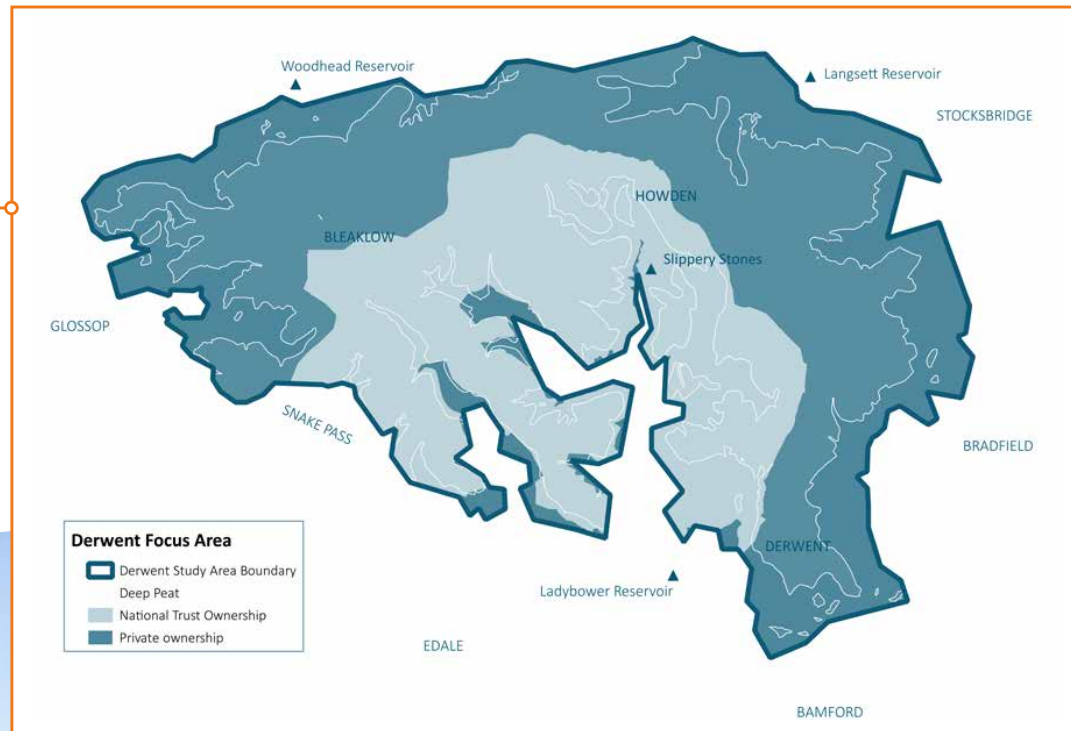
Combining freely available GIS datasets, local knowledge and expert fire behaviour analysis, the project identifies areas where fires are most likely to start, which areas are most vulnerable to wildfire, how fires are likely to behave and what capacity there is to fight them. This information provides an opportunity to develop a strategic approach to reducing wildfire risk across the moorlands if everyone works together.

20 million people live within an hour's drive of the Peak District National Park





The PDNP with moorland areas split into focus zones.



The Derwent focus area, with multiple land ownership.

“The first thing that caught my attention was the integration of simple and complex techniques for a comprehensive assessment. It is not often that the tiers of traditional risk assessment, mapping and modelling are combined in this way, from simple to complex.”

Prof. Guillermo Rein,
Fire Science,
Imperial College London



The project developed three tiers of assessment

For the full report please visit:
peakdistrictwildfire.co.uk

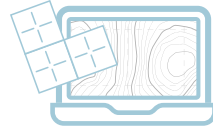


Tier One

Based on the wildfire risk assessment template produced by the Upland Management Group (commissioned by Defra), Tier one assessment divides the landscape into 1km OS grid squares. Habitat managers provided their own subjective assessment of various influencing factors grouped into three key elements:

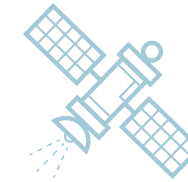
- ignition
- combustion
- control

This approach harnesses the essential local ground knowledge of individual habitat managers.



Tier Two

Tier Two involved the collation of various publicly available and limited access GIS datasets to objectively assess vulnerability under the same three key elements, ignition, combustion and control. The datasets evaluated include visitor pressures, ignition history, fuel complex (surface vegetation and peat depth), accessibility and water availability. Vulnerabilities identified through this objective assessment were found to correlate strongly with the subjective assessments of Tier One, strengthening the evidence base.



