Public perceptions of wildfire in Great Britain: case studies from Wales, England and Scotland

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ABSTRACT

Wildfires pose significant risk to the environment and society of Great Britain, a threat that remains largely unrecognized by the public. The sheer number of vegetation fires, although mostly small, exert significant pressure on Fire and Rescue Services and environmental management organisations. They present unique challenges, including being an emerging and under-researched issue.

This exploratory research project aimed to address underexplored areas of the public's understanding of local wildfire hazards and ascertain the relevance to them. Given the highly contextual nature of wildfires, a case study approach was employed, encompassing three locations: the South Wales Valleys, Dorset in England, and the Highlands in Scotland. It collected survey data on risk perception and awareness, as well as attitudes towards prescribed fire.

Underscoring the perceptions of risk was local knowledge, where many residents were strongly connected to the locality. Across locations there was a characteristic subgroup with significant concern regarding wildfire in their area, and then a smaller subgroup concerned for themselves personally. The predominant sentiment was concern for "other's" and typically the non-human. However, despite a perceived lack of direct impacts, consequences were not entirely negated, through care for the area and nature; this indirect concern presents an avenue for fostering engagement. Notably, the study also identified a group that exhibited little or no concern, with some disputing the applicability of the term "wildfire" to the British context. Regarding acceptability of fire there was mostly partial acceptance, although there are some stronger views in favour particularly where there is a perceived necessity or understanding of the benefits. The disagreement and uncertainty demonstrated a lack of knowledge of outcomes and conflation with wildfire phenomena. Overall, the findings highlight gaps in knowledge and the need for localised information to establish greater relevance of risks to the public.

DECLARATIONS

1

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

Signed: [redacted]

Date: 31.12.23

2

This thesis is the result of my own investigations, except where otherwise stated and that other sources are acknowledged by giving explicit references and a bibliography is appended.

Signed: [redacted]

Date: 31.12.23

3

I hereby give consent for my thesis, if accepted, to be available for electronic sharing.

Signed: [redacted]

Date: 31.12.23

4

The University's ethical procedures have been followed and, where appropriate, that ethical approval has been granted.

Signed: [redacted]

Date: 31.12.23

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LIST OF ABBREVIATIONS

Acronym	Meaning
AIDR	Australian Institute Disaster Resilience
AONB	Areas of Outstanding Natural Beauty
BBNP	Brecon Beacons National Park
BCP	Bournemouth, Christchurch, and Poole
CIFFC	Canadian Interagency Forest Fire Centre
CROW	Countryside and Right of Ways
CRR	Community Risk Register
DCLG	Department for Communities and Local Government
DEFRA	Department for Environment, Food and Rural Affairs
DERC	Dorset Environment Research Council
DWFRS	Dorset and Wiltshire Fire and Rescue Service
EFFIS	European Forest Fire Information System
EWWF	England and Wales Wildfire Forum
FAO	Food and Agricultural Organisation of United Nations
FCE	Forestry Commission England
FRS	Fire and Rescue Services (UK)
GFMC	Global Fire Monitoring Centre
HH	Healthy Hillsides
IFM	Integrated Fire Management
IP	In-person survey sample
IRS	Incident Recording System
JHI	James Hutton Institute
KfWf	Knowledge for Wildfire
MFFP	Moors for the Future Partnership
NFNP	New Forest National Park
NFPA	National Fire Protection Association (USA)
NPS	National Parks Service (USA)
NRR	National Risk Register
NRW	National Resources Wales

NSA	National Scenic Areas (Scotland)
ON	Online survey sample
ONS	Office of National Statistics
PDNP	Peak District National Park
RCT	Rhondda Cynon Taf
RSPB	Royal Society for the Protection of Birds
RUI	Rural-urban interface
SAC	Special Area of Conservation
SFRS	Scotland Fire and Rescue Service
SPA	Special Protection Area
SSSI	Sites of Specific Scientific Interest
SWF	Scotland Wildfire Forum
SWFRS	South Wales Fire and Rescue Service
TSWRC	The Southwest Research Company Ltd
UHP	Urban Heaths Partnership
UKFDRS	UK Fire Danger Rating System
WHO	World Health Organisation
WUI	Wildland-urban interface

CHAPTER 1: INTRODUCTION

1.1 Introduction to the thesis

This thesis delves into how the British public understands wildfire risk, a subject previously lacking dedicated research. Despite the growth of wildfire research in Britain and calls for knowledge on the subject, the human-hazard relationship of wildfire risk in its communities remains underdeveloped. This gap is particularly surprising given the potentially fascinating insights that could be gleaned from comparing a region where wildfires were historically rare (a non-fire-prone country) to areas where they are commonplace (fire-prone countries). As wildfire risk in Britain rises, filling this knowledge void is imperative for bolstering resilience. Prospects of increased wildfire threat presents formidable challenges to those tasked with its management, compounded by a public that often lacks awareness and wildfire-specific knowledge. This project aims to uncover what residents know about the risks they face and what concerns occupy their thoughts, as well as noting links to beliefs about climate change and the use of fire. The overarching aim was gaining public knowledge and attitudes. The key target data was public-facing, generalised opinions.

This thesis collates three case studies findings, using survey research targeting residents in an area in the South Wales Valleys in Wales, Dorset County in the south of England, and the West Highlands in Scotland. Exploring various fire contexts in different environments and locations across Britain. It examines themes of wildfire risk perception, awareness, knowledge, and the acceptability of prescribed fire.

The research revealed some local awareness of wildfire hazards, characterised by a subgroup with significant concern regarding local wildfire risks, and to a lesser extent, personal vulnerability. Concern for wildfire is heightened where the possibility and probability of wildfires are perceived to increase, influenced by local ignition issues, climate change, and the severity of potential consequences. Despite the country not being associated with the risk, there is local acceptance, likely where the hazards are firmly placed in local context and awareness of specific occurrence rather than a general association of living in an environment associated with wildfire. However, outside of this subgroup, many remain apathetic or unaware of the risks. While there is some concern, barriers to perception, minimisation of impacts, and a lack of preparedness knowledge are evident, highlighting key areas for public education.

The findings align with dynamics observed elsewhere, such as how risk is constructed and factors influencing fire use attitudes. On the other hand, unlike fire-prone countries, additional barriers to wildfire perception exist in Britain. The perception of a 'too wet' climate, the idea that anthropogenic ignitions negate the concept of [natural] 'wild' fires, and the perceived small scale of British wildfires contribute to apathy and a disconnect from the perceived 'true' wildfires in fire-prone regions. This disparity between public and expert perspectives of wildfire in Britain underscores the need for unidirectional engagement to raise awareness. Additionally, negative experiences with authorities during past events that were inadvertently collected, highlight the necessity for improved preparedness and community inclusion in planning efforts.

This introductory chapter sets the context for understanding British [or UK] wildfires, outlines the objectives of this thesis, and previews its structure. Following the introduction, the thesis presents the methodology, the three case studies, and a comparative chapter synthesising findings to draw a national perspective on public wildfire awareness.

1.2 Global and UK wildfire

1.2.1 What is a wildfire?

Public perspectives may differ from that of experts, so it is crucial to ascertain what is being referred to here and how is this accepted within research. Wildfires are ‘uncontrolled vegetation fires’. The phenomenon is perhaps easily understood by contrasting it to prescribed fire (e.g., CIFFC, 2017), hence are uncontrolled, unwanted, or unplanned (CIFFC, 2017; FAO, 2007; NPS, n.d.; Scottish Government, 2013; WHO, n.d.). A prescribed fire on the other hand would be defined as “any supervised burn conducted to meet specific land management objectives” (Santin & Doerr, 2016, page 6). There is various nomenclature to refer to the same phenomena. Often, wildfires are named by de factor terms depending on where you are in the world such as “bushfire” being a preferred term in Australia (AIDR, n.d.; Russell-Smith *et al.,* 2007); “wildland fire” commonly used in US (Monroe & Nelson, 2004; Toman *et al.,* 2011) and “forest fire” the widely used term in Europe (FAO, 1999; Tedim *et al.,* 2015a). Names also vary by the type of vegetation burned, including forest fire, savanna fire, brush fire, scrub fire, grass fire, and peat fire (Moore, 2019; Stacey *et al.,* 2012), although these terms may be used regardless of vegetation type, where forest fire is a general term used in Europe, or bushfire being used in Australia.

More generally, other terms may be encountered which refer to the occurrence of vegetation fires without reference to their value, such as vegetation fire, landscape fire, fire on Earth, biomass fire (Bowman *et al.,* 2020). These are often used when talking generally, often the case in physical, ecological or biological research, although perhaps ambiguously wildfire may be used interchangeably in these general instances of vegetation fires. It is also worth noting that prescribed fire also has various terms such as, managed burn, controlled fire, or controlled burn (Belcher *et al.,* 2022; Stacey *et al.,* 2012). On one hand, it may be appropriate to use these various synonyms interchangeably; however, they do represent specific socio-cultural meanings of fire on the landscape (Robinne et al., 2018), as well as representing the perspective of the research discipline from which the literature is being read. The possibly self-explanatory terms illuminate something about the affected land (wildland) or vegetation (forest, shrub, grass), and the cultural, research or political framework (prescribed, agricultural, biomass).

Wildfire has been classified in various ways including ‘ecological disturbance, ‘ecological perturbance’, ‘socio-ecological disturbance’, ‘ecosystem service’, ‘natural hazard’, ‘semi-natural hazard’, and ‘climate-sensitive hazard’ (Tedim & Leone, 2020). Moreover, Tedim and Leone (2020) also note that even within the same research field, wildfire is thought of in various ways, speaking to the myriad vocabulary which may be confusing to those introducing themselves to the subject as much as it wastes energy on clarifications of those deep into wildfire research. The ‘dilemma of definition’, as Tedim and Leone (2020) termed it, is that wildfires are entangled in a quagmire of subtly or significantly varying vocabulary. However, research faces other issues regarding wildfire knowledge, including the wickedness of its occurrence.

How wildfire is included in research has undergone some transformation. As the context of fire on Earth has changed, various disciplines have taken interest with the phenomena. The phenomena, however, is a wicked one (Allen & Gould, 1984; Carroll *et al*., 2007), which spans and connects processes across research disciplines, for example are complex of have multiple causes spanning social, physical, biological, and ecological disciplines, as well as crossing socio-political boundaries requiring multiple agencies, authorities, or nations (Roos *et al*., 2016). This is why it has been argued as to best understand wildfire, it has been argued there is a need for inter-, trans-, multi-disciplinary research (Coughlan & Petty, 2012; Stoof & Kettridge, 2022).

The global and regional wildfire problems and increasing risks ((Gill *et al.,* 2013; Cohen, 2008; Gill & Stephens, 2009; Mell *et al.,* 2010; Shafran, 2008; Tedim *et al.,* 2015a; Tedim *et al.,* 2015b) has led to increased interest in wildfire phenomena (McCaffrey *et al*., 2013; Toman *et al*., 2013). Moreover, failures of previous policies and the increasing inefficiency of suppression has meant a re-evaluation of management strategies (McCaffrey, 2004a). Suppression policies are criticised for not addressing the ecological role and the lack of sustainability have led to shifts in wildfire management perspectives (Moore, 2019; Myers, 2006; Rego *et al*., 2010; Sande Silve *et al*., 2010). This has also led to shifts in research perspectives. As Stoof and Kettridge (2022) point out, in an age of research where it is accepted that previous approaches of perceiving all fire as 'bad' and wanting to put it out, in order to live with fire there must be diversity, and connection of fire knowledge across cultures, countries, and science (thus interdisciplinary). These failures of management and learnings of new research mean wildfire has somewhat been put into perspective as a global and constant (Andela *et al.,* 2017; Bowman *et al.,* 2011; Flannigan *et al.,* 2009; Forkel *et al.,* 2019; Giglio *et al*., 2013; Krawchuk *et al.,* 2009; Mouillot & Field 2005; Randerson *et al*. 2012; Scott *et al.,* 2014), as well as normal, historic, and vital phenomenon for both ecology (Bixby *et al*., 2015; Bowman *et al*., 2009; He *et al*., 2019; Scott, 2000; Scott & Glasspool, 2006) and humans (Brain & Sillent 1988; Gowlett, 2016; Pyne, 1997, 2016; Pyne & Goldammer, 1997; Rolland 2004; Roos *et al*., 2014; Scott *et al.,* 2014).

Wildfire research has thus shifted, previously focusing more on physical aspects of research with demands for ecological and socio-ecological framings of fire (Pyne, 2007). There has been increasing shifts in research perspectives where the prominence of wildfire risk has highlighted focus of wildfire as a natural hazard (McCaffrey, 2004a). This social research aligns with other natural hazards literature using a geographical approach to risk theory (Kendra, 2007), as well as wider risk perception theory which asserts that individuals subjectively and qualitatively judge risks (Fischhoff *et al*., 1984; Sjoberg *et al*., 2004; Slovic *et al*., 1987, 2004; Slovic, 1987, 1999; Wilson *et al*., 2019).

A key interest for research as risk has increased has been that uncontrolled vegetation fires are natural hazards (McCaffrey, 2004a; Moritz *et al.,* 2014). Although wildfire has possibly not always been regarded as a natural hazard (McCaffrey, 2004a), the changing levels of risk and consequences bring focus to it as a hazard. However, it is pertinent to point out here that the occurrence of wildfires happens at the convergence of multiple forcings, both anthropogenic and natural (Flannigan *et al.,* 2005; Flannigan *et al.,* 2009; Flannigan *et al.,* 2013; Fischer *et al.,* 2016; Gill *et al.,* 2013; Roos *et al.,* 2016; Scott *et al.,* 2014). Thus, they may also be classified as semi-natural hazards (Cavan & McMorrow, 2009; Gazzard *et al.,* 2016), or possibly quasi-natural hazards or environmental hazards (Smith, 2013). Regardless, the step to include wildfire in natural hazards research, or use the discipline's theories and methodologies has been crucial in understanding the phenomena. The inclusion of social research helps to answer key questions about how to best manage (considering social and ecological outcomes) (Moore, 2019; Myers, 2006; Sande Silve *et al*., 2010) and encourage mitigation from communities adversely affected, understanding key questions about why people may react differently or favour different management techniques (McCaffrey, 2004a).

1.2.2 UK perspective on wildfire

1.2.2.1 Wildfire in the UK: definitions, responsibilities, frequency, magnitude

The UK perspective on wildfire does arguably differ to more global views as it is not a traditionally fire-prone area and instead is experiencing different and somewhat novel risks. Principally, UK wildfire hazards are not on the same scale as fire-prone area like Australia or the Mediterranean, although this is not to say that wildfire risk is insignificant, events can be large, and do pose challenges (McMorrow, 2011; Scottish Government, 2013). The accepted definition across agencies is one set out in Fire and Rescue Service (FRS) guidance: "*Any uncontrolled vegetation fire which requires a decision, or action, regarding suppression*" (Scottish Government, 2013, page 10). This has been described as a liberal definition as all non-prescribed theoretically fall within this definition because a zero-tolerance policy towards fire means all must be attended by Fire & Rescue Services (Gazzard *et al.,* 2016). The guidance by Scottish Government (2013) does itself point this out, arguing that for a more logical categorisation practitioners need to differentiate a wildfire event from more numerous small vegetation fire events, although these criteria are rarely referred to and instead most often reports and literature group all FRS vegetation fire incidents together. The criteria for categorising a wildfire as such, includes one of the following: be larger than 1ha, have a sustained flame length of at least 1.5m, require at least 4 FRS appliances, require more than 6 hours of resources, or present a serious threat to life, environment, property or infrastructure.

A key starting point is understanding the frequency and magnitude of wildfire occurrence in the UK, in order to achieve this must look at wildfire records. There is no single agency responsible for wildfire in the UK, where the FRS become a de facto practitioner through its statutory obligation as the fire service to fight fire (McMorrow, 2011). Due to the densely populated nature of the UK, there is a zero tolerance to fire (Gazzard *et al.,* 2016). Wildfire is a wicked problem in the UK where responsibilities spread across various governmental departments and management of the hazard cycle is also split across agencies (Gazzard *et al.,* 2016). There is therefore no dedicated wildfire agency responsible for its management, and no dedicated wildfire records. The records held by FRS are the most complete wildfire data available, for which the standardised Incident Recording System (IRS) was introduced in 2009 (McMorrow, 2011). While this provides some details of wildfire events, there are limits for its application to wildfire records, where it is not dedicated some parameters are not suited to recording events, for instance it is structured by financial year which splits the spring wildfire season. Additionally, there are crucial inaccuracies in location, the categorisation of property type, and estimated size (Gagkas *et al.,* 2021). Under this system incidents are categorised as primary or secondary; criteria for a primary fire include, being in non-derelict buildings, vehicle, or outdoor structure; involving a causality or rescues; or attended by five or more appliances (Welsh Government, 2022). As most vegetation fires in the UK are small, the majority fit within the secondary category. This classification does usefully offer a proxy measure for classifying more 'true' wildfire events versus minor vegetation fires, that is primary or secondary incidents respectively. Another measure of wildfire in the UK is utilising satellite observations as a wildfire record. A key limitation to this dataset is that it only captures larger events, estimated as those over 30 ha, and as so many of UK wildfires are small, there would be many UK events omitted making it an incomplete dataset (Belcher *et al.,* 2022).

Moreover, the devolved governments also present challenges for understanding the UK wildfire records, where records and analysis differ between countries within the UK. There is a lack of a nationwide synthesis of data, although one analysis by Forestry Commission for

Great Britain found a range of 20,000 to over 60,000 per year between 2009/10 to 2012/13 (financial years) (Gazzard, 2014).

Individual publications by England, Scotland, and Wales to provide statistics individually. For England, Forestry Commission England (FCE) used FRS incident data for vegetation fire call outs between April 2009 and March 2021, findings approximately 30,000 vegetation fires per year (FCE, 2023). FCE (2023) did create a subset including only major wildfires using the above national operational guidance, finding 12,000 classified as primary incidents, and 13,000 according to another 'major' wildfire classification (FCE, 2023). In Scotland according to FRS records there were a total of 132,829 vegetation fire incidents between April 2009 and December 2020, averaging at over 11,000 a year (Scottish Government, 2022a). Further was analysis conducted which filtered these incidents to a more specific wildfire dataset, resulting in 9745 across the whole period; of these 1,325 were greater than 1000m^2 (Gagkas *et al.,* 2021). Wales, a smaller area, has 2000-4000 annually (2012 to 2021) (Welsh Government, 2022); South Wales in particular has a very high number of ignitions (Welsh Government, 2022; Jollands *et al.,* 2011). This begins to describe the magnitude of wildfire, but differing classifications and analysis make comparing and combining country records difficult.

The majority of wildfires in the UK are small due to the country's dense population, fragmented fuel sources, and immediate suppression efforts (Arnell *et al*., 2021b; Gazzard *et al*., 2016). Taking England as an example, 99.5% of incidents were less than 1ha, and half were less than 5m^2, burning a total of 79,000 ha, with annual variations from under 3,000 ha to over 26,000 ha (FCE, 2023). A summary of the magnitude of wildfires in England is shown in Table 1.1.

<table>
<tr><th colspan="6">Size of wildfires in England</th></tr>
<tr><th>Group</th><th>Size of wildfires in group</th><th>Number of fires</th><th>Notes</th><th></th><th>Number of fires</th></tr>
<tr><td>SMALL
(And very small)</td><td>< 1ha</td><td>360,833</td><td>Of which:
(very small)
53% ≤ 5 m²
16% 6 - 10 m²</td><td>SMALL</td><td>360,833</td></tr>
<tr><td>MEDIUM</td><td>1 - 49 ha</td><td>1303</td><td>(80% of non-small)</td><td rowspan="4">NON-SMALL</td><td rowspan="4">1,633</td></tr>
<tr><td>LARGE</td><td>50 - 99 ha</td><td>45</td><td></td></tr>
<tr><td>VERY LARGE</td><td>100 - 999 ha</td><td>67</td><td></td></tr>
<tr><td>LANDSCAPE</td><td>≥ 1,000 ha</td><td>18</td><td></td></tr>
<tr><td>TOTAL</td><td></td><td>362,466</td><td></td><td></td><td>362,466</td></tr>
</table>

Table 1.1 – Size of IRS recorded wildfires in England from financial years 2009/10 to 2002/21, summarised from FCE (2023).

1.2.2.2 Wildfire in the UK: temporal and spatial distribution

The UK has two wildfire seasons, spring and summer (McMorrow, 2011). As a moisture-limited system, fuel moisture is a key factor in UK wildfires; the drying of vegetation in spring is considered the primary driver (Grau-Andrés *et al*., 2018; Belcher *et al.,* 2022). Having said that, being a moisture limited does mean that it is possible for fires to occur throughout the year despite varying temperatures (Belcher *et al.,* 2022). The main peak in spring is demonstrated by a daily average in January 2003 of 40 heathland and grassland fires, compared to 762 and 1,010 in March and April the same year (Scottish Government, 2013). April is the most often the month highlighted by FRS incident records across datasets and analyses (FCE, 2023; Glaves *et al.,* 2020; Scottish Government, 2022a; Welsh Government, 2022). However, intra-annual variation can occur meaning the timing of wildfires within the year may change, such as a late spring or drier summers. Such as in 2018 observed across the UK, where more wildfires occurring in summer compared to spring, peaking in July (Scottish Government, 2022a; Welsh Government, 2019a). The Welsh bulletin helpfully compares this to rainfall and sunshine hours (Welsh Government, 2019a, page 15-16), demonstrating that higher rainfall in April and May compared to other years (e.g., Welsh Government 2020, page 15; and Welsh Government, 2021, page 15) which reduces up to July correlate to wildfires later in the year. Moreover, there is inter-annual variation, where more occur overall in drought years, such as 1995, 2003, 2011 (and possibly 2018, 2019) and fewer in wet years (Belcher *et al.,* 2022; McMorrow 2011). This has been described as an intermittent or sporadic occurrence pattern (McMorrow, 2011; Gazzard *et al.,* 2016). There are crucial and complex dynamics in this variation, where for instance, wet years allow fuel-build up (McMorrow, 2011) but the intermittent behaviour may mean lapse in attention on the issue and diversion of resources (Gazzard *et al*., 2016).

Next, considering the distribution of wildfire throughout the UK, as a temperate region and moisture limited fire system (Belcher *et al.,* 2016), there is plenty of vegetation for fuel for wildfire in the UK. They occur in vegetated spaces across the country, although some are more prone to experience fire risk. This includes semi-natural habitats, such as heathland, grassland, moorland, peatlands, and a somewhat lesser extent forest (Belcher *et al.,* 2022; de Jong *et al*., 2016; Glaves *et al.,* 2020; Lindley *et al.,* 2006; McMorrow, 2011; Vanha-Majamaa, 2006). Examples for UK wildfires in these semi-natural areas can be found in Figure 1.1 and Figure 1.2.

Wildfires in UK open habitats (grassland, heathlands, moorlands and peatlands)

Studland Heath, Dorset,
August 2022 (BBC, 2022a)

Saddleworth Moor, Manchester,
June 2018 (BBC, 2018)

South Wales, April 2020
(Courtesy Craig Hope)

Figure 1.1 - A selection of typical wildfires across GB in open habitats which typically burn larger areas.

Wildfires in UK forests and woodlands

Swinley Forest Fire, England, May 2011 (Belcher *et al.,* 2022, page 7)

Moray, Scotland, 2019 (Belcher *et al.,* 2022, page 7)

Cwmcwrn Forest, Wales, 2018 (Courtesy of Craig Hope)

Figure 1.2 - A selection of typical wildfires across GB in forests which, although rarer, can experience severe fire behaviour and crown burning.

Larger expanse of vegetation increases wildfire risk where it is able to spread, where open habitats (heathlands, peatlands, moorlands, and grasslands) have a particular propensity for larger fires [area burned] making up a majority of large fires (>30ha) (Belcher *et al.,* 2022). For instance, the majority of MODIS detected fires (biased to larger events) analysed by McMorrow (2011) showed 57% of fires from November 2006 to June 2010, occurred on scrubland, herbaceous moors, and heathland, and just 5% on forest land. The estimated figure from FRS incident records is much higher, where it has been suggested that open habitats account for 80% of area burned in Britain according to IRS statistics (Gazzard, 2014).

Furthermore, fuel type and characteristics are highly consequential for fire risk. In the UK, gorse on heathlands is a key fuel which has long been associated with fire risk (Bruce *et al.*, 2006). These highly flammable species has been described as 'fire-adapted', where fire has encouraged germination and presented succession beyond the open habitat perpetuating its dominance in the ecosystem (Davies *et al.,* 2008).

Adding to this, mountain, moorland and bog have been highlighted for their wildfire risk owing to the fuel type, topography, and difficulty in suppression (Albertson *et al.,* 2010; Gazzard *et al.,* 2016); these often remote and difficult to traverse terrain coupled with the flammable fuels result in the potential for larger or longer lasting [difficult to access and suppress] fires.

Forests generally have low fire risk in the UK unless there are exceptional weather conditions, are young plantations of conifers, or are adjacent to heather ecosystems (Davies & Legg, 2016). Conversely to open habitats, forest fires make up a small proportion of area burned in the UK (McMorrow, 2011; Vanha-Majamaa, 2006). They have been argued however to make up larger proportion of the number of fires compared to the area burned (Belcher *et al.,* 2022). Moreover, although rarer, intense forest fires have been observed crown fires, in the canopy of trees (Scott *et al.,* 2014) do occur in the UK such as during the Swinley Forest fire in May 2011 (Oxborough & Gazzard, 2011; Belcher *et al.,* 2022). Very large fires do occur in forests, risking significant infrastructure and assets, another example being Wareham Forest in May 2020 (Belcher *et al*., 2022).

The value of these habitats exacerbates the fire risk. Interestingly, it has been pointed out that the most fire-prone areas of the UK, open habitats, often coincide with designated protected landscapes [such as National Parks, Sites of Specific Scientific interest (SSSI), Special Protection Areas (SPA), Special Areas of Conservation (SPAC) and Areas of Outstanding Natural Beauty (AONB) - or National Scenic Areas (NSA) in Scotland], hence increasing the environmental consequences of fire in these places (Belcher *et al.,* 2022). Additionally, heathlands have internationally significant value where the biodiversity is internationally recognised, as well as vital provisioning, supporting, regulatory and cultural ecosystem services (Glaves *et al.,* 2020). These habitats are already under stress, by fragmentation, loss, and human interference generating greater vulnerability (Cordingley *et al.,* 2015), making them more vulnerable. Dorset is an area which has many internationally recognised areas including SAC, SPA, and SSSI; moreover, many of these heathlands are in the form of small pockets of urban heaths, being close to or fragmented by built-up areas, roads, buildings (Dorset Council, 2023a; Panter, 2018; Panter & Caals, 2023). Exemplifying the importance of these areas, is the initiation of the Urban Heaths Project, set up due to these concerns, including receiving £1.2 million in European funding for the Urban Heaths LIFE project (Dorset Environmental Records Centre [DERC], 2023). Moreover, peatlands habitats or those that sit over peat, carry significant concern for fire risk due to the adverse environmental consequences of burning peat (Bain *et al.,* 2011; Carroll *et al.,* 2009; Vanha-Majamaa, 2006).

Beyond these semi-natural habitats, another crucial space for high fire risk in the UK is near built-up areas or at the rural-urban interface (RUI). This is a UK equivalent of the wildland-urban-interface (WUI), the place of high fire risk elsewhere in the world; as the UK lacks landscapes like ‘wildlands’ in the north American sense of the word, the term WUI has been pointed out as inappropriate for the UK (Gazzard *et al.,* 2016; McMorrow 2011). There are a high number of fires in the RUI, but it accounts for low area burned due to discontinuous fuel; for instance, built-up areas account for annually around 16,000 fires but only 171ha per year (Belcher *et al.,* 2022). Crucially, these areas have characteristically high ignition risks due to the proximity of fuel and people, and high access (Belcher *et al.,* 2022; Bruce *et al*., 2006; Gazzard *et al.,* 2016; Glaves *et al.,* 2020; Grundy & McMorrow, 2013; Vanha-Majamaa, 2006). The RUI is also a crucial place of risk for fire management due to the potential consequences as people, property, and infrastructure is present, increasing risk life and assets (Belcher *et al.,* 2022). Some examples of wildfires near built-up areas are shown in Figure 1.3.

Wildfires in the 'high risk' RUI

Wildfire near Fort William, Scotland (BBC, 2022b)

South Wales Valleys (Courtesy of Craig Hope)

Upton Heath, Dorset, (Ford, 2020)

Wildfire scars near the boundary of residential areas in South Wales (Belcher *et al.,* 2022: page 6)

Figure 1.3 – A selection of images of wildfire in the RUI across GB, a location of high ignition risk and high potential threat to life and property.

Next, considering more specific locations of fire risk in the UK, there are places which may be considered hot spots. A map of area burned by MODIS detected wildfires over a five-and-a-half-year period demonstrates that large wildfires are spread across the UK (Figure 1.4). Places to note from Figure 1.4, include McMorrow (2011) highlighting Northern England (Northumberland, North York Moors, Pennines, Peak District and Cumbria), South Wales, Dorset (see Figure 1.4B). An analysis of Community Risk Registers (CRR) by McMorrow (2011) highlighted stakeholder concerns of wildfires in Northumberland, South Wales, and Cumbria. In a separate case Glaves *et al.,* (2020) highlight similar areas, specifically South Wales, Dorset, Southern Pennines, and Highlands. Northern England has been highlighted as above, as well as being a hotspot for wildfire research in the UK, particularly in the Peak District and Pennines (e.g., Albertson *et al*., 2009; Albertson *et al.,* 2010; Cavan & McMorrow, 2009; McEvoy *et al.,* 2008; McMorrow *et al.,* 2010), demonstrating the pertinence of this location. South Wales is also often highlighted (Belcher *et al*., 2022; Glaves *et al.*, 2020; McMorrow, 2011); this is an area of significance where there is a very high number of ignitions. Jollands *et al.,* (2011) has previously suggested that South Wales experiences 8-fold the number of fires per unit area than the UK as a whole (as of 2000-2008 statistics); this high activity is associated with arson.

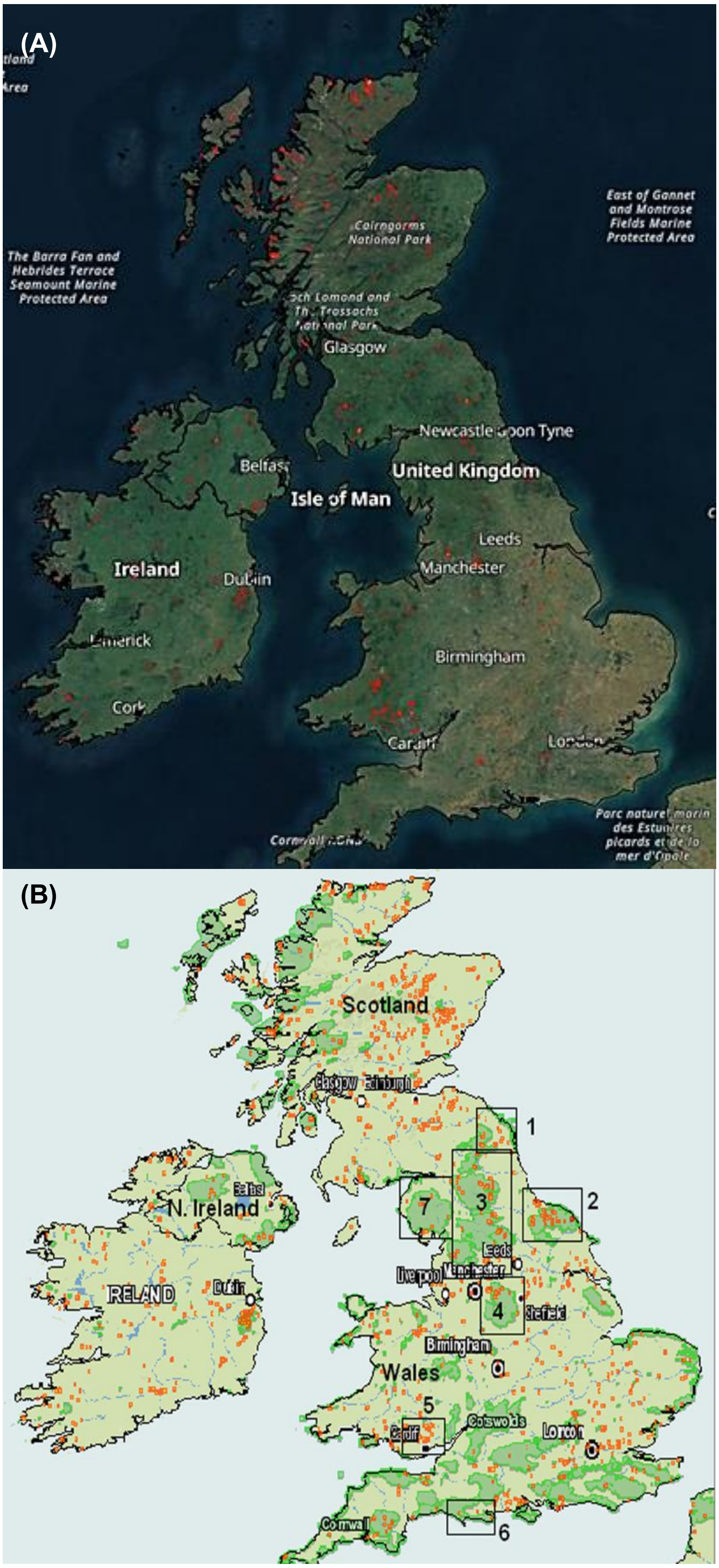


Figure 1.4 – (A) MODIS detected area burned for UK from 1st Jan 2018 to 19 Sep 2023 (European Commission, 2023). And (B) Wildfire hotspots according to McMorrow (2011: page 47) of MODIS hotspot for wildfires in the UK between 1 Jan 2003 and 29 March 2010 in orange and protected lands in green. Highlighting areas: 1, Northumberland; 2, North York Moors; 3, Pennines; 4, Peak District; 5, South Wales; 6, Dorset; 7, Cumbria.

Moreover, despite not being discussed by McMorrow (2011) Scotland has a notable presence of fires in both Figure 1.4A and B. Scotland was highlighted as place of fire risk in UK by Bruce *et al*. (2006), echoed by Luxmoore (2018) with an emphasis on the role of escaped burns. Moreover, the review by Glaves *et al.,* (2020) highlighted the Highlands in Scotland as an area of high activity. The rural area is highlighted as having high occurrence and area burned in analysis of Scottish Fire and Rescue Service (SFRS) data (Scottish Government, 2022a), although, as Glaves *et al.,* (2020) notes this is partially contributed by its large size.

1.2.2.3 Wildfire in the UK: impacts, risks and their acknowledgement

The UK therefore experiences wildfire, despite not being traditionally fire-prone nor associated typically with wildfires (Scottish Government, 2013) and events can be large, such as the Wareham Forest Fire which required national coordinated responses (Belcher *et al.,* 2022). The UK thus experiences the effects of wildfires, as mentioned above, there are environmental consequences, of which can be exacerbated by the vulnerability of the ecosystem they occur on. Moreover, where they occur near more densely populated centres there is a more significant economic and human risk. Additionally, there are significant impacts as a result of the number of vegetation fires, which put significant strain on resources, primarily FRS resilience (McMorrow, 2011; Scottish Government, 2013). The response costs to the FRS alone have been estimated at £55 million annually and more in more severe years (Gazzard *et al*., 2016). Large fires can be resource extensive and expensive; such as, a large moorland fire in the Peak District in July 2006 had 30 days of firefighting which equated to £1 million (McMorrow, 2011). Furthermore, there are additional costs of loss of revenue, loss of timber, and restoration (Belcher *et al.,* 2022). For example, for the Swinley Forest fire in May 2010, on top of firefighting costs (estimated at over £500,000), there were further financial consequences of replanting, costs to businesses, and road closures, totalling an estimated £1,129,700 (Belcher *et al.,* 2022). Another Peak district fire in April 2003 burned 3 square miles of moorland, including protected areas, had smoke which resulted in closure of the airport and roads, and restoration alone cost £2 million (McMorrow, 2011). Recurrent wildfires, especially in protected areas, can be costly for the environment and those managing the environment, for instance, the Peak District National Park (PDNP) spent £16 million in restoration costs of recurring peat fires in the Peak District and South Pennines (Belcher *et al*., 2022).

There are a variety of impacts of wildfires in the UK. These are most often environmental, especially where they happen on valuable or protected landscapes or occur in remote uplands (Albertson *et al*., 2010; Belcher *et al*., 2022). Impacts may include destruction of semi-natural habitats (Whitehead *et al.,* 2021), damaging sensitive habitats (Grant *et al*., 2012), harming wildlife and conservation (Belcher *et al*., 2022), damage to freshwater catchments and other ecosystem services (Albertson *et al*., 2010), peat degradation (Caroll *et al.,* 2009; Bain *et al.,* 2011), loss of CO_2 especially in peat fires, loss of biodiversity, and resulting in long-term recovery needs (Belcher *et al.,* 2022) and costly restoration (Albertson *et al*., 2010). There are impacts on people and assets, especially those close to urban areas or infrastructure. Wildfires may affect infrastructure, assets, industry, agriculture, communities, transport, loss of income or closure of businesses, evacuation, and crucially, the safety of firefighters (Belcher *et al*., 2022). The impacts can also be far reaching, such as the spread of smoke and its resulting air pollution; of which a study has found evidence of in the UK already (Graham *et al*., 2021). There is also the strain on society; as mentioned the frequency of events impact the resilience of FRS's, putting pressure on a public-funded service, indirectly generating risk by removing FRS resources from elsewhere, and where it is a more novel issue it creates the extra expense of a need to invest in learning new expertise (Aylen *et al.,* 2006; Belcher *et al.,* 2022; McMorrow, 2011).

With the variety of risks to various environmental assets and society there are various stakeholders (meaning groups with vested interest or impacted by their occurrence) concerned about wildfire in UK. These stakeholders are affected in various ways; as Aylen *et al.,* (2006) puts it, the risk means different things to different groups. Some examples of these impacts include income for grouse estates, water pollution for catchment, a loss of amenity for the National Trust, threat to wildlife concern for the RSPB (Aylen *et al.,* 2006). The type of impacts plays into risk calculations, where McMorrow (2011) notes the typical impacts being environmental are difficult to value, although there are consequences for society, including clean water and aesthetics. Moreover, this consequents in underestimation of wildfire risks in the UK (McMorrow, 2011).

Wildfires are not new hazards for the UK, but the acknowledgement of the risk across is the UK is perhaps new. Acknowledgement for the hazards has been slow; for instance, it was only added to the National Risk Register (NRR) in 2013. This is despite concerns being raised at more local levels since the beginning in the 1990s (Gazzard *et al.,* 2016). After appearing in the 2013 NRR (Cabinet Office, 2013), wildfire has continued to be included (Cabinet Office, 2015). Political barriers have perhaps hindered focus on the risk where they occur in more rural areas which have smaller proportions of the population hence less interest (McMorrow, 2011). This is contrasted by a catalyst in wildfire receiving greater attention by central government was during the risk assessment process for the London 2012 Olympic Games (Gazzard *et al*., 2016). Other barriers to acknowledgement have been pointed out as the nature of the risk predominantly affected environmental assets which are largely undervalued (McMorrow, 2011).

1.2.2.4 Wildfire in the UK: trends and risk factors

There is the suggestion in literature that wildfire is increasing in the UK most notably that connected to the implication that the UK has already experienced longer warm spells (Belcher *et al.,* 2022). However, owing to the lack of historic wildfire records (IRS only introduced in 2009), it is difficult to discern trends (Belcher *et al.,* 2022). Similarly, there is evidence of increasingly visible wildfire across Northern European, despite being traditionally non-fire-prone areas (Prat-Guitart *et al.,* 2019). In fact, Belcher *et al*., (2022) conducted a comparison of wildfires in recent years in the UK to those in other northern European countries of similar latitude, finding a similar pattern, corroborating that fire conditions in temperate settings have become more common (Belcher *et al*., 2022). Additionally, anecdotal accounts from Fire Service officials draw on personal experiences of perceived increased lengths and scale of events, although these could not be matched to trends from satellite records which were short and incomplete (Belcher *et al*., 2022). Later the authors do also note that these databases do show that recent years (2018, 2019, 2020) have had more fires and greater area burned than in the last ten (Table 1.2).

Annual Area Burned by Major UK Wildfires		
Period	Number of fires accounting for damage	Area burned
Background annual average	25	6 550 ha
2019 (record high)	137	29 396 ha
2018	79	18 031 ha
2011 (previous high)	44	17 197 ha

Table 1.2 – Peaks in annual area burned by major fires in the UK (those large enough to be picked up by satellite, typically >30 ha) compared to annual average. Adapted from Belcher et al. (2022, page 23).

There is consensus that the UK will experience more, or larger wildfires as a result of climate change (Albertson *et al.,* 2010; Arnell *et al.,* 2021a; Arnell *et al*., 2021b; Belcher *et al.,* 2022; Davies *et al.,* 2013; McEvoy *et al*., 2006; Perry *et al*., 2022). Considering broader predictions of changing UK climate, crucially warmer, drier summers and more drought (Grau-Andres *et al.,* 2018; Jenkins *et al*., 2009) these would be more conducive to fire risk (Albertson *et al.,* 2010). Extremes in weather will be crucial for wildfires in the future in the UK where increased frequency and intensity of drought will change seasonal trends in fuel moisture (McEvoy *et al*., 2006). In other words, projected increases in drought will lead to greater frequency and severity of fires, and increased seasonal variability (Albertson *et al.,* 2010; Davies *et al.,* 2013). The years of 2018 and 2019 have been identified as the most recent peak in wildfire in the UK, with anomalous activity potentially connected to extreme weather (Belcher *et al.,* 2022; Arnell *et al.,* 2021a).

Notably, a recent paper by Perry *et al*., (2022) found that spring activity may remain similar but warned of increases in summer and potentially into autumn may mean more prolonged activity through the year. This is crucial for management of fire where this could increase the intensity of incidents to last across both spring and summer peaks. Moreover, it is important in these climate change discusses to consider the full dynamics of links between climate, fuel and fire regimes (Davies *et al*., 2008). For the UK, there is both the dynamic of warmer wetter winter leading to increased vegetation growth and hence enhanced fuel loads, as well as drier hotter summers would lead to conditions more conducive to fire (Perry *et al*., 2022); this exacerbates projections of fire risk further.

There are important factors beyond climate-weather changes to risk factors for wildfire in UK; hence projections of the future must include more than anthropogenic climate change as a risk factor. An important factor in changing risk has not only been drought, but also various environmental changes across the UK; this includes, declines in agriculture and changing land management, as well as cultural shifts (acceptance of prescribed fire and grouse moors). Firstly, changes in agriculture and reduction of grazing stocks (including sheep), as well as reduction in wild grazing of deer, resulting in reduces in grazing, leading to fuel accumulation and changing structure (reducing fire breaks) (Davies & Legg, 2016; Davies *et al*., 2008). The planting of trees, specifically young conifers has also added to fire risk (Bruce *et al*., 2006). Moreover, the pressure to reduce managed burning has been linked to increases in wildfire (Bruce *et al*., 2006; Davies *et al*., 2008). Demographic changes in rural areas, migration of older and retired populations and loss of young skilled work force, and rising labour forces, meaning fewer staff available for burning operations (Bruce *et al*., 2006; Davies *et al*., 2008). Factors such as ease of access, holiday periods, proximity to urban areas have been associated with ignition risks in UK (Glaves *et al*., 2020; Jollands *et al*., 2011; Mcmorrow *et al*., 2006).The problem of increasing fire risk in UK has been linked to the previous socio-political changes with the introduction of public access rights at turn of millennia, in form of Countryside and Rights of Way (CROW) act in 2003 in England and Wales, and Land Reform Scotland act in 2003 in Scotland, the increased access to countryside leading to greater ignition risks (Bruce *et al*., 2006; Davies *et al*., 2008; Davies & Legg, 2016). Moreover, considering the future, the climate change visitor economy is an interesting dynamic between human behaviours and fire risk in the context of climate change; there is a notion that fairer weather leads to more recreational activity in outdoor environments, especially where on National Parks or semi-natural landscapes, which could contribute to fire risk (McEvoy *et al*., 2006, 2008).

1.2.2.5 Fire on the UK landscape and prescribed fire controversy

Fire has been present on UK landscapes for centuries (Simmons, 2003; Worrall *et al.,* 2010). There are records of fire as a common land management tool going back to the late medieval period in southern England and Scotland (Fyfe *et al.,* 2003; Rackham, 1986); including evidence of swaling in Exmoor in the 1300s (Rackham, 1986) and a Scottish 'muirburn' act in Scottish parliament in the 1400s (Dodgshon & Olson, 2006). Moreover, there is potential evidence of use for hunting and land clearance dating back further than this, to the late Mesolithic or early Neolithic times (Davies *et al.,* 2008; Fyfe *et al.,* 2003; Tucker, 2003). The history of fire in the UK landscape is significant, shaping the open, treeless characteristic of modern uplands (Davies *et al.,* 2008). These areas are described as semi-natural; while they appear 'natural,' their form has been heavily influenced by centuries of human activity, including burning and grazing (Davies *et al*., 2008). UK heather and gorse are considered fire-adapted, as fire has encouraged seed germination and prevented succession, even in a non-fire-prone country (Davies *et al.,* 2008). Despite the importance of fire in shaping our modern landscapes, global Western societies have largely excluded fire from their practices, leading to a loss of traditional fire knowledge and an appreciation for its benefits and historical significance (Pyne, 2016). This trend is also evident among British populations (Davies et al., 2008).

Prescribed fire in the UK has been useful for agriculture (Worrall *et al.,* 2010). Various terms used around the UK to refer to controlled burns, illuminating the cultural significance of these fires, include swaling in Exmoor and muirburn in Scotland (Belcher et al., 2022). Initially, a key purpose of prescribed fire was land management for livestock grazing (Worrall *et al.,* 2010). Rotational burning has been the predominant method over the last 150 years (Davies & Legg, 2008). By creating a mosaic of burnt areas with various ages, on cycles of between 8 and 25 years (Tucker, 2003), the intention is it to have more diverse vegetation and encourage more palatable shoots which benefits the productivity of grazing pastures and increased red grouse populations for shooting (Worrall *et al.,* 2010). Later, strip burning on grouse moors began in the nineteenth century, although it did not become widespread until the 1900s (Worrall *et al.,* 2010). In sum, burning for grazing tends to involve large more infrequent burns, but burning for grouse is numerous and smaller scale (Yallop *et al.,* 2006) both of which continue to be used today (Worrall *et al.,* 2010). However, contemporary guidance in Scotland's muirburn code suggests all should be enough to be controlled and ensure mosaic (Scottish Government, 2021). Furthermore, another previous use of fire in agriculture was burning of straw stubble on farmland, although it is now prohibited (Bruce *et al*., 2006). More recently prescribed burning for wildfire fuel management has been utilised (Belcher *et al.,* 2022; Reed *et al*., 2009), although often risk reduction is a secondary objective to burning for agricultural purpose (Douglas *et al*., 2015). Tactical burns have also been introduced as another use of fire, a term used by FRSs to refer to the use of fire during firefighting (Belcher *et al.,* 2022).

Today, agricultural fire continues on uplands and moorlands (Tucker, 2003; Yallop *et al.,* 2006). Prescribed burning is now heavily regulated in the UK with various legislations and codes in each country (summarised in Harper *et al*., 2018, page 693). It is estimated that 114km^2 of English uplands are burned today (Yallop *et al.,* 2006), and other estimates of 15-18% of peatlands (Natural England, 2010; DEFRA, 2010) Typical habitats include blanket bog, heathland, and grassland (Natural England, 2001). Burning is mostly done for controlling *Calluna vulgaris* (heather) or *Molinia caerulea* (purple moor grass) habitats (Tucker, 2003). Today, a majority of burning revolves around grouse moor management, where Scotland and northern England are most associated with this (Matthews *et al*., 2020; Tharme *et al.,* 2001; Thomson *et al*., 2020).

Although there is continued use, it has drawn in controversy and questions over the impacts as public attitudes shift against fire use (Davies *et al.,* 2016a). Key concerns often highlighted around this prescribed fire include escape, wildlife and habitats, aesthetics air quality and respiratory health, water quality, safety, and carbon storage issues (Carroll *et al*., 2021; Davies *et al.,* 2008; Ramchunder *et al.,* 2009; Ward *et al.,* 2007; Wulfhorst & Nielsen-Pincus 2003). Concerns around impacts on ecosystem services, biodiversity, carbon sequestration, and water quality were argued as opening a debate for banning fire use (Davies *et al.,* 2008). Moreover, the increased controversy of the use of prescribed burning in Ireland has been connected to the conflation of agricultural burning and wildfire, as a result of the country experiencing increased visibility of wildfire in recent years (Carroll *et al.,* 2021). The increased scrutiny over the use of fire has been argued to be creating barriers to its use, including through public scrutiny and policy changes (Carroll *et al*., 2021). There is significant debate around prescribed fire in the UK, often asking ecological questions over the presence of fire on the landscape, but also raising cultural questions about the place of agriculture fire and traditional practices, and fire for wildfire mitigation (Carroll *et al*., 2021; Davies *et al*., 2008; Davies *et al*., 2016a; Davies *et al*., 2016b).

1.2.3 Global wildfire occurrence, trends, and problems

Wildfire in the UK is happening against the backdrop of global wildfire context and changes to fire risk; as well as global shifts in management approaches where discontent with previous western regimes of suppression have been critiqued for not appreciating the ecological role of fire (Calkin *et al*., 2015; Ingalsbee, 2017; Tedim *et al*., 2015b). In response to these changes, there has been increased interest and funding in social research of wildfires, beyond the previous biophysical centric paradigm (Pyne, 2007), seeing wildfire as anthropogenic (Bowman *et al.,* 2011) and looking at wildfire risk from social perspectives (McCaffrey, 2004a; McCaffrey *et al*., 2013; McCaffrey, 2015).

To understand wildfire, it is important to comprehend factors leading to their occurrence. Vegetation fires occur as a culmination of various factors. Three key contributions are fuel (vegetation), environmental conditions conducive for burning, and ignitions (Krawchuk *et al.,* 2009). For fuel, vegetation must grow and be continuous enough for fire to spread (Flannigan *et al.,* 2009; Hargrove *et al.,* 2000; Meyn *et al.,* 2007; Swetnam & Betancourt, 1998). Next, the environmental conditions are required to be right at the time for burning, primarily through creating dryness in the fuel (Scott *et al.,* 2014). And finally, there needs to be an ignition source, which can be natural such as lightning, or anthropogenic, including both of accidental and intentional origin (Scott *et al.,* 2014). To understand vegetation fire occurrence is to appreciate that there is a myriad of factors that culminate in various ways across temporal and spatial scales. The various forcings are of both biotic and abiotic origin, and either natural or anthropogenic in nature including fuel amount, type, continuity, structure, and moisture level, as well as climate-weather dynamics, ignition sources, and humans (Flannigan *et al.,* 2005; Flannigan *et al.,* 2009; Flannigan *et al.,* 2013; Fischer *et al.,* 2016; Gill *et al.,* 2013; Roos *et al.,* 2016; Scott *et al.,* 2014).

Anthropogenic forcings have become increasingly clear and on a global scale; the various ways humans play a part in the systems of wildfire are well established, acting to change landscapes to be more or less flammable and act as ignition agents lighting and extinguishing (suppressing) fires (Bowman *et al.,* 2011, 2020; Chuvieco *et al.,* 2008; Flannigan *et al.,* 2013; Lavorel *et al.,* 2007; Krawchuk *et al.,* 2009; Moritz *et al*., 2014). Humans may change flammability, by deforestation, logging, urban or agricultural development, and changing vegetation type, including introducing invasive species (Moritz *et al*., 2014), Arguably, in light of the Anthropocene, humans have also influenced climate-weather and wildfire dynamics (Bowman *et al.,* 2020). Finally, humans are a key ignition type for wildfire globally; in fact, it has been posited that human activity is likely responsible for most vegetation fires globally (Flannigan *et al.,* 2013) and some fire regimes are described as human-dominated regimes (Archibald *et al.,* 2012; Balch *et al.,* 2017; Prestemon *et al.,* 2002; Syphard & Keeley, 2007). The UK is a human-dominated system, where almost all wildfires are ignited by humans or human activity, including arson, cigarettes, barbecues, sparks from vehicles, ordnance in military training areas, and escaped prescribed burns (Glaves *et al.,* 2020; McMorrow, 2011). Crucially, these may be accidental or intentional. For example, South Wales experiences prolific ignitions due to deliberate fire setting (Jollands *et al.,* 2011); IRS data estimates as many as three quarters of fires between April 2020 and March 2021 were deliberate (Welsh Government, 2022).

Changing wildfire risk is a key part of contemporary wildfire discourse. It is often cited that wildfires are increasing in frequency or area burned (Arnell *et al*., 2021b; Calkin *et al.,* 2014a; Kaval, 2009). Having said that, global area burned has been found to be decreasing in recent decades which has been attributed to large scale land use changes reducing burnable area (Andela *et al.,* 2017; Forkel *et al.,* 2019). This does not negate changes in wildfire activity and behaviour but rather demonstrate the complexity of the aforementioned influencing factors. Moreover, despite overall there existing global net decreases, there are significant regional increases, such as in the western US and Canada, southern Europe, Scandinavia and Amazonia (Jones *et al*., 2020). It is widely accepted that there is increasing wildfire risk and certainly concern over their future occurrence, (e.g., Ganteaume & Jappiot 2013; IAWF, 2019; Jones *et al*., 2020; Modugno *et al.,* 2016; Moreira *et al.,* 2011; Moritz *et al*., 2014; Steelman & McCaffrey, 2011). There is evidence of already experiencing elevated impacts of wildfires on human and ecological assets (Gill *et al*., 2013; Mortiz *et al*., 2014) and increases in fire weather (Abatzoglou *et al*., 2019). Fire-prone areas especially are experiencing, or projected to experience, worse events (Bowman *et al.,* 2017; IAWF, 2019; Ganteaume & Jappiot 2013), and these present challenges for managers as they are at the limit of suppression abilities (Dunn *et al.,* 2017; Komac *et al.,* 2020). Having said that, what is of interest here is a key part of the global problem that new regions are being impacted (Jolly *et al.,* 2015). Such as the phenomena becoming increasingly visible in temperate regions, including many northern European countries in recent years (Prat-Guitart *et al.,* 2019; Stoof & Kettridge, 2022). This includes projections of increased wildfire risk in the UK (Arnell *et al.,* 2021a, 2021b; Perry *et al*., 2022).

There is consensus that climatic, environmental, and social factors are contributing to general increases in fire risk. Anthropogenic climate change is often at the centre of discussions, seen as the major reason for the wildfire problem (Benson *et al.,* 2008; Sommers *et al.,* 2011). There is a consensus that fire weather, that is, conditions conducive to wildfire with combinations of temperature, humidity, rainfall, and possibly high winds (Jones *et al.,* 2020) is increasing (Jolly *et al.,* 2015; Jones *et al.,* 2020). Anthropogenic climate change induced changes in global temperatures, more frequent heatwaves and droughts will contribute to increased fire weather (Jones *et al.,* 2020). However, future predictions are also reliant on other influences moderating fire activity, in other words even with increases in fire weather, burned area will only increase if there is still burnable area or ignitions occurring, as well as potentially being counteracted by suppression (Bedia *et al.,* 2015; Jolly *et al.,* 2015; Jones *et al.,* 2020; Syphard *et al.,* 2017).

Anthropogenic modification of landscapes is another aspect of wildfire risk changes, by shifts in land cover and varying fuel loads. There is consensus that fuel accumulation is a key risk factor across both fire-prone and non-fire-prone regions, either by rural or land management change (Ganteaume & Jappiot 2013; Modugno *et al.,* 2016; Moreira *et al.,* 2011) or as a result of previous policies of fire suppression (Gill *et al.,* 2013; Steelman & McCaffrey, 2011).

Firstly, social changes, particularly in rural areas, have expanded flammability on landscapes, such as the decline of rural areas in Europe meaning previously cultivated land has been abandoned (Modugno *et al.*, 2016). De-ruralisation induced social challenges, including unemployment, tourism pressure, economic decline, and population loss to urban spaces have resulted in abandoned agriculture, diminished grazing, increased plantations, all contributing to elevated fuel loads (Ganteaume & Jappiot 2013; Modugno *et al.,* 2016; Moreira *et al.,* 2011). This has occurred across Europe; the Mediterranean is one place highlighted (Komac *et al.*, 2020). In the UK, rural change is a relevant part of its wildfire issue, as land management and agriculture declines, such as reduced grazing and planting of young conifers, had led to fuel load increases (Bruce *et al.*, 2006; Davies *et al.*, 2008). Secondly, previous wildfire management policy has been a significant contributing factor modifying landscapes and altering wildfire risk in fire-prone areas (Steelman & McCaffrey, 2011). This wildfire paradox, of extinguishing fires leading to increased future fire is often highlighted in the US (Calkin *et al.,* 2015), but the concept is relevant wherever there is suppression policy, including in Europe (Xanthopoulos & Athanasiou, 2019). As a result, there has been a growing attitude of discontent with this suppression management approach (Toman *et al.,* 2013).

Furthermore, another crucial aspect of increasing fire risk globally is increased exposure, that is, people moving into fire risk areas. This is particularly relevant for the wildland-urban-interface (WUI), as significant migration sometimes referred to as ‘amenity migration’ has led to migration and building in these areas of risk (Dupey & Smith, 2018; Modugno *et al.,* 2016; Paveglio *et al.,* 2015; Shafran 2008; Steelman & McCaffrey, 2011).

The pervasive discourse in wildfire literature regarding these changes in risk has led to emergence of rhetoric of wildfire ‘problems’, including globally (Gill *et al.,* 2013), in the WUI (Cohen, 2008; Gill & Stephens, 2009; Mell *et al.,* 2010; Shafran, 2008), in Europe (Tedim *et al.,* 2015a; Tedim *et al.,* 2015b), as well as countries of northern America (Calkin *et al.,* 2015; Tymstra *et al.,* 2020). These discussions include varying contexts of environmental changes, as well as discontent with policy, and management issues. However, another key challenge is that wildfire has also been described as a ‘wicked’ problem (Allen & Gould, 1984; Carroll *et al.*, 2007; Gazzard *et al.*, 2016). Because wildfire is something which is difficult to define, complex, has multiple causes, and solutions which may require more than one authority. Practically speaking wildfires can cross organisational and national boundaries (Roos *et al.*, 2016). Alternatively, its management may fall under the responsibility of various agencies, such as in the UK (Gazzard *et al.*, 2016; McMorrow & Aylen, 2018). Academically speaking, it transcends disciplinary boundaries, creating competing terms and methodological limits (Tedim & Leone, 2020). Hence, a key contemporary demand is for wildfire literature to be inter-disciplinary, to cross these disciplinary boundaries (Roos *et al.*, 2016; Stoof & Kettridge, 2022).

1.2.3.1 UK wildfire problem

Each country may have its own challenges to face, as the wildfire context changes. For the UK, as a non-fire-prone country, it does not face the challenge of mega-fires that fire-prone areas do (Bowman *et al.,* 2017; Ferreira-Leite *et al.*, 2015), instead it is facing an emergent risk where previously lacking impacts could become more widespread (Perry *et al.*, 2022). There is a consensus climate change will lead to increased fire risk in the UK. As mentioned above, findings are that climate change could lead to more variable seasonality (Albertson *et al.,* 2010), with warmer, drier summers, and droughts leading to more frequent and potentially severe wildfire (Albertson *et al.*, 2010; Davies *et al.*, 2013). A more prevalent summer season could increase the length of ‘fire-fighting seasons’, potentially extending into autumn as well, meaning more sustained risk through the year, despite that spring largely stay same (Perry *et al*., 2022). Moreover, wetter growing seasons could lead to more vegetation and fuel loads (Perry *et al.*, 2022). Fairer weather may have a further dynamic on fire risk due to increased ignition risk as a result of increased outdoor recreational activity (McEvoy *et al*., 2006, 2008).

Another key risk factor for wildfire in the UK has been other environmental changes, similar to other parts of Europe where rural changes are contributing fire risk discussed above. These include, de-ruralisation and agricultural changes leading to loss of grazing, planting of young conifers, and decreases in fire use, leading to increased fuel load and continuity (Bruce *et al*., 2006; Dougill *et al*., 2006; Davies *et al*., 2008). Declining rural areas has not only decrease prescribed fire practices, but also meant less supervision available during burning, which has increased the risk of escaping burns (Bruce *et al*., 2006). Fuel has been a growing concern, as McMorrow (2011) notes land managers previously expressing concern. Another contributor to wildfire hazards in the UK is public access to the countryside (Bruce *et al*., 2006).

The novelty and lack of appreciation of wildfire presents challenges for mitigating wildfire. The UK differs in that it is an industrialised country with little knowledge on both fire behaviours and wildfire management, although it experiences fire (Davies *et al*., 2006). Being a non-fire-prone area, the hazard is not widely understood, and recognition of the impacts have been slow (Gazzard *et al*., 2016; McMorrow, 2011). There is limited policy, organisational and research knowledge of fire similar to other temperate regions such as the Netherlands (Stoof *et al*., 2012). There is a lack of evidence base (Gazzard *et al*., 2016), including longer term records to discern trends (Belcher *et al*., 2022). There are also gaps in the ecological understanding of impacts of vegetation fires. And the phenomena, as a hazard, has barely been explored, with no understanding of the public's awareness and attitudes.

The lack of organisational knowledge and preparedness is crucial (Stoof *et al*., 2012), where there is a lack of national governance as well as resources and training gaps in firefighting services (Gazzard *et al*., 2016). This has been argued as a result of the slow recognition of the risk and lack of supportive national structures addressing wildfire management, where much of the solutions to wildfire has been based on local forums and champions working innovatively, creating a patchwork (Gazzard *et al*., 2016). Wildfire management in the UK is not holistic as it does not take into account the entire hazard cycle, each agency singularly tackling their part of the chain. For instance, FRS merely doing the suppression, but the Department for Environment Food and Agriculture (DEFRA) being in charge of prevention (Gazzard *et al*., 2016). These silos of political structures create barriers for more effective decision making, hence the functional fragmentation of the hazard chain contribute to a wicked problem (Allen & Gould, 1984; Carroll *et al*., 2007) of wildfire in the UK crossing organisational boundaries (Gazzard *et al*., 2016; Roos *et al*., 2016). Similarly, McMorrow (2011) argued that the government policy on habitat management in moorlands does not adequately address wildfire risk management. The issue of wildfire in discussion on environmental management speak to other a general lack of holistic management of environmental hazards, where similar issues are echoed by other hazards literature in the UK, namely floods (Cologna *et al.,* 2017). Moreover, the focus of fire as the responsibility of FRS has created an approach based on suppression, which does not account for the whole hazard chain and this does not lend itself to thinking of fire ecologically (Gazzard *et al*., 2016). Having said there, a tension in policy exists in the fact that the country is densely populated so there is a need for suppression while also a need to consider the dangers of fire exclusion.

Another significant aspect of the UK wildfire problem is the issues facing FRSs, the de facto wildfire fighters. Wildfires already place significant pressure on firefighting services, due to the sheer number although they are mostly small (Scottish Government, 2013). The seasonality of UK wildfire tests FRS resilience as incidents are concentrated to short periods in the year (Gazzard *et al.*, 2016; Scottish Government, 2013). Moreover, the statutory responsibility for firefighting falls with FRSs, but these often urban-centric services have little experience or expertise in wildfire firefighting (McMorrow, 2011). The partial funding of FRS based on taxation consequently means a bias to urban areas where the focus is on training and equipment for structural fires (McMorrow, 2011; Gazzard *et al.*, 2016). Many of these firefighting services also lack familiarity with wildfire hazards, meaning there is a lack of experience, training, expertise, equipment (Gazzard *et al.*, 2016; McMorrow, 2011). This lack of experience has already been identified as a problem. Swinley Forest Fire in May 2011 required 300 firefighters from 6 fire brigades and burned for over a week, the largest incident in Berkshire's history, it put firefighters in an unknown environment facing unpredictable and fast spread of fire (Oxborough & Gazzard, 2011). There is a need for new firefighting techniques, such as the use of a bulldozer during the suppression efforts of Wareham Forest in 2020 (Belcher *et al.*, 2022). Moreover, wildfires on different landscapes also pose unique and variable challenges for firefighting, such as the risk of large fires threatening valuable environmental assets, and then the RUI or urban fires posing risk to life, property, and infrastructure requiring a possibly different approach (Belcher *et al.,* 2022). Large fires can also require multi-agency responses, drawing on national firefighting resources, or needing coordinated efforts, which put significant pressure on fire services. One extreme test of resilience was Wareham Forest fire in 2020 has all 50 Dorset and Wiltshire Fire and Rescue Service (DWFRS) stations in attendance, using 70 out 74 appliances, as well as having to draw in additional 22 pumps from other FRSs. This strained the service for an extended period, as the fire burned for more than 2 weeks.

1.3 Thesis structure

The widespread lack of familiarity with wildfire hazards and knowledge gaps are a crucial part of UK wildfire problem. Raising awareness of wildfire in the UK is a key aim for practitioners, where it is currently possibly an underrated or undervalued issue (McMorrow, 2011). The emergence of social science in wildfire research demonstrates the value of using these methodologies to understand wildfire and wildfire risk with importance in informing management and mitigation. It is important to learn from mistakes elsewhere both in regard to not holistically addressing various needs of management approaches, as well as using social research to understand public perspectives. Another benefit to social wildfire research in UK is the opportunity to add to the current global wildfire sphere, comparing perceptions in a new context (non-fire-prone). This study aims to ascertain the level of awareness and knowledge the British public have of wildfire hazards, as well as beginning to compare it to attitudes of fire on the landscape in general. Where there is likely a disconnect between the public and the significance of prescribed fire for the modern landscape, investigating the awareness of the public to prescribed fire is another interesting avenue.

Placing this research within the context of UK wildfire is integral to understanding the perceptions themselves, but also understanding the context of global wildfire research is also integral to understanding how these perceptions in a non-fire-prone country compared to a fire-prone country. Therefore, this thesis will first lay out what is known in UK about wildfire as background (see 2.1), and then provide the theoretical basis for understanding perspectives on risk through a review of the wildfire social research field (see 2.2). It will then lay out the methodological basis of the research (see 3), addressing key research gaps through the aims of the thesis, and justifying the data collection methods employed. It will then present the three case studies set in each of the three countries of Britain (see 4, 5, 6) and finally compare their findings in order to build a picture of the UK as a whole (see 7).

CHAPTER 2: LITERATURE REVIEW

This literature review is divided into two parts: Part 1 reviews UK wildfire research field and its agenda, and Part 2 examines the emergence, theoretical base, and findings of the global social wildfire research. The review is structured to first provide an appreciation of the UK wildfire context and then the theoretical understanding of risk perception related to wildfire hazards. Global research has almost entirely focused on fire-prone contexts, and the UK is yet to contribute to the wildfire risk perception field. The large gaps in UK wildfire knowledge warrant a separate examination to understand the nature of wildfire risk and ascertain any indication of public risk perception. However, to theoretically base this research, it is also necessary to understand the global literature. The dynamics of wildfire risk have been found to be largely applicable across different regions, similar to how risk concepts from natural hazards literature apply across various hazard types. Nonetheless, the local context of a place's wildfire risk is integral to understanding these dynamics. Thus, both the UK and global contexts are important.

2.1 PART 1: UK wildfire research

2.1.1 <u>State of UK wildfire research field</u>

The UK wildfire research landscape is in its infancy owing to the fact that wildfire hazards have been underappreciated. The expanding fire risks in the UK as a result of climate (Arnell *et al*., 2021a; Davies & Legg, 2016; Perry *et al*., 2022) and environmental changes to agriculture and landscape (Bruce *et al*., 2006; Davies *et al*., 2008; Davies & Legg, 2016), are putting increasing strain on stakeholders and potentially increasing the impacts (Perry *et al*., 2022). This has demanded research, where knowledge is lacking (Gazzard *et al*., 2016; McMorrow, 2011). Over the last decade or so there has been significant development of the UK wildfire research landscape. Crucial to this growth are some key academic projects. However, where knowledge production has been slow, stakeholders have sought knowledge on their own accord, hence while there is some peer reviewed material, there is a lot of UK wildfire research from outside of academia.

Regarding the academic literature, interest and funding is crucial for research. Significant academic led projects in the UK are shown in Table 2.1, although not exhaustive lists of academic endeavours, they represent key contributions to the field and thus the knowledge created. For instance, the FIRES project led to research around PDNP, looking at mapping and understanding occurrence (Albertson *et al.,* 2010; Cavan & McMorrow, 2009; McEvoy *et al.,* 2008; McMorrow *et al.,* 2010). Additionally, the Knowledge for Wildfire (KfWf) project aimed at knowledge exchange, led to the Wildfires 2015: The UK Wildfire Prevention Conference, Glasgow (KfWf, n.d.). This was fruitful in that it also prompted a journal special edition (Scott *et al.,* 2016a, 2016b), including key articles for the UK such as, Davies *et al.,* (2016a) and Gazzard *et al.,* (2016); as well as other outputs of this project including, Davies *et al.,* (2016c). Moreover, the wildFIRE lab at University of Exter (University of Exeter, n.d.), works towards understanding fuels and fire in the UK, as well as internationally focused research. Finally, most recently, the UK Fire Danger Rating System (UKFDRS) project has various work packages looking at, fuel mapping, fuel moisture, flammability, fire behaviours, and assessing actual occurrence (UKFDRS, n.d.). Research is of course facilitated beyond these academic projects. For instance, by the Moors for the Future Partnership (MFFP) concerned with moorlands in England, particularly around Manchester (MFFP, n.d.), which supported part of the aforementioned work and facilitated more (e.g., Dixon & Chandler 2019; Carroll *et al.,* 2009).

UK Academic Wildfire Projects			
Project Title	**Years Active**	**Organisations**	**Source**
Fire Interdisciplinary Research on Ecosystem Services; fire and climate change in UK moorlands and heaths FIRES)	2007-2009	Manchester University with PDNP Authority	Manchester University (n.d.)
Knowledge for Wildfire (KfWf)	2012-2017	Manchester Uni with NERC	KfWf (n.d.)
wildFIRE lab	2013-present	University of Exeter Funded by 1.52-million-euro European Research Council Starter Grant (Scott *et al.,* 2016a).	University of Exeter (n.d.)
UK Fire Danger Rating System (UKFDRS)	2020-2024	Various academic institutions (lead by Manchester University) and Forestry Commission Research Agency	UKFDRS (n.d.)

Table 2.1 – Significant UK academically lead wildfire research projects.

Stakeholders have an interest due to experiencing pressures, hence there is a lot of ancillary literature which is key to the UK wildfire knowledge base. Other published material includes government reports (e.g., UK Government, Scottish Government, Welsh Government); environmental body reports (e.g., FCE, Natural England, Natural Resources Wales [NRW], and Nature Scot); non-government organisations (e.g., Wildlife Trust, Royal Society for the Protection of Birds [RSPB], Woodland Trusts, Moorland Association); and regional and local stakeholder groups such as wildfire groups and forums (e.g., Healthy Hillside, Urban Heaths Partnership [UHP], England, and Wales Wildfire Forum). In fact, much of the knowledge exchange in the UK is occurring through informal or stakeholder led activities, although academics may be involved (Gazzard *et al.,* 2016). This includes the annual England and Wales Wildfire Forum (EWWF) led conference (EWWF, n.d.).

2.1.2 Scope of the UK wildfire research field

UK wildfire research has had particular focuses, including wildfire data and reporting; studies understanding occurrence, including risk factors and spatial studies, with particular focus on climate change and human factors. There has been some research on impacts, although empirical evidence is lacking. One particular topic which has significant academic attention is UK fuel and fire behaviour studies, although this is less relevant for this thesis. Wildfire is also present within topics of environmental management. There is also a focus of fire with prescribed fire and its impacts in mind.

Firstly, useful research includes reporting of UK wildfire occurrence and issues. There is a pervasive rhetoric in UK discourse that despite wider opinion discounting the issue, there are significant problems and significant occurrence of wildfire in the UK and seeking to evidence this (e.g., Scottish Government, 2013). There is some literature which summarises the nature of wildfire and discusses management and associated issues (Bruce, 2000; Bruce *et al*., 2006; McMorrow, 2011; Gazzard *et al.,* 2016). There is also useful guidance from Scottish Government (2013) on the significance of wildfires from the FRS perspective.

A key first aim of UK wildfire research has been on establishing knowledge on wildfire occurrence as a result of the issues of poor evidence base and limited datasets (Belcher *et al.,* 2022; Gazzard *et al.,* 2016). Early summaries especially include complaints of lack of data, for example Bruce *et al*., (2006) quoting figures but having uncertainty around their origin. The introduction of the IRS system for FRS in 2009 (McMorrow, 2011) was a key turning point for this topic of research and established a standardized dataset; this remains the most complete and widely used dataset. However, there are significant limitations to this dataset, including the short length of data, and issues associated as a result of this not being a dedicated wildfire recording system. While there are many parameters collected (described in Gagkas *et al*., 2021, pages 2-4), there are estimates and inaccuracies, such as location, categorisation of property type, and estimated size (Gagkas *et al.,* 2021), as well as the causes rarely being investigated (McMorrow, 2011). Hence, studies have discussed the application of this dataset, and although they found spatial patterns these are limited in accuracy (Critchley & McMorrow, 2015; Grundy & McMorrow, 2013; Walker *et al*., 2009).

Synthesising and analysing UK wildfire datasets are a key step in understanding occurrence across the UK. This is often done by environmental bodies but is vital research (FCE, 2019, 2023 Gagkas *et al.,* 2021; Jollands *et al.,* 2011; Luxmoore, 2018). Usefully, Gagkas *et al.,* (2021) demonstrates a recent synthesis and methodology relevant to adapting the IRS dataset, which could be helpful for the future. However, differing methods across the devolved agencies make comparisons difficult. This also includes a lack of national coherence regarding how the definition of wildfire is applied, and hence disparities once the data is processed; for example, Scottish analysis (Gagkas *et al*., 2020; Scottish Government, 2022) compared to English (FCE, 2023) and Welsh (e.g., Welsh Government, 2022). A complete, comparable, and accurate wildfire dataset for the UK ultimately remains unresolved with the lack of dedicated fire database, inaccuracies in the IRS data, and inconsistent analysis.

Beyond FRS records there are other datasets available, but they are more incomplete in comparison. Occasionally, there is dedicated monitoring done regionally, such as by rangers in PDNP (McMorrow *et al.,* 2009; McMorrow & Lindley, 2009), on Dorset heaths by DERC though the UHP (UHP, n.d.) as well as some monitoring done by Natural England and Ministry of Defence (Glaves *et al.,* 2020). While more comprehensive, dedicated, and reliable, there is only a patchwork of coverage across the UK. Moreover, another key alternative dataset is available through remote monitoring, utilising European Forest Fire Information Systems (EFFIS) service by European Commission (2023). This dataset is biased to larger events (those greater than approximately 30ha) in order to be detected by satellite and many wildfires in the UK are small, hence this produces an incomplete dataset. While arguably this would still collect a large proportion of the total area burned as the larger fires account for the majority of area burned (Belcher *et al*., 2022), it would omit large proportions of the number of events. The smaller fires are highly relevant as they also use many resources, where the sheer number of callouts is in itself a test for FRS resilience requiring resources (Scottish Government, 2013).

Next, the next key topic of UK wildfire literature has been explorations of its occurrence seeking to understand its influences. Studies have investigated patterns of occurrence within areas, including on moorlands in the Pennines (Walker *et al*., 2009), and the PDNP (Albertson *et al*., 2009; Dixon & Chandler, 2019; Lindley *et al*., 2009). As well as summaries across various types of habitats, particularly heathlands (Glaves *et al*., 2020; Vanha-Majamaa, 2006). There has been a clear focus on the PDNP in the north of England. Notably, moorlands have appropriately been an area of concern for this research, with particular focus around the Peak District National Park and the South Pennines (Albertson *et* *al*., 2009, 2010; Aylen *et al*., 2006; Lindley *et al.,* 2009; McMorrow & Lindley, 2006; McMorrow *et al*., 2006; McMorrow *et al*., 2009; Walker *et al.,* 2009). These locations likely common as a key seat of wildfire research was the FIRES project based in Manchester University (Manchester University, n.d.). This is sensible due to the risks associated with moorlands because of the remoteness and the fact they often sit over peat (Albertson *et al.,* 2010; Bain *et al.,* 2011; Carroll *et al.,* 2009; Vanha-Majamaa, 2006). However, as there are other parts of risk to UK wildfire, such as those in the RUI being a crucial place of fire risk (Belcher *et al.,* 2022; Gazzard *et al.,* 2016; Glaves *et al.,* 2020; Grundy & McMorrow, 2013; Vanha-Majamaa, 2006), this demonstrates need to research wildfire in a variety of high-risk environments and places across the UK. There are a handful of studies exploring occurrence in other environments across the UK, including an extensive report on influences on occurrence in South Wales (Jollands *et al*., 2011), in Scotland (Luxmoore, 2018), and summaries from UHP group in Dorset on wildfires on heathlands (Panter, 2018; Panter & Caals, 2023). Glaves *et al*., (2020) is a recent review of previous findings, while focusing on heathlands, does discuss findings across various environments, including highlighting the importance of the RUI for UK wildfire. Generally, there is consensus amongst this work of what influences wildfire occurrence, risk factors including high risk habitats and patterns in its occurrence both temporally and seasonally.

A crucial part of this effort of understanding occurrence is the focus of the influence of climate change. The UK has been included in broader European (Wu *et al*., 2015), or global scale analyses (Krawchuk *et al.,* 2009), including that which mentions trends of greater prevalence of fire across northern European countries (Belcher *et al*., 2022; Prat-Guitart *et al.,* 2019). Wildfire and climate change is often a theme of policy research in particular, including a more recent summary of evidence (Belcher *et al*., 2022; McMorrow *et al*., 2010). There is a reasonable base of research that has explored wildfire and climate change considering UK dynamics in particular, of which there are some complex relationships between fuel, weather and fire to consider (Arnell *et al.,* 2021a, 2021b; Albertson *et al.,* 2010; Davies & Legg, 2016; McMorrow *et al*., 2010; Perry *et al*., 2022).

UK wildfire research has crucially included the consideration of humans as risk factors in exploration of its occurrence. Studies investigating spatial patterns have speculated there is a link between wildfires and human settlements or roads (Grundy & McMorrow, 2013; Jollands *et al.,* 2011), however where these use IRS datasets these associations could be artefacts of systematic error in the dataset as the locations are often where the fire appliance was situated rather than accurate fire locations (Walker *et al.,* 2009). It is however well accepted that humans are key ignition agents, as fires are anthropogenically started in the UK. Hence, more accessible places will have more ignitions (Aylen *et al*., 2006; Belcher *et al.,* 2022; Bruce *et al*., 2006; Gazzard *et al.,* 2016; Glaves *et al.,* 2020; Grundy & McMorrow, 2013; Vanha-Majamaa, 2006). This explains the high-risk nature of the RUI. Moreover, the opening of land to the public through land rights including CROW Act and Land Reform Scotland were identified as a factor in the shift in wildfire risk since the 2000s (Bruce *et al*., 2006; Davies *et al*., 2008; Davies & Legg, 2016). Restricting access is therefore something which has been discussed in management discourse, blocking off recreational areas to prevent ignition, although this is seen as not socially optimal (Aylen *et al*., 2006). Moreover, the consideration of human agents in fire risk has also extended to dynamics in relation to climate change; it has been posited that outdoor activity changes as a result of fairer weather due to climate change will act to increase ignition risk - referred to as the Climate Change Visitor Economy (McEvoy *et al*., 2006, 2008; McMorrow *et al.,* 2006, 2009). This would place additional pressures on recreational places such as National Parks including through increased potential fire risk. Thus, demonstrating the consideration of human agents in UK wildfire research.

Regarding the human impacts, there is limited understanding, although Graham *et al*. (2020) conducted a study on into the impact of smoke from a UK wildfire; studying the impact of the Saddleworth Moor fire in 2018, there were correlated increases in emissions including in significant urban settlements some distance from the fire and levels that exceeded WHO guideline limits. There has been some research into health impacts of wildfire globally, where smoke has been identified as a concern including firefighter health (Kochi *et al.,* 2010; Komac *et al.,* 2020). More empirical data is needed to better understand the impacts of fire events in the UK, including potential long-term impacts. This may be especially relevant in the South Wales Valleys which has significant repetitive ignitions (Jollands *et al*., 2011), along with a history of industry leaving contaminants in the environment and respiratory health vulnerabilities (NRW, 2014) and deep-rooted deprivation and health inequalities (Welsh Government, 2019b).

Biophysical focuses of research were a key focus from early on (Bruce *et al*., 2006) and remains a significant part of the literature base, especially academic specific material. That is, striving to understand the fuel and fire behaviours of UK context and its ecological effects. Studies have considered fuel conditions and fire behaviours to better understand the dynamics leading to fire risk (Davies & Legg, 2008, 2011; Davies *et al*., 2010; Grau-Andres *et al.,* 2018; Legg & Davies, 2009). Additionally, this is a continued focus with the ongoing UKFDRS project, assessing fuels behaviour and conditions in the UK (UKFDRS, n.d.). Additionally, ecological and atmospheric effects of fire are often a key interest (Davies *et al*., 2013; Gray *et al*., 2021). This is of particular significance to prescribed fire research and ultimately the debate around its use; in addition to studies looking more specifically at effects of controlled fires (Allen *et al.,* 2013; Clay & Worrall, 2015; Davies & Legg, 2008; Davies *et al*., 2010; Harper *et al*., 2018; Lee *et al.,* 2013; Tucker, 2003). There is therefore also relevant material on wildfire through the prescribed fire research.

Wildfire also appears in broader UK environmental research, where it may not be the subject but emerges as a key question, or uncertainty. Particularly wildfire appears in discourse around the future of moorlands or heathlands, with questions around rural change, agricultural changes, grouse moors, and peat (Bain *et al*., 2011; Carroll *et al*., 2009; Cordingley *et al*., 2015; Dougill *et al*. 2006; Werrity *et al*., 2019). Moreover, UK wildfire is also a component for broader vegetation fire research, where there is fierce debate over the future presence of fire on the landscape as fire has become more controversial (Davies *et al*., 2008; Davies *et al*., 2016a; Werrity *et al*., 2019).

2.1.3 Perceptions of the wildfire hazard in the UK: acknowledging risk

Considering the breath of topics, the UK wildfire research field has thus far focused on understanding occurrence and biophysical and ecological aspects. This has left a significant gap in understanding it as a hazard from a social perspective. A key gap is therefore the lack of empirical study of UK public's reaction to the unfamiliar hazard. Stoof *et al*. (2012) pointed out that as temperate regions, like the UK, Netherlands, and New Zealand are not associated with wildfire, competing with more well-known hazards, such as flooding, snowstorms, or earthquakes. Consequently, there is a lack of awareness and underestimation resulting in unprepared communities (Stoof *et al*., 2012). Literature in the UK has indeed pointed out the slow acknowledgement, for instance, Gazzard *et al*., (2016) describes that local problems around wildfire activity and concern in the UK emerged as early as the 1990s but it did not reach national agenda until the 2010s (Cabinet Office, 2013). Wildfire has since remained on the NRR (Cabinet Office, 2015, 2017, 2020) possibly because climate change risks strongly influence agenda and wildfire is associated with this. McMorrow (2011) argued the lack of awareness has been due to lack of reporting, the sporadic nature of their occurrence, and under-estimation of impacts on environmental assets. It has also slowed because many happen in moorlands away from risk to life and hence do not get attention (Gazzard *et al*., 2016). Specifically, the sporadic or intermittent nature creates wavering interest (McMorrow, 2011; Gazzard *et al*., 2016). A catalyst to achieving national attention from a potentially London-centric political view, was that the identification of wildfire as a risk during preparation for the London 2012 Olympic Games put it on the agenda (Gazzard *et al*., 2016).

Stakeholders, certainly at a local level, have expressed concerns for many years over wildfire. In response to local issues there have been informal and networking solutions, including the development of wildfire groups and forums (Bruce, 2000; Bruce *et al*., 2006; Gazzard *et al*., 2016). Gazzard *et al.,* (2016) argues that these have been a crucial part of the evolving response to wildfire. The first wildfire group was founded in 1997 and named The Peak District Fire Operations Groups, along with another example in Scotland, the South Grampians wildfire group, these became a model for other groups, including in Northumberland, and Cumbria (Gazzard *et al*., 2016). Interestingly, some of these locations correspond to the areas highlighted for significant wildfire occurrence in McMorrow (2011). There are now 14 groups in England and Wales acknowledged by EWWF (EWWF, n.d.). Networking in the form of forums has also been crucial. The first forum, Scottish Wildfire Forum, was set up in 2004, born out of crisis after a severe 2003 season; this was a model for the later England and Wales Wildfire Forum set up in 2007 after the severe 2006 season (Gazzard *et al.,* 2016). Groups strive to solve their issues independently, namely in effort to improve firefighting expertise knowledge, or to protect key assets. Gazzard *et al*., (2016) provides examples, including The Peak District Fire Operations Groups building expertise in rapid fire suppression using helicopters as they prioritised minimising damage to peat. Additionally, in the spirit of knowledge exchange the Northumberland Fire Group learning skills in back burning from Catalonia in the search for more economical options, as a result of being located in a sparsely populated are with limited resources (Gazzard *et al*., 2016). Moreover, Northumberland FRS was also involved in a European glossary on wildfire and forest fire for common and consistent terminology (Stacey *et al*., 2012). The UHP in Dorset is concerned with the vulnerability of large stocks of heathland (UHP, 2022a). Through DERC, there was a successful set up of improved monitoring and GIS capabilities (DERC, 2023). UHP also set up Firewise UK in 2009 for public education with a key aim to reduce ignitions (Ford, 2020). Moreover, Healthy Hillside in Wales was set up more recently by NRW (2016), in response to concerns over land management where there are high amounts of publicly owned land and prolific recurrent ignitions in the Valleys. There are a variety of stakeholder partners involved in their work It is a wildfire group but has a broad collaborative focus looking at solutions for more than just wildfire mitigation, with numerous stakeholder partners involved (Jenkins & Woodcock, 2019).

A survey by McMorrow (2011) of CRR details a representative look at how the risks were approached by stakeholders as of 2010. CRRs are essentially risk assessments completed by emergency and other services within local resilience forums; hence, the CRR are an indication of some stakeholder acknowledgements of risk (although it should be noted these are not wildfire specific). The survey showed that out of 49, 73% included forest or moorland fire. McMorrow (2011) also modelled the risk assessments using a matrix of likelihood over 5-year period and severity from insignificant to catastrophic (Figure 2.1). Most of the CRRs had low likelihood, with some medium and high, notably Northumbria, South Wales, and Cumbria stated high. Furthermore, most rated the impacts as minor with the exception of a few being moderate or significant. The type of impacts of UK wildfires likely plays into the low valuing of the severity. McMorrow (2011) highlighted some of the typical impacts, where fatalities are thankfully rare, injuries to firefighters are a key direct impact, and to a lesser extent structural damage; however, the majority of the direct impacts are on environmental assets, such as clean water and aesthetics, hence are hard to value, or possibly under-valued.

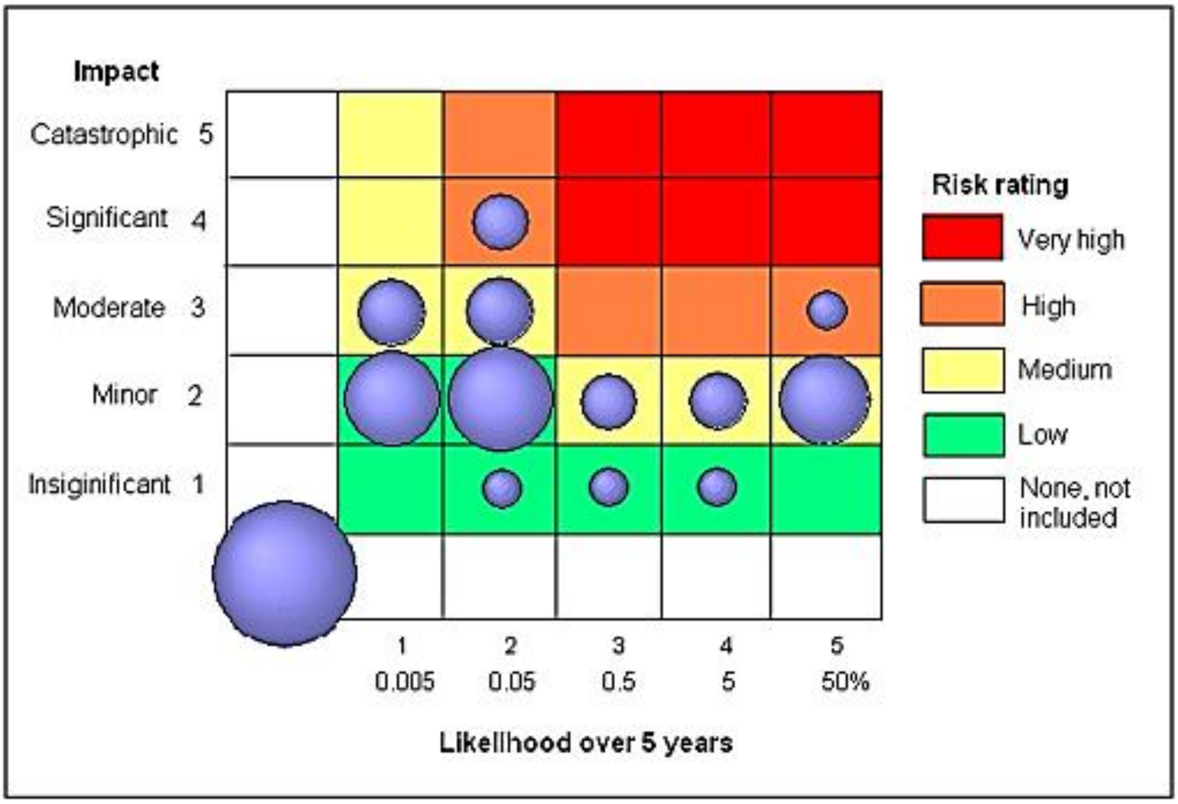


Figure 2.1 – CRR rating for likelihood and impact of forest and moorland fire in Britain for 2010. Circles are proportional to the number of CRR entries, N=49 (McMorrow 2011, page 51).

That provides some insight into out how stakeholders acknowledge wildfire hazards, although there remain large gaps in research on stakeholders' perceptions. There is even less research available on empirical public perception. here is much more research on other natural hazards in the UK, with flooding receiving significantly more attention to perceptions in the media, related to climate change perceptions, and mitigation behaviours (Capstick *et al.,* 2015; Cologna *et al.,* 2017; Gavin *et al.,* 2011; Lo & Chan, 2017). This gap has in fact been identified by stakeholders, including by those in Dorset working on the Firewise UK scheme (Ford, 2020). There are a handful of examples of stakeholders collecting wildfire perception data, including the Healthy Hillside and UHP. Healthy Hillsides conducted some brief public data collection, focusing on opinions and values of those in the local area (Jenkins & Woodcock, 2019). They found that 46% valuing the countryside including mountains, woodlands, rivers and 14% valuing scenery. And 26% of the community wanting crime or anti-social behaviour addressed. This lacked depth and did not investigate how they understood the risk. Moreover, the UHP collected some perception data covering brief questions related to wildfire and preparedness to inform a potential Firewise Community in the area. The project conducted door-to-door interviews with residents along two streets which backed onto urban heaths in southeast Dorset that had experienced a wildfire recently (Lewis, 2018). Two areas adjacent to heaths were picked as places of interest for Firewise UK. They found relatively high awareness of risk to their properties, finding 89% Dunyeats and 85% Great Oven said could be at risk from wildfire, and they found 68% showed interest in getting involved in Firewise. Additionally, a Forestry Commission report did investigate knowledge and awareness of both stakeholders and the public in South Wales (Jollands *et al.*, 2011); this is the most thorough insight into wildfire perceptions, although it does not explore any measure of risk. Specifically, this covered opinions on wildfire occurrence, as well as conducting focus groups which aimed to explain the issue of wildfire-arson.

2.1.4 Perceptions on prescribed fire in the UK

A key aspect of fire research is investigations of prescribed fire. Perceptions of prescribed fire are crucial to wildfire in a few ways; it is relevant for the contemporary environment in way of a legacy of semi-natural flammable landscapes as a result of its historic use (Davies *et al*., 2008). Moreover, the perceptions of prescribed fire in Ireland has been linked to wildfire concerns (Carroll *et al*., 2021). Crucially, the presence of controlled fire influences fire risk, where reductions in prescribed fire has been linked to fuel increase (Bruce *et al*., 2006; Davies *et al*., 2008); and as a heated debate around prescribed fire exists it is crucial to understand this in order to inform what consequences this may have for public attitudes to wildfire mitigations. Coincidentally, prescribed fire may become more relevant where wildfire risk increases, which may counteract public opinion of being more fearful of fire (as identified by conflation of concerns with increased visibility of wildfire in Carroll et al., 2021). Already demands grow for more fire use in order to manage fuel (Davies *et al*., 2016a). Being an industrialised country there is generally a lack of fire knowledge (Davies *et al*., 2008), and where wildfire hazards are a smaller scale, prescribed fire may be the only exposure to (or knowledge of) landscape fire. That includes crucial knowledge, ecological knowledge, of risks and benefits of fire. Possibly relevant to the UK is the idea of societal perspectives on fire where societies have been detached from open fire, born out of firefighting traditions in urban areas for safety, fire has been enclosed (Pyne, 2016; Scott *et al*., 2014). The increased controversy in UK possibly demonstrates this 'modern' view of fire as bad, such as the simplification of narratives around fire ecology and management approaches (Davies *et al*. 2016a, 2016b).

UK literature has covered the presence of prescribed fire on the landscape, particularly on moorlands and peatlands, including a prevalence through history for agriculture (Davies *et al*., 2008; Dodgshon & Olsson, 2006; Fyfe *et al.,* 2003; Prat-Guitart *et al*., 2019; Rackham, 1986; Simmons, 2003; Yallop *et al*., 2006; Worrall *et al*., 2010). And discussion over its possible future place (Davies *et al*., 2008; Davies *et al*., 2016a, 2016b; Reed *et al*., 2009). This includes contemporary agricultural burning (Douglas *et al*., 2015), particularly prevalent on grouse moors (Yallop *et al*., 2006).

Literature has covered the debate of the future of prescribed fire, both discussions of the subject itself and narration on the debate itself (Brown *et al*., 2016; Davies *et al.,* 2016a, 2016b, 2016c; Douglas *et al.,* 2016). Debate has raised both ecological and management questions over its use. The has been increasing controversy around prescribed fire in the UK, raising both ecological and management questions (Davies *et al.,* 2016a). Aspects of the controversy are fairly unique to the national context, partly, as Davies *et al*., (2016a, 2016c) argue, due to tensions muddied with politics, such as social tension of class divisions between working class and sporting elite (burning on grouse moors for shooting), as well as potential bias in the narrative in media. There has been criticism of simplifications of the way fire can be used and options for the future, contributing to the controversy (Davies *et al*., 2016a, 2016b). Key differences of debate over prescribed fire between the UK and fire-prone areas, are not only questions over how 'natural' fire is and hence what the ecological consequences are, but also where objectives are not only to counter wildfire risk, or where the main driver is not risk reduction, instead are agricultural outcomes. Prescribed burning in UK for risk reduction has been used (Reed *et al*., 2009), although this would mostly be a secondary outcome of burning for agricultural purpose (Douglas *et al*., 2015). Increasingly, there is also the use of fire for wildfire firefighting, in the form of tactical burns (Belcher *et al*., 2022).