Tier Three

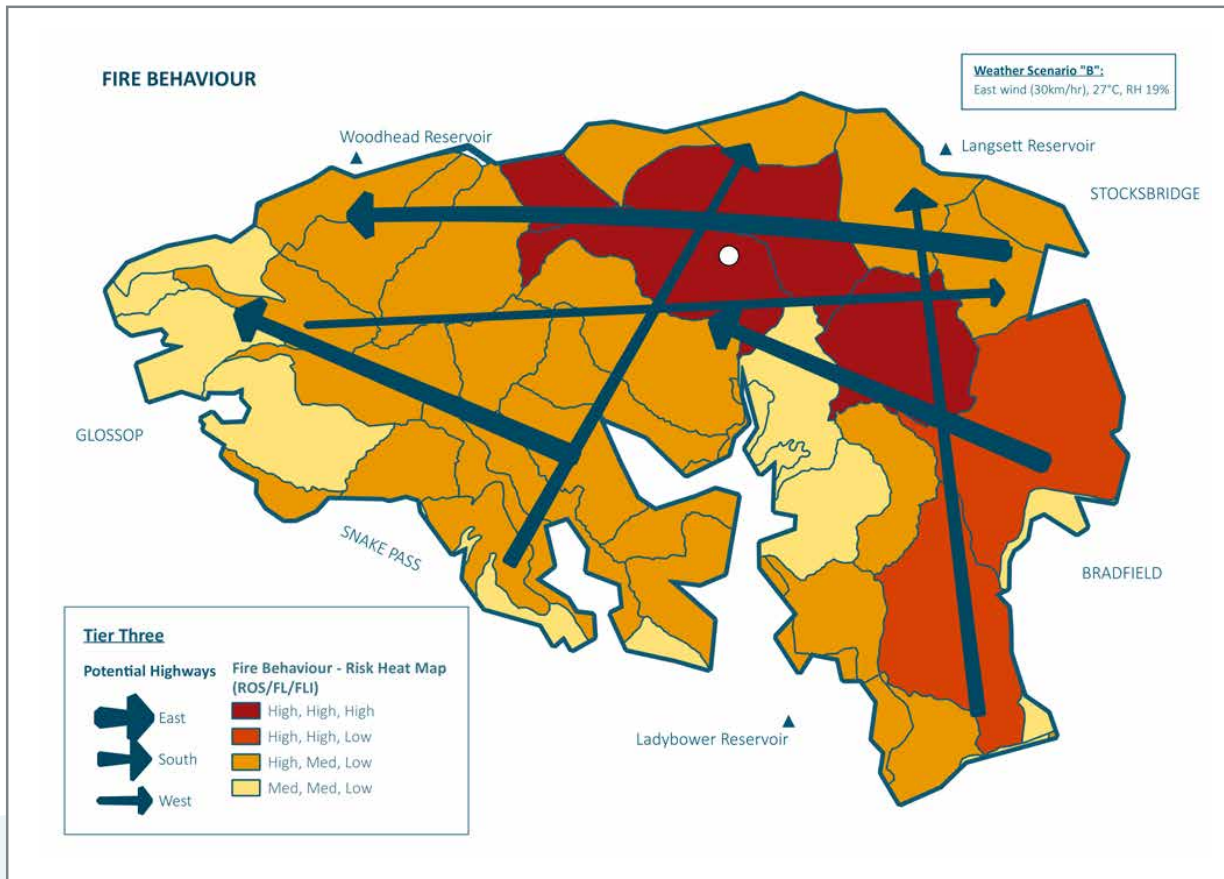
The third tier involved a combination of global fire monitoring systems, satellite data, remote ground information and historic data bases, employed to analyse and forecast potential fire behaviour within present fuels. The purpose of this modelling is to establish an understanding of how the fuel, topography and supportive weather conditions interact. Fire behaviour and FRS capacity can then be evaluated to identify areas where action can be taken to achieve successful intervention.

Risk of not being able to control	Flame Length (feet)	Rate of Spread (chains/hr)	Rate of Spread (m/hr)	Fireline Intensity (Btr/ft-s)
Low	0 - 4	0 - 10	0 - 200	0 - 500
Medium	5 - 11	11 - 40	201 - 800	501 - 2,000
High	12 - 20	41 - 80	801 - 1,600	2,001 - 4,000

Fire behaviour in relation to capacity to control



Tier 3 methodology - see full report for more information.



Tier Three Assessment - Fire behaviour risk heat map for the Derwent focus area

The Fire Behaviour Risk heat map for the Derwent study area above shows the combined rate of spread (ROS), flame length (FL) and fire intensity (FLI) and the potential fire highways. The areas shaded dark red are of particular concern. At the white dot, FL is predicted to be 7.6m and ROS of 2,393m/hour and is way beyond the capacity of FRS to control.

Understanding the connectivity of fire behaviour and the location of high risk areas means fire highways can be identified. Under an east wind a fire would devastate swathes of internationally important habitat. This process also allows identification of strategic management hubs indicating where mitigation is required to help FRS to control the fire. Small measures can make a significant difference.

“One of the major strengths of the report is the interdisciplinary approach to understanding the wildfire risk and mitigation situation. By covering environmental, social and economic considerations, the report makes a careful approach to the many trade-offs that are required for landscape wildfire management.”