A key concern of the prescribed fire research field has been on answering the ecological questions to inform the debate (Davies *et al*., 2008; Davies *et al*., 2016a). However, there have been calls for cultural understandings to assist the debates (Carroll *et al*., 2021; Edgeley & Paveglio, 2016). It is important to include social research, to understand the reality of use. For instance, it is impossible to investigate prescribed fire without understanding when and how it is used to aptly apply ecological research (Carroll *et al*., 2021). Additionally, social research will also provide insight into attitudes and opinions, which are avenue through which to objectively discuss the debate, and understand where biases are, important considering that researchers also debate amongst themselves. Carroll *et al*., (2021) conducted a study in Ireland that collected perspectives of practitioners, finding traditions of fire use, barriers to contemporary use, and ultimately collecting attitudes on prescribed fire in the context of the UK.

2.1.5 Key gaps in UK wildfire research field

Research has addressed key questions over occurrence and behaviours, and consequences for environmental management, but there has yet to be insightful consideration of how the public view the hazard. There is a concentration of research on moorlands and heathland, as well as areas in Northern England around the PDNP in particular. While it is sensible to focus on where the risk is greatest, it is important to consider a variety of environments around Britian, from the RUI to more rural areas. There has been more social commentary and enquiry onto discourse around prescribed fire on UK landscapes, and despite centuries of history of fire use there is a potential disconnect between the publics' and experts' knowledge.

2.2 PART 2: Social wildfire research field growth and findings

2.2.1 Emergence of social wildfire research

It is useful to draw on the global theoretical base of wildfire risk perception, where the UK lacks any social enquiry into wildfire. This part will examine the emergence of the global wildfire social science field and its established findings on what influences wildfire risk perception, as well as attitudes toward prescribed fire. The social wildfire research field grew substantially, particularly in the USA, from the turn of the millennia as a result of increased interest due to changing wildfire risk and discontentment with previous management approaches (Toman *et al*., 2013; McCaffrey *et al*., 2013). People are facing increased wildfire risk and wildfire problems globally as result of a culmination of various forcings, namely changing climate-weather feedback, environment, fuel loads, and increased exposure of people (Abatzoglou *et al*., 2019; Arnell *et al*., 2021b; Bowman *et al*., 2020; Calkin *et al.,* 2014a, 2015; Cohen, 2008; Ganteaume & Jappiot 2013; Gill *et al.,* 2013; Gill & Stephens, 2009; IAWF, 2019; Jones *et al*., 2020; Kaval, 2009; Mell *et al.,* 2010; Modugno *et al.,* 2016; Moreira *et al.,* 2011; Moritz *et al*., 2014; Moore, 2019; North *et al*., 2015; Shafran, 2008; Tedim *et al.,* 2015a; Tedim *et al.,* 2015b; Tymstra *et al.,* 2020). A significant part of this problem is the previous dominant paradigm of suppression in wildfire management. Discontentment grew with this approach, due to what is often referred to as the 'wildfire paradox; or 'firefighting trap', where suppression leads to increased fuel loads and, counterproductively, higher future risk (Busenburg, 2004; Calkin *et al.,* 2014b, 2015; Cochrane & Bowman, 2021; Cohen, 2008; Collins *et al.,* 2013; Ingalsbee 2017; North *et al*., 2015; Xanthopoulos & Athanasiou, 2019). Fires are now occurring beyond the capabilities of suppression (Bowman *et al.,* 2017; Dunn *et al.,* 2017; Ferreira-Leite *et al*., 2015; Komac *et al.,* 2020), demonstrating the failures of the approach. Fire exclusion is therefore unsustainable, and critiques highlight its short-sighted drawbacks which neglect the ecological role of fire (Calkin *et al*., 2015; Ingalsbee, 2017; Moore, 2019; Moritz *et al.,* 2014; Tedim *et al*., 2015b).

Hence with these new challenges facing wildfires there was increased interest and shifts in research perspectives on fire. Various developments in research began broadening perspectives on vegetation fire. Firstly, satellites arguably revolutionised distributional studies facilitating view at a global scale (Scott *et al.,* 2014). This bore an appreciation that landscape fire is global (Andela *et al.,* 2017; Bowman *et al.,* 2011; Flannigan *et al.,* 2009; Forkel *et al.,* 2019; Giglio *et al*., 2013; Krawchuk *et al.,* 2009; Mouillot & Field 2005; Randerson *et al*. 2012; Scott *et al.,* 2014). Estimates of annual area burned range between 300 and 464 Mha, equal to 3 to 5% of Earth's land cover (Giglio *et al*. 2013; Randerson *et al*. 2012; Van Der Werf *et al*., 2006). Moreover, historical perspective demonstrated that plants have co-existed, even evolved, with fire since the first signs of plant life (He *et al*., 2019; Scott, 2000; Scott & Glasspool, 2006). The long history of fire means habitats where fire is present became fire-adapted, and fire therefore plays a role in maintaining habitat health (Bixby *et al*., 2015; Bowman *et al*., 2009). Focusing on fires as biological and ecological phenomena and on the relationships between fire and the Earth demonstrated fire was a normal, even vital part of the Earth system (Bond & Keeley, 2005; Coughlan & Petty, 2012). Historical perspectives similarly showed that humans have also co-existed and evolved with fire (Brain & Sillent 1988; Gowlett, 2016; Pyne, 1997, 2016; Pyne & Goldammer, 1997; Rolland 2004; Roos *et al*., 2014; Scott *et al.,* 2014), Delving into the histories and interaction of fire and mankind emphasised the importance of fire for humans which have arguably been forgotten (Pyne, 2001, 2016; Scott *et al*., 2014; Scott *et al*., 2016a). Considering this disconnect between modern western perspectives on fire and historical relationships, literature has suggested that a shift occurred with industrial development, resulting in a loss of fire from everyday life (Pyne, 2016). With industrialisation and urbanisation, fire became enclosed and then othered, a process that has been described as a 'demonisation' of fire (Scott *et al*., 2016a). Within this history, the development of western wildfire management was also crucial. Originating from fire management from European traditions of fire exclusion, it was developed for urban areas but extended into forests (Doerr & Santin, 2016; Scott *et al*., 2014). A command-and-control approach (Holling & Meffe, 1996) became pervasive through society with public campaigns such as Smokey Bear spreading this message of fire as wholly bad (Doerr & Santin, 2016).

This demonisation of fire was also perpetuated through a disaster narrative. Creating negative assumptions by focusing on vegetation fire through a lens of disaster events of landscape fire, the media focusing on a small proportion of events which are disastrous which shapes public perception (Bowman *et al*., 2020; Doerr & Santin, 2016; Moore, 2019). For instance, wildfires are reported when they get large and prescribed burns are rarely reported (Jacobson *et al*., 2001) highlighting negative outcomes rather than benefits of fire. A focus on suppression emphasised this negativity by re-inforcing beliefs of their unwanted nature (Moore, 2019). The media's focus on sensational aspects rather than longer term or more fulfilled discussion about vegetation fire does not lend itself to holistic narratives (Anderson *et al*., 2018; Berglez & Lidskog, 2019; Cordener & Schwartz, 2019; Morehouse & Sonnet, 2010). It has been argued that the media selects news and narrates stories (Yell, 2010). Yell (2010) for instance, contends that through affect the telling of disasters both shares information and elicits emotion from the audience, creating a convincing argument against fire. Furthermore, in the age of social media how events are shared online will increasingly affect perception (Weber *et al*., 2020). Including affective sharing of stories, of which may focus on the non-human also, one very moving example was activism around non-human symbols, the koala bear specifically, during the Australia black summer bushfires (Leimbach & Palmer, 2022).

With this longer-term perspective on the place of fire, and a re-found appreciation of fire as ecological, which have been described as a 'rediscovering' of fire (Pyne, 2016). As research perspectives have shifted there was a demand for a shift from the physical paradigm of fire research, to appreciating the ecological, as well as anthropogenic aspects of fire (Pyne, 2007). Similarly, management approaches have also shifted due to discontent with previous approaches and taking learnings from these new research perspectives, including ecological and socio-ecological concepts. This includes the development of socio-ecological concepts in management, sometimes referred to as integrated fire management (IFM), which look to longer-term, sustainable solutions that amalgamate fire management into broader land management, and consider both ecological and social outcomes (Moore, 2019; Myers, 2006; Sande Silve *et al*., 2010). This theme of integration has also been considered for UK landscapes (Davies *et al*., 2008). IFM involves more holistic, proactive approaches which ruminate the entire risk management cycle of prevention, response, and recovery (Myers, 2006; Rego *et al*., 2010). These directly contrasts the governance in the UK discussed above, where silo structures and wickedness interrupt the hazard management cycle across various agencies (Gazzard *et al*., 2016). Theories of holistic management are pervasive across fields of risk theory (Cologna *et al*., 2017). Herewith, a rhetoric of coexisting with fire emerged (Moritz *et al*., 2014; Birot *et al*., 2009; Stoof & Kettridge. 2022), as well as the idea of resilience borrowed from ecology (McWethy *et al*., 2019; Newman-Thacker *et al*., 2023), and the creation of resilient landscapes and communities became a popular goal for mitigation (McGee, 2011; Mortiz *et al*., 2014; Newman-Thacker *et al*., 2023; Smith *et al*., 2016; Tedim *et al*., 2016; Wunder *et al*., 2021).

Moreover, further putting wildfire into perspective was considering it as a natural hazard. Wildfire was previously omitted from the hazard field, likely as suppression management had been effective, increases in risk then demanded attention to the hazard, as well as individual mitigations (McCaffrey, 2004a). Moreover, changing management approaches created more questions about public attitudes to public fuels management; for example, early wildfire social science in the USA aimed to understand attitudes towards a let burn policy in Yellowstone (Toman *et al*., 2013). Crucially, this interest in social research and mitigation studies has been complemented by funding. An early hotspot for research has been the USA (McCaffrey *et al*., 2013) as a place well associated with these policy failures and experiencing high fire risk creating interest (Busenburg, 2004; Calkin *et al.,* 2014b, 2015; Cohen, 2008; Mell *et al*., 2010), and funding opportunities being available - a key first catalyst being the National Fire Plan around the turn of the millennium (McCaffrey & Olsen, 2012 McCaffrey *et al.,* 2013;; Toman *et al.,* 2013). To address increasing risk, wildfire research turned to social science, risk, and natural hazards literature.

2.2.1.1 Theoretical influences on social wildfire research

Wildfire research turned to already established disciplines, as McCaffrey & Kumagai, (2007) put it, there was "no need to reinvent the wheel". Drawing on wider risk perception as well as natural hazards research, the social science of wildfire field emerged. (McCaffrey, 2004a). Understanding the concepts of 'risk perception' is thus crucial. Risk is often defined as the function of the probability of an event and the magnitude of its consequences, and scientific analysis typically uses quantitative calculations of these for their risk assessments (Lo & Chan, 2017; Renn, 2008). However, an individual's assessment may differ, literature now appreciates that an individual may 'perceive risks', interpretating signs of uncertain events that are influenced by factors other than what technical approaches would include in calculations, such as knowledge, experience, feelings, heuristics, and personality (Wachinger & Renn, 2010; Wachinger *et al*., 2013).

In the 1960s and 1970s new concepts about risks were emerging (Wilson *et al*., 2019). As new technologies, such as nuclear reactors and pesticides, were developed, it begged new questions about how to approach risk to ensure safety and reliability. From these engineering roots, a modern scientific approach to risk analysis was born (Kirby, 1990). Crucially, at the same time, there were disparities between how these technical experts viewed risk using probability-based calculations, and how the public viewed risks using experiential judgements (Drottz-Sjoberg, 1999; Plough & Krimsky, 1990). Specifically, there was a lack of understanding of why the public had stronger reactions to the same risks technical experts calculated as minor (Kasperson *et al*., 1988). The realisation of the qualitative nature of laypersons judgements led to the psychometric paradigm of risk perception where risk can be ‘perceived’, and is not scientific but cultural (Fischhoff *et al*., 1984; Slovic, 1987, 1999). The psychometric risk perception field focused on the subjective nature of risk, developing mechanisms behind these judgements, based on cognition, emotion, and experience (Sjoberg *et al*., 2004; Slovic *et al*., 2004). This literature has founding ideas on the relationship between objective risk sources and an individual’s understanding and reaction to the phenomenon (Oltedal *et al.,* 2004).

An individual’s perception of risk is influenced by many factors, such as a person’s knowledge of the hazard, familiarity or experience with the source of danger, intuition, emotion, control over the situation or the ability for it to be controlled, and characteristics about the danger such as its dramatic nature (Oltedal *et al.,* 2004). It is not necessarily that a person’s evaluations of potential threats are irrational, but instead reflect patterns of decision making (Renn, 2008). The way humans make judgements has been described as an experiential and intuitive cognitive process, using images and associations linked by experience and emotion (Slovic *et al*., 2004, 2010). In other words, rather than monotonous calculations, individuals may use various mental heuristics to judge risk (Slovic *et al*., 2004). Hence, there is notion of some shortcuts in decision making; acting as beneficial to humans as they are able to process risks efficiently and make a situation more manageable through reducing uncertainty or eliminating it by denial (Slovic, 1987, Slovic *et al*., 1990). However, this may mislead a person to underestimate the risk ergot delay or fail to act, or they may assume total protection to mitigations that only offer partial (Slovic, 1987). By denying a hazard’s likelihood or disregarding the impacts, people can calmy live in hazardous places (Beebe & Omi, 1993). Alternatively, using an affect heuristic (Slovic, 1987), unconscious emotion ties to the consequences or a dread factor of the risk controlling the risk assessment outcome, so that dreaded and unknown events are seen as riskier (Dohle *et al*., 2010; Slovic, 1987, 1992). Events which are unfamiliar may evoke more negative emotions due to notions of catastrophic potential (Slovic,1987). Thus, the same risk may evoke different emotional responses or have different meanings to different people (Šotic & Rajic, 2015). The characteristics of a risk may also influence how motivated a person is to protect themselves, where more pervasive effects of previous events lead to more action, compared to more intensive but easily forgotten risks providing less motivation (Burton *et al.,* 1993; Slovic *et al*., 1990). The way people judge risks is therefore qualitative and complex.

Parallel to the development of a psychometric paradigm to risk research, was a similar shift in natural hazards work from focusing on technical measures of risk to socio-cultural understandings; these provided new comprehension of how people respond to risk, found to be in a subjective way rather than an economically rational one (Lo & Chan, 2017). White (1974) was an original geographer advocating for more social study in hazards research (Tobin & Montz, 1997).

A key motivation for natural hazards research is to reduce the loss to societies so a key aim of studies has been to understand adaptations to hazards, particularly how individuals adopt mitigation measures, and why some are favoured over others (Mitchell, 1974). A key part of this field is understanding the risk perception gap or paradox mentioned there, that is, a risk may be acknowledged ('perceived') but no action is taken to protect oneself (Cohn *et al*., 2008; Wachinger *et al*., 2013). Perception became a variable accounting for the disparity between what were theoretically deemed as ideal adaptations and actual actions (Whyte, 1986). Building a field which primarily found responses to natural hazards to be built on firstly, that an individual's awareness and perception of a hazard (e.g., time lived, past experience), and then how knowledge translated to action on the risk (e.g., resources, comparison with other daily concerns, method of calculating probability of hazard) (Burton *et al*., 1993; Palm 1990).This demonstrates similarities with broader risk perception theory, where the public's judgement is more conditional with various other factors compared to technical measures, indeed, McCaffrey (2004a) notes some convergence in the two literature fields.

Early on in the social wildfire field, McCaffrey (2004a) points out the similarities between wildfire risk perception with wider natural hazards literature, and comparable findings continue (McCaffrey *et al*., 2013; McCaffrey, 2015). Wildfire risk literature, like other risks, have found differences between experts' and public's perception (Meldrum *et al*., 2015). The idea that people do not understand or ignore risks is present for wildfire-prone areas as other natural hazards work (McCaffrey, 2004a). There are apparent contradictions of how an individual can experience a fire and still do nothing, or the fact that information about a risk does not necessarily lead to action (McCaffrey, 2004a). Therefore, understanding the social aspects to how risk is perceived and reacted to is crucial. As McCaffrey (2004a) argued, it is highly appropriate, even necessary, to draw on existing understandings of mechanisms of risk perception to better understand wildfire risk perception and mitigation decision making, to ultimately work towards adaptation to wildfire risk. Hence the aim of wildfire social science is firstly to understand risk perception and mitigation behaviours, as well as ascertaining public attitudes to management actions.

2.2.2 Scope of the social wildfire research field

Social wildfire research thus has key aims to understand wildfire perception and mitigation behaviours, as well as ascertaining public attitudes to management. These were both fundamental aspects of the early literature base with a dominant focus on pre-fire attitudes and mitigation from 2000-2008 (McCaffrey *et al.,* 2013). Having said that, numerous nuances have been found, particularly in the dynamics between perceived risk and the uptake of action (McCaffrey *et al.,* 2013; McCaffrey 2015), means this remains a key focus of studies, even in contexts (countries and fire regimes) which it has already been extensively studied (Dupey & Smith, 2018).

Research has been heavily concentrated to fire-prone countries and the wildland-urban interface environment in particular as key places of high fire risk (McCaffrey *et al*., 2013; McCaffrey, 2015). An early social science review showed an overwhelming majority in the US, comprising 93% of the literature, with a minimal amount from Australia (McCaffrey *et al.,* 2013). Then a later review, with just 3 more years' worth of literature searched, had half from outside the US, including mainly Australia, then Canada, with some from New Zealand and Mediterranean Europe (McCaffrey 2015), showing rapid global growth, although the research remains dominated by key fire-prone countries and crucially from highly westernised societies.

Findings across countries so far suggest the dynamics are the same, as well as compared to wider risk perception dynamics (McCaffrey 2015; Olsen & Sharp, 2013; Shindler *et al*., 2009; Toman *et al*., 2006, 2011; Vining & Merrick 2008). The differences found between countries are argued to reflect context, such as ecological variations in fire occurrence, regulations, or agency-community relationships rather than the influences on an individual's perception and response (McCaffrey & Olsen, 2012). Of course, varying fire contexts between countries and landscapes are important as the risk source changes (Gordon *et al.,* 2013; Oltedal *et al.,* 2004). As the boundaries of fire danger are expanding into countries not traditionally fire-prone (Jolly *et al*., 2015; Prat-Guitart *et al*., 2019) there are key questions for how fire risk is perceived in countries where it was not previously widespread. In other words, by a public that may be unaware or unaccustomed to it. This has been pointed out in relation to UK and other northern European countries such as the Netherlands (Stoof *et al*., 2012). There has been a handful of perception studies in Northern European countries like Sweden which is less well known for its wildfire risk that may be useful (Berglez & Lidskog *et al.,* 2019; Butler *et al.,* 2019; Eckerberg & Buizer, 2017), but key gaps remain. It is important to gather studies of varying fire contexts to understand how applicable current knowledge is as well as to inform outreach to foster preparedness, where the efficacy of wildfire mitigation has been shown to be connected to localised design and taking local context into account (Everett & Fuller 2011; Stidham *et al.,* 2014).

2.2.3 Key literature findings

2.2.3.1 Wildfire risk perception findings

Studies have investigated how the public view wildfire risk, as a key part of pre-fire mitigation and preparedness topics within wildfire social science (McCaffrey *et al*., 2013). In fire-prone areas, in particular the WUI, studies have largely found high wildfire risk perception (Carroll *et al.,* 2004; Cohn *et al.,* 2008; Martin *et al.,* 2007, 2009; McCaffrey 2004a, 2008; Steelman 2008). This acknowledgement of risk is sensible given that risk perception is associated with the risk source (Oltedal *et al.,* 2004). Despite generalised acknowledgement in high-risk areas, the perceptions are highly variable, where not everyone in the same area reacts the same way (McCaffrey, 2008). This complexity reflects the individualised experiences and uncertainty of a hazard corroborating wider socio-psychological constructions of risk (Daniel, 2007; McCaffrey, 2008). This is also consistent to natural hazards studies in the UK focusing on flooding (Lo & Chan, 2017). Common findings on the factors affecting the wildfire risk perceived include, individual probability calculations, the timeframe and spatial area considered, the type of consequences considered, perceived vulnerability to consequences, knowledge, previous experience, and personal considerations (McCaffrey *et al*., 2013).

A person may focus on either probability or severity when assessing a risk (Drottz-Sjoberg, 1999). McCaffrey *et al*., (2013) notes social wildfire literature demonstrates wildfire risk is built around individual probability calculations as well as the magnitude and type of consequences. In particular, severity has been found to be a crucial contributor to higher risk perception (Cohn *et al*., 2008; Martin *et al*., 2007). So, focusing on potential consequences when perceived as catastrophic, leads to a notion of high risk where, especially if an extreme event has been experienced, the risk may become more feared (Cohn *et al*., 2008). Moreover, increased sense of vulnerability is also crucial to perceiving a higher risk, linking to the severity of event as the consequences become heightened (Collins, 2012; Martin *et al*., 2007; Olsen *et al*., 2017). Additionally, Collins (2012) found that value of property affected risk perception. Potential damage is a key influence on risk perception in other natural hazards work (Sattler *et al*., 1995), supporting the notion of risk based on severity or vulnerability heightening perceived consequences. The perceived consequences are important (McCaffrey *et al*., 2013), where contrastingly, McMorrow (2011) explains that a lack of direct impacts, or the undervaluation of those impacts, is partially responsible for the lack of acknowledgment of wildfire hazards in the UK.

Probability is also crucial to the extent of wildfire risk perceived (McCaffrey *et al*., 2013), even if these calculations are possibly more embedded rather than explicitly drawn on by individuals (Cohn *et al*., 2008). Likelihood may also be calculated in terms of how likely a person is to be affected in relation to the area. For instance, studies have concurred that the spatial frame considered may change the extent of risk, risk accumulates for larger scales so community is more likely to be affected than an individual, and conversely it seems less likely that an individual themselves would be affected (Collins, 2012; Steelman, 2008). This is also true of general risk perception of a lower probability for themselves, exemplifying an unrealistic optimism (Armour & Taylor, 2002; McKenna, 1993).

Awareness of the surrounding environment also influences probability calculations. Wildfire studies have found how close an individual is to wildland vegetation is a predictor of risk perception (Koksal *et al.,* 2019; Olsen *et al.,* 2017). The wealth of social science in the WUI demonstrates that those living in the WUI generally acknowledge the higher risks (Carroll *et al.,* 2004; Cohn *et al.,* 2008; Martin *et al.,* 2007, 2009; McCaffrey 2004a, 2008; Steelman 2008; Wolters *et al*., 2017). There is also the notion of residing in rural areas having wildfire risk (McLennan *et al.,* 2015). Whereas urban residents generally have less initial awareness of fire risks, assign lower probabilities, and have greater resistance to personal mitigations (Gardner *et al*., 1987). Moreover, literature has also suggested that being aware of being close to hazardous (fuel) conditions can increase risk perception (Olsen *et al.,* 2017; Wolters *et al.,* 2017). Olsen *et al.,* (2017) found that those that perceived greater risk were closer to fuel and these indeed corresponded with higher probability in models; this suggested that either homeowners are ‘savvy observers’ of the landscape, or they are effectively receiving messages about the high risk. Similarly, another risk perception study of flooding found individuals were good at estimating risk over space by applying risk to where was associated with previous events, demonstrating how those in a risky place can be keen and effective observers (Wachinger *et al*., 2013). Generally, research has suggested that those in places already studied have some, or good, ecological knowledge of fire (McCaffrey & Olsen, 2012). Moreover, environmental conditions, topography, and ecological knowledge have been found to influence the risk perceived, suggesting how knowledge of conditions that make fire riskier (either more likely or severe) increases risk perception (Collins, 2012; McCaffrey, 2008).

Therefore, rather than living somewhere in and of itself being the variable, awareness or knowledge can increase risk perception. Knowledge is a well-established factor identified in risk perception more widely (Wachinger *et al*., 2013; Wachinger & Renn, 2010). A person’s knowledge is influenced by personal experience, common sense, and communication with neighbours, local forums (e.g., ‘Homeowners Association’) or government agencies, and mass media (Martin *et al*., 2007; McCaffrey *et al*., 2011).

One aspect of knowledge is past experience. A key thought in risk perception is that it increases after past experiences; experience is something to base knowledge of a risk on (Slovic, 1987) and recollection of events may become a tangible judgement for expected frequency (Palm, 1990; Tversky & Kahneman, 1973). The availability heuristic demonstrates that the past is used to inform the future specifically by the ease with which something comes to mind (Tversky & Kahneman, 1973). How frequently a hazard happens, whether it was recent or distant in memory, and whether there were significant outcomes, will determine how easily it comes to mind and thus how profound the risk is. In other words, the more memorable it is the higher the risk perception. Experiencing consequences are important, because if they have experienced damage or psychological stress it becomes more memorable (Sattler *et al*., 1995). Conversely, this does mean where a hazards exposure was less severe, it may then be perceived as less risky (Halpern-Felsher *et al*., 2001). Overall, wildfire studies have somewhat concurred that previous experience with wildfire does act to increase perception of wildfire risk (Blanchard & Ryan, 2007; Champ & Brenkert-Smith, 2016; Cohn *et al.*, 2008; Flint, 2007; Kumagai *et al.*, 2004; McGee *et al.*, 2009). Primarily through raising awareness (Cohn *et al.*, 2008), as seeing the impacts of an event can increase the perceived consequences (Champ & Brenkert-Smith, 2016). Looking at how a personal experience with fire may affect perception, a longitudinal study Flint (2007) found an increase in risk perception following an event compared to before. Additionally, Cohn *et al.*, (2008) did find that an event did raise the profile of future risk through awareness of potential consequences.

Having said that, findings overall on the influence of past experience of a wildfire on the level of risk perceived have been mixed. Cohn *et al.*, (2008) found that personal experience had two dynamics on risk perception, either increasing through emotive response (fear) especially when the event was severe, or conversely, dampening risk where an extreme event led to diminished possibility of severity in the future. Hence personal experience can also have a dampening effect (Champ & Brenkert-Smith, 2016; Cohn *et al.*, 2008; Fischer, 2011; Kumagai *et al.*, 2004; McGee *et al.*, 2009). A common notion explaining this drop is that they become less likely, because lightning does not strike twice (Champ & Brenkert-Smith, 2016). Cohn *et al.*, 2008 found this to be especially true where wildfires are more extreme and so a person feels it is unlikely to experience another 1 in 100-year event in their lifetime; this is somewhat justified in wildfire occurrence because fuel would be burned thus limiting the severity of another event in the near future. Notably the mixed effect is further exemplified continues, where there may be increases in possibility of a future event but minimisation of the severity (Cohn *et al.*, 2008). Champ and Brenkert-Smith (2016) point out the complexity of experience, as they asked the question of how much seeing was believing. In their study, seeing in the form of first-hand experience may not necessarily lead to higher risk perception, however learning from neighbours or being aware of risk moving across neighbouring lands had stronger correlations with risk perception. In other words, it is not necessarily personal experience, but greater knowledge that leads to greater appreciation for future risk. Thus, for Champ and Brenkert-Smith (2016) hearing from neighbours had a stronger influence on risk perceptions than personal experience.

Furthermore, repeated exposure is often thought as a key variable in risk perception (Slovic, 2000) where more frequent interactions with a hazard may improve the accuracy of risk assessment (Tversky & Kahneman, 1973). This is somewhat corroborated by assertions that length of time lived in the area can increase the fire risk perceived (Brenkert-Smith *et al.*, 2006), as well as when comparing full-time residents with part-time (Collins, 2012). It has also been noted that urban residents have lower perception of wildfire hazards (Gardner *et al.*, 1987; McGee, 2005). Hence, new residents may not understand a threat (Brenkert-Smith *et al.*, 2006) which is important where there has been migration of people into the WUI, populations have varied hazard-related knowledge (Eriksen & Prior, 2011). Having said that, time lived may not be a simple variable to associate with the level of risk perceived, as it has also been found that long-term residents may be complacent, for instance believing adequate protection will come from government as it previously has acting to decrease perceived consequences (Brenkert-Smith *et al.*, 2006). Furthermore, the mixed relationship between exposure and risk perception is exemplified by findings that when the frequency is very high, relevant for seasonal hazards, there is a possibility that the risk becomes a part of life and hence ignored, which has been referred to a ‘disaster subculture’ (Tierney 1993). Exposure and familiarity may therefore be part of risk perception, but other factors may moderate it.

Indirect familiarity is another key influence on risk perception, as highlighted by notions of socially amplified risk (Brenkert-Smith *et al.,* 2013) and findings that information from neighbours may be a better predictor than direct experience (Champ & Brenkert-Smith, 2016). Indirect exposure or knowledge may come from informal connections, government agencies, local agencies, and media (Champ & Brenkert-Smith, 2016; Eriksen & Prior, 2011; Jarrett *et al*., 2009; Martin *et al*., 2007; McCaffrey, 2004b; McCaffrey *et al*., 2011; McCaffrey & Olsen, 2012). This information may lead to a socially amplified probability of fire (Brenkert-Smith *et al*., 2013). How people acquire knowledge is key; how much a source is trusted is often highlighted (Brenkert-Smith *et al.,* 2013; Eriksen & Prior, 2011; McCaffrey & Olsen, 2012). Government is a consistently trusted (McCaffrey & Olsen, 2012) or credible (Shindler *et al*., 2009) source. Moreover, where local context is accounted for, or when the agency is more local, this increases trust or the influence of the information source on a person's perception (McCaffrey, 2004b). However, informal connections are potentially as or more important for influencing the level of risk a person assesses, such as neighbours, family, or friends (Champ & Brenkert-Smith, 2016; Jarrett *et al*., 2009). Possibly important is the impact on perceived consequences as a result of information from neighbours or friends (Brenkert-Smith *et al.,* 2013). Therefore, information sources are crucial. Moreover, personal knowledge can override expert information; broader risk literature has found that the more an individual knows the more they trust their own opinion over experts (Siegrist & Cvetkovich, 2000). So, when information is lacking trusted information sources become more important (Wachinger & Renn, 2010). Trust is therefore significant when the hazards are unfamiliar, infrequent, and complex, making it highly relevant to environmental risks (Paton, 2008). Building trust between agencies and communities is therefore crucial to ensure an informed public, and it has been highlighted in wildfire research, the need to nourish community-agency relationships, including trust (Lijeblad *et al*., 2009; Olsen & Sharp, 2013; Olsen & Shindler, 2010; Rasch & McCaffrey, 2019; Steelman *et al*., 2014). Moreover, an interesting observation about the efficacy of information in conveying risk is that where information is too abstract, such as the use of statistics which are intangible, the reality of the risk may not be understood (Kumagai *et al*., 2004).

Media is important for attitudes towards fire, it may act as an information source, but also has to power to perpetuate narratives (Paveglio *et al*., 2001; Yell, 2010). As mentioned above this may more broadly shape perception to wider landscape fire through a disaster narrative, but it may also amplify risk perception through awareness of consequences or affect (Johnson *et al*., 2006). Other natural hazards research concurs that media is a source of information about hazards (Wachinger *et al*., 2013). This includes in the UK, where flooding risk perception has been linked to media influences (Cologna *et al.,* 2017; Gavin *et al.,* 2011), although other research emphasises that the power of media to shape personal risk perceptions may be lower as other sources of information (such as social networks) may take precedent (Brenkert-Smtih *et al*., 2013).

Other considerations or factors determining risk perception may be less about the risk itself and instead moderated by other mental processes. Firstly, considerations about wildfire risk perception include personal variations such as a risk tolerance which balances the benefits with experiencing the risk, such as balancing the risks of living in a forest [fire-prone place] with the benefits; studies finding the latter outweighing the former (Daniel, 2007; Gardner, 1987; McCaffrey, 2007). This draws on the idea of a person minimising risks to live in risker places (Beebe & Omi, 1993) and are comparable to other natural hazards research where aesthetics, amenities, or fertile soil meaning economic opportunities balances with risk (Wachinger *et al*., 2013). Another consequence of intuitive risk perception is an element of denial relevant to the fact that there is greater risk attributed to a community scale than a personal one, where it is seen as more unlikely that the individual would be affected over everyone else (Collins, 2012; Steelman, 2008). Another consideration may be that wildfire risk is not the only hazard for an individual to consider, and it occurs within the context of their life. An interesting result came from a study on wildfire and hurricanes (Newman *et al.,* 2014) that individuals living near the ocean in the western part of Florida described hurricanes as being a greater risk and hence wildfire was minimised.

Another aspect of an individual's knowledge or beliefs that may influence wildfire risk perception are individual beliefs about climate change and wildfire. Despite the focus on climate change for changing wildfire risk in literature, considering how perceptions of the two may interact in public perceptions is interestingly mostly absent from a lot of research especially in the early field (McCaffrey, 2015; McCaffrey *et al.,* 2013). This is especially interesting where the two risks are interconnected. A limited number of studies have focused on the influence of climate change beliefs on wildfire risk perception (Schulte & Miller, 2010), as well as the influence of wildfire experience on climate change beliefs and behaviours (Lacroix *et al*., 2020). Another study has considered how climate change was included in wildfire media reporting (Berglez & Lidskog, 2019). A link was found in the USA with high awareness of climate change impacts as positively related to wildfire risk perception, and a variable in mitigation too (although only marginal) (Schulte & Miller, 2010). Involuntary factors of wildfire occurrence have been linked to greater severity of risk, where it creates the sense of lack of controllability (Cohn *et al*., 2008; Martin *et al*., 2007). The influence of climate change beliefs could potentially be more relevant to the UK if wildfire is seen as emergent because of climate change. The country broadly speaking is one which has a high acceptance of climate change science and where scepticism is generally low, although it ebbs and flows (Capstick *et al*., 2015), so climate change beliefs may act to amplify wildfire risk.

Furthermore, considering the interaction of wildfire and climate change perceptions, is an influence in the other direction – that experiencing a wildfire event may change or strengthen a person's belief of climate change science. There is more general literature which has considered how experiencing extreme weather may affect climate beliefs, with the notion that experience of a climate-related event will increase support of climate change science because it reduces the abstract, intangible nature of climate risks (Bergquist *et al*., 2019; Borick & Rabe, 2017; Whitmarsh, 2008). A study in England of how the experience of flood and air pollution may affect climate change risk perception and behaviours found that those who experienced flood had little change to climate change belief, but air pollution (poor air quality effect on health) victims did have some (Whitmarsh, 2008). The flooding victims were found to have understanding of different causes for flooding than climate change, as personal observations were more trusted, instead blaming blocked drains and road resurfacing rather than changing weather. Whereas those affected by air pollution identified the cause as humans changing the air, which would be more complimentary with the idea of anthropogenic climate change. Perception of air pollution and climate change has also been linked by study previously (Bord *et al*., 2000), with most other literature supporting the fact that there is no evidence that other weather event experiences (e.g., flooding) affect climate change support (Lacroix *et al*., 2020). A wildfire study has been done on this topic; Lacroix *et al*., (2020) found indirect exposure to wildfire of seeing smoke had a stronger effect on climate change risk perception than direct exposure, which highlights the need for atmospheric link. The authors did note that it did not change an individual's mind, but did strengthen opinion. On the other hand, while this relationship between perceptions is interesting, a paper on flooding and climate change in the media by Gavin *et al.,* (2011), warns against the politics of reporting on individual weather events with climate change focus, explaining that the ambiguities of causal effect of climate change on events is a possible avenue for climate deniers to use this to muddy debate. Also, emphasizing the involuntary nature of influences on wildfire could counterintuitively increase the sense of severity beyond where anything can be done – where it has been found that external involuntary factors (such as drought) may act to reduce motivation to mitigate as the risk becomes uncontrollable (Martin *et al.*, 2007).

2.2.3.2 Wildfire mitigation decisions findings

An important part of the social wildfire field is investigating how this perception of risk translates into mitigating behaviours. A person is able to influence the probability of a wildfire happening on their land in ways that make it unlike other natural hazards (Champ & Brenkert-Smith, 2016; Cohen, 2000). There are various strategies to achieve the goal of adaptation, or living with, wildfire hazards (Paveglio *et al.*, 2019). These include, firstly, the use of mitigations, such as reducing fuels near homes, or 'defensible space' (US Forest Service, 2023), and using fire-resistant materials; policies, such as more effective land planning; and education or assistance, such as Firewise Communities USA. Residents are able to employ various mitigations on their own property and studies have therefore looked at uptake of mitigation and Firewise behaviours (e.g., Brenkert-Smith *et al.*, 2006; Absher & Vaske, 2006; Wolters *et al.*, 2017), as well as in creating fire-adapted communities (e.g., Paveglio *et al.*, 2019). Homeowner action is directed either at reducing the hazard on their own properties or as part of collective decisions and actions at a community level (Jakes *et al.* 2007).

The early questions about why, despite living in high-risk areas, mitigation was not adopted was a key starting point for the field regarding this topic (McCaffrey, 2004a). Henceforth, mitigation has continued to be a key angle for the wildfire social research field, of which the findings continue to be found to be highly nuanced (McCaffrey, 2015). A common notion is that with more information about a hazard an individual will then be motivated to mitigate the risk, contrarily research suggests this automatic move to action is not always the case (McCaffrey, 2004a). Additionally, the point has been made that perceiving a fire risk too passively in the eyes of experts, or not acting on a risk, is not necessarily due to a lack of awareness, instead there are other factors in the personal assessments a resident may make that lead to the decision to mitigate (McCaffrey, 2008). Generally though, risk perception is associated with better preparation for wildfire (Brenkert-Smith *et al.,* 2012; Martin *et al.,* 2009; McNeill *et al.,* 2013; Shindler, 2007; Vaske *et al.,* 2007; Winter *et al.,* 2004) and research in fire-prone areas has demonstrated that most have taken at least some action to protect their property (Absher & Vaske, 2006; Brenkert-Smith *et al.*, 2006; Cvetkovich & Winter, 2008; Dickinson *et al.*, 2015; Kent *et al.,* 2003; McCaffrey, 2008; McGee, 2005; McGee & Russell 2003; Monroe & Nelson, 2004). Conversely, it has been found that high risk perception does not always lead to preparations (Brenkert-Smith *et al.*, 2006; Cohn *et al.*, 2008; Collins, 2008; Daniel *et al.,* 2002; Kent *et al.,* 2003; Koksal *et al.,* 2019; Martin *et al.,* 2009; McCaffrey 2004a; Schulte & Miller, 2010; Steelman 2008). This has been referred to as the risk perception gap or paradox, the gap between awareness and action (Cohn *et al.*, 2008; Eriksen & Gill, 2010) and is consistent with wider risk literature, which has argued the two are interfered by experience and motivation, trust, responsibility, and personal ability (Wachinger *et al.*, 2013). Understanding the complexities of decisions to mitigate are crucial in fostering fire-adapted communities (Paveglio *et al.*, 2019). These ideas of nuanced mitigation are important for stakeholders to consider preparedness, for instance it has been pointed out that ignoring wildfire risk makes populations more vulnerable, thus being realistic about social behaviours is key when thinking about management plans (Komac *et al.,* 2020). Key factors found in studies include, perceiving a risk, but particularly when it is seen as more severe or there is a vulnerability; perceiving issues or hazardous conditions close by; perceiving wider benefits; competing with daily life; social cues; and place attachment.

Perceiving a risk is a prerequisite to mitigation, but not always causal. For instance, when the risk is low an idea that may be relevant is that when the perceived risk drops below a certain threshold, the probability of risk treated as nil (Slovic *et al.,* 1977). An example of this effect was found in insurance research where there was a community wide lack of insurance against a particular storm (Haer *et al.,* 2017). There is an element of cost-benefit analysis, where an individual not only needs to acknowledge the risk is sufficiently likely and the impacts would be adequately damaging to justify a mitigation action (McCaffrey, 2008). Characteristics about the risk such as being rare or a reliance that suppression will be sufficient may act to negate a need for mitigation despite acknowledgement of a risk (McCaffrey, 2008). For natural hazards there is uncertainty in decisions as the risks are low probability but high impact (Haer *et al*., 2017).

While a link with general risk perception may be more tenuous, studies have found stronger links between perceived consequences or severity of risk and mitigation, as well as a perceived vulnerability (Dickinson *et al*., 2015; Martin et el., 2007, 2009; McNeill *et al.,* 2013; Olsen *et al.,* 2017; Shindler 2007; Vaske *et al.,* 2007; Winter *et al.,* 2004). The focus on severity or vulnerability is also associated with living next to hazardous conditions. For instance, the scenario where neighbours have issues has been identified as positively influencing mitigation actions (Olsen *et al.,* 2017). However, there is some dichotomy here, that when the risk is perceived as extremely severe it can create a perceived inefficiency of mitigation. For example, involuntary influences on a hazard, such as extreme weather, can create the sense that no matter what preparation is done, when a large fire occurs it will burn everything (Martin *et al*., 2007).

Another key aspect to mitigation decisions, is the framing of risk, crucially, it is most effective when it is localised (Kent *et al*., 2003; McCaffrey, 2004b). When designing outreach that takes into account the locality, is tailored and specific to the context, this fosters more action (Brenkert-Smith *et al.,* 2012; Christianson *et al.,* 2014; Everett & Fuller 2011; McCaffrey *et al.,* 2011, 2013; Monroe *et al.,* 2006; Steelman *et al.,* 2014; Steelman & McCaffrey 2012; Stidham *et al.,* 2014). In other words, there is no point having the same scheme as somewhere else without considering its appropriateness through effective interaction, trust, and relevance (Steelman *et al.,* 2014; Steelman & McCaffrey 2012). Specifically for example, paying more attention to addressing specific concerns of local people, can make information more relevant and the perceived efficacy of work increased (Toman *et al*., 2006). Moreover, the dissemination of information is more successful when it is done interactively and not unidirectionally (Eriksen & Prior, 2011; McCaffrey 2004b; Toman *et al*., 2004; Toman & Shindler, 2006). It is also important to cater to the various knowledge levels within a community, where it has been highlighted that they are heterogeneous groups (Brenkert-Smith *et al*., 2006; Eriksen & Prior, 2011; Martin *et al*., 2007).

Therefore, there are some links to fire risk but additional moderators, such as balance with other values and trust in suppression, affect taking mitigating action (Collins, 2008). A crucial consideration identified is that the action needs to be perceived as effective (Absher & Vaske, 2006; Brenkert-Smith et a., 2006; Bright & Burtz, 2006; McFarlane *et al*., 2011; Winter & Fried 2000). This includes both the perceived efficacy of a potential action and self-efficacy, meaning how successfully an individual would be in implementing it (Martin *et al*., 2007, 2009). This also links to the fact that if the risk is perceived as uncontrollable, the mitigation is thus seen as ineffective (Martin *et al*., 2007; Winter & Fried, 2000). Additionally, if a wildfire risk is seen as random this also acts to create a perceived inadequacy of mitigation (Winter & Fried, 2000).

Moreover, perceiving other benefits beyond reducing fire risk has been found to increase motivation consistently across studies (McCaffrey, 2015); including, improving aesthetics or social networks, such as better relations with neighbours and government agencies (McGee, 2011). Mitigations may be done for other reasons than fire risk reduction (McGee 2005; Nelson *et al*. 2005; Bright and Burtz 2006). Additionally, the decision to mitigate may be a trade-off between risk reduction and other amenities; often the two are seen as opposed (Brenkert-Smith *et al*. 2006; McCaffrey, 2008; Monroe & Nelson 2004; Nelson *et al*., 2005). Amenities associated with vegetation include privacy, wildlife, aesthetics, recreation, and wind breaks, as well as a desire for 'naturalness'. Studies have found that individuals can actively ignore wildfire risks where other concerns take precedent. For instance, a study found that while residents were able to accurately perceive the level of fire hazards in various hypothetical images of fuel conditions, it may not be the predominant or even significant concern of residents in the WUI (Daniel *et al.,* 2002). For example, there may be a reluctance to cut down trees where there is strong attachment to forested areas (Cohn *et al*., 2008). Others have noted that outcomes of mitigation measures may not always have undesirable outcomes and may align with wildfire mitigation actions (McCaffrey *et al*., 2011).

Undertaking mitigation actions competes with everyday life (Champ *et al.,* 2013; Cohn *et al*., 2008; Eriksen & Gill, 2010; Koksal *et al.,* 2019; McFarlane *et al.,* 2011; Reid & Beilin, 2013). This may include competing with other risks or where securing livelihood is more pressing than addressing a potential future natural hazard, especially as they tend to be infrequent (Wachinger *et al*., 2013). This is especially relevant for economically pressured areas as mitigating an environmental hazard becomes unimportant (Cohn *et al*., 2008). Practicalities also play a role, namely capacity to undertake action including financial, time, and ability (Bright & Burtz 2006; Eriksen & Gill, 2010; McCaffrey *et al.,* 2013). Financial or physical ability, as well as confusion or ignorance will affect the amount and type of action, thus there should be an aim to not only raise awareness but support the capacity of people to mitigate (Wachinger *et al*., 2013). Indeed, a lack of information has been found to play act as barriers to wildfire mitigation (Dickinson *et al*., 2015). Support is also important, where there may be engagement but lack of action, such as Cohn *et al*., (2008) found that some attended workshops but undertook no action on their home. Agency outreach is important for both disseminating information about risks, options for mitigation, and supporting mitigation (McCaffrey *et al*., 2011). There is evidence that even modest outreach is effective in improving ecological knowledge (McCaffrey & Olsen, 2012). Generally low cost and effort options for preparation that achieve multiple outcomes are more popular than removing vegetation or structural changes (McFarlane *et al*., 2011). Moreover, age is linked to physical ability and motivation where there may be less action by older residents (Champ *et al.,* 2013; Fischer, 2011). However, Brenkert-Smith *et al*. (2012) found the opposite trend that older residents were more likely to adopt measures than younger residents and no other personal characteristics had relationships with mitigation.

Another influence on mitigation is the influence of social cues. In addition to conditions on neighbouring land affecting the sense of risk, what neighbours do may create peer pressure, or where neighbour fail to act, this may lead to frustration, heightened sense of risk, and sense of futility (Brenkert-Smith *et al*., 2013; Cohn *et al*., 2008; Dickinson *et al*., 2015; Martin *et al*., 2007; McCaffrey *et al*., 2011). Similarly, social interactions are also important for mitigation. Interactions may be general to area or wildfire specific (Brenkert-Smith *et al*., 2013), they are important for disseminating information on risk, as well as knowledge about options for mitigation (McCaffrey, 2004; McCaffrey *et al*., 2011). This highlights how multiple factors will encourage mitigation, from social cues to social amplification of knowledge; for instance, McCaffrey *et al*., (2011) found a combination of common sense, peer influences, and local programmes that gives information on actions or assists in the decision of what to do.

Moreover, crucial aspect of social interaction in wildfire mitigation are concept of social capital or place attachment, two more recent additions to the field (McCaffrey, 2015). Place attachment literature interrogates the relationship between people and place (Lewicka, 2011); it can be thought of as a symbolic attachment of an individual or group to place (Billig, 2006). Studies suggests that those more attached to either their home or community, or with deeper historical relationships with the land, are more inclined to mitigate fire risk to protect these places as well as creating more support [social capital] to enable mitigation in the area (Anton & Lawrence, 2014, 2016; Brenkert-Smith, 2010; Eriksen & Gill 2010; Jakes & Langer 2012; Kyle *et al*., 2010; Gordon *et al*., 2020). Notably, rural areas generally have higher place attachment, where in fact, living in fire prone areas can itself increase place attachment (Anton & Lawrence, 2016). Social capital is the degree members of a community are connected (Putnam, 2000). For wildfire mitigation, more connected communities have correlated with increased mitigation actions (Kyle *et al*., 2010). An example is that social capital may act to reduce mitigation costs, such as neighbourhood workdays where neighbours can share the labour of actions on homes (Brenkert-Smith, 2010). Additionally, cooperative neighbours are also helpful in fostering preparedness (Stidham *et al.,* 2014). Social cohesion through sense of community and collectively solving a problem are a resource that can help prepare (Prior & Eriksen, 2013). Notably, a study in England and Wales of flooding risk found mitigation actions to be socially motivated, highlighting the importance of social networks and engagement in natural hazards preparedness (Lo & Chan, 2017).

Having outreach that is based on approaching and supporting communities rather than individuals has been an emergent theme (McCaffrey, 2015). This draws on the well-accepted idea that there is a cumulative element to the risk perceived for the area compared to an individual property. Supporting a whole community creates more incentive to mitigate as it would be perceived as more useful, as well as assertions that there is better engagement in mitigation when there is a shared responsibility (Steelman, 2008). Hence community-based approaches have become popular, and community has developed as a crucial theme in wildfire mitigation literature (McCaffrey, 2015). This includes the emergence of concept of fire-adapted communities (Paveglio *et al*., 2019). An example of a community led approach is Firewise Communities, developed by the National Fire Protection Association in USA in 2002 (NFPA) (NFPA, 2023). The scheme encourages residents to consider and participate in mitigation, with the goal to save life and property, using workshops and public education and encouraging both community efforts and individual tasks. The idea is that the whole community is involved including homeowners, planners, community leaders, and firefighters, based on the idea that each place may have unique needs (Wolters *et al*., 2017). This builds on being community-based, utilising social capital, and being tailored to the area. Subsequently from this archetype, similar schemes have developed elsewhere in the world, such as Fire Smart scheme in Europe (Faivre *et al*., 2018).

In fostering good community-agency relationships, trust is not only crucial for individuals accepting knowledge about risk but also in generating good relationships (Lijeblad *et al*., 2009; Olsen & Sharp, 2013; Olsen & Shindler, 2010; Rasch & McCaffrey, 2019; Steelman *et al*., 2014). Trust in authorities is necessary to facilitate advice to be taken on board by communities for preparation and during crisis (Wachinger *et al*., 2013). Factors that feed into trustworthy relations include competence of agency personnel; perception of shared norms and values; perception of fairness and equity in the planning process; and following through on commitments (Cvetkovich & Winter 2008; Lijeblad *et al.,* 2009; Olsen & Shindler 2010; Vaske *et al.,* 2007; Winter *et al.,* 2004).

2.2.3.3 Acceptability of prescribed fire

Ascertaining public attitudes to fuels management, including mechanical thinning and prescribed fire, has been another topic in social wildfire research (McCaffrey *et al*., 2013). Hence findings on acceptability of prescribed fire globally are mostly discussed in relation to wildfire risk management. Whereas, in the UK, prescribed fire is primarily used for agriculture, with more recent use for wildfire mitigation, the debate is therefore centred around its agricultural application that is attached to other social tensions around sporting estates, as well as new questions about the implications in light of changing wildfire risk (Davies *et al*., 2008; Davies *et al*., 2016a, 2016c; Brown *et al*., 2016; Luxmoore, 2018). There is debate of the use of fire elsewhere, for example Australia has ardent debate around uncertainty over its effectiveness in reducing risk and impacts on diversity, where there are opposing views of the priority of reducing fire risk to protect assets versus priorities of nature and biodiversity (Altangerel & Kull, 2013). These reflect contextual differences of the debate in relation to fire risk, but also demonstrate similarities in the concerns over the intended and unintended consequences primarily on nature.

There have been common dynamics identified in attitudes towards the use of fire for mainly fuels management across literature. Wildfire studies in fire-prone countries have generally found high acceptability (Absher & Vaske, 2006; Brunson & Shindler, 2004; Kaval, 2009; Lim *et al*. 2009; McCaffrey 2006, 2008; McCaffrey *et al*., 2008; Shindler & Toman, 2003; Shindler *et al*., 2009, 2011; Toman & Shindler, 2006; Vogt *et al*., 2007; Walker *et al*., 2007). Where reviews have calculated averages of 80% giving full or partial acceptance (McCaffrey, 2015; McCaffrey & Olsen, 2012). This high is possibly because of the context of high fire-risk and hence a perceived need, or because these are in fire-prone areas where fire occurs more naturally. These perceptions do vary from “a legitimate tool that can be used anywhere” to “a tool that can be used infrequently in selected areas” (Shindler & Toman 2003; Shindler *et al*., 2009, 2011). There is therefore some conditional acceptance and resistance to fire. For instance, the notion of a preference for mechanical reductions of fire risk rather than prescribed burns has been identified (Absher & Vaske 2006; Fried *et al*. 2006; Kent *et al*. 2003; Ryan & Wamsley 2008; Toman *et al*. 2011). Key factors that influence acceptability include familiarity, knowledge, trust, perceived benefits and all perceived outcomes (McCaffrey, 2015). Reviews of literature have pointed out that factors most associated with acceptability are familiarity and trust (McCaffrey, 2015; McCaffrey & Olsen, 2012).

Familiarity with tool increases acceptability (McCaffrey *et al*., 2008; Ryan & Wamsley 2008; Toman *et al*. 2004, 2008). Firstly, there is the idea that exposure increases support, exemplified by fuels treatment tours having a positive effect on views towards prescribed fire (McCaffrey *et al*., 2008; Toman *et al*. 2004, 2008). In relation to landowner experience, non-tribal landowners’ perceptions demonstrate lack of experience and comfort around fire compared to tribal landowners (Carroll *et al*., 2004), suggesting a lack of comfortability around fire of more industrialised populations. It is argued that seeing fire leads to better knowledge of impacts rather than focusing on assumptions about fire which is typically that it is destructive (Blanchard & Ryan, 2007). This points to a fact that where an individual does not know much about it, there may be uncertainty over effectiveness or consequences, generally leading to less acceptance (Altangerel & Kull, 2013). It has been argued that media has shaped wider perceptions of landscape fire, for instance, it rarely shares news of prescribed fire instead the messaging is exclusively of (disaster) wildfire events (Jacobson *et* *al*., 2001) hence distorting exposure through sensational aspects rather than more well-rounded discourse (Anderson *et al*., 2018; Berglez & Lidskog, 2019; Cordener & Schwartz, 2019; Morehouse & Sonnet, 2010). Through a negative reporting bias and affective impressions, there are automatic negative assumptions about the technique (Paveglio *et al*., 2011). For UK as a highly urbanised country these wider perceptions of landscape fire will be highly relevant, as individuals may have limited knowledge or exposure to fire use (Davies *et al*., 2008). Moreover, it has been pointed out that because wildfire is becoming more visible, it introduces a controversy over fire use where controlled and uncontrolled fire are possibly conflated (Carroll *et al*., 2021). In these cases, it also raises ecological questions about the suitability of landscapes and ecosystems to fire (Davies *et al*., 2016a).

It is well-accepted that knowledge of the fuel treatment positively influences support (Ascher *et al.,* 2013; Blanchard & Ryan, 2007; Brunson & Shindler 2004; Cortner *et al.,* 1984; Kumagai *et al*., 2004; McCaffrey 2004b; Paveglio *et al*., 2009; Shindler & Toman 2003), where it is surmised that people will only support a management tool they understand (Kumagai *et al*., 2004). More specifically, rather than knowledge or familiarity directly increasing support, it is that it leads to awareness of benefits (Ascher *et al.,* 2013; Paveglio *et al*., 2009). Another dynamic is that knowledge creates less focus on negative potential (Blanchard & Ryan 2007; McCaffrey, 2004b; McCaffrey & Olsen, 2012). For instance, a study found reading educational material increased awareness of benefits and individuals were then less likely to think the tool was unnecessary, that they disliked the aesthetics, or that smoke was problematic for households (McCaffrey, 2004b).

Balancing all the outcomes of prescribed fire therefore contribute to its acceptability and uncertainty or concerns about the impacts lead to resistance to the technique (Altangerel & Kull, 2013). Typical outcomes of concern include escape of the fire, impacts on wildlife (biodiversity or forest health), aesthetics, safety, water quality, air quality and respiratory health, and carbon storage issues (Bell & Oliveras, 2006; Blanchard & Ryan, 2007; Brunson & Evans, 2005; Carroll *et al*., 2004; Jacobson *et al*., 2001; McCaffrey *et al*., 2008; Ramchunder *et al.,* 2009; Toman & Shindler, 2006; Ward *et al.,* 2007; Wulfhorst & Nielsen-Pincus 2003).

Balancing fire risk and biodiversity is a key part of perceptions. Biodiversity or forest health is the key consideration (Altangerel & Kull, 2013; Bowker *et al*., 2008; Burns & Cheng 2007; Fischer, 2011; McCaffrey *et al*., 2008; Paveglio *et al*., 2011; Vining & Merrick,2008; Walker *et al*. 2007). In fact, it often competes with reducing fire risk as the primary consideration (Burns & Cheng, 2007; McCaffrey & Olsen, 2012). This is also exemplified by the tension within the Australian debate Altangerel and Kull (2013). The tension between reducing risk and protecting biodiversity is crucial to acceptance (Altangerel & Kull, 2013; Eckerburg & Bruizer, 2017). Altangerel & Kull (2013) pointed out this was influenced by the social construction of risk exposure, specifically that living in these places was voluntary for people, whereas using prescribed fire was involuntary for nature, which could be an argument against its use. Eckerburg and Bruizer (2017) similarly discuss that the potential increasing use of fire for risk reduction purposes, raises questions not only over safety and techniques, but more philosophical considerations of people and nature. These include how much safety (risk reduction) should be prioritised over other species where there is conflicting interests, and how much people should intervene in nature. These questions consequently mean the ecological investigation is not the only investigation needed in solving debate around fire use, to understand how society and stakeholders want to manage the land (Carroll *et al*., 2021; Davies *et al*., 2016a; Eckerburg & Bruizer, 2017).

Escaping or controllability is another key concern around the use of fire (Carroll *et al*., 2004; Mylek & Shirmer, 2020; Vining & Merrick, 2008; Winter *et al*., 2002). Generally, both escape and wildlife are noted as concerns, as well as aesthetics (Blanchard & Ryan 2007; McCaffrey 2006; Monroe *et al*. 2006; Shindler *et al*. 2009). Concerns around smoke are also noted (Blanchard and Ryan 2007; Bowker *et al*. 2008; Carroll *et al*., 2004; Jacobson *et al*. 2001; Lim *et al*. 2009; McCaffrey *et al*. 2008; Shindler *et al*. 2009), including mention of health problems (Mylek & Shirmer, 2020; Ryan & Wamsley, 2006; Shindler & Toman, 2003). Notably, McCaffrey & Olsen (2012) points out smoke is a less common concern and is often not perceived as an argument against doing prescribed burns, although is noted for prescribed fire more than wildfire. Air quality and respiratory health are often raised in literature, even if is not always by a majority of participants, as well as carbon storage issues (Ramchunder *et al.,* 2009; Ward *et al.,* 2007; Wulfhorst & Nielsen-Pincus 2003). Considering how individuals feel impacted by the use of fire, a study of attitudes in Idaho, in relation to health issues from burning 14% major effect, more than half felt unaffected, and the rest stated it was bothersome (Wulfhorst *et al.,* 2006). Another interesting attitude was that regarding disruption to daily activities, very little reporting of disruption like skipping work, most were behavioural changes such as closing windows or limiting time outside (Wulfhorst *et al.,* 2006). This demonstrates the nature of disruptions to communities which are considerations for acceptability from their perspective.

Perceiving fire as necessary is a contributor, especially where there is more partial agreement and consideration of the tool in particular circumstances (Shindler & Toman 2003; Shindler *et al*., 2009, 2011). There has been some link between acceptability and fire risk (Blanchard & Ryan 2007; Flint 2007), but it is often only slightly (McCaffrey & Olsen, 2012). There is some evidence that fire use is deemed more appropriate near specific places of high risk or on hazardous fuel (Brenkert-Smith *et al.,* 2013; Mylek and Shirmer, 2020), playing to the consideration of fire risk. As Mylek and Shirmer (2020) point out, perceptions about fuel load do play a part, but experiencing a fire not key influence. Despite wildfire awareness being very high in this study (Australia), there was a need for building support by addressing the benefits and costs, and to maintain attention on wildfire through the attention cycle to build support for burning. Moreover, there has been fuller acceptance found in rural areas and more conditional by urban residents (McCaffrey, 2008; Shindler *et al*., 2011), similarly, let burn is also more accepted in remote locations (Toman *et al*., 2011). This either relates to greater exposure to fire and benefits, or a balance of other considerations such as escaping and safety being more pronounced in more urban environment.

The importance of trust in shaping acceptance has been highlighted (McCaffrey, 2015). Perceived competency and trust (and confidence) of those carrying out increase acceptability (Ascher *et al*., 2013; Fried *et al*. 2006, Kumagai *et al*., 2004; Monroe *et al*. 2006; Mylek & Shirmer, 2020; Olsen & Shindler 2010; Shindler *et al*. 2011; Shindler & Toman, 2003; Toman *et al*. 2011; Toman *et al.,* 2014; Vaske *et al*. 2007; Winter *et al*. 2006; Winter & Cvetkovich 2008). Specifically, confidence in a land manager to use the technique increased acceptance, as well as the perceived success of the outcomes making them more effective tools in the hands of capable personnel (Toman *et al.,* 2014). Having more trust links to concerns about escaping, where the perceived ability to control fire, or ability to apply fire as a tool is crucial to acceptability (Mylek & Shirmer, 2020). If individuals believe fire is controllably it creates acceptance, which is why literature suggest focusing on the pass successes to increase acceptability (Martin *et al*., 2007), as well as highlighting expertise and skill of personnel also increase controllability (Ascher *et al*., 2013; Martin *et al*., 2007).

Therefore, in summary to perceptions on prescribed fire, key lessons for practitioners are that communicating benefits is a crucial move that could increase acceptability (Paveglio *et* *al*., 2009), where there is often a focus on negative associations of risk of prescribed burning, to improve acceptability there needs to be focus on positive assumptions, so that the immediate thoughts are good (Ascher *et al*., 2013).

2.2.3.4 Wildfire and gender: linking risk perception and mitigation

A much more recent aspect of fire perception research (McCaffrey, 2015). Overall relationships of risk and response to demographics are mixed (Brenkert-Smith *et al*., 2012; McCaffrey & Olsen, 2012). Some difference of women in risk response, in that women possibly have higher risk perception (Brenkert-Smith *et al*., 2012; Jarrett *et al*., 2009; Shindler *et al*. 2009, 2011). However, it is often found to not have any relationship (Fischer 2011; Jarret *et al*., 2009; McCaffrey & Olsen, 2012; Toman *et al*., 2011).

Within natural hazards literature there is the idea of systematic structures around gender in ideology and practice, that generate differences in perception of risk Gustafson (1998). A study on earthquake risk in Italy found women may perceived greater likelihood but found that men are more likely to report preparedness and have heightened sense of preparedness and self-responsibility (Bodas *et al*., 2019). Additionally, a flooding study in Ireland of risk perception and behaviours of groundwater users found men were more aware of need for action and had more information (McDowell *et al*., 2020). In wildfire research there are some similar gender behaviours, where Australia has disproportionate male fatality (Tyler & Fairbrother, 2013b). Comparing with other US studies that this could be due to gendered norms of women as risk aversion and ‘caregivers’ contribute to men defending the home while women leave the danger zone (Tyler & Fairbrother, 2013a, 2013b, 2018).

There is also thought on how wildfire spaces are gendered, or that they are “men’s business” (Tyler & Fairbrother, 2013). Eriksen (2014) found women were less engaged with issues and similarly Eriksen and Gill (2010) found men were more prepared. Work on diversity in community engagement, specifically arguing for there to be more gender sensitive outreach, where there are barriers to women engaging in wildfire mitigation because spaces are male dominated (Eriksen *et al*., 2010; Eriksen, 2014).

Moreover, regarding the acceptability of fire a limited number of studies have examined differences between groups (McCaffrey & Olsen, 2012). There is some suggestion that women are less approving due to generally being more concerned over controversial practices (Lim *et al*., 2009; Ryan & Wamsley, 2006). It was also found that women were more concerned about smoke impacts of prescribed fire than men (Lim *et al*., 2009)

2.3 Summary of key gaps and opportunities

Therefore, there are key gaps in UK wildfire knowledge, and an absence of social research into wildfires as a hazard, as well as public perspectives on fire use. There has also been significantly more interest in research in northern England, likely owing to the nature of the funding and project opportunities that have arisen. Nonetheless, despite the various problems with wildfires and environments across the country, there is little research available. There are significant opportunities for public education and engagement into this hazard, especially where there is an underprepared or uninformed population that itself exacerbates risk. Moreover, as prescribed fire has declined and there is debate over its place on British landscapes, ascertaining attitudes to prescribed fire, especially when framing it as a phenomenon which manages wildfire.

Additionally, there is also the opportunity within the context of global wildfire social research field to compare the findings to a new location, one where wildfire is more unfamiliar and an underrated hazard. Where industrialised countries which are fire-prone have become disconnected from fire (Pyne, 2001), a key question is looking at how the perceptions compare in a country where wildfire is not as visible (non-fire-prone).

It is vital that when creating knowledge on wildfire in Britain, that it follows the learnings of the global field, that social wildfire research is crucial. That is not because the biophysical paradigm no longer useful (Pyne, 2007), but in order to most appropriately understand the dynamics and reactions to a natural hazard, it requires natural hazard and risk perception theories and methodologies.

This thesis will have a variety of environments, from rural to urban, including the RUI, to ascertain a breadth of British contexts and allow for some comparisons. It will gain knowledge on understanding risk from public perspective, building on what has been done in South Wales, as well as the perceptions of Firewise UK schemes. It will link prescribed fire perceptions to wildfire, where prescribed fire is a research topic in the UK which has received slightly more academic attention than wildfire perceptions.

CHAPTER 3: METHODOLOGY

3.1 Research Design

3.1.1 Research aims

The overarching aim of this project was to discover the social perceptions of wildfire in Great Britain, motivated by the backdrop of changing wildfire risk, an unprepared population and a significantly lacking evidence base. On one hand the many gaps provided broad opportunities, on the other, there was no base of UK wildfire social research to expand upon. Thus, this study is exploratory. The aim here is explore a variety of opinions, decipher common beliefs in public opinion and gain a broad understanding of perceptions across parts of the country. Despite the increasing acknowledgment of wildfire risk by UK stakeholders, there has been a persistent gap in research is on public recognition and awareness. There is scarce study of prescribed or wildfire knowledge. This research provides empirical evidence covering a general sample of the population. Utilising a case study approach to delve into specific localities to account for local fire contexts and how this influences public awareness. Survey data was collected using simultaneous in-person and online recruitment. Although admittedly with a weak sampling frame and lacking specific data on the context of the participants, this study has at least 185 participants in each location with varying demographic characteristics and covers three different areas of fire context around Britain. It enquires into the level of risk perception the public have, how much they understand it to be a 'real' hazard, and how much they understand about wildfire at all. It also explains how these fit into attitudes towards having fire on the UK landscape. This project therefore aims to discover how wildfire is thought of by local residents in three areas across Great Britain. First delving into each context and secondly, using a base set of comparable questions across all locations building these three cases together to develop a national understanding of social perceptions to wildfire. There are a variety of research questions following themes of risk and awareness, attitudes to prescribed fire, and comparison of the data collection methods. Beyond the comparable set of questions was an opportunity to tailor a few questions to each area's issue; these covered themes of fire in the media, mitigation, and prescribed (agricultural) fire. In the Valleys, questions were asked regarding foreign fires and sources of this news. Additionally, to address the presence of the Firewise scheme in Dorset, there was an additional focus on awareness of the scheme and knowledge of personal protections. Lastly, to address the local context of rural setting and muirburn presence of the Highlands, an additional focus was added to ascertain awareness for such practices.

The first set of research questions are:

> RQ1: How much, and what risks do residents associate with local wildfire?
>
> RQ2: How much do residents know about local wildfires, specifically, how aware of it are they and what did they think it entails?
>
> RQ3: What was resident's sentiment towards having fire on the landscape?
>
> RQ4: What do the three case studies begin to suggest about wildfire perception across Great Britain?
>
> RQ5: How did the two data collection methods compare?

The set of case study specific questions meant a secondary set of research questions:

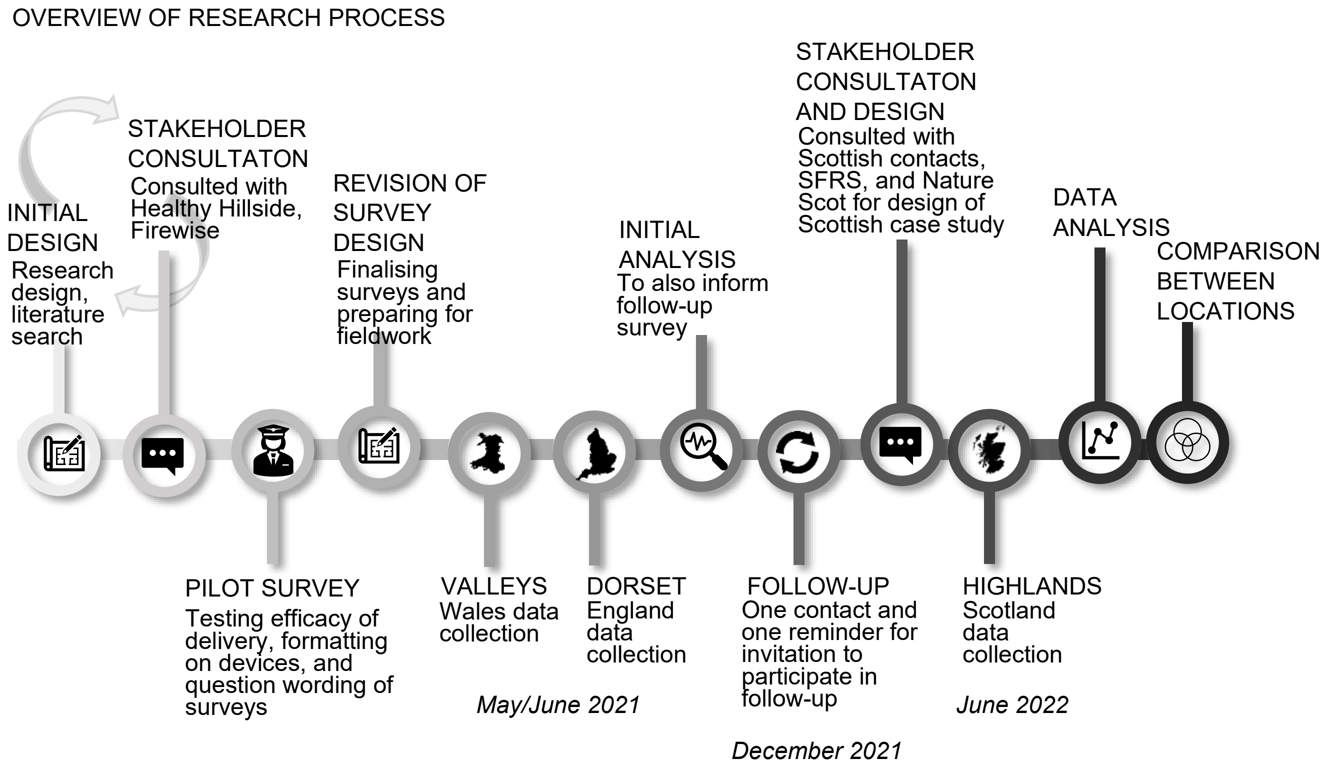
RQ6: How aware were Valleys' residents of foreign wildfire events, and where did they get this information from? (Valleys)

RQ7: What do Dorset residents already know about personal property protection, and how willing are they to take part in Firewise? (Dorset)

RQ8: How aware are Highlands' residents of the use of fire on their landscapes, and what was their understanding of it? (Highlands)

3.1.2 Design: Creating an approach

A case study approach was employed for this research to be able to consider how local fire context may influence wildfire perceptions, where local context is vital to understanding wildfire occurrence (McCaffrey *et al.,* 2013). This approach is ideal where there are issues within communities in order to achieve depth in understanding where there may be complexity (Mabry, 2008), which in this instance makes it apt. It is also beyond the capabilities of this study to investigate the whole of Great Britain, so exploring three places makes it practical. Three locations were picked, including an area of South Wales Valleys in Wales, the county of Dorset in the south of England, and a portion of the Highlands in Scotland. Survey instruments were used to capture the opinion of a variety of residents in each area, which was collected by in-person (face-to-face) and online (social media) survey forms. The same base survey was collected across the three areas, using identical collection procedures to ensure they were directly comparable. With each context in mind, the perceptions would be explored and then compared to build a picture of how Britain perceives wildfire. The research process involved design and stakeholder consultation, a pilot survey, case studies (for Valleys, Dorset, Highlands), and follow-up data collection (Valleys and Dorset). An important note regarding the timeline of the research is that due to disruption by COVID-19 there was a shift in design part way through. This explains the gap between the last and first two case study.



An important part of the design process was consultation with local stakeholders. The consultations were done for the initial development of the approach, deciding on study locations, research aims, and survey content and questions. This included in South Wales involvement in the Healthy Hillside group meetings and activities as well as more individual discussions with members. Additionally, in Dorset consultation with UHP and Firewise UK group, with some input from DERC as well. The Scottish stakeholder consultation involved individuals from across Scotland from SFRS and Nature Scot.

There were crucial findings from this consultation. Healthy Hillsides provided insight into the issues facing stakeholders as key background context and raised key concerns about the level of concern in communities and beliefs about the link to climate change. Firewise UK provided information and access to DERC, and for questions for survey, the consultation yielded suggestions of use of resident's knowledge of months and causes, as well as questions around Firewise and personal property protection Finally, the consultation for Scotland provided insight into the issues in Scotland and locations of interest, including through a short survey to individuals from SFRS (14 replies), as well as consultation with Nature Scot also highlighting local context and the relevance of understanding broader sentiments towards landscape fire for the survey.

3.1.2.1 Case study locations

The three study areas were chosen as a result of significant wildfire contexts along with practicalities, such as having connections to stakeholders in the areas, and travel capabilities influencing the locations and specific study areas. Each experiences some issue with wildfire (see 4.1.3, 5.1.1, and 6.1.1). These are all places highlighted in literature as 'hotspot' areas, with some wildfire issue. South Wales and Dorset were highlighted as hotspot areas in Britain by McMorrow (2011) and the Highlands was highlighted within Scottish Government (2022a) analysis, as well by Glaves *et al*., (2020). The various locations around parts of Britain offered various wildfire contexts, as well as socioeconomic and environmental contexts.

The South Wales Valleys is an area with a prolific number of ignitions and has a wildfire problem defined by a high number of deliberate fire setting, arguably socially driven by socioeconomic issues (Jollands *et al*., 2011). Moreover, this area was well known to the researcher due to a master's dissertation on the wildfire topic in this area, as well as involvement with the Healthy Hillsides group.

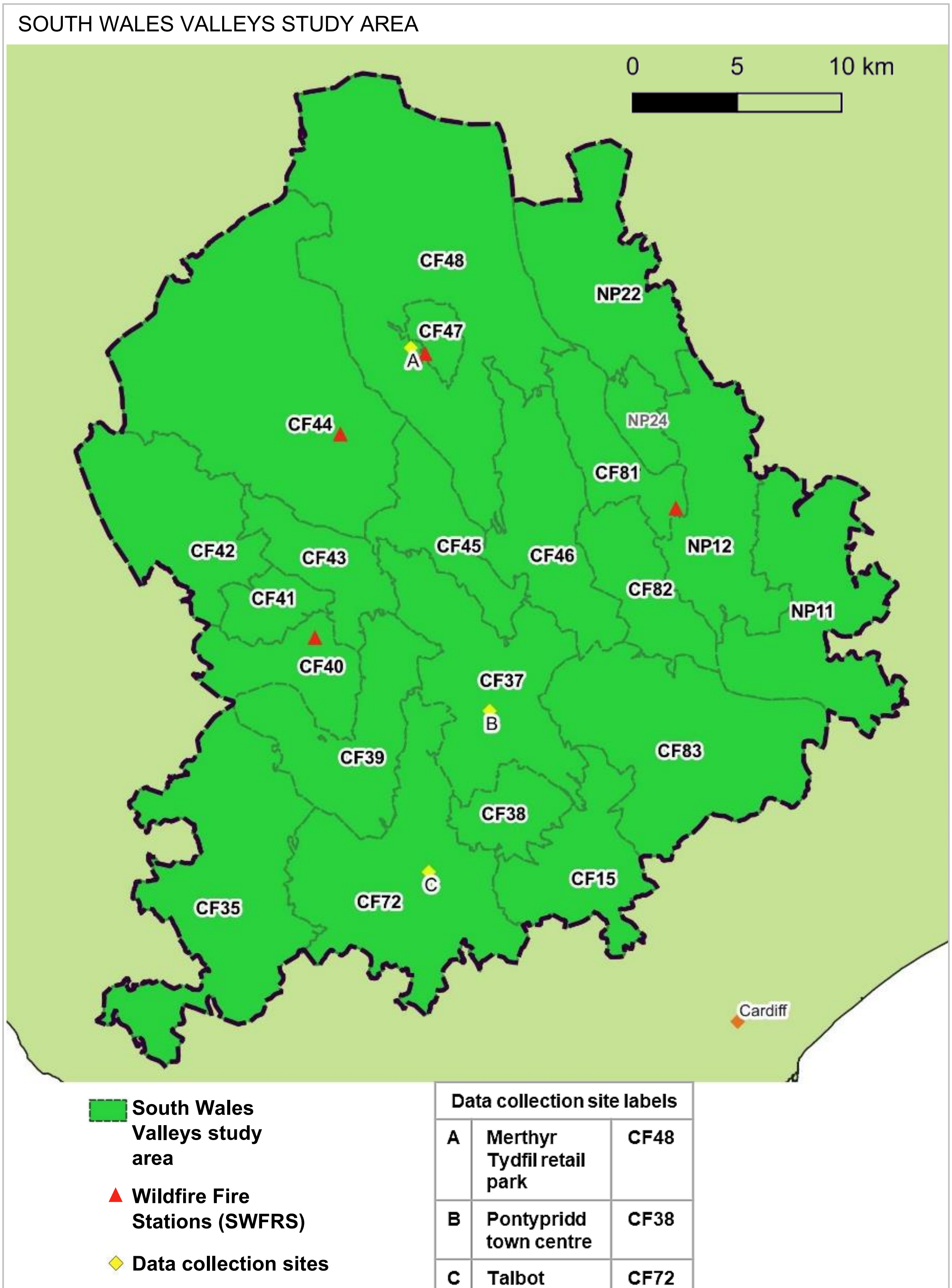
Dorset is an area which experiences wildfires on its heathland, which are also designated protected areas, and close to people representing high risk (Gazzard *et al*., 2016; Glaves *et al*., 2020; Panter & Caals, 2023). While Dorset does not have high numbers of fires (Glaves *et al*., 2020), it has experienced large resource intensive wildfires which have drawn national attention of firefighting resources such as Wareham Forest Fire in May 2020 (Belcher *et al*., 2022). As a result of the fires on heathland and the proximity to people (where there had been instances of evacuations), a Firewise UK scheme was set up in 2009 as the first place in the UK to adopt a community-based education scheme based on Firewise USA (Ford, 2020). The connections with Firewise UK and opportunities of doing research were motivations for studying in Dorset.

The Highlands is an area highlighted in wildfire statistics in Scotland (Scottish Government, 2022a). Moreover, in consultations with stakeholders in Scotland, the west of Scotland was suggested, because the east Scotland and Scottish Borders are more associated with agricultural burning practice on grouse moors where the land capabilities are more favourable (James Hutton Institute [JHI], 2023; Tharme *et al*., 2001). Being in areas with greater awareness of prescribed fire could potentially differ too far from the other case studies where the focus had been on hazardous wildfire. Having said that, muirburn is a feature of potentially all of rural Scotland so some difference did exist with the other locations. This could be seen as an opportunity of comparison of perceptions to landscape fire, while keeping the focus on wildfire risk. The Highlands was also the most rural of the three case studies, being another point of comparison between locations. This third case study was not originally in the research design, however owing to COVID-19, the original foreign case study had to be replaced. Ultimately this did offer an opportunity to compare the results to different parts of Britain. However, it did mean that fire use became a more prevalent theme, as those in Scotland were more aware of it. Thus, prescribed fire focused questions were only asked in the follow-up (and hence only a proportion of all the participants) for the first two case studies, but in the original (by all participants) in the Highlands study, which would have not necessarily been the decision in hindsight.

3.1.2.2 Defining the boundaries of the study areas

Postcode districts were used to define the specific areas of study. Utilising postcode districts as the unit areas had multiple benefits. Firstly, they are standardised units unlike a town or village thus providing consistent distinct areas to locate participants within the study area; they are at a greater resolution than local authorities; created an outline of study area; and served as an eligibility criterion for participants. The postcode district boundaries therefore largely dictated the exact shape of the study area.

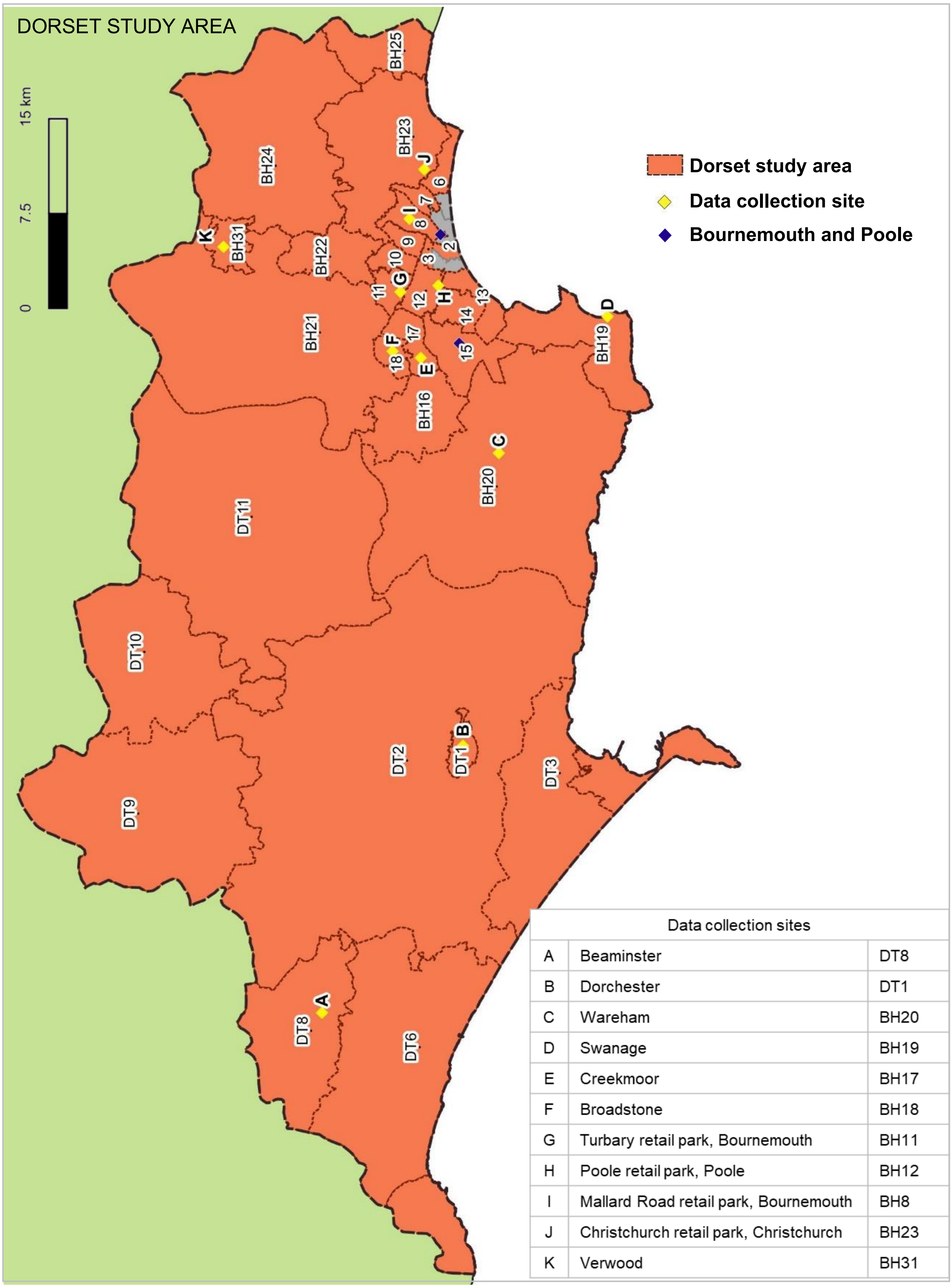
For the first case study a portion of the South Wales Valleys was chosen for a more practical amount of area to cover. The area chosen included the Rhondda Valleys, known as a particular hotspot of South Wales fire setting problem (Jollands *et al.*, 2011; NRW, 2016), as well as the base of the Healthy Hillside group. This study area shown in Figure 3.1 also encompassed the four wildfire fire stations (red triangles in Figure 3.1). The study area was made up of 22 Cardiff (“CF”) postcodes. As ‘the Valleys’ could have been an ambiguous term on the adverts also stated some of the town names to encourage those from the right area. Therefore, N=1 response was discounted, being too far east (NP4). This was the smallest area of the three and suburban, thus it relatively densely populated (see 4.1.1).



Data collection site labels		
A	Merthyr Tydfil retail park	CF48
B	Pontypridd town centre	CF38
C	Talbot Green retail park	CF72

Figure 3.1 - South Wales Valleys study area, showing postcode district boundaries, data collection sites, and wildfire stations. (Map source data: EDINA, 2021a, 2021b).

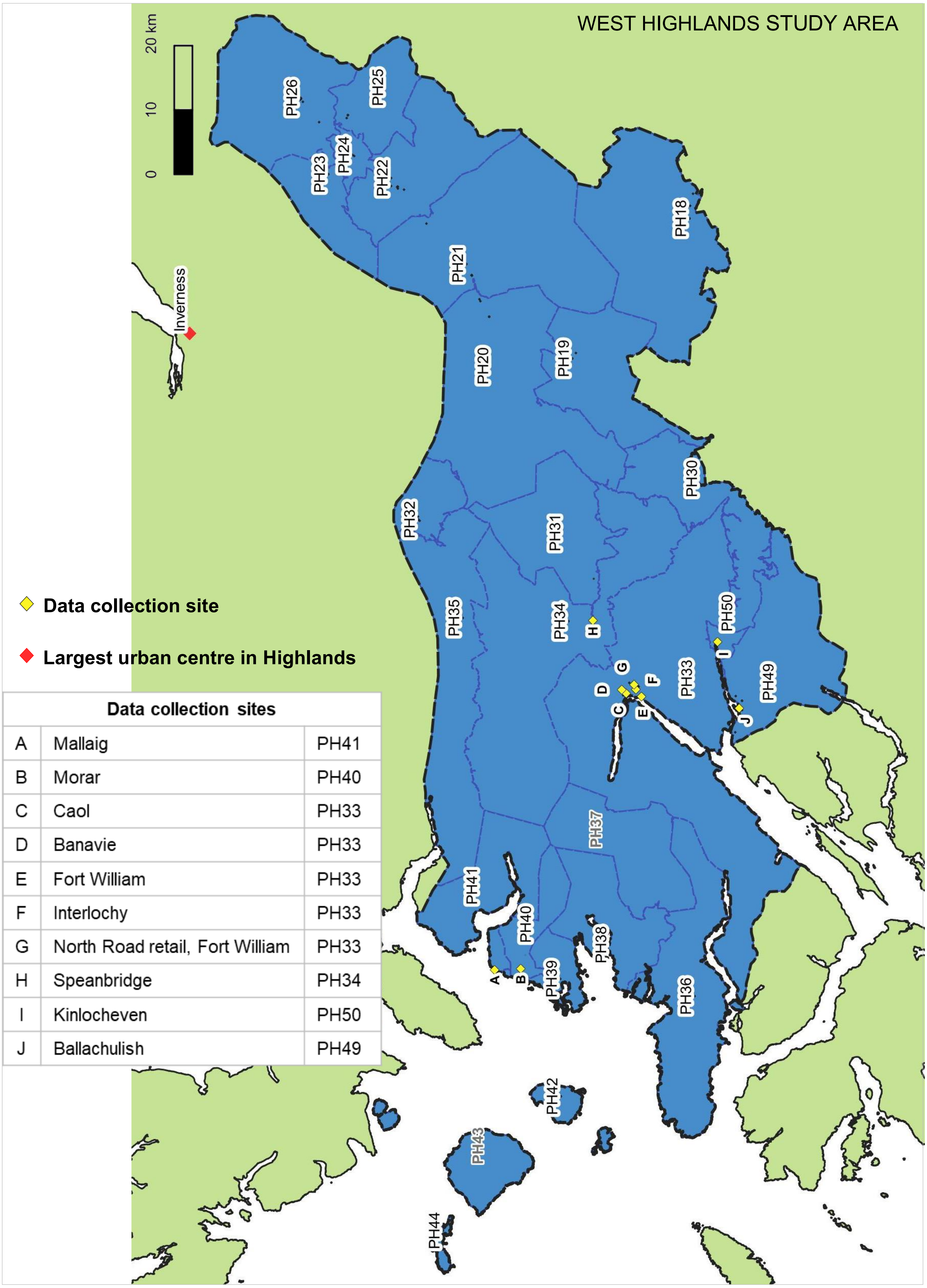
For the second case study Dorset County was chosen as the focus as the location of Firewise UK. Firewise pays particular attention to southeast where the significant urban areas are due to their focus on urban heaths, but this study area included Dorset more broadly. The study area includes, both West Dorset and Bournemouth, Christchurch and Poole (BCP) local authorities, and a selection of “DT” and “BH” postcode covering this area. The study area was made up of 37 postcodes (Figure 3.2). There were no responses from outside these areas. This had the most postcodes and had the largest population of people including a densely populated conurbation, although there are also some more rural parts (see 5.1.1).



Data collection sites		
A	Beaminster	DT8
B	Dorchester	DT1
C	Wareham	BH20
D	Swanage	BH19
E	Creekmoor	BH17
F	Broadstone	BH18
G	Turbary retail park, Bournemouth	BH11
H	Poole retail park, Poole	BH12
I	Mallard Road retail park, Bournemouth	BH8
J	Christchurch retail park, Christchurch	BH23
K	Verwood	BH31

Figure 3.2 - Dorset study area showing the postcode boundaries and data collection sites. (Map source data from EDINA, 2021a, 2021b).

For the third case study, a portion of the Highlands was chosen as a local authority highlighted for wildfire activity (Scottish Government, 2022a), as such a large area it was not feasible to cover its entirety within the resources of the project. The study area was therefore based partly by The West Highland Way railway line due to practicalities of travel, as well as following more settlements due to the rural environment and hence being nearer to more people. The study area is made up of 27 postcodes. It had the largest area of the three, however the rurality meant it had the smallest population (see 6.1.1).



Data collection sites		
A	Mallaig	PH41
B	Morar	PH40
C	Caol	PH33
D	Banavie	PH33
E	Fort William	PH33
F	Interlochy	PH33
G	North Road retail, Fort William	PH33
H	Speanbridge	PH34
I	Kinlocheven	PH50
J	Ballachulish	PH49

Figure 3.3 – The Highlands study area with the postcode boundaries and data collection sites. (Map source data from EDINA, 2021a, 2021b).

3.1.3 Design: Data collection

3.1.3.1 Survey instrument

Surveys are a well-established tool in social science for acquiring a range of data on participants characteristics, behaviours, attitudes, beliefs, and awareness of events (McLafferty, 2010; McQuirk & O'Neil, 2016; Parfitt, 2005). Additionally, surveys are a popular and fundamental tool in natural hazards research specifically for ascertaining knowledge and perception (Bird, 2009). Surveys are also a common research tool in wildfire social science (Dupey & Smith, 2018; McCaffrey & Olson, 2012); for instance, a review of US literature on wildfire or prescribed burning with keywords of risk, attitudes, perceptions, decision making or mitigation, found that half used surveys (Dupey & Smith 2018). UK research on climate risks and natural hazards have also employed surveys (Lo & Chan, 2017; Taylor *et al.,* 2014). Surveys are also relevant because there is an element of exploration to this research as so little is known, where they assist in gathering a variety of opinions. Surveys ask the same questions to everyone in a population to compare all their answers (Fowler, 2013, therefore surveys discover what is common across a population and provide generalisable statements (Gable, 1994). Survey is thus an apt choice to gather a variety of opinions and ascertain general perceptions of wildfire.

Moreover, surveys have advantages over other social research methods, generally requiring less effort and time from participants, being more cost-effective, and having access to larger areas (McQuirk & O'Neil, 2016). However, there are some established limitations, including a lack of in-depth data, where they are instead finding generalisations which generates limited knowledge especially where there is nuance (Fowler, 2013). Additionally, there is a lack of discoverability in that once questions are asked it cannot be amended or expanded (McQuirk & O'Neil, 2016). Using a web-based using LimeSurvey features did allow for editing once published in the case of typos or incorrect settings, but frustrations of survey research where limited discoverability remain. The follow-up did allow for clarification to the climate change question, but this was limited as there was not the space to expand on every question.

3.1.3.2 Recruitment

The target population was adult residents (not just homeowners) in the three study areas, aiming for cross section of public. There was no distinction between homeowners and non-homeowners, as it not appropriate to limit the target population as in other studies where the focus may be household mitigation. Moreover, the survey was aimed at residents rather than tourists. This was expressed in the advert and on the consent page. Additionally, participants were asked for their residing postcode to check their eligibility. Furthermore, the target population was the general public and not stakeholders, similarly to the study by McCaffrey (2008) which excluded those employed by relevant agencies to firefighting or forestry. In this this case there were questions to ascertain involvement as part of the demographic characteristics at the end of the survey. A response would be indicated as “flagged response” if they had a relevant occupation, as well as explicitly asking for any involvement in wildfire or organisations related to its management. Additionally, efforts were made to ensure the general public was targeted and not those with specialised knowledge; this meant avoiding publicising the survey using wildfire groups or Fire Services as well as not sharing it through personal or professional connections within the wildfire community.

There was both in-person and online recruitment with an optional online follow-up survey. For the localised study areas, in-person recruitment was deemed most appropriate to target local resident. Having said that, due to disruptions by COVID-19, the recruitment had to be adjusted to accommodate social restrictions meaning there would possibly be people avoiding or unable to be in public. A supplementary online recruitment was added with the advantage of being done remotely. The two surveys were held concurrently to ensure consistent local wildfire activity was occurring during the survey. An additional disruption by COVID-19 was a delay to research and hence time pressure meaning the surveys had to be collected in May and June. This could be considered a suboptimal time, as it is during wildfire season, when there is potentially heighten risk perception due to greater awareness of their occurrence. Thus, an optional follow-up survey was added, collected 6 months later at the opposite time of year, repeating the risk questions to identify any possible time-frame bias in the method. This did require additional effort by the participants.

The surveys therefore employed a mix of recruitment strategies. Convenience sampling (Galloway, 2005) was employed in-person when visiting places with high footfall and inviting people to partake. There are pitfalls to this technique, as it is not random (Galloway, 2005), but underrepresentation was in some ways balanced by going on various days of the week and at various times of day. This technique offers finding a range of opinions that could then be more rigorously tested, beneficial for exploratory studies (Galloway, 2005), such as this. Purposive sampling (Bird, 2009) was used for the online surveys, using community pages and groups on the social media site Facebook, similar to the methodology used by Bhutta (2012). To some extent, snowballing sampling (Bird, 2009), was also employed as participants were invited to share with acquaintances in the area, where the survey asked for a postcode to ensure they remained residents. The follow-up employed longitudinal sampling (Bird, 2009), inviting participants to leave a contact at the end of the original survey; where they then received an invitation and one reminder at the launch of the follow-up survey.

The two survey modes offered various benefits and limitations. Face-to-face surveys being spatially restricted often seen as negative (Bird, 2009), but in this case it becomes useful. Moreover, the researcher travelling and experiencing the locations provided a sense of the environment and appreciation for this in the context of vegetation fires. More similar to structured interviews the in-person data collection allowed participants to elaborate on the questions, where extra comments were also noted. Additionally, face-to-face surveys can motivate participants rather than a need for them to want to participate themselves (Bird, 2009). On the other hand, there is the potential for response bias due to unwanted interviewer effects, such as filtering or censoring of opinions, or the researcher leading participants (Bird, 2009; de Leeuw, 2008; Doyle, 2005). The standardised questions were asked being careful to manage influence (Fowler, 2013) to minimise this effect. It is possible with the bigger decrease in scores in repeat that in-person were due to being more agreeable in-person, although it may also be because it was asked at a less active wildfire period. Moreover, there are additional logistics and costs in face-to-face surveys (Doyle, 2005), especially in this case where need to travel to the case study locations. Accessing the localised population however, created a compelling reason to expend this cost for this collection mode.