Thomas EL Smith,
Associate Professor in Environmental Geography
London School of Economics & Political Science

The Tier 3 data demonstrates that, regardless of training, equipment and access, within parts of the landscape there is presently little or no possibility of the FRS controlling wildfire, particularly during extreme weather conditions.

The potential environmental, financial and social losses are enormous.

Combining the tiers to form a mitigation strategy

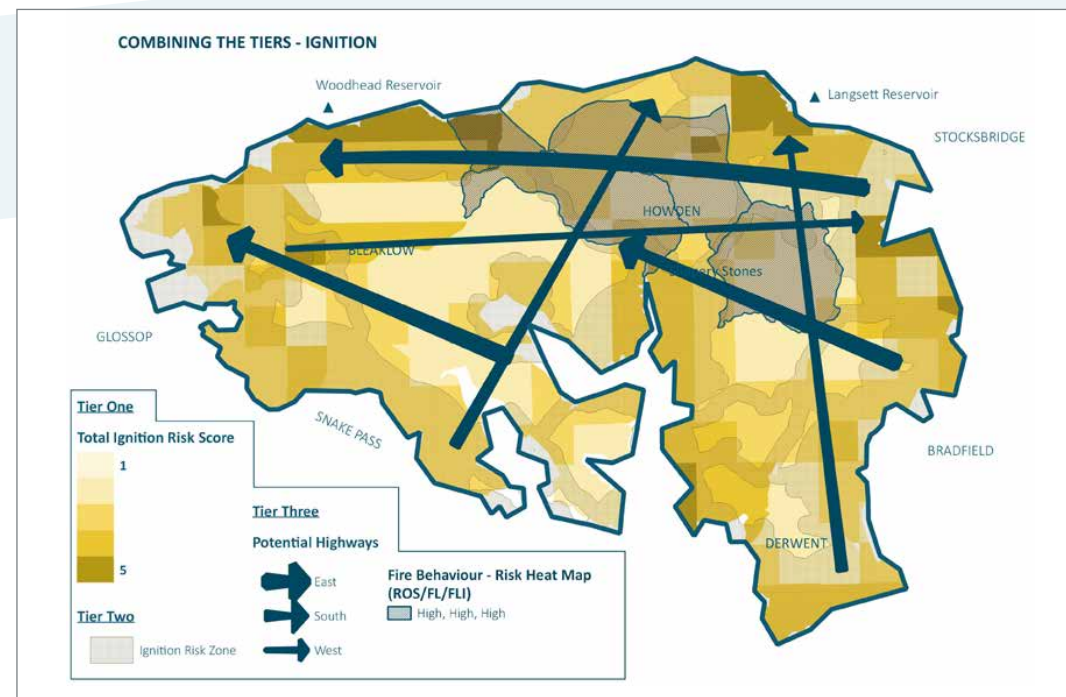
Compiling the three tiers of assessment helps create a clear picture of the areas at high risk of ignition, potential fire behaviour within a given fuel complex, where fire may be controllable and where fire is likely to be beyond control.

This is the starting point for the creation of a Landscape Wildfire Management Plan. The combined assessment highlights four key issues where collaboration needs to be facilitated at a landscape scale to make a difference:

1. How do we stop fires from being ignited in the first place?

Through ignition management, better education, better communication and better reporting.

We can significantly reduce the chance of ignition through better reporting, better education and better communication, as well as the physical presence of patrols, ensuring resources are targeted to areas where they will have the most effect. Ignitions are often accidental and campaigns to raise awareness of the consequences of irresponsible behaviour will be key, as well as for example, providing designated BBQ sites and banning local sales of disposable BBQs. The darkest risk score areas on the ignition map show where to concentrate effort.



Combining the three tiers to identify mitigation options



FRS can run out of options to tackle extreme fires

2. When fires are ignited, how do we minimise the effects?

By breaking the continuity of fuel load.

The type of fuel, its size, shape, quantity, arrangement over the landscape, topography, moisture content driven by weather conditions and prevailing winds all determine the fire behaviour. In turn these dictate the fire fighting capacity for control. According to internationally recognised classification, well trained and equipped FRS would find a flame length above 3.4m and a rate of spread greater than 800 metres per hour beyond its ability to control. Fire crews with little experience of moorland fires that lack specialist equipment would be overwhelmed by less severe fires.

Keys drivers of fire behaviour are **landscape characteristics, fuel complex** and **weather conditions**. Of these, stakeholders have the opportunity to influence only the continuity and arrangement of fuels, to break connectivity of potential fire highways and reduce fire behaviour.