There are many benefits to online survey, namely, they are inexpensive, rapid, save labour on data input, require fewer resources needed to administer, participants can answer at their convenience, and have greater reach, accessing more participants (Evans & Mathur, 2005; Lafferty, 2010; McQuirk & O'Neil, 2016; Van Selm & Jankowski, 2006). Although in-person participants elaborated outside of the set questions, studies have suggested that online participants often submit more lengthy open question responses (Van Selm & Jankowski, 2006), and there were some more detailed responses from online participants across all case studies here, especially those with stronger opinions. Moreover, the utilisation of survey software enables more design flexibility and additional information such as completion time (Evans & Mathur, 2005). For this study, LimeSurvey was used through a subscription with the University, which incurred no costs. It also offered both design options and additional functions.

On the other hand, there are some limitations to web-based surveys. There are inherent biases to web-based survey samples, a key issue is that they cannot reach individuals who lack the necessary computer skills or equipment, resulting in the systematic underrepresentation of certain groups (Couper *et al.,* 2007; Best & Krueger, 2002). However, since the emergence of email and web-based survey in academia (Van Selm & Jankowski, 2006), internet usage has continued to increase so these biases are reducing. In the UK, internet usage is relatively widespread, with 92% of adults being internet users, up from 91% in 2019 (ONS, 2021). According to ONS (2021) data for the study areas, this trend remains largely consistent. Even in the rural Highlands, internet usage is 89.5%, and in the Valleys, it is 89.1% (possibly due to socioeconomic disparities in the area). In contrast, Dorset has a higher proportion of internet users at 94.5%. Notably, the 65+ years age category does have slightly lower internet usage than other ages, especially those above 75 years. Using social media sites could potentially introduce further bias as not everyone is as likely to use the application. Along these lines, Bhutta (2012) highlights the opportunities of utilising social media sites in research, particularly the widespread use of Facebook. However, Bhutta also notes that these samples often have uneven representation, including a higher proportion of female participants. There are fewer people aged 65+ on Facebook, especially 75+ years (Herd Digital, 2023). Another well-known bias of internet-mediated research is selection bias, where it relies on self-selection; first an individual's needs to encounter the survey, then decide to take part and spend their time doing so (Greenacre, 2016). Other key limitations to online research, includes that they potentially reach unintended recipients (Smith & Leigh 1997). In this case advertisement clearly described the intended participants and postcodes were collected, although it was possible they may provide a fake postcode. Moreover, the layout and readability of surveys can vary across hardware and software (Evans & Mathur, 2005). In this case, to ensure it was readable the format was tested during the pilot on laptops and using various mobile phone models - through acquaintances of the researcher - as a common device used to access Facebook (Herd Digital, 2023). Of course, not every phone could be tested, but common operating systems including IOS, Android and Google were assessed. Additionally, online surveys have a drawback that they may be taken multiple times (Smith & Leigh 1997), however another benefit to the LimeSurvey software was that it logged IP and blocked repeated attempt to minimise this fault (Gosling *et al.,* 2004).

This research used a web-based survey, but also used a social media site as a research tool. Internet mediated research has been a growing methodology (Madge, 2007) and social media is a more recent avenue to explore. Bhutta (2012) argues that online social media sites offer opportunities for research, pointing out the benefits of speed, cheapness, and ease to conduct single-handedly, as well as the lack of a need for need for mailing lists, and has access to various communities (e.g., public pages and groups). According to research as of 2020 there were 44.84 million Facebook users in UK, with 44% using it daily (Herd Digital, 2023); this research also notes that the 18-24 age group has decreased, but 65+ has increased from 4% to 9% as of 2020. The groups with shared interests already existing on Facebook is one particular opportunity (Bhutta, 2012), although it has to be considered that this shared interest may create homogenous groups rather than being representative; Bhutta (2012) does state their research did not have a random sample. There is also a benefit to engaging with these forums as they are access to interested groups which may be useful for outreach. This is useful to wildfire literature which suggests utilising social capital to improve engagement with mitigation (Fairbrother *et al.,* 2013; Jakes & Langer, 2012; Kyle *et al.*, 2010; MacDougall *et al.*, 2014; Stidham *et al.,* 2014).

3.1.3.3 Procedures

The surveys were carried out in early summer, the Valleys study in May 2021, Dorset in June 2021, and Highlands in June 2022. It should be noted that the last case study took place a year after the first two, but crucially was carried out at the same time of year. The in-person and online surveys were conducted concurrently; the online survey was launched first and ran for 4 weeks while in-person took place over a 2-to-3-week period within this time. As the online did not require as many resources it could be kept live for longer, however because of the time of year it was felt appropriate to not spread results over more than a month. The aim for both samples was initially 100, however the in-person data collection was much slower than anticipated so this was lowered to 90. The Valleys and Dorset both hit this target, however Highlands was a few short due to it being a more time-consuming process (as more rural and touristic) and the lack of ability to extend fieldwork. All online surveys reached their target of 100 minimum and the Valleys significantly exceeded it.

3.1.3.3.1 In-person sample: face-to-face survey procedures

The in-person survey used face-to-face data collection. Data collection sites were locations chosen for high footfall, including high streets and retail parks. The Valleys data collection sites included a town centre, and two busy retail parks (yellow diamonds in Figure 3.1). These were chosen as places in varying parts from south to north including places closer to Cardiff City and further up the Valleys towards Brecon Beacons in the north. The Dorset data collection sites (yellow diamonds in Figure 3.2) were chosen as places of high footfall, but avoided the more touristic centres of town, instead targeted retail parks in more residential areas. There were 11 sites with some spread across the area; there were many more around the southeast as there was more choice of high footfall, and a lack in the north, the result of the practical limitations of travel. The data collection sites in the Highlands (yellow diamonds in Figure 3.3) were limited by resources, needing locations to be accessible by public transport; and further limited by the rurality where there was a limit to places of high footfall. There was an effort to avoid tourist hotspots where possible, although the rurality made this challenging.

Overall, the in-person data collection was laborious and more time consuming than anticipated. There was a very slow attrition of responses, possibly hindered by COVID-19 ongoing social distancing which was discouraging people from talking to a stranger. An observation made while in the field is the reply to invites to get involved. As people walked past, they were politely asked "*Do you have a minute to talk about wildfires?*". While some replied, "*I'm not interested*", or even "*I'm not interested in what you are selling*", some replied saying *"I don't know anything about wildfires*". Everyone in the area was a target population, although these comments indicate there were potentially more people that did not participate that had less understanding. This would suggest there is more apathy in the general population than results here may suggest.

3.1.3.3.2 Online sample: self-administered web-based survey procedures

The online survey method was a self-administered version of the in-person mode. An online link (URL) was shared to access a web-based survey compatible with both computer and mobile operating devices. LimeSurvey was the software used to design and host the survey. To share the link, adverts were posted on Facebook pages, groups and forums, with permission those in charge of these community sites. An advert had an eye-catching visual as well as text attached to the post. This advert intentionally did not include any images of wildfire to avoid biasing response after seeing a triggering or leading photo. This advert included basic information on who was eligible, the survey topic, an easy URL, as well as invitation to share the post to others. There was also the option to like, share, and comment on the post to the community pages allowing more interaction with the post. The amount of online advertising was similar throughout the study locations, picking a couple of towns from each postcode as keywords to search on Facebook to find community groups and pages. These community sites did differ in size and engagement, but there was effort to ensure that there was adequate advertising to cover the study area. Notably, Dorset with the largest area and with the number of people eligible, had the largest exposure but did not have the largest magnitude of response, perhaps suggesting greater apathy in this location. On the other hand, the Highlands was the least densely populated but still had a satisfactory response.

3.1.3.3.3 Optional follow-up survey

At the end of the survey participants were invited to be contacted for a short follow-up. It was entirely optional as it would require more of the respondents' time. The follow-up was designed after receiving the initial responses, allowing for reflection on key questions to ask, and it was conducted six months after the two case studies (December 2021). It was not deemed practical to also conduct one for the Highlands. The main aim of comparing responses at another time of year was to test the theory of the issue-attention cycle (Mylek & Schirmer, 2020). Therefore, the repeated questions were kept identical. Additionally, there was a brief section to re-ask questions on other topics. To clarify opinion on climate change, questions on this were re-phrased, and participants were also asked about landscape fire due to the addition of the Highlands case study and importance of prescribed fire.

Participants had an initial invite to their given contact information, which is there was no reply was followed by one reminder. They were asked to provide the contact info in order to pair with the original response. Notably, once responses were linked the personal information was deleted. The responses of the groups of participants that agreed to the follow-up and replied were compared to the overall responses to check for bias in responses (for example if there were replies from people that agreed with wildfire being a problem hence a concern bias). Both follow-up samples had similar representations of the original surveys go onto reply to the follow-up (see Appendix vi)and Appendix vii).

3.1.4 Design: The survey

Survey design is crucial to good quality research (McQuirk & O'Neil, 2016; Oppenheim, 2000; Parfitt, 2005; Sarantakos, 2013). Various design choices, such as question wording, format, sequence, and questionnaire length are integral to reliability, validity and keeping the respondent engaged (Bird, 2009; McQuirk & O'Neil, 2016; Sarantakos, 2013). Reliability being the consistency of a question so that if questions are duplicated it generates the same results (Bird, 2009), and validity, meaning whether it measures what was intended (Oppenheim, 2000). Crucially, various steps of good design practice were followed, including steps of external scrutiny and a pilot, with multiple revisions throughout these steps (Sarantakos, 2013). A pilot was completed of in-person and online surveys; this was based in the researcher's area for ease, which was another part of the South Wales Valleys, hence outside of the study area but equally relevant to wildfire topic. This tested question wording, structure, multiple choice options, and possible completion errors, as well as the web-based survey design and software. There were a few minor clarifications made at this stage to help with readability and the researcher also gained familiarity with the survey software. Copies of the survey are available in Appendix 1: .

During the construction of the questions key principals were followed to ensure readability and clarity, including, simplicity, using the intended populations vernacular or simple language, shortness, one focus and avoiding double barrelling, (Bird, 2009; Sarantakos, 2013). Additionally, suggestive questions were avoided, as well as giving examples within the questions (Fowler, 2013; Sarantakos 2013). Moreover, no leading information about the nature of wildfire occurrence in the area was given, either in the advert or survey itself. Readability was ensured by providing appropriate instructions, as well as ensuring attractive and professional colour and design to encourage completion (Sarantakos, 2013). The design features on LimeSurvey assisted with these design decisions.

Moreover, considerations on formatting and structure included format and order, ensuring sensibility and smooth movement through topics (Sarantakos, 2013). In this case, the questions were grouped by theme with heading as suggested by (Bird, 2009), following what Sarantakos (2013) describe as a mixed questionnaire format where questions are ordered logically and in sections. A progress bar was also used to minimise fatigue and encourage completion (Ghazi *et al.*, 2018). The structure was considered to ensure it was clear and to avoid disengagement of the respondent, Sarantakos, (2013, page 253) argues the golden rule is that the questionnaire should contain as many questions as necessary and as few as possible. The aim here was to balance gathering a depth of information with a range of thoughts, from as various people as possible. Hence aimed for up to 10 minutes. Every question had a clear role and purpose (McGuirk & O'Neill, 2016), addressing each research question. The main survey across the case studies had similar lengths, the Valleys was slightly shorter due to fewer additional questions. Timings provided by LimeSurvey of the median timings of each survey demonstrate something about the length and the average time participants offered to complete this: Valleys=7 minutes, Dorset=9 minutes, and Highlands=10 minutes. The in-person took similar time, some going through questions more quickly where they added no extra detail whereas others with more interest had additional conversation. Length varied where participants could spend longer answering the open questions or adding additional comments. The follow-up surveys were shorter, taking a median of 4 and 5 for Valleys and Dorset respectively.

The survey consisted of a mix of open and closed questions. Each question had clear instructions of how to complete then, including how many responses they should give (Bird, 2009). The two question structures have opposing benefits and limitations (Sarantakos, 2013), thus a mixture of two means a mix of the benefits of both, creating data that is a mix of quantifiable and easily summarised, as well as in-depth and providing verbatim evidence (Bird, 2009). Closed questions have key benefits of an ease of administering and analysis, allowing for comparisons and quantification, avoiding irrelevant information given by respondents, and encouraging more complete surveys (McQuirk & O'Neil, 2016; Sarantakos, 2013). In the design, adequate options were offered (tested in pilot) (Sarantakos, 2013), and "other" and " I don't know" categories were used to minimise forcing participants to predefined answers they did not agree with (McGuirk & O'Neill, 2016; Oppenheim, 2000). Open questions provided opportunities for gathering information and offered freedom of thoughts (Oppenheim, 2000), for respondents to share honest opinions (McGuirk and O'Neill, 2005), as well as identify information not foreseen by the researcher (Sarantakos, 2013). This was useful for a small selection of questions to provide more ample data, as well as the fact the attitudes to wildfire or prescribed fire were not known (Sarantakos, 2013). The number of open questions was minimised to not overload the researcher as open questions are much more time consuming (Sarantakos, 2013) and encourage completion (Bird, 2009).

3.1.4.1.1 Survey Questions

The survey questions were kept the same for both recruitment collections, with the same base survey across the case studies to allow for some synthesis and comparison between locations. The questions were informed partly by consultation with stakeholders, where they had key questions for the public (see page 51), as well as by the gaps in risk perception and awareness of wildfire in the UK. The starting point for the focus of the surveys was to answer key questions about awareness of wildfire occurring in local areas, and how residents perceived the risk. This forms the first and main theme of the survey risk and awareness and addressed RQ1 and RQ2. Understanding the attitude to the use of fire is another aim, relevant for managers considering utilisation as mitigation strategy, as well as adding to literature on debate around its use. This was asked in the follow-up for Valleys and Dorset, but with a much more focus in the Highlands where there is more relevance for prescribed fire in wildfire issues. These questions addressed RQ3 and RQ8. The other changeable sections of surveys covered themes of foreign wildfire and media (asked in the Valleys) addressing RQ6; and awareness of Firewise and personal mitigation (asked in Dorset) addressing RQ7. Finally, synthesising and comparing the shared questions across case studies, aimed to build a picture of perceptions across Great Britain, through a crucial discussion chapter (see 7), addressing RQ4. As there were two modes of data collection, it was important to consider how findings differed between these two, potentially owing to methodological design such as sampling strategy; sections of this methodology chapter (see 3.2), as well as the discussion chapter (see 7) address RQ5.

The surveys firstly asked for the residing postcodes. The main body started with risk and awareness, including attitudes to wildfire for the area and themselves, timing of risk, whether participants had seen wildfire locally, and ascertaining knowledge around occurrence including influences and climate change. Next, there was the space location specific questions; including the awareness of foreign wildfire, awareness of Firewise and property protection, and Muirburn and attitudes towards fire. The follow-up repeated risk questions, re-asked questions pertaining to climate change, and added attitude towards landscape fire. Questions at the end of the survey asked for participant characteristics, namely age, gender, occupation, and crucially, whether they had a connection to wildfire management or prescribed fire.

3.1.5 Data analysis methods

The data input for in-person was done manually, whereas there was an automatic download available for the online mode. Unexpectedly, the two survey samples did ultimately have differing responses, these can be summed as the online sample being more aware or concerned by local wildfires. The responses are therefore presented separately where there are meaningful differences but combined where possible for the purposes of ease of presentation and enhanced focus on the overall findings. For questions which have been combined, the separated results are provided in Appendices vi), vii), and viii). Unfortunately, the differences between the two samples resulted in sample sizes too small to be statistical analysed using the chi squared test, as they violated the assumptions of expected frequencies (McCarroll, 2016). Additionally, due to lacking and uneven distribution of responses within the study areas, spatial patterns could also not be tested by comparing postcodes. However, it is worth noting descriptively which postcodes had more responses in the online groups, as these areas may have shown a greater interest in participating in the survey due to selection bias (Greenacre, 2016).

To analyse results, for the closed questions patterns of responses to questions are descriptively noted, including differences between the samples. Microsoft Excel was used to summarise and interpret the responses, looking at frequencies of responses to the closed question categories. The responses to questions were compared between questions in some cases, as well as some questions being compared to the given characteristics of the participants (age and gender); these are presented in cross-tables.

For the open-ended questions content analysis was employed (Driscko & Maschi, 2016; Krippendorff, 2004) to interpret the results. This analysis tool is used to identify attitudes, views, and interests (Driscko & Maschi, 2016) making it appropriate here. It allows some quantification, where it is qualitative in developmental stages and quantitative in the presentations, such as presenting frequencies (Hardwood & Garry, 2003). Microsoft Excel was used to tag responses with codes, organise and theme the codes, and count frequencies for presentation of the content of the responses. The coding process was a predominantly inductive one, where the categorisations were driven from the data, created a posteriori (Popping, 2015). As themes emerged that were similar to pre-existing literature, there was some deduction to use corresponding language. To ensure better reliability of recording what participants said, the codes needed to essentially be re-recordings of the participants expressions, logical, a natural portrayal, short, specific, exhaustive and mutually exclusive (Krippendorf, 2004; Popping, 2015). Moreover, the stability of the codes (Hardwood & Garry, 2003) was somewhat ensured as the codes were re-addressed over time through an iterative process, revisiting the same questions repeatedly and then again as traversed through the case studies. It is useful to explain the process of how the codes were found (Popping, 2015). This coding process began with analysing the first case study, identifying and summarising all the points made in each person's response. Where the open questions generally had short answers, there were often only one or two points made, although they potentially had multiple. As points recurred these generated codes; similar codes were grouped by theme. Each part or whole of the answer would be covered by a code, making them mutually exclusive (Krippendorf, 2004). This process was repeated for the next case study where codes and themes would be re-organised to create one succinct coding system across studies. This was again repeated for the last case study and eventually iteratively going through the codes for each question across each case study. It is important for the coding process to be iterative, applying the constant comparison element from grounded theory (Glaser & Strauss, 1967). The responses were then visualised using a frequency of each code being raised, where a code could be raised once by each participant, showing the proportion of participants who raised it, to illuminate on the prevalence of each theme or code amongst the participants.

3.1.6 Ethical considerations

A variety of ethical considerations were made during the design of the research and throughout, including seeking approval through the University process. Key considerations were made based on the core ethical issues of research named by Wilson and Darling (2020), namely, consent, anonymity, expectations, data management, sensitive topics and positionality. Firstly, a cover letter (Sarantakos, 2013) was included at the beginning of the survey, which participants were required to accept this in order to progress onto the survey. This crucially addressed consent and expectations (Wilson & Darling, 2020) by detailing what could be expected from the participants, the expected use the data, and consenting to participation. Data management (Wilson & Darling, 2020) was a key principle to consider, where there was a necessity for appropriate handling of personal data. Only necessary personal data was collected, hence why only the first half of the postcode was collected. To facilitate the follow-up, contact information was needed, given optionally. Storage and use of this data followed GDPR guidelines, including that information was stored securely on a password protected device. Once a follow-up response had been received the personal data was replaced with a pseudonym and deleted from the researcher's record. It was not shared nor used for any other purpose than for the follow-up. Another consideration was the possibility of it being a sensitive topic. The topic of natural hazards had the potential to be sensitive, although it was unlikely due to the lack of impact of wildfire on people directly in the UK; there were deliberately no probing questions about personal or extreme experiences. Only adults (over 18 years) were eligible for the survey. Positionality (Wilson & Darling, 2020) was another principle to consider. This was relevant for both surveys, in-person as face-to-face research meant encountering personally, and online where there is a name and visible Facebook profile of the researcher attached to the post. The greater response by women in both survey samples across all the case study locations is possibly a result of the visibility of the researcher's position, being a female themselves.

Furthermore, considerations were made for the ethics of the use of an online social media platform (Madge, 2007) considering the privacy, protection of both researchers and participants, as well as in ethical use of the social media site. This includes that the researcher's profile was kept private during the research, making use of the privacy features available on Facebook, so that no personal information was visible. Users of the site would be able to see a name, gender, small photograph, and that the researcher was a student at Swansea University, but no other details or personal content. This was intentionally done to show it was from a legitimate person rather than a robot and a genuine researcher interested in the material. Additionally, there was no personal communication by the researcher to any member of the community groups. Interaction was allowed on the post and appropriate communication with participants was made if they had further questions or comments; the posts were mostly well interacted with which was positive for the research.

3.2 Participation across the case studies

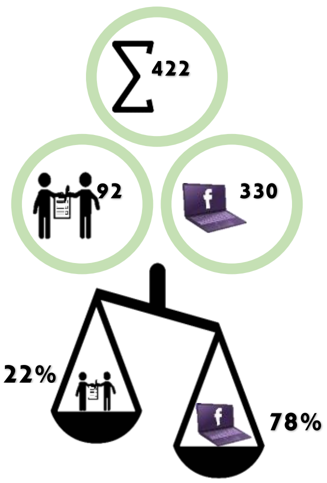
Across the two recruitment samples there were two samples of the public; one of those visiting public spaces and the other using Facebook and members of community groups or people they shared the survey with. The three case studies had differing extent of responses to the surveys, rate of response, and characteristics of the participants, although there were many similarities.

3.2.1 South Wales Valleys survey responses

3.2.1.1 Size and distribution of Valleys' responses

There was a total of 422 responses in the South Wales Valleys case study, 92 in-person and 330 online. The online survey had a very high amount of interest with a quick and abundant response. The online sample accounts for the majority of the combined sample. Across the 4 weeks it was live there was a mean of 17.4 responses a day. On the other hand, the in-person surveys were much slower to collect despite high footfall. For the number of hours of data collection, there was a mean of 1.6 responses an hour.

SAMPLE SIZES FOR SOUTH WALES VALLEYS CASE STUDY



The postcode districts provided by respondents demonstrate the distribution of responses. In the combined sample there were responses from across the whole study area except one postcode district (Figure 3.4). However, there are some large disparities in the number of participants from each postcode; a minimum of 1 and maximum of 66. Of the 21 postcodes with at least one response, 76% had more than 5 responses, 62% had more than 10, 38% had more than 20.

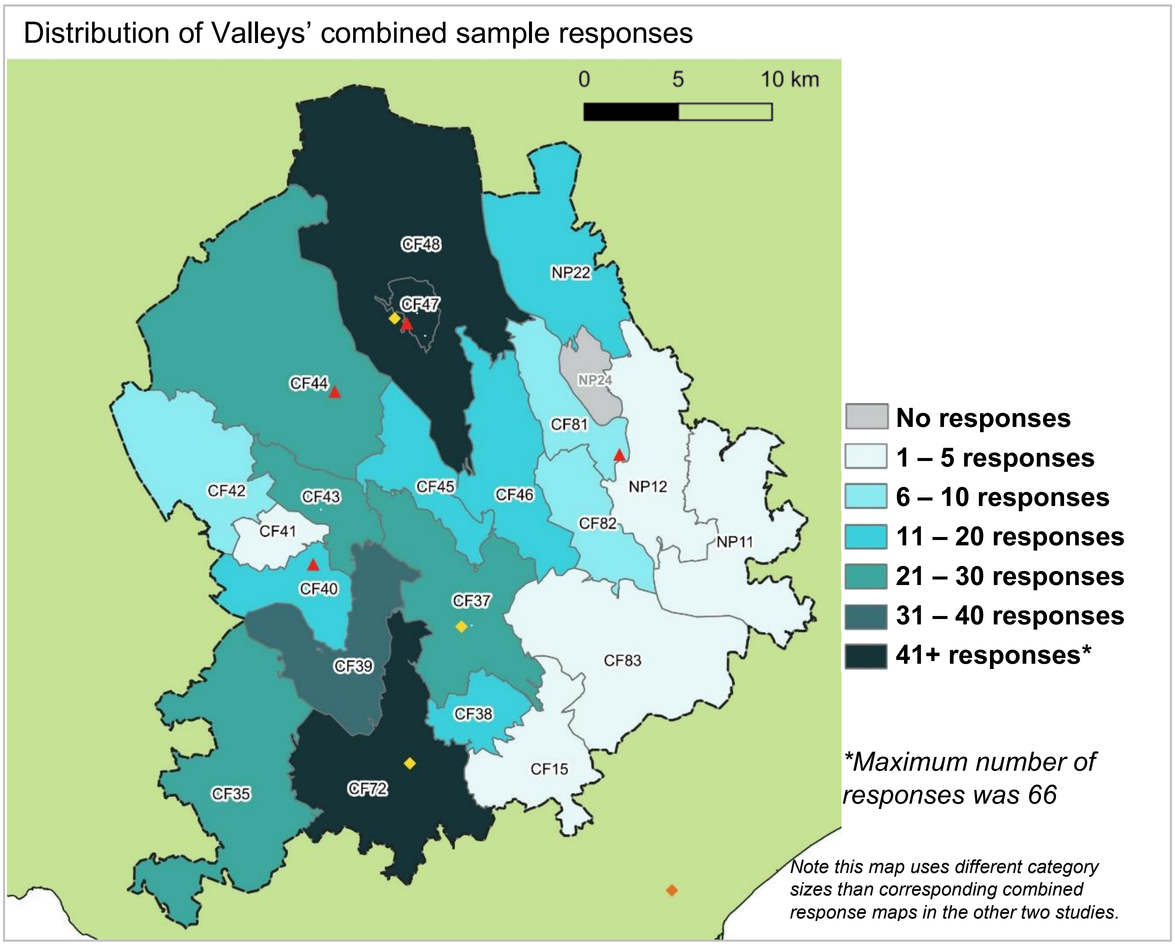


Figure 3.4 – Number of responses from each postcode in the Valleys across both survey modes (N=422).

The in-person sample did have concentrations of response near data collection sites (Figure 3.5A). 18 of the 22 had at least one response and of the 18 that had responses, 28% had just one or two responses, 44% had more than 5, and 11% had more than 10. However, considering the resources of the study, there is reasonable spread across the area except in the east. The online response also concentrated to an area (Figure 3.5B), in this case there was a high number of responses around the two Rhondda Valleys, especially in CF44, CF45, and CF37. Rhondda is an area known for wildfire as suggested by social research in Jollands *et al.,* (2011). Moreover, compared population distribution, the lack of responses in the east cannot be explained by a lack of people living there. Hence it is possible here that the areas with higher response demonstrate areas with greater concern through selection bias (Greenacre, 2016).

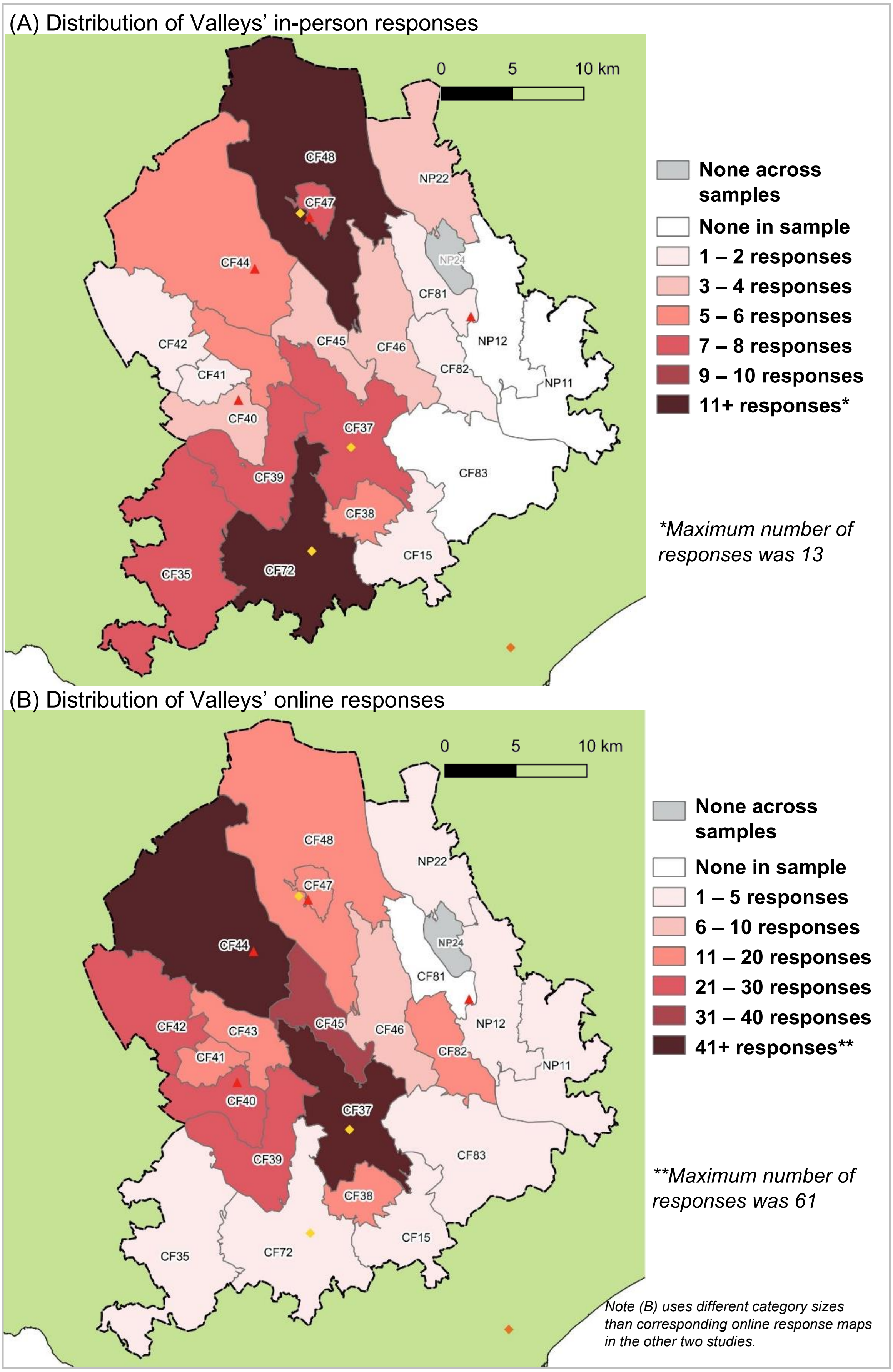


Figure 3.5 – Number of responses from each postcode of the two samples in the Valleys, in-person (N=92) and online (N=330).

3.2.1.2 Valleys' follow-up sample

There was a total of 119 follow-up responses. For the in-person original sample there was a total of 22 in-person follow-up replies, 65% of the original sample agreed to a follow-up and 24% went onto give a reply. Online there was a total of 97 follow-up replies, 55% of the original sample agreed to a follow-up and 29% went onto give a reply. More in-person initially agreed to be contacted, but a smaller proportion went onto give a reply. The sample size of the in-person follow-up is much smaller, so while there are still interesting insights, a key limitation is this small size.

3.2.1.3 Valleys' participant characteristics

The participant characteristics within the samples were compared to the wider population (Figure 3.6). Both samples had more women than men, comprising around two thirds of the samples. While the two samples had a large difference from the wider population, there was only a 3% difference between them. There were participants from all the age categories in both Valleys samples, there was participation from a range of ages, and the latter were reasonably similar to the wider population. In-person had fewer of the 25-34 and 35-44 age groups, and more of the eldest category (65+). The biggest difference was the lack of 65+ online.

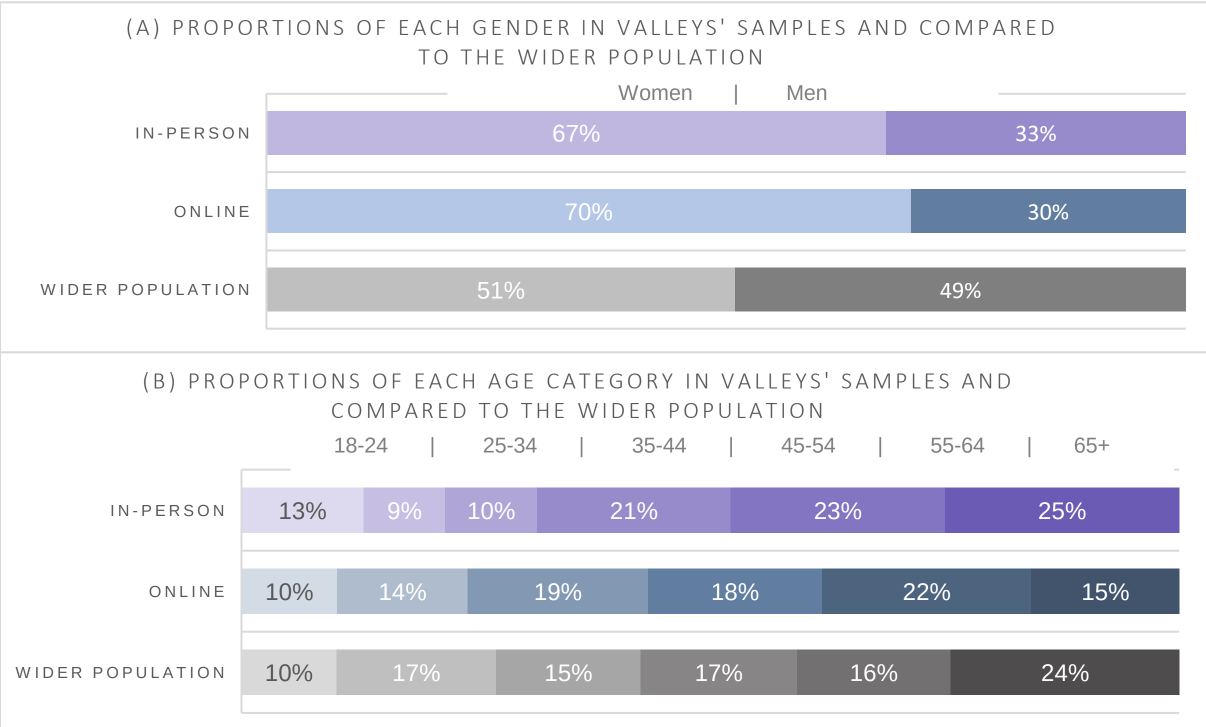


Figure 3.6 – Valleys participant characteristics compared to the wider population (population data from ONS, n.d.), for (A) gender, where in-person N= 92 and online N=319 (97%). And (B) age, where in-person N=92 and online N=323 (98%).

The occupations given were categorised into groups. There were a variety of participants from different occupation groups in both samples (Figure 3.7), and although there were also some differences between the samples these were mostly small. The largest were that the in-person sample had much fewer 'education, training, and library' and 'civil services', but more 'sales and retail', 'not working', 'business and financial operations' and 'emergency and protection services'.

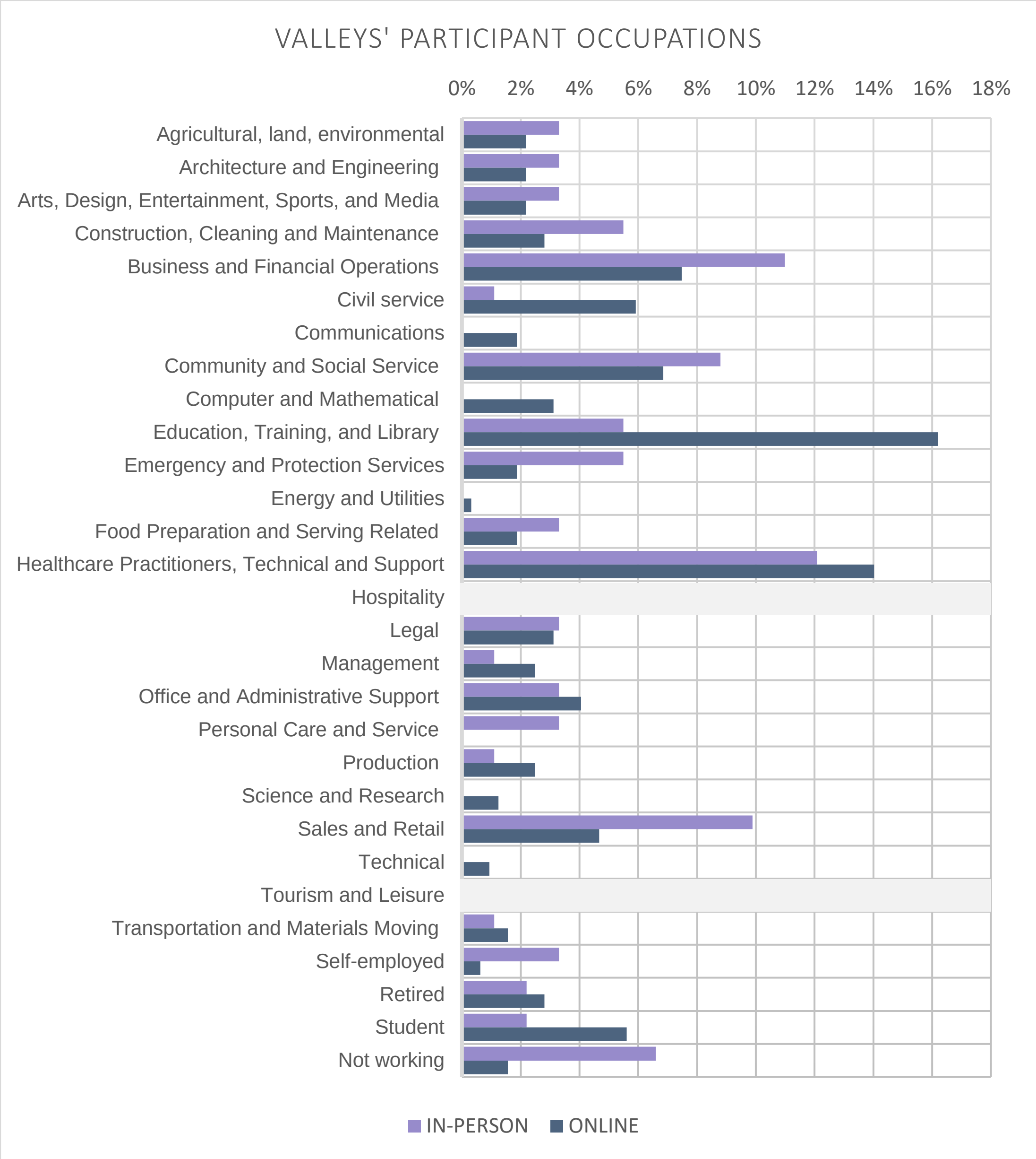


Figure 3.7 – The occupation categories of participants from the two Valleys samples. For in-person N=91 and online N=321 (97%).

Participant responses were flagged according to their occupation or whether they declared involvement in any work related to wildfire. These included those working in the Fire and Rescue Service, policing, forestry, ecology, and agriculture (in this case farmers). There were some participants in both samples which were flagged (Table 3.1) although the proportion of the total sample remained small, so it is reasonable to conclude this was representative of a general public rather than those with specialised knowledge.

FLAGGED PARTICIPANTS IN THE VALLEYS						
	IN-PERSON		ONLINE		COMBINED	
Fire service	3	(3%)	1	(<1%)	4	(1%)
Policing	1	(1%)	2	(<1%)	3	(<1%)
Mountain rescue			na			
Ecology / Environmental	2	(2%)	2	(<1%)	4	(1%)
Forestry	0		1	(<1%)	1	(<1%)
Agricultural	0		2	(<1%)	2	(<1%)
Grounds and outdoors	1	(1%)	2	(<1%)	3	(<1%)
The council			na			
Volunteer			na			
National trust			na			
	7	*8%*	***10***	*3%*	***17***	*4%*
	92		330		422	

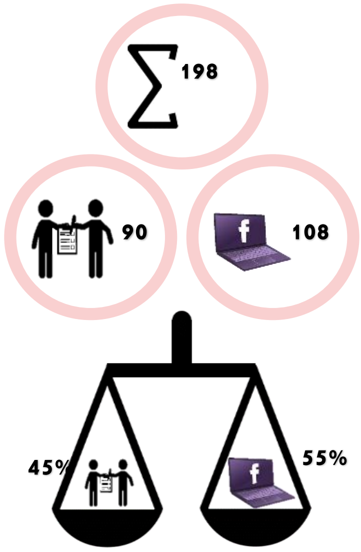
Table 3.1 – Flagged participants in the Valleys due to involvement in work related to wildfire.

3.2.2 Dorset case study samples

3.2.2.1 Size and distribution of Dorset participants

There were 90 in-person responses and 108 online, comprising a total of 198. The Dorset online survey had some interest, collecting a mean of 6.4 per day, although considering the population across the case study the response is relatively low. The Dorset in-person collection was slower than anticipated, collecting a mean of 1.07 an hour. There was high footfall, but there was disinterest or people being seemingly too busy, as well as some tourists rather than residents.

SAMPLE SIZES FOR THE DORSET CASE STUDY



There were 37 postcodes allowed in the Dorset study area, of which 31 had responses (Figure 3.8). Examining the distribution, the postcodes lacking responses were not concentrated to one part of the study area. Additionally, these also included postcodes within the very highly populated southeastern conurbation. The minimum frequency from a single postcode was 1 and the maximum was 23. Of the 31 postcodes with responses, 6 had just 1 or 2 responses, 17 had 5 or more responses and 6 had 10 or more.

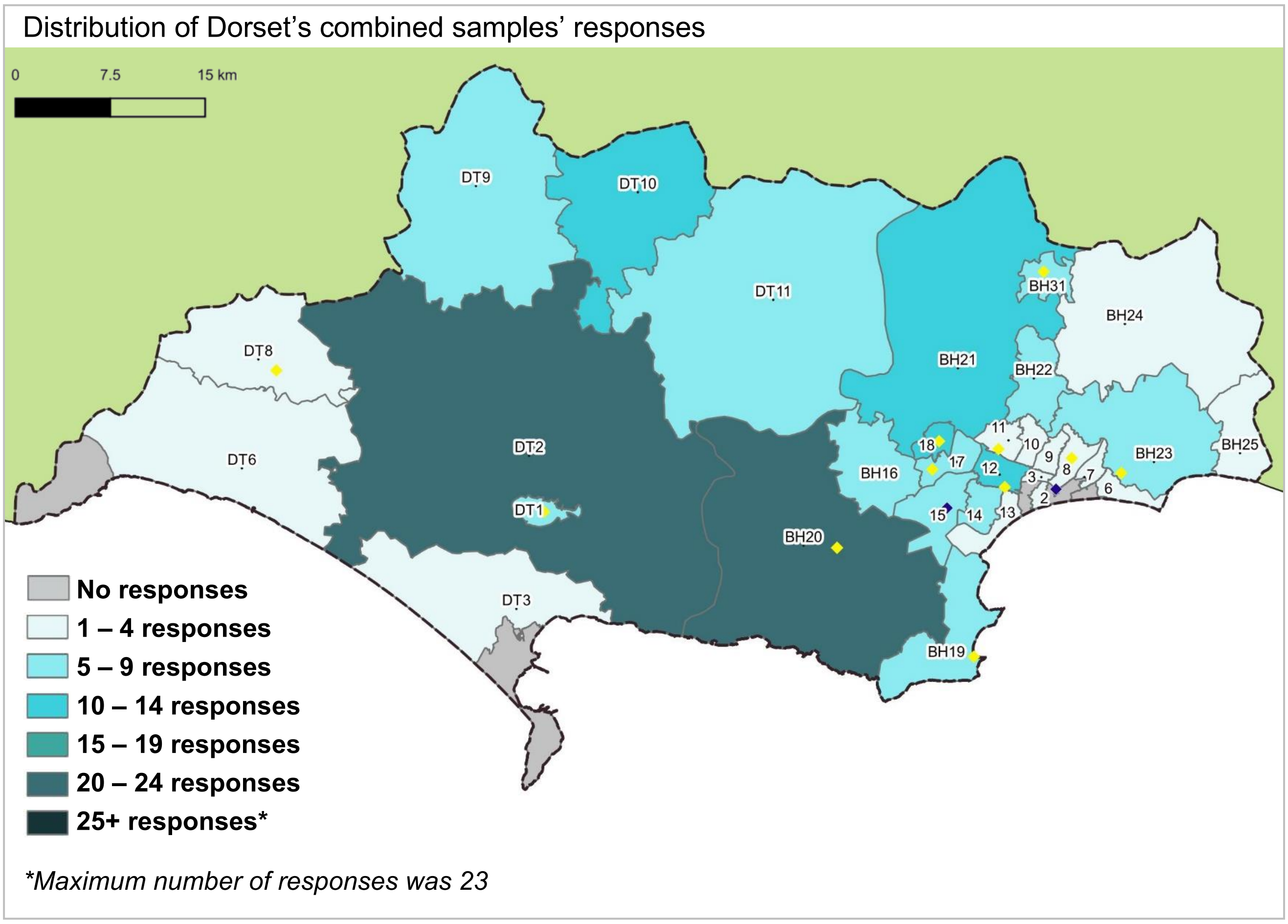


Figure 3.8 – Number of responses from each postcode in Dorset across the two samples (N=198).

The in-person sample had 29 postcodes with responses, many had only 1 or 2 responses and the maximum any postcode has was 9. Looking at the distribution there is some clustering near data collection sites (Figure 3.9A). Despite there being many data collection sites in the southeast, there were postcodes with no or very few responses in that area, which could be explained by the number of potential postcode districts and population size compared to the number of responses garnered. Looking at the distribution of the online sample (Figure 3.9B), there is a noticeable concentration around the centre of Dorset, with a relative lack of responses in the east despite the high population density with the urban centres of Poole and Bournemouth. This is possibly explained by a selection bias, where more participants have responded where there is greater concern, for example, BH20 (with a high level of response) is the postcode where a recent wildfire had occurred, that is, Wareham Forest Fire in May 2020 (Belcher *et al.*, 2022; BBC, 2022c).

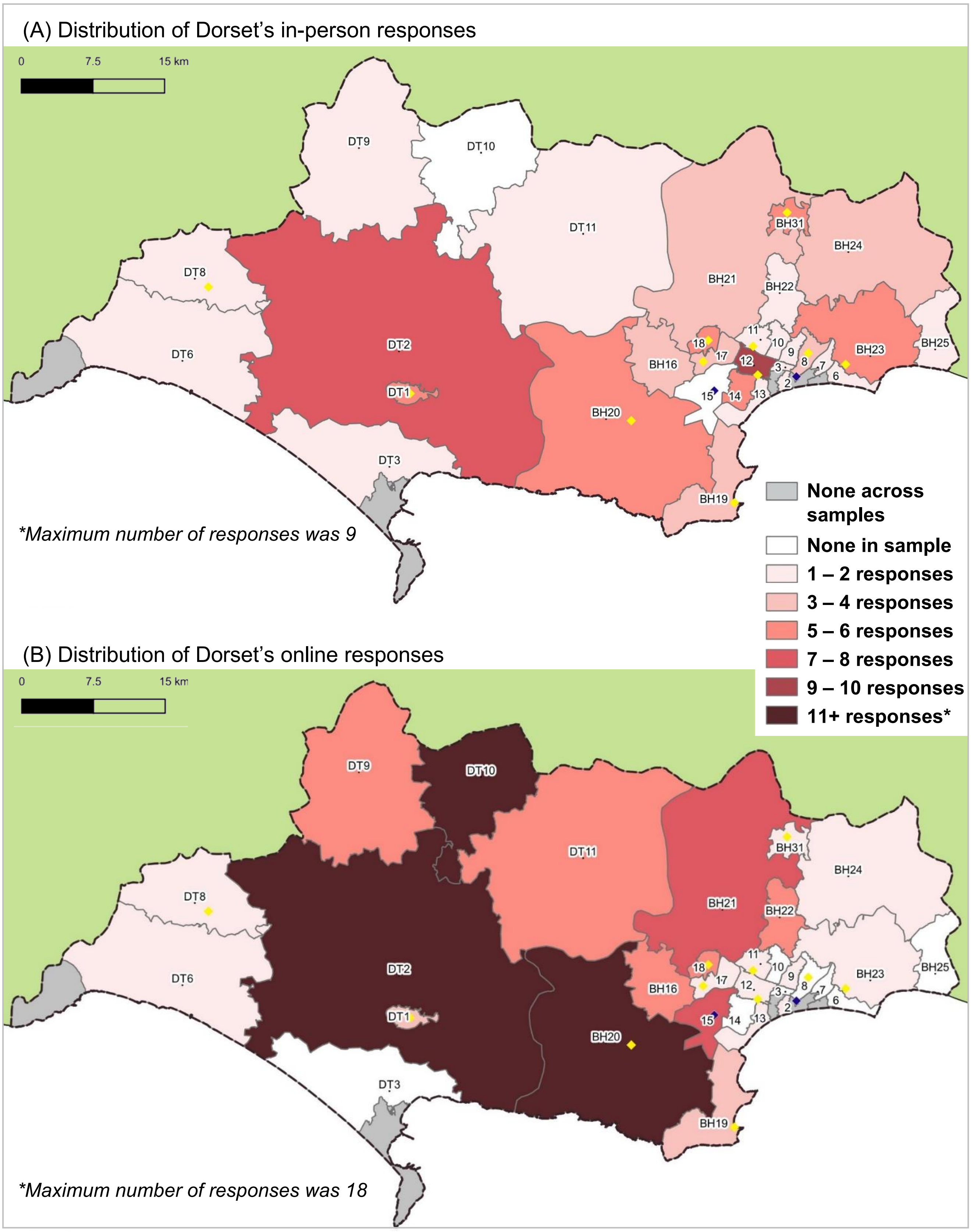


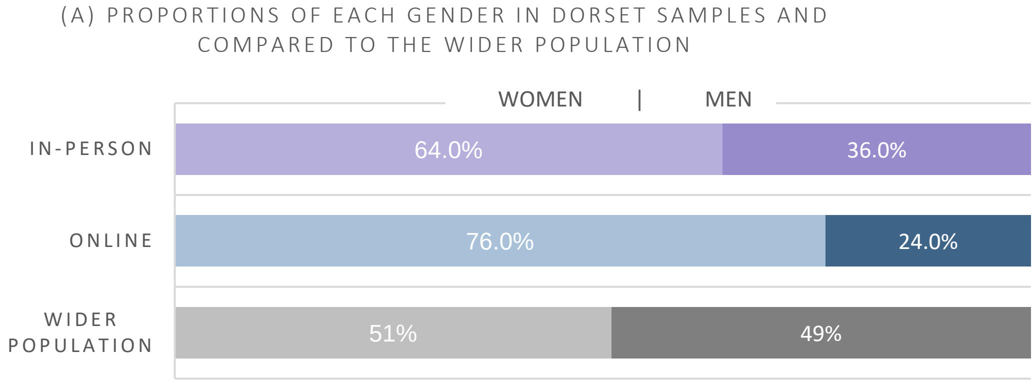
Figure 3.9 – The distribution of responses within the (A) in-person and (B) online samples.

3.2.2.2 *Dorset follow-up sample*

Of those that agreed to be contacted around half ultimately gave a follow-up response. There was a total of 61 follow-up responses in Dorset, both follow-up samples are very small which is a key limitation. There was a total of 26 in-person follow-up replies, 59% of the original sample agreed to a follow-up and 29% went onto give a reply. Online, there was a total of 35 follow-up replies, 55% of the original sample agreed to a follow-up and 32% went onto give a reply.

3.2.2.3 *Dorset participant characteristics*

The participants characteristics (Figure 3.10) show there were more women than men in both samples, where online had a larger majority (differed by 12%). The in-person had more of the eldest and youngest age group, as well as fewer of the 45-54. Additionally, comparing to the wider population, the online lacked the eldest and youngest age groups.



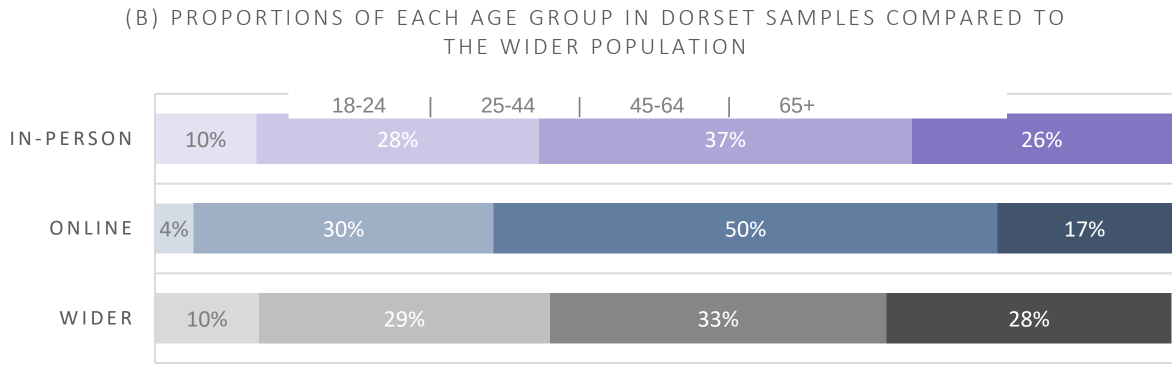


Figure 3.10 – Dorset participant characteristics compared with the wider population (population data from ONS, n.d.). For (A) gender, where in-person N=90 and online N=104 (95%). And (B) age group, where in-person N=90 and online N=106 (97%). Separated age groups available in Appendices.

The occupations provided were grouped into common categories and shown in Figure 3.11. There were a variety of types of occupations of the participants in both samples and differences between the two were mostly small. The in-person had more hospitality, retired, student, and 'not working'. The online had more 'business and financial operations', healthcare, 'education, training, and library', and 'community and social services'.

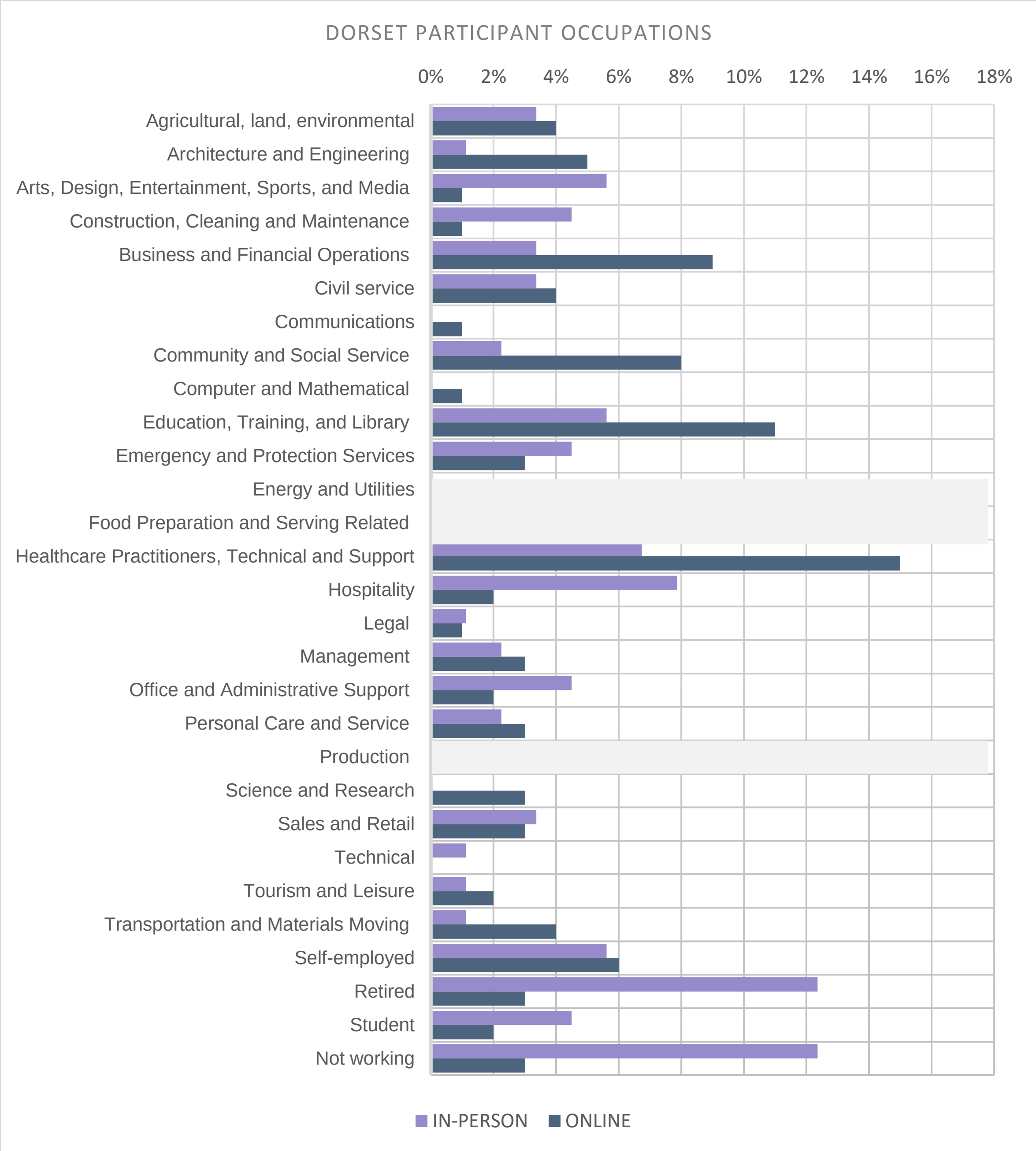


Figure 3.11 – Dorset participant occupation types, for the in-person (N=90) and online samples (N=198).

Participants' responses were flagged according to whether they declared any work related to wildfire or having relevant occupations, such as working for FRS. Additionally, those that noted working worked in the council were also flagged in the case of Dorset, because Firewise UK is based within the organisation. The flagged participants made up relatively small proportions of each sample, although the online sample had more (Table 3.2).

FLAGGED PARTICIPANTS IN DORSET						
	IN-PERSON		ONLINE		COMBINED	
Fire service	1	(1%)	1	(1%)	2	(1%)
Policing	2	(2%)	1	(1%)	3	(2%)
Mountain rescue			na			
Ecology / Environmental	1	(1%)	2	(2%)	3	(2%)
Forestry	0		1	(1%)	1	(1%)
Agricultural / land management			na			
Grounds and outdoors			na			
The council	1	(1%)	3	(3%)	4	(2%)
Volunteer	0		2	(2%)	2	(1%)
National trust			na			
	5	*6%*	***10***	*9%*	***15***	*8%*
	90		108		198	

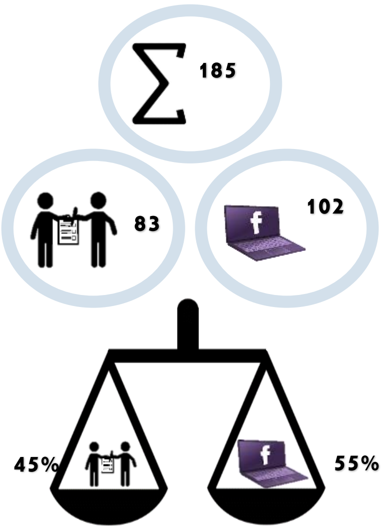
Table 3.2 – Flagged participants from the Dorset study due to involvement in work related to wildfire.

3.2.3 Highlands' case study samples

3.2.3.1 Size and distribution of Highlands' participants

There was a total of 185 responses in the Highlands case study; 83 in-person and 102 online. The online is therefore only slightly bigger, making up 55% of the total. This study had the slowest data collection process, likely owing to its rurality and the presence of numerous tourists. There was some disinterest, but many participants seemed aware of the topic. For the online survey there was a mean of 5.3 collected per day. For the in-person survey, there was a mean of 0.9 collected per hour.

SAMPLE SIZES FOR THE HIGHLANDS CASE STUDY



The postcode districts demonstrate the spatial distribution of participants, where the combined sample somewhat covered the study area (Figure 3.12). There were certainly postcodes that had a very high number of responses, notably PH33 had the most. The lack of responses somewhat corresponds to areas with fewer people.

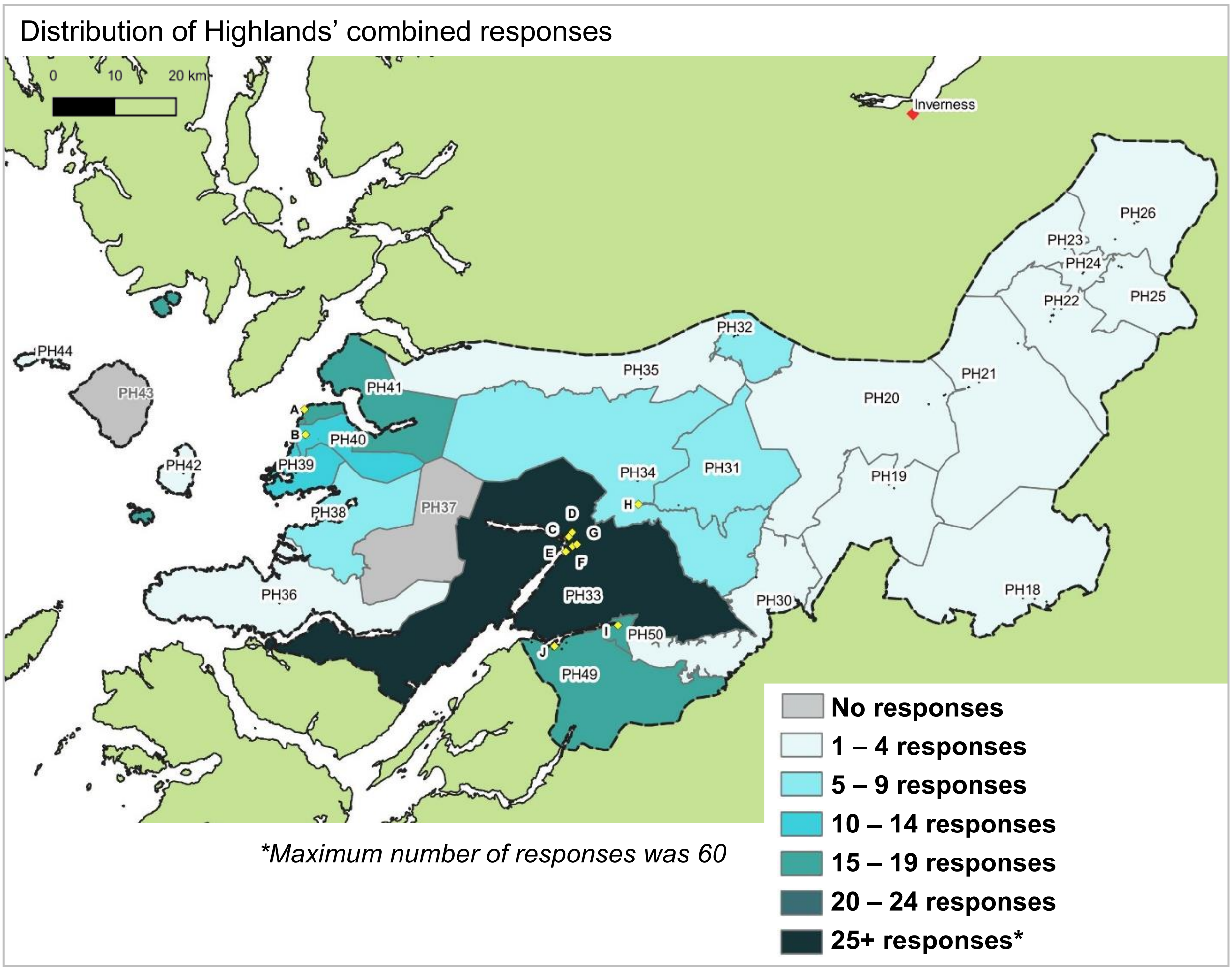


Figure 3.12 - Number of responses per postcode in the Highlands for the combined samples (in-person and online surveys), N=102.

The two surveys had similar distributions of participants (Figure 3.13). The in-person did cluster around data collection sites, hence is lacking in the east where there were no sites. The online sample had a distribution which corresponds to higher population density (and therefore also where there were data collection sites), which does suggest rurality was a determining factor in response, rather than level of interest.

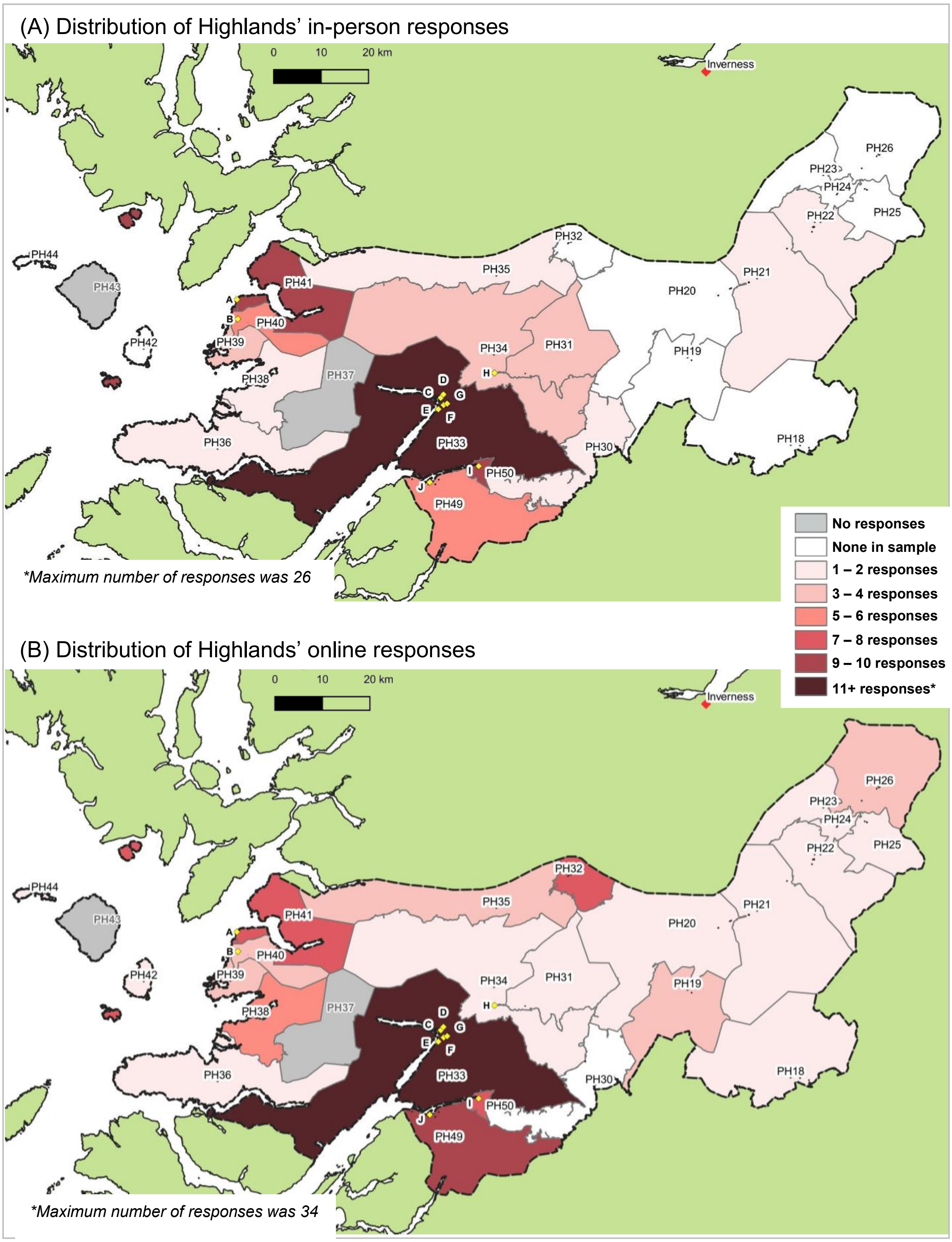


Figure 3.13 - Distribution of participants in the Highlands study across the two samples: (A) in-person and (B) online.

3.2.3.2 Highlands' participant characteristics

Both samples had more female respondents, where the online sample had a higher majority by 7% (Figure 3.14A). There were participants from a variety of age groups in both samples (Figure 3.14B). The in-person had more of the eldest category than the online, and fewer of the 35-44. The age ranges were loosely comparable to the wider population; both samples had a smaller proportion of the youngest category and the online lacks participants from the eldest.

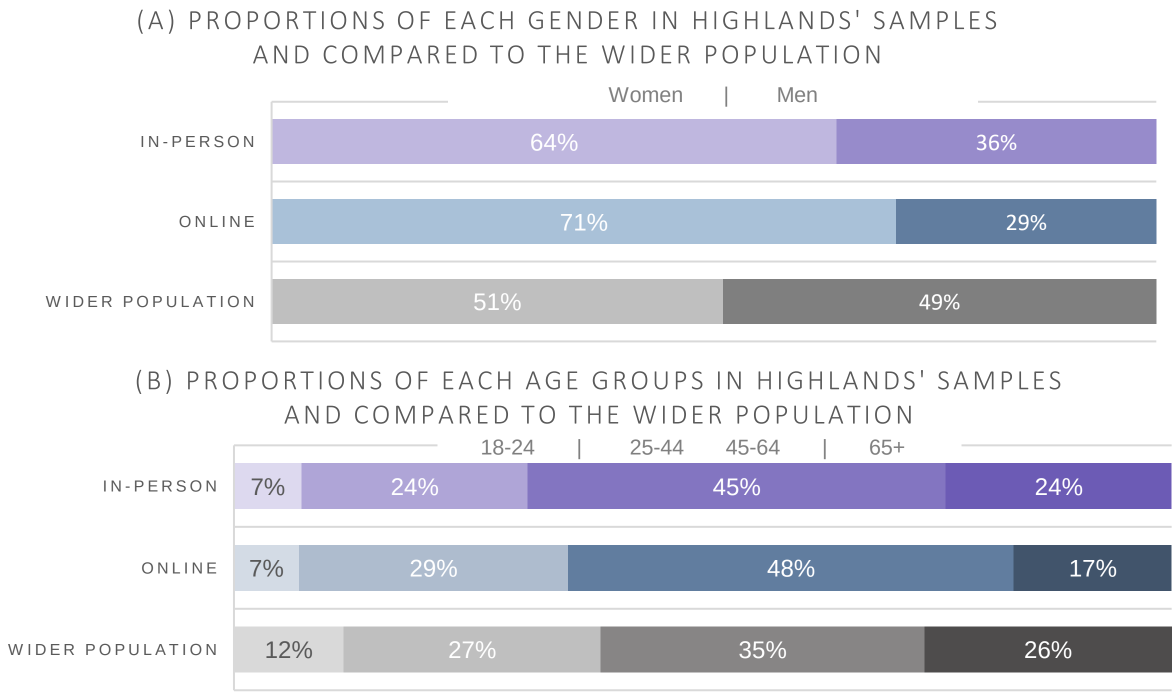


Figure 3.14 – Highlands' participant characteristics compared with the wider population (National Records of Scotland, n.d.). For (A) gender, where in-person N=90 and online N=104 (95%). And (B) age group, where in-person N=83 and online N=102 (100%). Separated age groups available in Appendix.

There were respondents from a variety of occupations, but there were some more common occupation types (Figure 3.15).

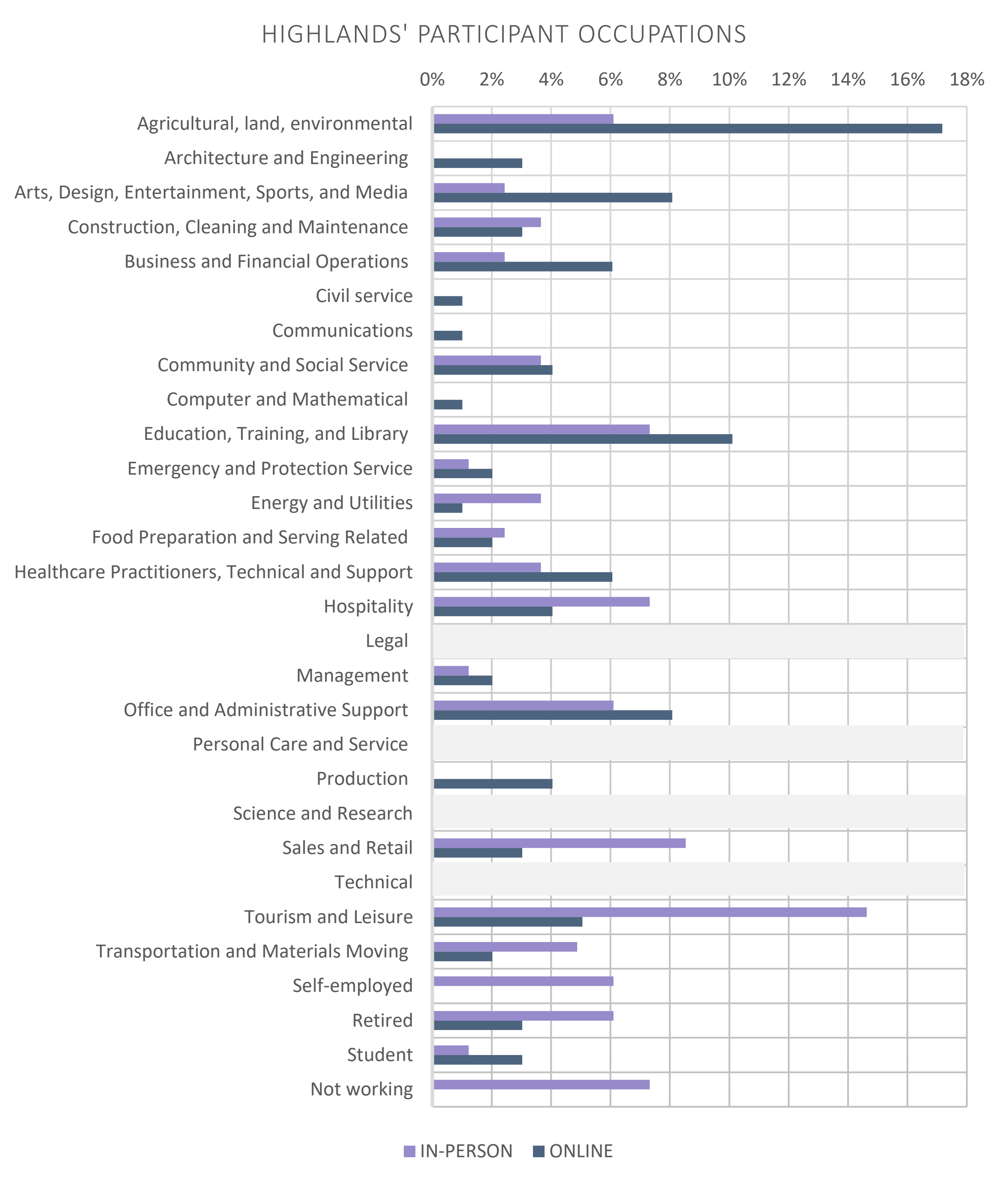


Figure 3.15 – Highlands' participant occupations, in-person N=83 and online N=102.

Participants' responses were flagged for either the occupation or extra information given when asked if they worked in any capacity with wildfire (Table 3.3). There were a reasonable number of participants that were flagged, these were mainly agricultural or environmental. There were no emergency workers, unlike the other two case studies. Also distinct to the other case studies, there were participants with direct connection to prescribed fire, 5 participants (with agricultural occupations) stated they carry out prescribed burns. Additionally, 1 participant declared that they monitored barbeques in camping areas (with environmental occupation).

FLAGGED PARTICIPANTS IN THE HIGHLANDS	IN-PERSON		ONLINE		COMBINED	
Fire service			na			
Policing	0		1	(1%)	1	(1%)
Mountain rescue	1	(1%)	0		1	(1%)
Ecology / Environmental	1	(1%)	7	(7%)	8	(4%)
Forestry			na			
Agricultural / land management	3	(3%)	7	(10%)	10	(7%)
Grounds and outdoors	0		3	(3%)	3	(2%)
The council			na			
Volunteer			na			
National trust	1	(1%)	1	(1%)	2	(1%)
	6	*7%*	***19***	*18%*	***25***	*13%*
	83		102		185	

Table 3.3 – Flagged participants in the Highlands due to involvement in work related to wildfire.

3.2.4 Comparing participation and samples

3.2.4.1 Comparing interest between locations

The level of response to the surveys is perhaps telling in itself. The speed and volume of responses from the Valleys online survey was outstanding compared to the other locations, especially considering it had the fewest postcode districts, although it was relatively urban or suburban. Dorset with the largest area had the highest amount of coverage but did not have a high response online. This lack of interest potentially points to apathy or lack of perceived relevance of the topic. Highlands was the most rural and did have the smallest online sample, however considering the magnitude of difference of the wider populations and the level of interest there is potentially greater perceived relevance of this topic for this area.

The collection in-person was affected by the type of data collection site, including how busy it was, as well as how much it attracted local people rather than tourists. Having said this, the response level between the case studies was most similar across this mode of data collection. The Valleys in-person collection was the shortest, and Highlands was the longest. The rurality and touristic nature of the Highlands likely explains this. Dorset in-person survey data collection was also affected by having tourists present, although not to the extent of the Highlands.

The level of interest in the follow-up was similar across both Valleys and Dorset, where between 24% and 32% of the original samples gave a follow-up, in both cases the online had a slightly greater response.

3.2.4.2 Comparing participants between locations

The in-person spatial distribution did generally cluster around data collection sites but was effective in reaching people from within the study area, and through varied placement of data collection sites was able to have some variation in participant postcode. There were some limitations where practicalities determined data collection sites, such as travel and access, as well as requiring high footfall and so not being able to avoid tourist areas. It is possible the online responses came from areas more concerned about wildfire, which would in itself be an interesting finding of risk perception, where hotspots in participation reflect places of greater risk perception.

There was a majority of women across all samples and the online in all case studies had a marginally higher majority. The study by Bhutta (2012) utilising Facebook also had a disproportionately female response, so the high proportion of female responses online could be a methodological artefact. Data on Facebook use may explain this as although there is an even split of female and male users on Facebook [52% female (Herd Digital, 2023)], male users may be less active. In this case the bias could also come from male users to be less likely to be members of the community groups used here. However, the fact that all in-person samples also have more women suggests another potential influence. It is possible that there is an element of the researcher's visibility, as a woman, encouraging more response from the same gender. Alternatively, it may reflect that women are more encouraged to get involved in wildfire, or community-based issues in general.

Looking at the age of participants in the samples (Figure 3.16), the online samples consistently lacked the eldest category (65+), and in two of the three (Valleys and Dorset) also lacked the youngest age group (Figure 3.16). The lack of older participants in the online samples is possibly the bias of it being web-based and lacking older internet and Facebook users (Herd Digital, 2023; ONS, 2021).

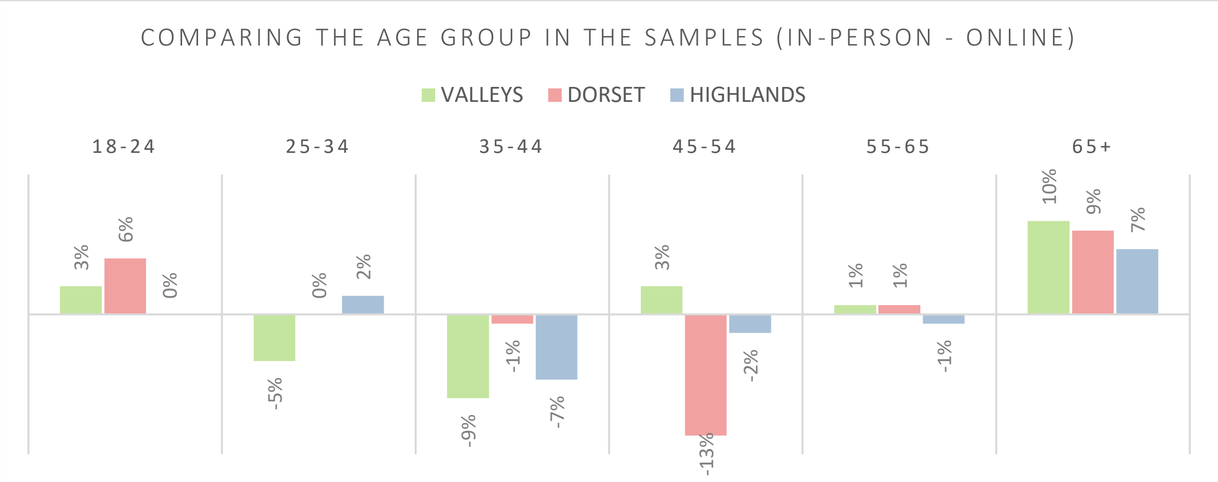


Figure 3.16 – Comparison of the proportion of participants from each age groups in the two samples, for each case study. (Positive value corresponds to more in-person).

The occupations did vary although all areas had a variety. The most poignant observation is that the Highlands had more rural jobs and more flagged responses, especially those that directly work with prescribed fire. Having said that, of the flagged responses Highlands had no Fire and Rescue Service personnel, whom the other two case studies did have responses from. In all locations flagged responses accounted for small proportions of the samples, suggesting they are representative of a general public rather than those with expert wildfire knowledge which was the aim.

3.2.4.3 Comparing responses between the samples

There were differences in the responses between the samples (see Figure 3.17 and Figure 3.18). The online samples consistently showed greater awareness and concern for wildfire in the local areas compared to in-person participants. While this was consistent, the magnitude of the difference did vary. The online sample in the Valleys was considerably different to the in-person; whereas Dorset and the Highlands online was the more similar. The responses generally differed most for considering wildfires a problem in the area and participants' personal risk scores. All in-person samples had lower responses to agreeing wildfires were a problem, and fewer high individual risk scores. Additionally, fewer in-person had also seen wildfires, or had not seen multiple wildfires. Moreover, looking at the months considered highest risk, the Valleys had very different responses, whereas Dorset had little difference. In the Firewise questions in Dorset, there was some difference in that in-person were less willing to take part. And in the Highlands, the online was more aware of muirburn. These all concur that the online sample were generally more interested, concerned, or connected to the topics addressed in the survey. The systematic differences between the samples suggest methodological differences or biases. A selection bias online would explain the disparities.

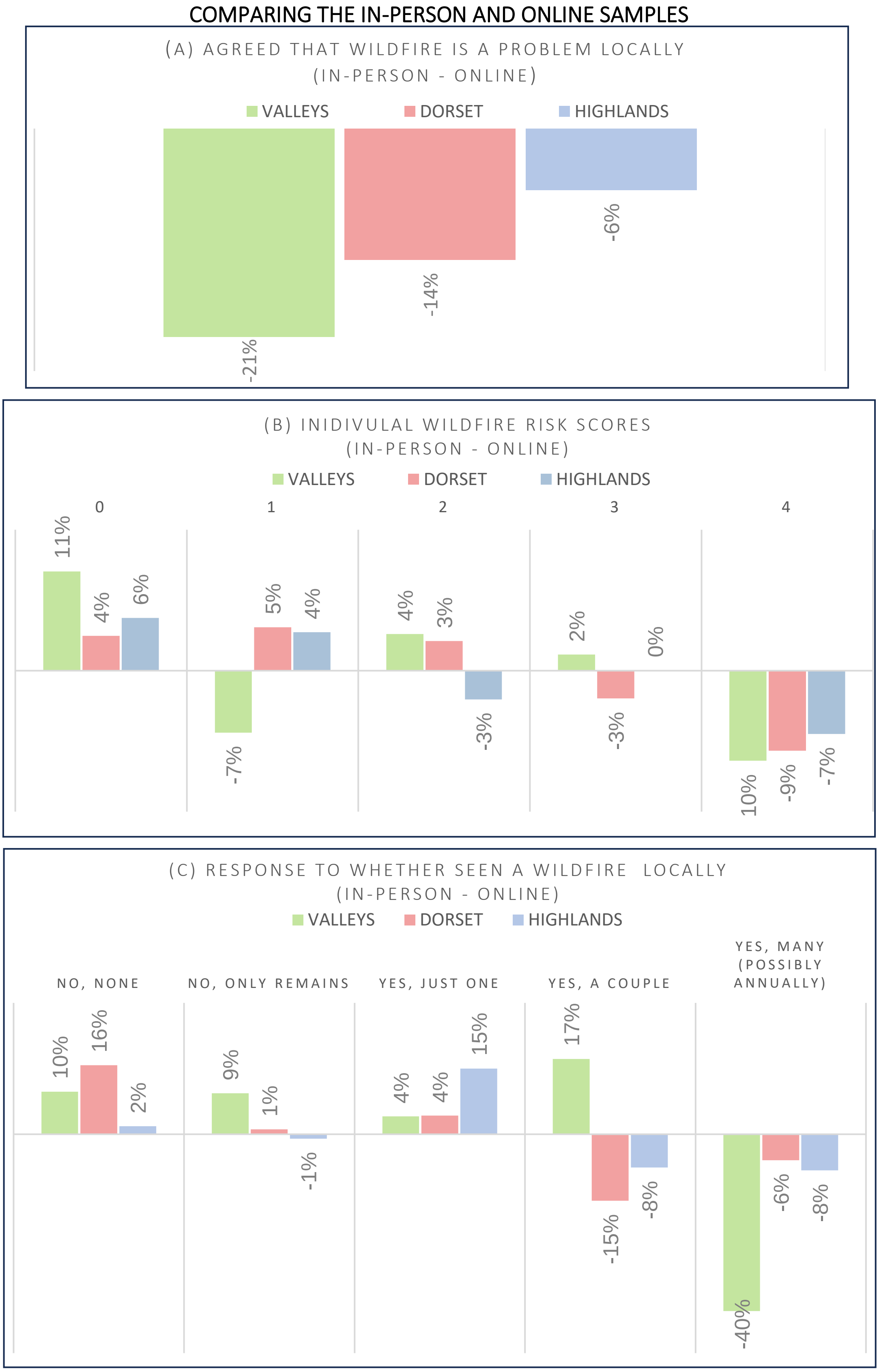


Figure 3.17 - Comparing the in-person and online responses to risk and awareness questions including (A) problem for area, (B) individual risk score, and (C) whether seen a wildfire locally. (Positive value reflects higher proportions in-person).

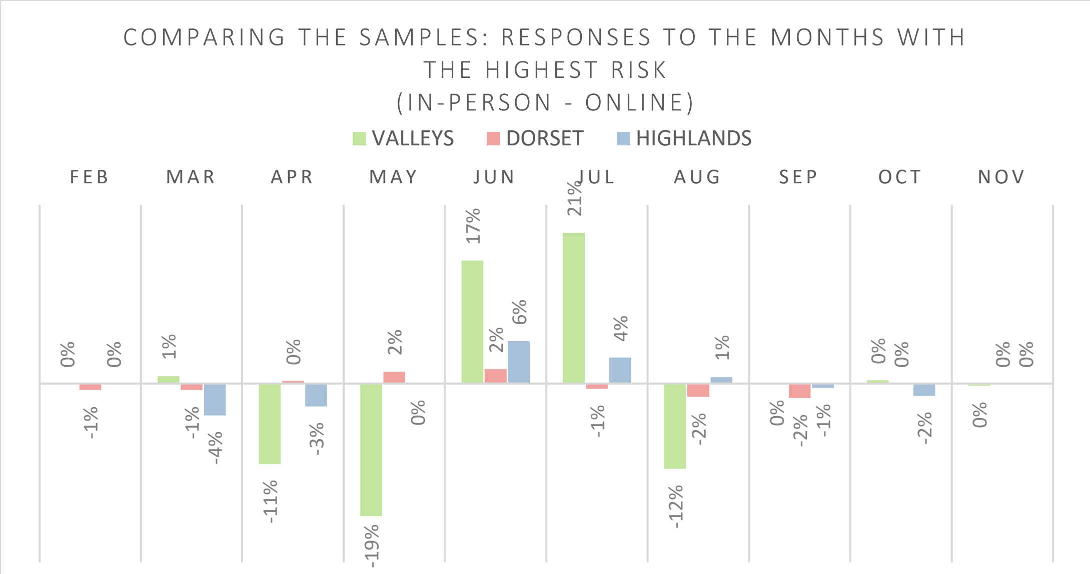


Figure 3.18 - Comparing responses to high-risk months between the two samples. (Positive value reflects higher proportions in-person).

Having said this, in areas or for questions where responses were more similar it suggests more widely held awareness or beliefs – in either direction. Moreover, the responses to the types of concerns, influencing factors, and beliefs related to climate change were more similar between the samples. The differences may be explained by the fact that online samples captured a greater proportion of concerned or aware groups, and the in-person did still capture some from this subgroup of the population.

3.3 Evaluation of methods

3.3.1 <u>Evaluating the two recruitment strategies</u>

The simultaneous in-person and online recruitment presented an opportunity to reach the public in different ways. The sampling strategies were effective in garnering responses and mostly show a varied range of participants. However, they suffer a weak sampling frame and there is a significant gender bias across all samples in which men are under-represented. Moreover, the online sample also demonstrated biased views where there was greater awareness and or concern, potentially due to a selection bias.

The disparity in the participants the samples accessed did result in limitations to the data analysis, and complications in presenting the results. The cumbersome resulting findings meant a part of the analysis was comparing the samples rather than focusing on the content of the responses.

Having said that, the differences did provide further insight into perceptions in the area, which only having one would not have shown. It demonstrated the presence of a more concerned subgroup in each locality, where the online methodology was more effective at accessing. This is in itself a potentially useful finding for stakeholders, in order to reach those most susceptible to engagement. This is explicitly demonstrated in the difference between the samples in the Firewise questions in Dorset.

In sum, the online recruitment was effective at getting participants with minimal effort but suffered significant response bias. Whereas the in-person data collection was considerably more time consuming and laborious but produced more representative samples. The diversification of data collection was made necessary by disruption to the study, and ultimately perhaps generated more insight into public perceptions, rather than less.

3.3.2 Evaluation of study

Overall, the study produced a large amount of data. As an exploratory study this research was successful in drawing out generalised attitudes towards wildfire and prescribed fire in Britain.

Reviewing the efficacy of the survey research shows that it was an appropriate tool for gathering a broad set of views and not being overly demanding of time from participants. It was relatively encouraging for more complete responses, although there were potentially more disinterested people that would have been discourage by the length. There were a range of opinion garnered suggesting some diversity in the samples. There was also reasonable variation of short and long form responses, although, as to be expected, there was the classic frustrations of a lack of nuance and explanations for all questions. Fortunately, the in-person data collection afforded some opportunity for probing, which added depth to results which would otherwise have been lacking. Moreover, specifically, a key limitation was not asking participants in all locations to explain the risks scores, after finding the explanations in the Highlands so insightful. Overall, giving more opportunities to make comment throughout the survey could have been useful, although not setting them as mandatory to not discourage completion.

Reviewing the breadth of topics was also apt, having risk and knowledge is a crucial balance to be able to ascertain more than just how concerned residents are, but also ascertaining the level of awareness and knowledge. It was also useful to draw on the acceptance of prescribed fire, putting the wildfire perceptions into perspective and garnering more about the value of fire for British society. Mix of questions worked well, where there was completion but also inclusion of longer open-ended questions.

The recruitment strategies were effective at getting some response, and from participants with a range of ages, locations, and occupations. However, there would have been people omiited from the sampes. The online survey suffered the limitations of internet-based research (Couper *et al.,* 2007; Best & Krueger, 2002), excluding older participants despite increases in usage of the internet by this age group. There was a clear concern bias in the online sample, likely a consequence of self-selection bias (Greenacre, 2016), exacerbating the omission of responses from those less interested. Therefore, a non-response bias (Bird, 2009) must be considered where there were those, especially online, with less interest in this issue, that did not respond. Moreover, the gender bias across all samples also indicates a lack of complete representativeness and means the comparisons with gender are inconclusive. Crucially, while there was reasonable reach to the general public, the fact that it is not possible to know who did not take part means that the sampling frame is weak.

The lack of sampling frame and lack of participant characteristics was a significant oversight. The lack of context on an individual fire risk to see how perceived calculations compared to technical measures. The postcode districts, while a highly practical methodological choice, potentially created issues in analysis where they were too coarse and heterogenous, and crucially, the level of fire risk is variable. As pointed out in the methodology, the convenience sampling technique, not being random, does require more rigorous testing (Galloway, 2005); hence this study should act as an exploratory stage of investigating these questions.

Moreover, some of the sample sizes were very small, which presented significant limitations in the data analysis by violating assumptions of inferential statistics (McCarroll, 2016), as well as meaning patterns in the responses may have been obscured. Additionally, the small sample sizes in conjunction with the uneven responses from postcodes and differences between the in-person and online samples, resulted in a lack of statistical analysis of responses to the closed-questions. However, using descriptive statistics there remain valuable insights into the data. Additionally, the variety of views and repetition of the same points demonstrate a general sense of the varied perceptions across local communities.

Overall, the weak sampling frame, as well as lack of nuance did mean the findings were limited in what they could claim, where the preliminary nature of the findings should be emphasised. They most appropriately will act as a stepping stone for further research. From the suggestions of these findings there are various interesting avenues that would be intriguing to explore. This includes developing understanding of how probability and severity influence the calculations of risk, more about the misconceptions of wildfire in Britain, understanding risk perception overtime and in relation to other hazards, and finally understanding how wildfire hazards are perceived by those that do not live in the area, or how someone from a fire prone area would behave in another area.

Reviewing the follow-up survey, this was somewhat useful to provide perspective on the influence of occurrence at the same time as the original data collection, where differences were not as large as expected. It was also an opportunity to re-address questions which were left unclear from the original survey. However, it had limited findings due to small sample sizes, particularly the Valleys in-person follow-up group and both of the follow-up samples in Dorset. There was a reasonably consistent proportion from the original samples that went onto complete a follow-up, and these represented various views and were not limited to those more concerned. A crucial next step for research would be to investigate the relevance of wildfire hazards in Britain over time, perhaps also comparing to other hazards and daily life to put these results into perspective, and more specifically test variation of risk perceived over the year.

Lastly, in reviewing this study it is crucial to consider the disruption caused by COVID-19. This study faced significant limitation attributable to this interference, practically delaying data collection to be during the wildfire season, as well as creating additional time pressures on study's resources. The data collection method underwent substantial transformation, shifting to a mix of recruitment strategies, which ultimately added significant workload to the analysis. As well as crucially changing the location and focus of one of the case studies. Where the Highlands case study was not initially included, questions relating to prescribed fires were only incorporated in the follow-up surveys for the Valleys and Dorset case studies, meaning fulfilled comparison was not possible (where sample sizes for the posing of the questions in the first two case studies were small). Nonetheless, ultimately, the Highlands study was a valuable addition in consolidating perceptions on wildfire from across varying environments in Britain and offering varying landscapes and contexts (including one with a presence of prescribed fire) to compare results to.

CASE STUDY 1: SOUTH WALES VALLEYS

4.1 Introduction to the Valleys

This case study collected and analysed perception data of residents in an area of the South Wales Valleys (Figure 4.1), colloquially known as ‘The Valleys’, which experiences a prolific number of wildfires (Jollands *et al*., 2011). This study specifically focused on only a portion of ‘The Valleys’ in and around Rhondda, including the Rhondda, Cynon, Taf, and Merthyr Valleys (Figure 4.2).

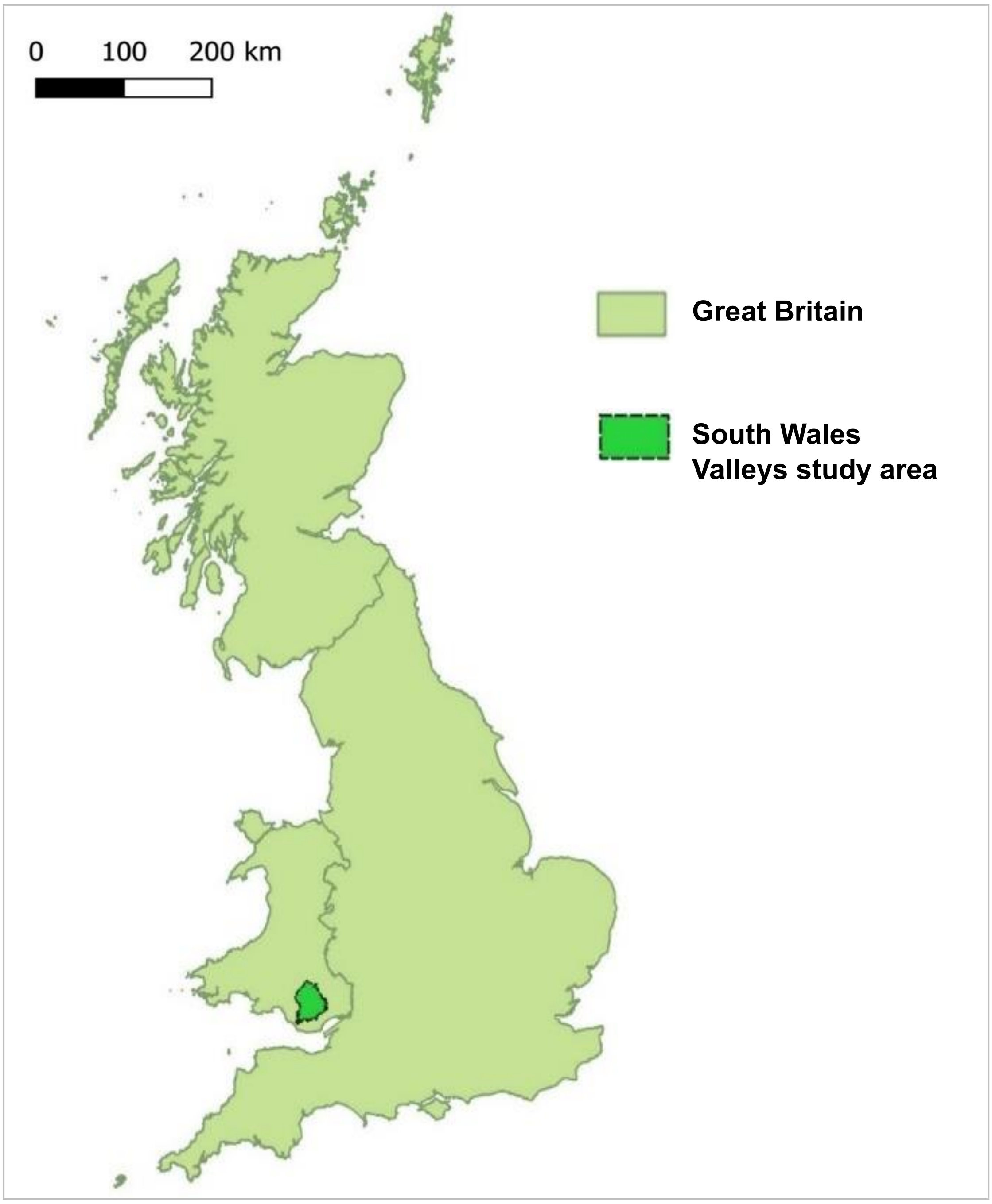


Figure 4.1 - The Valleys study area within Great Britain; map source data from EDINA (2021a, 2021b).

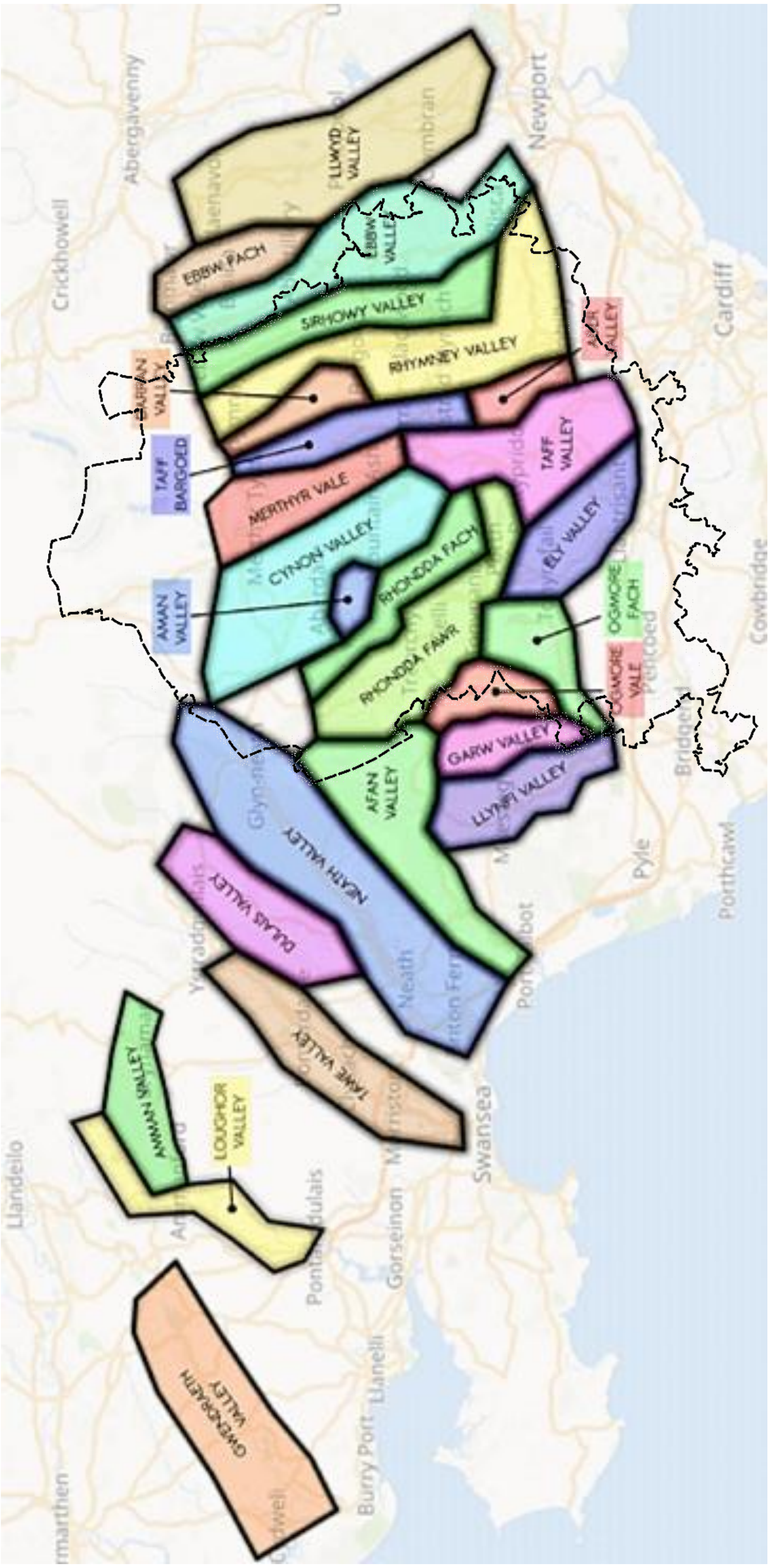


Figure 4.2 – The entire South Wales Valleys (Anon, 2021) with an approximate overlay of the study area.

4.1.1 <u>The Valleys: environmental characteristics</u>

The study area covers a relatively urbanised landscape, in the Rhondda Cynon Taf (RCT) and Merthyr Tydfil local authorities 77% live in urban areas and 23% live in rural (ONS, n.d.). The study area has an overall population density of 518 people per km^2; the minimum density of an included postcode was 182 and the maximum was 1870 (ONS, n.d.). Looking at the distribution of people within the area there are ribbons of development (Figure 4.3). The area is relatively urban, with fringe settlements, and becomes more rural in the north near the Brecon Beacons National Park (BBNP).

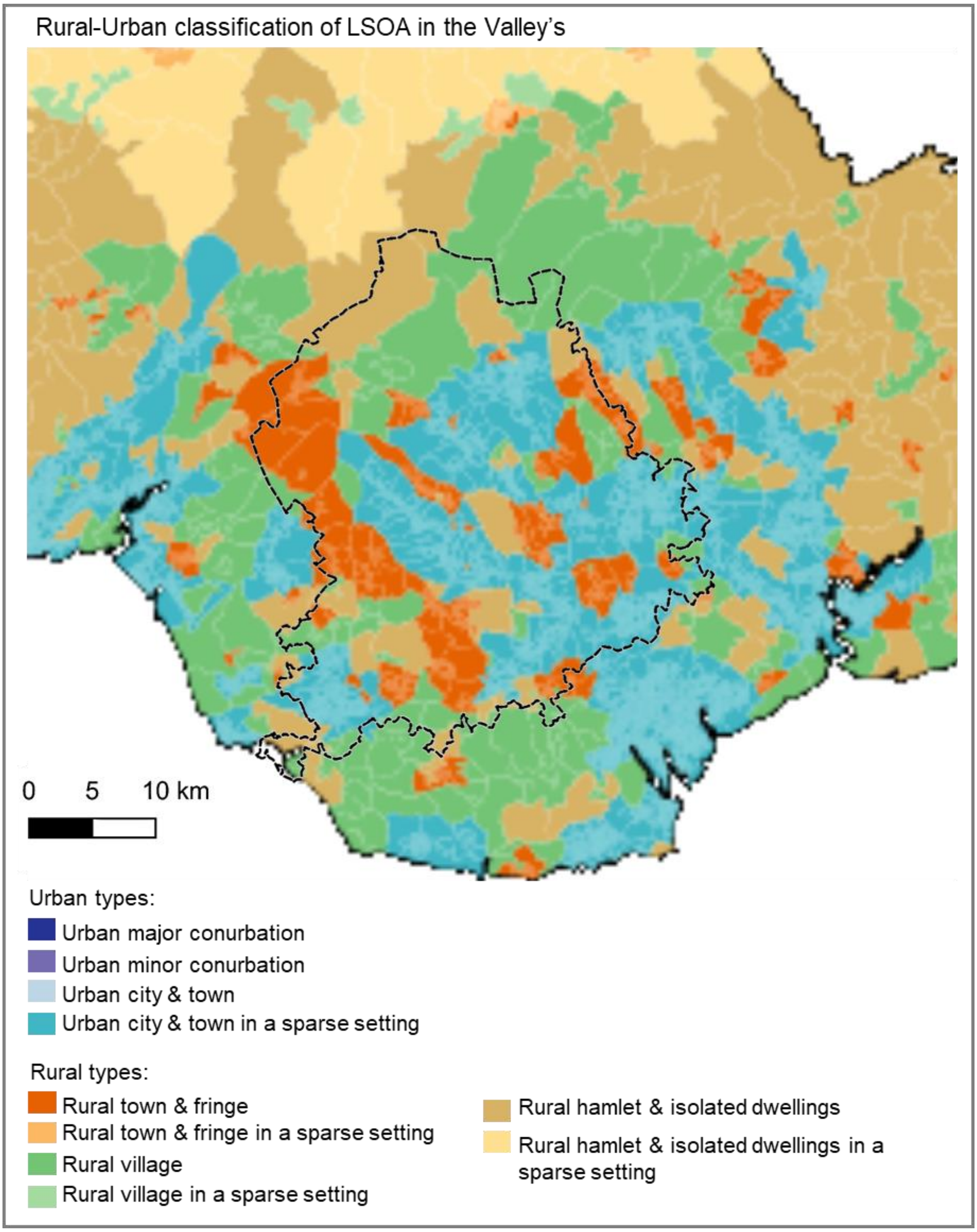


Figure 4.3 – Rural-urban classifications of the Valleys study area (adapted from ONS, 2017a).

The distinctive contemporary landscape of the Valleys reflects the past industry that led to transport and residential development, including the extensive iconic terraced housing and characteristic ribbon development constrained by topography (NRW, 2014). The decline of industry has left a legacy of high population densities, industrial buildings, terraced housing, and spoil heaps (NRW, 2014). The ribbons of development can be identified on the land cover today, which are adjacent to grassland hills with broadleaved woodland and conifer plantations (Figure 4.4). This results in a place where dense populations and vegetation are intertwined.

Valleys' Study Area Land Cover

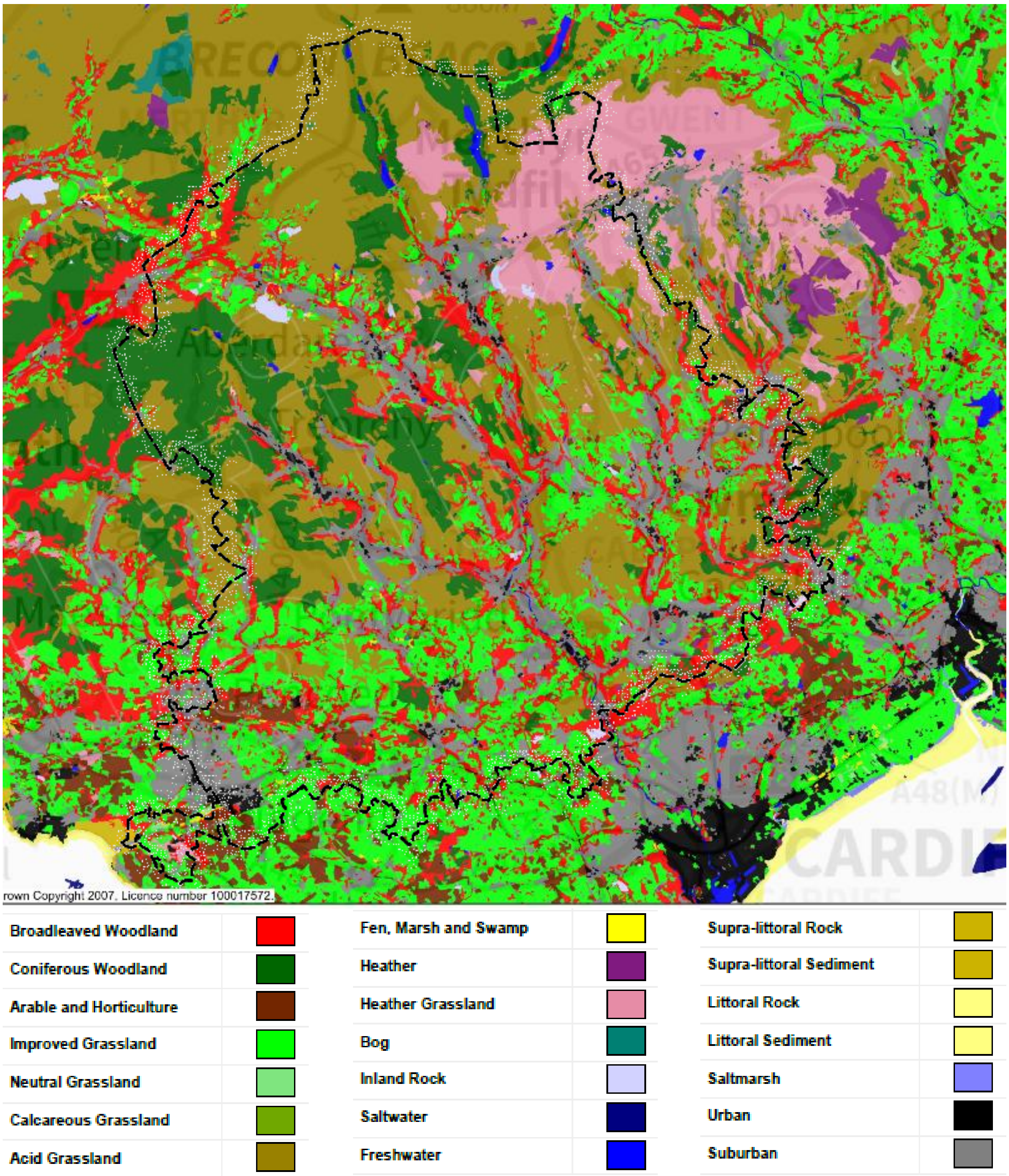
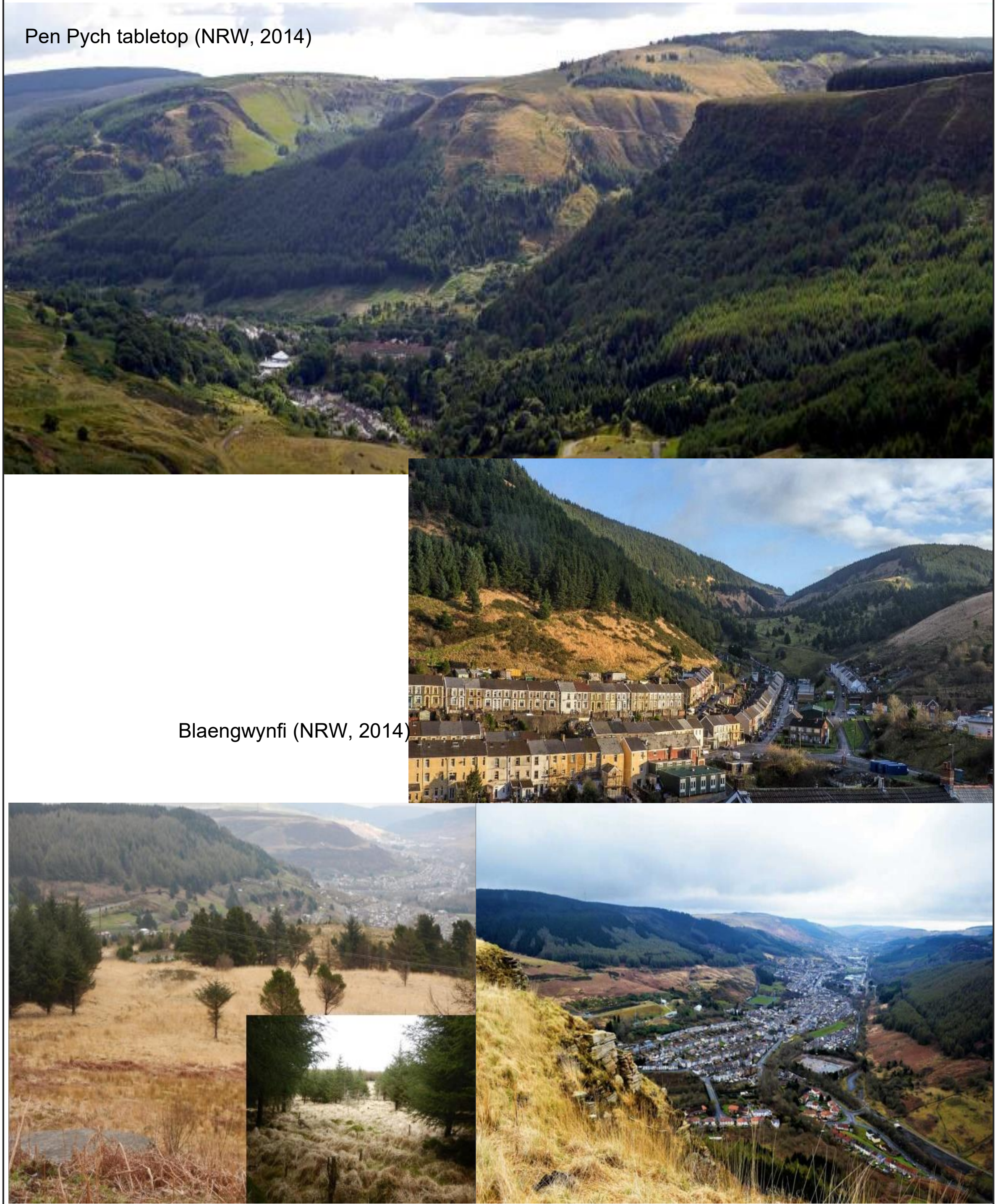


Figure 4.4 – Land cover of the Valleys study area (EDINA 2021c).

The Valleys is an expression of urban-rural fringe environments, which in wildfire terms means an intermix of fuel and ignition sources (Figure 4.5). This demonstrates how the environmental features contribute to a landscape conducive to wildfire, with ignition risks near flammable landscapes in particular grassland, bracken, and steep slopes (Jenkins & Woodcock, 2019). There is also an economic vulnerability as the forestry stocks sit within this high-risk area.

PEOPLE AND FUEL INTERMIXED IN THE ICONIC VALLEYS' LANDSCAPES



Bracken on the hillsides, Healthy Hillsides (Jenkins & Woodcock, 2019)

Pen Pych viewpoint, (RCT County Borough Council, 2018)

Figure 4.5 - A collection of photographs demonstrating the characteristic landscapes making up 'The Valleys', where people and fuel are intermixed at the fringe of urban and rural land cover producing a landscape conducive to wildfire.

4.1.2 The Valleys: socioeconomic characteristics

Another aspect of the legacy of the industrial heritage in the Valleys is the impact on society, specifically, the de-industrialisation that contributed to socioeconomic inequalities. A map of deprivation in Wales (Figure 4.6) shows how areas within the South Wales Valleys are some of the most deprived in Wales. As of 2019 RCT had two of the top 10 most deprived areas in Wales and Merthyr Tydfil had one, all of which have been highlighted as deep-rooted (Welsh Government, 2019b, page 12). The longstanding deprivation is evidence in a report to Welsh Assembly in 2004 (David *et al*., 2004). Key issues associated with this deprivation include, low educational attainment, unemployment, lack of opportunities, low income, health inequality, and crime (Welsh Government, 2019b; David *et al*., 2004). Within the Valleys, crime has been associated with poverty, drugs and alcohol abuse, robbery, vehicle crime, and violence (David *et al*., 2004). These have already been linked to incidents of wildfire in the area by Jollands *et al*., (2011), who noted that crime, vandalism, anti-social behaviour, and substance abuse are all factors identified as contributors to wildfire ignitions. As well as broader connections between socioeconomic characteristics and fire (Jennings, 1999). Moreover, the inequalities also potentially create vulnerability to wildfire, for instance, where there are prior respiratory health problems, which may be compounded by wildfire smoke. There is a significant gap in research for the health impacts of the prolific wildfire occurrence in this area, which is especially relevant where environmental contamination from past industry may worsen pollution from fire.

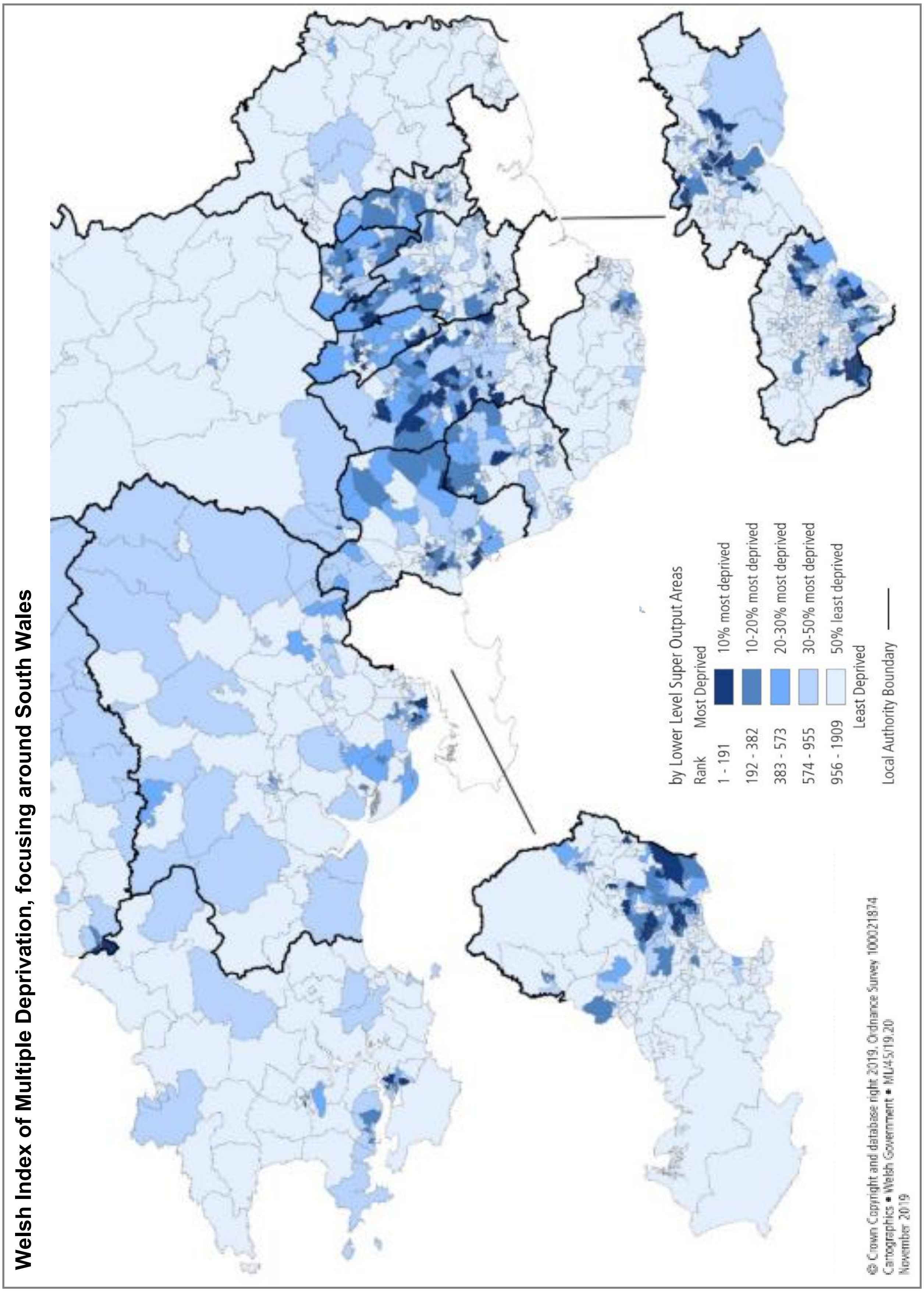


Figure 4.6 - Welsh Index of Multiple Deprivation in South Wales, showing the most deprived in dark blue (from Welsh Government, 2019b, page 9).

4.1.3 <u>The Valleys: wildfire problem</u>

The Welsh Government (e.g., 2019a; 2020; 2021; 2022) produces an annual bulletin to summarise the FRS incident data on outdoor vegetation fires. Notably, similar to FCE (2023) statistics, this uses a more liberal definition of wildfire by not filtering events by qualifying parameters such as size or number of appliances. The categorisation of 'primary' and 'secondary' incidents (see page 4) could be used as a proxy measure of major versus minor (respectively) events. In the most recent period from 2012/2013 to 2021/2022, there were around 2000-5000 vegetation fires annually (Welsh Government, 2022). Since levelling out in 2012, the latest peak was 2018/19 (Welsh Government, 2022). Taking April 2020 to March 2021 as an example, grassland, woodlands, and crop fires made up 22% of all fires attended by Welsh FRS, that is, 5% of primary, and 33% of secondary, demonstrating a significant effort by SWFRS (Welsh Government, 2022). Primary fires had more woodland land type, whereas secondary had mainly grassland, pasture, grazing, and scrubland (Welsh Government, 2022).

There is a seasonal peak in spring, especially April, March, and May (Jollands *et al*., 2011; Welsh Government, 2020, 2021, 2022). However, 2018 had the highest in July, then June and May; looking at the bulletin for that year this anomaly is likely explained by the wet spring and then less rainfall in June and July (Welsh Government, 2019a, page 15-16), delaying spring drying out of vegetation (Belcher *et al*., 2022; Jollands *et al*., 2011). Moreover, other potential temporal trends have been identified, such as a weekend effect (Jollands *et al*., 2011), and intra-annual trends of an association with school holiday timings, which is especially pronounced if this coincides with vegetation drying out in spring (Jollands *et al*., 2011).

The Valleys is a hotspot for vegetation fires in Wales demonstrated by the concentration of incidents in South Wales (Figure 4.7). Across recent bulletins (Welsh Government, 2019a, 2020, 2021, 2022) RCT consistently had a high number for Wales, of which a higher proportion are deliberate. Between April 2020 and March 2021, SWFRS attended 1,053 deliberate fires, where 297 were in RCT (SWFRS, 2023). In sum, the problem with wildfires in South Wales is the prolific and recurrent ignitions of which a very high proportion are deliberately set (Jollands *et al*., 2011). Healthy Hillsides states that 96% of the 76,000 wildfires over the last 20 years across the South Wales Valleys were deliberately set (SWFRS, 2023). This is compared to the whole of Wales with 75% of grassland, woodland, and crop fires recorded as deliberate (Welsh Government, 2021). These place significant pressures on FRS, including testing its resilience at times of high activity, as well as pressures on other public services as a result of other impacts associated with the anti-social behaviour associated with the deliberate fire setting.

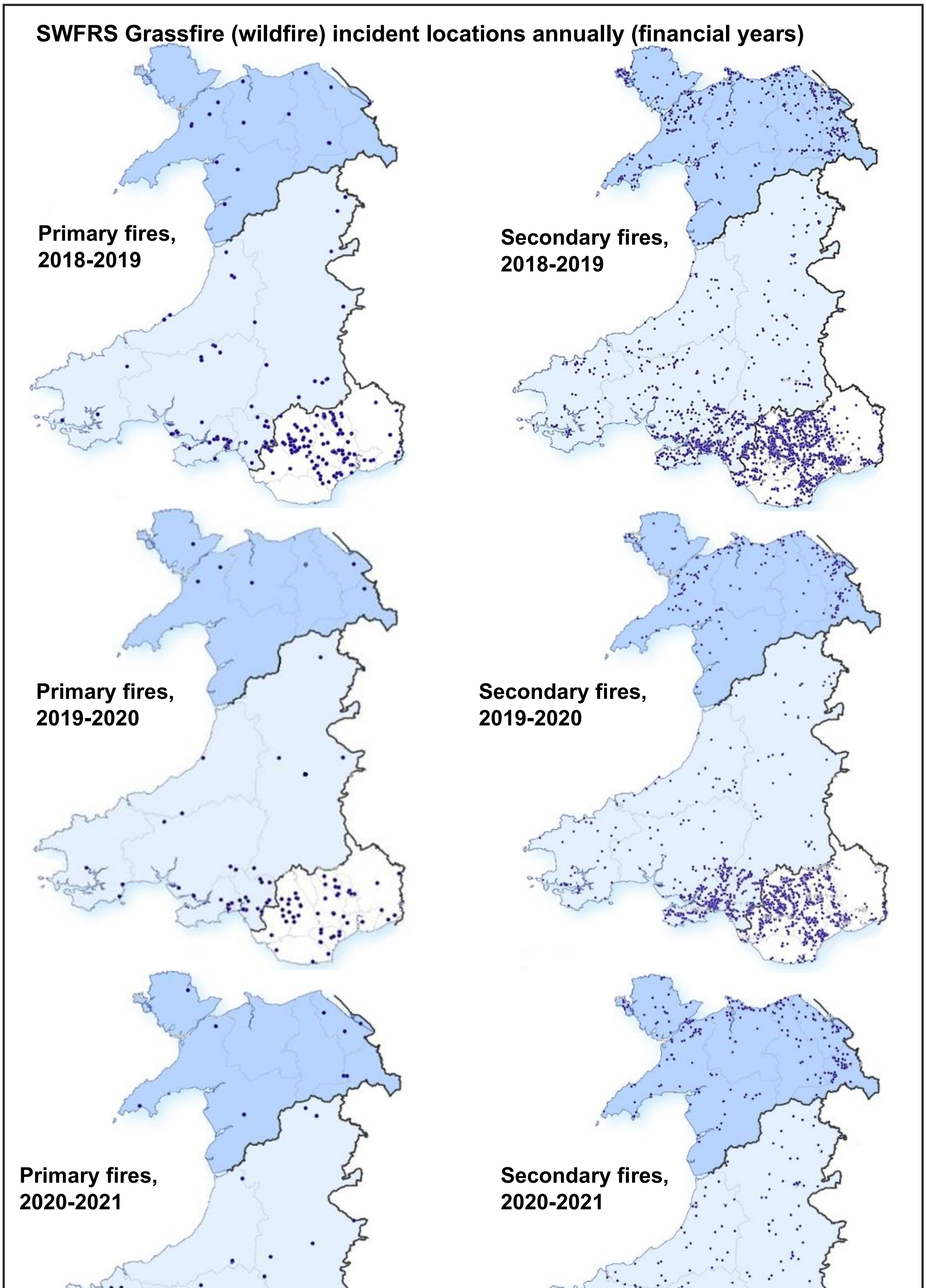


Figure 4.7 - IRS outdoor vegetation fires locations (from Welsh Government, 2019 page 7 and 9, 2020 page 7 and 9, 2021 page 7 and 10).

Some typical wildfires in South Wales are shown in Figure 4.8. They are often found on the hillsides, adjacent to urban areas, and are mostly smaller and grassfires, however, larger primary fires do occur on more open hillside or in forested upland areas.

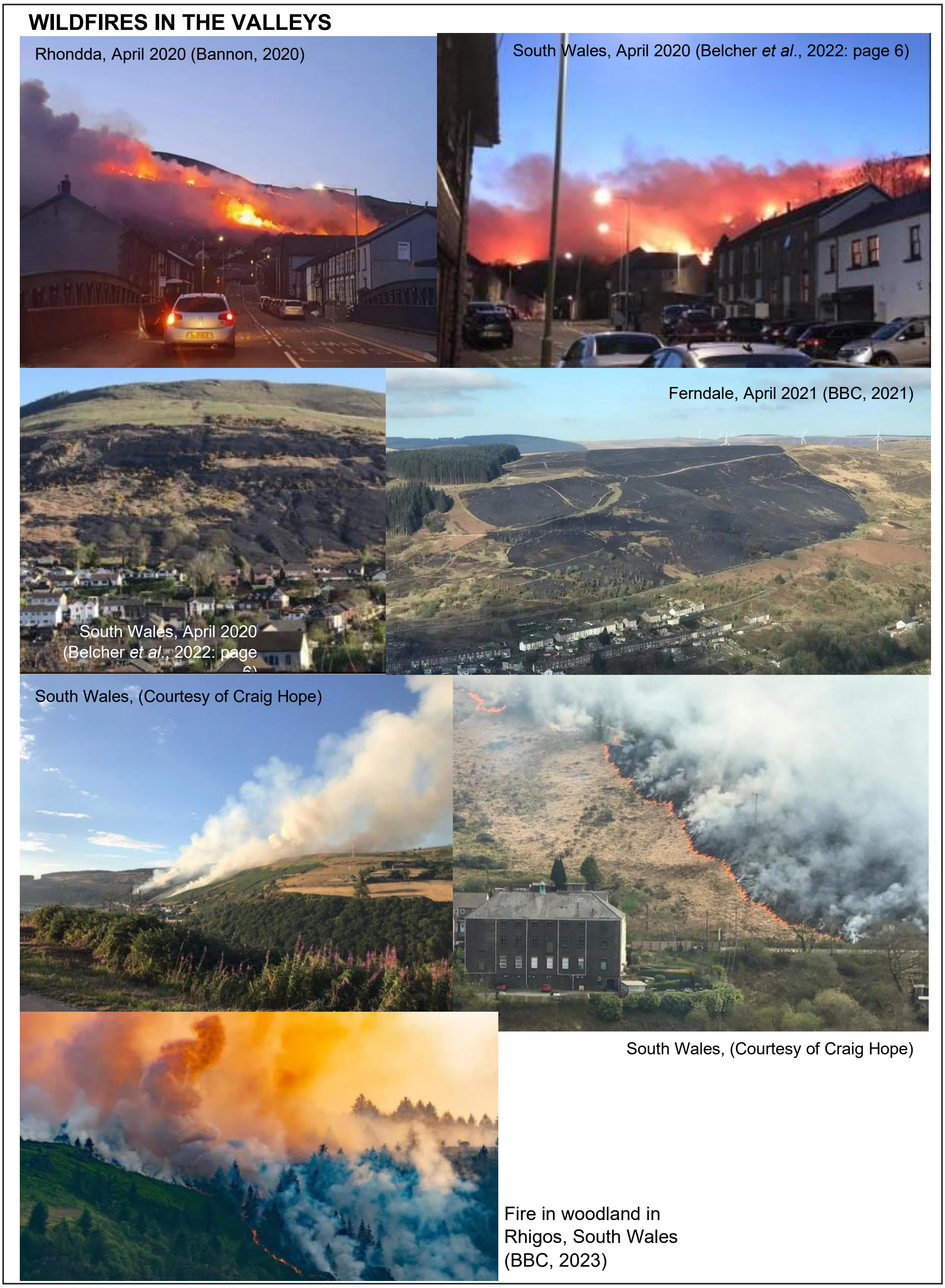


Figure 4.8 - A selection of images of typical South Wales Valleys wildfires.

A combination of environmental and social characteristics contributes to these wildfires. Firstly, factors highlighted by Jenkins and Woodcock (2019), including, dense linear urban populations adjacent to rural areas (e.g., Figure 4.9), high levels of access to these areas, and a well-connected habitat where there is sufficient fuel, including invasive bracken, and steep slope terrain that enhance flammability. Moreover, land management changes in the Valleys are also contributing to fire risk, where a decline in grazing has led to fuel accumulation and continuity, as well as having a high proportion of publicly owned land (Jenkins & Woodcock, 2019). Access and proximity to fuel is a key factor for these fires (Jollands *et al*., 2011), alike to the RUI in general (Gazzard *et al*., 2016; Glaves *et al*., 2020). Open access land was linked to increased risk of ignitions across Britain since the 2000s (Bruce *et al.,* 2006; Davies *et al.,* 2008; Davies & Legg, 2016). Across Wales, as much as one fifth of its area is open access land (NRW, 2023).

Figure 4.9 - Urban populations adjacent to vegetation contributing to fire risk, demonstrated by a previous burned area on Valleys' hillsides. Courtesy Craig Hope.

There are well-documented social drivers to the wildfire problem in South Wales. As mentioned above, the wildfire arson in the Valleys has been attributed to the socioeconomic deprivation in the area through higher prevalences of crime, anti-social behaviour, vandalism, alcohol and drugs misuse, and fly tipping (Jollands *et al*., 2011). Moreover, Jollands *et al*., (2011) highlighted the significance of access in relation to deliberate fire setting, where theories of opportunistic arson are relevant as criminals find opportunities that appear in their daily life (Felson & Cohen, 1980; Gonzales *et al*., 2005). The motives attributed to this arson by Jollands *et al*., (2011) include, excitement, boredom, harmless fun, malicious vandalism, psychological reasons, out of frustration for the socioeconomic situation, and due to drug or alcohol misuse. This corresponds with wildfire arson literature that describes a type of wildfire arson around excitement, linked to the accessibility of vegetation arson as a relatively low risk form of vandalism (Willis, 2004). A key social driver, is that there is arguably somewhat of a subculture of arson, identified in Jollands *et al*., (2011) as a 'generational element', as well as a societal competition and 'egging on' of arson. Anecdotally, people in the area note that ignitions can perpetuate further ignitions as different sides of the Valleys compete over the level of response, spurred on by the presence of firefighting appliances, particularly helicopters. Moreover, the Healthy Hillsides initiative describes a 'cultural tolerance' to wildfire, indicating a general acceptance or normalisation of the frequent occurrence of fires. The study by Jollands *et al*., (2011) did pick up on public perceptions that demonstrated awareness of these social issues of wildfire especially, blaming children, holidays, and a subculture encouraging of fire setting. A public survey was carried out by Healthy Hillside which looked at opinion and values of the local area, although did not touch on extent of risk perceived (Jenkins & Woodcock, 2019).

4.2 Findings in the Valleys

4.2.1 The extent and type of risks associated with local wildfire

4.2.1.1 Whether wildfire was a problem for the area, or themselves

There was generally agreement that wildfires were a problem for the local area across both samples (Figure 4.10). There was a noticeable difference between the samples where the online had a more convincing majority of 92% responding "yes" compared to 71% in-person.

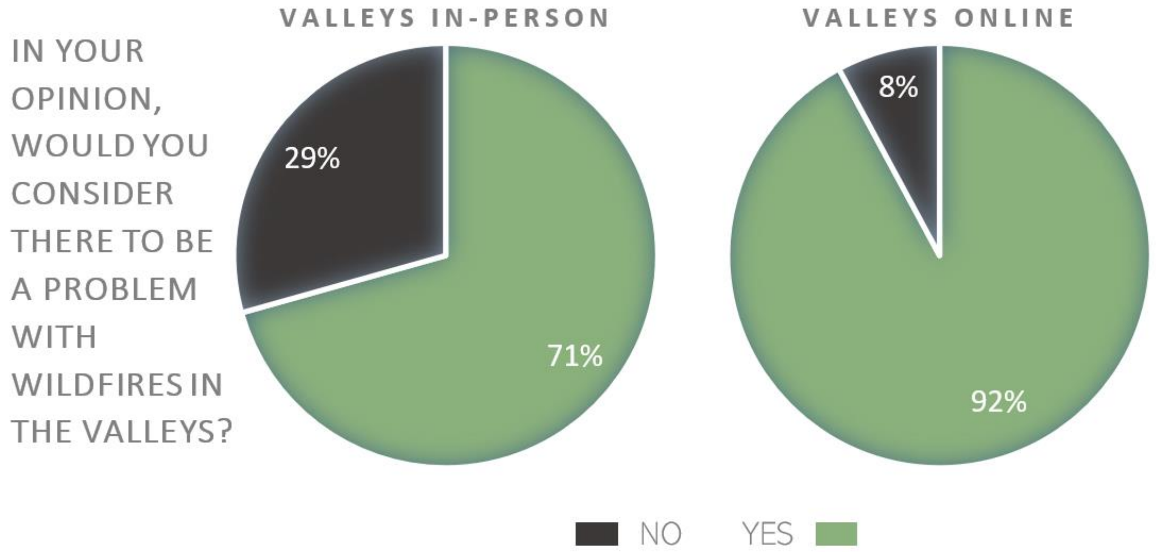


Figure 4.10 – Valleys' participants' responses to whether they consider wildfire a problem for the local area. In-person N=92, and online N=330.

The online sample showed both awareness and concern for the problem with a high proportion of agreement with this question, as well as raising issues around local wildfire at other points during the survey and as extra final comments. Similar comments were also made by in-person participants, although the in-person group comprised of more participants that did not show concern. There was a sense from some participants, especially online, of a grave concern around these fires. For example, one stated, "*Malicious starting of fires is becoming a big risk in the South Wales Valleys to wildlife and properties*" (VON62). Another commenting on the magnitude of fires, "*I think it is a massive worry that there are so many fires*" (VON67). There was a high level of concern for the area, especially online, demonstrated by the calls for action and prevention of fires. For instance, an online participant added that "*The fires need to stop, there needs to be tougher consequences… It's such a waste of resources and such a risk to the public*." (VON2). Another, noting that the "*Fire on our hills costs us all… No place for it not to be treated as the criminal offence it is*" (VON54). However, there were also participants that demonstrated concern to a lesser extent, acknowledging it as an intermittent problem, "*It's more that every few years there's a problem*" (VIP23).

There were participants that responded no, in some cases comments allude to the fact that it was not due to a lack of awareness of fires, but a disconnect with them as a problem. This included those who associated the problem with elsewhere. For instance, "*not immediately for me, but maybe for those further up the Valleys*" (VIP43); another similarly pointing out "*not where I live but for those on the hillside*" (VIP46); and another pointing out that it is "*Up in the Rhondda, not where I live*" (VIP41). Moreover, for others it was that they no longer saw them as an issue, for example, "*No, it's less now, Llantrissant used to in the summer, but you* *don't see it anymore*" (VIP42). Whereas for some that said no it was a denial of the hazard, where there was a disconnect with the hazard itself and the country, for example picking up on the climate not being conducive to them as problematic, "No, *because we live in a wet climate, they couldn't get bad*" (VIP65). Alternatively, some showed a complete lack of awareness, one commenting, "*No, never heard of them*" (VIP14).

The uneven responses from across postcodes, meant location of participants could not be compared to risk responses. However, something can be said anecdotally about spatial patterns. As alluded to in comments made, there were particular areas more associated to the risk, that is, further up the mountain and further north (away from city centre), where participants further south (e.g., CF72) expressed less concern for themselves. Additionally, considering the distribution of responses in the online group, where there is a potential selection bias (Greenacre, 2016), the pattern of responses possibly corresponds to areas with higher level of concerns regarding wildfire risk.

Next, participants were asked how much of a risk wildfire posed to them, or their property, personally, rather than an assessment for the area. Both samples had a variety of scores (Figure 4.11). Again, the online sample showed higher levels of concern, with fewer scores of 0 and more scores of 4. The mean for risk scores in-person was 1.4 and the modal score was 0; for online the mean score was 1.7 and the modal score was 1. Across both samples most scores were low, either 0 or 1, that is, 57% of the in-person group and 54% of those online. This suggests that most may not feel significantly directly affected, despite a majority acknowledging a problem for the area.

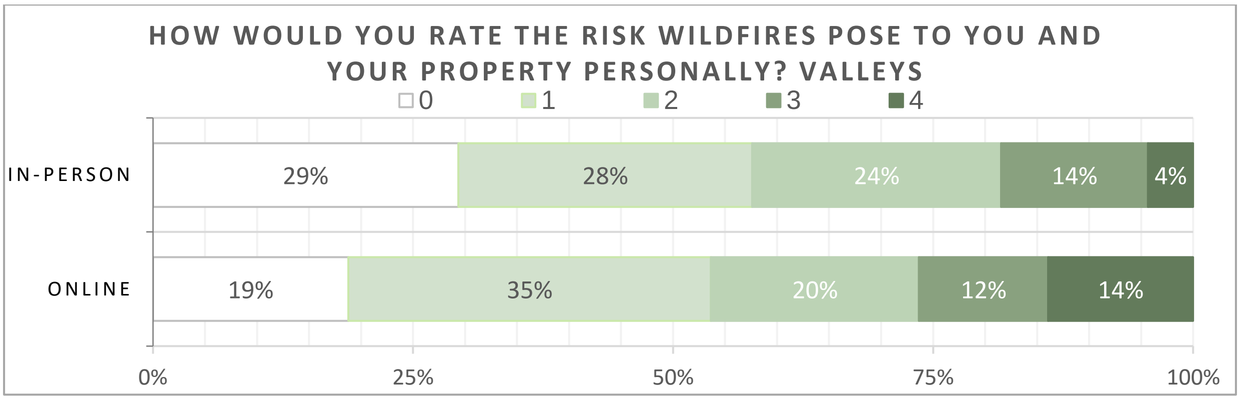


Figure 4.11 – Valleys' participants scores for the level of risk they feel wildfire locally poses to them. In-person N=92 Online N=330.

Some of the comments made in-person reveal some of the reasons why low risk was given. A common comment for lower scores, was a lack of relevance spatially, explaining, "*Not really where I am*" (VIP26). As well as comments that places more associated with wildfire were further up the Valleys, such as, "*Not so much down here [lived in CF72]* " (VIP6); and "*If I was where I used to live, higher up mountains, it would be higher*" (VIP45). As well as not being near vegetation, one commenting "*I don't live near trees*" (VIP72). Or a lack of relevance because of the type of housing "*I live in a block of flats, so not very relevant to me personally*" (VIP52). Exposure was therefore a key element to the perceived risk level. There was a sense that fires typically happened away from people hence did not pose high risk, an online participant commented, "*We do have fires up on common land, usually deliberate. But they do not affect my property or close to where I live*." (VON121).

For those that gave higher scores, there were both characteristics about the hazard, as well as awareness of the problem which played into severity and likelihood of the hazard. There were some that disliked them, hinting at previous experience in the area, "*I really don't like* *when they happen*" (VIP51 [score 4]). As well as characteristics about the hazard, specifically concern over the controllability, one participant noting "*A wildfire would be bad if one did happen, they can get so out of control*" (VIP79 [score 4]). Additionally, there was suggestion that concern about the local issues around fire created greater risk, for example, "*if local authorities don't get on top of the troublemakers, then it's going to get worse, yes I feel at risk*" (VIP17 [score 4]). Another expressed concern of increases in the future, "*The prospect of heathland and forest fires increasing in both frequency and intensity is not a happy one where communities are so closely interwoven with the natural landscape*, *my risk score might then increase*" (VON310 [score 2]).

Therefore, there was a suggestion in these comments that an increased awareness of a problem could contribute to a higher personal sense of risk. The responses to these two questions are compared in Table 4.1. There were higher proportions of scores of 0 in the group that disagreed wildfires were a problem in the area, compared to those that agreed, especially in the online sample. This relationship was not clear cut however, in that not everyone that agrees wildfires are a problem acknowledge a personal risk, supporting other moderating actors such as level of exposure (e.g., house location).

Comparison of answers to whether wildfire is a problem and personal risk scores [V]							
IN-PERSON		**Individual wildfire risk scores**					
		0	1	2	3	4	
Is wildfire a problem locally?	Yes	26%	28%	23%	17%	6%	*(N=65)*
	No	37%	30%	26%	7%	0%	*(N=27)*
		(N=27)	*(N=26)*	*(N=22)*	*(N=13)*	*(N=4)*	
ONLINE		**Individual wildfire risk scores**					
		0	1	2	3	4	
Is wildfire a problem locally?	Yes	16%	36%	21%	13%	14%	*(N=304)*
	No	46%	27%	12%	8%	8%	*(N=26)*
		(N=62)	*(N=115)*	*(N=66)*	*(N=41)*	*(N=46)*	
LEGEND		0%	100%	Proportion of participants answering whether wildfire is deemed a problem			

Table 4.1 – Comparison of Valleys' responses to whether wildfire problem and individual risk score. Showing the proportion of participants that answered at each score for each group of responses to problem.

Moreover, looking at how perceptions varied within the samples, the responses were compared to participant characteristics, including gender and age. Firstly, considering how participants from each age group responded, shows that the youngest group,18-24 years, had fewer participants that agreed there was a problem (Table 4.2). The youngest group also had higher proportions of scores of 0 in both samples (Table 4.3).

Comparison of answers to whether wildfire is a problem and age [V]								
IN-PERSON		**Age group**						
		18-24	25-34	35-44	45-54	55-64	65+	
Is wildfire a problem locally?	Yes	58%	63%	67%	68%	76%	78%	*(N=65)*
	No	42%	38%	33%	32%	24%	22%	*(N=27)*
		(N=27)	*(N=26)*	*(N=22)*	*(N=13)*	*(N=4)*		
ONLINE		**Age group**						
		18-24	25-34	35-44	45-54	55-64	65+	
Is wildfire a problem locally?	Yes	79%	96%	95%	93%	88%	98%	*(N=297)*
	No	21%	4%	5%	7%	13%	2%	*(N=26)*
		(N=62)	*(N=115)*	*(N=66)*	*(N=41)*	*(N=46)*		
LEGEND		0%	100%	Proportion of participants from each age group				

Table 4.2 - Comparison of Valleys' responses to whether wildfire was considered a problem locally and the participant's age. For participants that provided an age, in-person N=92 (100%) and online N=323 (98%).

Comparison of answers to individual risk score and age [V]								
IN-PERSON		**Age group**						
		18-24	25-34	35-44	45-54	55-64	65+	
Individual risk score	0	58%	75%	33%	16%	19%	17%	*(N=27)*
	1	17%	13%	22%	37%	33%	30%	*(N=26)*
	2	17%	0%	22%	37%	19%	30%	*(N=22)*
	3	8%	0%	22%	5%	24%	17%	*(N=13)*
	4	0%	13%*	0%	5%	5%	4%	*(N=4)*
		(N=12)	*(N=8)*	*(N=9)*	*(N=19)*	*(N=21)*	*(N=23)*	
ONLINE		**Age group**						
		18-24	25-34	35-44	45-54	55-64	65+	
Individual risk score	0	24%	20%	19%	13%	19%	20%	*(N=61)*
	1	27%	33%	40%	37%	38%	33%	*(N=115)*
	2	18%	16%	18%	27%	18%	24%	*(N=65)*
	3	21%	22%	10%	7%	8%	10%	*(N=38)*
	4	9%	9%	13%	17%	17%	14%	*(N=44)*
		(N=33)	*(N=45)*	*(N=62)*	*(N=60)*	*(N=72)*	*(N=51)*	
LEGEND		0%	100%	Proportion of participants from each age group				

*Table 4.3 - Comparison of Valleys' responses to individual risk score and the participant's age. For participants that provided an age, in-person N=92 (100%) and online N=323 (98%). *Note this anomaly is the response of a SWFRS firefighter, possibly explaining the difference to the rest of this age category.*

Secondly, there is little difference in responses between the two gender groups for the consideration of wildfire as a problem (Table 4.4). There is also little difference between the two gender groups for individual wildfire risk scores (Table 4.5).

Comparison of answers to whether wildfire is a problem and gender [V]									
IN-PERSON		**Gender**			ONLINE		**Gender**		
		Women	Men				Women	Men	
Is wildfire a problem locally?	Yes	58%	63%	*(N=65)*	**Is wildfire a problem locally?**	Yes	79%	96%	*(N=285)*
	No	42%	38%	*(N=27)*		No	21%	4%	*(N=26)*
		(N=62)	*(N=30)*				*(N=218)*	*(N=93)*	
LEGEND		0%	100%	Proportion of participants from each gender group					

Table 4.4 - Comparing Valleys' responses to whether wildfire was considered a problem locally and the participant's gender. For participants that provided a gender, in-person N=92 (100%) and online N=311 (94%).

Comparison of answers to whether wildfire is a problem and gender [V]									
IN-PERSON		**Gender**			ONLINE		**Gender**		
		Women	Men				Women	Men	
Is wildfire a problem locally?	0	26%	33%	*(N=27)*	**Is wildfire a problem locally?**	0	17%	23%	*(N=58)*
	1	23%	37%	*(N=26)*		1	36%	37%	*(N=112)*
	2	29%	17%	*(N=22)*		2	20%	18%	*(N=60)*
	3	16%	13%	*(N=13)*		3	12%	13%	*(N=38)*
	4	6%	0%	*(N=4)*		4	16%	10%	*(N=43)*
		(N=62)	*(N=30)*				*(N=218)*	*(N=93)*	
LEGEND		0%	100%	Proportion of participants from each gender group					

Table 4.5 - Comparing Valleys' responses to individual risk score and the participant's gender. For participants that provided an age, in-person N=92 (100%) and online N=323 (98%).

4.2.1.2 Type of concerns about wildfire

Participants were asked their concerns regarding local wildfire occurrence. The two samples are combined for this question where the types of concerns raised were consistent. The concerns focused on impacts on nature, humans, the wider fire problem (use of resources, frequency of fires), or a concern about it getting bigger (or become difficult to control) (Figure 4.12). Generally, most gave a combination of both concern about nature and people, but 22% noted only concerns about nature, more than the 10% that only had concerns surrounding human impacts. Overall, there were more concerns about nature than people.

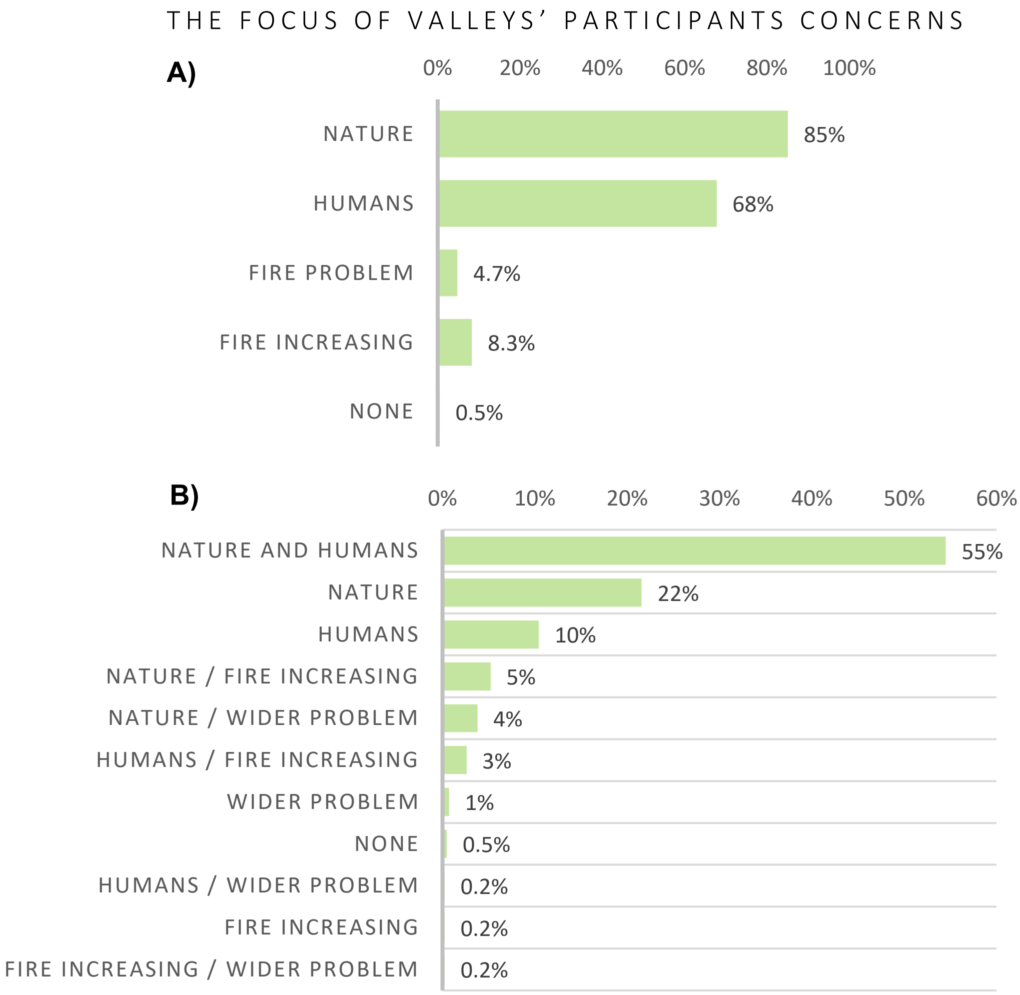


Figure 4.12 - Focus of Valleys' participants concern. (A) The proportion of participants who expressed each type of concern, and (B) The proportion of participants who gave each combination of focuses across top concerns. For the combined Valleys sample, N=422.

Participants' specific concerns fit into groups, including all life, impacts on nature and the environment, people themselves ('people'), the built human environment and society ('human'), atmospheric impacts, as well as effects of having a fire problem on society, and concerns about the immediate event getting out of control. The coded list of concerns resulting from responses are shown below (Figure 4.13). The number of participants who gave each concern are shown in (Figure 4.14).

THE RANGE OF SPECIFIC CONCERNS AROUND WILDFIRE OCCURRENCE RAISED BY VALLEYS' PARTICIPANTS

All life	• General concern for life
Nature	• Wildlife • Animals • Habitats • Plants • Environment • Landscapes (mountains, woodland, countryside) • Long-term impact • Eyesore (diminished natural beauty) • Quality of environment (loss biodiversity, endangered species)
People (bodies)	• Safety of people • Their own safety • Health • Their own health • Other's safety • Inc. those closer to fire or up the mountain, family, friends, pets, walkers, children, vulnerable people, fire starters • firefighters
Human (built and social)	• Property generally • Their own property • Other's (those close to fires, or up mountain) • Infrastructure, economic, disruption to area • Particularly, loss of amenities and area, loss to forestry, disruption to community, closing roads
Atmospheric	• Smoke, air quality, pollution • Climate change feedback Mostly, smoke and resulting air quality impact on health, including concerns for those who have pre-existing respiratory conditions
Wider problem	• Impacts on society of having fires, and amount of recurrence • The indirect impacts of waste of resources, costs of attending and recovering, and lack of punishment for offenders
Fire increasing	• Ability to fight the fire • Fire getting bigger (impact more areas, encroaching on urban, or getting more intense)
Emotion	• Upset, sad, angry, fearful

Figure 4.13 - Resulting codes from participants' responses to their two biggest concerns regarding wildfires in the Valleys. Combined sample, N=422.

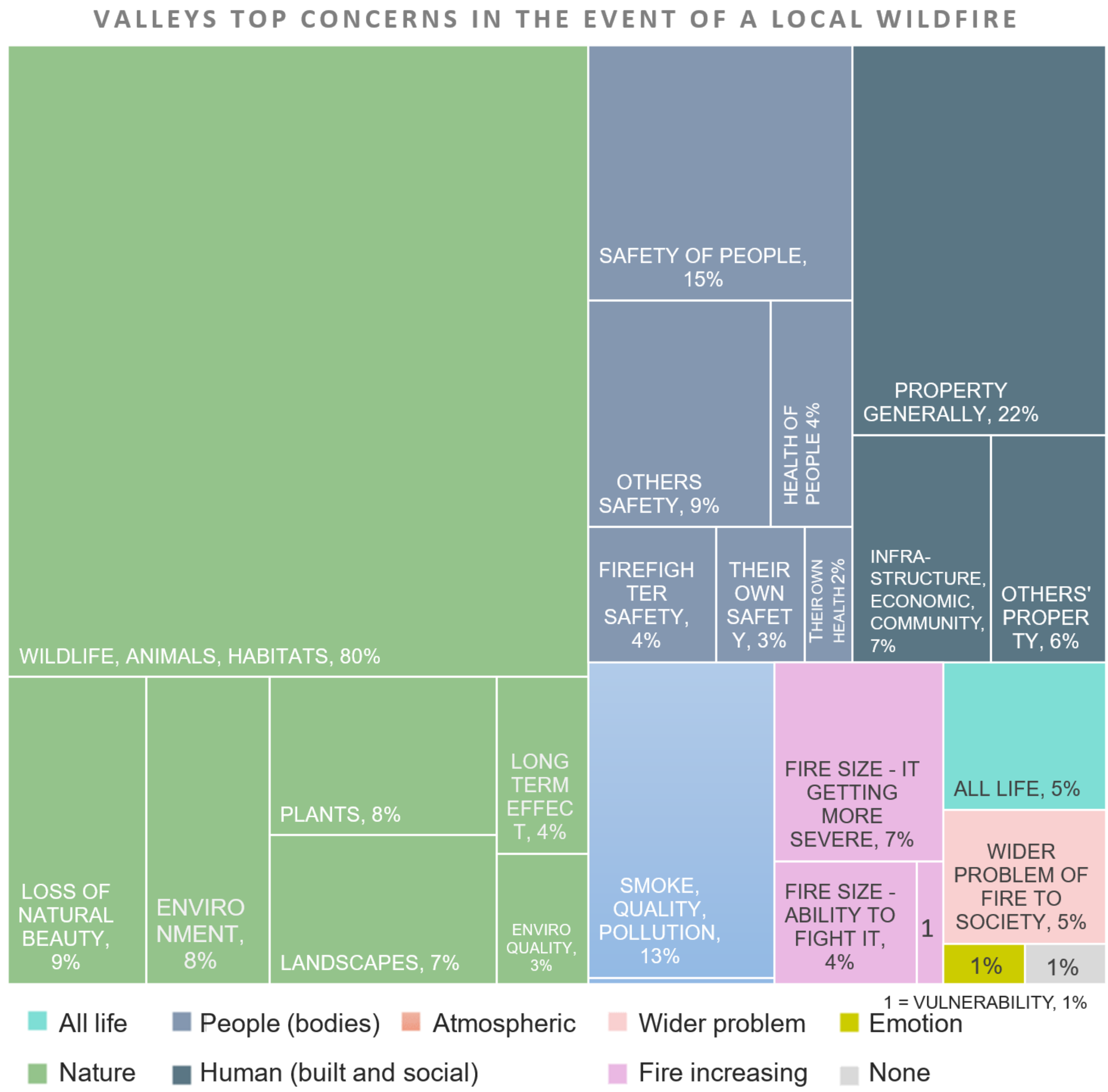


Figure 4.14 - Proportions of participants raising each type of concern in the Valleys. Combined samples, N=422. (Note participants could add up to two concerns, so percentages will add up to more than 100%.)

The most common were impacts on wildlife and animals, with the vast majority (80%) raising at least some concern about them. Impacting specific landscapes was another, notably mountains and woodlands, as well as aesthetics. The proportion that gave these concerns shows the focus in many participants' minds of the framing of the hazard and its direct impacts being on nature rather than people. In other words, it's not necessarily a hazard for people, but it is a hazard for animals or the environment. Moreover, some even explicitly expressed that their consideration of risk from wildfire does not go beyond nature, such as "*Wildlife, not much else*" (VIP45). Having said that, this does not necessarily mean they feel they would feel unaffected by the fact it only affects nature, for instance, some expressed concern about how this would be upsetting, such as "*Upsetting to see the devastation to nature and our beautiful Valleys*" (VON63). Moreover, there were also concerns about impacts on the natural environments and reduction of aesthetics, "*They're a real eyesore, takes away the beauty of the Valleys*" (VON8), disliking the aftermath of "*The black*" (VIP70). Overall, the sentiment of the magnitude of the consequences were relatively minor. However, there was some more extreme and emotive language used in relation to the non-human impacts, including mention of death, suffering, and sympathy, which was not indicated for human impacts.

Of those that raised concerns for people, the specific impacts included direct impacts on people, such as safety and health, as well as other more indirect impacts on humans such as property, infrastructure, and community spaces. 34% of participants gave a direct impact on people (bodies), and 41% gave an indirect impact on individuals and society. That is, of those that gave human impacts, 51% said bodies and 61% said built. There was a small proportion that expressed concern about safety. There were also some participants who noted concerns around their vulnerability to the health impacts; for example, "*I'm asthmatic so not being able to breathe*" (VON202). Additionally, these concerns about safety and health were also othered, including to particular groups, such as children, fire starters, vulnerable people, and firefighters. Disruption to the area was a key indirect concern focused on people, as wildfires could result in blocked access to recreational spaces. For example, concerns that wildfires "…*would block everything off*." (VON133). Moreover, 14% gave an atmospheric impact on the environment, noting concerns about smoke, and to a lesser extent pollution causing climate change. There was anecdotal evidence of having to close windows as a result of fires, demonstrating the types of affects the events have on society, "*The smoke - I've had to shut my windows before*" (VIP47).

Additionally, some Valleys' residents raised concerns regarding the impacts of recurrent fires on wider society, including the "*Waste of firefighter resources*" (VON270). These concerns were shared at other parts of the survey, including online comments, in particular expressing calls for wanting greater consequences for those that set fires. One added at the end of the survey for instance, "*Fire on our hills costs us all. Destroys and wrecks our area. Causes air pollution. Costs society in time and resources. Risks our firefighters. No place for it not to be treated as the criminal offence it is*." (VON255). This echoes findings by Jenkins & Woodcock (2019), when exploring the values of the area, that 26% wanted crime and anti-social behaviour addressed.

To sum, these responses reveal something about the perceived hazard wildfire represents locally. There is more concern for environmental impacts, however there are significant impacts on people although mostly indirect, smoke inhalation being the most prevalent direct impact on people. There is also the suggestion that the impacts are more readily perceived for the area than individually, where even where more direct hazards to people are identified, these are othered to other groups of people, or places away from their direct location (as some areas are seen as more likely to experience fire).

4.2.1.3 Months with the highest perceived wildfire risk

Participants were asked which months were considered to have the highest risk, giving up to two (Figure 4.15). There was a spread of choice of months across the year with March to October mentioned for the in-person group, and March to November mentioned online, the majority of participants across both noting April to August. The key difference between the samples was that in-person had a main peak in frequency in July and other summer months (June to August), and a secondary much smaller peak in spring. Whereas the online sample had participants giving months across both spring and summer more evenly; July and August were chosen by slightly more participants, but April and May were a much closer second peak.

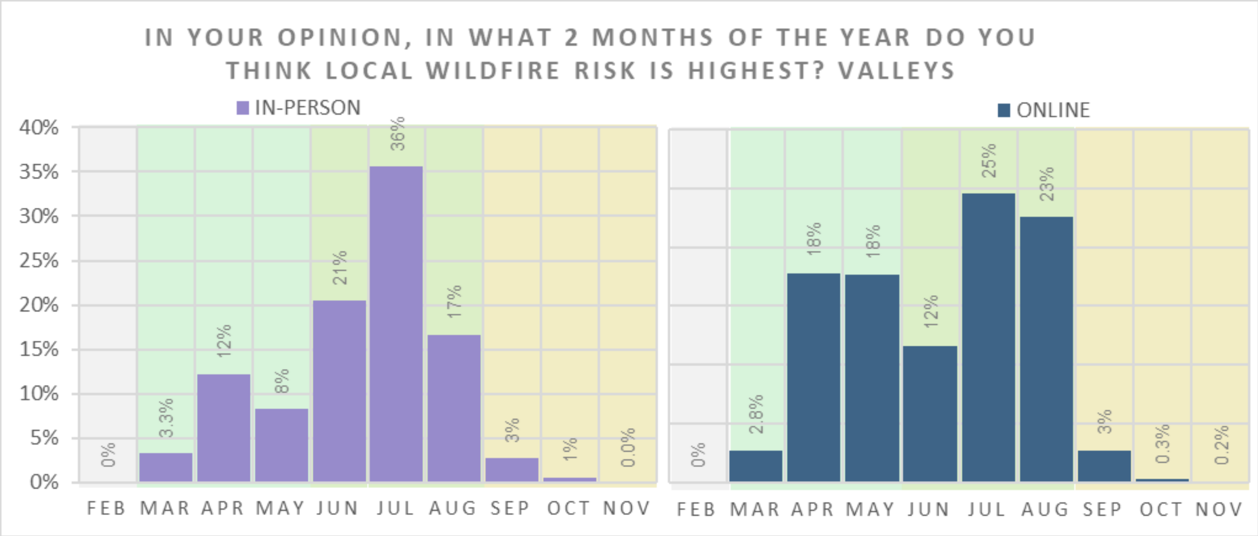


Figure 4.15 – Valleys' participants response to the months with the highest risk. In-person, N=92 and online N=330. Note participants could pick up to two months so percentages will add up to more than 100%.

Participants mostly chose two consecutive months, but there were some who gave more spread-out months e.g., "April and August". This suggests risk was perceived as more spread more over the year. There was also the idea of variability, where comments suggested participants understood that it could vary between years. One noting "*April and May, but anytime in Spring. It depends when it dries out*" (VIP8). There were also comments that the variation could be in relation to "*School holidays*" (VIP73). This indicates that some had familiarity with occurrence patterns. The top six most common pairs are presented in Table 4.6, demonstrating the spread of risk. Notably, July and August were the most common pair in both samples. Thus, summertime was a key time of year in both samples, although many in the online group highlighted the springtime.

Most common responses from Valleys' participants of months with highest wildfire risk			
IN-PERSON		ONLINE	
June + July	32%	July + August	32%
July + August	26%	April + May	18%
April + May	12%	June + July	10%
April + July	10%	May + June	9%
May + June	4%	April + August	6%
March + September	3%	March + April	5%
	87%		*80%*

Table 4.6 - The six most common pairs of months chosen by Valleys' participants as having the highest wildfire risk. For in-person N=92 and online N=330.

Comparing these perceptions to actual fire data (Figure 4.16), shows a possible disparity. Many participants highlighted summer, however SWFRS data presented by Welsh Government (2021) indicates that April and May have the highest number of incidents. Perceptions have possibly been influenced by anomalously high summer wildfire seasons, such as the summer of 2018 (Welsh Government, 2019), which become more newsworthy and hence is when activity is associated. It is possible participants' focus is on perceived severity rather than probability, which would fit to an association with extreme conditions in summer such as heatwaves and droughts when it is perceived more likely to get a bigger event. However, data indicates that spring has higher area burned, where greater frequency does beget greater area burned (Belcher *et al.*, 2022).

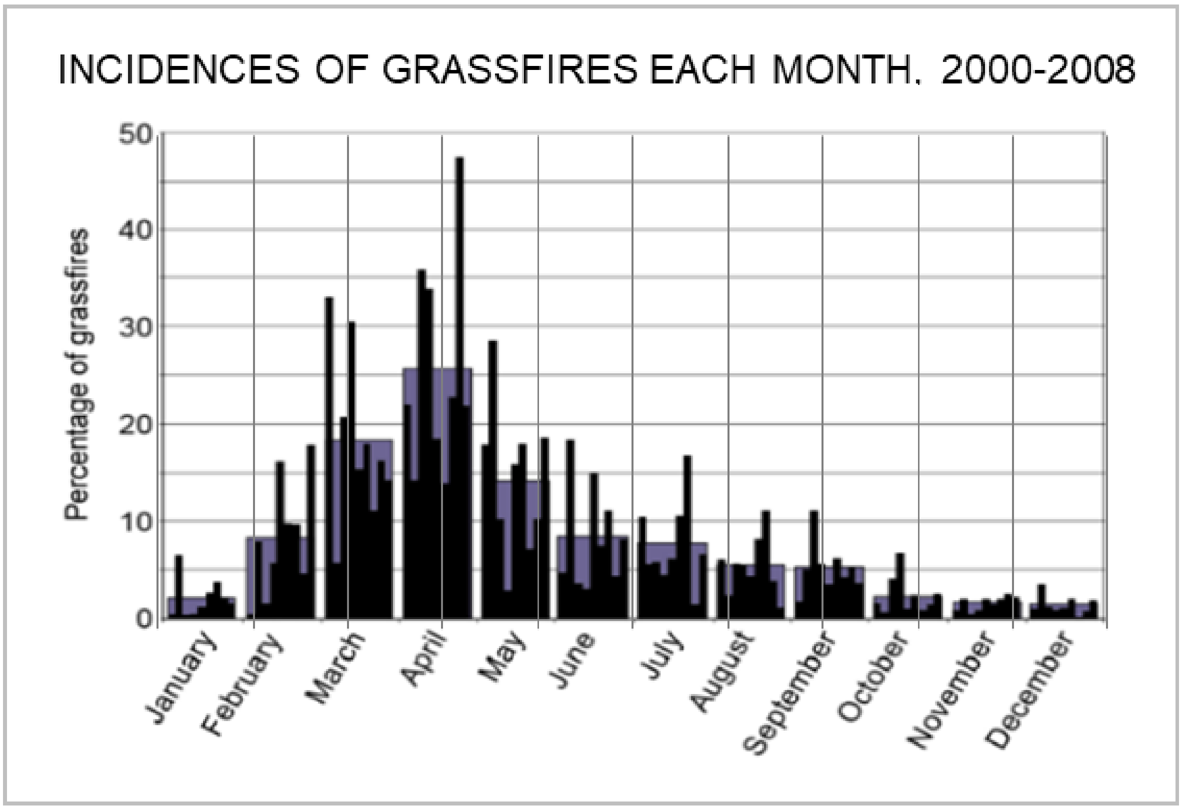


Figure 4.16 – Monthly occurrence of wildfires (grassfires) in South Wales, over the period from 2000 to 2008 (Jollands et al., 2011, page 8).

4.2.1.4 Follow-up, repeating answers at another time of year

The two risk questions, framed for the area and for themselves, were repeated in the follow-up. There was a decrease in the overall proportions of participants that answered yes in the follow-up compared to the original survey; the in-person decreased by 16% and online by only 2% (Figure 4.17). It is useful to consider the paired responses across the two surveys. 73% of the original in-person follow-up gave the same answer and 90% of the online. The predominant shift was from yes to no, more so in the in-person sample (23%) compared to the online group (7%). There was also some shift in the other direction, although minimal.

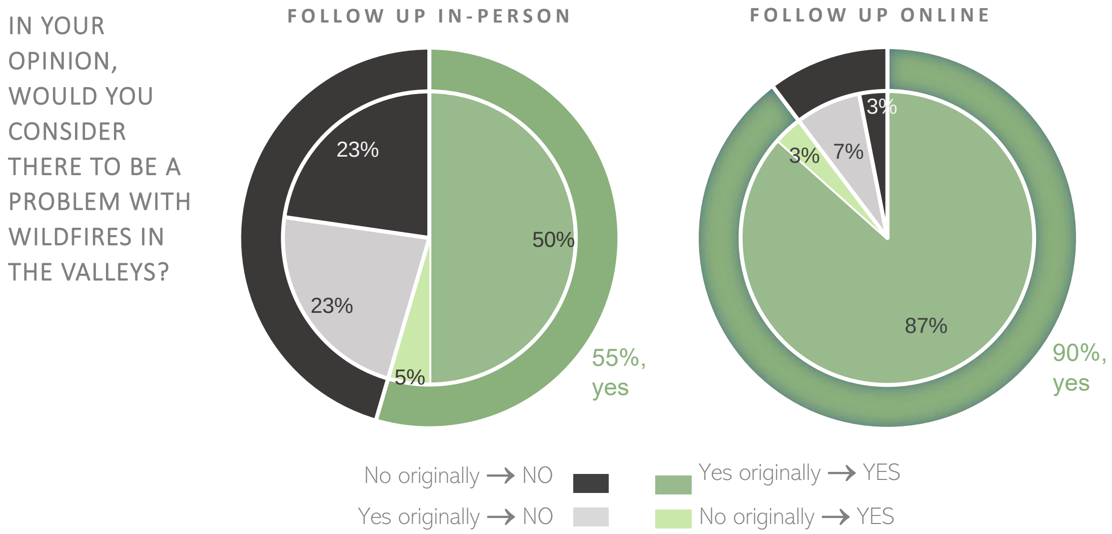


Figure 4.17 – Valleys' follow-up responses to whether they consider wildfire a problem for the local area. (In-person N=22, and online N=97.)

Similarly, examining the repetition of risk scores in the follow-up compared to the original response, the overall trend was a decrease (Figure 4.18). Specifically, for those in the in-person sample there was a decrease in scores of 3 (where there were very few scores of 4 originally) and the online sample showed a decrease in scores of 3 and 4. As expected, both samples showed increases in scores of 0 and 1. This was expected considering the data was collected in winter, outside the wildfire season, which would lead to reduced attention and concern. Although wildfires were not likely to happen at that time of year, there were still some higher scores, which either speaks to their concern, or because the question was interpreted as risk at times of fire activity rather than on that day.

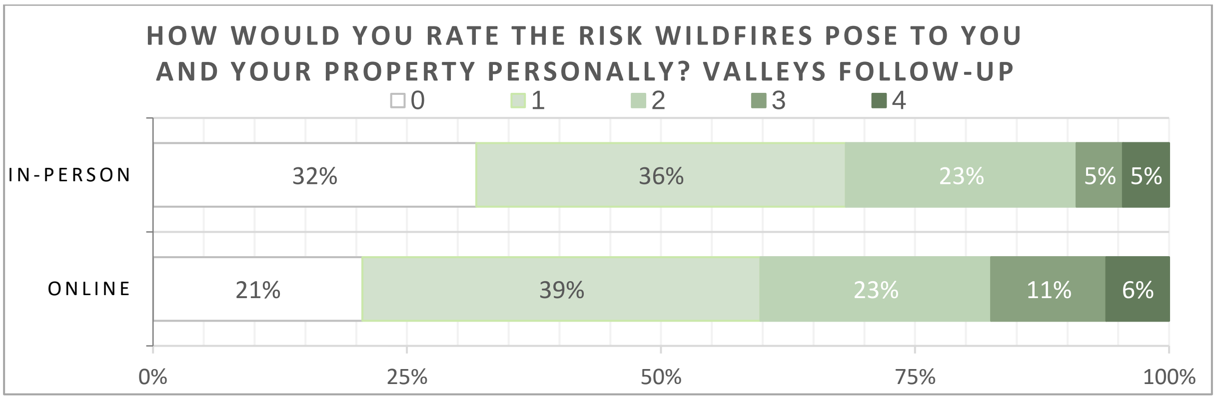


Figure 4.18 – Valleys' follow-up participants score of the level of risk they feel wildfire locally poses to them. In-person N=22, and online N=97.

4.2.2 Familiarity with local wildfire occurrence

4.2.2.1 Visibility of wildfire on Valleys landscapes

Beyond ascertaining the perceived level and type of risks, garnering an understanding of how aware and knowledgeable Valleys' participants are of local wildfire was a key aim. Considering how many acknowledge a 'problem' suggests that there is a high general awareness. A key measure of participant's awareness in the survey was a question about the visibility of wildfire in the Valleys area. Looking at Figure 4.19, one can identify most participants have seen wildfires in the area; 77% in-person had seen at least one (88%

including a scar), and 95% online had (97% including a scar). Moreover, a majority of participants across the samples had seen multiple wildfires in the area (70% in-person and 93% online). Again, there are differences between the two samples. In this case, the online group had witnessed more wildfires. In fact, the majority of online participants (75%) had seen many wildfires or see them annually, whereas in the in-person group the proportion that had seen them as regularly was much smaller. Regardless of the difference between the samples these findings demonstrate high visibility of wildfire on Valleys' landscapes.

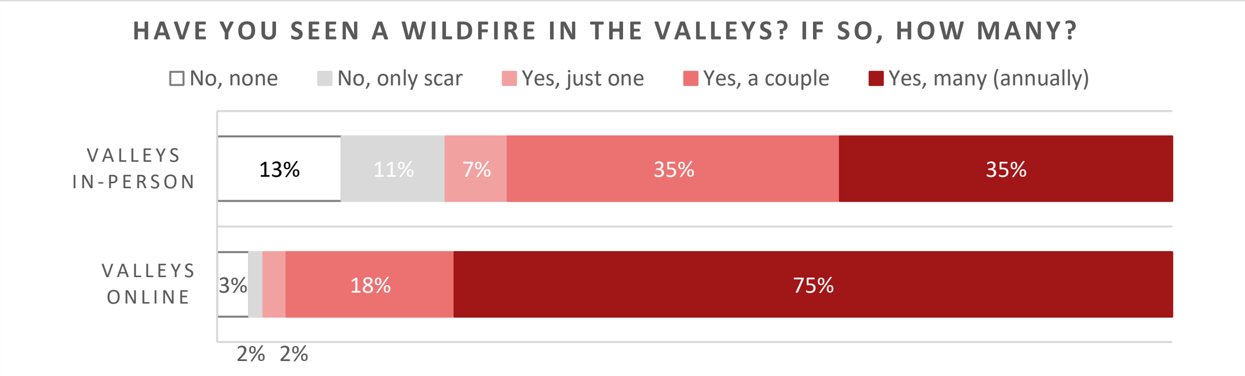


Figure 4.19 – Valleys' participants' responses to whether they had seen a wildfire in the local area. In-person N=92, and online N=330.

In-person remarks highlight the degree of familiarity people have with seeing them. Participants noted places they associated with seeing wildfires, where the visibility was more regular, including the association with the mountains, "*Couple, usually up in the hills*" (VIP23), as well as places, such as, "*Yeah many, seen them in Ferndale, Tylertown [both located in CF43]"* (VIP1), and "*A couple. I see remains a lot along the A470, Aberdare [located in CF44]*" (VIP53). The level of familiarity was also exemplified in other ways, one noting sensing them by smell, "*Yes many, but I smell them more than I see them*" (IP41). On the other hand, there were participants that had not seen wildfire but were aware of their presence through other information sources. For instance, one participant commented on hearing about them rather than directly witnessing them, "*Only the remains of them, but I've heard many stories of them around here. I'm disgusted at the fire setting*." (VIP77). Another noted seeing them through news coverage, "*No, but I see it on the news about this area getting them*" (VIP6). Therefore, wildfire does appear to be something many in the area are familiar with. Having said that, this is not something ubiquitous across all participants, there were some who had not seen wildfires. Also, there were comments that suggest they are unaware of their presence too, one noting, "*No, I've never heard of them happening*" (VIP49).

Furthermore, it should be noted that in response to this question there was some hesitation with the word wildfire, where some participants felt it was inappropriate. One participant commented in reply, "*Vegetation fires yes, but I wouldn't say they are wild*" (VIP7). Another participant commented that they would refer to them as grassfires, "*People start fires, they're not wild though, grassfires we call them*" (VIP20); indeed, this is a term also used in Welsh Government bulletins. Moreover, there was another comment along these lines as an extra comment in the online group, "*I think that most of what you call 'wildfires' around my area are started deliberately by idiots. They're just arson fires*." (VON141). These comments suggest participants from this area may not consider all outdoor vegetation fires wildfires, either because they are not large enough or in remote areas ("wild"), or because they are deliberately set by people and not ignited naturally. This is an interesting perception considering the vast majority of wildfires in Britain are started by humans; the dichotomy between something being started by humans but viewed as a natural hazard, may not be something accepted by the public.

Responses to this question were compared to whether participants had considered wildfires a problem (Table 4.7). In both samples, a greater proportion of those that answered “no” to considering wildfires a problem also answered that they had not seen a wildfire. Although only a descriptive comparison, this does imply seeing wildfire and acknowledging a problem are somewhat related. In other words, this suggests that greater visibility can lead to elevated awareness and potentially concern, or that those aware of a problem are more likely to notice more fire. Notably though, having seen a wildfire does not mean participants automatically acknowledge them as a problem; there were participants that had seen wildfires and not agreed they are problematic.

Comparison of answers to whether wildfire is a problem and whether wildfire had been seen locally [V]							
IN-PERSON		**Whether participants had seen a wildfire**					
		No, none	No, only remains	Yes, just one	Yes, a couple	Yes, many / annually	
Is wildfire a problem locally?	Yes	9%	9%	9%	37%	35%	*(N=65)*
	No	22%	15%	0%	30%	33%	*(N=27)*
		(N=12)	*(N=10)*	*(N=6)*	*(N=32)*	*(N=32)*	
ONLINE		**Whether participants had seen a wildfire**					
		No, none	No, only remains	Yes, just one	Yes, a couple	Yes, many / annually	
Is wildfire a problem locally?	Yes	1%	2%	2%	16%	79%	*(N=304)*
	No	31%	0%	8%	35%	27%	*(N=26)*
		(N=11)	*(N=5)*	*(N=8)*	*(N=58)*	*(N=248)*	
LEGEND	0%	100%	Proportion of participants answering whether wildfire is deemed a problem				

Table 4.7 - Comparison of Valleys participant responses to problem and seen questions. (Note small sample sizes.) For in-person N=92 and online N=330 samples.

Reflecting on the question about which months have the highest risk, it is possible that some participants from the online group were more aware of the actual timing of events, which might explain why a larger portion of the sample identified spring months as having higher risk. The participants’ responses to the months with highest risk and whether they had seen wildfire were compared (Table 4.8). Those that had not seen wildfire had more participants putting summer months, especially in the in-person group. This suggests that the assumption is wildfire is a summer occurrence, but having seen them in spring may shift the perception of risk.

Comparison of answers to whether wildfire is a problem and whether wildfire had been seen locally [V]				
	IN-PERSON		ONLINE	
	Not seen	Seen some sign of fire	Not seen	Seen some sign of fire
Feb	0%	0%	0%	0%
Mar	0%	8%	9%	5%
Apr	8%	25%	18%	31%
May	0%	5%	18%	17%
Jun	50%	30%	18%	12%
Jul	33%	28%	36%	33%
Aug	8%	4%	0%	1%
Sep	0%	1%	0%	0%
Oct	0%	0%	0%	0%
Nov	0%	0%	0%	0%
Legend	0%	100%	Percentage of participants that either had or had not seen wildfire	

Table 4.8 – Comparison of Valleys' participants' responses to the months with the greatest risk and whether they had seen a wildfire. For in-person N=92 and online N=330 samples.

Moreover, similar to the risk questions, the responses to whether they had seen wildfire were compared to the participant's characteristics. Firstly, looking at the various age groups (Table 4.9), the youngest group had a much higher proportion not having seen wildfire and fewer having seen many (or regularly). The other age groups had more similar proportions. Secondly, comparing whether participants had seen a wildfire and gender shows that the proportions of responses were very similar (Table 4.10).

Comparison of answers to whether participants had seen a wildfire and their age [V]								
IN-PERSON		Age group						
		18-24	25-34	35-44	45-54	55-64	65+	
Whether seen a wildfire locally	Yes, many / annually	8%	38%	56%	37%	43%	30%	*(N=32)*
	Yes, a couple	25%	38%	22%	42%	19%	52%	*(N=32)*
	Yes, just one	8%	0%	11%	11%	10%	0%	*(N=6)*
	No, only remains	8%	13%	11%	5%	19%	9%	*(N=10)*
	No, none	50%	13%	0%	5%	10%	9%	*(N=12)*
		(N=12)	*(N=8)*	*(N=9)*	*(N=19)*	*(N=21)*	*(N=23)*	
ONLINE		Age group						
		18-24	25-34	35-44	45-54	55-64	65+	
Whether seen a wildfire locally	Yes, many / annually	70%	73%	76%	72%	78%	76%	*(N=241)*
	Yes, a couple	21%	13%	19%	20%	17%	18%	*(N=58)*
	Yes, just one	0%	7%	2%	3%	1%	2%	*(N=8)*
	No, only remains	0%	4%	2%	0%	0%	4%	*(N=5)*
	No, none	9%	2%	2%	5%	4%	0%	*(N=11)*
		(N=33)	*(N=45)*	*(N=62)*	*(N=60)*	*(N=72)*	*(N=51)*	
LEGEND		0%	100%	Proportion of participants from each age group				

Table 4.9 - Comparing Valleys' responses to whether they had seen a wildfire locally with participant age. For those who provided an age, in-person N=92 (100%) and online N=323 (98%).

Comparison of answers to whether participants had seen a wildfire and their gender [V]				
IN-PERSON		**Gender**		
		Women	Men	
Whether seen a wildfire locally	Yes, many / annually	32%	40%	*(N=32)*
	Yes, a couple	34%	37%	*(N=32)*
	Yes, just one	8%	3%	*(N=6)*
	No, only remains	11%	10%	*(N=10)*
	No, none	15%	10%	*(N=12)*
		(N=12)	*(N=8)*	
ONLINE		**Gender**		
		Women	Men	
Whether seen a wildfire locally	Yes, many / annually	74%	77%	*(N=233)*
	Yes, a couple	18%	16%	*(N=55)*
	Yes, just one	2%	2%	*(N=7)*
	No, only remains	2%	1%	*(N=5)*
	No, none	4%	3%	*(N=11)*
		(N=33)	*(N=45)*	
LEGEND	0%	100%	Proportion of participants from each gender group	

Table 4.10 - Comparison of Valleys' responses to whether they had seen a wildfire locally with participant gender. For participants that provided a gender, in-person N=92 (100%) and online N=311 (94%).

4.2.2.2 Familiarity with influences on local wildfire occurrence

Examining participants' opinions on the factors influencing local wildfires provides more insight into their familiarity with the issue. Participants were asked what the two most important factors for local wildfire are. The factors cover a variety of themes, weather, build-up of vegetation, time of year, people (ignitions), agriculture, and combination of factors. The specific factors given are displayed below the various groups (Table 4.11). 67% in-person chose multiple-choice options for these factors, compared to 97% of online. However, examining the factors raised by participants (in italics) reveals almost all aligned with pre-existing themes, suggesting that difference is likely due to the ease with which in-person participants could give more detailed responses rather than giving different responses to the online group.

Factors chosen by Valleys' participants as most important for wildfires locally							
Group	Weather	Build-up of fuel	Time of year	Agriculture	People affecting ignitions	Combination	I don't know
Subgroup	Dry Weather	Build-up of vegetation	Time of year	*Farmers*	Any ignition by humans	Combination of hot, dry weather, build-up of vegetation, time of year, and or people ignitions	I don't know
	Hot weather	*Dry undergrowth*	*Spring*		*Arson*		
	Wind		*Summer*		*Children **		
					*Holidays **		
					*Boredom **		
					*Lack of education **		
					*ASB **		
					*Fly tipping **		
					Off-road vehicles		
					Litter		
					Negligence		
					*Contributors to arson		
	3	**2**	**3**	**1**	**11**	**1**	**1**

Table 4.11 - The most important factors for local wildfire according to participants in the Valleys (across both samples). Factors raised by participants rather than given as a multiple-choice option in italics.

People and weather were two key factors identified by Valleys' participants, along with build-up of fuel and time of year as the two other factors identified by smaller proportions (Figure 4.20A). The vast majority of both samples stated people as the most important factor; the online sample had 93% choose people, and in-person had 82%. Similar majorities included weather as a factor, with 70% and 63% respectively. The specific factors (Figure 4.20B) demonstrate localised knowledge. Key risk factors include general arson, as well as blaming children, school holidays, and boredom, and a handful noting negligence. This knowledge mirrors the perceptions found in Jollands *et al*., (2011), considering how the public view the occurrence and the association with anti-social behaviour and crime. Both groups acknowledged the importance of dry and hot weather. Time of year was also mentioned, including spring and summer; this could be due to environmental conditions or because of school holidays.

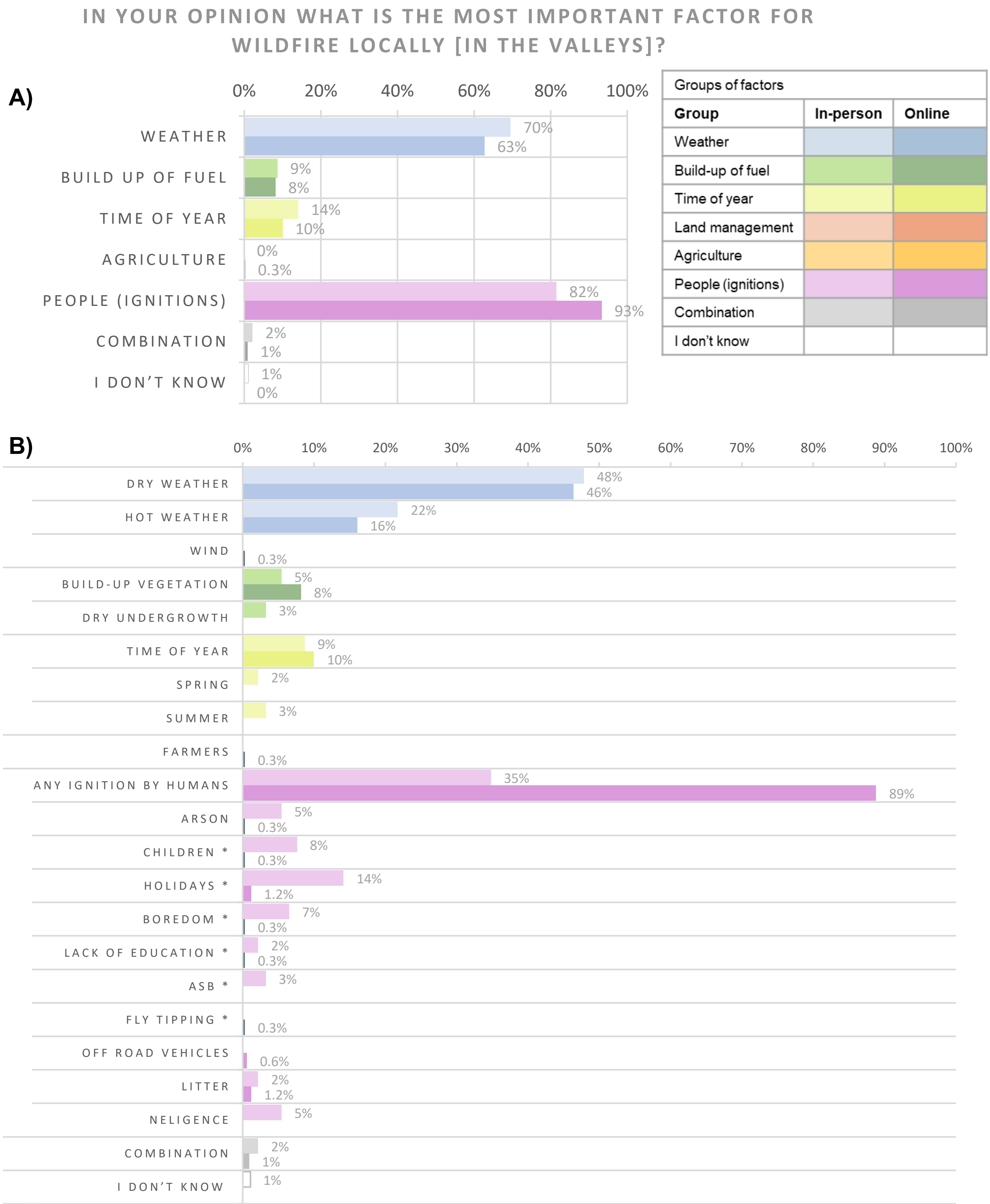


Figure 4.20 – Factors perceived as most important in affecting wildfires in Valleys (In-person N=92, Online N=330).

Examining the full responses (up to two factors), the most common pairs are shown in Table 4.12. People and weather were the most common in both samples. Moreover, people given as the only most important factor was given by a reasonable proportion of both groups, with slightly more online.

Most common full responses from Valleys' participants on factors for local wildfire risk		
	IN-PERSON	ONLINE
People *and* weather	48%	52%
People alone	16%	21%
People *and* time of year	7%	9%
People *and* build-up of fuel	4%	5%
Two Weather	5%	3%
Weather *and* time of year	5%	1%
Two People (ignitions)	3%	2%
Weather alone	2%	2%
Weather *and* build-up of fuel	3%	2%
	93%	*99%*

Table 4.12 - The full responses from Valleys' participants, to what is/are the most important factor/s contributing to local wildfire. (In-person N=92 and online N=330).