Fuel Management

Fuels with high surface area to volume are called fine fuels. These dry quickly and ignite easily. Fine fuels are up to 6mm in diameter and found in huge quantities in a continuous arrangement across the Peak District moorlands in plants like heather, grass and bilberry. Sub-surface fuels, i.e. carbon rich peat, may take longer to dry out but once in drought conditions are equally vulnerable and more difficult to extinguish.

Improving Resilience

Where achievable, high water tables, can build resilience below the surface in the peat fuel as well as restrict heather growth above the surface and is part of ongoing peatland restoration work across our upland peatlands.

Mitigation is required to limit fire spread.

Fuel management in strategic locations (cutting, mowing, grazing, vegetation diversification and cool burning) is vital. Ensuring the right mitigation is carried out in the right places, is key.

The evidence gathered by this report can be used to identify Strategic Management Areas where more diverse habitats with reduced fine fuels would have the greatest mitigation impact.

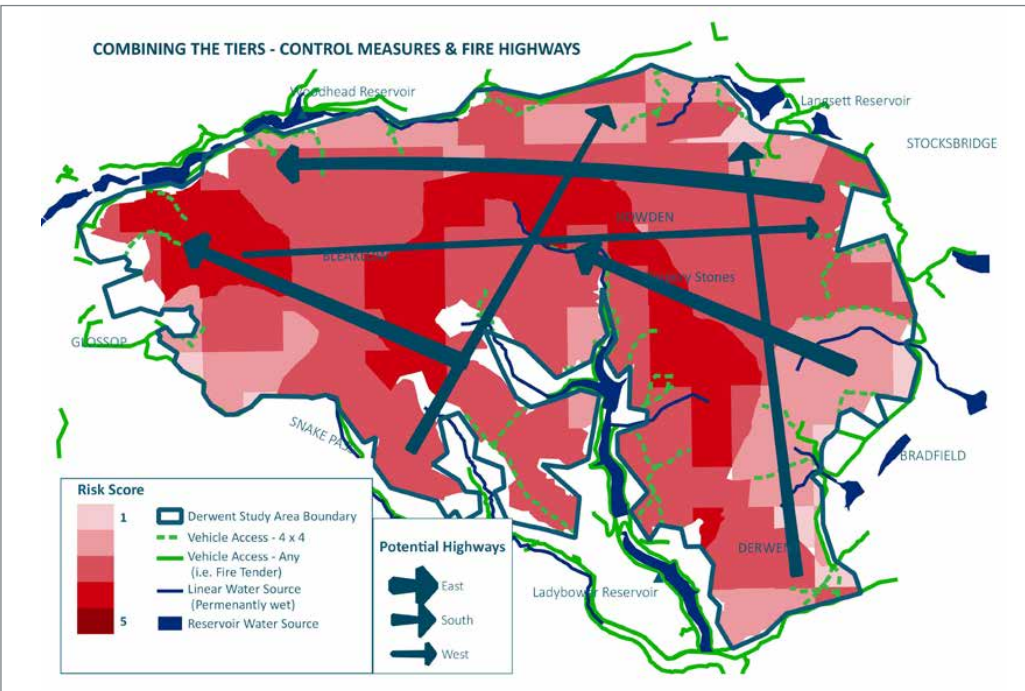
3. How do we improve the success of those fighting the fires?

By improving access, improving water availability and improving equipment and training.

Currently, the expectations placed on FRS to contain fire spread and protect landscape values are unrealistic. Once opportunities for control have been created amongst the fuel complex the next step is to ensure that in the event of a wildfire, intervention measures are sufficiently robust. Proximity to water, access and equipment and training are all key factors.

In order for the UK FRS to be successful in the future, it must continue to develop its response to the ever-growing threat of wildfire by working closely with other stakeholders and assist with their spatial planning, including land management plans which incorporate fire risk analysis and planning, hazard awareness and mitigation measures.

For the full report please visit:
peakdistrictwildfire.co.uk



The green lines on the map above show the existing access routes around the fringes only. There is scant access to interior spaces.

“Many of the current aims and areas of focus of the National Fire Chiefs Council (NFCC) Wildfire Forum and NFCC Wildfire Tactical Advisor group are reflected within the report. Of note are the recommendations relating to effective fuel management and fuel continuity breaks in areas of high wildfire risk, the development of localised multi-agency tactical fire plans and enhanced collaboration with wildfire stakeholders. These will assist the development of a more mature and sophisticated fire behaviour analysis and prediction capability.”