The high proportion of answers about people demonstrate a rhetoric that wildfires in the Valleys were "…*manmade*" (VIP7). There was a notion that "*Without people there would never be fires*" (VIP34); another explaining, *"People, it's not hot enough here"* (VIP65). There was a notable awareness of wildfire arson as a contributing factor, with a clear emphasis on its significance. This included blaming children and young people, including boys specifically. For example, blaming, "*Kids, vandals!*" (VIP17); as well as "*youngsters, mainly boys*" (VON56). The blaming of children was also a function of school holidays as a risk factor. Furthermore, factors contributing to the arson were also discussed as participants commented on motives for the arson, including themes of boredom, vandalism, lack of education, peer pressure, and disregard were identified in their answers and comments around the issue of deliberate fire setting. For example, the association of pointless vandalism, one commenting, "*The mindless vandalism of the countryside*" (VON83). Additionally, the idea of excitement and peer pressure, such as "*arson 'for a laugh'…*" (VON205), and "*Youngsters who are setting these fires are so irresponsible and think fire is harmless and just think they are clever and cool!*" (VON43). Participants also spoke to a subculture of fire setting, "*Groups of people regularly travel here to start fires*" (VON195). These are highly consistent with the findings in Jollands *et al*., (2011). Moreover, attached to this awareness of arson was sentiment that there needed to be action, as mentioned previously. For example, "*The mindless vandalism of the countryside should be taken seriously and the perpetrator prosecuted. It's sad to see the destruction of wildlife habitat and now the risk to homes backing onto to the mountains*." (VON132). Another in-person commenting, "*The arson has got to stop, needs to be tougher consequences. It's such a waste of resources and such a risk to the public*." (VIP34)

It is worth noting that while deliberate human ignitions were most common, there were a few who noted other types of human ignition including litter such as paperwork or "*glass left and reflecting causing a fire*" (VON219), as well as starting from the heat "*some fires are from arson and some are caused from the intensity of the heat during summer*" (VON210). This is interesting from a perspective of the level of wildfire education.

Next, exploring the influences on local wildfire further, participants were asked their opinion on the influence of climate change on wildfire activity currently, or in the future. The results in Figure 4.21 show that considering current activity, almmost half disagreed (43%), many elected 'I don't know' (30%), and the rest said yes (27%). The overall proportions did shift when it was reframed for future activity, almost the same proportion said I don't know, but much fewer disagreed (18%) and half agreed (52%).

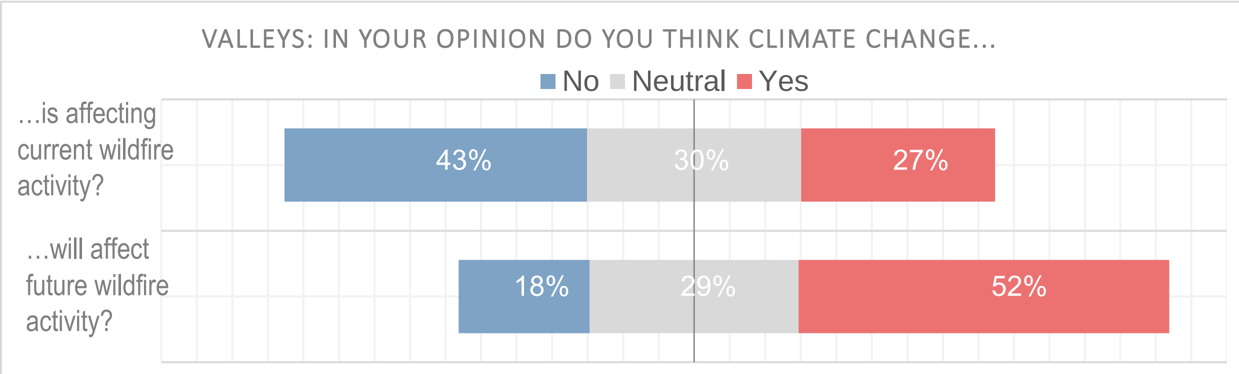


Figure 4.21 – Valleys' participants' responses to whether they believe climate change had affected current wildfire activity or would in the future. (Combined sample N=422)

Considering the reasoning behind these attitudes, it is possible participants were answering depending on a belief about climate change science or affecting the area. The follow-up survey provided an opportunity to re-ask questions about wildfires and climate change and ascertain if there was a sense that climate change was not affecting the area at all. Therefore, follow-up participants were asked if they believed climate change to be affecting the area, and then wildfire (Figure 4.22). There was a highly agreeable response to the fact that climate change would affect the area. Relative to this, there was more disagreement it would affect wildfires in the area. Hence, it is possible a small portion of reasoning of the lack of agreement in the original survey was a disagreement with climate change science, but more disagreement was based on the connection between climate change and wildfires in the area specifically.

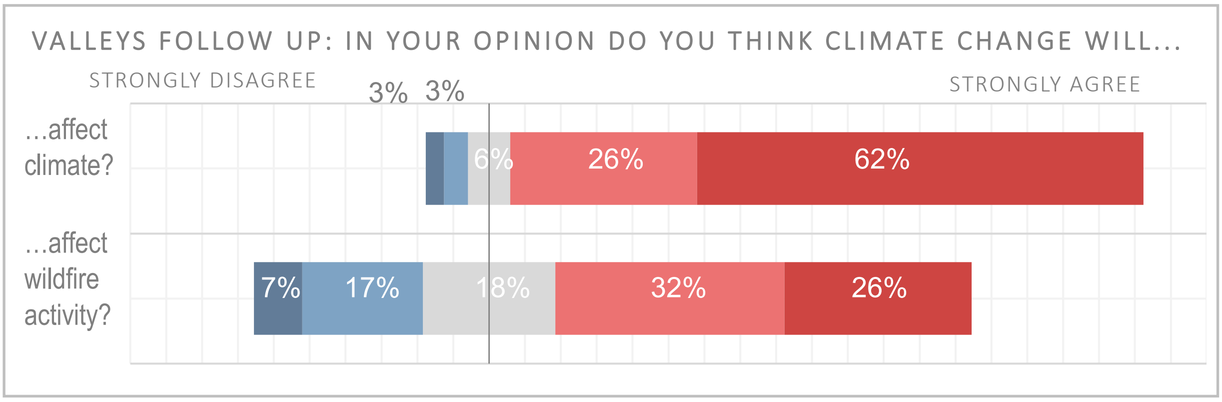


Figure 4.22 – Valleys' follow-up responses to whether they believed climate change is affecting climate in the UK, or wildfire activity. (Combined follow-up sample N=119.)

Comments made shed light on reasoning here. There was doubt or disagreement with climate change, including a lack of personal observations of changes to climate, "*I've lived here years, and it's not changed, maybe just got wetter.*" (VIP90). As well as uncertainty about the influence of people on climate, one participant noting, "*Still uncertain how much our climate is changing is due to human intervention… I think there is so much we don't know and other scientists disagree with the general consensus...*" (VON312); another reasoned, "*I think climate change is a natural progression not a human one*" (VON242).

Disagreement with wildfire being affected, was reasoned in a variety of ways. Firstly, one explanation for was disagreement was that the risk was minimised compared to other countries, so despite acknowledgement of cause and affect, any change was negated. One that disagreed explained, "*Elsewhere yes, but not in this country, it won't get hot enough to make fires bad*" (VIP65). Additionally, there was a basis of judgement on personal observations and experience, where climate change affecting the area was negated such as "*We always seem to have wet summers, July and August are washouts so wildfires aren't a problem in S Wales. I believe climate change is happening in the World, but I have yet to see a warmer drier summer in the UK.*" (VON288). Similarly, other observed no apparent changes in wildfire activity, disagreeing, "*because I've lived here all my life and seen them every year, no change in wildfire*" (VIP69). For some, their own observations appeared to negate scientific perspective, *"Well scientists would probably argue that it has, but me, I personally I haven't seen a change*" (VIP77). Moreover, the idea of the area as well as Britian was being too wet for wildfire was pervasive, where here the assumptions of the climate negated any change in activity, such as "*We have terrible weather, it's too wet*" (VIP42). Moreover, there was also reference to juxtaposing and apparently contradictory, flooding hazard, "*Flooding is more of the problem for me, that's what will change with climate change"* (VIP50). Lastly, a key reasoning for disagreement was notions of wildfires in the Valleys being human-caused, and hence climate change not exerting influence. This ties in with the high proportion that identified humans as the most important influence (where 20% and 23% of in-person and online gave only people as the most important influence). Comments made that allude to this notion include, "*Well, wildfires in the valleys are more to do with people, so climate doesn't have a great effect*" (VIP87). Another said, "*I do not believe that fires are a result of climate change as weather is unpredictable. Man is responsible for these fires*." (VON104). This demonstrates a possibly more widely held misconception of the dichotomy that if it is 'started' by arson then it cannot be 'caused' by climate change (Jones *et al*., 2023).

Beyond those who disagreed there were many who were neutral. This included a lack of knowledge or observation, "*I do not know enough about wildfire activity to be able to tell if its changed or not, but I guess science says it probably will in the future*" (VIP58). Especially in relation to the future, there is more uncertainty, one participant commented, "*No one knows*" (VIP77).

On the other hand, a larger proportion agreed with the influence of climate change. Key notions about this include more general agreeable sentiment that "*Yes, it would make sense*" (VIP91). Additionally, there was also concern attached to this influence. For instance, one participant commented, *"If people don't step up, we will get hotter spells*" (VIP10); another noting, "*People need to take climate change seriously or we will face problems like these*" (VON31). Additionally, another implication was the concern about foreign fires associated with climate change acted to influence risk perception hear, possibly through a dread factor (Slovic, 1987); a participant noting, "*It's scary to think it is increasing, and I hope it doesn't get as bad as places with the big fires like Australia*" (VIP59). This also suggests that awareness of foreign wildfire issues, and exposure to news coverage, especially where there is disaster, potentially leads to greater concern when a similar risk is experienced domestically. News coverage about wildfires increasing elsewhere may lead to greater awareness about the types of consequences and trigger fear for the occurrence more locally.

4.2.2.3 Awareness and sources of Australia black summer

Participants were briefly asked about their awareness of the Australia black summer bushfires, and the sources of this information. The majority of participants recalled this event (98% in-person and 99% online). Television news was noted by a majority, where many also noted social media. Online news, family or friends, radio, newspaper, word of mouth, and work were also mentioned. There were only small differences between the samples in the types of sources. This suggests exposure to global wildfire news, particularly larger disaster events. Aligning with other comments made, this speaks to the fact that media – especially local where it is more relevant, but also global in that it shares awareness of possible consequences – is a key information source regarding wildfires for those in Britain, where there is a lack other sources of information.

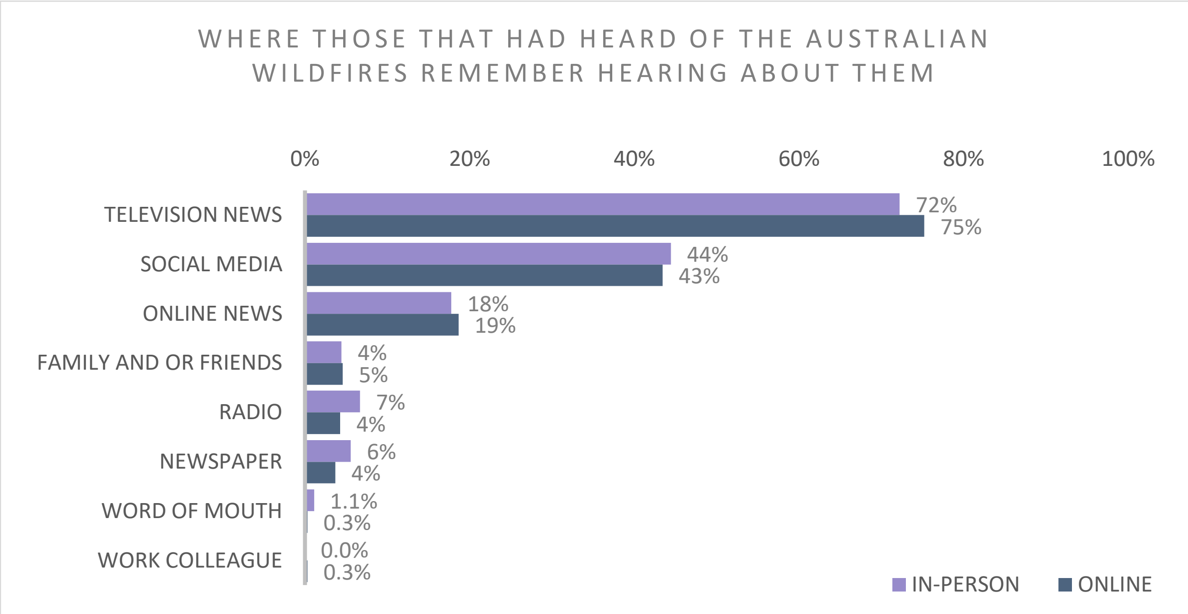


Figure 4.23 - Sources of information that Valleys' participants remember hearing about the Australian wildfires. The proportions are of all those that had previously answered yes to hearing about them, for in-person N=90 and online N=327.

4.2.3 Attitudes towards prescribed fire

Moving on to participants attitudes towards prescribed fire, when asked to what extent the use of fire as a tool on the landscape would be acceptable, nearly half agreed (47%), and over a quarter disagreed (29%) (Figure 4.24). Note this was only asked in the follow-ups survey with a combined sample off 119.

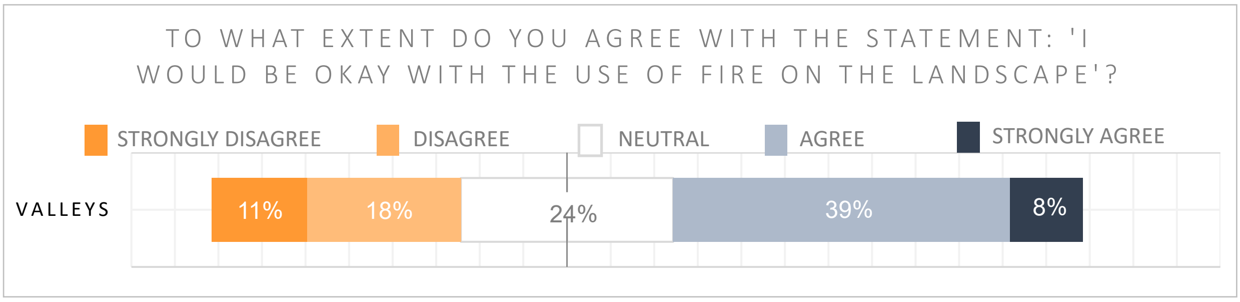


Figure 4.24 – Valleys' follow-up participants agreement with the use of fire on the local landscape. Combined follow-up, N=119.

Participants were also asked to explain this response, the explanations were coded based on the degree of agreement. These codes were compared to the closed-question responses (Table 4.13). Notably, both those that strongly agreed and agreed included conditions, indicative of nuanced and partially accepting stances. Of those that responded as neutral, there was a lack of opinion being neither for nor against, as well as giving arguments either way but remaining undecided.

Comparison of participants' responses to the closed and open question regarding agreement with fire use locally [V]						
		Agreement in closed question				
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Sentiment towards fire use identified	Reason for its use	0%	0%	4%	53%	86%
	Reason for, but with condition	0%	0%	21%	47%	14%
	Arguments both ways	0%	0%	4%	0%	0%
	Neither for nor against	0%	0%	43%	0%	0%
	Some understanding, but against	0%	15%	21%	0%	0%
	Reasons against its use	100%	85%	7%	0%	0%
LEGEND	0%	100%	Proportion of participants answering a particular way to the closed question			

Table 4.13 – Comparison of responses to agreement with fire use compared with the type of explanation. For combined follow-up, N=119.

Among those that agreed, Figure 4.25 illustrates the specific rationales provided. The most common justification was the perceived benefit of reducing wildfires, where other advantages were also mentioned, including the belief of it being beneficial for the environment. Additionally, believing fire was an historic or long-standing tool was another key reason in favour. The conditions raised were mainly regarding ensuring burns were carried out properly and in a controlled manner, as well as wanting experts involved.

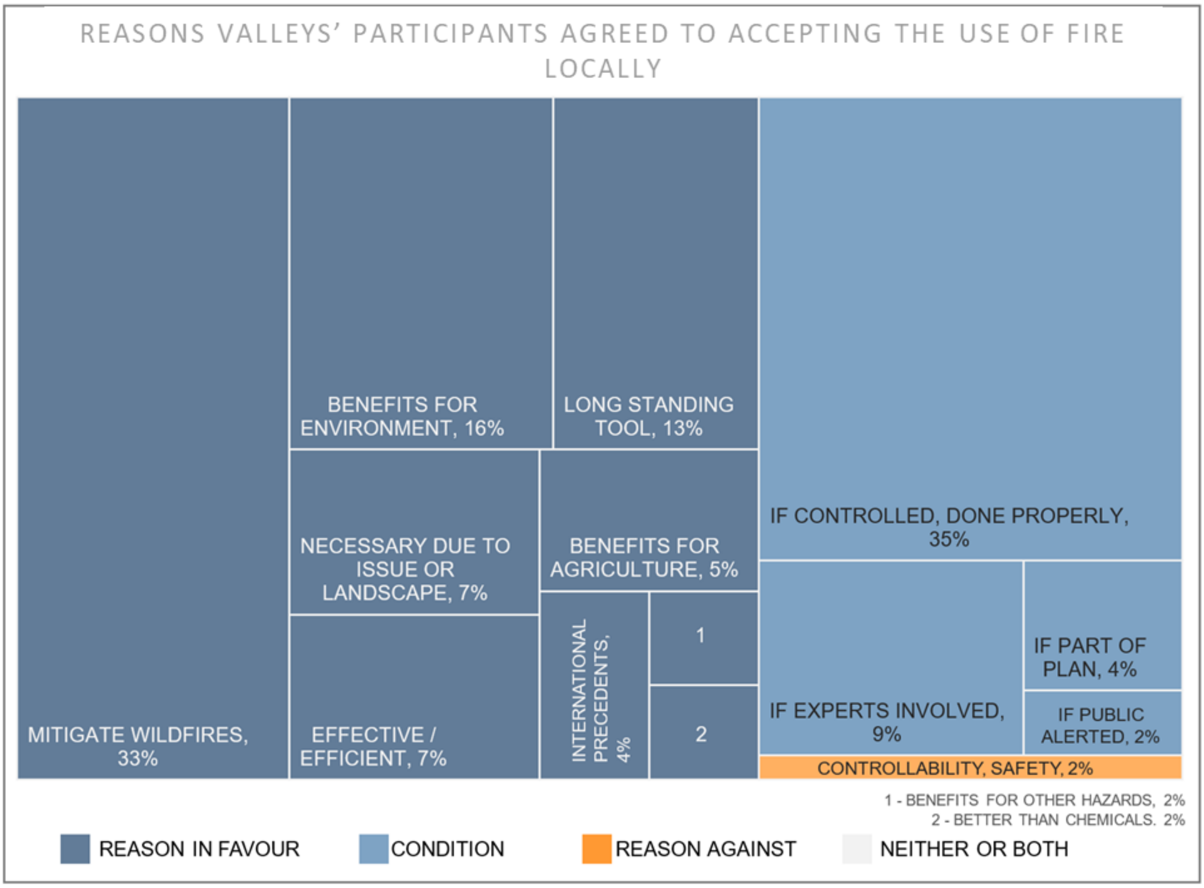


Figure 4.25 - Reasons Valleys' participants were agreeable to the use of fire on the local landscape (asked in follow-up, N=56).

Awareness of the benefits of controlled fire for mitigating wildfire was a key reason for its acceptance. For example, one participant explained, "*Very beneficial. It could stop wildfires occurring which could pose real harm*" (VON309). There was the sentiment that controlled fire was favourable to uncontrolled, "*I would rather a fire controlled than wait for nature or idiots to start one that may be more devastating*." (VON288). There was also specific awareness of fuel problems "*It helps to keep bracken down which is becoming a problem in my local area as farming practices no longer help control its spread*." (VON232). Additionally, there was also more general approval in order to help wildfires and improve safety, such as, "*I'm for anything that can help stop out of control fires*" (VON275), and "*It would make the community safer*" (VON135).

There was a familiarity with the technique, explaining that "*Firebreaks and controlled burns are a well-established tool*" (VON205). Having an awareness for its use, including historically, was a key reassurance for participants, and acted to show they were effective and beneficial. One participant agreed because "*It's been in practice for many years, so don't see a reason for it not to continue*" (VIP27). The fact it is a "*Well-tried and tested technique*" (VON50) was a reassurance. Alternatively, knowing it is used abroad, rather than locally, also gave reason for agreement, one participant noting it is "*Used abroad to great effect*" (VON28).

Having said that, many participants gave conditions, where maintaining good practice and control was crucial, as well as in a way that was sensitive to nature, one explaining, "*It would be good if it was controlled and didn't harm wildlife*" (VON237). Another notes the need to balance ecological needs and fire danger, "*Controlled burning with an ecologically considerate management ethos will help to mitigate the dangers of uncontrolled accidental fires or malicious arson*" (VON179). There were conditions that the involvement of experts and stakeholders would be a reassurance, including the Fire Service. One explained it would be acceptable provided burns were, "*controlled and only if approved by the Fire service*." (VIP87). The need for expertise involved was echoed by some, "*So long as it is managed by properly qualified personnel such as farmers or natural resource wales etc*." (VON156). Moreover, within these conditions there was a sense that it would be a last resort, "*I trust that a land management team would have deemed it necessary, no other option and the work would be risk assessed manger and supervised*" (VON155). Trust appears here in relation to knowing experts were involved in decision making process, including in the planning and carrying out of the burns. For example, another participant remarks, "*If this is planned and controlled, I'd think that relevant surveys and risk assessments would have been carried out so it would be okay… I don't think it belongs here though*" (VON88). This also echoes the fact there was some level of hesitation or partial agreement where they think fire is a limited tool and a last resort. Lastly, there were a few comments about desiring the public to be made aware of these burns, one noting it would be "*Fine as long as it is done properly & the public are aware of the reasons for it*" (VON15).

Conversely, the explanations of those that argued against the use of fire (Figure 4.26) demonstrated this was largely because of concern for the impacts, including on nature, air quality, controllability, and aesthetics. Again, there was a sense of resistance to fire, with sentiments that alternatives were preferred. The concerns of fire use somewhat matched the concerns of wildfire, showing there may be a lack of distinction between the two, contributing to the idea of landscape fire as unavoidably negative, or anti-nature.

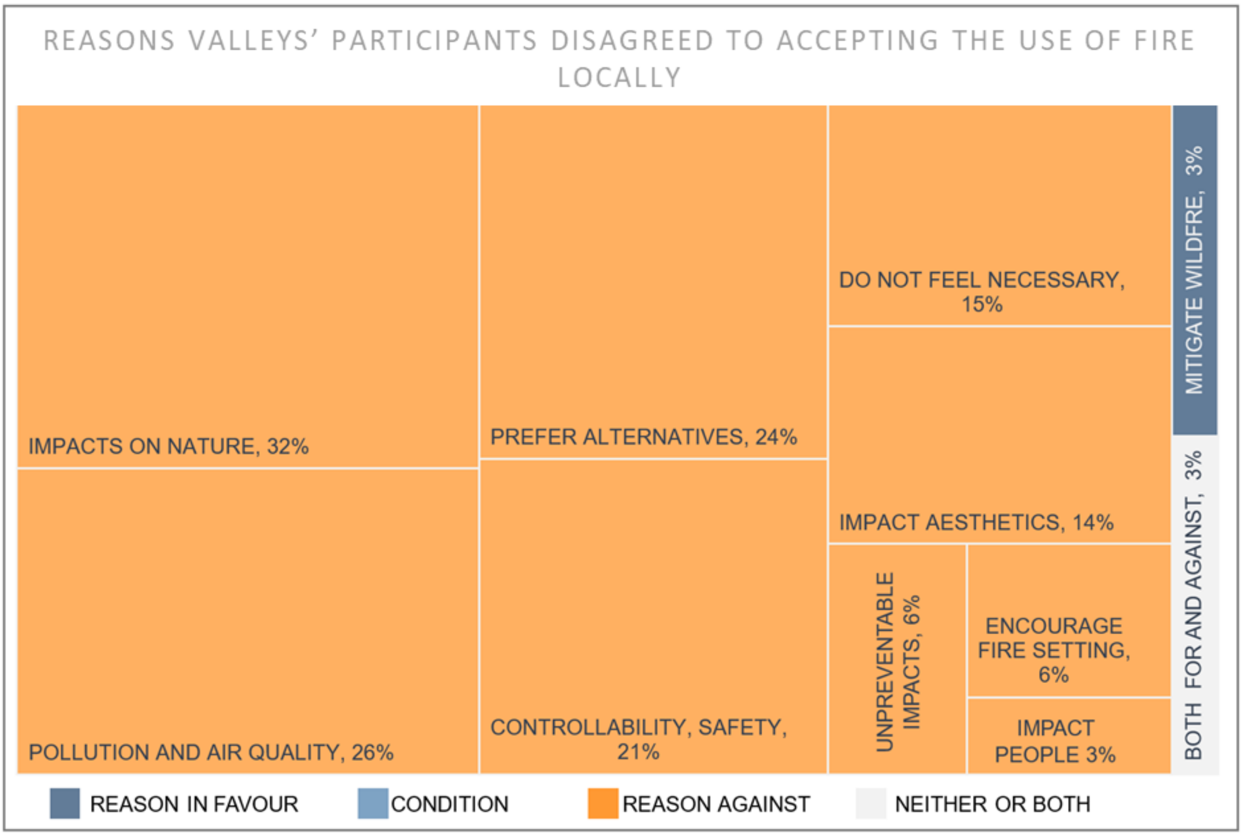


Figure 4.26 – Reasons Valleys participants were against the use of fire locally (asked in follow-up survey, N=34).

The most common concern was that for nature, such as being "*… worried about the wildlife*" (VIP12). Broadly seen as environmentally damaging, including damage to nature and polluting. For example, "*I would imagine that these controlled fires serve a purpose but I'm not sure how much pollution they create and there would be damage to wildlife"* (VON20). This also demonstrates that residents may be aware fire use has a purpose or benefit, but their attitude remains against it because of perceived unintended impacts, concerns, or uncertainties. There was a sense there were unavoidable negative impacts, built around a rhetoric of fire as damaging. For examples, disagreeing because "*Fire ruins landscape*" (VON237); another explaining they believed "*Fire is non-selective and very destructive*" (VON2). This anti-nature rhetoric was widely held, "*Sometimes it's needed, but forests are a place for life to flourish not be burned*" (VON225). As well as "*I suppose there is pros and cons of controlled fire with low intensity being used to manage the landscape, cons being the wildlife.*" (VIP24). There was also a sense of wanting to not interrupt nature and that it should be left to be 'natural'. For example, "*Our wildlife is already suffering from the effects of climate change and human activity, and I could not agree with a statement that would cause further distress to wildlife. It only belongs if caused by natural events, it does not belong when it is caused by human activity*" (VON74). This speaks to a sense that in this environment the risk does not outweigh interrupting nature, which did not volunteer to live where humans want to burn.

There were other concerns beyond nature. Interfering with aesthetics was one, for example, believing burns "*… are an eyesore*" (VIP80). Moreover, where participants had awareness of regular wildfires in the area, the idea of more fire created frustration, including unappealing aesthetics. For example, a comment that they "W*ould have to see them all the time then, we've had enough*" (VON192). Air pollution and smoke was another significant concern, where the concerns about wildfire smoke exacerbated the opposition to the use of fire, such as, “*The air pollution it causes is pretty depressing when you are living amongst the smoke and smell fires cause*” (VON211). Again, this speaks to a frustration with disruption of wildfires creating resistance to all landscape fire. Furthermore, this resistance to fire, centred around the idea of fire as destructive and the Valleys had already undergone damage, the use of fire was perceived to exacerbate this. For example, one participant explained, “*The area has been blighted by coal tips, general neglect and de-industrialisation for decades so it's difficult to muster enthusiasm for something which will literally burn the local landscape and be nothing but an eye sore and nuisance for local people*” (VON32). Therefore, in the disagreement to proposed prescribed fire there was a general resistance to fire, a dislike, and preference for other solutions, “*Better to not have fires, I’m sure they could use something else*” (VIP76).

A perceived lack of controllability and concerns over escape were also given as reasons against fire use. For example, there were some that were “*Not convinced by how ‘controlled’ fires can be*” (VON5). Fire was perceived as too risky with concerns about safety, for example, “*Every fire carries risk, it could be too dangerous to wildlife and also people, including firefighters*” (VIP75). There were also comments about the risk being too much where they felt controlled burns were unnecessary and a waste of resources, “*Not good, too risky and waste of resources*” (VIP66).

Lastly, there were a small number of comments about the suitability for the area. Including concerns about it encouraging fire setting as a justification to omit all fire. For example, “*We have enough trouble with kids starting fires on the hills. Authorised fire setting would only serve to endorse the actions of these people*. *The answer is no fire setting by whoever for whatever*.” (VON255). There was also some understanding that there was no need, for example “*Wildfires in my area are always deliberate cases of arson in the summer months. The problem is not a build-up of dead vegetation and so controlled fires would have little use*.” (VON250). As well as because the area was not suited: “*No need. The areas affected are too small for this to work*” (VON11).

The reasons participants responded with the neutral option, including being neutral and having no opinion, as well as believing there was arguments both ways. The reasons shown in Figure 4.27 show that a lack of knowledge was common, but uncertainty also stemmed from concerns over impacts, as well as having conditions to use.

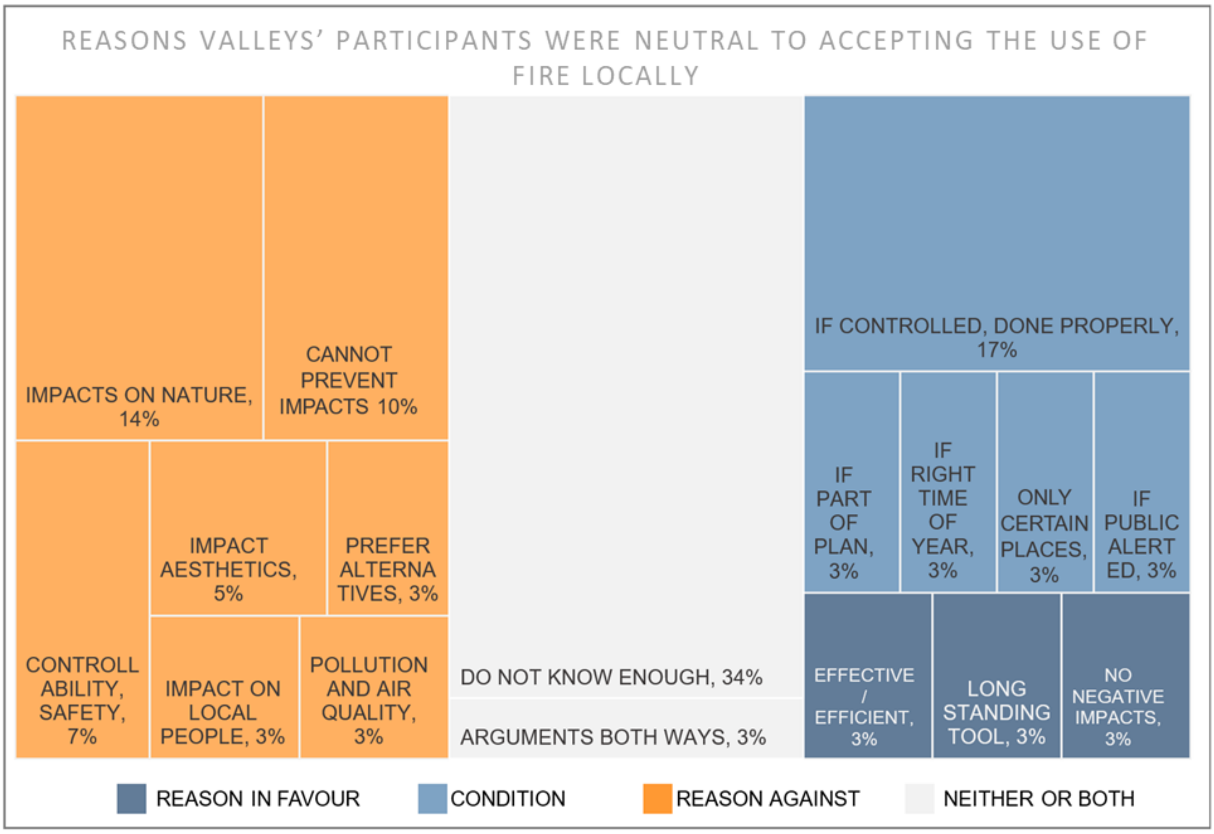


Figure 4.27 - Reasons Valleys' participants were neutral to prescribed fire on the local landscape (asked in follow-up, N=29).

There were participants that lacked knowledge and were more neutral, such as one explanation that, "*I don't know enough to judge, but I don't think it would bother me*" (VON80). There were comments about the lack of understanding the benefits, as well as impacts, such as, "*Don't feel I know enough about how effective this is and the impact it will have on wildlife*" (VON120); another noting, "*I'm not sure what the environmental implications of this would be. I don't know of a situation where fire would be necessary*" (VON164). There was comment of a lack of awareness about fire use in this country and knowing what specific applications, for example, "*We don't live in Australia and to my knowledge fire is not commonly used as a land management tool. If there is strong evidence to demonstrate that burning the local mountains will improve things for all of us, then I think a large education piece is in order*" (VON32). These demonstrate that knowing the use and benefits is crucial in generating acceptance.

There were comments that appreciated the fact it may be a legitimate tool, but their personal attitude was against fire. For example, having argument both ways, hence, "*Neutral response because I support it as a way of managing land (this is something farmers have always done here) but I'm against it because it scars the landscape*" (VON303). Again, participants may understand a benefit, but be uncertain about negative impacts, especially towards nature, for example, "*I understand the benefits of controlled wildfires in order for healthy grass growth to come through but I am still unsure how exactly controlled and managed they are and how much destruction they can cause to ground nesting birds and other wildlife*" (VON115).

Next, these responses to acceptability of fire use were compared with previous responses regarding concern about wildfires in the area, or personally. Firstly, comparing responses to the consideration of a wildfire problem (Table 4.14), there is no pattern of difference between the groups, except there not being any that disagreed with there being a problem and strongly agreeing to fire use. Next, comparing to risk scores (Table 4.15), again the distribution is mixed, although those that gave the highest wildfire scores had more that strongly disagreed to fire use. This could demonstrate that where there is concern over wildfire there is more hesitation, as prescribed fire is deemed too risky.

Comparison of answers to whether agree with fire use and opinion on whether wildfire is a problem [V]				
COMBINED SAMPLES		**Is wildfire a problem locally?**		
		Yes	No	
Agreement with fire use	Strongly agree	10%	0%	*(N=10)*
	Agree	36%	50%	*(N=46)*
	Neutral	24%	25%	*(N=29)*
	Disagree	19%	10%	*(N=21)*
	Strongly disagree	10%	15%	*(N=13)*
		(N=99)	*(N=20)*	
LEGEND	0% 100%	Proportion of participants answering whether wildfire is deemed a problem		

Table 4.14 – Comparison of Valleys' responses to whether prescribed fire was acceptable and if wildfires were considered problematic. Follow-up sample N=119.

Comparison of answers to whether agree with fire use and individual risk score [V]							
COMBINED SAMPLES		**Individual wildfire risk**					
		0	1	2	3	4	
Agreement with fire use	Strongly agree	4%	7%	14%	8%	14%	*(N=10)*
	Agree	30%	49%	25%	58%	29%	*(N=46)*
	Neutral	37%	20%	29%	17%	0%	*(N=29)*
	Disagree	19%	11%	29%	17%	14%	*(N=21)*
	Strongly disagree	11%	13%	4%	0%	43%	*(N=13)*
		(N=13)	*(N=22)*	*(N=27)*	*(N=44)*	*(N=42)*	
LEGEND	0% 100%	Proportion of participants answering whether wildfire is deemed a problem					

Table 4.15 - Comparison of Valleys' responses to whether prescribed fire was acceptable and how at-risk participants felt. Follow-up sample N=119.

Comparing these responses to the participants age (Table 4.16), the youngest group was again the main outlier compared to the other ages, in this case having more neutrality and less strong acceptance and more strongly disagreeing. The eldest category also had more strongly disagree. The middle age groups had more that strongly agreed. Moreover, responses were also compared with participants' gender. Table 4.17 shows that there was more disagreement in the male group.

Comparison of participants' agreement to fire use and their age [V]								
COMBINED SAMPLES		Age group						
		18-24	25-34	35-44	45-54	55-64	65+	
Agreement with fire use	Strongly agree	0%	8%	10%	14%	10%	4%	*(N=10)*
	Agree	13%	33%	48%	43%	39%	38%	*(N=46)*
	Neutral	50%	42%	24%	24%	19%	15%	*(N=29)*
	Disagree	13%	8%	10%	14%	29%	19%	*(N=21)*
	Strongly disagree	25%	8%	10%	5%	3%	23%	*(N=13)*
		(N=8)	*(N=12)*	*(N=21)*	*(N=21)*	*(N=31)*	*(N=26)*	
LEGEND	0%	100%	Proportion of participants answering whether wildfire is deemed a problem					

Table 4.16 – Comparison of Valleys follow-up responses to whether prescribed fire was acceptable and the participant's age. For the Valleys follow-up sample who provided an age N=119 (100%).

Comparison of participants' agreement to fire use and their gender [V]				
COMBINED SAMPLES		Gender		
		Women	Men	
Agreement with fire use	Strongly agree	10%	6%	*(N=10)*
	Agree	40%	40%	*(N=46)*
	Neutral	26%	17%	*(N=29)*
	Disagree	16%	20%	*(N=21)*
	Strongly disagree	8%	17%	*(N=13)*
		(N=80)	*(N=35)*	
LEGEND	0%	100%	Proportion of participants answering whether wildfire is deemed a problem	

Table 4.17 - Comparison of Valleys follow-up responses to whether prescribed fire was acceptable and the participant's age. For the Valleys follow-up sample who provided a gender N=115 (97%).

4.3 Summary of Valleys Findings

To sum, the Valleys' residents surveyed here demonstrate an extensive and relatively widespread level of awareness for wildfire occurrence and the associated local issues. The fact that no information was given to participants about the nature of wildfire occurrence in the area, but there was a widespread awareness of the issues of wildfire demonstrates a high level of knowledge around wildfires. Having said that, of course there are a number in the area which appear to be unaware of wildfires. As well as some who are aware to an extent of activity but do not acknowledge a problem. Furthermore, gaps between public understanding and expert perspective were identified, especially where there was disconnect with the term 'wildfire', and denial of its impacts, and minimisation compared to foreign ('true') wildfire. The months highlighted as highest risk also identified possible lack of knowledge by some residents and spaces for education. Climate change was generally a concern where it will increase fire risk, however there was some disconnect, where there were misconceptions over the dynamics of influence and hence disregard to be influence of climate change. This is poignant for public education, where correcting these misunderstandings may be a crucial lesson.

Awareness of this problem did possibly influence personal risk. There was both frustration and upset at knowledge of the fire problem, demonstrating some emotive reactions. One participant noting, *"I remain shocked by these fires and appalled at the consequences for wildlife, the natural environment and the air quality of those who live in the areas affected"* (VON161). Aligning with this there were calls for action on this issue to prevent these ignitions. Generally, there was greater concern for the area, highlighting the importance of personal exposure and living in a place associated with high-risk, as well as regarding the perceived consequences as relevant and significant. Often the direct impacts were othered, mostly to nature. There was concern for impacts on people despite this, including property, and disruption. Moreover, the impacts being othered did not necessarily mean residents discounted them, where there was significant concern for the non-human and dislike for wildfires. Key concerns in the Valleys included, wildlife, the landscape, smoke inhalation, aesthetics, and property. There were generally little differences between demographic groups, however, younger participants did often have different responses to the other age groups. Younger participants had had lower perception of risk, either due to lack of relevance or awareness.

CASE STUDY 2: DORSET COUNTY, ENGLAND

5.1 Introduction to Dorset

5.1.1 <u>Dorset: environmental character</u>

This case study collected perception data of residents in the county of Dorset, in the southwest of England (Figure 5.1). Dorset is primarily rural with areas that are highly urbanised. Of the areas included in this study, 41% live in rural areas and 59% live in urban (ONS, n.d.). Examining the study area (Figure 5.2) the southeast shows a significant density of people. The overall density of the included postcodes was calculated at 289 people per km^2; with a large range across postcodes with a minimum population density of a postcode of 40 and a maximum of 6270 (ONS, n.d.).

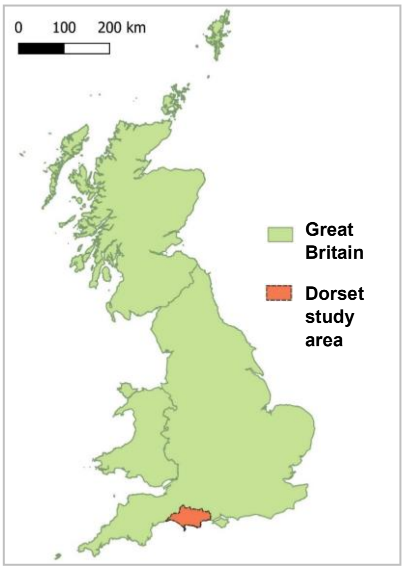


Figure 5.1 - Dorset study area within Great Britain. (Map source data EDINA, 2021a, 2021b).

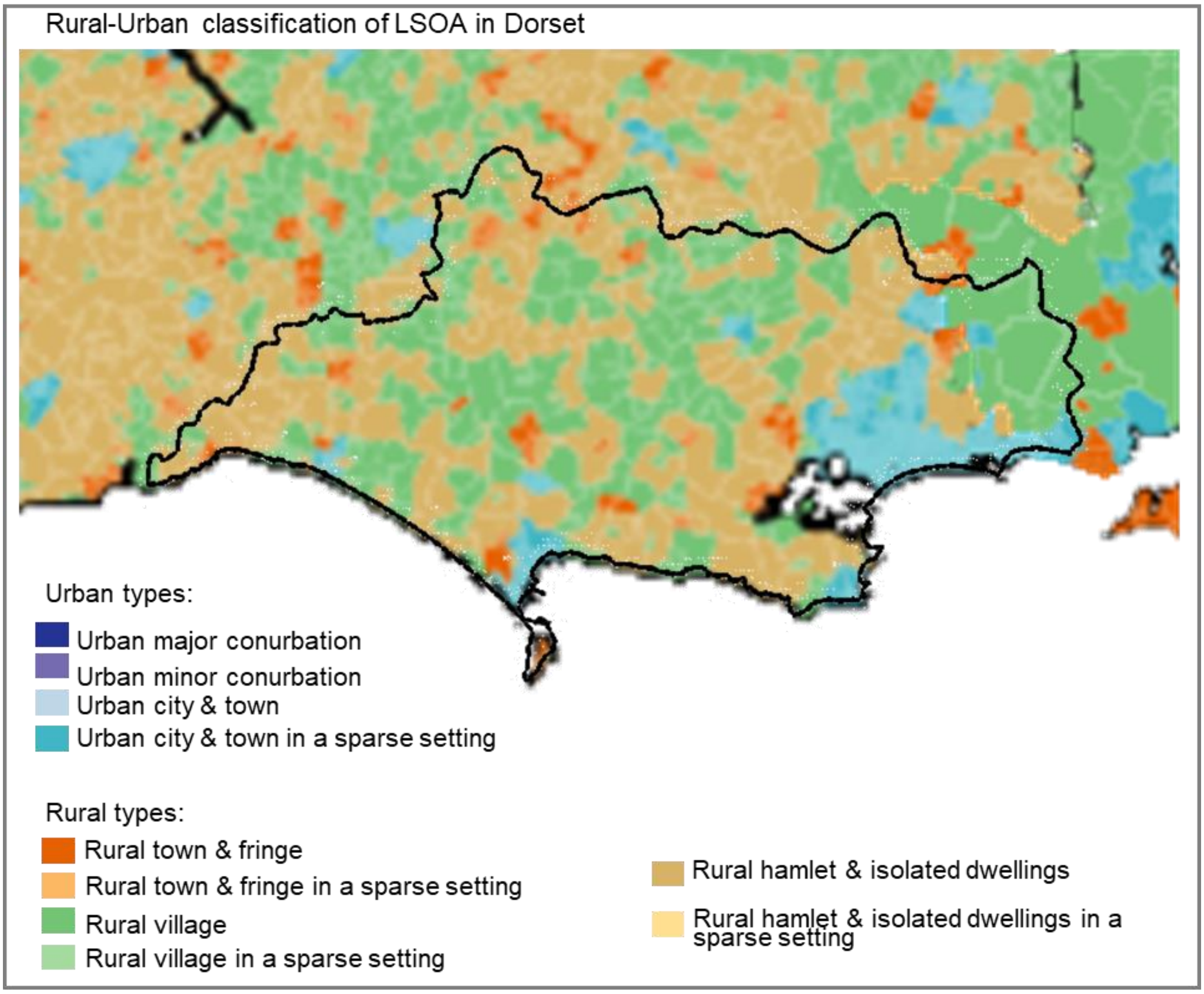


Figure 5.2 - Population distribution in Dorset by rural-urban classification (adapted from ONS, 2017b, 2017c).

Dorset's environment is characterised by a variety of urban, rural and coastal areas (Figure 5.3). A key tourism location for England, it is home to a portion of the Jurassic Coast. There is extensive coverage of grassland and arable lands, contrasted by significant conurbation in the southeast (Figure 5.4).

Dorset landscapes, touristic hotspots, and valuable heathlands.

Visit Dorset (2023a)

High fire risk around Corfe Castle, a tourist hotspot - August 2022, (Ffitch, 2022)

Durdle Door, Dorset (Whitelocks, 2017)

Heathland in Dorset (UHP, 2018)

"Urban heaths" (Natural England 2013, 11)

Figure 5.3 – A selection of images reflecting some of the characteristic elements of Dorset's environment.

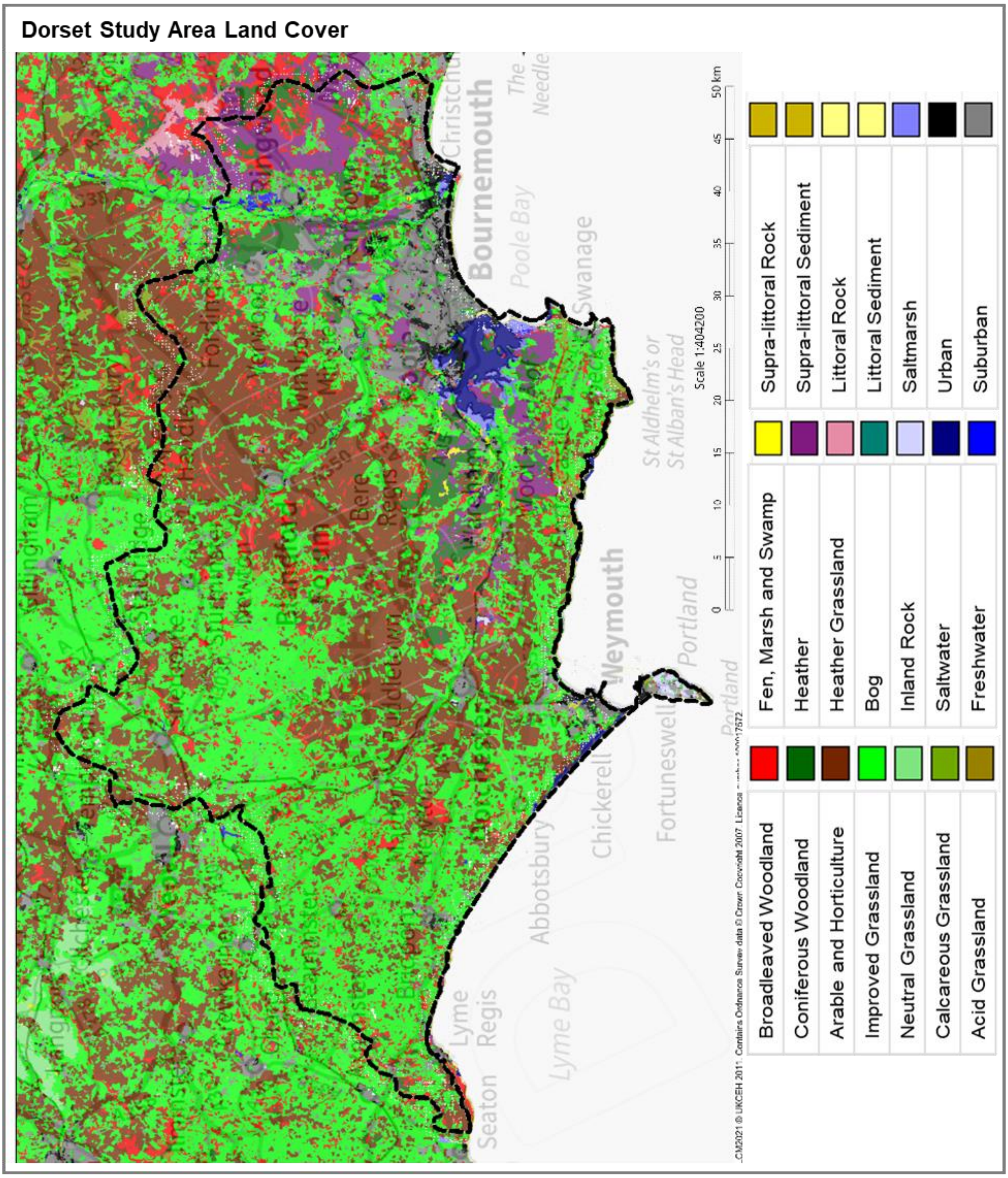


Figure 5.4 – The land cover of Dorset (EDINA, 2021d).

A large proportion of Dorset's area is designated protected landscape, including AONBs, SSSIs, SPAs, SACs and a portion of the New Forest National Park (NFNP) (Figure 5.5). In fact, the lowland heaths are of international importance recognised by the EU (Dorset Council, 2023b). The heathland is under pressure from fragmentation and human interference, exemplifying a tension between human use of these areas and biodiversity (Cordingley *et al.*, 2015). Nearly a third of Dorset's heathlands are located within urban areas and thus in close proximity to nearly half a million people (Dorset Council, 2023c).

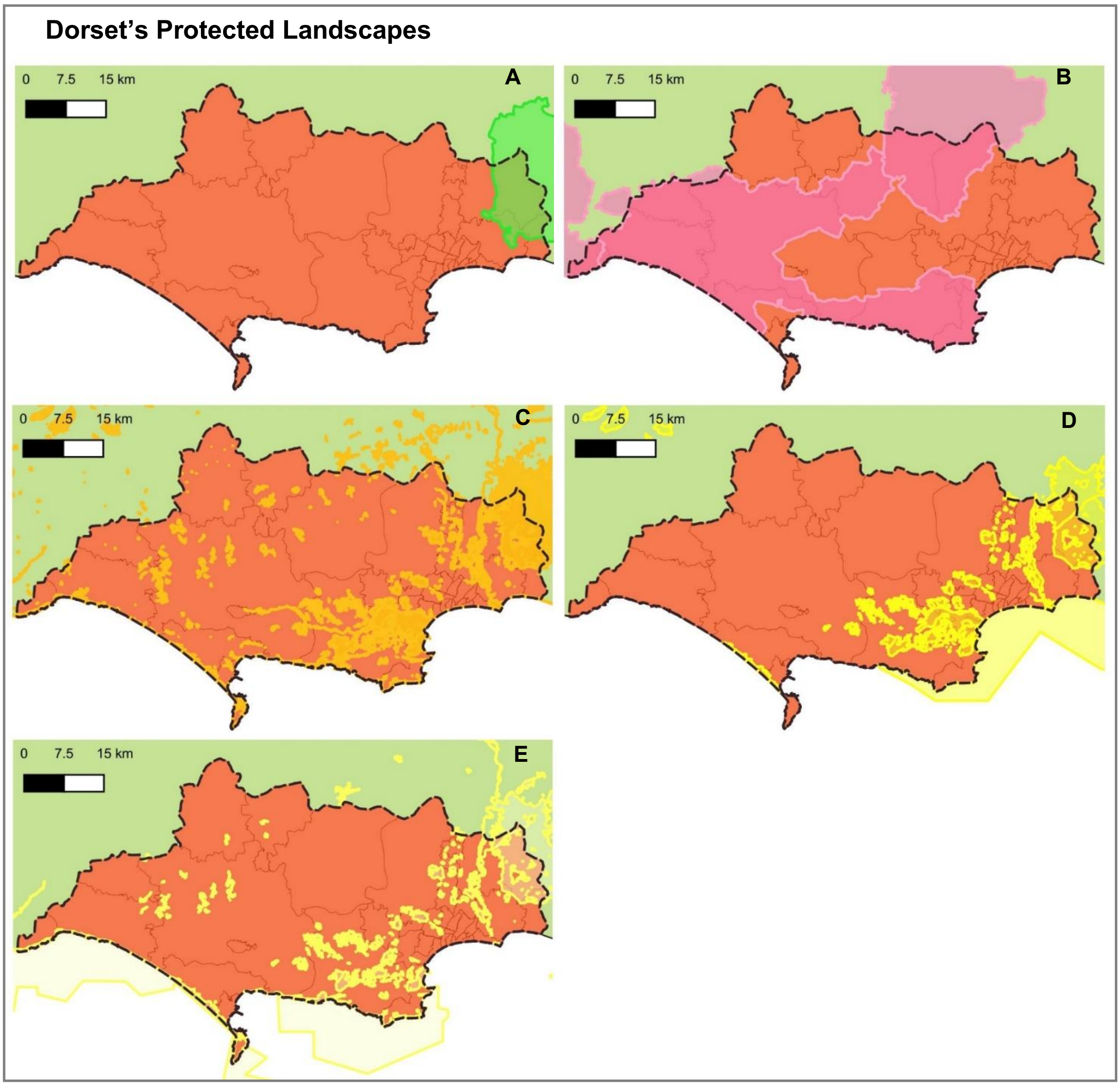


Figure 5.5 – Dorset's protected landscapes (base map data from EDINA 2023a, 2023b). (A) NFNP (Natural England, 2022a); (B) AONB (Natural England, 2020); (C) SSSI (Natural England, 2023a); (D) SPA (Natural England, 2022b); and (E) SAC (Natural England, 2023b).

5.1.2 Dorset: socioeconomic character

Dorset is generally considered a relatively affluent area, although like any place there is variations in wealth; Dorset and BCP scored averagely on the deprivation index compared to rest of England and Wales in the 2021 Census (ONS, 2023). Tourism is a significant industry in Dorset, where the picturesque environmental character and sightseeing attractions bring high number of tourists. Annually there are approximately 3,640,000 staying visits of both domestic and international tourists, and a further 26.4m day visits; with estimated visitor spending of £1.825 billion and the industry accounting for 11% of all employment (The South West Research Company Ltd, 2020, page 4).

5.1.3 Dorset: wildfire problem

Dorset and the southwest experiences a moderate number of wildfires compared to the rest of England, however there are larger proportions of area burned where there are more open habitats (Glaves *et al.*, 2020). There are also significant heath and gorse fires that occur close to urban areas and key infrastructure in the RUI environments of Dorset, and the county has been highlighted for the significance of these small fires (McMorrow, 2011; Gazzard *et al*., 2016). Ignitions as a result of recreation is a concern for the urban heaths due to the proximity to people and tourism, for instance, it was the designated cause of the Wareham Forest Fire, which was very costly (Panter & Caals, 2023). Wildfires on the heaths are typically small, there are some larger events; records monitored and collected by rangers from UHP of wildfires on the heaths demonstrates the range of sizes (Table 5.1). Within this period, the largest event was Wareham Forest Fire which burned 226 ha over a two-week period, where 188 ha were burned within the first day (Belcher *et al*., 2022).

Fires on the heaths: UHP wildfire records (April 2020 – December 2021)		
Size of fires	Number of fires	
Up to 10 m^2	139	*(68%)*
10 – 100 m^2	17	*(8%)*
100 – 1,000 m^2	21	*(10%)*
1,000 – 10,000 m^2	18	*(9%)*
>10,000 m^2	8	*(4%)*

Table 5.1 - Over a years' worth of wildfires on the urban heaths in Dorset, using UHP records. (From Panter and Caals, 2022, page 49).

The protected landscapes that have high fire risk are of international significance, hence the acquisition of EU LIFE project funding by UHP (UHP, 2023a; DERC, 2023). The UHP is keenly invested in mitigating the impact of fires on heaths neighbouring urban areas in the southeast of the county (Panter, 2018; Panter & Caals, 2023). There has been effort to improve monitoring and setting up a UK version of the public engagement scheme, Firewise (Ford, 2020). Firewise UK is a key outreach and education effort, set up in 2009. There has been outreach of both Firewise home preparation leaflets (DWFRS, 2019), as well as a recent campaign about the risks of barbeques (2022 after data collection) (DWFRS, 2022). The Wareham Forest Fire was publicised as caused by a disposable barbeque (Ffitch, 2020).

Images reflecting typical wildfires in Dorset are shown in Figure 5.6. The wildfire events can be intense, and there are recent examples which draw attention. Including the Upton Heath fire in 2011 which required evacuation of residential areas in the vicinity and was a motivator for public engagement leading to Firewise UK (Ford, 2020). Additionally, the recent Wareham Forest Fire in May 2020 was highlighted by Belcher *et al*. (2022) for the requirement of national collaboration of firefighting resources, the size of the incident, as well as the poignant environmental impacts due to the landscapes it occurred on.

DORSET WILDFIRES

Wareham Forest Fire in May 2020


(BBC, 2022c)


(BBC, 2022c)


(BBC, 2020)


(Ford, 2020)

Wildfires near built-up areas, as well as near tourist areas.


Fire near Studland, August 2022, (BBC, 2022a).


Upton Heath, Dorset, in 2011 (Ford, 2020).

Wildfires on heathlands of which some are designated protected landscapes (inc. SSSI).


Studland Heath fire, August 2022 (BBC, 2022a)


5 ha heath burn spar in Christchurch, August 2022 (BBC, 2022d)

Figure 5.6 – A selection of images of wildfires in Dorset, demonstrating the largest most recent event (Wareham Forest), the issue of fires near built-up areas and tourist hotspots, as well as the adverse environmental impacts on Dorset's heathland stock.

5.2 Findings in Dorset

5.2.1 The extent and type of risks associated with local wildfire

5.2.1.1 Whether wildfire was a problem for the area, or themselves

Participants were asked if they considered wildfires a problem. A majority in both samples agreed (Figure 5.7). The online survey group had a higher majority compared to the in-person sample, 71% compared to 58% respectively.

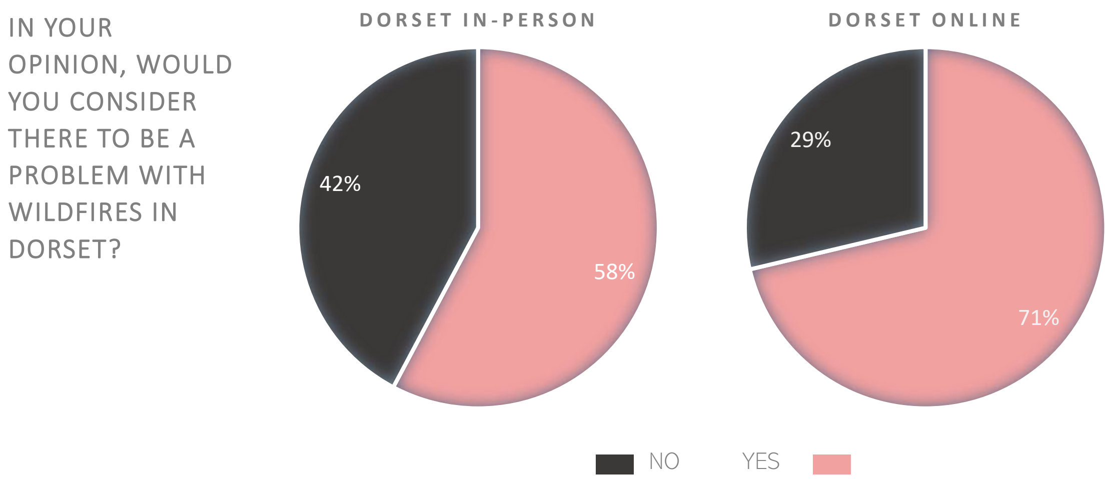


Figure 5.7 – Dorset participants' responses to whether they consider wildfire a problem for the local area. (In-person N=90 and online N=108).

There was some acknowledgment throughout the survey of a problem where participants referenced concerns about wildfires in the local area, more so by the online group. From participant that agreed, there was acknowledgement of local problems. For instance, "*Yes, we get them a lot, especially on the heaths.*" (DIP5). This also points to an element of wildfire discourse centred around the environment. As indicated by other comments, such as, "*I know that there are fires in the heathlands, that's a real concern for area*" (DON71). Thus a key focus of the problem is that to natural areas, another example being, "*In our area of Dorset we have a few wildlife places which are affected by fires.*" (DON50). Additionally, there was also comments around the issue of changing wildfire activity in the area, "*It is super scary the wildfires over the past few years, we are deeply concerned for our local area but also for other global communities and wild areas"* (DON51). This suggests the awareness of foreign wildfire can influence concern for wildfire hazards close by.

On the other hand, from participants that responded no to this question, comments suggest that this may be partly due to a lack of awareness, an element of disconnect with the term wildfire, or minimising of the risk (not problematic). The lack of awareness by some was exemplified by an element of surprise when asked the question and a notion that it was not something associated or possible, in the area "*I wouldn't really think that could be a thing here*" (DIP15). As well as comments on a lack of awareness, such as "*Not that I've ever heard of*" (DIP86). Beyond this surprise, there was also the idea that wildfires in the UK, or at least the forms that occur in Dorset, arguably do not 'count' as a wildfire. This included comment on the inadequate size "*They don't get big enough to be wildfires*" (DIP30). As well as the fact they are too close to or within urban areas, "*The ones that happen round here aren't wildfires, they're not wild, too close to towns*" (DIP16). Or simply the idea that 'you cannot get a wildfire in the UK', with comments such as, "*Well I wouldn't think the ones here* *count, wildfires aren't a problem for the UK.*" (DIP73). This also included the reasoning that "*The UK is too wet for wildfires*" (DIP44).

Next, participants were asked how at risk they felt personally rather than the area (Figure 5.8). In this framing, most demonstrate limited concern for wildfire – around half in both samples gave a score of 0 - despite relative agreeability for its effect on the area. Moreover, 78% of the in-person sample and 69% online gave a low score of either 0 or 1, demonstrating a general lack of personal risk. There were a small group of participants who gave the higher scores (3 and 4) 20% of online and 8% of in-person. There is a difference between the two samples, namely that the online had higher proportions giving the highest scores, thus demonstrating more direct concerns about local wildfires.

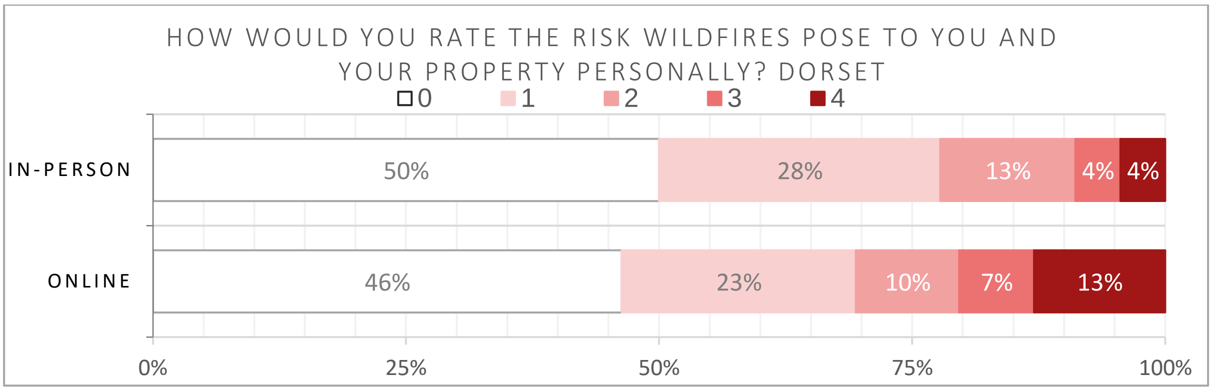


Figure 5.8 – Dorset participants individual wildfire risk scores, where in-person N=90 and online N=108.

From comments made by participants face-to-face or from extra comments online, there were some common justifications for the low scores. This includes the relevance of the hazard to them spatially as a reason for low scores (0 and 1), such as, the association of the risk with natural environments away from people, "*My home is not in danger of wildfires. The fires in this are not near homes but in open spaces*." (DIP31). Thus, living in a built-up area negated the risk, for instance one comment that "*My property is not at risk as live in a town*" (DON61). Moreover, there were more general notions of a lack of presence of a risk "*There is no current risk from wildfires*" (DON66), another commenting "*Well they're just not a risk for the area, I've never thought about one happening before*" (DIP80). There was a minimisation of the probability, "*Unless we have an extreme 6 month drought there's little risk to our property*" (DON97). Risk was also minimised where severity may be perceived as negligible, as well as the perceived consequences being othered to the environment. For example, "*You get the occasional bad fire, which is awful for the environment, but I wouldn't be worried about myself*" (DIP16).

On the other hand, by a small group that gave the higher risks (3 and 4), there were notable concerns. Comments regarding the effects of wildfire being seemingly severe acted to create a threatening prospect, such as, "*They're scary and they harm everything indiscriminately*" (DIP4). Moreover, while others believed they were only a concern for open areas, there were others that acknowledged a danger to the fires near urban areas [from BH2], "*Everyone is so close together around here, they're dangerous*" (DIP14). There were also some that acknowledged a risk as they lived near somewhere more association (i.e. near forests rather than in towns). One noting a high-risk score, "*Well I fear of them getting close to our house as we are near to the forest*" (DON16). The heathlands were associated with high risk by some, "*We are in a high risk area, our home is surrounded by heath land that has experienced fires already*" (DON108). Similarly, living near heaths was also identified as a risk factor contributing to interest in taking part in Firewise (see 5.2.3.2). The prevalence of proximity to heathlands as a high-risk area is also highlighted by a previous survey carried out by UHP that asked for people that lived on roads adjacent to heaths, 89% Dunyeats and 85% Great Oven said could be at risk from wildfire (Lewis, 2018). Interestingly, the results here are lower than the previous small-scale study, likely explained by the fact this covered more diverse environments, whereas the previous research focused on only roads next to heaths. Those next to heath are therefore a particular sub-group that are concerned, although not everyone in these areas may acknowledge a risk where this research shows some minimisation by lack of association or perceived lack of direct consequences.

Additionally, comments above also allude to the fact that awareness of previous fires have elevated the risk in some residents' minds. Notably, there was significant interest from those in BH20 which is where Wareham is located, demonstrating that a large local event may increase interest in engagement. Moreover, the Wareham Fire was also a motivation for interest in Firewise (see 5.2.3.2), either due to the high profile raising concerns and questions, and for a select few due to poor experiences during this event.

Beyond this question, a few participants offered some particularly negative stories around experiences with fire in the areas. The negativity revolving around the management of these events, specifically a lack of communication from authorities. There were multiple comments about lack of preparedness by agencies, contributing to negative experiences, one recounting, "*As the closest property to the Wareham Forest fire I can assure you that the fire management was woefully inadequate, and the forestry commission were at best a joke*" (DON45). There was also discontent with the lack of planning, one participant described their experience:

> *"Living nightmare for 3 weeks. House filled with smoke at 3am. Carbon monoxide poisoning risk. Can't get vehicles out or in due to fire hoses, so trapped for weeks. Lack of duty of care by forestry commission. Risk of evacuation and having to leave our 100 + animals behind. No info or liaison until Wildfire experts turned up. Constant reignited of fire and threat even though we thought it was gone. I dread to think how it would go next time." (DON22)*

Furthermore, aligning with this sense of lack of preparedness, there were concerns raised for personal vulnerabilities. For example, online participant wrote, ""*Please consider the needs of people like myself with complex disabilities for whom unplanned evacuation in the event of a nearby wildfire would be almost impossible… I think vulnerable people in high-risk areas should have individual evacuation plans that can be shared with the emergency services*" (DON19).

These first questions demonstrate some level of awareness of a problem, although this may not be widespread. This awareness may be crucial to acknowledging local wildfire risk where there is a lack of association or perceived feasibility of their occurrence. Comparing the participants' responses to the two questions demonstrates a plausible connection (Table 5.2). Those that answered "no" to considering wildfires a problem had a much higher proportion give scores of 0 than those who answered yes, which supports a relationship between the two. There were participants that agreed to wildfires being a problem but also gave low risk scores, as well as a small proportion that answered no and put higher scores. This illustrates that there are many factors influencing the level of risk perceived, and that although there may be concern for the area, the risk may be perceived as irrelevant to the individual.

Comparison of answers to whether wildfire is a problem and personal risk scores [D]							
IN-PERSON		**Individual wildfire risk scores**					
		0	1	2	3	4	
Is wildfire a problem locally?	Yes	87%	11%	3%	0%	0%	*(N=38)*
	No	23%	40%	21%	8%	8%	*(N=52)*
		(N=45)	*(N=25)*	*(N=12)*	*(N=4)*	*(N=4)*	
ONLINE		**Individual wildfire risk scores**					
		0	1	2	3	4	
Is wildfire a problem locally?	Yes	77%	13%	3%	0%	6%	*(N=31)*
	No	34%	27%	13%	10%	16%	*(N=77)*
		(N=50)	*(N=25)*	*(N=11)*	*(N=8)*	*(N=14)*	
LEGEND	0%	100%	Proportion of participants answering whether wildfire is deemed a problem				

Table 5.2 – The proportions of Dorset participants acknowledging a problem from those that answered each risk score.

Furthermore, considering how the perceptions varied within the samples, the responses to these risk questions were compared to participant characteristics. It must be noted that some of the sample sizes of the age groups are very small, thus these patterns may be unreliable. Moreover, there was also an under-representation of men which may influence reliability of the comparisons with gender.

Firstly, comparing the responses to age with whether wildfires were considered a problem (Table 5.3), shows a noticeable difference in the youngest age group (18-24) with a higher proportions of disagreement in both samples, especially in the in-person sample. The 25-34 in-person category also had more ‘no’ responses in the in-person sample. Individual risk scores were also compared to the participant’s age (Table 5.4). The younger participants again gave more low scores and fewer high scores. The online group had less difference between the ages, although the youngest age group had very few give the highest score.

Comparison of answers to whether wildfire is a problem and age [D]								
IN-PERSON		**Age group**						
		18-24	25-34	35-44	45-54	55-64	65+	
Is wildfire a problem locally?	Yes	11%	40%	60%	69%	65%	70%	*(N=52)*
	No	89%	60%	40%	31%	35%	30%	*(N=38)*
		(N=9)	*(N=10)*	*(N=15)*	*(N=16)*	*(N=17)*	*(N=23)*	
ONLINE		**Age group**						
		18-24	25-34	35-44	45-54	55-64	65+	
Is wildfire a problem locally?	Yes	50%	67%	68%	82%	58%	78%	*(N=75)*
	No	50%	33%	32%	18%	42%	22%	*(N=30)*
		(N=4)	*(N=12)*	*(N=19)*	*(N=33)*	*(N=19)*	*(N=18)*	
LEGEND		0%	100%	Proportion of participants from each age group				

Table 5.3 - Comparison of Dorset responses to whether wildfire was considered a problem locally and the participant’s age. For participants that provided an age, in-person N=90 (100%) and online N=105 (97%).

Comparison of answers to individual risk score and age [D]

IN-PERSON		Age group						
		18-24	25-34	35-44	45-54	55-64	65+	
Individual risk score	0	78%	70%	47%	38%	41%	48%	*(N=45)*
	1	11%	0%	40%	31%	35%	30%	*(N=25)*
	2	11%	20%	0%	25%	18%	9%	*(N=12)*
	3	0%	10%	0%	6%	0%	9%	*(N=4)*
	4	0%	0%	13%	0%	6%	4%	*(N=4)*
		(N=9)	*(N=10)*	*(N=15)*	*(N=16)*	*(N=17)*	*(N=23)*	

ONLINE		Age group						
		18-24	25-34	35-44	45-54	55-64	65+	
Individual risk score	0	24%	20%	19%	13%	19%	20%	*(N=47)*
	1	27%	33%	40%	37%	38%	33%	*(N=25)*
	2	18%	16%	18%	27%	18%	24%	*(N=11)*
	3	21%	22%	10%	7%	8%	10%	*(N=8)*
	4	9%	9%	13%	17%	17%	14%	*(N=14)*
		(N=4)	*(N=12)*	*(N=19)*	*(N=33)*	*(N=19)*	*(N=18)*	

LEGEND 0% 100% Proportion of participants from each age group

Table 5.4 - Comparison of Dorset responses to the risk wildfire posed to them and the participant's age. For participants that provided an age, in-person N=90 (100%) and online N=105 (97%).

Additionally, the responses were also compared to gender. Comparing how the responses varied by the gender of the participants (Table 5.5), shows both samples had less agreement from the male groups. Furthermore, comparing the individual risk scores with participant gender, there was no clear pattern (Table 5.6).

Comparison of answers to whether wildfire is a problem and gender [D]

IN-PERSON		Gender			ONLINE		Gender		
		Women	Men				Women	Men	
Is wildfire a problem locally?	Yes	62%	50%	*(N=52)*	Is wildfire a problem locally?	Yes	74%	67%	*(N=73)*
	No	38%	50%	*(N=38)*		No	26%	33%	*(N=28)*
		(N=58)	*(N=32)*				*(N=77)*	*(N=24)*	

LEGEND 0% 100% Proportion of participants from each gender group

Table 5.5 - Comparison of Dorset responses to whether wildfires were considered a risk and the participant's gender. For participants that provided a gender, in-person N=90 (100%) and online N=101 (94%).

Comparison of answers to individual wildfire risk scores and gender [D]

IN-PERSON		Gender			ONLINE		Gender		
		Women	Men				Women	Men	
Individual risk score	0	43%	63%	*(N=45)*	Individual risk score	0	47%	33%	*(N=44)*
	1	34%	16%	*(N=25)*		1	25%	21%	*(N=24)*
	2	14%	13%	*(N=12)*		2	8%	21%	*(N=11)*
	3	3%	6%	*(N=4)*		3	8%	8%	*(N=8)*
	4	5%	3%	*(N=4)*		4	13%	17%	*(N=14)*
		(N=58)	*(N=32)*				*(N=77)*	*(N=24)*	

LEGEND 0% 100% Proportion of participants from each gender group

Table 5.6 - Comparison of Dorset responses to the risk wildfire posed to them and the participant's gender. For participants that provided a gender, in-person N=90 (100%) and online N=101 (94%).

Comparing possible patterns in perceptions by location, the distribution of online participants lacking from postcodes in urban areas possibly suggests a selection bias indicating a lack of interest in the issue. Those in urban areas were less inclined to participate, perhaps because they did not associate the issue directly with where they live. Consequently, they may have believed the survey was not relevant to them (even though all residents were the target audience), or they simply lacked interest or concern in the issue. However, this could also be a function of the insufficient number of responses collected compared to the various postcodes and population size. On the other hand, the elevated interest from those in BH20, which is where Wareham is located, demonstrates a different possible selection bias, where a major local event may increase interest in engagement.

5.2.1.2 Type of concerns about wildfire

Participants were asked for their concerns regarding local wildfire. The types of concerns given between the samples were similar, hence the results are presented as the combined sample. The concerns raised reveal something about how residents frame wildfire hazards and shed light on the extent to which they believed they might be affected. The focus of the concerns included impacts nature, people, the immediate fire increasing (or becoming out of control), and the wider problem of recurrent fires on society (Figure 5.9). The vast majority showed concern for nature, although many also showed concern for human. Many gave a mix of both nature and people concerns across the two possible answers. A higher percentage gave only impacts on nature (27%) compared to concerns only for people (12%). The range of specific concerns are shown in Figure 5.10 and the proportions of participants who expressed each concern are shown in Figure 5.11.

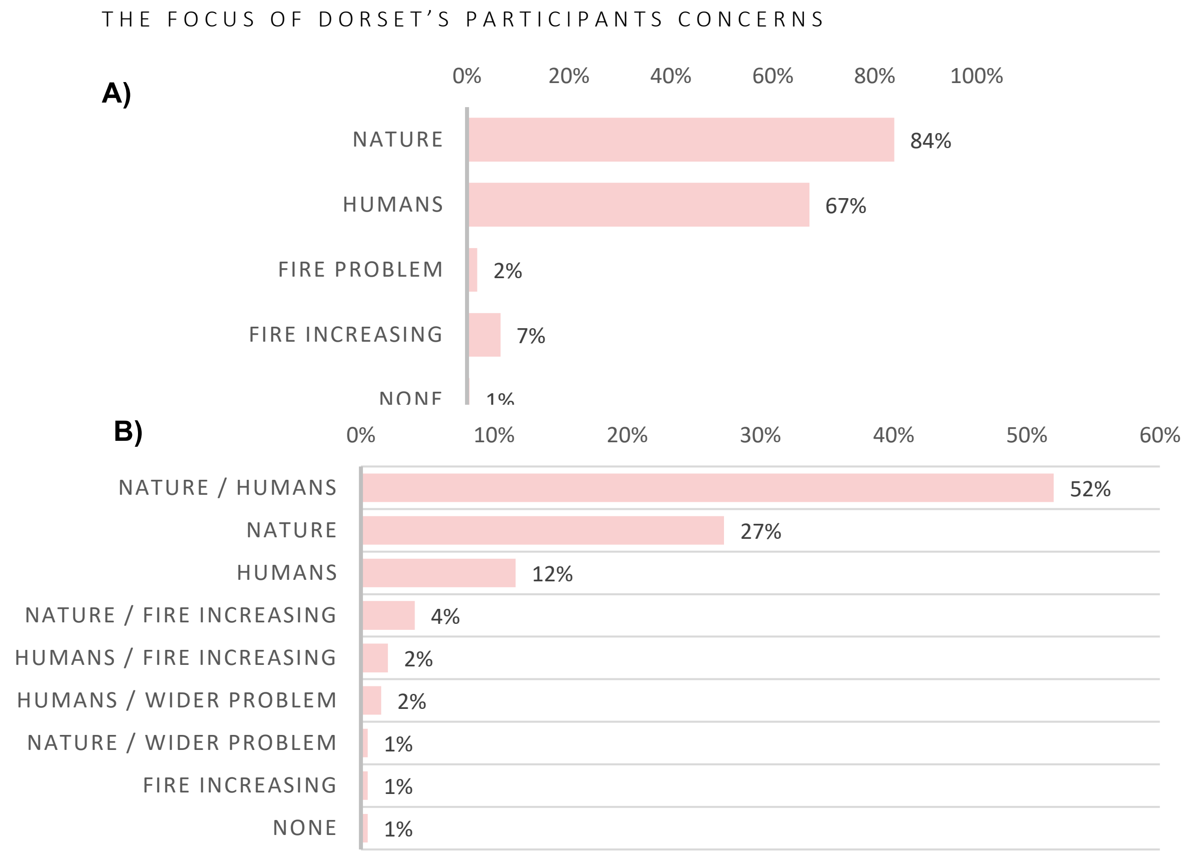


Figure 5.9 - Focus of Highlands' participants concern. A) The proportion of participants that expressed each type of concern, and B) the full focus of response across the two possible answers. Combined sample N=185.

THE RANGE OF SPECIFIC CONCERNS AROUND WILDFIRE OCCURRENCE RAISED BY DORSET PARTICIPANTS

All life	• General concern for life	
Nature	• Wildlife • Animals • Habitats • Plants • Environment	• Landscapes (heathland, woodland, countryside) • Long-term impact • Eyesore (diminished natural beauty) • Quality of environment (loss biodiversity, endangered species, vulnerable SSSI)

People (bodies)	• Safety of people
	• Their own safety
	• Health
	• Their own health
		• Other's safety
		  • Inc. family, friends, pets, walkers, children, vulnerable people
		  • firefighters

Human (built and social)	• Property generally • Their own property • Other's (those close to fires, or up mountain)	• Infrastructure, economic, disruption to area • Particularly, loss of amenities, forestry, and use of area; disruption and closing roads
Atmospheric	• Smoke, air quality, pollution • Climate change feedback	Air pollution, and contributing to climate change were key focuses, as well as accidents from smoke.
Wider problem	• Impacts on society of having fires, costs of fighting and remediation	
Fire increasing	• Ability to fight the fire • Fire getting bigger (impact more areas, or more severely) • Vulnerability (thatched properties)	

Figure 5.10 - Resulting codes from the specific concerns regarding local wildfire given by Dorset participants. For the combined sample, N=195.

DORSET TOP CONCERNS IN THE EVENT OF A LOCAL WILDFIRE

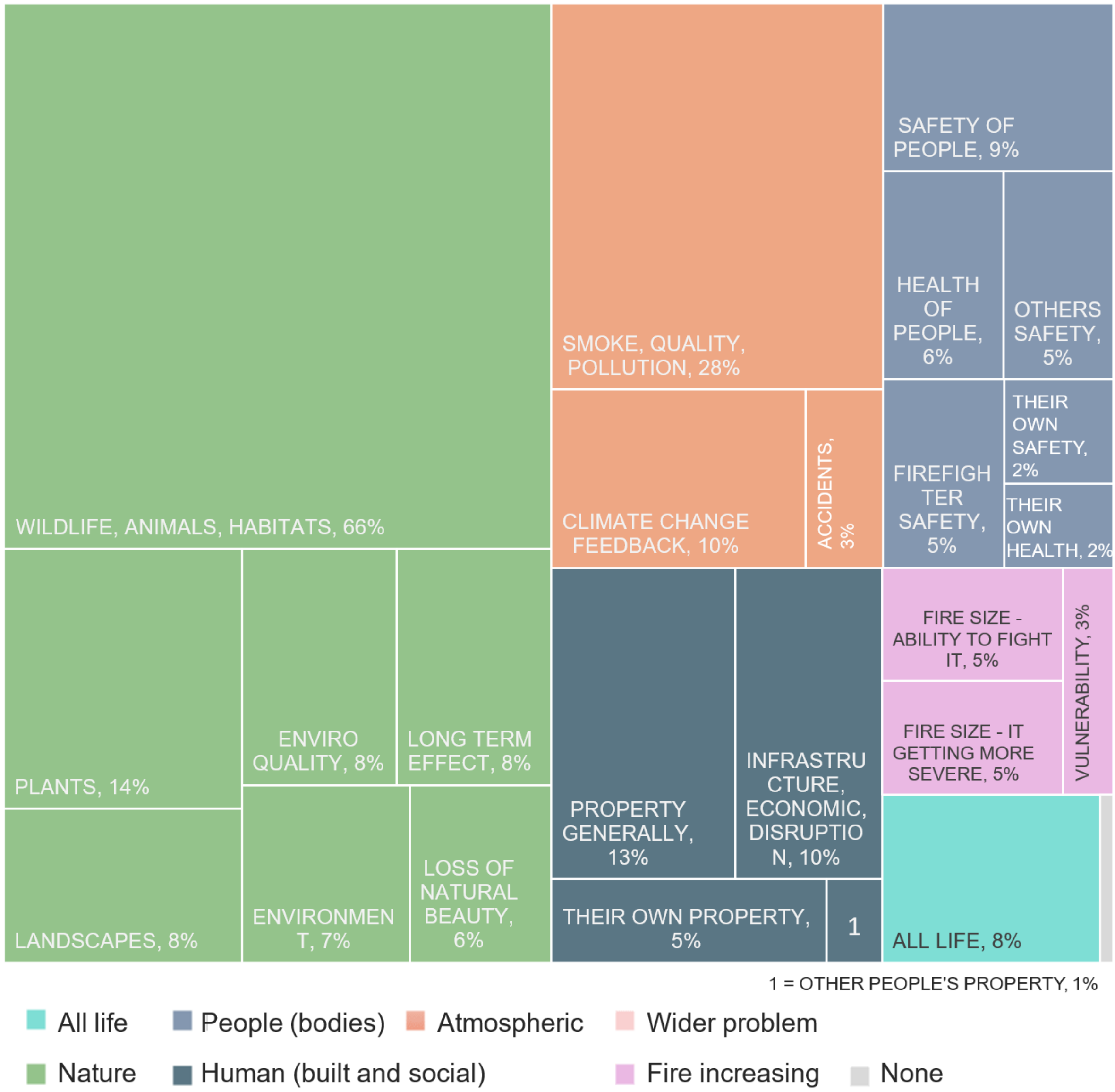


Figure 5.11 - Proportions of participants in Dorset raising each type of concern. For the combined sample, N=198. (Note participants could express up to two concerns, thus percentages will add up to more than 100%.)

Damage to nature was a predominant impact associated with wildfires in Dorset. The majority (66%) stating a concern for wildfire, animals, and habitats. There was also concern for plants specifically (14%), as well as the environmental quality, for example noting "*danger to rare species"* (DON100) and "*impact on SSSI*" (DON27). Some participants exclusively gave concerns for nature, for example one commented that, "*It's all environmental, so environment and wildlife*" (DIP4). When the focus was not on humans, with some participants explicitly stating that wildfires did not impact people and only occurred in natural areas away from communities, there was an 'othering' of the impacts, leading to a perceived lack of consequences. However, despite this 'othering' of the risk, it did not negate the care participants had for these areas, as they still placed value on them. For example, *With the small areas of heath and woodland we have left we can't afford to be complacent about wildfires*" (ON103). In fact, some demonstrated very high levels of concern for these non-human impacts, where images of fire trigger affect, "*Wildfires burn so indiscriminately, just devastation for environment and poor animals that cannot get away quick enough*" (DON13).

Heaths were an item of concern in participants minds, both for the biodiversity and impact on the amenities, for example, "*Damage to amenity and recreation areas*" (DON15). Another pointed out that "*Areas might become roped off or made inaccessible to the public to limit foul play/accidental ignition due to ignorance*." (DON40). There was value in these areas, for example another noted, "*We live on Lychett Bay nature reserve and so lots of other walking and cycling locally, plus we're nature lovers and I'd hate to see loss of habitat and death of vegetation and wildlife*." (DON40).

Despite a dominant focus on the environment, there were concerns raised that related to people. Notably, of those that gave an impact on humans, there were more that gave one on the built and social environment (46%) than impacts directly on people such as safety or health (31%). That is, of those that gave any human impact, 47% said one on bodies and 69% said one on human built environments. Notably, some noted their own thatched properties as the concern, exemplifying awareness of a perceived vulnerability. Much of the concerns regarding safety were directed towards others, especially firefighters and emergency services.

Furthermore, there were significant concerns about smoke and pollution, some explicitly referencing climate change feedback, as well as air quality. For example, "*Toxic smoke, SIGNIFICANT air pollution*." (DON46) and "*Smoke* inhalation" (DON107). These are a demonstration of an impact where there is more widespread concern for direct consequence on people and themselves. And there was an appreciation for the wider reaching consequences of this effect "*A great many more people are at risk from the air pollution caused by these fires & can affect areas far from the area of the fire depending on the wind strength & direction*." (DON53). Lastly, there were also concerns for the characteristics of the wildfires, that is, incidents getting larger or out of control. For example, "*The speed, means wiping everything out and dangerous to firefighters*" (DON3).

5.2.1.3 Months with the highest perceived wildfire risk

Participants were asked the months considered to have the highest wildfire risk, giving up to two (Figure 5.12). The two samples gave very similar responses, where the vast majority picked summer months, specifically July and August. There were also participants that selected June and May. There was some range in the months chosen, in-person ranging from April to September and online ranging from February to September, although very small proportions chose months beyond those aforementioned.

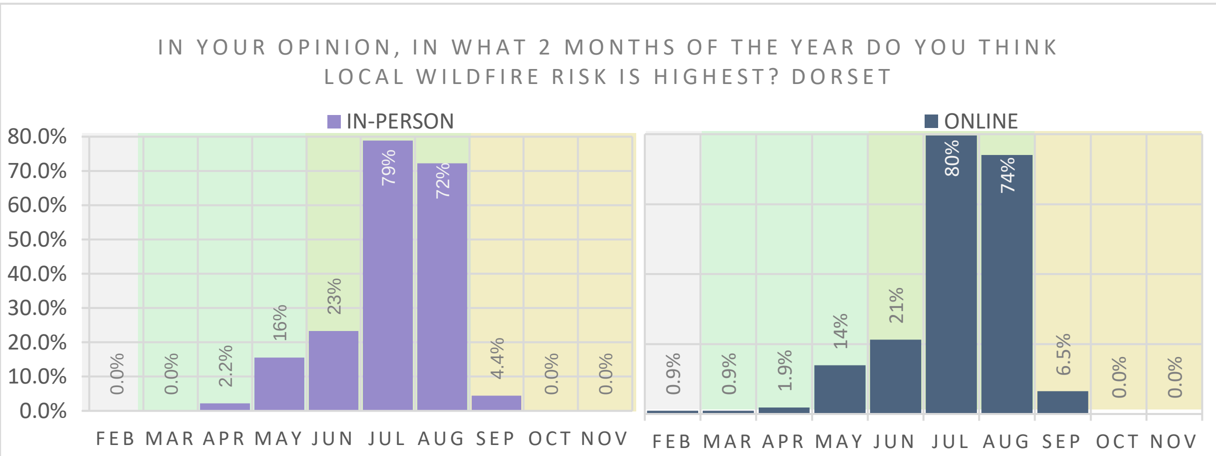


Figure 5.12 - Dorset participants' responses to the months with the highest risk. For in-person, N=90 and online N=108 samples. (Note participants could pick up to two months so percentages will add up to more than 100%.)

Participants could select two months, examining the chosen pairs of months with highest risk Table 4.6, shows that most gave two consecutive months, possibly showing that the risk was seen as mostly within the same season or at one time of year. The top three most common pairs were the same across the two samples, and the majority of participants across both samples choosing July and August.

Most common responses from Dorset participants to months with highest wildfire risk			
IN-PERSON		ONLINE	
July + August	61%	July + August	64%
June + July	16%	June + July	13%
May + June	8%	May + June	7%
May + August	4%	August + September	6%
August + September	4%	May + August	3%
April + May	2%	April + May	2%
	95%		*95%*

Table 5.7 - The six most common pairs of months chosen by Dorset participants as having the highest wildfire risk. For in-person N=90 and online N=108 samples.

Many participants therefore associate summer as the time of wildfire risk. Comments made which exemplify this include one participant that selected July and August remarked, "*generally see them in summer*" (DIP11). One noted seeing a specific event as the basis for their answer, "*well I saw Wareham around spring or early summer*" and picked May and June (DIP34). There were some comments that suggested the months were given by assumptions rather than knowledge, for example, "*I wouldn't know, I guess they would happen in summer*" (DIP88). Similarly, there was also comments about the association of summer with heatwaves behind the logic of when they pick times of high risk stating, "*I guess whenever there's heatwaves, June and July*" (IP24).

Comparing these perceptions to wildfire records shows a potential disparity between perception and reality. FRS data for England (FCE, 2022), as well as data from the UHP for heaths in Dorset (Panter, 2018; Panter & Caals, 2023) note that both fire occurrence and the size of fire peaks in April. Whereas there is the widespread association of fire risk in summer by participants here. Admittedly, there are intermittently peaks in summer such as the summer of 2018 (FCE, 2022), as well as records of wildfires on urban heath showing a peak in the summer of 2020 (Panter & Caals, 2023). While April is generally the month with the highest, the notable events in summer are more newsworthy and draw more attention, thus become the focus of perceptions. This idea supports comments where months were given based on memory of recent events like Wareham in May 2020. This potentially demonstrates a focus on the severe rather than probability in ascertaining the greatest timing of risks, although this may be a subconscious preference in their risk framing.

5.2.1.4 Follow-up, repeating answers at another time of year

A small proportion went onto complete a follow-up survey in Dorset, in which the two questions about risk were repeated. It is important to note the very small sample sizes for these questions, so the findings are extremely tentative. Firstly, when participants were asked if they considered wildfire a problem for the area the overall proportion of yes answers in both samples decreased (Figure 5.13), by 8% and 10% for the in-person and online respectively. Looking at the paired answers across the original and follow-up surveys, generally responses shift from yes to no, 25% in-person and 19% online, although there were some that shifted in the opposite direction.

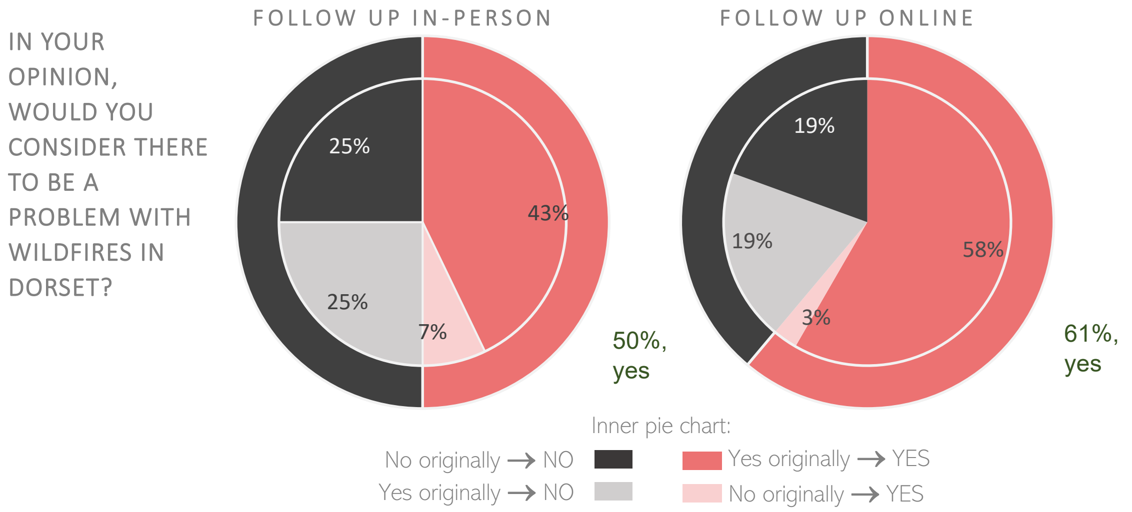


Figure 5.13 - Dorset follow-up responses to whether wildfires are a problem. For in-person follow-up sample N= 26 and online follow-up sample N=35.

Secondly, in the repetition of the individual wildfire risk scores there were similar decreases perception of the hazard, with overall decreases in scores. Where low scores (0 and 1) increased by 8% in-person and 6% online. As both samples demonstrate a similar pattern, these winter (December) results demonstrate there is some general concern through the year, but it is elevated in summer (original survey in June). Further investigation is needed to compare spring and summer risk perceptions. However, based on the question about risk throughout the months, summer wildfire risk may be more prominent in residents' minds.

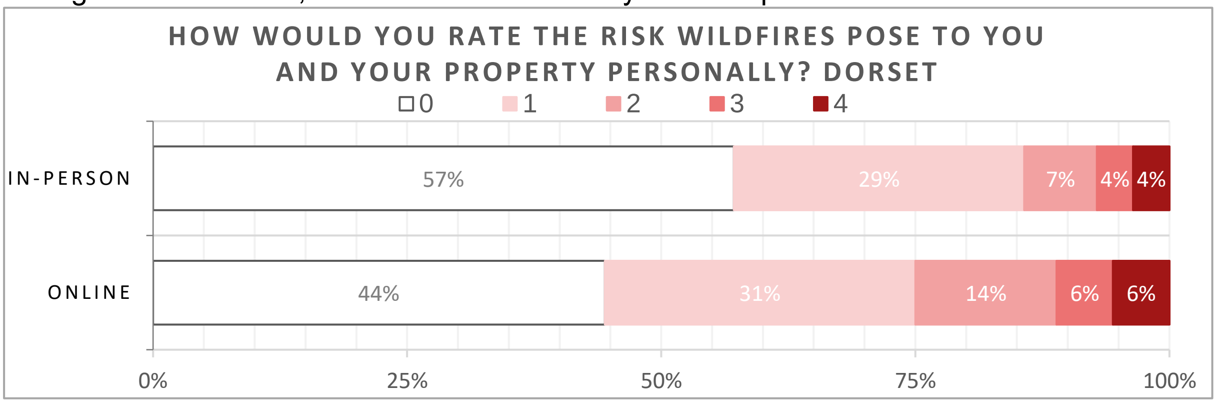


Figure 5.14 – Dorset follow-up survey responses to level of individual wildfire risk. For in-person follow-up sample N= 26 and online follow-up sample N=35.