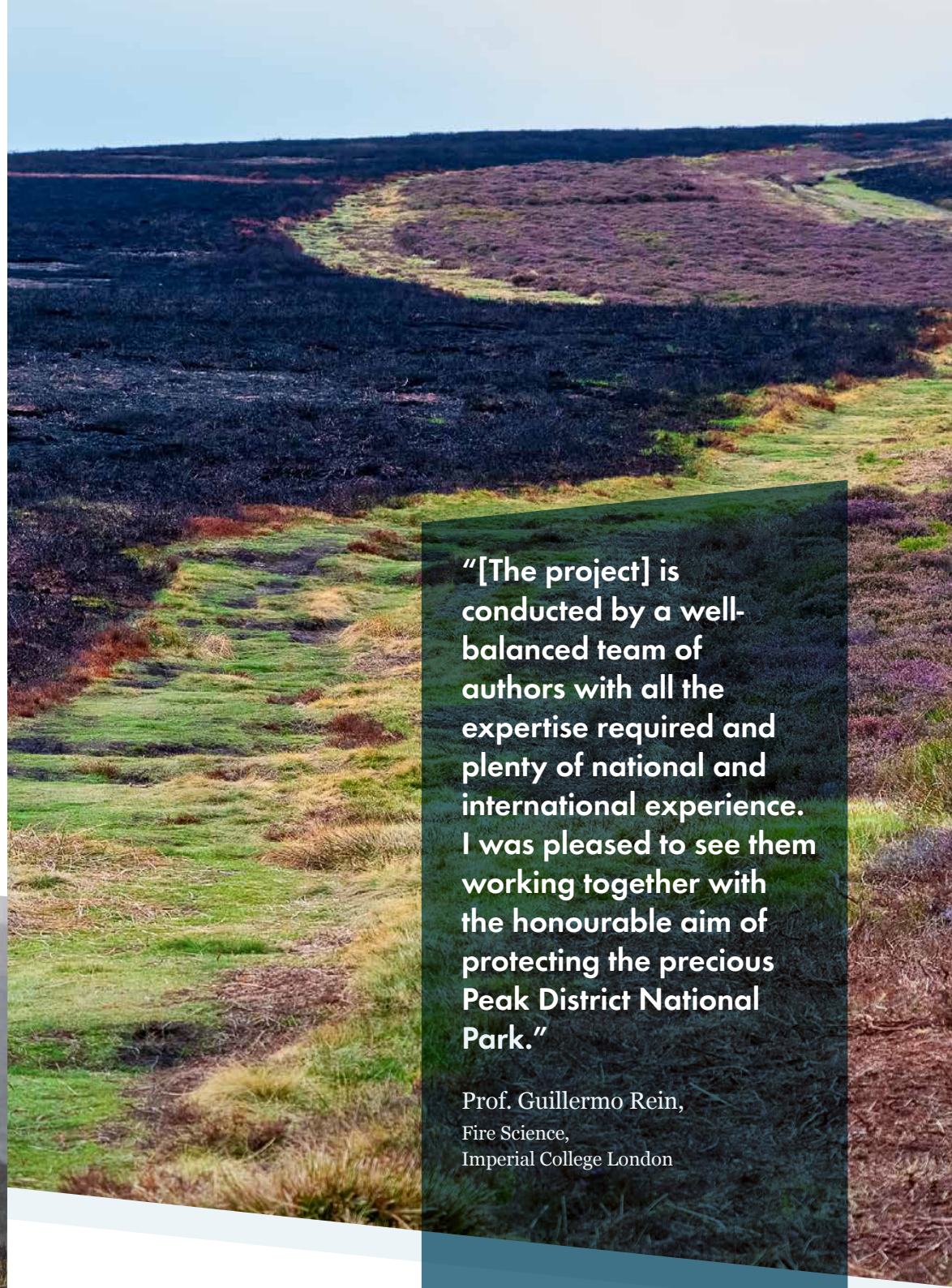
Paul Hedley,
Chief Fire Officer for Northumberland FRS and
National Fire Chiefs’ Council (NFCC) Director

4. How do we improve stakeholder collaboration?

A key objective of the project has been promoting stakeholder collaboration; including early online workshops discussing the development and completion of Tier One assessments to site visits within the Derwent study area with a variety of representatives from various different stakeholder groups. The project has been clear that it does not wish to advocate any particular management, but sets out to provide an evidence base for habitat managers to work together to find solutions.

The next step is to build on this collaboration and develop a Landscape Wildfire Management Plan for the Derwent area. It will identify the values stakeholders wish to protect, which will in turn inform ways in which ignition can be reduced, fire behaviour managed, and fire response improved.

All landowners and habitat managers need to work as one, regardless of individual objectives, to protect the landscape as a whole.

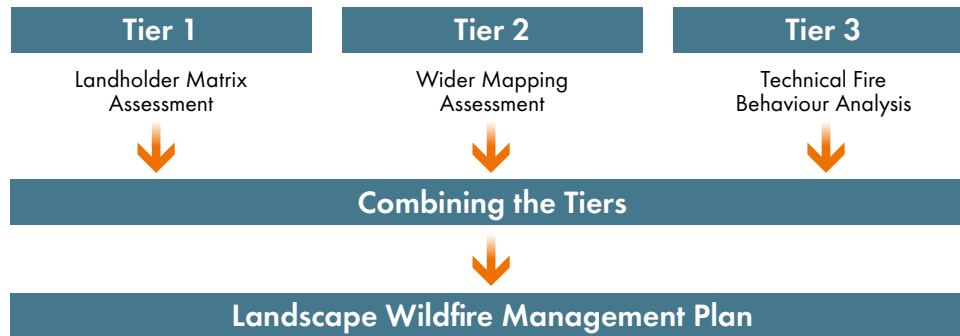


“[The project] is conducted by a well-balanced team of authors with all the expertise required and plenty of national and international experience. I was pleased to see them working together with the honourable aim of protecting the precious Peak District National Park.”

Prof. Guillermo Rein,
Fire Science,
Imperial College London

What next?

- 1 Further refinement of the methodology before completing assessments for the remainder of the Peak District.
- 2 Develop Strategic Landscape Management Plan for the Derwent Focus Area.



- Identify the values to be protected
- Visitor management plan
- Fuel mitigation plan
- Fire response plan

We must act now to protect our natural assets

Wildfire poses a more significant threat than it has done in the past and the valuable environmental and socio-economic assets are becoming more vulnerable to the effects of fire. We cannot eliminate ignition entirely and when fuel loading/distribution is high risk, many wildfires will inevitably remain outside the capacity of existing firefighting systems.

The only question now is how dominant and damaging future wildfire events are allowed to become.

Wildfire adaptation action is needed now, with both policy and financial support.

We must prepare now to reduce the risk and mitigate the devastation of wildfire



Leadership and collaboration are key

Policy

Protection is a key plank of the England Peat Action Plan – May 2021. The Government has said it will support and engage with the Wildfire Forums across the country, demonstrating leadership across government to embed good practice. This report now supplies that good practice.



Expertise

The Peak District is well placed to become a Centre for Excellence for wildfire training, analysis and mitigation strategies, supporting FRS nationally. With a Landscape Wildfire Management Plan as an exemplar, the data and process can be refined and added to build confidence in the model outputs and recognition for this powerful tool with wide application.