5.2.2 Familiarity and awareness of local wildfire occurrence

5.2.2.1 Visibility of wildfire in Dorset

Beyond understanding participants' beliefs about the local wildfire hazards, another key aim was to ascertain their familiarity and awareness of these risks. One metric of this the extent to which wildfire had been seen in the area. There was a reasonable proportion of participants in each sample that had seen a wildfire or seen a scar, that is, 61% in-person and 77% online (Figure 5.15). There was a noticeable difference between the samples, more in-person had not seen a wildfire with fewer having seen multiple, although similar proportions had seen either one or scars of wildfire.

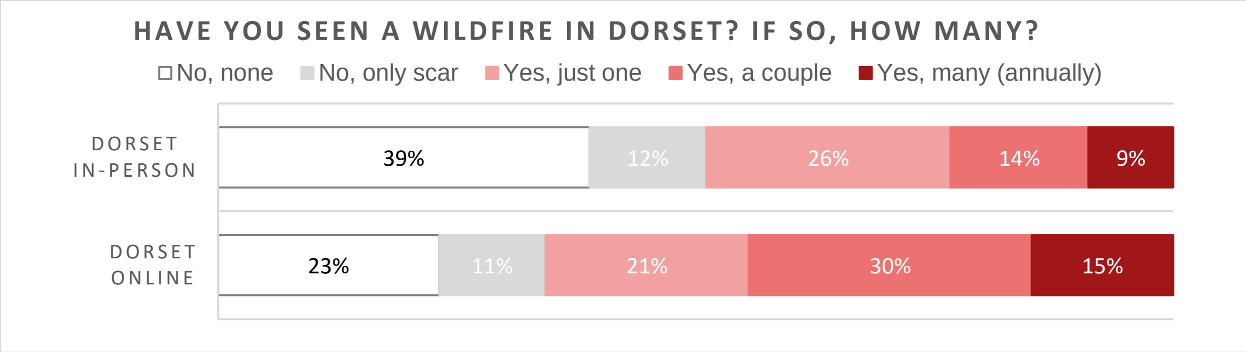


Figure 5.15 - Dorset participants' responses to whether they had seen a wildfire locally, where in-person N=90 and online N=108.

Comments made in-person reveal more about the visibility of wildfire in Dorset. There was a sense of familiarity from some participants, who recalled specific events or places, such as, "*Yeah in Studland*" (DIP6). There were many that specifically mentioned Wareham, which was also a key talking point elsewhere, including for those who noted higher risk perception, "*Well I saw the aftermath of the one in Wareham, it was so sad*" (DIP2). Contrastingly, those that had not seen wildfire demonstrated a lack of familiarity. One commented, "*No never, and I didn't even realise it was a thing*" (DIP69). Others that said no did comment on hearing about them, even if they had not personally seen, suggesting some indirect familiarity, "*No not near me, although I have heard about them and think one happened in one of the heaths I go to*" (DIP79).

The responses to whether participants had seen a wildfire and whether they were considered a problem were compared (Table 4.7). Across both samples, the group that responded no to problem had greater proportions stating they had not seen wildfire and a lack of participants that had seen many. This suggests that greater visibility possibly leads to awareness of a problem.

Comparison of answers to whether wildfire had been seen locally and if it is considered a problem [D]							
IN-PERSON		**Whether participants had seen a wildfire**					
		No, none	No, only remains	Yes, just one	Yes, a couple	Yes, many / annually	
Is wildfire a problem locally?	Yes	15%	15%	37%	17%	15%	*(N=38)*
	No	71%	8%	11%	11%	0%	*(N=52)*
		(N=35)	*(N=11)*	*(N=23)*	*(N=13)*	*(N=8)*	
ONLINE		**Whether participants had seen a wildfire**					
		No, none	No, only remains	Yes, just one	Yes, a couple	Yes, many / annually	
Is wildfire a problem locally?	Yes	8%	12%	22%	38%	21%	*(N=31)*
	No	61%	10%	19%	10%	0%	*(N=77)*
		(N=25)	*(N=12)*	*(N=23)*	*(N=32)*	*(N=16)*	
LEGEND		0%	100%	Proportion of participants answering whether wildfire is deemed a problem			

Table 5.8 - Comparison of Dorset participant responses to problem and seen questions. For in-person N=92 and online N=330.

Moreover, comparing those that had seen some sign of wildfire in the area (wildfire or a scar) with months perceived to be highest risk, implied that seeing wildfire created awareness for springtime risk. However, those that had not seen any sign of wildfire gave almost exclusively summer months. This possibly suggest that there is an assumption of summertime risk, where seeing wildfire creates awareness beyond this time that an individual did not have or makes this time of year more memorable and hence is recalled for this question. However, there may be more influence this perception, such as news stories of large events.

Comparison of answers to whether wildfire had been seen locally and opinion on months of highest risk [D]				
	IN-PERSON		ONLINE	
	Not seen	Seen some sign of fire	Not seen	Seen some sign of fire
Feb	0%	0%	0%	1%
Mar	0%	0%	0%	0%
Apr	0%	4%	0%	2%
May	0%	22%	8%	15%
Jun	20%	13%	12%	12%
Jul	74%	55%	72%	63%
Aug	6%	7%	8%	6%
Sep	0%	0%	0%	0%
Oct	0%	0%	0%	0%
Nov	0%	0%	0%	0%
Legend	0%	100%	Percentage of participants that either had or had not seen wildfire	

Table 5.9 - Comparison of Dorset participant responses to whether they had seen a sign of wildfire with answers to the months with the highest risk. For in-person N=90 and online N=108.

Moreover, whether they had seen a wildfire locally were compared with some demographic characteristics. Firstly, looking at how the various age groups responded to having seen a wildfire (Table 5.10), there were much higher proportion of participants from the youngest group that had not seen a wildfire in both samples. Where the next youngest age category also had a higher proportion stating they had not seen in the in-person sample only. Next, comparing responses to this question from each of the gender groups found no clear trend (Table 5.11).

Comparison of answers to whether participants had seen a wildfire and their age [D]								
IN-PERSON		Age group						
		18-24	25-34	35-44	45-54	55-64	65+	
Whether seen a wildfire locally	Yes, many / annually	0%	10%	13%	13%	6%	9%	*(N=32)*
	Yes, a couple	0%	0%	13%	13%	18%	26%	*(N=32)*
	Yes, just one	11%	10%	20%	44%	18%	35%	*(N=6)*
	No, only remains	11%	0%	20%	13%	18%	9%	*(N=10)*
	No, none	78%	80%	33%	19%	41%	22%	*(N=12)*
		(N=12)	*(N=8)*	*(N=9)*	*(N=19)*	*(N=21)*	*(N=23)*	
ONLINE		Age group						
		18-24	25-34	35-44	45-54	55-64	65+	
Whether seen a wildfire locally	Yes, many / annually	0%	25%	21%	15%	5%	11%	*(N=241)*
	Yes, a couple	0%	17%	26%	33%	26%	44%	*(N=58)*
	Yes, just one	0%	8%	26%	21%	32%	22%	*(N=8)*
	No, only remains	25%	17%	11%	15%	5%	6%	*(N=5)*
	No, none	75%	33%	16%	15%	32%	17%	*(N=11)*
		(N=33)	*(N=45)*	*(N=62)*	*(N=60)*	*(N=72)*	*(N=51)*	
LEGEND	0%	100%	Proportion of participants from each age group					

Table 5.10 - Comparison of responses to whether they had seen a wildfire locally with participant age. For participants that provided an age, in-person N=90 (100%) and online N=105 (97%).

Comparison of answers to whether participants had seen a wildfire and their age [D]				
IN-PERSON		**Gender**		
		Women	Men	
Whether seen a wildfire locally	Yes, many / annually	7%	13%	*(N=8)*
	Yes, a couple	19%	6%	*(N=13)*
	Yes, just one	24%	28%	*(N=23)*
	No, only remains	16%	6%	*(N=11)*
	No, none	34%	47%	*(N=35)*
		(N=58)	*(N=32)*	
ONLINE		**Gender**		
		Women	Men	
Whether seen a wildfire locally	Yes, many / annually	8%	33%	*(N=14)*
	Yes, a couple	38%	8%	*(N=31)*
	Yes, just one	19%	29%	*(N=22)*
	No, only remains	12%	13%	*(N=12)*
	No, none	23%	17%	*(N=22)*
		(N=77)	*(N=24)*	
LEGEND	0%	100%	Proportion of participants from each gender group	

Table 5.11 - Comparison of Dorset responses to whether they had seen a wildfire locally with participant gender. For participants that provided a gender, in-person N=90 (100%) and online N=101 (94%).

5.2.2.2 Familiarity with influences on local wildfire

To further ascertain participants' level of familiarity and knowledge with local wildfire, they were asked what influence was most important. The groups of original multiple-choice answers included weather, build-up of vegetation, time of year, ignitions by people, and a combination. In addition, Dorset participants added factors related to land management (Figure 5.16). 83% of in-person choices were multiple-choice options compared to 94% of online. The vast majority of the more specific factors given beyond the multiple-choice fitted into the existing groups, suggesting they were more detailed answers given more easily when face-to-face rather than differing in content.

Factors chosen by Dorset participants as most important for wildfires locally						
Group	Weather	Build-up of fuel	Time of year	Land management	Other people affecting ignitions	Combination
Subgroup	Dry Weather	Build-up of vegetation	Time of year	*Poor land management*	Any ignition by humans	Combination of hot, dry weather, build-up of vegetation, time of year, and or people ignitions
	Hot weather			*Blame forestry*	*Negligence*	
					Barbeques	
				Developers	*Camping*	
					Tourists	
	2	**1**	**1**	**3**	**5**	**1**

Figure 5.16 – The most important factors for local wildfire according to Dorset participants (across both samples). Factors raised by participants (and not multiple-choice options) in italics.

The proportions of participants that gave a response from each category as well as the proportions that gave the specific factors are shown in Figure 5.17. Ignitions by people were given by a vast majority of participants in both samples (Figure 5.17A), as well as weather although to a slightly lesser extent. The online group had a higher majority noting ignitions by people. Examining the specific factors given (Figure 5.17B), barbeques were the most common more specific human ignition risk factor, followed by tourists and negligence. Moreover, dry weather was more common than hot weather.

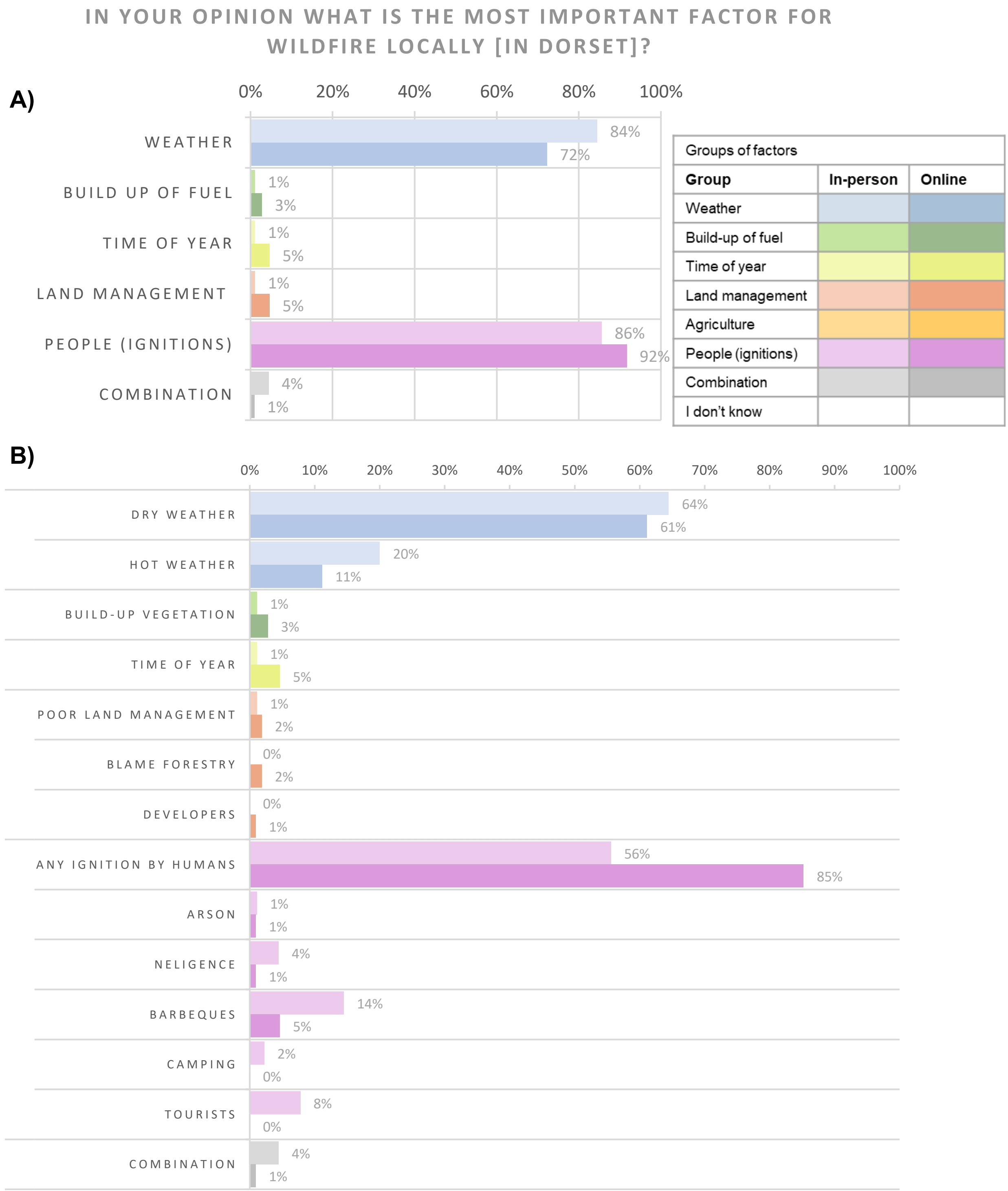


Figure 5.17 - Dorset participants' responses to the most important factor for wildfire locally, showing firstly, (A) the proportion of participants that gave a factor from within a group and secondly, (B) the proportion that gave each specific factor. Combined sample, N=198.

Disposable barbeques were blamed for local problem and there were many comments about the need to ban these. For example, "*I would like a UK wide ban on disposable barbecues. There are fires every year in Dorset and disposable barbecues are nearly always to blame, I believe they banned sale of them in Purbeck....but it was dead easy to buy one in Dorchester and take it anywhere you liked!*" (DON103). Another saying, "*Disposable BBQs must be banned as they create high risk of wildfires. See Wareham Forest Wildfire in Dorset* *in 2020*" (DON49). Notably this indicates the dissemination of information regarding previous events shaping knowledge. One participant noted hearing of this in the media, "*There is much on the media about the causes barbecues etc*." (DON53). This demonstrates the role media has in shaping awareness of natural hazards in the UK. Moreover, there were also calls for more education in relation to these ignitions, one noting "*Carelessness and stupidity has long been the root cause of the fires. More education regarding the dangers of starting fires and having barbeques is needed in the same way as education about the dangers of the sea, its tides and currents as well as running water*." (DON44).

Beyond these human ignitions, weather was a very common factor in both samples, particularly dry weather. The majority of participants answered in similar ways, that is weather or a human ignition factor, or a combination of both. There was relatively little mention of vegetation or land management factors, the small minority that did attest to it, blamed organisations responsible for managing land, "*The biggest cause of wildfires is poor management and infrastructure of the organisations tasked with managing the forests and heathlands*" (DON22). One participant showing contempt with the Forestry Commission, arguing to "*sack the Forestry Commission*" (DON72).

Participants were able to provide two responses, the most common pairs are shown in Table 5.12. Ignitions by people and weather were the most common and was chosen by a majority. Ignitions by people alone was somewhat common in both, and two weather factors was highlighted by some in-person.

Most common full responses from Dorset participants on factors for local wildfire risk		
	IN-PERSON	ONLINE
People *and* weather	61%	64%
People just one	16%	19%
Weather two	10%	2%
People *and* Time of year	1%	5%
Combination	4%	1%
Weather just one	2%	2%
People two	3%	1%
People *and* land management	1%	2%
Weather *and* build-up of fuel	1%	1%
Weather *and* land management	0%	2%
	99%	*99%*

Table 5.12 – Dorset participants full answer to most important factors. Combined sample, N=198.

Subsequently, developing further insight into participants' understanding of wildfire influences, a question was posed to ascertain beliefs of climate change influence on current and future wildfire activity (Figure 5.18). There was relatively high agreement where half agreed current had been affected and only 22% disagreed. Agreement increased when the question was from towards the future, where 75% agreed and 11% disagreed. This suggests that many believe climate change to be a significant contributor to fire risk. The increased number agreeing for the future suggests that disagreement to current influence of climate change is simply a notion of it not having an effect *yet*.

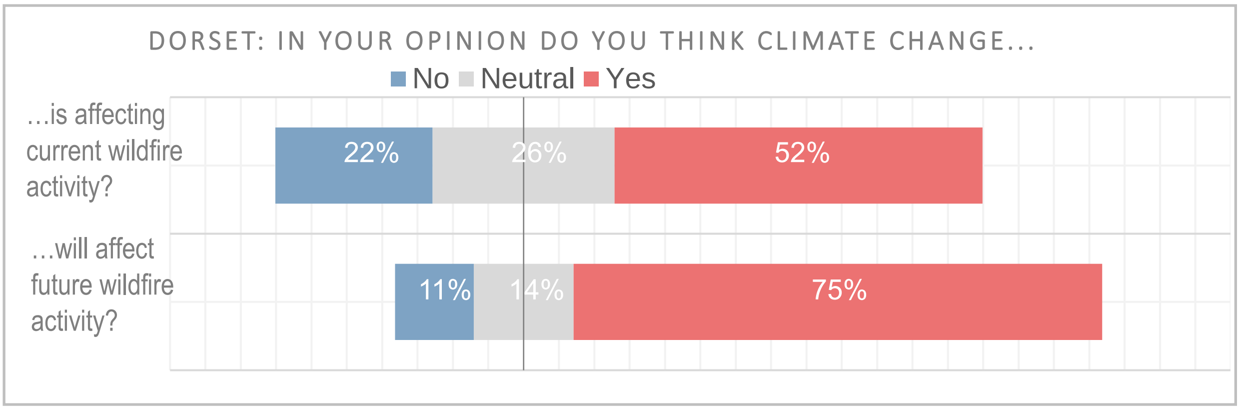


Figure 5.18 – Dorset participant responses to belief of influence of climate change on local wildfire activity. For the combined sample, N=198.

Having said that, possible justification for disagreement to these questions could be related to a disagreement with climate change science or about the influence on wildfire specifically. In the follow-up there was the opportunity to ask whether participants believed climate change to be affecting the area, and then wildfire (Figure 5.19). The responses show that very few disagreed with climate change changing the area in the future, but more disagreed that it would affect wildfire; 93% agreed climate change would affect the area, whereas 72% agreed it would affect wildfires in the area.

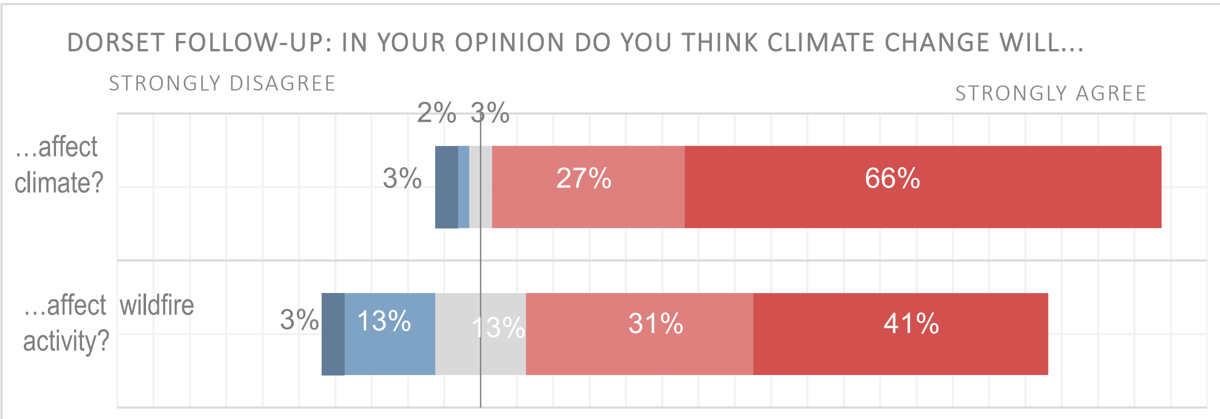


Figure 5.19 - Dorset follow-up responses to whether they believe climate change to be affecting the area, as well as wildfire. Follow-up combined sample N=61.

Comments made around wildfires and climate change in Dorset explain some of the possible reasonings. For most, there was agreement over the influence of climate change on wildfire in Dorset, more so for the future, comments made demonstrate this concern, one stating, "*Yes, it's very worrying to think of the increased risk and frequency due to climate change*" (DIP43). This indicates those with concern for climate change may be more likely to have concern for local fire risks. There were also links to awareness of foreign changes associated with climate change contributing to awareness of occurrence and consequences more locally. For example, a participant commented, "*I saw the impact first hand of the huge fires in the south of France this year and this is something we now need to think about here. That is a scary thought*" (DON99). Moreover, there was a comment which suggests that acknowledgement of increasing wildfire activity may influence perceptions of climate change, where one participant argued: "*If this is about global warming then everyone needs to think what are they doing.*" (DON29).

Alternatively, for some there was only partial agreement, for instance, accepting an influence of climate change and general increase in the area, but acknowledging climatic factors are not alone responsible. For example, owing changes to a combination of factors, one stating, "*the impact of climate change and human behaviour has made it much more dangerous and unpredictable*." (DON19). Another participant similarly commented, "*I have lived in an area of high risk for a long time. The fires seem to have increased. Some years more than others. We cannot totally blame global warming. The causes are nearly always reported as being a result of human action*." (DON53). This last point also demonstrates a theme in public understanding of wildfire occurrence where causal issues are misinterpreted; as Jones *et al*., (2023) argues, the idea of influences on longer time scales versus ignitions as 'causes'.

Contrastingly, there was disagreement with the influence of climate change on wildfires, although admittedly by only a small number of Dorset residents. There was a small portion that that disagreed climate change was affecting the area, or disputed climate change science outright (disagreeing with influence on the area in the follow-up). There were more that disagreed with its influence on only wildfire. Comments made allude to possibly justifications for this, for example, one participant commented on their observations which did not suggest to them there had been changes, "*I have lived in this location all of my life. There have always been wildfires long before all of the concerns re global warming*" (DON44). This also points to the fact that individuals may trust their own knowledge or observations over technical evidence.

Participants that were undecided in the original survey questions, or neutral in follow-up, were larger than the group that disagreed in some cases. This suggests that there is perhaps uncertainty around the influence of climate change more than mere disagreement. Comments made suggest that a lack of first-hand knowledge may explain this, "*I wouldn't know what it means for the UK, I've never thought about it.*" (DIP50), another noting, "*Well maybe in the future, but up till now I would have no clue*." (DIP1). There was also suggestion about uncertainty specifically on the consequences for Britain, where an individual may be agreeable with climate change affecting wildfire elsewhere but are unsure more locally where any change would not compare, "*not like in Australia, California*" (DIP240). This also points to a disconnect between wildfires in Britain compared to other countries.

5.2.3 Awareness and interest in Firewise and mitigation actions

5.2.3.1 Awareness of Firewise

A key interest of this case study was to ascertain familiarity with, as well as attitudes towards Firewise UK. Firstly, participants were asked if they had heard of Firewise (Figure 5.20), whether that is UK or USA, the majority (over 90%) had not heard of it. There was a fraction more that said they had heard of Firewise in the online sample (3% difference).

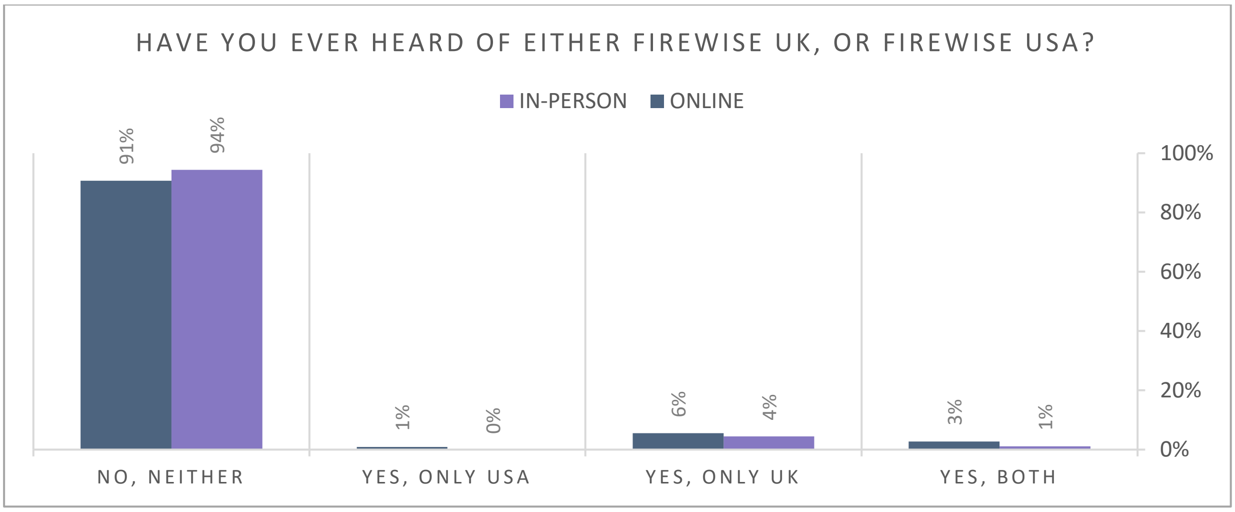


Figure 5.20 – Whether participants had heard of Firewise UK or USA. For in-person N=90 and online N=108.

Details of the few that had heard of Firewise were examined, including comparison to postcode, and whether the response was flagged for some involvement with wildfire (Table 5.13). 9 of the 15 respondents that had heard of Firewise were responses that were flagged for doing work involving wildfire. Looking at the 6 remaining participants, there were many that had a BH20 postcode, one from BH21, and one from DT10. BH20 was the location of Wareham Forest Fire, so it could be that due to some outreach or research by them on local information regarding wildfire, they came across Firewise.

Details on participants that had heard of Firewise				
Heard of Firewise	Sample	Postcode	Flagged response	Reason flagged
Both	In-person	BH20	Yes	Firefighter
Both	Online	BH21	Yes	Volunteer (Forestry England / Council rangers)
Both	Online	DT10	No	
Both	Online	BH20	Yes	
Only UK	In-person	BH14	Yes	Police officer
Only UK	In-person	BH12	Yes	The council
Only UK	In-person	BH21	Yes	Retired police officer
Only UK	In-person	BH20	No	
Only UK	Online	BH21	Yes	Countryside officer
Only UK	Online	BH2	Yes	Forester
Only UK	Online	BH15	Yes	Firefighter
Only UK	Online	BH18	Yes	Volunteer (Countryside Team)
Only UK	Online	BH20	No	
Only UK	Online	BH20	No	
Only USA	Online	BH21	No	

Table 5.13 – Comparing those that have heard of Firewise to possible exposures to the information, including work with wildfire and location.

5.2.3.2 Willingness to take part in Firewise

Next, participants were asked if they were interested in joining a scheme like Firewise (Figure 5.21) as well as explaining this choice. There were mixed results, 38% of the in-person group said yes and 39% said no; then 54% of online group said yes and 24% said no. Thus, the online group showed more interest, including a higher proportion of definite agreement compared to partial. In a previous study by UHP (Firewise) focusing on two roads adjacent to heaths identified as high risk (Lewis 2018), 15 out of 22 household (68%) expressed interest in helping with project. This study covered a much larger area with a variety of perceptions of risk. This suggests that more specific localities more adjacent to high-risk areas would have greater proportion of interest. This might include, next to heaths, and suggested by the high number of responses from BH20, potentially close to Wareham or other locations that have recently experienced a wildfire event (especially if more severe).

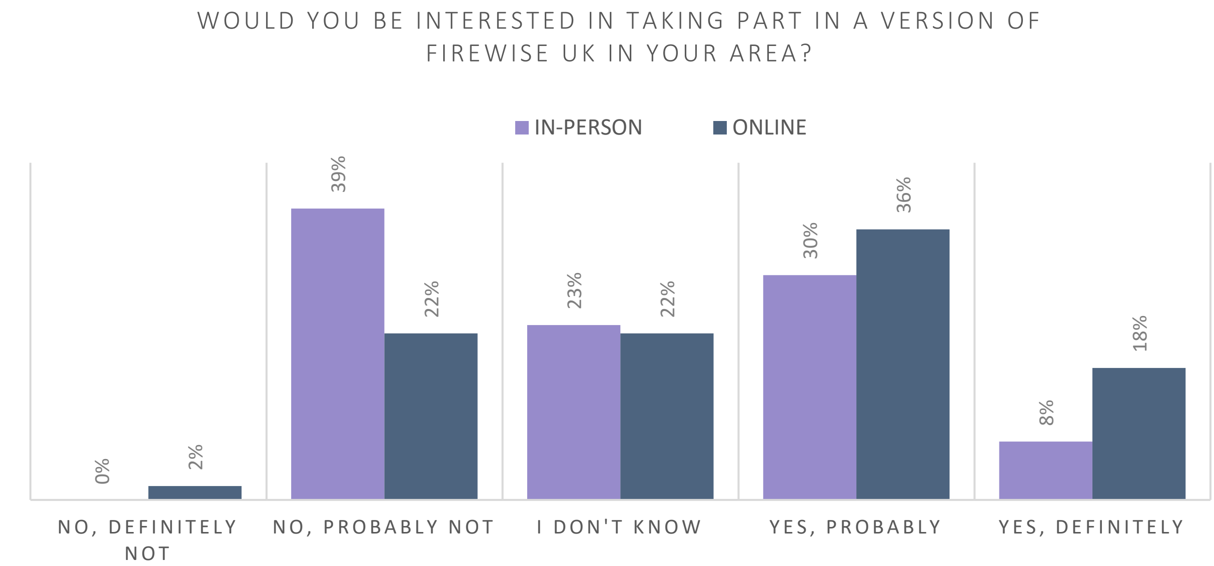


Figure 5.21 –Dorset participants interest in taking part in Firewise. For in-person N=90 and online N=108.

The explanations for this question were coded, including giving a summarising overall sentiment. The sentiment in the explanation was compared to the closed-question responses (Table 5.14). Almost all of the negative responses were tentative rather than definite, possibly due to politeness in response to the closed-ended question and a reluctance to completely dismiss the idea of participating. Moreover, the majority of those that answered “I don’t know” gave reasons for not getting involved, again possibly reflecting politeness.

Sentiment identified in explanations of willingness to take part in a Firewise-like scheme, compared to actual response						
IN-PERSON		**Actual response given**				
		No, definitely not	No, probably not	I don’t know	Yes, probably	Yes, definitely
Sentiment identified	Reason for taking part		-	-	100%	100%
	Unsure		-	33%	-	-
	Reason not to take part		100%	67%	-	-
ONLINE		**Actual response given**				
		No, definitely not	No, probably not	I don’t know	Yes, probably	Yes, definitely
Sentiment identified	Reason for taking part	-	-	4%	100%	100%
	Unsure	-	4%	33%	-	-
	Reason not to take part	100%	96%	63%	-	-

Table 5.14 – Type of explanation to reasonings level of interest in Firewise (Dorset) compared to closed question response.

The explanations were coded to discern the factors motivating interest or contributing to a lack thereof (Figure 5.22). Common reasons raised included, a push factor or lack thereof, an opinion about the approach, a general interest in knowledge, ability to help, and having mixed opinion or being undecided.

REASONS FOR, OR AGAINST, INTEREST IN TAKING PART IN A LOCAL FIREWISE SCHEME

GROUP OF REASONS	REASONS FOR TAKING PART	REASONS FOR NOT TAKING PART
PUSH FACTOR, OR LACK OF	Concern for risk to themselves Concern for fire activity Concern for area, heaths, nature	No risk concerns, or feel unaffected Do not feel at risk, but still positive
OPINION ABOUT APPROACH	Discontent with current management Want locals involved, 'joint' responsibility In favour of education / awareness	Doubt in Firewise Think other management needed Believe others responsibility Believe others need educating
INTEREST IN KNOWLEDGE, GENERAL OR SPECIFIC	General interest for extra knowledge, useful Want to know causes/impacts Want to know what they can do	
ABILITY TO HELP	Has spare time Already involved	Lack time or ability
MIXED	Lack time, but still positive and possibly willing	
UNDECIDED		Unsure what it entails

Figure 5.22 – Overview of the reasons for whether interested or not in getting involved with Firewise.

The reasons given for those that answered "yes" to taking part are shown in Figure 5.23. The most common reason was an interest in extra knowledge. While direct concern about fire was a key driving factor for interest and mentioned by 26%, there were other more general motivators mentioned by 24%, including general concerns for areas, heaths, or nature. Notably, 8% gave the fact they had free time and wanted to do stuff in the area, demonstrating that motivation may not be wildfire specific.

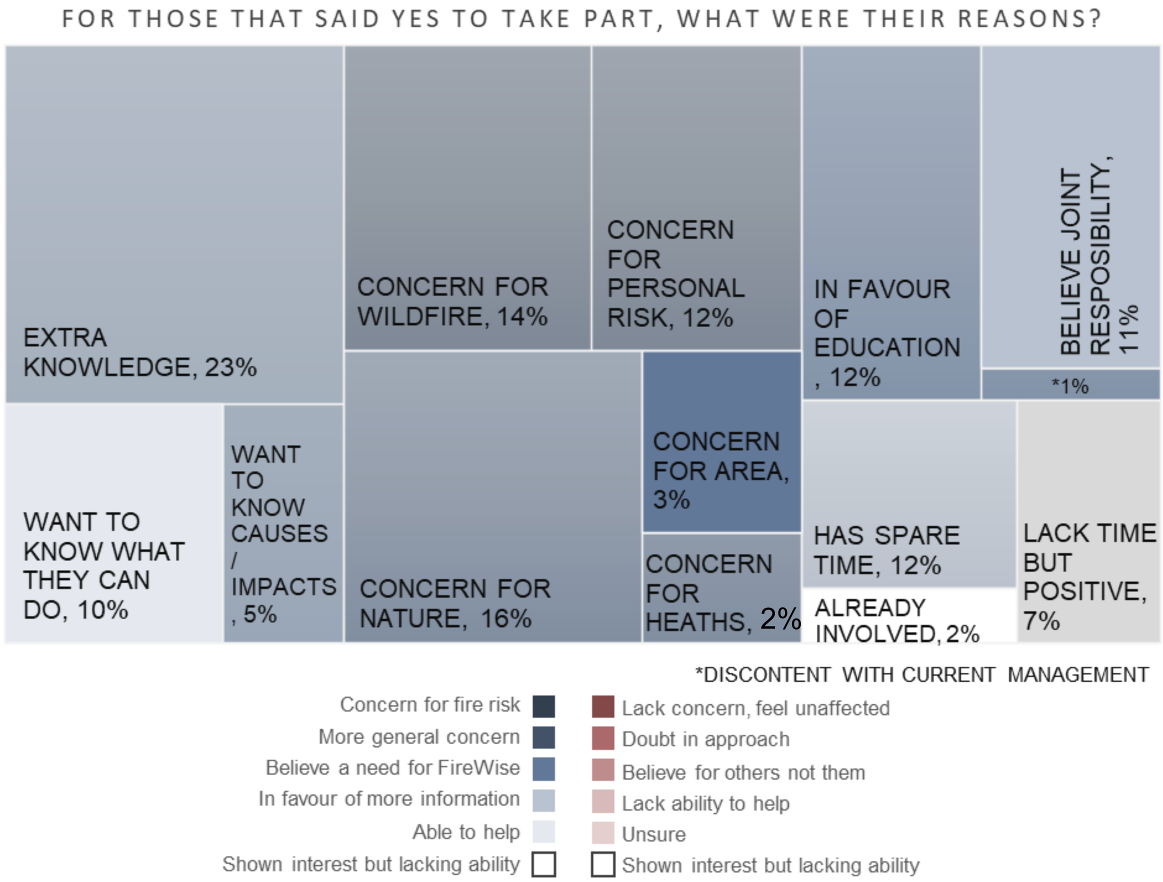


Figure 5.23 - Dorset participants' reasons for interest in a Firewise scheme. For those that answered "yes" (probably or definitely) to being interested in taking part, N-92.

The extra knowledge was perceived as useful, especially if they had no previous knowledge. For example, one participant noted it is "*Good to know this stuff. I have no knowledge and have never even considered wildfires to be a serious risk in this area. All knowledge is good*" (DON9). There were also comments about wanting knowledge on what they could do including to prevent occurrence or reduce the impacts. For example, one noted, "*I'd like to learn more about the causes, impacts and preventions and be able to put those preventions in place when needed. I'd like to be aware of any dangers my actions could cause in terms of animal habitation and vegetation growth.*" (DON69); another noted, "*If I can help reduce the impacts I am keen*" (VIP21). Notably 7% noted a lack of time but were still interested. This suggests there may be more that would be open to education on this topic and there is appetite for this, although it may unlikely there would be full engagement in mitigation.

Concern for fire risk, as well as specific risk to themselves were key driving factors for interest. Where concern over the fire problem contributed to interest in working towards mitigation, "*With recent increase, something needs to be done*" (DIP66). It was highlighted that areas where previous fires had been might have a shared interest, "*I think a lot of people in the Purbeck area would be interested in Fire Wise. The Wareham forest fire last year was devastating and the heathland in the area seems to have smaller fires every few months.*" (DON19). Some highlighted previous wildfire experience highlighting gaps in knowledge. For example, one explained, "*I live very close to the Heath, and we had a huge fire a couple of years ago that was terrifying. It would have been useful to know if there was anything we could have done to prepare or help in that situation*" (DON39). Therefore, living close to areas of fire risk often mentioning heaths, were important drivers, as well as perceived vulnerabilities, such as being isolated, "*We are isolated and need to learn how best to protect ourselves*" (DON22). It is possible this more direct concern for the issue would act as greater motivators for mitigation and be more realistic for stakeholders to work with.

There were almost as many that raised more general concerns as reasons for interest, caring about the area, nature, or heaths. For example, "*I am not in an immediately vulnerable are for wildfires but am interested in wildlife and the damage wildfires can do to wildlife in Dorset*" (DON66). Many demonstrated care for their surroundings, for example "*We live near one and want to protect the heaths*" (DON108). Some noted really caring, "We are passionate about protecting the environment and wildlife, both locally and globally." (DON40). Additionally, where it was perceived as a visible issue also contributed to wating to mitigate it, despite perhaps not experiencing direct impacts, "*After seeing Wareham Forest before and after the fire of 2020 and how it totally devastated and killed so much wildlife and habitat and it is our responsibility to do something*" (DON61).

Moreover, there was also support for this type of management, supporting education and awareness for its importance to prevent, one explained their belief that "*Education is the key to preventing careless attitude towards the causes of wildfires*" (DON74). There were also those that wanted local communities involved in management, hence the scheme appeared attractive, "*The community should be involved, because we could be informed or inform the authorities about local wildfires and be proactive in the process*." (DON73).

Conversely, the explanations of those that selected no interest are shown in Figure 5.24. Lacking time or ability was the most common reason given, as well as perceiving the risk as irrelevant. There were also beliefs which demonstrated doubt over Firewise itself or the approach to preparedness. As well as the notion it was others' responsibility, or other people were the problem. These suggest a lack of appreciation for the benefits of Firewise, including a possible gap in how the scheme was conveyed in the survey.

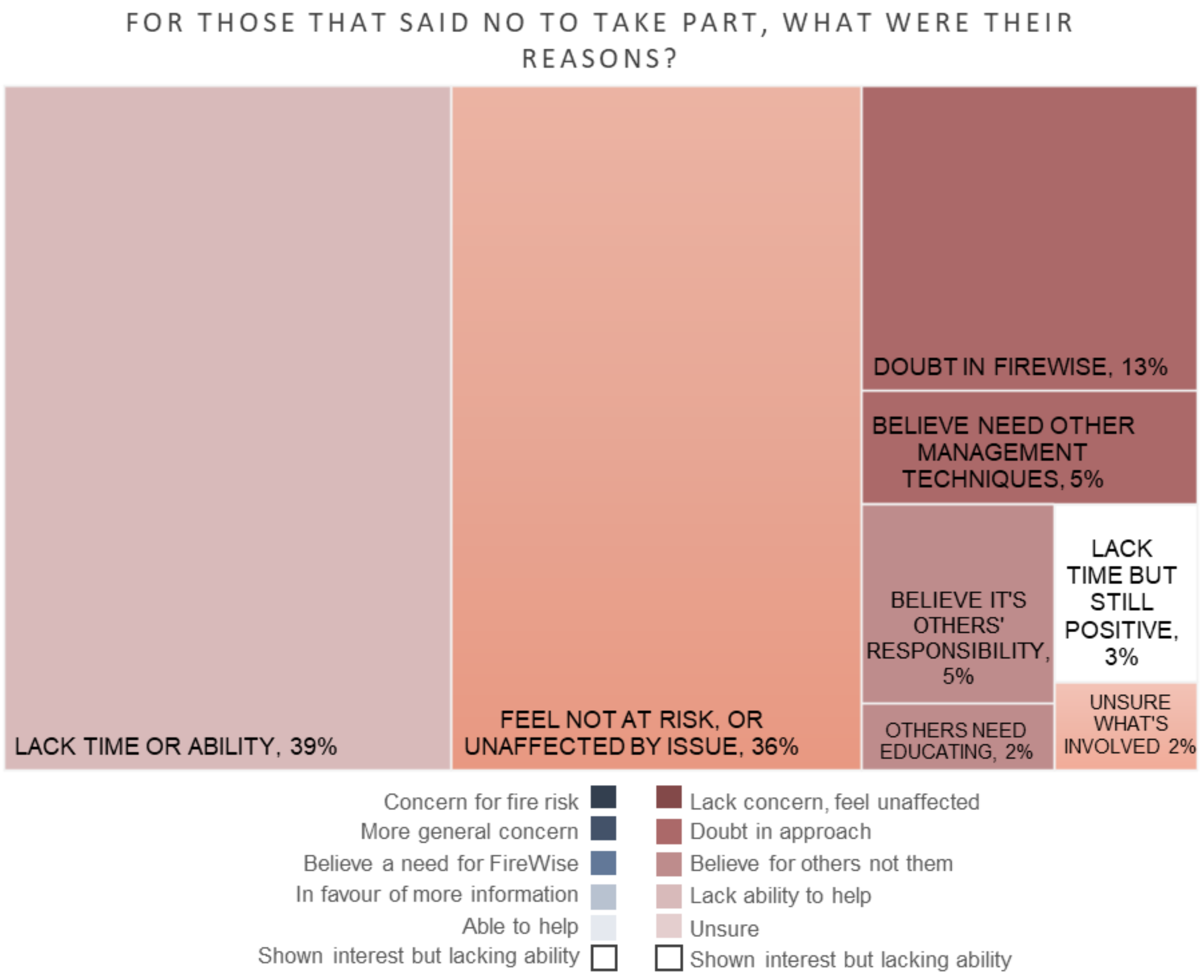


Figure 5.24 - Dorset participants' reasons for not being interested in taking part in a Firewise scheme. For those that answered "no" (probably or definitely not), N=61.

A lack of time, including having too many other commitments, were key reasons given. As well as lacking ability, including due to age. This did not necessarily mean they were uninterested instead were being realistic about commitment. For example, one participant reasoned that, "*In theory I would say yes but not sure I have time in life at present*" (DON30). This highlights how the hazard is occurring in the context of daily life and that an individual may have other priorities, especially where the risk is infrequent and especially if it is of small magnitude. A lack of driving factor was another common reason, mostly noting the lack of risk or relevance, for instance not living adjacent to burnable area. This also included the reasoning that they "*…don't own a house*" (IP65).

There were also comments which demonstrated doubt in Firewise scheme or the approach. This included because of limited knowledge of benefits of Firewise, for instance, "*I don't see the point*" (DIP83). As well as a lack of perceiving benefits specific to the area, for example, one noted that "*Because it originated from the USA. Our houses and needs are very different*" (DON16). This suggests that if the scheme was framed in the correct way, that is, relevant to the locale, beneficial, and with backing from proper authorities, this may increase support or interest. There was also a sense held by some that it was not their responsibility, believing the management was the concern of the state, "*I think it is better to pay for this via our council taxes.*" (DON1). Alternatively, others believed it was not their responsibility as they were not contributing to the problem, for instance one explained that "*I am aware of what I personally can do to prevent them happening but agree more people do need* *educating.*" (VIP69). Other doubts where related to the approach, rather than preparing houses and individuals they would "*…rather tackle root cause of fires and look at landscape management / human behaviour. Controlled fire can be used to manage lands and I'd rather that than have emergencies*" (DON10).

The explanations of those that were unsure are shown in Figure 5.25. There was a sense of being unsure of details, expectations, or benefits of the scheme. There was also doubt over interest by not feeling at risk, suggesting this may have been a more polite response to showing disinterest.

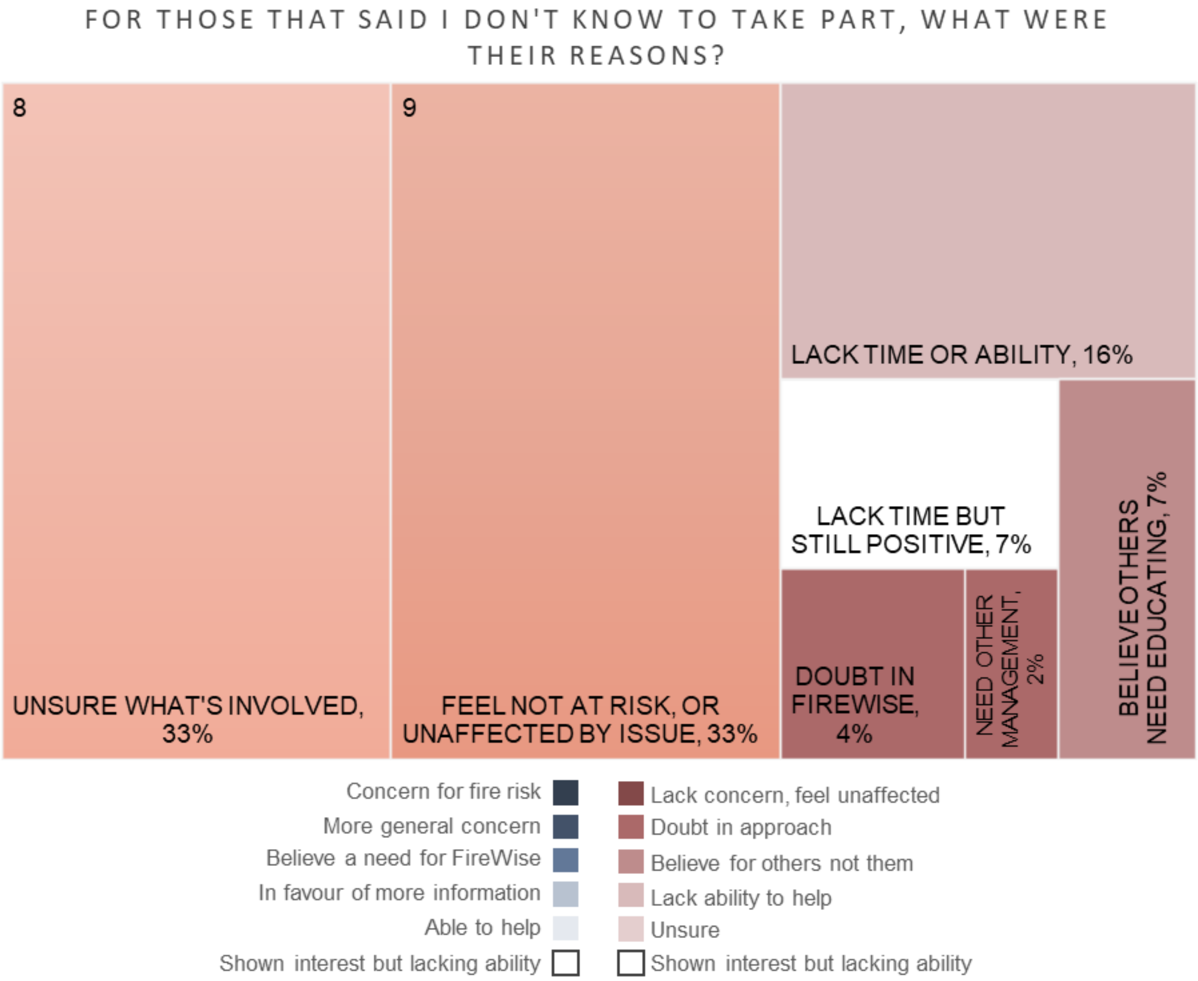


Figure 5.25 - Dorset participants reasons for being undecided on taking part. For those that answered "I don't know" to whether they would take part, N=45.

Similar to reasons against, there were participants that lacked time, some in fact remained positive but were being realistic about their daily life, for instance, "*In theory yes, but practically, honestly, probably not*" (DIP39). As well as uncertainty on what the expectations would be, for instance, "*Not sure what it is involved*" (DIP23). Some were uncertain about the approach, with a common justification being a lack of knowledge about the scheme. An unfamiliarity with Firewise as well as with wildfire lead to a lack of motivating factor, for example, "*Not something I've thought about. I'd need to know more*" (DIP86), another stating, "Without any detail it's difficult to judge." (DO27). This included lacking knowledge of benefits, for example, "*Not sure how beneficial this would be*" (DO37). Crucially, there was also doubt over the efficacy of the scheme, "*I'm not sure if has any influence and power*" (DON12).

The responses to interest in taking part in Firewise locally were compared to the participant's age (Table 5.15). The youngest age category had a higher proportion of no responses compared to all the other age categories. Those 65+ also had a marginally higher proportions selecting "no", although this varied only little from the other age groups. The highest proportion of yes was the 45-54 years category. Comments made support the fact that younger participants were less interested because they felt it was less relevant to them. Older participants may have felt that it was beyond their capabilities.

Comparison of participants' interest in Firewise and age [D]								
COMBINED SAMPLES		**Age group**						
		18-24	25-34	35-44	45-54	55-64	65+	
Interest in taking part in a Firewise scheme	Yes, definitely	8%	18%	18%	18%	6%	10%	*(N=26)*
	Yes, probably	8%	32%	32%	39%	39%	34%	*(N=66)*
	I don't know	23%	18%	24%	18%	33%	20%	*(N=45)*
	No, probably not	62%	32%	26%	22%	19%	37%	*(N=59)*
	No, definitely not	0%	0%	0%	2%	3%	0%	*(N=2)*
		(N=13)	*(N=22)*	*(N=34)*	*(N=49)*	*(N=36)*	*(N=41)*	
LEGEND	0%	100%	Proportion of participants from each age group					

Table 5.15 – Dorset participants' willingness to take part compared with participant age, combined sample for those that provided age N=195.

Comparing the responses of the various groups of individual risk scores (Table 5.16), the largest difference is that those that scored 0 had a higher proportion of no responses and the only "definitely not" responses. The other scores were mostly similar, although those that scored 2 and 3 had a higher proportion of "yes definitely" response. This demonstrates that personal concern for wildfire was a motivator for taking part, and may be a stronger impetus that translates to more actual mitigation. Conversely, a lack of awareness or concern for a problem meant there was a lack of interest in the scheme.

Comparison of answers to interest in Firewise and risk score [D]							
COMBINED SAMPLES		**Individual wildfire risk score**					
		0	1	2	3	4	
Interest in taking part in a Firewise scheme	Yes, definitely	3%	8%	48%	58%	6%	*(N=26)*
	Yes, probably	24%	44%	39%	25%	50%	*(N=66)*
	I don't know	29%	24%	9%	0%	17%	*(N=45)*
	No, probably not	41%	24%	4%	17%	28%	*(N=59)*
	No, definitely not	2%	0%	0%	0%	0%	*(N=2)*
		(N=95)	*(N=50)*	*(N=23)*	*(N=12)*	*(N=18)*	
LEGEND	0%	100%	Proportion of participants from each way of answering personal risk score				

Table 5.16 - Dorset participants' willingness to take part compared with individual risk scores, combined N=198.

Comparing the responses of interest in Firewise with acknowledging a problem in the area (Table 5.17), those that disagreed to a problem had a higher proportion of disinterest and slightly elevated proportion being undecided. However, there were participants that answered no that went onto show interest in Firewise. While awareness or concern for the problem in the area generally increased interest, there was also a broader interest in the scheme. As a previous quote highlighted, a participant might not initially be aware of the issue but want to help once it is brought to their attention.

Comparison of answers to interest in Firewise and considering wildfires a problem [D]				
COMBINED SAMPLES		**Is local wildfire a problem?**		
		Yes	No	
Interest in taking part in a Firewise scheme	Yes, definitely	18%	4%	*(N=26)*
	Yes, probably	37%	26%	*(N=66)*
	I don't know	20%	28%	*(N=45)*
	No, probably not	24%	41%	*(N=59)*
	No, definitely not	1%	1%	*(N=2)*
		(N=129)	*(N=69)*	
LEGEND	0%	100%	Proportion of participants from each way of answering whether wildfire is a problem	

Table 5.17 – Dorset participants' willingness to take part compared with acknowledgement of local problem, combined N=198.

The implications of these findings firstly highlight the importance of theories of place attachment and social capital to mitigation and community-based schemes, where concern for wildfire is not the only motivator. Additionally, where there is generally a lack of perceived personal relevance to hazard in Dorset, capitalising on the publics want for helping the area will be crucial. Therefore, focusing on how these schemes can improve more than just wildfire risk or personal preparedness should be a significant consideration for agencies and Firewise UK. The level of commitment could be crucial. Moreover, as far as disseminating knowledge there is certainly a demand for information, especially where perceived recent increases, or specific experiences, drive a perceived necessity to prepare. There is also a sense of lack of familiarity from some residents, even noting they were unaware until seeing this survey, demonstrating a need for public education. Where more effort or commitment may be demanded, there would likely be a drop in interest compared to the proportions initially showing interest here. These findings also somewhat confirm literature which explains that a concern about fire does not always translate to mitigation where there were barriers about perceiving benefits, uses, or feeling direct responsibility.

5.2.3.3 Awareness of mitigation actions

Regarding mitigation Dorset participants were finally asked what actions they were aware of, to protect their property. From the responses across all Dorset participants there was some uncertainty, 26% did not give a suggestion. Specifically, there were participants that were unsure (17%), some that perceived it as irrelevant to them because not at risk or was for others to do (9%),or felt unable to (1%). Those unable included the fact the house was located "…*between 2 SSSI sites*." (DON83). The other 74% gave a suggestion, these are summarised in Figure 5.26.

PARTICIPANTS' SUGGESTIONS FOR ACTIONS TO PREPARE FOR WILDFIRE

- Prepare outside
- Prepare inside
- Prepare themselves
- Be alert
- Practising fire safety
- Acting to reduce ignitions
- Change rules
- Protect the property
- Preparations for society

THEMES	SUGGESTED ACTIONS	
PREPARE OUTSIDE	Do gardening Trim vegetation Tidy garden Clear roof and gutters Clear drive Dispose of rubbish properly	Prepare perimeter (no wooden fences) Store flammables correctly Check machinery
PREPARE INSIDE	Check fire safety inside Check fire alarms	
PREPARE THEMSELVES	Have an evacuation plan	Have fire extinguishers Have a hose / water supply
BE ALERT	Keep aware Listen to news	Increase detection Check on neighbours
FIRE SAFETY	Do not leave fires unattended Ensure properly extinguished	
REDUCE IGNITIONS	Discourage smoking Do not have BBQs or garden fires	
CHANGE RULES AND LAWS	Ban BBQs, campfires, farm fires	
PROTECT	Damp down house Put up wind break	
GENERAL PREPARATION IN SOCIETY	Conduct education programmes Improve land management	

Figure 5.26 - An overview of the suggestions for actions participants believe they could undertake to mitigate wildfire.

Of those that gave a suggestion the frequency of each action is shown in Figure 5.27. There were many suggestions about how to prepare a property, including clearing the garden or trimming vegetation. There were a small number that suggested preparing inside by having fire alarms. Having a hosepipe or water supply was a common suggestion, although one participant pointed out doubt the extent to which this would help, "*Have a hosepipe but the water pressure would mean that it's probably not much help*" (DON3). Beyond these personal actions, many gave broader behaviours. A key one being reducing ignitions, specifically some wrote avoiding garden fires or use barbeques unsafely. There were also calls to ban barbeques and campfires, as well as introducing fines. Staying alert, including listening to local news, and forming neighbourhood watch style monitoring to increase detection was another suggestion by some.

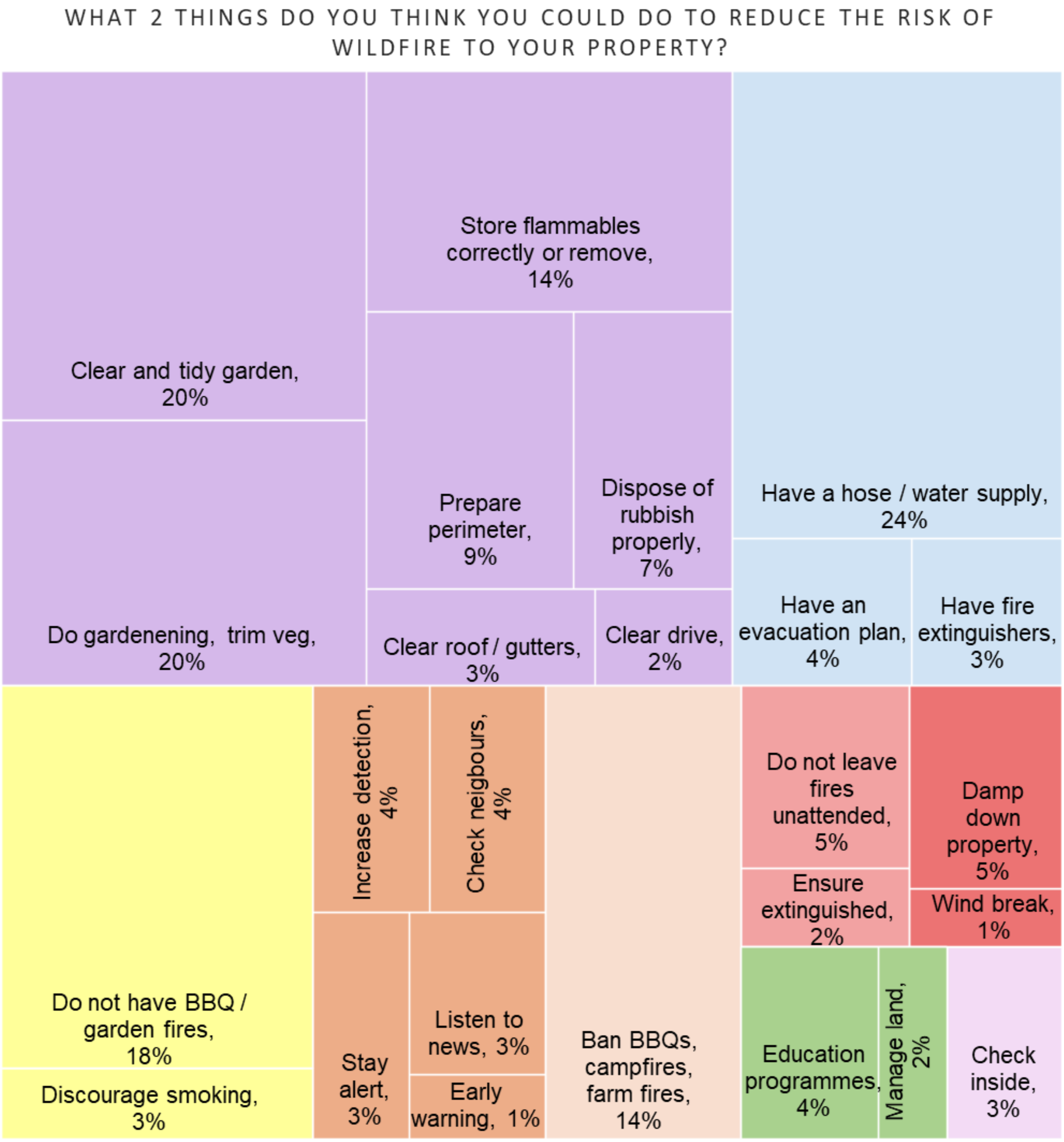


Figure 5.27 - Proportions of participants that gave each suggestion for actions to mitigate wildfire on their property. For those that gave a suggestion, N=146 (where 52 said not sure or were unable to).

Some of these suggestions are potentially less relevant as personal actions and instead pint to broader actions society or the local area can take. This is possibly due to either misunderstanding the question, not knowing a more relevant answer, or because preventing wildfires was the most relevant action they believed would protect their property. The lack of personal, attainable, realistic suggestions, along with the number of participants who did not provide any, indicates a gap in knowledge about mitigating fire risk near properties and protecting oneself.

5.2.4 Attitudes towards prescribed fire

The follow-up participants were asked the extent they would agree with the use of fire on the local landscape (Figure 5.28). In response, many were agreeable (52%). There was equal disagreement to agreement, however fewer strongly disagreed compared to the proportions that strongly agreed. Note this was only asked in the follow-up and had a very small sample (N=61), thus findings are tentative.

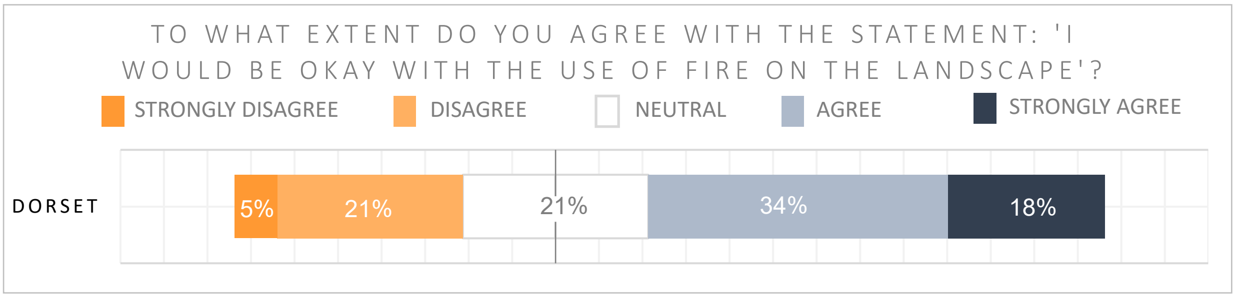


Figure 5.28 - Dorset follow-up participant' acceptance of prescribed fire locally, (N=61).

Participants were asked to explain their responses and these reasons were coded by the extent it demonstrated they agreed. These groupings were then compared to the closed-question answer (Table 5.18). This revealed that while those that agreed did give reasons for their use, there were also conditions to its use. Most of those that were neutral were neither for nor against, whereas others had mixed opinion.

Comparison of participants' responses to the closed and open question regarding agreement with fire use locally [D]						
		Agreement in closed question				
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Sentiment towards fire use identified	Reason for its use	0%	0%	0%	29%	82%
	Reason for, but with condition	0%	0%	0%	71%	18%
	Arguments both ways	0%	0%	23%	0%	0%
	Neither for nor against	0%	0%	62%	0%	0%
	Some understanding, but against	0%	15%	15%	0%	0%
	Reasons against its use	100%	85%	0%	0%	0%
LEGEND	0%	100%	Proportion of participants that gave each answer to acceptance			

Table 5.18 – Comparison of responses in Dorset to agreement with fire use compared with the type of explanation (N=61).

The reasons given for acceptance of prescribed fire are presented in Figure 5.29. The benefits of mitigating wildfires, as well as awareness of historic use as a tool, were common justifications. The notion of it being necessary and knowledge of its efficacy were also mentioned. There was a high proportion that also gave a caveat to the agreement, centred around ensuring control, proper planning, and having a positive impact.

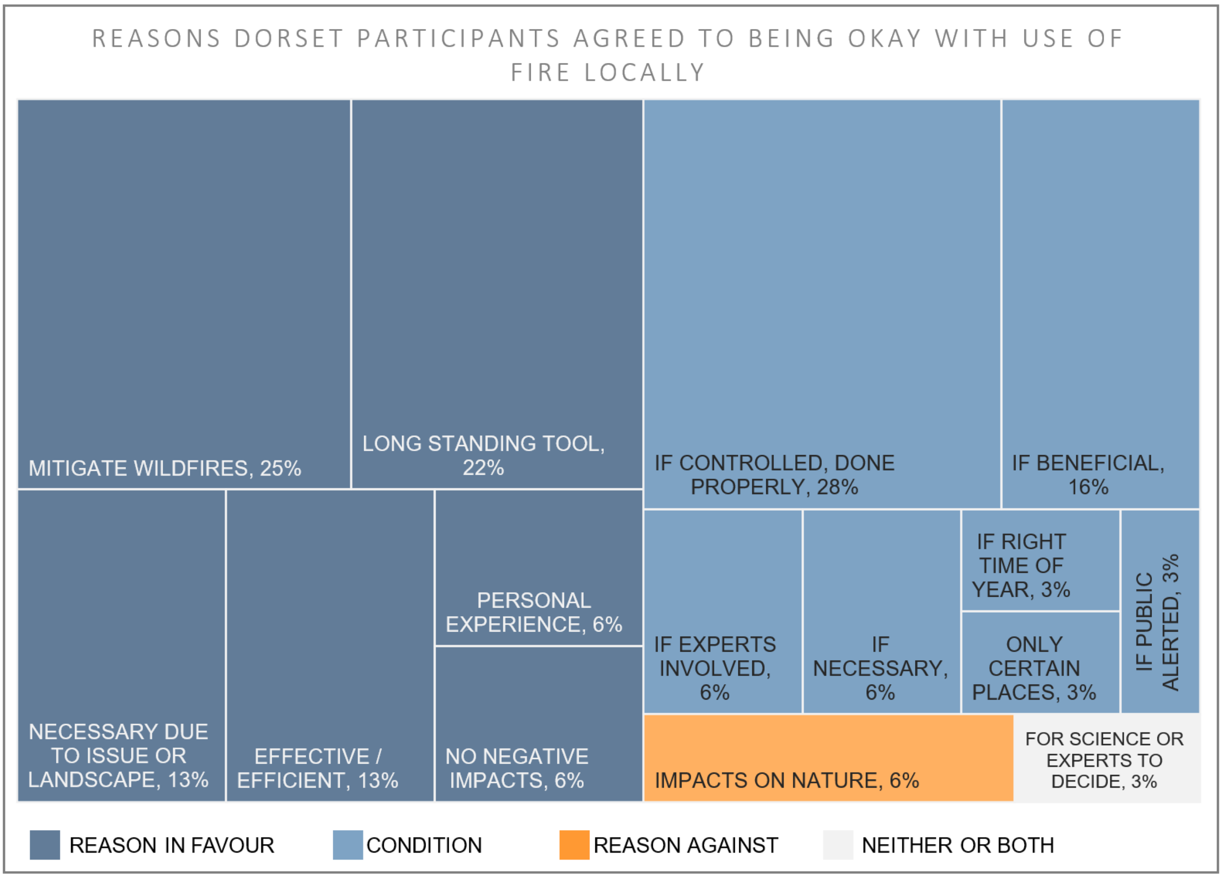


Figure 5.29 - Reasons Dorset participants were accepting of fire use, N=31.

Considering the benefit to the mitigation of wildfires was a crucial factor. There was an understanding that smaller fires could prevent larger events, "*Landowners should have more regular small-scale controlled burns to manage the scrub and prevent small wildfires becoming large and out of contro*l." (DON6), another stated, "*I would be happy with controlled burns... My main concern is spring/summertime wildfires that cause the most damage*." (DON67). There were also participants that expressed there was a need management, including in specific locations, such as in "*Canford heath and similar areas need active management*" (DON2). There was demonstration of more detailed knowledge of the benefits of fire use for broader environmental outcomes for land management as well as for wildfire, for example one participant noted, "*The need to use controlled fires in order to prevent larger uncontrolled ones is historically understood. Heather, for example benefits from being burned too. When used wisely, it can be an important tool for land management*." (DON101). The historic use of prescribed fire was also understood to be "*…a proven method*" (DON19). This points to familiarity with the process, as well as knowing the benefits (or that it is beneficial) increase support. Direct familiarity is also a convincing justification, one noting personal experience, "*I volunteer in conservation on heathland, do understand the benefit*" (DON72). Fire was perceived by some as an effective tool and there was also comment that it was an underestimated tool, one participant stating, "*Controlled burning gets a bad press from people who don't understand, it is a useful tool*." (DON78).

This agreement did involve a high proportion of conditions. There was hesitation about control and safety, where trusted officials were seen to increase its legitimacy, "*If it is done safely with qualified personnel then I think it's a good thing*." (DON24). There was also a reliance on expertise for the decision of whether fire was appropriate, one stating they agree, "*If that's what the experts say*" (DIP8). Moreover, there was also a condition around the need for its use to be justified as helpful or beneficial within a wider plan. For example, "*If it's going to be broadly good with all environmental quality in mind*." (DIP13); another noting "*As long as it is useful and properly managed, I worry about animals*" (DIP68).

Looking at the reasons given by those that disagreed with fire use in Figure 5.30, there was a focus on the concerns around the outcomes. The most common was regarding the impact on pollution, including air quality and climate change feedback. Additionally, there were also many with concerns about impacts on nature and doubts about controllability. In these concerns there were also nations that negative impacts were unpreventable, and a resistance to fire contributed to a preference for alternatives.

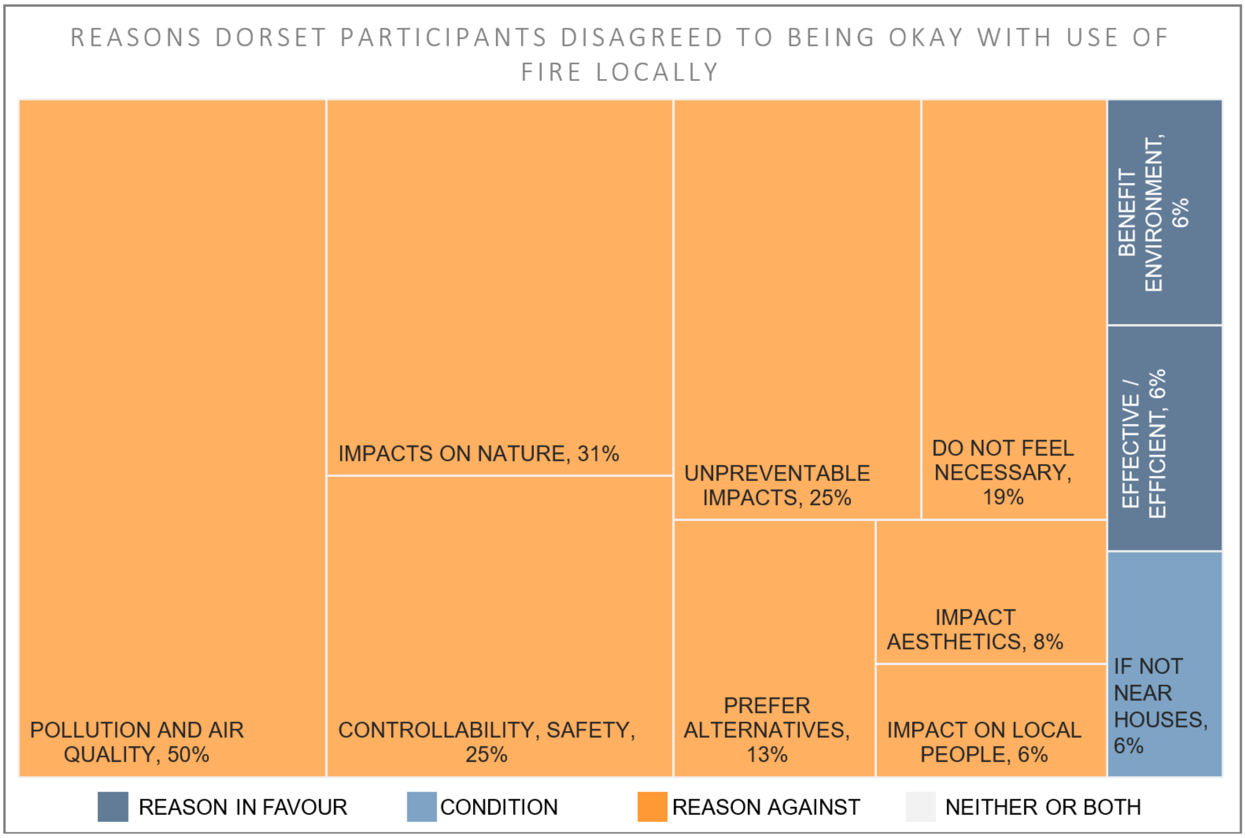


Figure 5.30 - Reasons Dorset participants were against fire use locally, N=16.

Concerns over pollution and air quality were key reasons given against fire use. Many of these revolved around climate change feedback, where a common belief was that the pollution was inevitable, "*Pollution is pollution regardless of its purpose, I am sure there are better ways for the environment to deal with this*." (DON32). Another noting, "*I do not think any pollution producing process that is not absolutely necessary should be used just for the sake of convenience*" (DON32). There were also concerns about the impact of air quality on people, "*One of my concerns is what effect is the air pollution having on people. We are often affected by the smoke from these burns having to keep our windows closed, not being able to hang washing out*." (DON53). Prescribed fires were perceived as not environmentally friendly, as well as not good for people, for example, one participant explained, "*Burning is bad for the environment whatever the cause. We have many controlled burns in our area with little thought as to the people who live here. Not good for asthmatics. Is it carcinogenic? What about wildlife, flora & fauna in the controlled burn areas?*" (DON91). This exemplifies how unknowns or uncertainties around impacts creates barrier to acceptance. The idea of even controlled fires as anti-nature was common, one explaining, "*The UK landscape is* *green, using fire to maintain the UK landscape is detrimental to the wildlife living within as well as the landscape itself*." (DON59). Moreover, a lack of necessity was another reason against fire use, "*I think burning vegetation is very rarely necessary, there are better, more environmentally friendly ways to get rid of unwanted vegetation"* (ON103), although potentially misinformed.

Contributing to hesitations around fire use, concerns over control and safety were evident. It was seen as a high-risk tool, because one "*Cannot guarantee control or that it will not have unintended consequences*" (DIP61). Furthermore, the concerns about safety were also linked to the type of environment, in more populated areas, for example, "*I am not sure this area is the right place, people are too close*" (DIP14). Another noted, "*We don't need fire in an overpopulated small country. The risk is too great and the potential damage to high*." (ON111). Another disagreeing and explaining, "*I agree with burning as a management tool for heath rejuvenation but the heathland in this area are surrounded by housing and have seen in other areas of the county how quickly the wind*" (DON30).

For the majority of those that were neutral, the reasoning was a lack of knowledge, as well as uncertainty over the impacts, or believing it is only appropriate in limited locations (Figure 5.31). Some simply considered it a dilemma for science or experts.

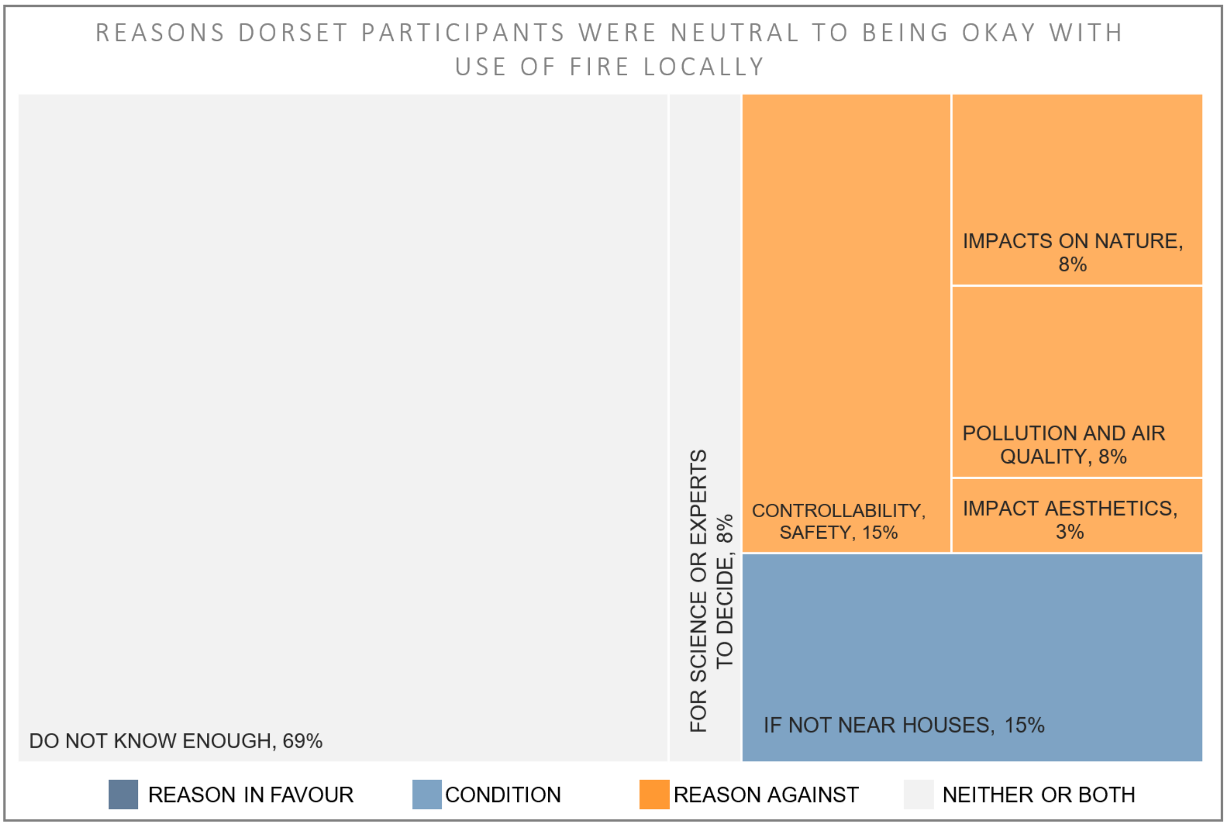


Figure 5.31 - Reasons Dorset participants were neutral to fire use, N=13.

Not knowing enough is a key reason for the neutral, for example, one explaining "*I don't understand the science in detail to be able to make an informed comment*" (DON66). A lack of knowledge leads to thinking of the concerns; for example, "*I don't know enough about the pros and cons. Would worry about air pollution near my home*" (DON34). This exemplifies how the assumptions are often negative when there is a lack of knowledge about outcomes and impacts. There was also a lack of understanding of the need for its use, "*I'm not sure why it's needed*" (DIP2). Furthermore, wanting science to determine demonstrates the importance on a desire for evidence of the impacts to evaluate the need and appropriateness. Having said that, there was also complete neutrality, where some had no opinion, for example, "*Because I don't desire controlled fires or oppose to them*." (DON73).

The responses to both this acceptability and previous questions of wildfire risk were compared. Note the sample sizes are small thus the patterns are speculative. There was more agreement to fire use from those that considered wildfire a problem (Table 5.19). However, acceptability of fire use compared to personal risk scores shows more mix of scores, although there is possibly slightly more agreement from those that gave higher scores (Table 5.20).

Comparison of answers to whether agree with fire use and opinion on whether wildfire is a problem [D]				
COMBINED SAMPLES		**Is wildfire a problem locally?**		
		Yes	No	
Agreement with fire use	Strongly agree	29%	4%	*(N=11)*
	Agree	41%	26%	*(N=21)*
	Neutral	15%	30%	*(N=13)*
	Disagree	6%	41%	*(N=13)*
	Strongly disagree	9%	0%	*(N=3)*
		(N=34)	*(N=27)*	
LEGEND	0%	100%	Proportion of participants answering whether wildfire is deemed a problem	

Table 5.19 – Comparison of Dorset responses to agreement with fire use and whether wildfires were considered problematic. Follow-up sample N=61.

Comparison of answers to whether agree with fire use and individual risk score [D]							
COMBINED SAMPLES		**Individual wildfire risk**					
		0	1	2	3	4	
Agreement with fire use	Strongly agree	7%	22%	25%	50%	33%	*(N=11)*
	Agree	32%	44%	25%	25%	33%	*(N=21)*
	Neutral	29%	11%	38%	0%	0%	*(N=13)*
	Disagree	32%	22%	0%	0%	0%	*(N=13)*
	Strongly disagree	0%	0%	13%	25%	33%	*(N=3)*
		(N=11)	*(N=21)*	*(N=13)*	*(N=13)*	*(N=3)*	
LEGEND	0%	100%	Proportion of participants answering whether wildfire is deemed a problem				

Table 5.20 - Comparison of Dorset responses to agreement with fire use and how at risk participants felt. Follow-up sample N=61.

Moreover, agreement was also compared to the participant's characteristics. Firstly, comparing to age (Table 5.21). The eldest age category had more disagreement that the other age categories. Furthermore, comparing the responses between the gender groups (Table 5.22), there is potentially less agreement (including less strong agreement and more strong disagreement) from women compared to men.

Comparison of participants' agreement to fire use and their age [D]								
COMBINED SAMPLES		Age group						
		18-24	25-34	35-44	45-54	55-64	65+	
Agreement with fire use	Strongly agree	33%	17%	33%	22%	9%	0%	*(N=11)*
	Agree	33%	33%	17%	33%	36%	55%	*(N=21)*
	Neutral	33%	17%	17%	22%	27%	18%	*(N=13)*
	Disagree	0%	33%	25%	22%	27%	9%	*(N=13)*
	Strongly disagree	0%	0%	8%	0%	0%	18%	*(N=3)*
		(N=3)	*(N=6)*	*(N=12)*	*(N=18)*	*(N=11)*	*(N=3)*	
LEGEND	0%	100%	Proportion of participants answering whether wildfire is deemed a problem					

Table 5.21 - Comparison of Dorset follow-up responses to whether they would agree to the use of fire with participants' age. For Dorset follow-up sample that provided an age, N=61.

Comparison of participants' agreement to fire use and their age [D]				
COMBINED SAMPLES		Gender		
		Women	Men	
Agreement with fire use	Strongly agree	16%	24%	*(N=11)*
	Agree	36%	29%	*(N=21)*
	Neutral	20%	24%	*(N=13)*
	Disagree	20%	24%	*(N=13)*
	Strongly disagree	7%	0%	*(N=3)*
		(N=44)	*(N=17)*	
LEGEND	0%	100%	Proportion of participants answering whether wildfire is deemed a problem	

Table 5.22 - Comparison of Dorset follow-up responses to whether they would agree to the use of fire with participants' age. For Dorset follow-up sample that provided a gender, N=61.

5.3 Dorset findings summary

In summary, a group of Dorset residents demonstrated acknowledgement and concern over a problem in the area, with a subgroup specifically concerned about themselves. Those near the heaths or forests were typically more concerned. However, location was not the only factor, an individual may live close but minimise risk, through low probability, lack of perceived direct consequences, as well as minimal severity. This also points to a disconnect between wildfire in Dorset and wildfire elsewhere.

While there was some widespread awareness and concern there was also a sub-group demonstrated an apathy towards the risk, as well as some being entirely unaware. This also possibly explains the lack of response online despite the population size eligible.

Regarding the perception of the risk, concern over fires in the area as well as visibility of fires, contribute to individual risk perception. Most impacts were othered to the environment. However, there was concern about safety, even if this was mostly othered to higher risk groups (including firefighters), as well as indirect impacts of use of spaces and impact of smoke on health. There were comments about increasing wildfire and there was general agreement that climate change had increased wildfire locally and even more so in the future. Most agreed with climate change science, there were more that disputed the influence of climate change on wildfire locally. This was mostly uncertainty over influence, as well as lack of personal observation either not noticing changes or not knowing enough about to comment. Concern for climate change was shown to be a reason for concern over the hazard, including where linked this to foreign increases, appearing to substantiate increase in the UK or potentially mobilise a fear element from the catastrophic nature of foreign wildfire.

Furthermore, there was a reasonable interest shown in the Firewise scheme, with a clear demand for knowledge, particularly among those who felt uninformed or had previous poor experiences with wildfire. More online participants showed interest compared to the in-person sample. The evident concern bias online suggests a potential to reach an engaged and more motivated audience through this platform. Crucially, a concern for fire specifically is not the only motivating factor identified here. Broader concern for the area, heaths, and nature generated interest in the scheme, as well as direct concern for wildfire. This highlights the relevance of place attachment and social capital in encouraging engagement. Moreover, tilting focus of schemes for broader outcomes than wildfire mitigation would certainly increase relevance and interest, as well as being sure to frame the schemes as highly locally relevant and authoritative (from ‘official’ sources).

Lastly, there was an acceptance to the idea of prescribed fire on the landscape, especially where there was familiarity with it, including awareness of its application historically or globally. However, there was uncertainty as well as concerns. A top concern was the impact on climate change, as well as negative impacts on nature, some perceiving fire as unavoidably bad, even if there is some use.

CASE STUDY 3: THE HIGHLANDS, SCOTLAND

6.1 Introduction to the Highlands

6.1.1 <u>The Highlands: environmental characteristics</u>
This case study is located within a portion of the Highlands (Figure 6.1), in Scotland, that loosely follows the West Highland Way railway line. The environment of the Highlands is characterised by its rural nature (Figure 6.2), with pockets of more accessible rural such as Fort William. The entirety of the study area is classified as rural when using a 2-fold rural-urban classification (Scottish Government, 2022b).

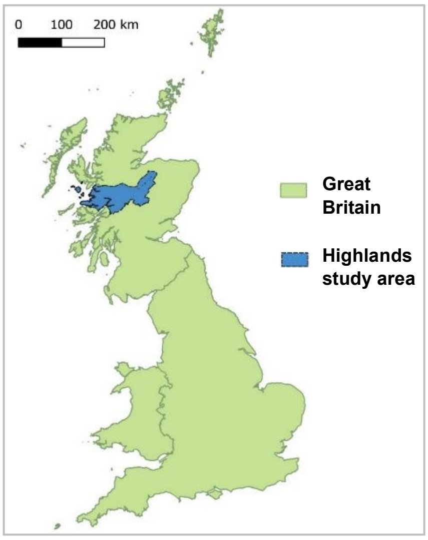


Figure 6.1 - The Highlands study area within Great Britain. (Map source data from EDINA 2021a, 2021b).

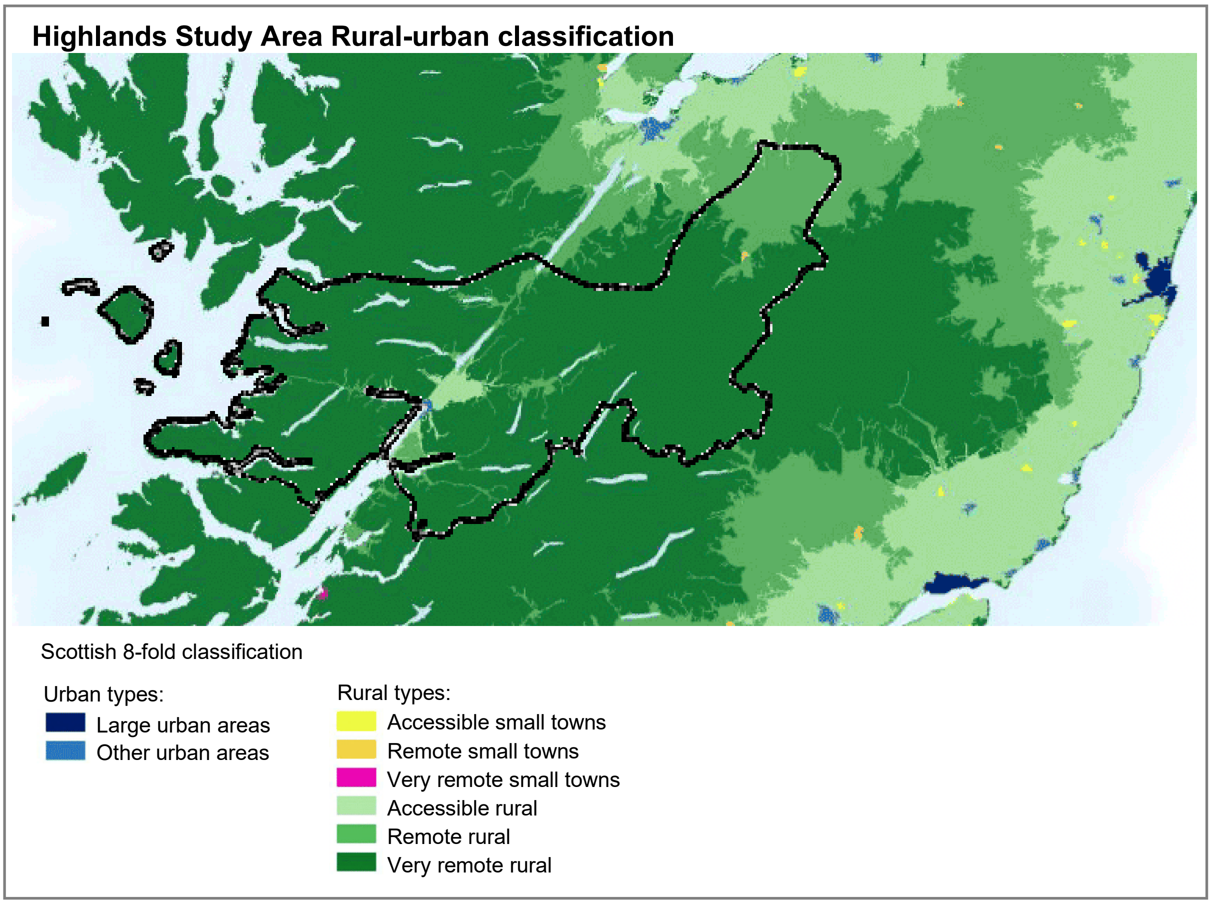


Figure 6.2 - Population distribution in the Highlands' study area by rural-urban classification according to Scotland 8-fold classifications (adapted from Scottish Government, 2022b).

The land cover is dominated by non-developed types, namely heather and grassland (Figure 6.3). The long narrow water bodies, lochs, are an iconic part of the Scottish environment of, especially in the Highlands.

Highlands' Study Area Land Cover

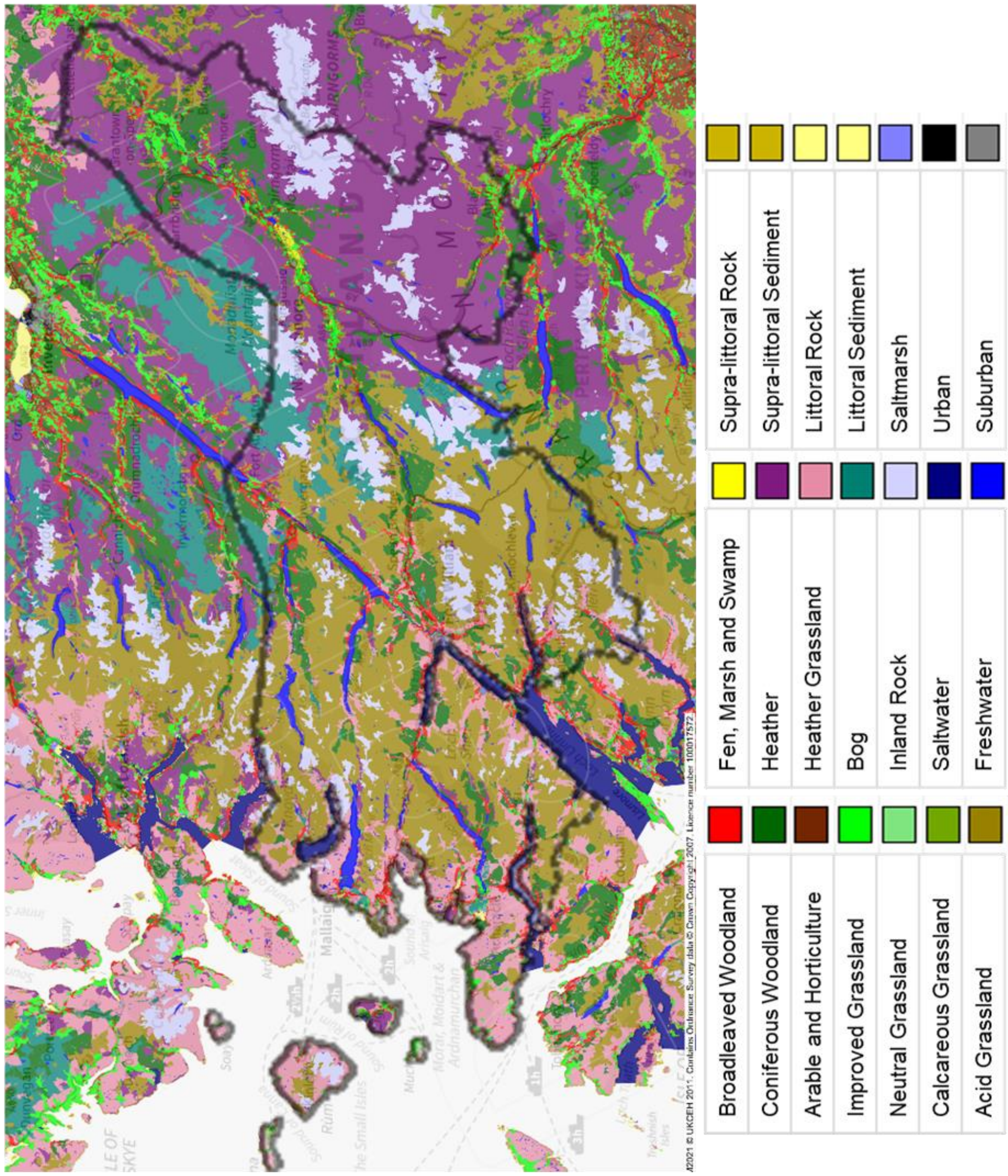


Figure 6.3 – Land cover in the Highlands (EDINA 2021e).

The identity of the area is therefore one characterised by the rurality, mountains, and lochs (Figure 6.4). An important aspect of this rural environment is the agricultural activity and location within Scotland, with the unique existence of crofts. The crofting form of land tenure is a characteristic part of the identity of rural Scotland and its landscape, constituting typical whitewashed houses on small arable fields with larger common grazing lands (Rhode, 2010). This is exemplified in Figure 6.4. The type of agricultural activity in Scotland is heavily determined by climate and environment, typically, the west is dominated by rough grazing in wetter conditions less suitable for arable agriculture as well as grouse (JHI, 2023; Matthews *et al*., 2020; Scottish Wildlife Trust [SWT], 2016; Skerratt *et al*., 2016).

HIGHLANDS' LANDSCAPES

A crofting landscape in Highlands and Islands (NFUS, n.d.)

Fort William next to Loch Eil, at the base of Ben Nevis (Trup, 2019)

Figure 6.4 – Images representing parts of the environmental character of the Highlands, characterised by mountainous terrain, lochs, coasts, and an agricultural footprint.