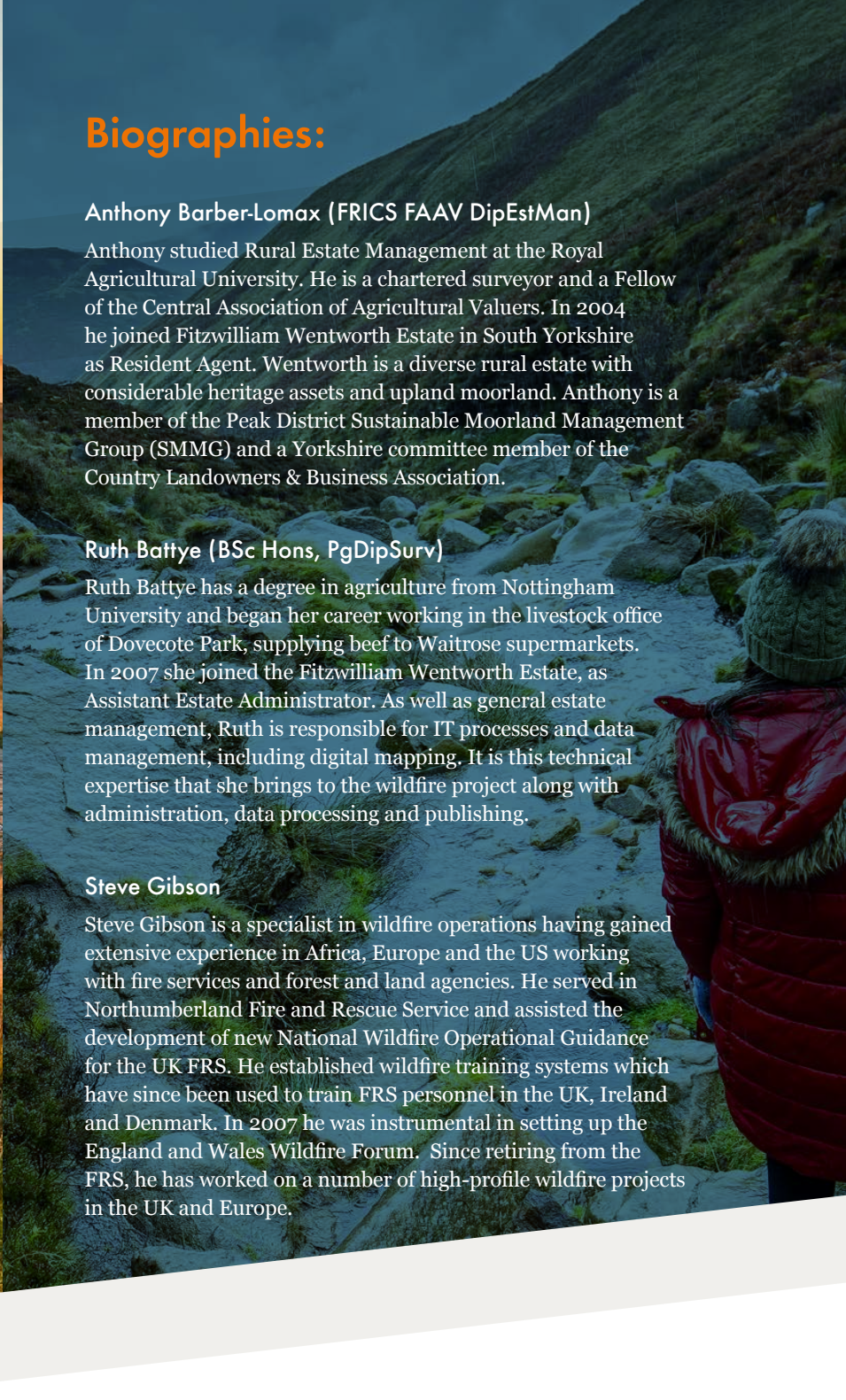
Leadership & working together

Leadership is required to engage all stakeholders to act collaboratively, in order to implement changes which will protect the landscape. If any wildfire strategy is to succeed it is essential that a stakeholder team is built that can carry out this important work.

It will require individuals from key agencies to be given the responsibility and resources to carry out such analysis and authority to implement the mitigation measures that have so far caused tensions leading to inaction.

A statement of leadership has been made through the 2021 Peat Action Plan, and the need for further evidence identified by Natural England in its 2020 report “The causes and prevention of wildfire on heathlands and peatlands in England.” The new Wildfire Framework for England (Home Office, Dec 2021) is a welcome step towards a national wildfire strategy. We call for all those allocated responsibility within the framework to integrate this approach and ensure the mitigation measures are implemented without delay. It is now up to stakeholders to work together to formulate responses to the evidence presented by the Project.

Whilst originally intended to mitigate risk in the PDNP, the project will also have wider applications across other landscapes in the UK.



Biographies:

Anthony Barber-Lomax (FRICS FAAV DipEstMan)

Anthony studied Rural Estate Management at the Royal Agricultural University. He is a chartered surveyor and a Fellow of the Central Association of Agricultural Valuers. In 2004 he joined Fitzwilliam Wentworth Estate in South Yorkshire as Resident Agent. Wentworth is a diverse rural estate with considerable heritage assets and upland moorland. Anthony is a member of the Peak District Sustainable Moorland Management Group (SMMG) and a Yorkshire committee member of the Country Landowners & Business Association.

Ruth Battye (BSc Hons, PgDipSurv)

Ruth Battye has a degree in agriculture from Nottingham University and began her career working in the livestock office of Dovecote Park, supplying beef to Waitrose supermarkets. In 2007 she joined the Fitzwilliam Wentworth Estate, as Assistant Estate Administrator. As well as general estate management, Ruth is responsible for IT processes and data management, including digital mapping. It is this technical expertise that she brings to the wildfire project along with administration, data processing and publishing.

Steve Gibson

Steve Gibson is a specialist in wildfire operations having gained extensive experience in Africa, Europe and the US working with fire services and forest and land agencies. He served in Northumberland Fire and Rescue Service and assisted the development of new National Wildfire Operational Guidance for the UK FRS. He established wildfire training systems which have since been used to train FRS personnel in the UK, Ireland and Denmark. In 2007 he was instrumental in setting up the England and Wales Wildfire Forum. Since retiring from the FRS, he has worked on a number of high-profile wildfire projects in the UK and Europe.