Fire is also a key part of the Scottish landscape. Muirburn is the term specific to Scotland referring to burning practices, that is, the controlled burning of moorland, typically burning heather in mosaic, either for grouse management or for grazing livestock and deer (Scottish Government, 2021). Some of the earliest evidence of fire documented in UK landscapes was found in Scotland, dating back to the later medieval times (Fyfe *et al*., 2003), as well as evidence of a parliamentary 'Muirburn Act' in the 1400s (Dodgshon & Olson, 2006). The Scottish Muirburn Code (Scottish Government, 2021) outlines contemporary good practice of muirburn, including recommendations and regulations.

The two key forms of muirburn are exemplified in Figure 6.5. Firstly, grouse moor estates, which centre around sporting, have been a predominant use of prescribed fire across the UK

(Yallop *et al.,* 2006; Worrall *et al*., 2010), now found almost exclusively in northern England and Scotland (Tharme *et al*., 2001; Thomson *et al*., 2020). Typically, this form takes the form of strip burning – strips approximately 30m wide and typically around 0.5 ha in total area (SWT, 2016). The intention is to burn heather when it becomes too large, in order to maintain the correct habitat and boost production of grouse birds (Scottish Government, 2021). Secondly, burning is also done to benefit livestock in rough grazing pastures (Scottish Government, 2021), which tend to be larger burns aiming for mosaic of habitats (burned and unburned) (Yallop *et al.,* 2006).

Scottish muirburn

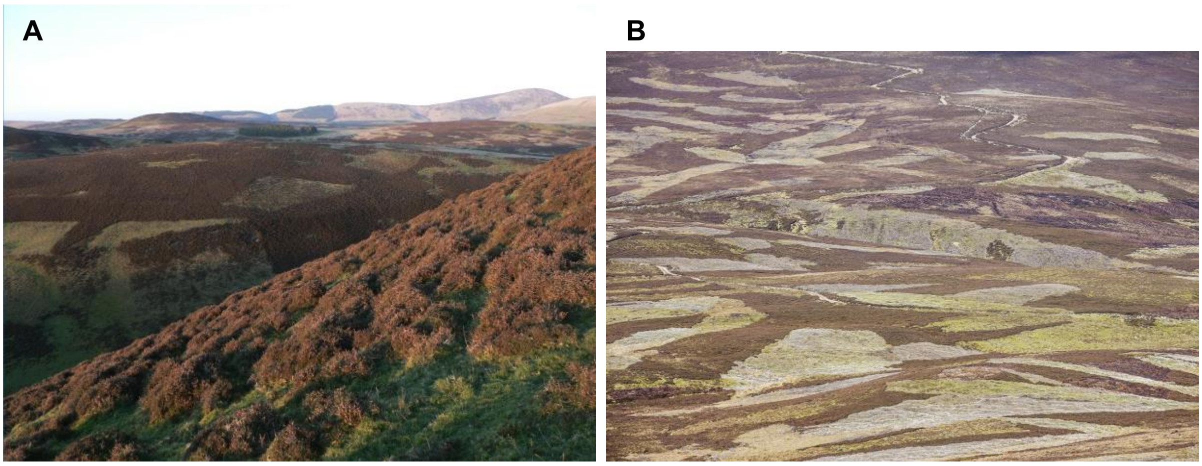


Figure 6.5 - Examples of muirburn in Scotland. Firstly, (A) depicting muirburn for rough grazing (Scottish Government, 2021), in typically larger mosaic burns. Then, (B) depicting the strip burn characteristic of grouse moor management in northern Scotland (Harper et al. 2018: page 699).

6.1.2 The Highlands: socioeconomic character

Highlands' society is defined by its rurality and agriculture, although tourism is becoming increasingly important. The tourism industry is a vital part of the Highlands economy today, with 2.918 million visitors spending £1.553 billion, that is, £776 million from day visitors and £777m from overnight visitors (Visit Scotland, 2020). Moreover, the Highlands and Islands enterprise (HIE) group (HIE, n.d.) state there are 3200 registered tourism businesses. Overall tourism was estimated to account for 13% of Highlands' employment in 2017 (Visit Scotland, 2020, page 6). The Highlands is a particular hotspot for tourism in Scotland, and the importance of it in the local authority is highlighted by the fact that the Highlands had the second highest rate of jobs per 1000 people made up by tourism (Visit Scotland, 2020, page 7). The Highlands is facing some challenges of rural deprivation, including higher consumption of fuel for heating and transport; lower accessibility of services, and limited opportunities to earn adequate income compared to urban areas (Thomson, 2016), making tourism Increasingly important for rural society.

6.1.3 The Highlands: wildfire problem

Scotland's environment is favourable to fire where remoteness, sloping terrain and open habitats are conducive to larger fires (Belcher *et al*., 2022) and present firefighting challenges due to greater costs, damage, and more costly remediation in these areas (Albertson *et al.,* 2010; Gagkas *et al*., 2020; Gazzard *et al.,* 2016). Moreover, as Fire Authorities in the UK are partly funded using tax there is a bias towards urban areas and funding of structural firefighting (McMorrow, 2011; Gazzard *et al*., 2016) thus as a highly rural area, the Highlands as well as the rest of rural Scotland potentially lacks resources. The ecosystems are also valuable, for instance, the UK has 9-15% of Europe's stock of peatlands, with 77% of this in Scotland (Bain *et al*., 2011). Also, often sitting over peat means additional environmental consequences including the reduction of carbon stocks (Bain *et al.,* 2011; Carroll *et al.,* 2009; Vanha-Majamaa, 2006).

Analysis of IRS data provides insight into the magnitude of wildfire activity in Scotland; from April 2009 to December 2020 there were over 132,829 vegetation fires recording by FRS, when filtered for criteria for wildfire events, there were 9745 wildfire events and 1325 were considered large (Gagkas *et al*., 2020; Scottish Government, 2022a). There is annual variation, ranging from 584 in 2014 to 1,184 in 2013 (Scottish Government, 2022a). Wildfires predominantly occur in the springtime, specifically April, followed by summer and then September (early autumn), and minimal activity continues through late autumn and winter (Scottish Government, 2022a).The monthly wildfire frequencies for the complete dataset, as well for only larger incidents, are presented in Figure 6.6. Spring has a bigger proportion of the larger fires. There are exceptions such as 2018 where the peak for activity was in July, owing to a prolonged warm spell. The timings of wildfires in Highlands are consistent with the overall pattern for Scotland (Figure 6.7)

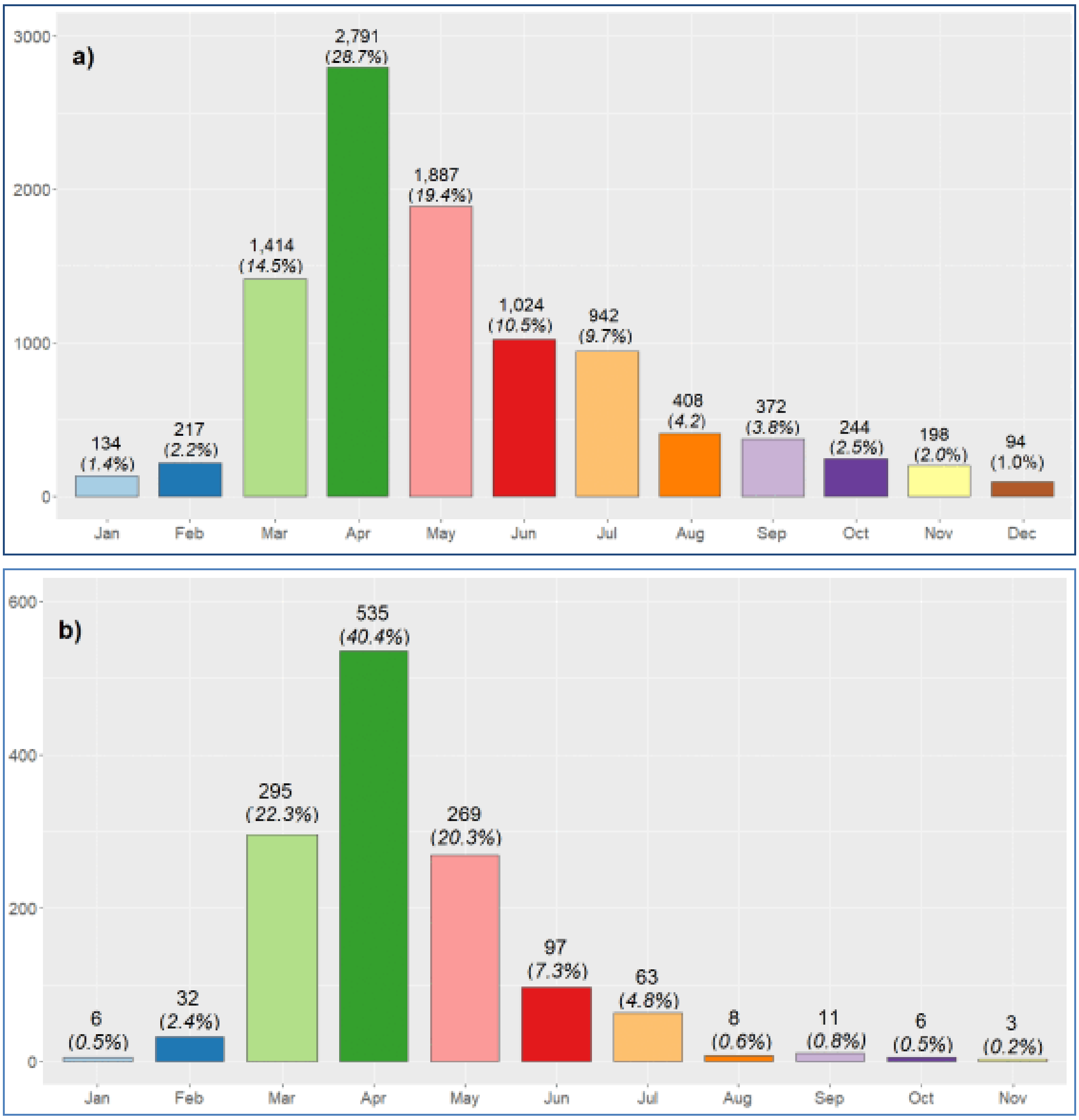


Figure 6.6 – "Monthly counts and proportions of IRS wildfires for the 2009-2020 period for a) complete wildfires dataset and b) wildfires with damage area greater than 1,000 m². " (Figure 5.2 in Scottish Government, 2022a.)

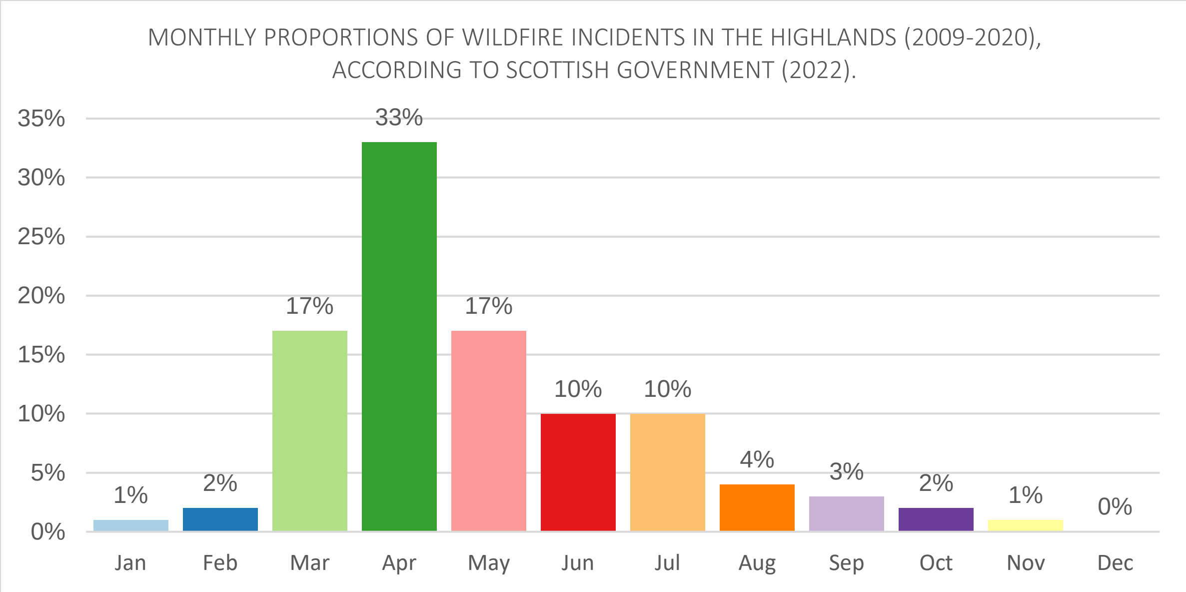


Figure 6.7 - Highlands monthly proportions of wildfire, totalling 1852 events. Adapted from Table 5.30 in Scottish Government (2022a): "Total counts and monthly proportions (%) of IRS wildfires per Local Authority (LA) for the 2009-2020 period".

Of the 9745 incidents, most were small, although larger events do occur (Figure 6.8A). Similarly, in the Highlands, there was a higher proportion of smaller fires, but it experienced more larger fires equating to 35% of all of Scotland's' large fires (Figure 6.8B). There is an emphasis of Scotland's wildfire in rural areas, most in accessibly rural 57%, as well as very remote rural 22%; conversely, only 5% occurred in urban land use types (Scottish Government, 2022a). Moreover, larger fires predominantly occur in more rural areas,58% occurring in very remote, 24% in accessible remote and 15% in remote. (Scottish Government, 2022a). More small fires occurred in RUI and urban areas, consistent with wildfire occurrence dynamics elsewhere in UK (Belcher *et al.*, 2022; Gazzard *et al.*, 2016; Glaves *et al.*, 2020). Key habitats for wildfires in Scotland include shrub, grassland, peatland, woodland, mountains and bogs. Grassland was the most common habitat type in other local authorities but for Highlands (and Na h-Eileanan Siar) key wildfire habitats were heath and shrub, or using an alternative classification, bog, peat and shrub.

(A) Size of wildfires in Scotland		
Category	Size	Proportion of the 9745
Small	<100 m^2	67%
Moderate	100-1000 m^2	15%
Bigger	>1000 m^2	14%
(B) Size of wildfires in Highlands local authority (LA)		
Category	Size	Proportion of total in LA
Small (DA0-100)	<100 m^2	44%
Moderate (DA0100-1000)	100-1000 m^2	17%
Bigger (DA>1000)	>1000 m^2	35%

Figure 6.8 – (A) Size of wildfires in Scotland, summarised from Scottish Government, (2022a, section 5.2.4). (B) Size of wildfires in Highland (2% not classified) summarised from Scottish Government, (2022a, Table 5.40).

The local authority with the most wildfires in Scotland was the Highlands, which was three-fold the next local authority, also with a greater proportion of the larger fires (Scottish Government, 2022a). It has been pointed out that this could be partially to do with the fact that it is so large (Glaves *et al*., 2020). Having said that, rural Scotland certainly has significant hazards posed by wildfire. Images depicting wildfires in the Highlands are shown in Figure 6.9. In the Highlands there were more accidental fires, whereas escaped burns are the key ignition source for Scottish wildfires (Scottish Government, 2022a; Glaves *et al*., 2020), a fact responsible for burns receiving scrutiny (Luxmoore, 2018; Werrity, 2019). Scotland wildfires have long been associated with escaped burn mainly on estates but also by crofters, particularly between February and April, although other ignitions include arson and unknown sources (Bruce *et al*., 2006). The relationship between wildfires and prescribed burning is significant where less prescribed burning has been linked to increases in fire risk over the last couple of decades, simultaneously, less supervision due to declining agriculture has led to increased risk of burns escaping thus increasing incidences of wildfire (Bruce *et al*., 2006; Dougill *et al*., 2006; Davies *et al*., 2008). There are clear warnings about ensuring control and good practice, for instance, in Muirburn guidance exemplifies the extent and acknowledgement of this (Scottish Government, 2021).

Wildfires in the Highlands

Figure 6.9 - A selection of images of wildfires in the Highlands.

6.1.3.1 Preliminary consultation with SFRS personnel

Insights into perspectives on wildfires in Scotland were gathered during preliminary consultations with SFRS personnel. This identified sentiments that echoed the challenges of escaped burns, changing agriculture, and increasing fuel loads. A small sample (14 responses) from across Scotland's services provided their views on the problem.

SFRS personnel noted that wildfires typically occur from May to September, though the season can be longer. They focused on a few significant, resource-intensive events. The primary challenges were associated with rural fire services, as wildfires were seen mainly as a rural issue, often due to escaped burns. They noted that problems arise when burns are improperly supervised or when sudden weather changes occur. The issue of wildfires resulting from recreational activities was also noted, particularly in the Cairngorms National Park.

There was consensus that wildfires have either worsened or will worsen, with most concerns focusing on increasing fuel loads due to changing agriculture and reduced prescribed burning. Climate change was mentioned but not always seen as the most important factor. The issue of rural fires was compounded by the prevalence of retained or part-time stations (see SFRS, n.d.), which experience more or larger wildfires, demanding resources from elsewhere.

SFRS personnel also raised concerns about firefighter safety and pollution. From their perspective, wildfires are exhausting, resource-intensive, and strain rural services, often requiring long travel times to bring in firefighters. Further details and examples can be found in Appendix iv.

6.2 Findings in the Highlands

6.2.1 <u>The extent and type of risks associated with local wildfires</u>

6.2.1.1 Whether wildfire was a problem for the area, or themselves

When asked if the area had a wildfire problem, participants from both survey samples in the Highlands showed some acknowledgement, just over half of the in-person group agreeing and nearly two thirds of the online (Figure 6.10). There was only a slight difference of 7% between the samples.

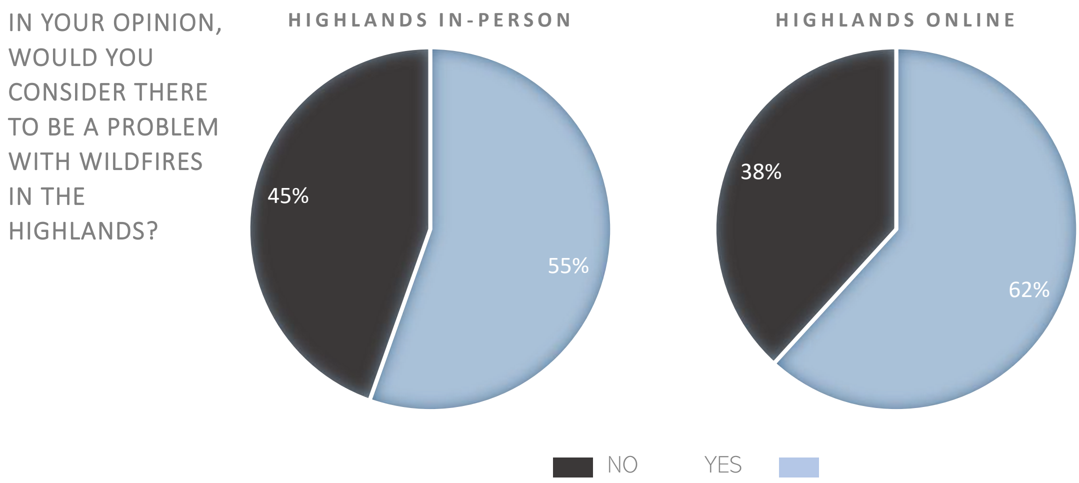


Figure 6.10 - Highlands' responses to whether wildfire was considered a problem, where in-person N=83 and online N=102.

There was certainly an awareness for wildfires in the area, highlighted by comments by participants throughout the survey online, as well as during face-to-face data collection. Some participants commented about personal experience, linking to the local problem, for instance one participant agreed wildfire a problem adding, "*Yeah and we've had them come up to the house before*." (HIP74). As well as some participants having more indirect or partial knowledge, *"I know they happen, but I don't know much more, sure there's people in the area that know lots*" (HIP25). The was also some awareness for potential causes on the problem in-person, where the problem was repeatedly blamed on agricultural groups, specifically crofters. For example, one commented, "*Yes, it's those crofters*" (IP38). This was echoed by online participants in other questions.

Having said that, not all agreed that wildfires were a problem, comments made in-person suggest this was not necessarily a case of a lack of awareness of their occurrence, rather not believing them to be problematic. For example, one commenting "*They seem to manage them fine enough*" (HIP14). Another reasoning the severity of fires does not constitute a problem, "*I've not known them to get big enough, not like elsewhere in the world*" (HIP46). Having said that, there were a small number of participants who had no awareness that answered no, for instance, an online later added "*I'm not sure I know of any local wildfires*" (HON37).

Participants were also asked the extent of risk wildfires posed to them. There were a range of scores, although over half in both samples gave scores of either 0 or 1 (Figure 6.11). The online sample showed slightly greater awareness or concern.

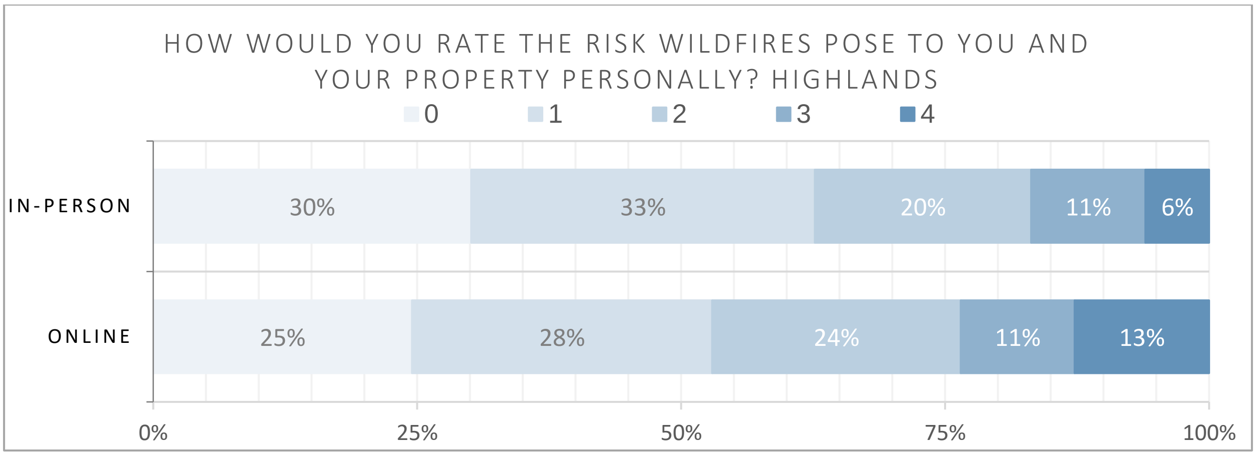


Figure 6.11 – Highlands' responses to risk posed by wildfires to themselves and their property, where in-person N=83 and online N=102.

Participants were asked to explain these scores. Responses were coded into justifications, as well as the overall sentiment regarding if they had given reason to be concerned, or not. The sentiments were compared to their response to the close-ended question of risk score (Table 6.1). Sensibly, for those who answered 0, the explanations were reasons not to be at risk and conversely those who have a score of 4 gave reasons for being at risk. Those who gave scores of 1 predominantly gave reasons not at risk, whereas 2 and 3 had more reasons to be at risk.

Given risk score compared to the sentiment in explanation [H]						
		Individual wildfire risk score				
		0	1	2	3	4
Sentiment identified in explanation	Reasons for being at risk	-	14%	61%	92%	100%
	Reasons for being at risk, but only minimal	-	2%	4%	3%	-
	Reasons for possible risk, but not likely	-	3%	-	-	-
	Risk to others	2%	-	4%	3%	-
	Reasons not at risk	98%	82%	30%	3%	-

Table 6.1 – Type of reason given in the Highlands for each risk score, for the combined samples N=185.

The reasons given followed some key themes demonstrating wildfire risk was constructed for the participants (Figure 6.12). The themes emerging from the codes included firstly, explaining their level of exposure, namely though the location of their house. Secondly, giving factors determining the likelihood of wildfire. Then to a lesser extent, pointing to the severity of fire, or a mixed reasoning where risk was minimal or othered.

REASONS FOR THEIR INDIVIDUAL WILDFIRE RISK SCORES				
	REASONS LEADING TO RISK PERCEPTION		REASONS FOR LACK OF RISK PERCEIVED	
Exposure	**Exposure of their house**	Near fuel Near area of high risk	**Lack of exposure of their house**	Not near fuel Not near area of high risk (e.g., in town, by water) Do not own property
	Vulnerability	House is remote Being unable to protect house	**Lack of vulnerability**	Community preparedness Have firebreak
	Exposure of their persons	As go out walking Indirect impacts of smoke		
	Generalised risk	Possible in whole area		
Likelihood of wildfire	**Fire occurrence history makes possible or likely**	Frequent Known to happen Had previously	**Fire occurrence history makes unlikely**	Not known to happen Not had near house Not had recently Had recently
	Land management leads to	Not well managed Blame controlled burning practices Blame crofters	**Land management mitigates**	Frequent Known to happen Had previously
	Tourists leads to	Tourists, camping		
	Weather leads to	Dry spring, summer Heatwaves	**Weather not conducive**	Too wet Only happen at extremes so not worried
Severity	**Possible impact high**	Bad if does happen	**Possible impact low**	Don't get out of control
Risk as mixed or minimal	**Consequences othered**	Concerned for friends Concerned for tourists		
	Risk is very low	Very small risk Some risk from embers or spreading of only larger fires	**Risk is unlikely**	Possible but not likely

Exposure | Lack of exposure
Fire occurrence increases risk | Fire occurrence decreases risk
Influencing factors increase risk | Influencing factors decrease risk
Potential fire severity | Lack of potential fire severity
Risk is minimal or other | Risk is possible, but unlikely

Figure 6.12 – Overview of reasons in the Highlands given for individual wildfire risk scores.

Key factors for those giving low scores (Figure 6.13) included a lack of exposure and awareness of the history of fire occurrence, which seemingly decreased their perceived risk. Not living near high-risk areas or fuel sources were primary reasons for the lack of exposure, with examples including living 'in town' or 'near the water'. Not having experienced wildfires nearby or recently contributed to the perception of lower risk, as participants felt a wildfire was no longer likely or possible, rather than thinking a recent lack of wildfires resulting in one being 'due'.

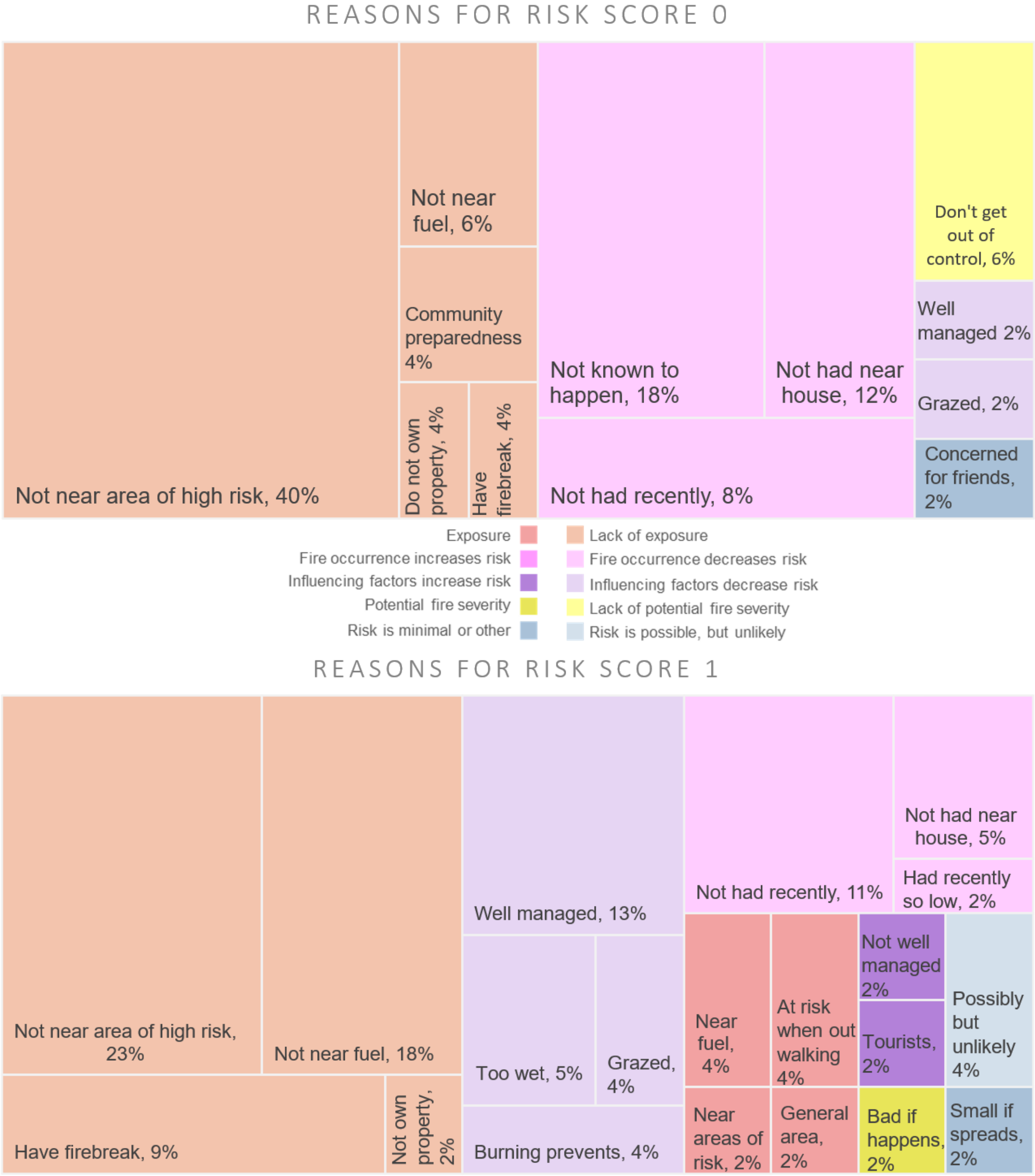


Figure 6.13 - Reasons given for individual wildfire risk scores of 0 and 1. For Highlands respondents that gave scores of 0 N=52, and 1 N=65.

A small proportion who gave a score of 0 cited the low severity of fires, indicating that while wildfires may occur, they are not significant enough to warrant concern. For most however, the lowest risk scores were associated with the improbability rather than the severity of fires. Among those who scored 1, the lack of exposure was again a primary theme, but there was also an increase in mentions of mitigating factors. These included effective land management (such as well-managed, grazed, or burnt areas) and the perception that the area was too wet for wildfires. This suggests an acceptance of the possibility of wildfires, but the dominant perception that they are unlikely.

A small proportion acknowledged some risk due to living near fuel, being exposed when out walking, or recognising a general risk for the area. Only 2% of those who scored 1 noted the high severity but low likelihood of wildfires, contributing to their overall score. Thus, for the majority, the probability of fire was a key factor in their risk assessment, although severity might also be considered within these estimates.

For those explaining risk scores of 2 (Figure 6.14), there is an increase in participants expressing factors exposing them to risk rather than a lack of exposure. These factors included their house location, proximity to fuel, areas of high risk, and certain vulnerabilities such as being unable to protect or being remote. Some participants also noted high general exposure in the area and indirect exposure to smoke. However, some mentioned mitigated risk to their house due to its location, not being near fuel, or having a firebreak, despite the general risk to the area. Beyond exposure, factors increasing likelihood were significant for this risk score. These included awareness of poor land management, ignition factors (crofters, managed burns, and tourists), and heatwaves. Fire history also played an increasing role as scores increased: some participants noted previous occurrences nearby (increasing perceived risk), while others believed recent wildfires lowered the risk, as with the lower scores.

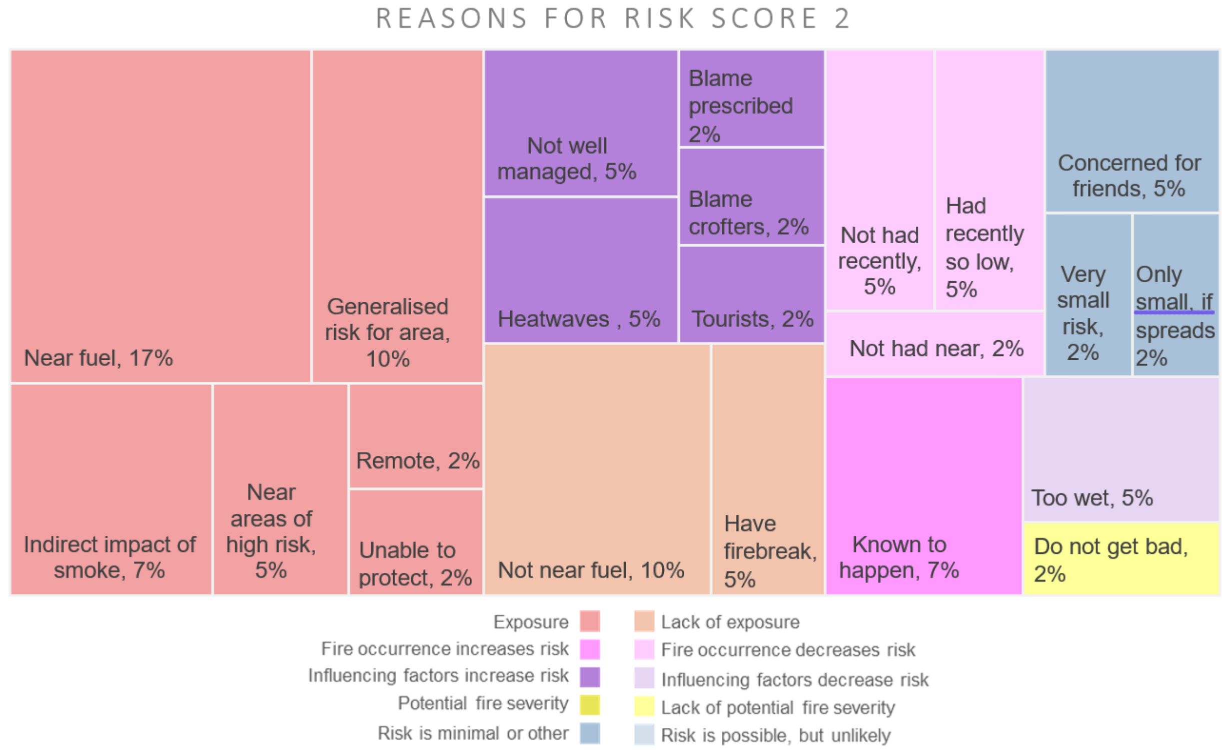


Figure 6.14 - Reasons given for individual wildfire risk scores of 2 by Highlands' participants, N=46.

The explanations for the highest scores (Figure 6.15) show that the shift from medium to high risk is primarily due to increased observations of previous fires, such as frequent wildfires or events nearby, as well as awareness of factors making wildfires more likely or more severe. For scores of 3, exposure and fire history were key themes, while for scores of 4, factors increasing likelihood and exposure were most prominent.

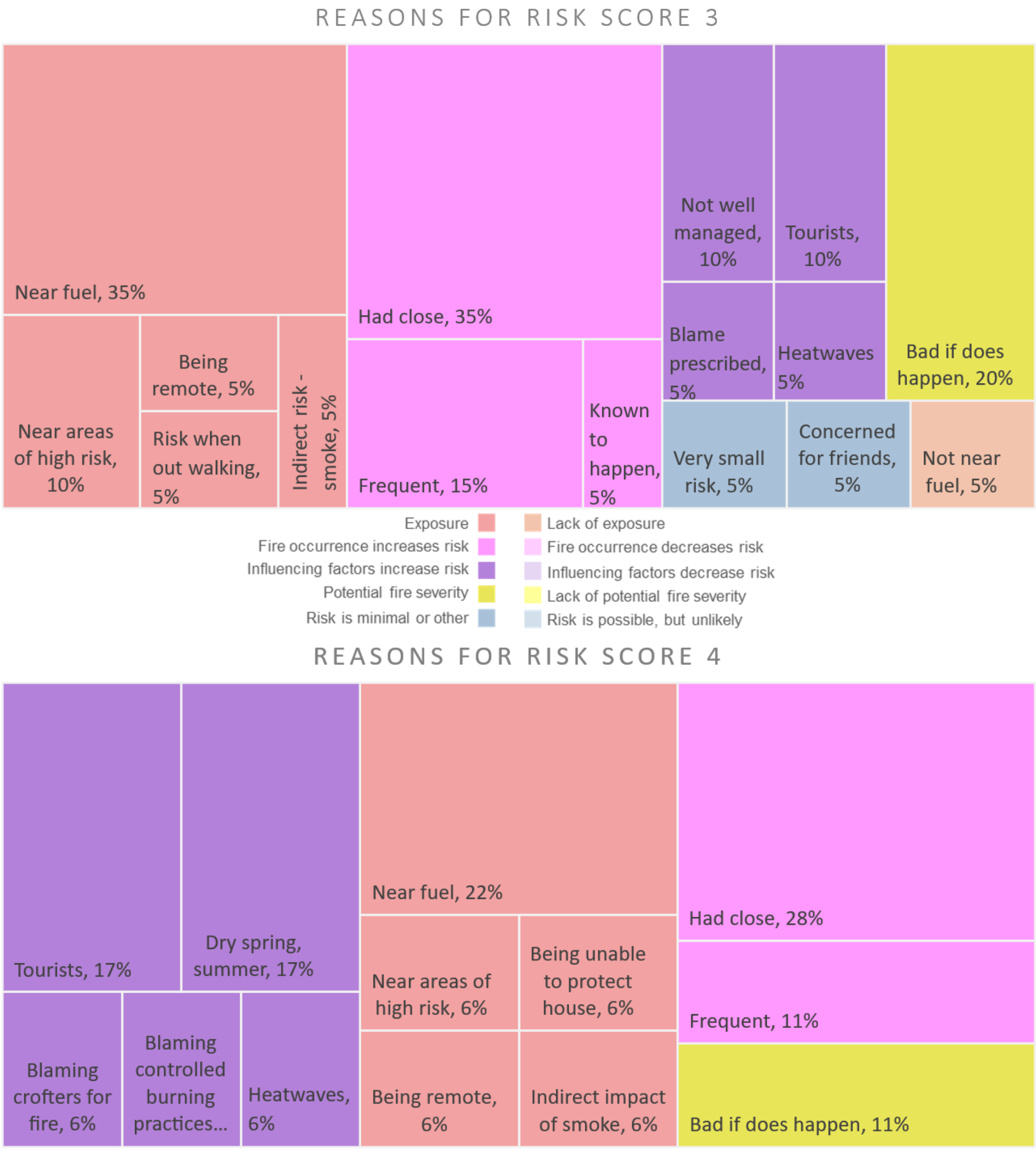


Figure 6.15 - Reasons given for individual wildfire risk scores of 3 and 4. For Highlands' participants that gave scores of 3 N=36, and 4 N=36.

Concerns about ignition sources (tourists and crofters) and external factors (seasonality and heatwaves) were significant for those giving the highest risk scores, indicating that increased knowledge about local wildfire issues raises risk perception. Participants explicitly mentioned concerns about severity, such as fires escaping the control of the fire service or insufficient firefighting resources, which were common in both high scores. A few also cited vulnerability, mainly due to remoteness, as key to their perceived high risk. Concerns about local fire issues pointed to the level of potential severity rather than ignition risk. In other words, local fire problem concerns reflect worries about fire service resources and the local landscape's fuel load and remoteness. These factors, although mentioned less frequently, highlight how local knowledge influences concern and risk perception.

In summary, perceiving wildfire risk in the Highlands primarily revolves around exposure and the possibility of wildfire. House location, particularly proximity to fuel or areas associated with occurrence, was the main factor for exposure, though personal exposure while walking or through smoke also contributed to risk perception at all levels although by smaller proportions of the samples. A lack of past wildfires often justified lower scores, while increased fire activity or awareness of it correlated with higher scores, indicating a perceived likelihood of future events.

Factors increasing the probability of wildfires, such as concerns about tourists, crofters, or extreme weather, were significant for those with the highest risk scores. Interestingly, a lack of recent fires made some participants believe the risk had disappeared rather than thinking a severe event was looming. This perspective may stem from the Highlands not being a fire-prone area, leading participants to assume wildfires won't happen rather than expecting them. Wildfire severity also influenced risk perception, with more severe fires or concerns about uncontrollable fires in the landscape present in higher scores. Vulnerability to wildfires, such as remoteness or inability to protect assets, also contributed to higher risk assessments. Conversely, a lack of perceived potential severity led to lower scores for those that acceptance the possibility of fire but minimised the consequences. Overall, the perceived unlikelihood or spatial disconnection from wildfires was more influential in leading to low-risk perception.

Therefore, the key factors in wildfire risk perception are the possibility and likelihood of wildfires. Awareness of local factors were very influential in increasing the perceived likelihood, crucial for high-risk scores, while perceived severity and controllability concerns also contribute to higher scores.

Next, from the reasons given above, it is clear an awareness of local wildfire problems shapes risk perception, particularly when these problems make wildfires more likely, such as local ignition factors and extreme weather. Comparing responses about acknowledging a local problem with personal risk scores (Table 5.2) provides insight. In both samples, those who answered "no" to a local problem had a higher proportion of 0 scores compared to those who answered "yes." However, the relationship is not straightforward; some participants acknowledged a local problem but gave low scores, while others disagreed about a local problem but gave higher scores. This discrepancy may stem from participants being aware of regional risks but not feeling personally exposed or recognising personal exposure while viewing the risk as widespread across the area.

Comparison of answers to agreement that wildfire is a problem and personal risk scores [H]							
IN-PERSON		Individual wildfire risk scores					
		0	1	2	3	4	
Is wildfire a problem locally?	Yes	87%	11%	3%	0%	0%	*(N=29)*
	No	23%	40%	21%	8%	8%	*(N=54)*
		(N=25)	*(N=27)*	*(N=17)*	*(N=9)*	*(N=5)*	
ONLINE		Individual wildfire risk scores					
		0	1	2	3	4	
Is wildfire a problem locally?	Yes	77%	13%	3%	0%	6%	*(N=37)*
	No	34%	27%	13%	10%	16%	*(N=63)*
		(N=25)	*(N=29)*	*(N=25)*	*(N=11)*	*(N=13)*	
LEGEND	0%	100%	Proportion of participants answering whether wildfire is deemed a problem				

Table 6.2 - Comparison of responses to whether consider wildfire a problem locally and individual risk to themselves.

Moreover, the perceptions somewhat varied according to participants' age. Firstly, examining differences in response to wildfire being a problem for the area (Table 6.3), the youngest group (18-24) had lower proportions of "yes" responses compared to other age groups, in both the in-person and online survey samples. Furthermore, in terms of individual risk scores, the youngest age group also had higher proportions of lower scores, particularly 0, compared to other age groups. The rest of the age groups showed variation but no distinct trend.

Comparison of answers to whether wildfire is a problem and age [H]								
IN-PERSON		**Age group**						
		18-24	25-34	35-44	45-54	55-64	65+	
Is wildfire a problem locally?	Yes	33%	73%	56%	63%	56%	85%	*(N=54)*
	No	67%	27%	44%	37%	44%	15%	*(N=29)*
		(N=6)	*(N=11)*	*(N=9)*	*(N=19)*	*(N=18)*	*(N=20)*	
ONLINE		**Age group**						
		0	1	2	3	4		
Is wildfire a problem locally?	Yes	57%	73%	72%	64%	58%	59%	*(N=65)*
	No	43%	27%	28%	36%	42%	41%	*(N=37)*
		(N=7)	*(N=11)*	*(N=18)*	*(N=25)*	*(N=24)*	*(N=17)*	
LEGEND		0%	100%	Proportion of participants from each age group				

Table 6.3 - Comparison of Highlands' responses to whether wildfire was considered a problem for the area and the participant's age.

Comparison of answers to individual risk score and age [H]								
IN-PERSON		**Age group**						
		18-24	25-34	35-44	45-54	55-64	65+	
Individual risk score	0	50%	27%	22%	47%	22%	20%	*(N=25)*
	1	50%	18%	44%	21%	28%	45%	*(N=27)*
	2	0%	27%	22%	11%	33%	20%	*(N=17)*
	3	0%	18%	11%	16%	6%	10%	*(N=9)*
	4	0%	9%	0%	5%	11%	5%	*(N=5)*
		(N=6)	*(N=11)*	*(N=9)*	*(N=19)*	*(N=18)*	*(N=20)*	
ONLINE		**Age group**						
		18-24	25-34	35-44	45-54	55-64	65+	
Individual risk score	0	43%	9%	28%	28%	13%	35%	*(N=25)*
	1	29%	36%	33%	20%	25%	29%	*(N=28)*
	2	14%	27%	17%	28%	38%	12%	*(N=25)*
	3	14%	9%	11%	8%	17%	6%	*(N=11)*
	4	0%	18%	11%	16%	8%	18%	*(N=13)*
		(N=7)	*(N=11)*	*(N=18)*	*(N=25)*	*(N=24)*	*(N=17)*	
LEGEND		0%	100%	Proportion of participants from each age group				

Table 6.4 - Comparison of Highlands' responses to the risk wildfire posed and age.

Next, comparing the responses between the genders, the differences were mixed and inconclusive. In response to wildfire being considered a problem the male group had less agreement in both the in-person and online samples. However, compared to the scores, the genders had somewhat an even spread, although where there were slight variations, these were in an opposing trend to the previous question.

Comparison of answers to whether wildfire is a problem and gender [H]									
IN-PERSON		**Gender**			ONLINE		**Gender**		
		Women	Men				Women	Men	
Is wildfire a problem locally?	Yes	62%	50%	*(N=54)*	**Is wildfire a problem locally?**	Yes	74%	67%	*(N=65)*
	No	38%	50%	*(N=29)*		No	26%	33%	*(N=37)*
		(N=53)	*(N=30)*				*(N=72)*	*(N=30)*	
LEGEND		0%	100%	Proportion of participants from each gender group					

Table 6.5 - Comparison of Highlands' responses to whether wildfire was considered a problem for the area and gender.

Comparison of answers to whether wildfire is a problem and gender [H]									
IN-PERSON		**Gender**			ONLINE		**Gender**		
		Women	Men				Women	Men	
Individual risk score	0	26%	37%	*(N=25)*	**Individual risk score**	0	25%	23%	*(N=25)*
	1	34%	30%	*(N=27)*		1	26%	33%	*(N=29)*
	2	21%	20%	*(N=17)*		2	26%	20%	*(N=24)*
	3	13%	7%	*(N=9)*		3	11%	10%	*(N=11)*
	4	6%	7%	*(N=5)*		4	12%	13%	*(N=13)*
		(N=53)	*(N=30)*				*(N=72)*	*(N=30)*	
LEGEND		0%	100%	Proportion of participants from each gender group					

Table 6.6 - Comparison of Highlands' responses to the risk wildfire posed and gender.

6.2.1.2 Types of concerns about wildfire

Participants were asked what specific concerns were held about local wildfire. The two survey samples are presented together here as they gave similar responses. The concerns were coded and then grouped by what they focused attention on, including, concerns regarding on impacts on nature, or humans, or a concern about it getting bigger (i.e., becoming difficult to control) (Figure 6.16). Generally, there were more participants focusing on concerns about natures than humans. Many gave a combination of the two (40%), but a reasonable portion gave only impacts on nature.

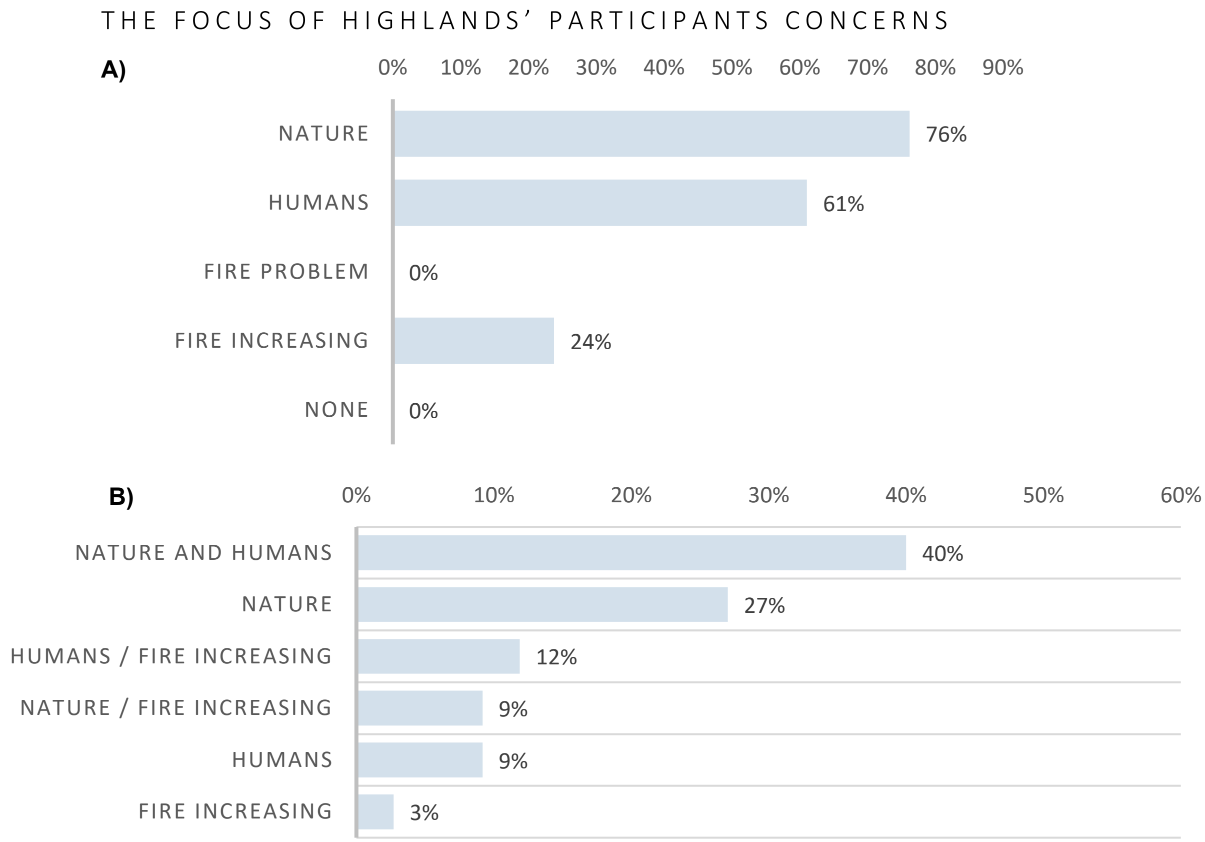


Figure 6.16 – The focus of Highlands participants' concerns for the combined sample (N=185). (A) The proportion of participants who expressed each type of concern (note that participants could give up to two concerns, so the total could exceed 100%). (B) The aims of participants' focus across the full response (up to two concerns, adding up to 100%).

The variety of specific concerns raised by participants are shown in Figure 6.17, these include a general concern for life (both human and non-human); impacts on nature such as wildlife, animals, plants, natural beauty; impacts on people directly through health and safety; other impacts on people, through assets, infrastructure, and society; then atmospheric impacts, that is the indirect impacts of smoke, including pollution and disruption; and lastly, impacts of the fire getting bigger or out of control. The frequency each of these raised is shown in Figure 6.18.

THE RANGE OF SPECIFIC CONCERNS AROUND WILDFIRE OCCURRENCE RAISED BY HIGHLANDS' PARTICIPANTS

All life	• General concern for life
Nature	• Wildlife • Animals • Habitats • Plants • Environment • Landscapes (heathland, woodland, countryside) • Long-term impact • Eyesore (diminished natural beauty) • Quality of environment (loss biodiversity, endangered species)

People (bodies)	• Safety of people
	• Their own safety
	• Health
	• Their own health
	• Other's safety
	  • Inc. family, friends, pets, walkers, children, vulnerable people
	  • firefighters

Human (built and social)	• Property generally • Their own property • Other's (those close to fires, or up mountain) • Infrastructure, economic, disruption to area • Particularly, loss of amenities, impact on tourism and farming, and disruption
Atmospheric	• Smoke, air quality, pollution • Climate change feedback Air pollution, and contributing to climate change were key focuses, as well as accidents from smoke.
Fire increasing	• Ability to fight the fire, becoming uncontrollable • Fire getting bigger (impact more areas, or more severely, 'wiping everything out') • Vulnerability (being remote)

Figure 6.17 - Resulting codes of the specific concerns held by Highlands' participants regarding local wildfire. Combined sample, N=185.

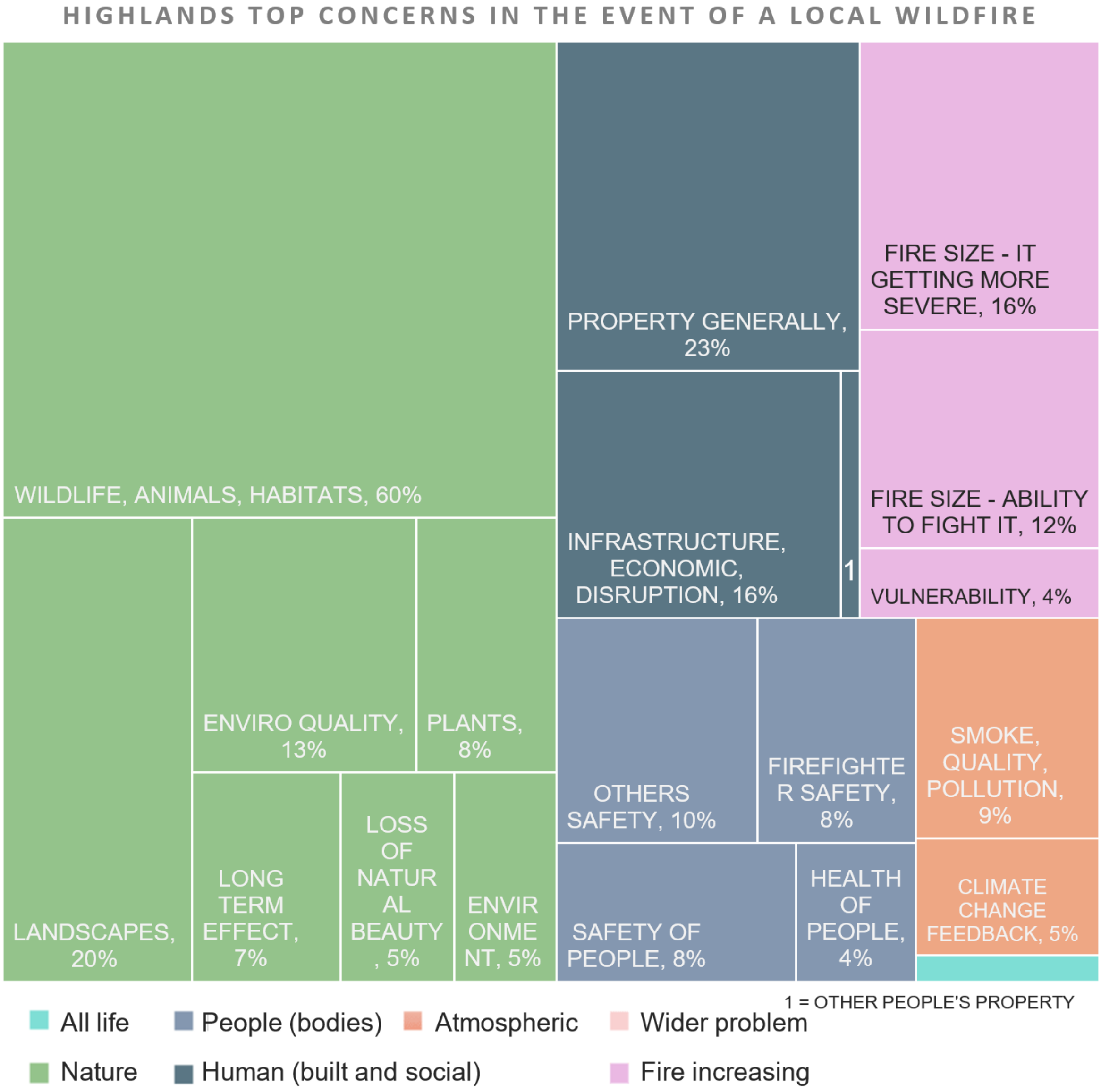


Figure 6.18 – Highlands' participants' specific concerns. For the combined sample, N=185. Note participants could put up to two concerns, hence percentages will add up to more than 100%.

The frequency of concerns demonstrates the dominance of impacts on nature in the forefront of participants minds, as these were raised by a large majority (72%). There was certainly concern over the extent or longevity of impacts, "*Wildlife; we live in a word that is changing and our wildlife is the most fragile of all and it concerns me greatly that unnecessary fires can cause untold damage*." (HON74). There were concerns raised regarding impacts on people. 26% gave a concern about people such as safety or health; 42% gave a concern about other human impacts such as properties, infrastructure, and economic loss. Of the people who gave any human impact, 43% specified direct to bodies and 69% specified human-built or social consequences. Notably, in this location there were concerns about the economic impact of the destruction of the environment through disruption or loss to agriculture or tourism industries. Many participants expressed concern about the severity of the events, meaning they have more widespread impact as well as concerns about the ability for it to be controlled and whether there are sufficient firefighting resources as the area is rural and the expanses of fuel are large. For instance, pointing out, "*The speed of spread, it takes firefighters time to arrive*" (HON67), and concern for "*Time to* *put it out due to limited resources*" (HON14). There were a small number of concerns about the atmospheric impacts, including air quality and pollution, as well as specifically mentioning contributions to climate change.

6.2.1.3 Months with the highest perceived wildfire risk

Participants were asked when wildfire risk was highest, giving up to two months (Figure 6.19). There was spread across spring and summer months, with effectively two peaks, first in April and May, and secondly, in July and August. The two samples gave very similar response with only a small difference.

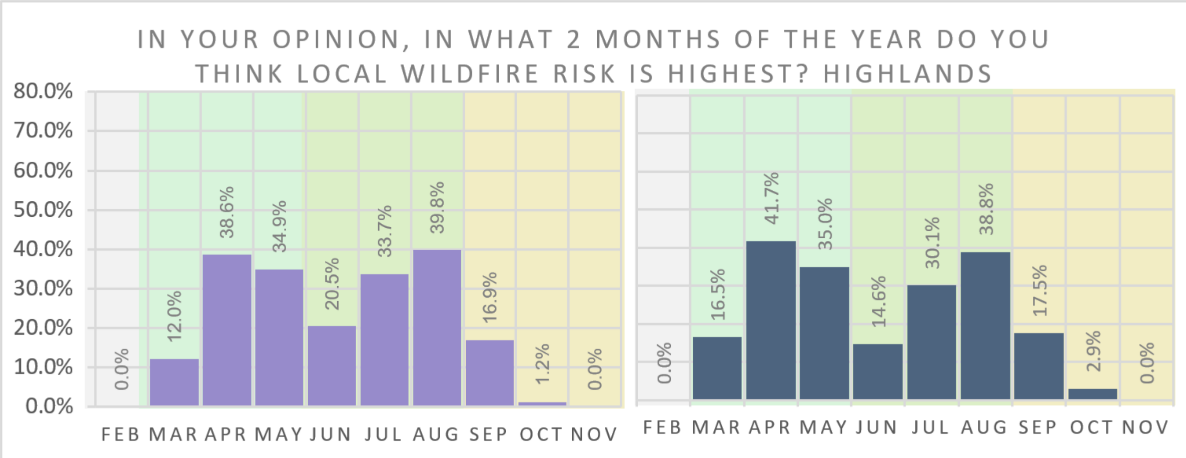


Figure 6.19 - Highlands' participant responses to which months have the highest wildfire risk, where in-person N=83 and online N=102. This shows the proportion of participants that voted each month, as participants could give up to two the figures will add up to more than 100%.

The combination of months chosen where examined as there was the option to pick two months. Most chose consecutive months, suggesting the opinion was focused on one time of year or season, although some did select a combination of spring and summer pairs, with one exception being May and August in the most common examples. Across the two samples there were very similar combination as the most common pairs (Table 6.7).

Most common responses from Highlands' participants regarding months with highest wildfire risk			
IN-PERSON		ONLINE	
April + May	61%	April + May	64%
July + August	16%	July + August	13%
March + April	8%	March + April	7%
June + July	4%	August + September	6%
August + September	4%	May + June	3%
May + August	2%	May + August	2%
	75%		*71%*

Table 6.7 - The six most common pairs of months chosen by Highlands' participants as having the highest wildfire risk. For in-person N=83 and online N=102.

Comparing these perceptions to wildfire records presented in Figure 6.7, there is some acknowledgement of the April peak in real data found in the perceptions. However, there are many that instead highlight summer as the highest risk. Certainly, summer has more focus in perceptions than the average magnitude in wildfire records of this time of year. This is possible due to anomalous years of newsworthy summer incidents, or the associations with weather where it is acknowledged as a factor, as well as heatwaves and droughts mentioned in the risk scores explanations. The awareness of spring months suggests an exposure to prescribed fire, where muirburn is associated with the spring (see part 6.2.3.1).

6.2.2 Familiarity with local wildfire occurrence

6.2.2.1 Visibility of wildfire on the landscape

The responses to the risk questions demonstrate some awareness of local wildfires among residents in the area. However, the high concern by a subgroup with extensive knowledge does not necessarily indicate ubiquitous awareness. One question aimed at understanding participants' familiarity with local wildfires was whether they had seen a wildfire locally. Many participants in the Highlands had generally seen wildfires, with a majority having seen multiple (Figure 6.20). Only 10% of in-person respondents and 8% of online respondents had seen no sign of wildfire. With little difference between the samples, this demonstrates that the area generally has very visible wildfires. The main difference between the samples is that more online respondents had seen multiple wildfires; 68% of in-person participants had seen more than one, compared to 85% of online participants. It is possible that with more prescribed burning in spring, there is a more widespread visibility at this time, making, meaning so many in the area have witnessed signs of fire on the landscape (whether they distinguish between prescribed or wild forms or not).

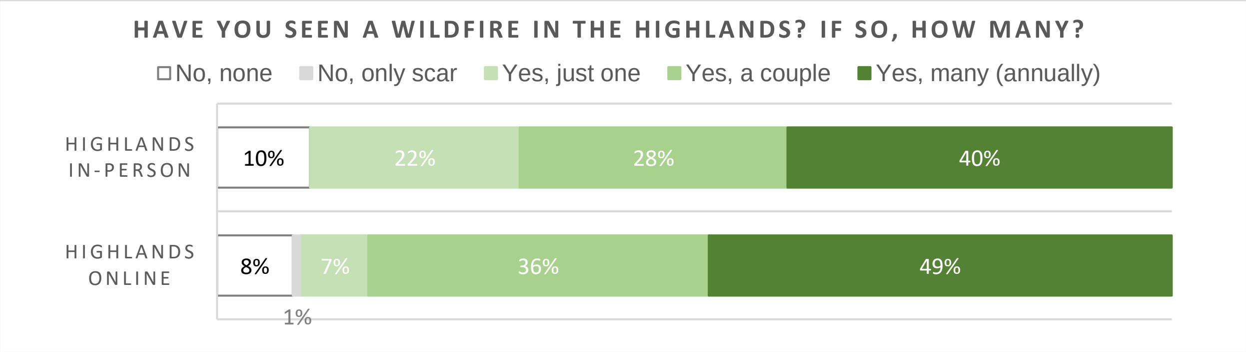


Figure 6.20 – Highlands' responses to whether respondent had seen a wildfire, presenting separate samples, In-person N=83, online N=103.

Participants' responses to whether they had seen a wildfire locally were compared with their answers to whether they considered wildfire a problem (Table 6.18). Due to the very small number of participants who had not seen a wildfire, some sample sizes are quite small. Nevertheless, those who identified wildfire as a problem were much less likely to report having seen no wildfires. Additionally, those who recognised wildfire as a problem had higher proportions that seen multiple fires or see fires regularly compared to those who did not perceive it as a problem. This suggests that witnessing fires, particularly seeing them frequently, may increase the recognition of wildfire as an issue in the area; alternatively, that being aware of a wildfire problem makes individuals more likely to notice wildfires.

Comparison of whether participants had seen wildfire locally and is it considered a problem [H]							
IN-PERSON		Whether participants had seen a wildfire					
		No, none	No, only remains	Yes, one	Yes, a couple	Yes, many / annually	
Is wildfire a problem locally?	Yes	17%	7%	24%	34%	17%	*(N=29)*
	No	0%	2%	15%	24%	59%	*(N=54)*
		(N=5)	*(N=3)*	*(N=15)*	*(N=23)*	*(N=37)*	
ONLINE		**Whether participants had seen a wildfire**					
		No, none	No, only remains	Yes, just one	Yes, a couple	Yes, many / annually	
Is wildfire a problem locally?	Yes	14%	0%	17%	56%	14%	*(N=36)*
	No	5%	2%	2%	24%	68%	*(N=66)*
		(N=8)	*(N=1)*	*(N=7)*	*(N=36)*	*(N=50)*	
LEGEND		0%	100%	Proportion of participants answering whether wildfire is deemed a problem			

Table 6.8 - Comparison of Highlands' participants' responses to whether they had seen wildfire and whether considered it a problem. For in-person N=92 and online N=330.

Furthermore, the months participants identified as having the highest wildfire risk were compared with whether they had seen signs of wildfire locally (such as a wildfire or burn scar) (Table 6.9). Participants across both samples who had not seen wildfires locally were more likely to choose summer months as the highest risk period, whereas those who had observed wildfires locally more frequently selected spring months. This suggests that summer is potentially assumed to be the high-risk season, while greater visibility of wildfires or prescribed fires in spring leads to greater awareness of fire risk at this time.

Comparison of answers to whether wildfire had been seen locally and opinion on months of highest risk [H]				
	IN-PERSON		ONLINE	
	Not seen	Seen some sign of fire	Not seen	Seen some sign of fire
Feb	0%	0%	0%	0%
Mar	0%	13%	0%	18%
Apr	0%	29%	0%	32%
May	0%	15%	0%	16%
Jun	40%	14%	25%	7%
Jul	20%	21%	63%	17%
Aug	40%	8%	13%	7%
Sep	0%	0%	0%	2%
Oct	0%	0%	0%	0%
Nov	0%	0%	0%	0%
Legend	0%	100%	Percentage of participants that either had or had not seen wildfire	

Table 6.9 – Comparison of Highlands' participants' responses to whether they had seen wildfire and the months believed to have the highest wildfire risk.

Whether participants had seen wildfire was also compared to their individual characteristics, including age (Table 6.10) and gender (Table 6.11). Of the in-person sample, the youngest group did differ from the other age groups in that fewer had seen many wildfires, and there was a slightly higher proportion having seen none. However, the online group had very little difference between the age groups. Furthermore, comparing to the proportions were very similar, and the fractional differences trend in different directions between the two samples.

Comparison of answers to whether participants had seen a wildfire and their age [H]									
IN-PERSON		Age group							
		18-24	25-34	35-44	45-54	55-64	65+	
Whether seen a wildfire locally	Yes, many / annually	0%	64%	33%	53%	39%	50%	*(N=37)*
	Yes, a couple	50%	18%	33%	32%	39%	10%	*(N=23)*
	Yes, just one	33%	18%	11%	11%	17%	25%	*(N=15)*
	No, only remains	0%	0%	11%	0%	0%	10%	*(N=3)*
	No, none	17%	0%	11%	5%	6%	5%	*(N=5)*
		(N=6)	*(N=11)*	*(N=9)*	*(N=19)*	*(N=18)*	*(N=20)*	
ONLINE		Age group						
		18-24	25-34	35-44	45-54	55-64	65+	
Whether seen a wildfire locally	Yes, many / annually	43%	36%	47%	52%	46%	59%	*(N=50)*
	Yes, a couple	43%	45%	41%	32%	38%	24%	*(N=36)*
	Yes, just one	0%	0%	6%	8%	13%	6%	*(N=7)*
	No, only remains	0%	0%	6%	0%	0%	0%	*(N=1)*
	No, none	14%	18%	0%	8%	4%	12%	*(N=8)*
		(N=7)	*(N=11)*	*(N=17)*	*(N=25)*	*(N=24)*	*(N=17)*	
LEGEND	0%	100%	Proportion of participants from each age group					

Table 6.10 - Comparison Highlands' responses to whether they had seen a wildfire locally with participant age. For those who provided an age, in-person N=83 (100%) and online N=102 (98%).

Comparison of whether participants had seen a wildfire and their gender [H]				
IN-PERSON		Gender		
		Women	Men	
Whether seen a wildfire locally	Yes, many / annually	40%	53%	*(N=37)*
	Yes, a couple	26%	30%	*(N=23)*
	Yes, just one	21%	13%	(N=15)
	No, only remains	6%	0%	(N=3)
	No, none	8%	3%	(N=5)
		(N=53)	*(N=30)*	
ONLINE		Gender		
		Women	Men	
Whether seen a wildfire locally	Yes, many / annually	49%	50%	*(N=50)*
	Yes, a couple	35%	37%	*(N=36)*
	Yes, just one	8%	3%	*(N=7)*
	No, only remains	0%	3%	*(N=1)*
	No, none	8%	7%	*(N=8)*
		(N=72)	*(N=30)*	
LEGEND	0%	100%	Proportion of participants from each gender group	

Table 6.11 - Comparison Highlands' responses to whether they had seen a wildfire locally with participant age. For those who provided a gender, in-person N=83 (100%) and online N=102 (98%).

6.2.2.2 Familiarity with influences on local wildfire occurrence

To further assess participants' familiarity with and knowledge of local wildfires, they were asked to identify the most important influences on wildfire risk. In addition to the five multiple-choice categories—weather, build-up of vegetation, time of year, people (ignitions), and combination of factors—two additional categories, land management and agriculture, were included based on other responses provided by Highlands' participants (Table 6.12). To an extent agriculture listed other human ignition agents (especially where escaped burns are a key ignition source for Scotland), however it was unclear whether participants were referring to the ignition factor or effect on fuel loads, so these were separated from the human ignition sources group. 82% in-person chose multiple-choice options, whereas 77% of online chose a multiple-choice option. The online picked more other options, suggesting that the original multiple-choice options were largely relevant, although possibly did not fully represent public opinion.

Factors chosen by Highlands' participants as most important for wildfires locally							
Group	Weather	Build-up of fuel	Time of year	*Land management*	*Agriculture*	Other people affecting ignitions	Combination
Subgroup	Dry Weather	Build-up of vegetation	Time of year	*Poor land management*	*Farmers*	Any ignition by humans	Combination of hot, dry weather, build-up of vegetation, time of year, and or people ignitions
					Crofters		
	Hot weather				*Controlled burns / muirburns (escaped)*	*Negligence*	
						Camping	
	Wind					*Tourists*	
						Steam train	
	3	**1**	**1**	**1**	**3**	**6**	**1**

Table 6.12 – The variety of factors chosen by Highlands' participants, grouped by similar themes. Additional answers provided by participants and not in the original multiple-choice options in italics.

The proportions of participants selecting each factor (Figure 6.21) indicate that human ignitions were perceived as a critical cause of wildfires, with weather also being a significant factor, followed by the build-up of fuel. Agriculture, including escaped burns, was mentioned as well. Specific ignitions of concern included the steam train and tourism. Tourists and campsites were blamed, for example, reference to "*ignorant tourists*" (HIP10). Agriculture and crofters were also identified as contributing factors, where a small portion expressed strong opinions, for example, "*Arrogant crofters with no sense of environmental preservation, or respect for planet*." (HON32). Fuel build-up, especially "*rank old woody heather*" (HON52), was noted by a number of participants, particularly those responding online. While many participants demonstrated highly localised knowledge, this was not universal. Some relied on estimations or guesses, as illustrated by one response: "*I don't know of anything particular, I guess it's the weather*" (HON58).

Figure 6.21 – Highlands' participants' responses to most important factors for local wildfire, where (A) is an overview of the theme of influence, and (B) is the proportion of participants that raised each specific factor. For in-person N=83 and online N+102.

Examining the paired responses for the full answer to the most influential factor shows a variety of pairs. People and weather emerged as the most commonly selected factors in both samples, with each being chosen individually as well. Paris including these two and build-up of fuel were also in the more common selections, especially online.

Most common full responses from Highlands' participants on factors for local wildfire risk		
	IN-PERSON	ONLINE
People *and* weather	37%	34%
People just one	23%	18%
Weather one	10%	8%
People *and* build-up of fuel	8%	12%
Weather two	6%	5%
People two	5%	4%
People *and* agriculture	0%	6%
Build-up of fuel *and* agriculture	0%	5%
Weather *and* agriculture	4%	1%
Weather *and* build-up of fuel	2%	1%
Build-up of fuel *and* land management	0%	2%
	99%	*99%*

Table 6.13 - Full responses, the individual or pair of factors, to the most important local influences on wildfire in the Highlands.

Next, to further explore how Highlands' residents perceive the influence on local wildfire, participants were asked whether they believe wildfire is currently affected by climate change or will be in the future. The proportion of participants who believed climate change would affect future wildfire activity was 25% higher than when considering if it had changed current activity. While there was a 14% decrease in "no" responses regarding future impacts compared to current impacts; this meant the "don't know" responses also decreased when considering future affect, by 7.5%. This indicates greater agreement as well as more certainty that climate change will affect future wildfires compared to current wildfires. Nonetheless, some participants still did not believe climate change would affect future wildfire activity.

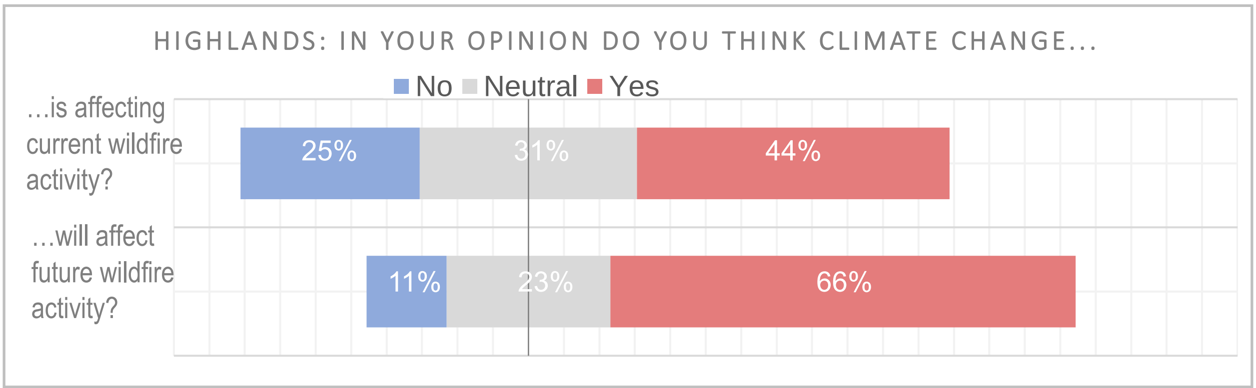


Figure 6.22 – Highlands' responses to their belief on the effect of climate change on local wildfire.

For those that disagreed, there was an acknowledgement of relying on personal observations, one participant reasons for example, "*I can't say I've noticed a difference*" (HIP31). Moreover, there were others that made comments speaking to a greater influence of anthropogenic factors over climatic, for instance, "*It would be more about what the farmers are doing than climate change*" (HON79). Moreover, there was also a minimisation of the risk in Britain, where changes elsewhere were perceived as worse, "*I don't think it'll get as bad here as other countries*" (HON68). The influence of climate change was also negated where there also the implication of a misconception about local climate being "*…too wet for that to affect here.*" (HIP16). While there was some denial, there was also some uncertainty. Some comments explain how some may have selected the "I don't know" response where they lacked knowledge or observations, as well as uncertainty over the influence of climate change, "*Well you think it's going to get warmer, but it's wetter, we'll have to keep an eye out in the future, I don't know for now*" (HON65).

On the other hand, those that agreed with the influence of wildfire shared a rhetoric of worsening risk, one estimating, "*Well yes I would imagine it'll get a lot worse*" (HIP38). Similarly, another commented, "*It's certainly not going to help*" (HIP67). Others related the increase in wildfire as a result of climate change to raise questions over how the environment is managed, "*Yes we need to look after our environment more, and that includes not burning our landscapes intentionally too*" (HON48).

6.2.3 <u>What was the familiarity with and attitudes towards prescribed fire?</u>

6.2.3.1 Familiarity with prescribed fire (muirburn).

The participants in the Highlands were mostly familiar with the term Muirburn in some capacity with only 16% and 13% of the in-person and online samples selecting "no" (Figure 6.23). There was only a small difference between the samples for recognising the term. Many recognised the term but were unsure of its meaning, especially in-person.

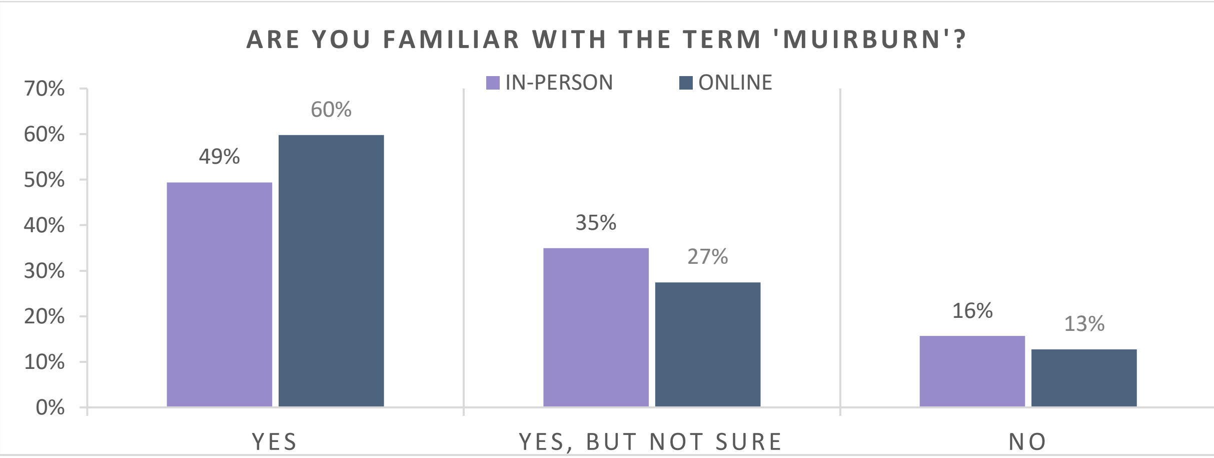


Figure 6.23 – Highlands' responses to whether they are familiar with the term 'muirburn', a Scottish term for prescribed burning.

To understand participants' interpretations of 'muirburn,' those who recognised the term were asked to describe their understanding. Explanations varied in specificity, but participants who provided explanations did comprehend 'muirburn' as referring to landscape burning, where the moors and hills were a focus. Aspects which were discussed included the timing, common locations, methods, and reasons behind its use (Figure 6.24).

Figure 6.24 – Variety of answers to what Highlands' participants understood muirburn to mean. Ranging in specificity of knowing it to be a controlled burn to giving a place, group, or reason for its use.

Firstly, the explanations of those that responded as "familiar but unsure of its meaning" are shown in Figure 6.25. Almost a third only recognised the term, then 18% gave a generic answer of being controlled burning. Most gave some reason why, the most common was for preventing wildfires, then promoting growth, and removing vegetation. Some gave descriptions of where there would be burning, the most common being on moors, and of heather or on heaths. This survey topic was probably a giveaway for wildfire as a reason hence why it was most common, unless participants were genuinely more aware of that use. Wildfire is relatively more recent as a purpose for burning landscapes in this location, more traditional uses of muirburn are grouse management and grazing (Scottish Government, 2021a; Worrall *et al*., 2010; Yallop *et al*., 2006).

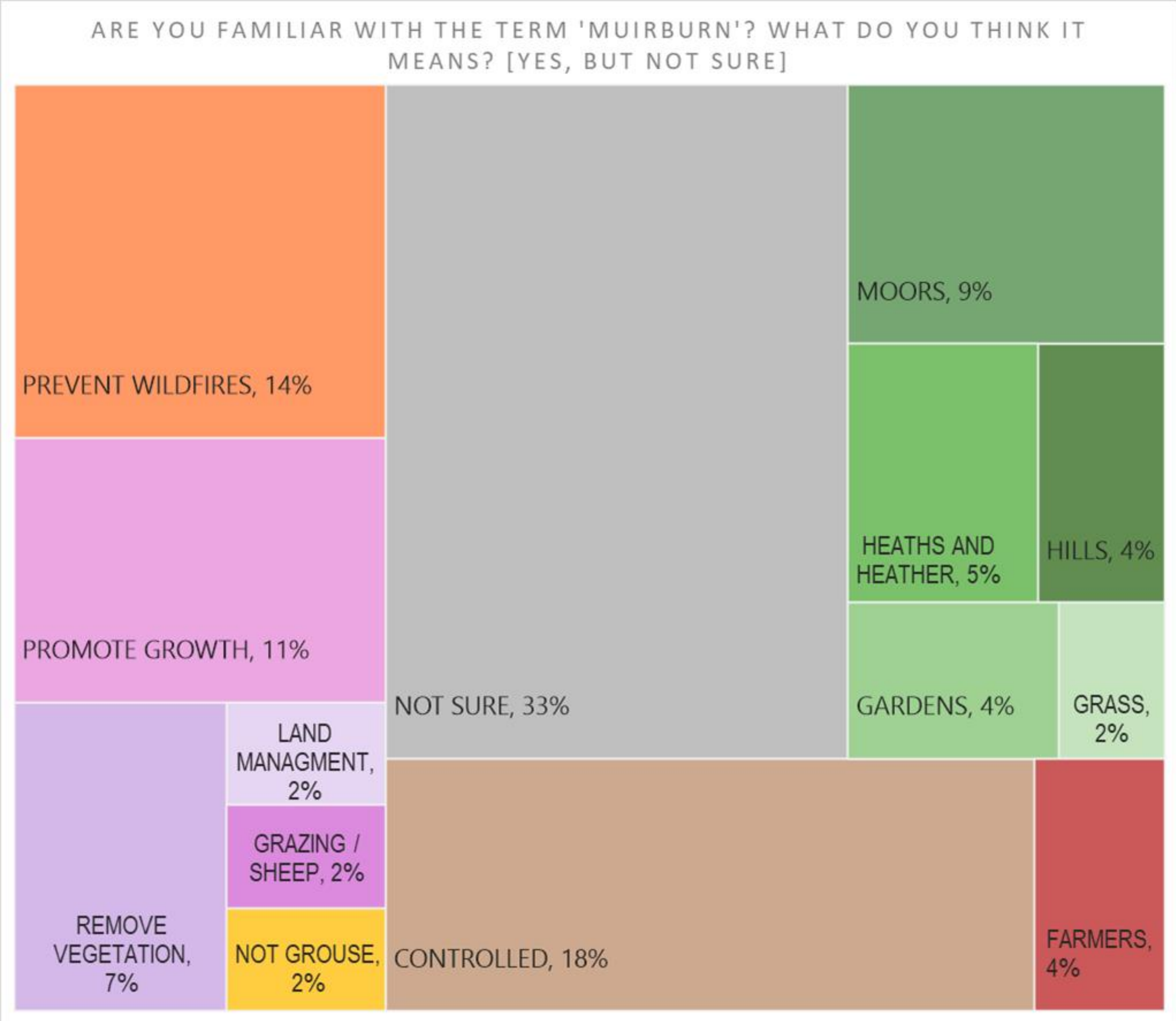


Figure 6.25 – Highlands' participants' explanations to what they understood muirburn to mean, for those that were familiar with it but unsure on its meaning, N=57.

Figure 6.26 presents the explanations provided by those who identified as "familiar with muirburn." Many participants noted various reasons for this practice, with the most frequent being its role in promoting new growth, such as encouraging "*new fresh shoots*" (HON4), and its use for grazing, particularly for sheep. Another common rationale was the removal of old, dead vegetation. Interestingly, despite the limited presence of grouse moors in the west, this use was notably recognised. Participants also mentioned general vegetation management, including specifying locations of heaths, heather, and moors. Additionally, some identified common practitioners of muirburn, such as farmers, estates, and crofters. A few specified that it typically occurs in spring. Overall, there is a broad understanding of the uses of controlled burning, although some knowledge may be quite basic, where some gave multiple aspects of these descriptions. There is a notable recognition of its ecological benefits, particularly among the 60% of online respondents and 40% of in-person participants who affirmed its use.

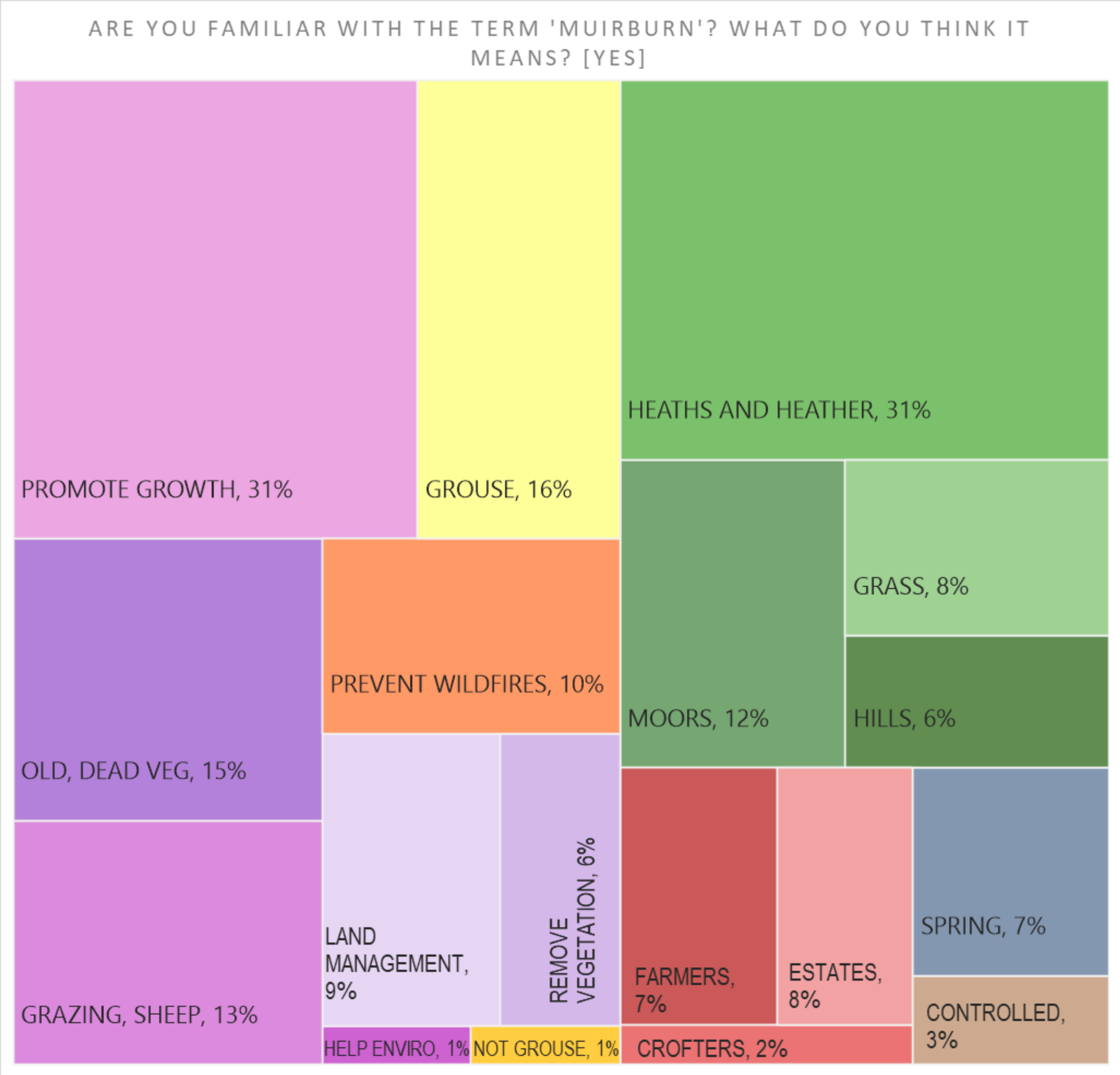


Figure 6.26 – Highlands' participants' explanations to what they understood muirburn to mean, for those that were familiar with it, N=102.

Participants were next asked about their awareness of controlled burning in their local area (Figure 6.27). There was a high level of awareness, with 64% of in-person respondents and 73% of online respondents indicating local familiarity with the practice. Among those who reported not being aware, some explained that the limited use of fire locally was a recent development. For those who were aware, many specifically mentioned muirburn, noting sightings in spring or in mountainous regions. Numerous participants also provided specific examples of controlled burning activities in the local area, of which the knowledge of ecological and agriclutral benefits matched those raised in explanations of muirburn. Also consistent with previous questions on muirburn, the online sample demonstrated slightly greater awareness.

Highlands' participants awareness of fire use on local landscapes

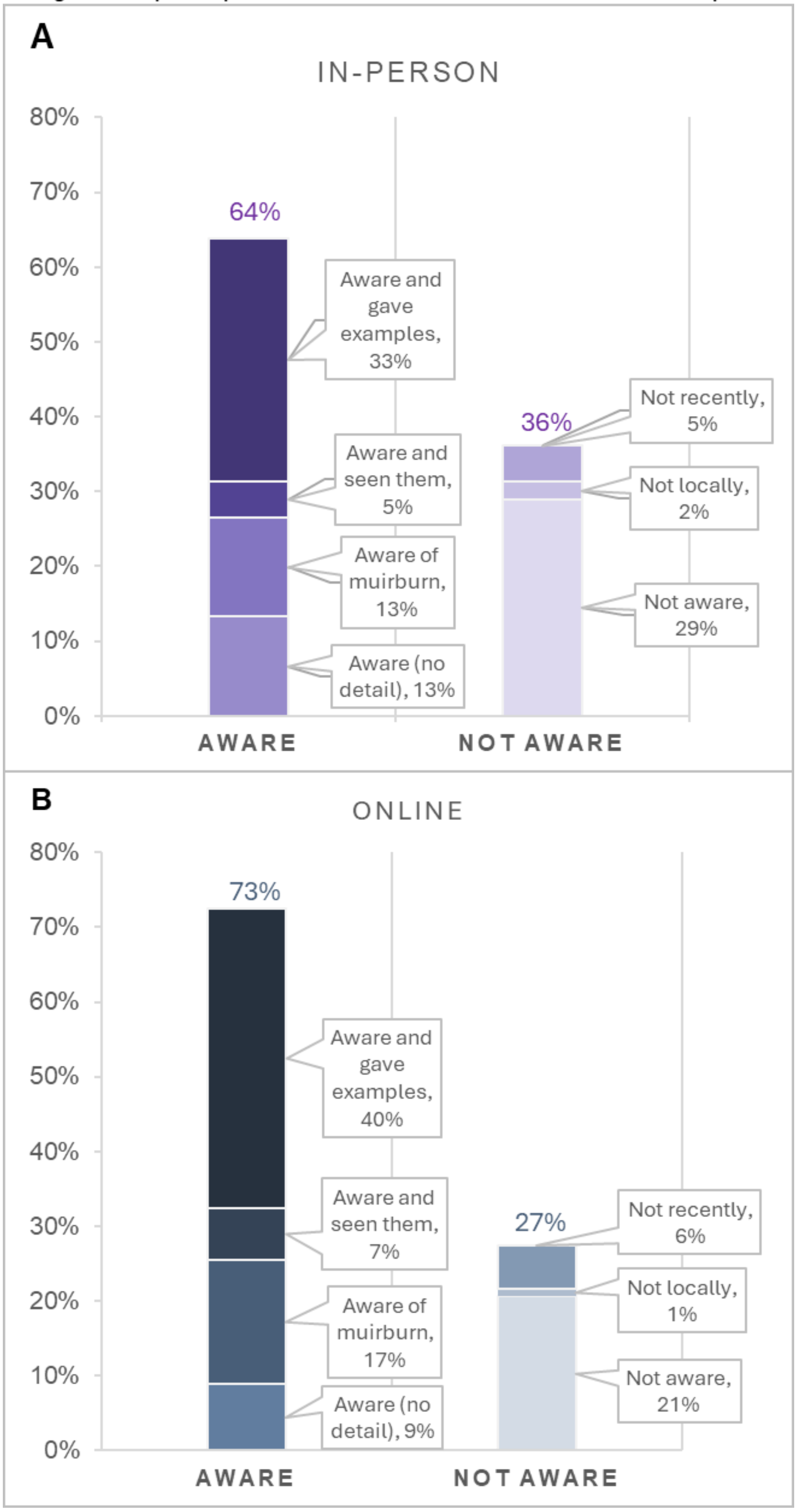


Figure 6.27 – Highlands participant's responses to whether they are aware of the use of fire on the local landscape. For (A) in-person N=83 and (B) online N=102.

Figure 6.28 displays the responses from participants who indicated awareness of local fire use and gave more specific examples. These examples were similar to those related to muirburn, addressing comparable purposes and locations. Approximately half of the in-person respondents who acknowledged awareness provided specific examples, noting agricultural uses, sightings on heaths and moors, and use by crofters. The online responses were similar, with just over half offering specific examples. The most frequently cited example was the use of fire for grouse management, which is notable given that most grouse estates are located in the east and the Scottish Borders. Other examples included agricultural practices, crofters, and the management of heather and gorse. Overall, there is widespread general awareness, and the examples given demonstrate the more memorable or readily associated knowledge of applications of fire.

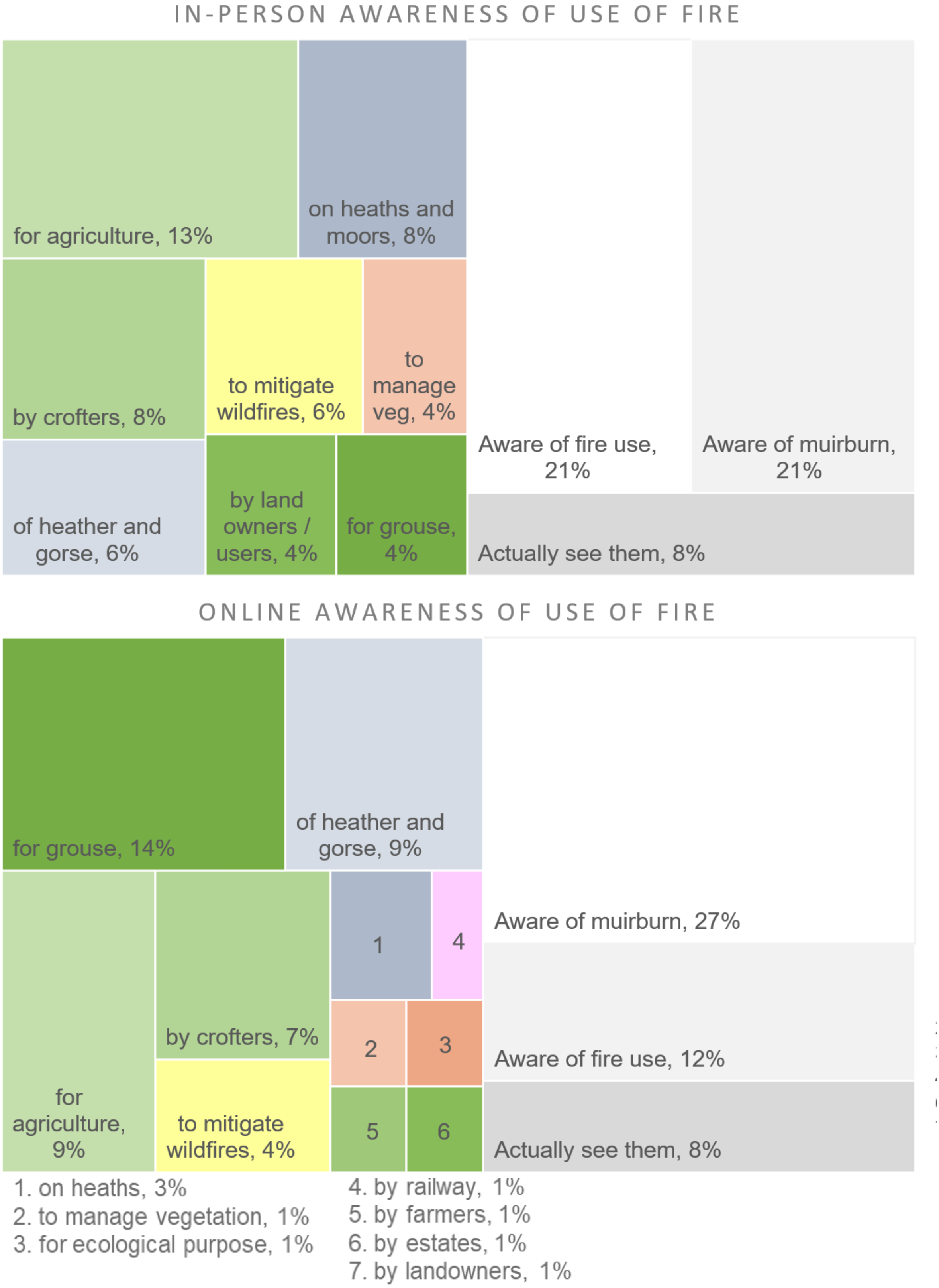


Figure 6.28 - For those that answered "yes", what local fire use were participants aware of, for in-person N=53, and online N=74.