Marc Castellnou

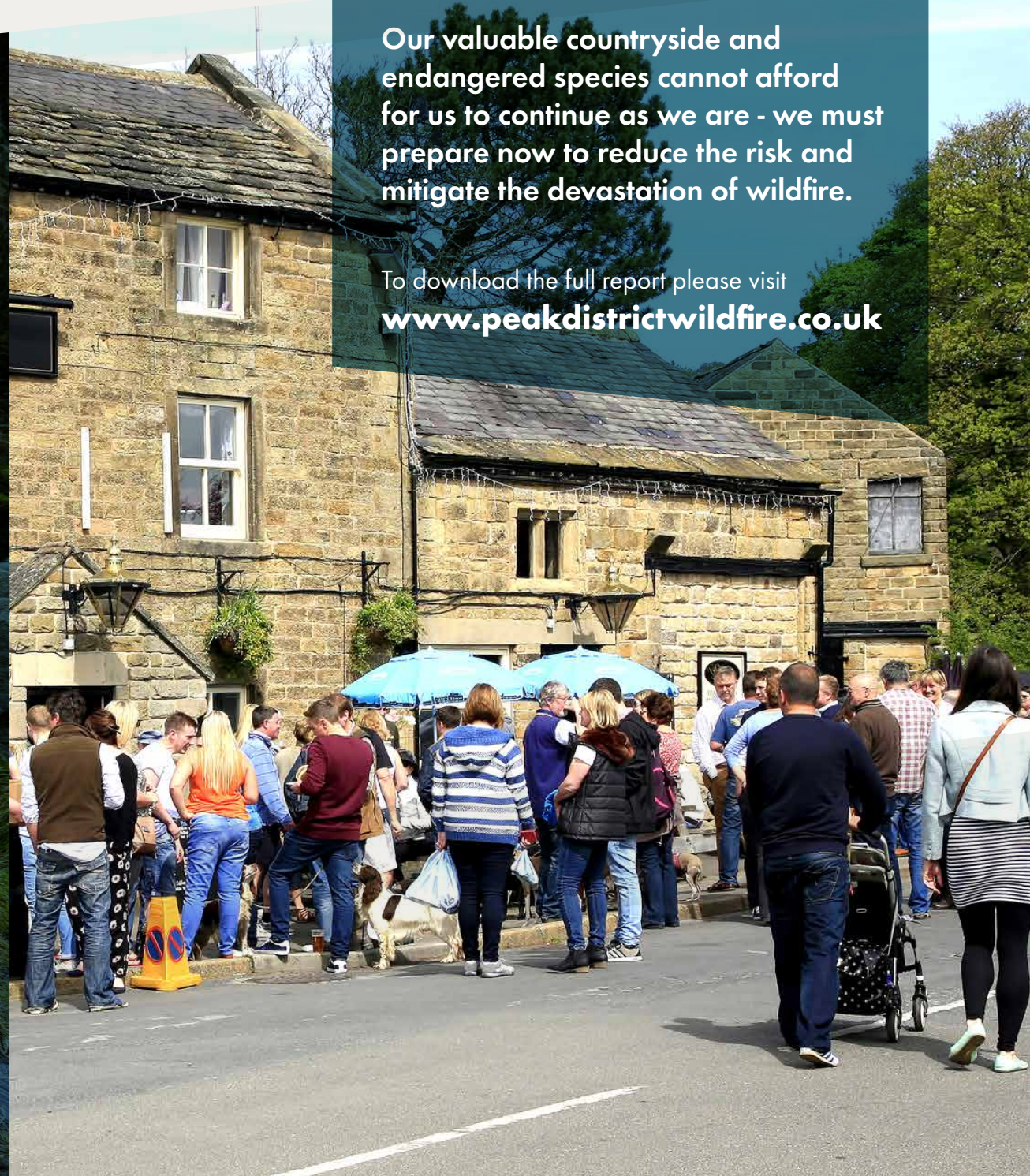
Marc is a forest ecologist from University of Lleida (Spain) and serves in the Catalan Fire Service as a Strategic Wildfire Analyst and Incident Commander as well as being Chief of the GRAF (Specialist Wildfire Unit Catalanian FRS). He is also a Wildfire Expert for the European Civil Protection and Humanitarian Aid Operations (DG ECHO). Marc has extensive experience of wildland fire fighting across the globe. He has been a senior expert for the European Forest Institute since 2014, the International Monetary Fund for crisis management in 2009-2010, and was awarded the Montero Burgos prize in 2017. He is an associate professor at University of Lleida, and has a PhD in Atmospheric Physics and Wildfire (Waweningen University, Netherlands). Marc took part in EU missions to Chile, Bolivia and Portugal, and provided advice to CALFIRE during wildfires in California in 2020 and 2021.

Mercedes Bachfischer

Mercedes was raised in Argentina, where she studied Environmental Management at the National University of Patagonia San Juan Bosco. Her career in wildfire began working at a provincial Fire Service for ten years with responsibility for information management (statistics, GIS, remote sensing), wildfire season assessment, and cartographic and meteorological support during incidents. She also worked as an instructor for the Wildfire Management National Service. She is currently a data analyst and researcher at The Emergency Program, a global wildland fire training programme in Catalonia. Mercedes is part of international wildfire strategic support teams, such as FAST (Fire Analysis Support Team) for the European Civil Protection and Humanitarian Aid Operations.

Our valuable countryside and endangered species cannot afford for us to continue as we are - we must prepare now to reduce the risk and mitigate the devastation of wildfire.

To download the full report please visit www.peakdistrictwildfire.co.uk





**We need the continued support
of decision makers at local,
regional and national levels.**

To answer the initial call by the Peak District National Park CEO, this project was intended to be applied to all the focus areas within the whole of the Peak District moorland area. It remains vital that this report will be the catalyst for more wide-spread engagement and provide the impetus for greater protection for biodiversity, carbon and people across the Peak District and far beyond.



The Steering Group

Download the Full Report and the Short Report here:
www.peakdistrictwildfire.co.uk