6.2.3.2 *Attitudes towards prescribed fire*

Participants were asked about their views on the acceptability of prescribed fire (Figure 6.29). The majority expressed agreement with its acceptability with a reasonable portion expressing strong agreement, although 19% of respondents disagreed. Almost a third were neutral, showing either uncertainty or lack of opinion.

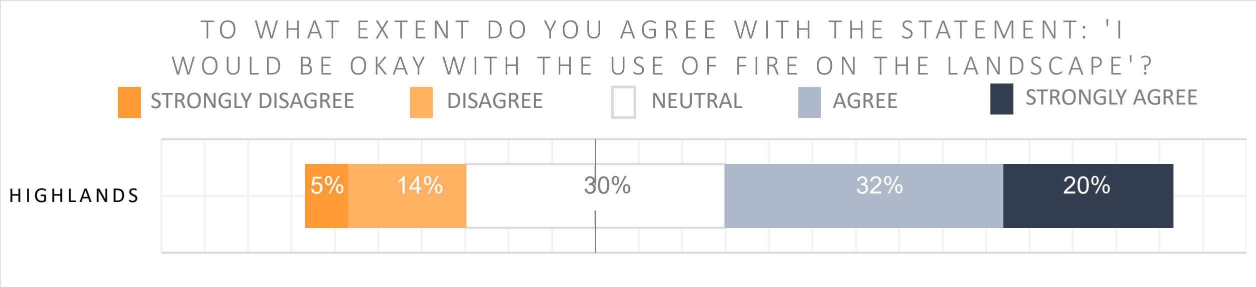


Figure 6.29 – Highlands' responses to whether participants would agree with the use of fire on the local landscape. Combined sample N=185.

Participants were asked to provide explanations for their views, which were then coded based on the degree of agreement they indicated. These explanations were compared with responses to the closed-ended questions (Table 6.14). The comparison reveals that some individuals exhibited conditional agreement, while those who were neutral sometimes expressed mixed sentiments, indicating varying degrees of ambivalence or uncertainty.

Comparison of participants' responses to the closed and open question regarding agreement with fire use locally [D]						
		Agreement in closed question				
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Sentiment towards fire use identified	Reason for its use	0%	0%	4%	51%	92%
	Reason for, but with condition	0%	0%	29%	49%	8%
	Arguments both ways	0%	0%	5%	0%	0%
	Neither for nor against	0%	4%	38%	0%	0%
	Some understanding, but against	0%	8%	20%	0%	0%
	Reasons against its use	100%	88%	4%	0%	0%
LEGEND	0%	100%	Proportion of participants that gave each answer to acceptance			

Table 6.14 – Highlands' participants' explanations to whether they would agree with fire use compared to the coded explanation. Combined sample, N=185.

The reasonings in support of fire use in the Highlands are shown in Figure 6.30. The most frequently cited rationale was that fire use is a traditional and longstanding technique, as well as the value for its role in reducing wildfire risk. Other benefits noted included environmental improvements and tick reduction. Additionally, some participants viewed fire use as necessary due to the region's remote and expansive landscape. A small proportion of respondents expressed conditional support, emphasising the importance of maintaining control over fire use when it is used.

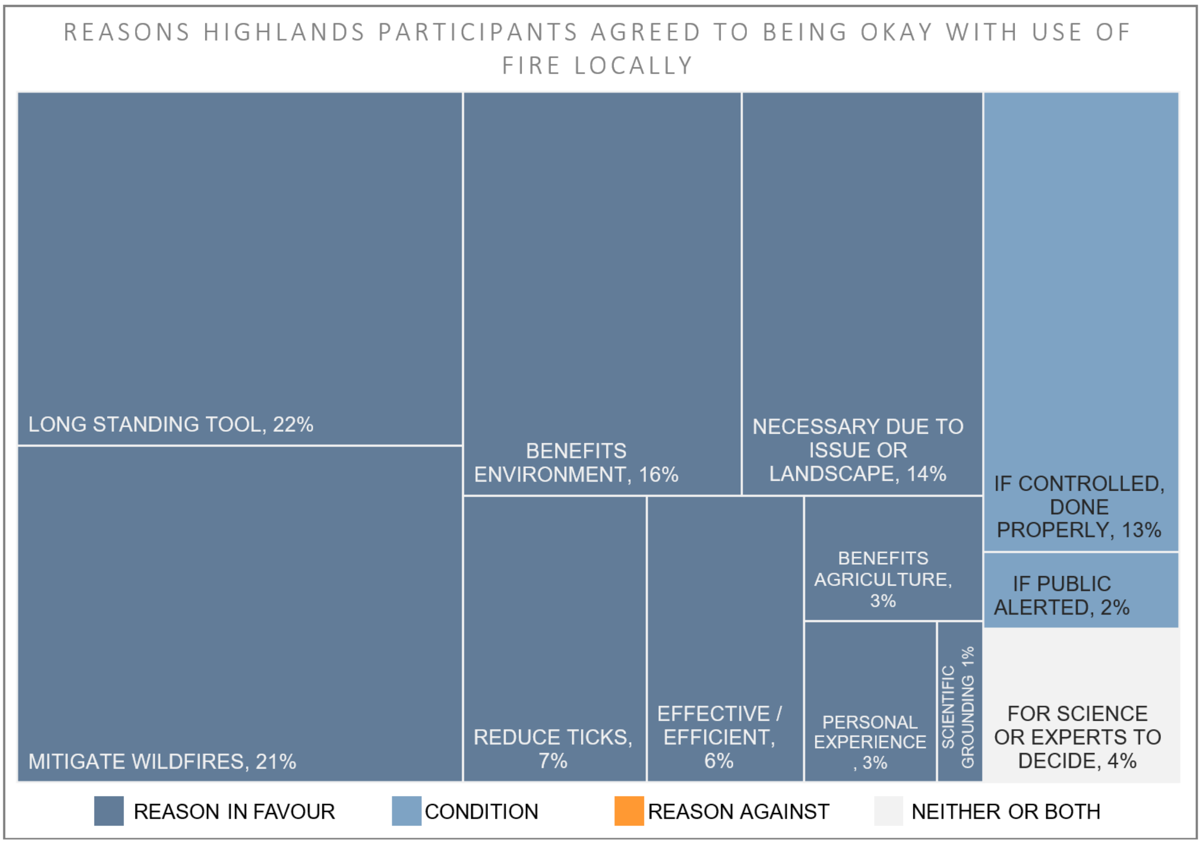


Figure 6.30 - Reasons given by Highlands' participants that were agreeable with the use of fire, N=95.

Support for the use of fire in the Highlands is notably rooted in its long-standing historical application. Many participants highlighted that fire is 'tried and tested', with one noting, "*Worked for centuries it can work now*" (HON27). The belief that fire use is acceptable because it represents a "*It's a natural, ecological process*" (HON89) also acted as considerable endorsement. Participants demonstrated a deep appreciation for its historical significance, with one remarking on its role in shaping the landscape, "*I live in an area where I have seen the benefits of this. Where generations have used this technique to give us the wonderful land, we now inhabit despite the nonsense spewed out by academics*." (HON23). This awareness of it being a legitimate tool was reinforced where there was personal familiarity, with one participant strongly agreeing due to "*Personal experience over 55 years*" (HON50). Such historical and personal justifications are crucial in garnering stronger support.

Participants also acknowledged the benefits of fire in reducing wildfire intensity, with one stating it "*Reduces catastrophes of uncontrolled fires*" (HON84). The importance of land management in preventing uncontrolled fires was noted: "*Fires can get out of control if land is not managed somehow*" (HON22). Some participants displayed a nuanced understanding of contemporary wildfire influences, such as "*In an increasingly fuel loaded countryside with the removal of herbivores and the misguided intentions of "rewilding" this is becoming a more essential tool than ever before*" (HON24). The necessity of fire for managing large landscapes was highlighted: "*Necessary practice, wildfires will be worse if not done. The old expertise cannot be lost*." (HON9), as well as the landscape, "*…Only way to deal with the vast expanses of land, and you may get a fire anyway*" (HIP43). Participants also recognised additional benefits beyond wildfire, including tick control and agricultural advantages: "*Got to manage the fuel somehow. And has agricultural benefits like helping grazing too.*" (HIP39).

This broader awareness of fire's benefits, rather than viewing it solely as destructive, contributes to its acceptability.

However, some participants expressed conditions for their support, focusing on control and prudent use. Concerns included ensuring that fire is managed effectively: "*As long as it is controlled and is of good to the muir*" (HON47), and using it sparingly: "*It has it's benefits, but it is not a practice that should be done lightly*" (HON98). There was also a call for expertise, with one participant emphasising, "*Only by professionals that can supervise and not let it get out of hand*" (HON64). Participants generally understood the benefits but stressed the need for wise management, including avoiding excessive or frequent use: "*Whilst it can be devastating, it is a natural occurrence and can stimulate new growth and reduce build-up of fuel. If it is too extensive gets out of control or happens too frequently, I would think it would be poor management*." (HON49).

Examining the responses from participants with direct experience in landscape fire or wildfire reveals that those with experience with the practice were generally more supportive. A couple with flagged responses disagreed with fire use, including a response from an individual who monitors bonfires. This person acknowledged the complexities of the issue and awareness of benefits but was personally opposed to the practice (which may be directly related to their experience with wildfire making them more resistant).

Flagged participants acceptance of fire use [H]		
Agreement with fire use	Reason for flag (involvement with wildfire)	Disclosed experience with prescribed fire
Strongly Agree	Small holding	Yes
Strongly Agree	Landowner	
Strongly Agree	Private estate - countryside range	Yes
Strongly Agree	55 years experience burning for agriculture	Yes
Strongly Agree	Environmental officer	
Strongly Agree	Gardener	
Strongly Agree	Wildlife trust	
Strongly Agree	Ecology	
Strongly Agree	Ranger	Yes
Strongly Agree	Small holder	Yes
Agree	Wildlife	
Agree	Crofter	Yes
Agree	Agriculture	
Agree	Conservation	
Agree	Work for National Trust	
Neutral	Mountain rescue	
Neutral	Volunteer National trust	
Neutral	Smallholder and B&B owner	
Neutral	Crofter	
Neutral	Biodiversity consultant	
Neutral	Emergency Services	
Neutral	Independent seasonal contractor at sheep farms	
Neutral	Work in land management	
Disagree	Landowner	
Disagree	Control of bonfires in visitor hot spots	

Table 6.15 - Agreement responses from participant with flagged responses in the Highlands.

Conversely, the arguments against fire use are illustrated in Figure 6.31. The most common concern was about controllability and safety, with some participants explicitly mentioning the poor reputation of current practices. Specific concerns about impacts on nature, as well as on people, air pollution, and aesthetics, were also noted. Additionally, some participants preferred alternative methods, expressing the belief that fire use is unnecessary and should therefore not be implemented.

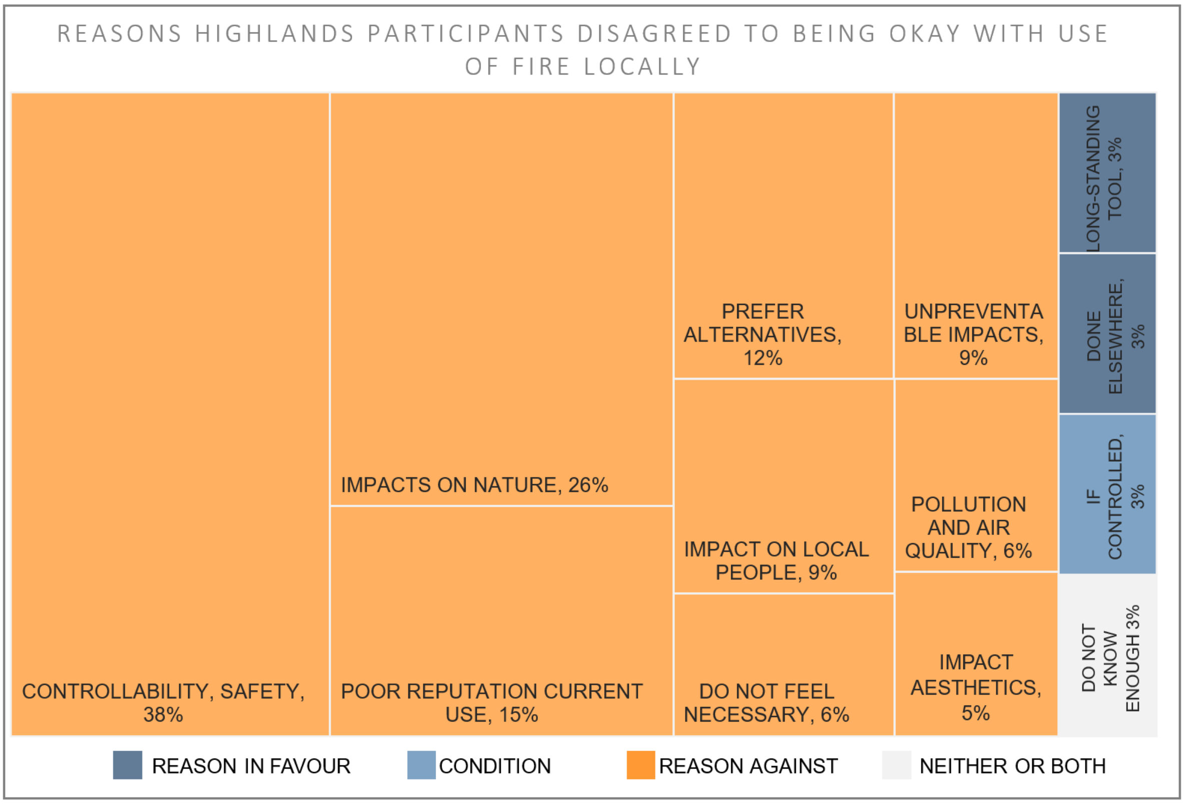


Figure 6.31 - Reasons Highlands' participants gave for their disagreement with fire use, N=34.

The most common reason against prescribed fire in the Highlands was concern over controllability and potential safety hazards. Many participants expressed worries about fires getting out of control and causing damage. For example, one participant said, "*You cannot guarantee control, I'm sure there's other ways*" (HIP66), indicating a preference for alternative techniques. Controllability was a crucial factor for those strongly against all landscape fires, with comments such as, "*There should be no fires as it can get uncontrollable & rip through the countryside*" (HON71). Fires were perceived as increasing risk rather than reducing it, as noted by a participant who believed, "*Adds to the risk, such large spaces could catch fire*" (HON99).

A significant factor in the Highlands was the poor reputation of fire use in the area, often attributed to improper execution and fuelling narratives of uncontrollability. A lack of proficiency among those conducting burns was frequently blamed. For instance, one respondent mentioned, "*Fire can still get out of hand. Unlicensed people doing it could affect others to the extreme.*" (HON100). Some residents held strong anti-fire or anti-crofting views due to ongoing issues with escaped burns. One participant strongly disagreed with fire use, stating, "*I'm sorry to be so over the top, but I'm so frustrated with the situation. This is the first time anyone has invited any discussion or opinions on the subject. So thank you very much. I had resigned myself to thinking there was nothing that could be done and that hopefully the practice will die out with the generation of crofters*" (HON43). The poor reputation of current practices perpetuates narratives of both uncontrollability, as well as improper planning leading to negative outcomes, another participant expressing concern because, "*The use of fire is not always as controlled as it should be. And is usually carried out in the spring when ground nesting birds are about and animals frequently cannot outrun it.*" (HON18).

Concerns about the impacts on nature, people, and air quality were also significant. For example, one participant noted, "*There will still be air pollution and harming of animals*" (HON16). Another noting, "*I would worry about the air pollution, it cannot be healthy, and it will not help climate change*" (HIP41). Embedded in some of these concerns was the belief that the negative impacts on the environment were unavoidable due to the nature of fire, disagreeing with its use because "*It burns indiscriminately*" (HIP17). As well as the pervasive notion of fire as exclusively damaging to the environment "*The burning of plants on grouse moors turns the landscape into a desert and is extremely detrimental to our ecosystems*" (HON59); this also demonstrates negative associations with grouse moors. Aligning with this resistance to fire use, it was perceived as more of a last resort, with some participants suggesting, "*It is better to find alternatives*" (HIP83).

Lastly, reasons given by those that were neutral are shown in Figure 6.32. Many participants expressed indecision, often citing a lack of sufficient knowledge or having mixed opinions and uncertainties.

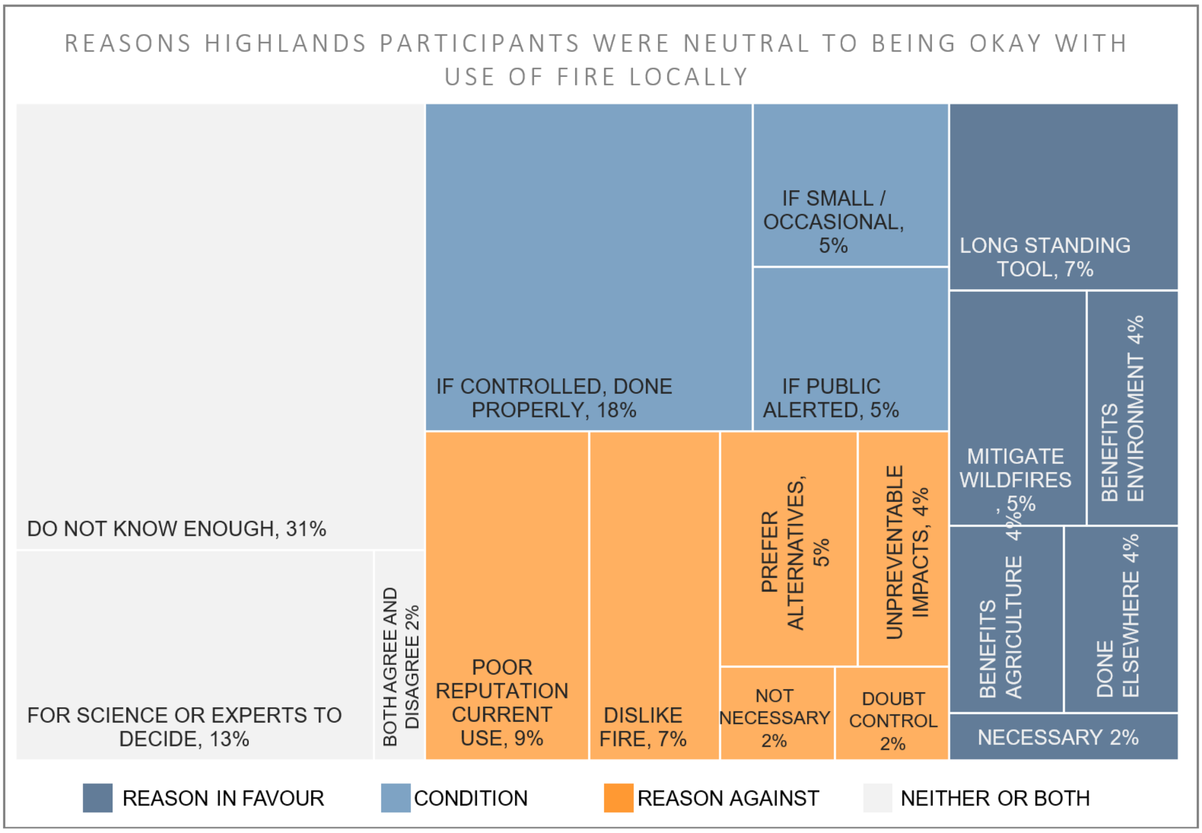


Figure 6.32 - Reasons Highlands' participants were neutral to fire use, N=56.

Around a third of participants explained that they did not know enough about the advantages or risks of prescribed fire. Additionally, 13% believed that the decision should be left to scientists or experts, indicating their indifference. Many expressed indecisiveness where they acknowledged the benefits but harboured doubts about the impacts. For example, one participant noted, "*I don't feel I'm educated enough to comment. I understand the need for agriculture but uncomfortable with the impact on vegetation which cannot recover*" (HON38). Uncertainties in outcomes, as well as around safety demonstrate a reluctance towards fire use, "*Don't know enough about it to know if it's safe*" (HIP16).

Trusting scientific expertise was a recurring theme among those who were neutral and demonstrate an avenue of reducing uncertainty. Participants indicated a willingness to defer to scientific judgment, as illustrated by the comment, "*If the science is good, then so be it*." (HON37). Some participants personally leaned against the use of fire but were willing to accept it if supported by science, with one noting, "*Let the science decide but does seem a shame*" (HIP8).

There were participants who recognised there were "*Arguments both ways*" (HON34). There were mixed opinions where they both acknowledged benefits or the fact that prescribed fires are used elsewhere but raised concerns about controllability or preferred limited use. This hesitation meant often it was partial agreement, giving conditions to use. A common condition, noting that poorly managed fires could be dangerous and damaging. One participant remarked, "*Fires set as part of a managed, attended, limited and planned scheme would be okay but fires set which are then left to burn uncontrolled and unsupervised are dangerous and damaging*." (HON2). Another noted that they, "*Agree when used in best practice and recommended by professionals, not by entitled landowners with little knowledge or consideration to the surrounding landscap*e" (HON13).

A clear decision-making process, the frequency of use, and the specific purposes, were crucial for acceptance. One participant summed it up by saying, "*If used sparingly and for the right reasons, to aid with regeneration of birch would be a positive, but to support grouse shooting would be a negative*" (HON96). This highlights the importance of distinguishing prescribed fire for wildfire management from controversial practices like grouse moor fires. Overall, the responses demonstrate the need for clear communication about the benefits, necessity, and responsible application of prescribed fire.

Lastly, the agreement with fire use was compared to previous responses regarding risk, as well as demographic characteristics. Firstly, comparing to whether wildfire was considered a local problem, there fractionally more disagreement with fire use where participants had agreed wildfire was a problem (Table 6.16). Next, those that gave the highest scores had less agreement with fire use (Table 6.17). However, the other scores were very similar. These suggest it is possible that having a concern about wildfire decreases acceptability. This is potentially linked to concern of escaped burns, as opposed to wildfire problems creating a perceived necessity for the use of fire.

Comparison of answers to whether agree with fire use and opinion on whether wildfire is a problem [H]				
COMBINED SAMPLES		**Is wildfire a problem locally?**		
		Yes	No	
Agreement with fire use	Strongly agree	21%	18%	*(N=37)*
	Agree	29%	38%	*(N=59)*
	Neutral	27%	33%	*(N=54)*
	Disagree	17%	9%	*(N=26)*
	Strongly disagree	7%	2%	*(N=9)*
		(N=119)	*(N=66)*	
LEGEND	0%	100%	Proportion of participants answering whether wildfire is deemed a problem	

Table 6.16 – Comparison of Highlands' responses to whether prescribed fire was acceptable and if wildfires were considered problematic (N=185).

Comparison of answers to whether agree with fire use and individual risk score [H]							
COMBINED SAMPLES		Individual wildfire risk					
		0	1	2	3	4	
Agreement with fire use	Strongly agree	12%	20%	29%	20%	22%	(N=37)
	Agree	30%	38%	36%	30%	11%	(N=59)
	Neutral	42%	27%	12%	40%	28%	(N=54)
	Disagree	14%	13%	14%	10%	22%	(N=26)
	Strongly disagree	2%	2%	10%	0%	17%	(N=9)
		(N=13)	(N=22)	(N=27)	(N=44)	(N=42)	
LEGEND	0%	100%	Proportion of participants answering whether wildfire is deemed a problem				

Table 6.17 - Comparison of Highlands' responses to whether prescribed fire was acceptable and wildfires risk scores (N=185).

Furthermore, comparing to age (Table 6.18) there were similar levels of agreement in different age groups. The responses were also compared to the participant's gender (Table 6.19), where there was no clear trend, except there was less neutrality and more strong agreement from male participants.

Comparison of participants' agreement to fire use and their age [H]								
COMBINED SAMPLES		Age group						
		18-24	25-34	35-44	45-54	55-64	65+	
Agreement with fire use	Strongly agree	15%	9%	19%	25%	24%	19%	(N=37)
	Agree	38%	36%	30%	36%	21%	35%	(N=59)
	Neutral	31%	27%	26%	23%	33%	35%	(N=54)
	Disagree	15%	23%	19%	11%	12%	11%	(N=26)
	Strongly disagree	0%	5%	7%	5%	10%	0%	(N=9)
		(N=13)	(N=22)	(N=27)	(N=44)	(N=42)	(N=37)	
LEGEND	0%	100%	Proportion of participants answering whether wildfire is deemed a problem					

Table 6.18 - Comparison of Highlands' responses to whether participants agreed with the use of fire on the landscape and the participant's age. Combined Highlands sample, N=185.

Comparison of participants' agreement to fire use and their gender [H]				
COMBINED SAMPLES		Gender		
		Women	Men	
Agreement with fire use	Strongly agree	18%	23%	(N=37)
	Agree	31%	33%	(N=59)
	Neutral	32%	25%	(N=54)
	Disagree	13%	15%	(N=26)
	Strongly disagree	6%	3%	(N=9)
		(N=125)	(N=60)	
LEGEND	0%	100%	Proportion of participants answering whether wildfire is deemed a problem	

Table 6.19 - Comparison of Highlands' responses to whether participants agreed with the use of fire on the landscape and the participant's gender. Combined Highlands sample, N=185.

6.3 Summary of Highlands findings

In conclusion, these findings reveal a notable awareness and understanding of wildfires and muirburn in the Highlands. Knowledge levels varied, with some participants displaying in-depth knowledge while others had more basic or no knowledge. Over half of in-person participants and nearly two-thirds of online participants recognised wildfires as a problem, attributing them to the steam train, crofters, and tourists. Both survey samples indicated general awareness of wildfire occurrence.

Participants' perceptions ranged from a lack of awareness to strong personal concerns about wildfires. Spring was identified as a high-risk period, although summer was also considered a key time for wildfire risk. The general acknowledgment of wildfire risk was greater for the area than for individuals, with many participants downplaying the risk compared to wildfires in foreign countries. Despite the high visibility of fire, most participants did not view wildfires as problematic, possibly due to familiarity with prescribed fire.

Individual risk scores highlighted the importance of spatial relevance, perceived likelihood and severity of fire, influenced by local landscape and vulnerability. Younger participants tended to have lower risk scores and were less likely to view wildfires as a problem. There were minimal differences between genders in risk perception.

Wildfire concerns focused more on impacts on nature than on humans, including damage to wildlife, health and safety risks, and economic losses. Limited firefighting resources in rural areas also raised concerns about fire controllability and severity.

The key differences between the survey samples were that online participants were slightly more concerned about wildfires and had more familiarity with the term "muirburn" and in-depth knowledge of its purposes and ecological impacts.

Most participants were familiar with "muirburn" and aware of controlled burning practices. Sentiments towards prescribed fire were nuanced and polarised. Some viewed it as necessary and legitimate due to reassurance from foreign use or its natural role and benefits. While others saw it as contributing to fire risk, especially where there was a reputation of poor execution. Opposition thus stemmed from concerns over controllability, safety, and negative impacts. Familiarity with prescribed fire generally led to more agreement on its benefits but improper use conversely led to significant opposition by others.

While many found prescribed fire acceptable for its long-term benefits and role in reducing wildfire risk, opposition stemmed from concerns about controllability, safety, and negative impacts. The concerns were exacerbated by a poor reputation of its use, where some blamed crofters and muirburn for wildfire occurrence. Neutral participants often deferred to scientific expertise due to a lack of knowledge.

CHAPTER 7 COMPARING WILDFIRE PERCEPTIONS AROUND GREAT BRITAIN

7.1 Comparing wildfire perception findings across case studies

7.1.1 Wildfire perceptions questions across case studies

The three case studies conducted across Britain have shed light on the varying levels of awareness regarding wildfire hazards. To understand these dynamics more deeply, this chapter compares the three studies: the Valleys, Dorset, and the Highlands. Each area presents a unique landscape of wildfire awareness and the perceived threats, offering valuable insights into how local contexts shape responses to wildfire hazards. Comparing the responses to questions between studies demonstrates similarities between areas pointing to a characteristic level of risk perception for Britain (a widespread lack of awareness with surprising subgroups with knowledge and concern), while the differences highlight how local issues influence perceptions.

The Valleys had the highest proportion of its samples agree that wildfire was a problem, while the Highlands had the lowest (Table 7.1). The proportion of agreement in the Valleys' study differed most from the other two, especially online, showing very high levels of acknowledgement from the local community. This is exemplified further by the greater response rate to the online survey in the Valleys, which was three times higher than the other locations despite not having the largest eligible population. Nonetheless, all areas had a segment of participants expressing significant concern. In all areas, the online sample had higher proportions acknowledging a wildfire problem. Beyond the concerned group, some participants disagreed with the question, either because they did not consider fires problematic or were unaware of their presence.

Proportions of participants believing wildfire to be a problem in the local area					
	Valleys		**Dorset**		**Highlands**
	Original survey	***Follow-up***	**Original survey**	***Follow-up***	**Original survey**
In-person	71%	*55%*	58%	*50%*	55%
Online	92%	*90%*	71%	*61%*	62%
Combined	87%	*83%*	65%	*56%*	64%

Table 7.1 - Proportions of participants that agreed wildfires were a problem locally, including results for follow-up.

There is a notable link between wildfire visibility and the perception of a problem. There were relatively high proportions that had seen wildfire, and this was common to all locations demonstrating a visibility of wildfire on at least parts of British landscapes (Table 7.2). Dorset had a much smaller majority that had witnessed wildfire compared to the other two locations. All locations had a higher proportion of online participants who had witnessed wildfires, with many having seen multiple or frequent occurrences. The online sample in the Valleys had the highest majority, with especially high figures of those that had seen multiple wildfires. The two survey samples in the Valleys also differed the most from each other, suggesting the online sample had greater bias in comparison to the area generally. The Highlands had more widespread visibility where the high proportions witnessing wildfire were consistent across both samples.

Proportions of participants that had seen a wildfire in the local area						
	Valleys		**Dorset**		**Highlands**	
	IP	ON	IP	ON	IP	ON
Seen sign of wildfire locally	87%	97%	61%	77%	90%	92%
Not seen sign of wildfire locally	13%	3%	39%	23%	10%	8%

Table 7.2 – Whether participants had seen a wildfire locally across all locations.

The intriguing connection between wildfire visibility and its perception as a problem is that, across all studies, a higher proportion of those who had seen wildfires considered them a problem compared to those who had not. In the Valleys, 86% of those who had witnessed wildfires considered them a local problem, compared to 35% without exposure. These findings align with Jollands et al. (2011), who reported that 83% of respondents who had seen wildfire evidence considered them a problem. In Dorset, a similar 83% of those who had seen wildfires viewed them as an issue, while only 23% without exposure shared this concern. However, in the Highlands, 67% of those with exposure found wildfires problematic, versus 29% without direct encounters.

However, visibility alone does not dictate problem perception. Some participants who had not seen wildfires still considered them a local problem, suggesting other factors contribute to risk perception. The 35% in the Valleys that considered wildfires a problem without having witnessed evidence of them demonstrates how awareness has been socially amplified. Comments note that hearing of stories, from the news, as well as from their persona social l networks, demonstrate the ways in which this happened. Similar comments were made in the other two locations, although both with slightly lesser proportions of those that had not seen wildfire going onto say they were a problem.

Moreover, not all who had seen wildfires perceived them as problematic. In the Highlands, a smaller majority of those who had witnessed wildfires viewed them as a local issue compared to the other locations as well as the study by Jollands *et al*., (2011). This highlights that visibility does not necessarily equate to concern. Crucially, the presence of prescribed fires in the Highlands may make fire more visible but less concerning. One participant for example saying: "*They seem to manage them fine enough*" (HIP14). Additionally, comments from across locations suggested that wildfires are often perceived as small or inconsequential, minimising the perceived risk. Conversely, Dorset did not have the lowest proportion agree it was a problem, but it did have the least visibility.

Comparing individual wildfire risk scores across the locations reveals that personal risk acknowledgment exists but is limited to a minority. The Valleys and Highlands exhibited similar distributions of risk scores, with the Highlands slightly lower in both samples. Conversely, Dorset recorded the lowest scores, marked by a higher frequency of scores of 0, and lower frequency of scores of 2 and 3. Notably, a consistent proportion of the highest scores appeared in all locations, with parallel patterns between the two corresponding samples. Specifically, in-person responses tended to have a lower proportion of scores of 4 (4-6%), while online responses exhibited a higher frequency (13-14%).

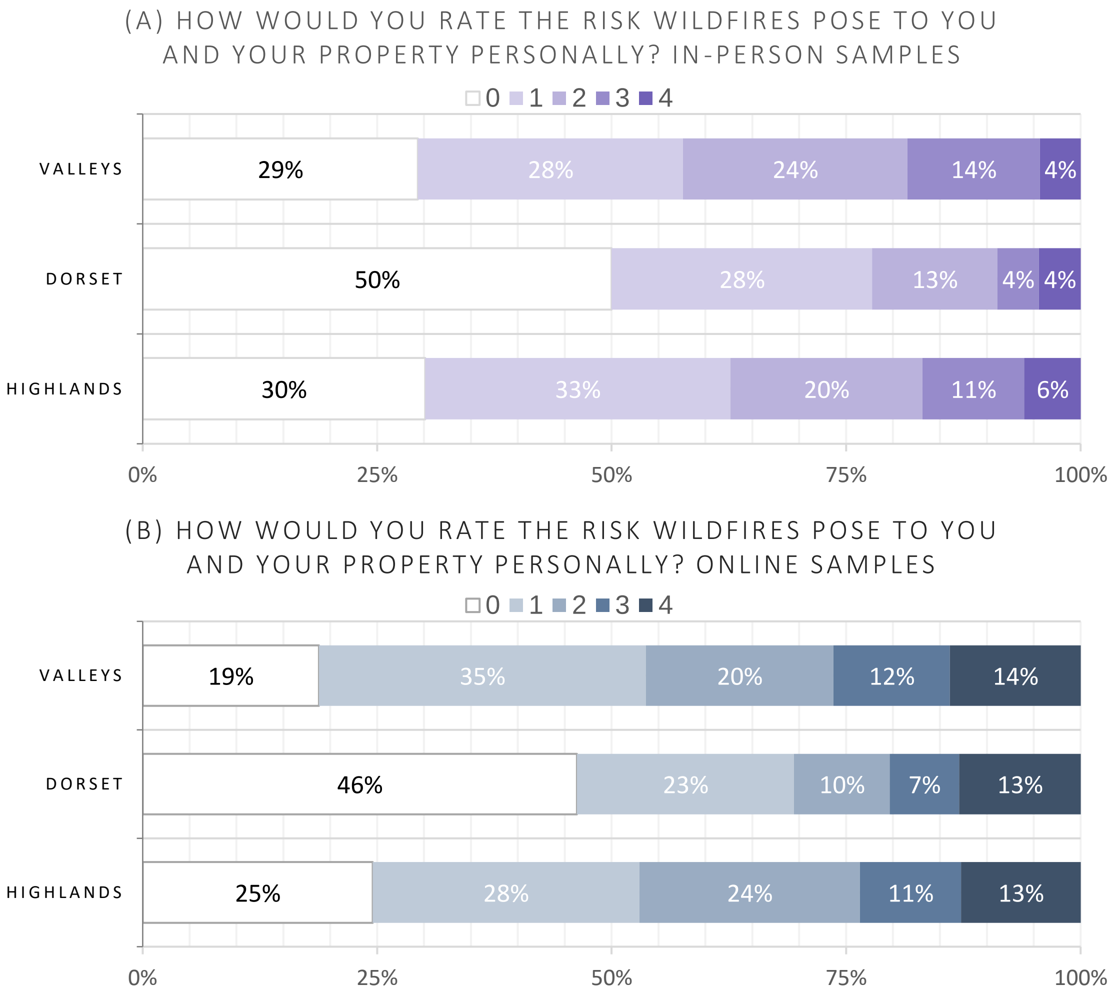


Figure 7.1 – Comparison of individual wildfire risk scores across case studies, showing (A) in-person and (B) online samples.

This suggests that within any locality with wildfires, there exists an equally concerned subgroup, which the online methodology accessed more effectively. The greater individual concern likely stemmed from more direct exposure and, consequently, a heightened relevance of wildfire risk. Participants' comments and the geographic distribution of online responses indicated that certain areas were more associated with higher scores. In the Valleys, regions further up the Valleys and higher up the mountains were most associated with wildfire. In Dorset the risk was primarily linked to heaths, natural areas, and places away from populated areas, making it more of an area hazard than a personal one. In the Highlands, the risk was most associated with more remote areas, and less so near lochs and town centres (mainly Fort William). Generally, there is a greater acceptance of the risk for the area than the individual, where they acknowledge problem for area but not relate to this personally.

Another possible link was identified in that awareness of a local problem could lead to a greater sense of personal risk, where those that answered "yes" did have fewer scores of 0. Hence the suggestion is that awareness or concern about the problem acts to elevate the individual risk perceived. The explanations of risk scores in the Highlands study corroborates this, as reasonings given for scores of 4 included factors which increased likelihood – in the case of the Highlands this was awareness of ignition factors like crofters, tourists or campers, the steam train, as well as extreme weather. Hence, awareness of a local fire problem increases the feasibility or likelihood of wildfires in the area, making them riskier. Probability is therefore a crucial aspect of risk calculations.

The follow-up results in the Valleys and Dorset demonstrate a potential influence of a wavering concern over time. The overall level of agreement with problem in the area dropped in the follow-up survey, with the exception of the Valleys online sample. This is either due to a more agreeable response given originally, or because the original survey happened at times of more fire. On the other hand, the differences between the samples were generally small, thus this supports the fact that there was legitimate concern for wildfire occurrence. The lack of drop in the Valleys online is possibly explained by the fact this group was much more concerned about the issue, potentially creating more memorable issues that do not waver over time, concurring with an influence of the availability heuristic (Sattler *et al.*, 1995; Tversky & Kahneman, 1973).

Exploring risk perceptions further, the case studies revealed similar themes in responses regarding the months perceived as posing the highest risk across locations, as well as location specific perceptions (Figure 7.2). In Dorset, there was a noticeable consensus of summer months as the peak risk period with responses aligned across both survey samples. In the Highlands, there was a combination of responses pointing to both spring and summer as high-risk periods, and this pattern was again consistent across both survey samples. Finally, the Valleys exhibited a mixed perception of monthly risk, encompassing both spring and summer, but with a distinction that more in-person participants favoured summer over spring than the online counterparts.

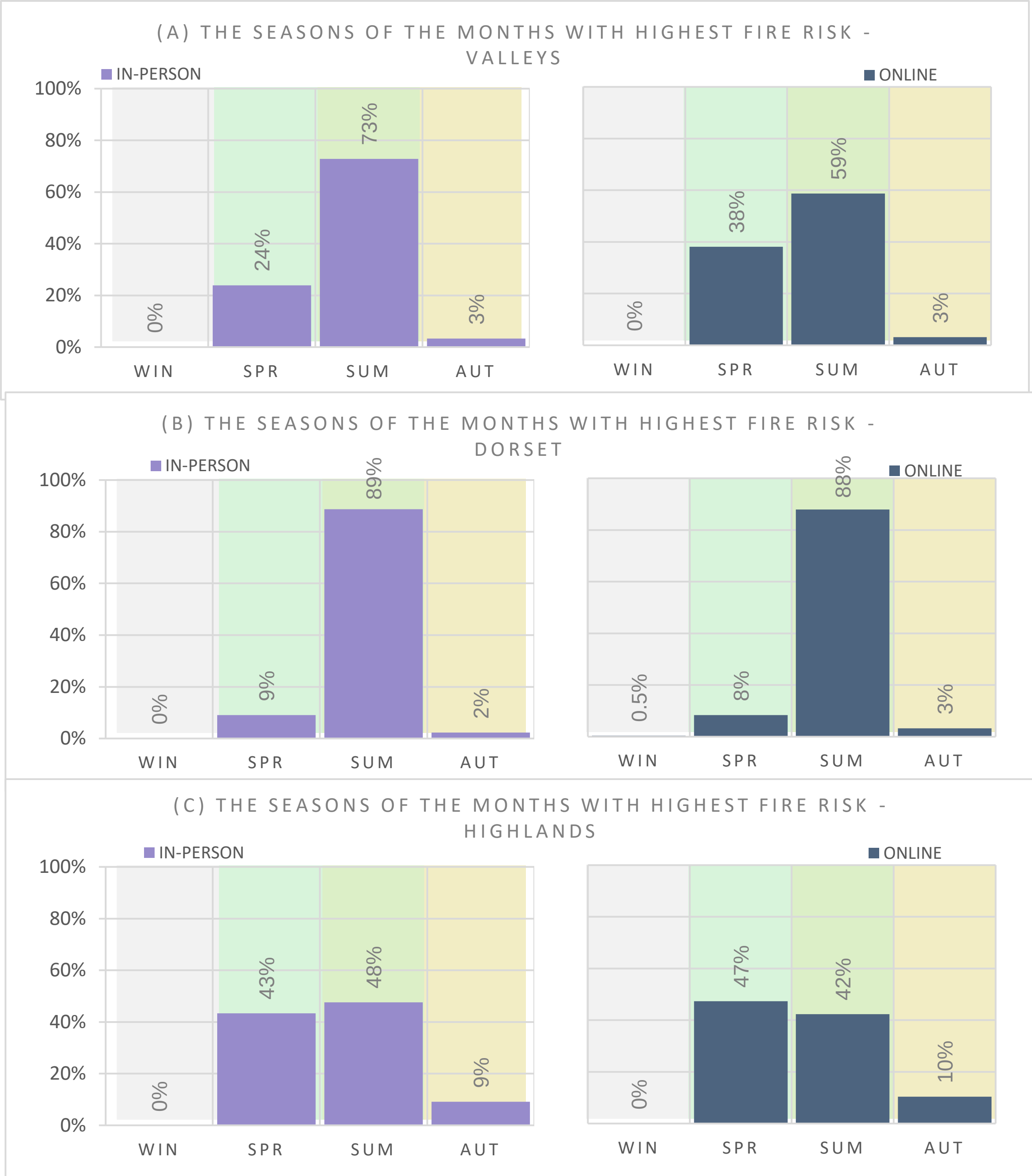


Figure 7.2 - Months of highest risk in participants opinion grouped by season, across all case studies.

Therefore, there was a widely held association of wildfires as a summer issue across all locations. This was most pronounced in Dorset, where the vast majority of both samples chose months in this season. In both the Valleys and the Highlands there was a mix of both spring and summer month raised, where the Highlands had almost equal proportions select each season, whereas in the Valleys summer remained slightly more preferred.

A connection was identified between whether participants had seen wildfires locally and the selected as high risk. Those that had witnessed wildfires were more likely to select spring months compared to those who had not. This suggests that while summer is generally assumed to be higher risk, visibility of fires in spring shifts perception, increasing awareness of springtime risk as more fires occur during this season. The widespread visibility of fire in the Highlands likely explains the similarity between samples, where fire is made more visible in spring due to the presence of muirburn. Additionally, it may be the case that for some in the Highlands, muirburn, known to risk wildfires, is associated with spring, thereby linking wildfire occurrence with this season through this knowledge.

Next, the types of concerns raised were similar throughout the case studies. Regarding the types of concerns around local wildfires, there was a mix of focus on impacts on nature and to a lesser extent human consequences. The majority raised a concern related to nature, in the Valleys 85%, Dorset 84%, and the Highlands 71%. There were concerns about impacts on people, but these were mostly indirect consequences. This included longer-term health impacts, property, as well as disruption to the area, including public access to areas and damage to infrastructure. Across all impacts on people, in the Valleys 68% mentioned these concerns, in Dorset 67% mentioned them, and in the Highlands 61% mentioned them. There were slight variations in the specific concerns, the Valleys had more concerns about air pollution and aesthetics, as well as the strain of the problem on society, Dorset had more concerns about climate change feedback, and the Highlands had more concerns around the wildfires becoming too large or out of control and having the resources to put them out. Residents in the Highlands also raised more concerns about economic impacts due to the vulnerability of tourism and agriculture. These locally specific concerns do add legitimacy to the notion of concern about wildfire for the area and make the hazard relevant to the area.

Overall, the type of concerns raised illustrates the type of hazard perceived. Across all areas the focus on natural impacts demonstrates how it is likely perceived as a hazard to the environment rather than people. Moreover, where direct impacts on people's safety were raised, they were often othered to more vulnerable groups (firefighters, children, elderly) or those closer to places associated with high risk. The most direct concern regarding themselves was often to do with air quality and long-term influence on health. Some raised (in the Valleys and Dorset especially) the fact they already had events where they were told to close windows and were already particularly concerned about health impacts. This othering of the perceived consequences, to non-human or other more vulnerable groups, also goes some way to explain the often-lacking high personal risk scores compared to the proportion that acknowledge wildfire as a problem in the area.

Another aspect to ascertaining residents' awareness of local wildfires was exploring residents' understanding of its influences. Ignitions caused by people and weather conditions (primarily dry, but also hot) were the two key factors identified, and this was consistent across all areas. The proportions noting ignitions caused by people were as follows: in the Valleys, 82% of the in-person sample and 93% of the online sample; in Dorset, 86% and 92%; and in the Highlands, 80% and 79%. Additionally, the proportions noting weather as a factor were: in the Valleys, 70% of the in-person sample and 63% of the online sample; in Dorset, 84% and 72%; and in the Highlands, 66% and 54%.

The responses to the influences of wildfire reflected locally specific knowledge, especially where more detailed answers were given. In the Valleys there were many that pointed out arson, especially blaming children and school holidays, as well as time of year (potentially also linked to school holidays). In Dorset many pointed out risks from disposable barbeques and carelessness. In the Highlands there was blame on the steam train, tourists, agriculture (particularly crofters), as well as fuel build-up being mentioned. Fuel build-up was much less focused upon, somewhat mentioned in each, although was mentioned by more in the Highlands. The fact that in-person had more non-multiple-choice answers in both the Valleys and Dorset, where these fit into categories similar to the multiple-choice options, it demonstrated an ease of giving more specific answers when face-to-face with researchers. The Highlands also had in-person giving more specific responses, however, where the knowledge or perceptions did differ slightly from the first two areas (where agriculture and muirburn was a more significant cause), this was not picked up on in the pilot hence was an oversight in the choice of multiple-choice options.

The locally specific knowledge identified within the responses to the influence of local wildfire suggests that either residents were effectively receiving messaging from agencies, such as the media outreach in Dorset about the risk of disposable barbeques, or they were well connected to social channels which are sharing information. The fact that the Highlands had a greater proportion mentioning fuel build-up points to increase knowledge around wildfire occurrence, which is potentially influenced by the greater presence of muirburn increasing awareness of fire ecology. Moreover, from explanations to the risk scores in the Highlands surveys it was clear that knowledge of these local risk factors did contribute to increased perceived risk through increasing the probability of fire. Nonetheless, while there was some more shrewd awareness by a portion of residents in each location, again especially online, there were also participants that had less specific knowledge on local risk factors, giving generic responses about common sense influences. Thus, there exists an opportunity for increased public education.

Next, the residents' understanding of local wildfire influences also encompassed their perceptions of climate change's impact. Overall, participants largely agreed that climate change affects local wildfires (Figure 7.3), likely due to its association with dry and hot weather – which were commonly cited influences. Dorset residents showed the highest agreement that climate change had already affected wildfires and would continue to do so in the future, with the fewest participants expressing uncertainty. Highland residents also largely agreed about future impacts but showed more uncertainty about current effects. In contrast, Valleys had the lowest proportion of agreement, with more participants disagreed than agreed about climate change's current influence on wildfire activity. The scepticism for an effect on current activity in the Valleys, while agreeing that weather is a key influence, is potentially due to a lack of observations about change up to now, or where there has been a longer history of fire due to arson before any perceived climate change, it negates the influence of it already. Whereas, in the Dorset the more recent increases may be more readily associated with climate change.

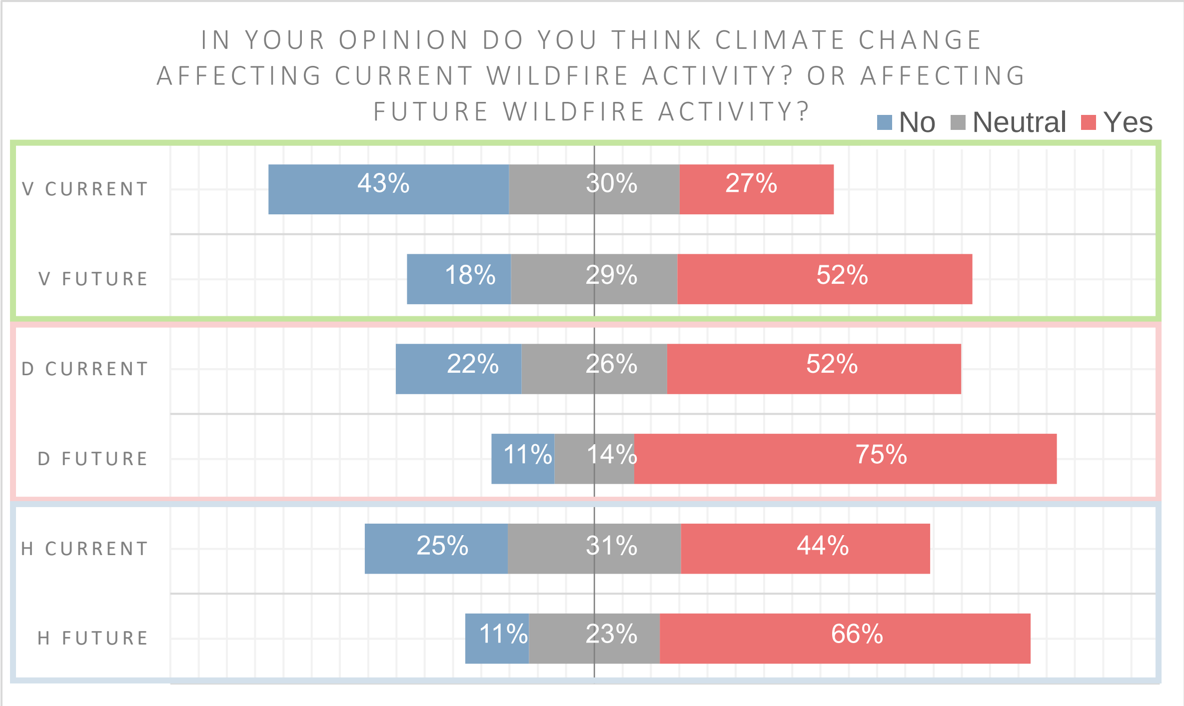


Figure 7.3 – Perceptions of climate change influence on local wildfires, current and future, across the three case studies.

Interestingly, having said that the association with climate change was sensible given the high appearance of weather, in the Highlands while weather was mentioned less frequently, residents generally agreed on the influence of climate change. This could be due to a greater awareness of other factors, such as agriculture and fuel build-up, raised by more participants. It indicates that while weather is an accepted factor meaning that climate change would influence occurrence (and where for some heatwaves were a reason to be concerned about risk) it is not seen as the most important influence. In Dorset, more participants cited weather as an influential factor, where participants either lacked knowledge on wildfire causes, or that changing risks are perceived as more directly linked to climate change, making weather appear more influential.

Furthermore, there was a prevailing notion that where wildfire occurrence was more linked to human activities, climate change might not have as much impact. The fact that it was established in both follow-up surveys that climate change was generally accepted to affect the area, but there was a disparity between that and agreement it would affect wildfire, demonstrates that climate change does not mean inevitable increases. This was especially true in the Valleys, where wildfires were often seen as 'arson fires' or entirely 'manmade'. While it is not incorrect to assert that climate change is not the sole determinant of wildfire risk (also true that global wildfire risk is influenced by climate change but moderated by factors like urbanisation), this belief could lead to complacency. The idea that stopping human ignitions would stop wildfires overlooks the reality that eliminating all ignitions is unrealistic. If climate change increases the susceptibility of landscapes, wildfires will become more severe and likely as human ignitions, even if not intentional will be inevitable, and even if they are made less common, when they do, fires could be larger. Notably, there was also a complacency where there was a notion that even with climate change, events would not be significant, or it would not increase to wildfires seen elsewhere, meaning that any affect was minimised or negated.

Overall, though, despite the disagreement demonstrating potential unrealistic optimism or complacency, most agreed. In fact, across locations belief in climate change did act to increase concern for the problem, especially where it played into the fear aspect where wildfires were associated with catastrophic incidences or large foreign events. This includes heatwaves being a factor for high risk in the Highlands, where it may lead to not only increased probability, but crucially, increased severity.

7.1.1.1 Comparing responses with age and gender

Examining the patterns between responses and participant characteristics revealed mixed results. The youngest age group (18-24 years) consistently had fewer respondents agreeing that wildfires were a problem, more scores of 0, and fewer instances of witnessing wildfires. This suggests that younger residents are less aware of wildfires due to a lack of exposure or relevance and are less concerned about the risk, including the inference that they may be less affected as they are less likely to own property. In fact, this specific reasoning was given in both the explanations of risk scores in the Highlands, and the question regarding interest in taking part in a Firewise scheme in Dorset. The lack of relevance of the issue, as well as general interest in Firewise by younger participants supports previous literature such as Brenkert-Smith *et al*., (2012) who also found younger participants less likely to adopt mitigation measures. In this study, the oldest group (65+) did not differ in the proportions interested in Firewise, however older participants did cite age as a reason for not participating. Conversely, other older participants noted being retired and having more spare time was a reason in favour of taking part. The 65+ age category was likely too coarse to enquire adequately about the influence of age. Fischer (2011) and Champ *et al*., (2013) noted that older residents might be less likely due to diminished ability.

Regarding gender, the effect on the way participants responded was unclear or mixed. Men were underrepresented in all samples, which might contribute to varying patterns. To fully understand the influence of demographic characteristics, further investigation is necessary. Having said that, the consistently higher response rate from women may indicate a greater interest in the issue due to selection bias (Greenacre, 2016). Previous wildfire studies have shown greater risk perception among women, linked to social norms portraying women as risk-averse and caregivers (Brenkert-Smith et al., 2012; Jarrett et al., 2009; Shindler et al., 2009, 2011; Tyler & Fairbrother, 2013a, 2013b, 2018). Here, the increased engagement with the topic on online groups by women demonstrate that they may be more inclined to engage, potentially as they are more concerned due to being risk averse. Previous literature does however show men can engage more, where gender norms of heightened self-responsibility in men link to more responsibility for mitigation (Bodas *et al*., 2019; McDowell *et al*., 2020), where they are also more likely to stay behind and protect homes (Tyler & Fairbrother, 2013a, 2013b, 2018). Literature has pointed out that wildfire mitigation can be a highly gendered space favouring men (Eriksen *et al*., 2010; Eriksen, 2014; Tyler & Fairbrother, 2013a, 2013b), so it is important to engage with all members of the public within communities to ensure effective communication and fulfilled mitigation.

7.1.2 Integrating wildfire risk perceptions across Britain: extent of risk

These surveys therefore reveal that the British public's acknowledgment of wildfire risks varies. Many residents remain unaware of both local and national risks and while wildfire susceptibility exists across all areas, concern is primarily concentrated within more informed subgroups. Acknowledgement of wildfire risk is highly connected to awareness of local issues. Hence it is generally the more well-informed groups that exhibit heightened awareness of local issues and notable concern. The online methodology likely captured more individuals from this concerned subgroup through selection bias, accounting for the higher levels of awareness and perceived risk in these samples. The range of perceptions among residents underscores the nuanced nature of wildfire perception (McCaffrey, 2015). The varying perceptions highlight how risk is based on qualitative factors rather than technical calculations (Fischhoff *et al*., 1984; Slovic, 1987, 1999). Speaking to this subjectivity is the disparities found between individuals and experts (Drottz-Sjoberg, 1999; Plough & Krimsky, 1990), between individuals in the same area (McCaffrey, 2004a), as well as between risk awareness and action (Cohn *et al*., 2008; Eriksen & Gill, 2010; Wachinger *et al*., 2013). Here, the variations in risk calculations done by individuals are moderated by their own sets of knowledge as well as beliefs.

The heightened concern by a group of the population aligns with the fact that there is heightened salience of wildfire risk at the local level by stakeholders while there is relatively lower national prominence (Gazzard *et al*., 2016; McMorrow, 2011). Therefore, although the public may underestimate risks compared to experts (e.g., Meldrum *et al.,* 2015), a key finding is that the concern for local wildfire hazards is shared by the public and stakeholders alike and is not limited to the latter. However, the personal risks associated with the hazard are most acknowledged by a smaller subgroup, so it may be thought of as a niche risk. As such, there are likely participants who are at risk that underestimate it.

There was a high level of concern for the problem in the Valleys, although not ubiquitous across the whole population, the high response rate online, and the high proportions of agreement, across both samples, demonstrate it is certainly acknowledged as a local issue. While there is greater acknowledgement for the area in the Valleys, the personal risk score shows that there is not a greater extent to the personal risk perceived compared to the other locations. Similar proportions across locations acknowledged a personal risk, where the online samples consistently had a similar greater proportion. Dorset residents had more participants unaware (not witnessed wildfire or heard about it), but did have many with awareness and some concern for the problem locally, and to a lesser extent, some with more specific and deeper concerns (especially those on the heaths). The Highlands had relatively less concern for the area, despite wildfire being more visible, but there was equally a more concerned subgroup with explicit concerns for their exposure (especially those that felt remote or vulnerable where there was limited access for the FRS). Additionally, the Highlands study had less difference between samples which suggests the awareness was more widespread.

There was a pervasive sense of indifference towards wildfires common to all areas. This was either a lack of awareness or a disregard for the risks. While this survey did also capture those that may not live directly next to a fire risk and to an extent this explains some of the lack of acceptance of risk, this study did identify a clear sense of apathy towards wildfires in Britain by some. There were key notions that underpinned these beliefs. Firstly, that wildfire in Britain is perceived as too small, insignificant, inconsequential, or not 'true' wildfires. As well as the idea that they could not be classified as 'wild' fire due to their proximity to urban areas or the origin being attributed to human causes. This also included the concept that the region's climate was too wet to support wildfires. These rationales, rooted in the belief that wildfires were irrelevant to Britain, acted as a formidable barrier to the acknowledgment of wildfire risks by some. Notably, a significantly larger contingent in Dorset exhibited apathy or unawareness of local wildfire hazards compared to other locations, where the location also had the lowest visibility of wildfire. Moreover, in the Valleys where the activity was highly associated with arson, the anthropogenic origins discounted the classification as 'wild' fires. Unlike the other regions, the Highlands exhibited a notable absence of comments asserting the impossibility of wildfires in the area. This is possibly influenced by its more rural setting, aligning with the fact that rural areas may be more associated with fire risk (McLennan *et al*., 2015).

Generally, the lack of association of the country to wildfire risk appears to act to create a complacency and optimism regarding the possibility as well as potential severity of events. Where there is unrealistic optimism even in high fire-prone areas (Armour & Taylor, 2002; McKenna, 1993), it is possible that there could be a mindset of disbelief that a wildfire could adversely affect someone in a non-fire-prone country – certainly this study has identified this as a crucial barrier for the British public to acknowledge a wildfire risk.

This study differs to previous literature based in fire-prone areas, which are places where the possibility of wildfire is not necessarily debated. Wildfires would be known to happen and people live with the risk, even if it may be underexaggerated (Beebe & Omi, 1993; Daniel, 2007; Gardner, 1987; McCaffrey, 2007). This study has highlighted that in Britain, there is effectively an additional barrier in that it is not readily associated with the risk. The decline of prescribed fire on the landscape (Bruce *et al*., 2006; Davies *et al*., 2008) and the lack of prevalent national wildfire risk has arguably created a barrier for society. The perception that wildfires cannot occur in Britain, including with the justification that it is too wet, or too urban, or indeed that they are started by people or not in wildlands, is crucial. The extent of perceived wildfire hazards in Britain is crucially modified by the potential magnitude, as well as the type of impacts. A key barrier is that the risk is minimised by the justification that wildfires would be 'too small' or insignificant, or not affect the individual. Although wildfire risk is not new, conditions are changing in a way that will not only make them more likely but more severe (Albertson *et al*., 2010; Arnell *et al*., 2021a, 2021b; Bruce *et al*., 2005; Davies *et al*., 2008; Perry *et al*., 2022). This could create a significant gap between public and expert perspectives if the complacency continues. Certainly, stakeholders should focus on the key misconceptions identified here to demonstrate to the public the reality of future risk, although it may take 'seeing it to believe it' the plausibility and legitimacy of wildfire hazards in Britain for those that are sceptical.

7.1.3 <u>Integrating wildfire risk perceptions across Britain: factors affecting risk</u>

With the characteristic extent of wildfire risk perception established, we can delve deeper into the specific responses across locations. This analysis will integrate awareness of wildfire issues, knowledge of occurrences, and attitudes towards climate change to reveal how these factors shape local perceptions of wildfire risk. Crucial themes found here in the factors influencing how wildfire risk is acknowledged, include, personal exposure or perceived relevance of the hazard, awareness of previous occurrence, visibility on the local landscape, awareness of specific local issues, the magnitude and type of perceived consequences, belief of climate change, and personal judgements.

There were higher proportions here that acknowledged a problem for the area than related the wildfire risk to themselves personally. This is most likely explained because of the key consideration made being the level of personal exposure compared to the susceptibility of the area. This difference was most pronounced in Dorset where there very both very urban and high fire risk areas.

Personal exposure is a key moderator evident in the explanations for the scores given in the Highlands, as well as other comments in the other surveys which demonstrate that there needs to be a perceived relevance. This exposure is mostly recognised by the location of their house, either next to fuel or near where previous wildfires have occurred. To a much lesser extent, there were participants that recognised the exposure beyond their house, including the impact on health of the pollution from local wildfires. The spatial aspect of risk is therefore a prerequisite to acknowledging wildfire risk. This is sensible in that the source of a hazard is crucial to the risk perceived (Oltedal *et al.,* 2004). Natural hazards research does highlight an importance of spatial factors over temporal (Wachinger *et al*., 2010).

Here, where participants live certainly has affected the risk perceived relevance of the risk. To a lesser extent, there was identification of vulnerabilities to their location increasing the risk, including observations of being near hazardous conditions, which would support findings elsewhere that knowledge of environmental and fuel conditions impacts risk perception (Collins, 2012; McCaffrey, 2008; Olsen *et al.,* 2017; Wolters *et al.,* 2017). For example, being concerned about neighbouring hazardous SSSI site, or the vulnerability of a thatched roof in Dorset. This was also exemplified in the Highlands where there was mention of a build-up of fuel, and the identification of being located in very remote areas. These factors certainly track with reality and demonstrates, while niche, there is public awareness for those where it is more relevant.

It has been found that the public can be accurate in judging riskier wildfire conditions, either because they are savvy observers or receiving education (Olsen *et al*., 2017). Here there is similar suggestion that wildfire risk awareness, is not innate but the result of receiving messaging or through experience. There was some knowledge of the influence of build-up of fuel, although this was not perceived as important as stakeholders' perspectives may assert, highlighting a potential gap between expert and public perspectives. This is therefore also highlighting an area for education, where messaging of wildfire dynamics and the importance of fuel for managing fire risk (in ways that can even counteract triggers) should be emphasised. However, the lack of consideration for a measure of objective risk in the data collection, where the postcode areas are heterogenous (e.g. including both individuals living in the middle of a town compared to in a vegetated area) is a key oversight. Hence, it is difficult to ascertain how well participants were able to measure the hazardous conditions around them.

Next, the relevance of the risk was also moderated by knowledge of previous occurrence. This factor was clearly demonstrated where it was included as a justification for both lower risk (where there has not been wildfire) and higher risk (where there is history of fire, especially when more recent). While still considering spatial distribution, it was the temporal pattern which was called upon in their minds as determining places associated with high fire risk. This supports findings that higher risk areas are also determined by temporal factors, where residents are known to use previous hazards to judge risk where the public can be keen observers (Wachinger *et al*., 2013). Notably, an interesting explanation for the influence of fire history was given in the Highlands was that, if a place had not experienced wildfires recently then it becomes low risk where it makes occurrence seem less likely or perhaps 'no longer possible', even though fuel may have accumulated and fire risk may still be present. This emphasises that the feasibility of wildfire is a key determinant for risk perception in Britain being a non-fire prone country.

Often, it was the previous occurrence of fire that marked an area as high risk. Participants frequently referenced past events to identify at-risk locations. For instance, in the Valleys wildfires were commonly associated with upland and mountainous regions of the Valleys, as well as areas known for fire like Rhondda and Merthyr (as opposed to the southern part of the study area despite the presence of vegetation), In Dorset, living near heaths or forests was perceived as high risk, with specific mentions of proximity to Wareham Forest, which had recently experienced a significant wildfire; where conversely, being in town centre negated it. In the Highlands, the perceived risk was higher in remote locations and near campsites, while towns and areas by lochs were considered to have less exposure. This pattern was also evident in the selection bias of the online surveys, where in the same places, interest was greater than the corresponding population density.

The possibility and probability of wildfire were crucial to the acknowledgment of risk. Factors that increased the probability were, therefore, critical. Knowledge of the wildfire problem was linked to an increased perception of risk, likely because awareness of it heightened the perceived probability of wildfire. For instance, awareness of more ignition risk factors meant it was more likely one would be started. This trend was evident across all studies: participants who recognised or considered there to be a local wildfire problem generally had higher risk scores. The explanations given for risk scores in the Highlands indicated that increased probability was a key justification for the highest scores, where knowledge or concern about a factor causing ignition, such as the campsites, tourists and steam train, as well as some other external influence, such as a heatwave. Probability calculations are integral to assessing wildfire risk (McCaffrey *et al*., 2013), and this importance is reflected in the British public's estimates of wildfire risk.

Another connection was identified in that those that had witnessed evidence of wildfire locally were more likely to acknowledge a problem. This visibility was arguably crucial in generating a possibility of wildfire and hence recognise it as a legitimate hazard. The influence of past experience has been linked to wildfire risk perception in literature (Blanchard & Ryan, 2007; Champ & Brenkert-Smith, 2016; Cohn *et al*., 2008; Flint, 2007; Kumagai *et al*., 2004; McGee *et al*., 2009). There was no direct measure in this study of experience, however there is a similar insinuation of an effect of visibility. This, however, does not necessarily have direct impact on residents, which is potentially why there was a link to increased acknowledgement of problem, but did not necessarily correspond to greater personal risk was recognised. In all areas more of those that had seen wildfire, acknowledged a problem, which supports previous research in South Wales (Jollands et al., 2011). Seeing was to some extent believing (Champ and Brenkert-Smith, 2016), where here it is possible witnessing wildfire acts as proof or knowledge of occurrence. The distinction for this context, is that there are pervasive notions that wildfires cannot occur in Britain, and certainly a disconnect that they could happen in an individuals' own locale, hence visibility creates a sense of both feasibility of the hazard in Britain and relevance for the local area, overcoming key barriers to acknowledgement of a risk.

For those that did express high personal risk, there were instances where recollection of past events was acting to increase perceived risk. Especially where experiences had been particularly negative. Where these were accompanied by strong negative emotions; this supports the idea the experience where there is stress makes more memorable (Sattler *et al*., 1995). There were examples where participants made notes of previous experience, many in BH20 postcode in Dorset in particular commenting about Wareham Forest Fire in 2020. These were connected to greater concerns and perceived risk. There were some recollections of particularly negative experiences, which were accompanied by strong negative emotions; this supports the idea the experience where there is stress makes more memorable (Sattler *et al*., 1995), hence severity of exposure influences the memory of the risk. Wildfire literature has demonstrated though the past experience has a mixed effect, in some cases dampening the risk due to notions that lightning does not strike twice (Champ & Brenkert-Smith, 2016; Cohn *et al*., 2008; Fischer, 2011; Kumagai *et al*., 2004; McGee *et al*., 2009). This was exemplified by explanations in the Highlands, where there were lower or more moderate scores because of a recent event. Therefore, similar to fire prone areas, in the Highlands there were comments that exemplified a dampening effect of past experiences of wildfire where one participant commented, "*Well I had one come up to my garden last year so not worried this year*" (HIP60). This links to literature that has shown the influence of increased knowledge generating greater risk perceived, including knowledge of past events (Palm, 1990; Martin *et al*., 2007; McCaffrey *et al*., 2011; Tversky & Kahneman, 1973).

The risk perceived are closely linked to local knowledge, where it increases the relevance of the hazard as well as generating awareness of impacts. This study argues it is through awareness of local occurrence or risk factor, there first a possibility, as well as increasing probability of wildfire hazards. Brenkert-Smith *et al.* (2013) linked knowledge from neighbours to the perceived increased probability rather than severity, as a result of knowledge or awareness through social connections. Similarly, the case here is that knowledge on risk factors (through media or social networks) create increased probability, especially ignition risks. The fact participants had localised knowledge also suggests a social amplification of the risk, where news coverage and peer to peer stories are spreading awareness of local occurrence and problems. Participants explicitly mentioned, in all locations, but especially in the Valleys, "hearing stories" of fires even if they had not witnessed them.

It has been found that informal connections are more salient in informing of the risk (Champ & Brenkert-Smith, 2016; Jarrett *et al*., 2009) and media not always most influential source of information, for instance, Brenkert-Smith *et al*., (2013) found risk was socially amplified but not through media. However, others have evidenced that media can amplify risk by generating awareness of consequence or through affective (Johnson *et al*., 2006), therefore media is important for public knowledge, a link also made for flooding in the UK (Cologna *et al*., 2017). Here, there were explicit comments in he Valleys about having awareness of previous occurrence of wildfires through news coverage. Additionally, in Dorset comments were made about hearing about the issue of barbeques in the news, and this is a theme identifiable in news coverage e.g., Ffitch (2020). Similarly, in the Valleys there is news coverage mentioning arson e.g., ITV (2020). Moreover, there were some emotional responses to the stories, such as stories of arson in the Valleys making them sad or angry. Frustration was especially common in reference to those that ignite fires, both accidentally or on purpose, such as, "*idiots that go around lighting fires*" (VON301) or "*stupid people with barbeques*" (DON49).

While Brenkert-Smith *et al*., (2013) found less impact of media on wildfire perception, it was pointed out that individuals had gained information from elsewhere first, either through personal experience or social networks. Hence, in British context, where more direct exposure is lacking, media becomes a more trusted and important source of information. It has been pointed out that media is important where individuals lack information about a hazard (Wachinger & Renn, 2010; Paton, 2008). For Britain, the media is an important way to hear about local occurrence and the information around what caused it, the impacts, and how likely to happen again. News coverage is an opportunity for experts to disseminate information (Brenkert-Smith *et al*., 2013). McMorrow (2011) previously noted the lack of experience with fire in the pubic as part of the reason for lack of acknowledgement, emphasising the importance of news sharing information. In other research, Cologna *et al.,* (2017) did find media had an influence on flooding perceptions even where experiences of this hazard are more common in the UK.

Moreover, the fact that news was specific to the locality possibly created greater sense of local risk factors and greater sense of relevance of the media coverage. This tracks to ideas found in previous research that information tailored to the location is crucial to the efficacy of the message (Brenkert-Smith *et al.,* 2012; Christianson *et al.,* 2014; Everett & Fuller 2011; McCaffrey *et al.,* 2011, 2013; Monroe *et al.,* 2006; Steelman *et al.,* 2014; Steelman & McCaffrey 2012; Stidham *et al.,* 2014). This may mean that this heightened wildfire risk may not translate to other areas of the country – where an individual does not live – as it lacks information regarding specific problems or past wildfire events. This requires further research to understand how people in areas other than they live, or tourists, know about general fire risk reduction behaviours, as well as the legitimacy of needing to do these in a place like the UK at times of high risk.

Therefore, either residents are seeing wildfires, hearing stories, or getting messages of high fire risk from media outreach by stakeholders or announcements like signage. In Dorset, both road sign such as near Corfe Castle in Dorset, as well as potentially effective messaging around barbeques in Dorset have been relatively effective, where there is reasonable awareness of occurrence and the risk of barbeques.

Additionally, another link was identified between those that had witnessed wildfire and the months selected as higher risk. More of those that had not seen wildfire picked summer months, although it was also possible that those more aware of a problem were more likely to notice wildfires or be aware of their occurrence in spring. It is possible that wildfire risks were mostly associated with (or assumed to occur in) the summer. This indicates a possible disparity between wildfire occurrence data and perception. Most wildfires occur in spring in Britain (e.g., Forestry Commission England, 2023; Scottish Government, 2022a; Welsh Government, 2022), but this time of year was not as readily associated with highest risk. Having said that anomalies do occur such as in 2018 where the Welsh Government (2019) bulletin demonstrated that a wet spring and dry summer contributed to a summertime high. The association of summer could be because of newsworthy summer extreme seasons, such as 2018, are more memorable and shape perception through the availability heuristic (Sattler *et al.*, 1995; Tversky & Kahneman, 1973). On the other hand, it is possible that summer was picked not because more fires happen, but because they are more severe. The association or memory of more extreme summer fires would correspond to when there are often newsworthy (larger) events, which discourse may also connect to noteworthy extremes of droughts or heatwaves, which may make them more memorable. Heatwaves were a factor identified as justification for higher risk scores in the Highlands. Alternatively, summer may have been picked because it is perceived as a hot and dry time of year, which were factors identified as important for wildfires by participants across areas. Also, for Dorset, the widespread blame on barbeques and tourism possibly creates an association with summertime as it is a holiday period so more recreation. The higher summertime risk is either that wildfires are seen as more frequent because of risk factors at this time of year or perceived as more severe due to extreme conditions like heatwaves.

Whereas, in Valleys the association with Easter holidays may explain some of selection of months in springtime. Then, more spring months may have been selected in the Highlands, where fire is visible at this time of year due to presence of prescribed fire, or because wildfires are associated with the risk of escaped muirburn which are known to occur in spring. In the Highlands there were that had seen wildfires across the two samples, and there was also more similar selection of months, possibly owing to a greater exposure to fire.

Overall, there is an underlying sentiment that summer is most associated with wildfire, perhaps an assumption, for any of the reasons suggested above. However, it is possible that awareness of springtime risk increases where there is increased visibility of fire shaping perceptions.

Next, considering the results of changing wildfire risk over time, there was some wavering perception of risk between the original and follow-up surveys, but risk did not entirely minimise out of season. The surveys were done at a time more associated with fire risk, so it is possible risk was heightened, however, differences between that and during the winter were only small. Especially for the more concerned Valleys' residents, it was not something deemed significantly less important just because they were being asked outside of the wildfire season. This potentially emphasises how for the Valleys in particular there was deep rooted concern for the issue. It is possible that in areas where there is less awareness of a particular issue or where the consequences are not as regular or widespread there would be greater wearing of concern – like how Dorset scores dropped more than the Valleys.

Beyond having knowledge of local factors affecting wildfire, primarily ignition risk, other crucial knowledge was knowledge of external factors. This study asked about the perceived influence of climate change. The influence of climate change was important for perceptions to wildfire in Britain. It was thought that the influence of climate change beliefs could potentially be more relevant to Britain if the fact it the risk is becoming more visible is perceived as a result of climate change, or at a time when climate change is increasingly prevalent as a causal factor for weather changes. The country broadly speaking is one which has a high acceptance, climate scepticism is generally low, although it ebbs and flows (Capstick *et al.*, 2015). This study also found that there was a majority of acceptance for climate change science; the follow-up results found 88% agreeing in the Valleys, and 93% in Dorset, that climate change could affect the area.

Climate change has been linked to increased wildfire risk perceived elsewhere (Schulte & Miller, 2010). Within the factors increasing likelihood of wildfires in the Highlands risk scores, drier and hotter springs or summers were included. There were comments that suggested a concern for climate change did influence concern over local wildfire. Some had a sense of concern about climate change in that it could create worrying situations in the future mostly.

Additionally, where climate change concerns were connected to awareness of foreign wildfire events, this acted to create more worry over local issues or the potential of increasing fires in Britian. Linking to these other disasters potentially creates a fear aspect worrying about the potential consequences, as well as an affective influence of hearing about foreign wildfire stories (Yell, 2010). These foreign wildfire stories increase awareness of potential consequences and make the wildfire hazard in general seem more catastrophic through a disaster narrative (Paveglio *et al.*, 2001; Yell, 2010). Furthermore, in the Valleys there was a high awareness of the Australian bushfires, most commonly by television but also social media. Affect in media dissemination of wildfire stories (Jacobson *et al.*, 2006; Yell, 2010) could be very relevant for wildfire perceptions between countries, where it generates understanding for consequences for people and wildlife. Where it has been pointed out British populations generally lack wildfire knowledge (Davies *et al.*, 2008), British individuals will fill in the gaps using foreign fires. For instance, the global activism on social media as a result of affect after Australia black summer bushfires (Leimbach & Palmer, 2022; Weber *et al.*, 2020) shared pervasive awareness of the consequences on wildlife. In this study wildlife was consistently raised, potentially evidencing influencing on this affective sharing of foreign wildfire consequences. The impacts on nature were certainly framed in a catastrophic way.

Conversely, while there was some disagreement with an influence of climate change on wildfire. The vast majority agreed climate change would affect the area (in Valleys and Dorset follow-up), however the small proportions that disagreed demonstrate some explanation for the lack of perceived influence on wildfire, in that there is doubt or uncertainty over the impact of anthropogenic climate change itself. There was a disparity between the proportions that agreed climate change would affect the area compared to wildfire specifically (in Valleys and Dorset follow-up), hence there were a set of participants that disputed the effect of climate change on wildfire specifically.

An individual may trust their own observations over experts, where if they have some level of knowledge, this is preferred (Siegrist & Cvetkovich, 2000). There were some justifications that personal observations of changing weather did not correspond to increasing projected wildfire, where it thought they had noticed it 'getting wetter'. As well as trusting their own knowledge over experts that it is affected by people more. There was a rhetoric that where wildfires were anthropogenically caused, it could not be the result of climate change. In the Valleys especially, where it was perceived as 'manmade' and that 'without people it would not happen', this led participants to disagree that climate change would affect it. This is a similar idea to a study on flooding in the in the UK regarding climate change, individuals believed their own knowledge about local factors such as blocked drains over the idea of changing weather (Whitmarsh, 2008). Additionally, the identification of these perceptions corroborates misconceptions about wildfire occurrence that have already been identified (Jones et al., 2023) and point to crucial gaps in public knowledge for stakeholders to address. Specifically, there is a need for differentiation on the "causes" of wildfire, where there currently exists a lack of distinction between effects of ignition versus longer term influences (Jones *et al*., 2023). This marries with the point that media has a habit of simplifying messaging (Berglez & Lidskog, 2019), which needs to be considered to properly address this issue of misconceptions, which may not be limited to Britain. Having said that, a BBC news article discussing myths around wildfires in the UK (Arguedas Ortiz, 2023) does demonstrate a use of media in disseminating clear information and the possibility of more nuanced news coverage; although it must be said that questions perhaps remain in how well these complex ideas could be engaged with in this unidirectional way, and how much the nuanced scientific knowledge is taken on board compared to personal knowledge or experience.

Moreover, there is a possibility that experiencing wildfire in Britian may increase residents' acceptance of climate change science. Similar to studies focusing on air pollution experience with climate change perception (Bord *et al*., 2000; Whitmarsh, 2008), wildfire could be more closely linked to climate change perceptions due to the more complementary nature of causes in the ways that air pollution was not intuitive as being influenced by climate change than flooding (i.e. logical global warming and wildfire link). Compared to studies linking flooding experience have found a disconnect (Bord *et al*., 2000; Whitmarsh, 2008). However, caution should be had, as there is a political danger of linking events to climate change as highlighted by Gavin *et al*., (2011). Moreover, focusing on the influence of climate change on wildfire may also counterintuitively create a focus on fire as an entirely natural, unstoppable, uncontrollable phenomenon. Uncontrollable risks may be more dreaded (Dohle *et al*., 2010; Slovic, 1987, 1992), and external factors such as extreme weather can increase uncontrollability and inflate the sense of severity beyond where anything can be done thus mitigation is perceived as ineffective (Martin *et al*., 2007; Winter & Fried, 2000). This removes focus from anthropogenic influences, the sense that it can be controlled by people which lends more support for mitigation, as there is a sense of efficacy in action (Absher & Vaske, 2006; Brenkert-Smith et a., 2006; Bright & Burtz, 2006; Martin *et al*., 2007, 2009; McFarlane *et al*., 2011; Winter & Fried 2000).

Another crucial influence on the perceived wildfire risk recognised in the case studies here these locations was the magnitude and type of perceived consequences. It has already been discussed within the case studies how the type of impacts associated with the local wildfires shed light on how the hazard is framed, that is, who it affects, and how badly it affects them. In ways this influences the relevance of the hazard or the exposure to individuals personally, but rather than spatially, instead the directness and extent of inconvenience or damage. The impacts were often of nature, certainly the more significant consequences of loss of life and devastating damage was associated with the non-human. This possibly creates a sense of wildfire as a hazard for the environment over a hazard to people. There were perceptions of consequences to people, namely health, and then indirect consequences to property, infrastructure, use of local spaces, aesthetics, and the economy in the Highlands. These types of risk also point to why there is greater concern for the area than individuals, as many of perceived consequences focus on these indirect impacts and disruption.

The type of hazards raised in these studies, including primarily the non-human, emphasises how the risk is generally othered. Where the impacts were directly on people, these were often othered to different groups, such as firefighters or children. As McMorrow (2011) points out, the undervaluing of impacts where they are largely environmental, has contributed to the slow recognition of risk, despite decades of occurrence. The intermittency and sporadic nature of wildfires in UK has also been blamed for the slow recognition (Gazzard *et al*., 2016; McMorrow, 2011). This insinuation from these effects which are intermittently experienced and mostly minimal when they are, is that it makes the event less memorable through availability heuristic (Halpern-Felsher *et al*., 2001), which plays to an underestimation of the impacts.

Where the impacts were more relevant, this heightened the sense of risk. One way they were made more relevant was the great magnitude, through higher severity. The severity of British wildfires is generally perceived as low indirect, however, for those that did perceive the hazard as relevant, concern over the severity of the incidents led to greater risk. In the Highlands especially, some individuals when asked about concerns simply replied about the spreading into urban areas or getting bigger and uncontrollable. This suggests that there is potential fear of them being more severe and not being as inconsequential as they often are.

Severity has previously been identified as a factor for higher fire risk (Cohn *et al*., 2008; Martin *et al*., 2007). For a smaller number in this study, there was acceptance of more severe fires which contributed to much heightened sense of risk, for example in the responses to explanations in the Highlands. Severity was also a contributing factor to higher risk score sin the Highlands, which was likely connected to the greater risk of being in more remote areas. Moreover, where participants were aware of global incidents and the impacts of these, there was a sense that wildfires could get severe, and a fear of these more catastrophic consequences contributed to a greater sense of risk. Where there was a particular vulnerability, this increased the sense of severity. This supports literature identifying vulnerability as a factor for higher risk (Martin *et al*., 2007; Olsen *et al*., 2017). A vulnerability was also mentioned regarding indirect impacts, where respiratory conditions such as asthma as a factor to consider regarding wildfires, which both made a more direct influence (although long term and less tangible) of local wildfires which may increase the relevance of the hazard for those that currently are more dismissive.

Within the perceptions discussed there is already some suggestion of personal judgements moderating the level of risk perceived. A key dynamic to the perception of risk is the minimisation or a denial. For some, this acts as a barrier to acknowledging a risk. This includes notions that wildfires cannot happen in Britain because the country is perceived as too wet, or disconnect with the term wildfire, because they are started by people. This also includes the idea there is a disconnect from ‘true’ wildfires that happen elsewhere, because they could not happen on the same scale.

Additionally, where the country is not associated, wildfire hazards compete with other hazards which are more prominent and thus perceived more relevant. This is an idea that has been pointed out as relevant for the UK and other temperate regions (Stoof *et al*., 2012). This mirrors a comparing hurricane and wildfire risks (Newman *et al.,* 2014). Here flooding was mentioned in the Valleys and Highlands, where for some, the occurrence of flooding apparently negating any risk of wildfire. This also speaks to misconceptions that the areas were too wet for wildfires. Moreover, in the context of climate change influence there was also a possible misconception identified in that increased risk of flooding negates wildfire.

A key disconnect with perceived 'British wildfire' is that it is too small. Where exposure to the hazard in the British context is generally not severe the risk is minimised, possibly through the availability heuristic this makes events less memorable (Halpern-Felsher *et al*., 2001). This also links to a perceived lack of direct consequences. Along these lines, where there is greater exposure to small fires, even if many occur, this may lead to a tolerance of the hazard where they are largely minimised in their potential severity. Differing from some findings in fire-prone areas where severity is minimised after an extreme event, where there may be a notion that lightning would not strike twice (Champ & Brenkert-Smith, 2016; Cohn *et al*., 2008; Fischer, 2011; Kumagai *et al*., 2004; McGee *et al*., 2009) in these contexts, where there is often minimal severity, the risk becomes tolerated. In natural hazards literature this has been referred to as a disaster subculture (Tierney, 1993).

There were notable dynamics regarding how well the presence of the hazard was accepted into the areas studied here. For instance, while Dorset had a great proportion unaware or dismissive likely owing to a lack of historic occurrence, the newness possibly acted to create a fear aspect. On the other hand, there was generally more acceptance of the occurrence in Highlands, with fewer barriers or denial of their occurrence likely due to the long presence of fire on the landscape (and a tolerance of them), but instead there were many that discounted them for being irrelevant or insignificant – not problematic – pointing to a cultural tolerance of them. This potentially explains why this area had widespread visibility while having a lower proportion of participants agree they were a problem. Conversely, wildfire in the Valleys was highly visible, and as regular as the Highlands, but had much higher proportions that considered it problematic. While there was likely some cultural tolerance, where there were comments about being accustomed to them and not thinking their occurrence is significant enough to warrant concern, potentially the sheer number or the associations of wildfire with deliberate and malicious arson linked to anti-social behaviour creates an intolerance and more problematic nature to wildfire occurrence separate to the unwanted impacts (hence problematic even if unwanted impacts are small). This frustration in the Valleys also uniquely played into greater resistance to prescribed fire where there was lack of tolerance for the potential effects of burning, such as smoke or the aesthetics, where these were associated with the intolerable wildfires. This arguably contrasts a greater level of comfortability in the Highlands, where there were comments about having wildfire close by and not fearing them, potentially contributing to the greater acceptance of prescribed fire.

Another potential influence on the extent of risk perceived is connected to the characteristics of the hazard. An unfamiliar risk may be perceived as more catastrophic, through dread or fear (Dohle *et al*., 2010; Slovic, 1987, 1992). The dread factor of unknown or uncontrollable risks creates catastrophe and evokes negative emotions. For those that were more concerned about wildfire, linking it to foreign images, having concern for increased severity, or factors that will increase risk (ignition problem or climate change), there was certainly concern over this unfamiliar risk. The uncertainty and lack of preparedness imparted fear. The rhetoric of wildfires as totally destructive, burning indiscriminately creates the sense of them being disastrous. Conversely, this may not always be the case where there is a perceived disconnect between foreign 'true' wildfire and the vegetation fires in Britain. The idea that Britain could not have one on a foreign scale could create a complacency as the risk is minimised, despite the fact that wildfires can be large and do pose risks.

Lastly, it is important to remember that environmental hazards occur within the context of daily life (Champ *et al.,* 2013; McFarlane *et al.,* 2011; Reid & Beilin, 2013). There may be competing daily life or other risks to consider or securing livelihood (Champ *et al.,* 2013; Cohn *et al*., 2008; Eriksen & Gill, 2010; Koksal *et al.,* 2019; McFarlane *et al.,* 2011; Reid & Beilin, 2013). Hence, where wildfire may be infrequent (Wachinger *et al*., 2013), or intermittent (Gazzard *et al*., 2016), there are other priorities.

In summary, there are nuanced views on probability and severity of wildfire risk in Britain. In the judgements of wildfire risk in Britain, the perception of a risk is possibly best explained by the idea that first the possibility must be acknowledged, and then the increased probability may heighten risk. The idea of feasibility is a crucial barrier to overcome for the public to acknowledge risk, and arguably is the key difference between findings in Britain and fire-prone areas. Denial of the possibility of wildfire in Britain, including the various rationale that wildfires cannot occur in Britain because the climate is too wet, or that they are not 'wild' because they are started by people or close to urban areas. Wildfire hazards in Britain were also minimised where they are perceived as typically too small or inconsequential and less memorable, through an othering of types of consequences, or do not compete in comparison with other environmental hazards or become irrelevant in daily life because of their intermittent nature. Wildfire therefore needs to be feasible, and then spatially relevant. Factors which act to increase likelihood act to significantly shift the risk of wildfire. The severity may be generally perceived as low and impacts othered, but there is concern over potential severity, and there are concerns about both direct and indirect impacts. Factors which increase likelihood include, awareness or concern over ignition problems, visibility of wildfires and awareness of previous events, and climate change. Perceived consequences are crucial in shifting the framing of the hazard from indirect to direct, although this does not negate the importance of indirect impacts where they may still generate concern and increase the relevance of the hazard and these issues. Mostly the concern exists for the area rather than individual. Perceived severity or vulnerability were crucial ways the hazards generated legitimacy, especially where these were linked to foreign images of wildfire. Moreover, the characteristics of wildfire as unfamiliar, and awareness through the media of catastrophic images, added considerable fear. Localised knowledge has been found to be crucial to awareness of the hazard and factors that increase the risk.

7.1.4 Interest in outreach and Firewise

The questions on mitigation in Dorset offer valuable insights, although they are limited to one of the case studies. Firstly, there was a lack of widespread awareness of the local Firewise scheme, with those aware of it primarily residing in BH20 or working for the local council. This suggests a gap in outreach, potentially addressable through social media, which was an avenue that accessed more residents with concerns about local wildfire, as well as interest in Firewise.

Insights into motivations, barriers, and uncertainties about participation are crucial for understanding interest levels and suggesting ways to enhance engagement across Britain. There is a notable gap in the literature regarding reactions to wildfire mitigations in lower-risk fire contexts. Typically, high perceived risk is seen as a prerequisite for mitigation efforts (Daniel et al., 2002; Kent et al., 2003; McCaffrey, 2004; Steelman, 2008), where perceived severity often correlates with increased mitigation behaviours (Dickinson et al., 2015; Martin et al., 2007, 2009; McNeill et al., 2013; Olsen et al., 2017; Shindler, 2007; Vaske et al., 2007; Winter et al., 2004). Despite Dorset residents showing less widespread concern about wildfires, there was still a willingness and interest to participate. However, the results here may include response bias, especially in face-to-face recruitment (Doyle, 2005), leading participants to appear more agreeable. This response bias was also demonstrated where the reasons for those that were neutral to the close-ended question displayed reasons against taking part, where they had selected “I don’t know”, but meant “probably not”, potentially to be more polite.

Nonetheless, there was a sense that even without a direct personal risk perceived, concern for the local area, its heaths, and nature, was a driving force for desire to be involved in Firewise schemes. This aligns with the understanding that the impact of wildfires on the environment generates affect and care. While it remains unclear how effectively this concern would translate into action, it suggests that even in less fire-prone areas, tailored mitigation efforts could be effective. Mitigation strategies may need to encompass broader environmental care or protection from other risks, they may even potentially not have wildfire as the headlining benefit. This would support the assertion that mitigation strategies are most effective when they are tailored to the area (Brenkert-Smith *et al.,* 2012; Christianson *et al.,* 2014; Everett & Fuller 2011; McCaffrey *et al.,* 2011, 2013; Monroe *et al.,* 2006; Steelman *et al.,* 2014; Steelman & McCaffrey 2012; Stidham *et al.,* 2014), in this case, focusing on environmental and wildlife targets may be compelling.

That said, there were participants that were particularly concerned about wildfire directly either generally (14%), or directly to themselves (12%), especially among those perceiving vulnerability (e.g., thatched roofs, proximity to SSSIs, or had previous negative experience during wildfire event), that were actively looking for information on preparing for wildfire. This supports literature on the significance of perceived severity, vulnerability, and hazardous conditions in motivating mitigation actions (Dickinson et al., 2015; Martin et al., 2007, 2009; McNeill et al., 2013; Olsen et al., 2017; Shindler, 2007; Vaske et al., 2007; Winter et al., 2004). The more direct concern to wildfire may create more compelling motivation to take part and translate into more committed or effective engagement with stakeholders and mitigation. The finding highlights the need for education in the area.

Conversely, there was also interest from those that have never considered the risk wanting to know more. In fact, the most common interest reason was the desire for knowledge, especially among those previously unaware of the hazard. Both those that have no concern and those with specific concerns, the general lack of knowledge about wildfire, especially with how to prepare and mitigate, show that communication is needed. This need for information was echoed in both of the other case studies, with participants even expressing frustration at not being asked for their opinions before. Thus, there is ample opportunity for improved education among residents. It would be best to frame this as locally as possible, where specific information has been shown in this survey to be more effective for educating about risk and making it most relevant to them.

Examining motivations for Firewise participation revealed, apart from this concern about wildfire, include motivations for concerns not directly related to wildfire risk. Instead, a desire to assist with general community aid (9%), protection of local spaces and heaths (4%), and protection of wildlife (16%). This speaks to the risk perception gap where awareness of a risk and mitigation are not always correlated (Cohn *et al*., 2008; Eriksen & Gill, 2010), but conversely highlights that a severe risk may not be needed to engage with the public, where the issue may be seen as wider reaching. In the Valleys for example, despite many not being directly exposed to the wildfire risk, where the issue is so entrenched in wider social issues, there may be as much motivation to do good, where members are more connected to the community. This highlighting the importance of community-focused preparedness (McCaffrey, 2015; Steelman, 2008) and place attachment (Billig, 2006; Lewicka, 2011). It is well established that stronger connections to the area and community can foster preparedness (Anton & Lawrence, 2014, 2016; Brenkert-Smith, 2010; Eriksen & Gill 2010; Jakes & Langer 2012; Kyle et al., 2010; Gordon et al., 2020).

Of the residents in the samples there is a level of connectedness to the locality, especially online. This is possibly an artefact of the methodology, specially using local social media groups, as they are more likely to contain members of the community that are more integrated with the area. Moreover, the Highlands was possibly more well connected, exemplified by the greater similarity between the two samples in the Highlands, showing a more homogenous group, where rural areas typically have higher place attachment (Anton & Lawrence, 2016). In locations that do have more variation in the population, including in more urban areas where there is a mix of knowledge levels (Brenkert-Smith *et al*., 2006; Eriksen & Prior, 2011; Martin *et al*., 2007), it could be useful to access more well-connected members of the community where they may be more open to engagement. Social capital has also been highlighted as important for natural hazards mitigation in a UK study of flooding (Lo & Chan, 2017). Hence the online methodology, that potentially accessed more well-connected community members, could be an ideal place to start.

Examining the reasons for individuals not taking part are just as illuminating. The reason expressed show both reasons not for taking part, as well as reason which instead showed doubt and uncertainties about the mitigation method itself. Barriers to involvement included a perceived lack of relevance to the problem, varying from believing they were not at risk, not believing it is needed, or not owning a house. The latter was especially true of the younger participants.

The other key theme in these reasons not to take part, was a lack of capacity, mostly time. This links to the importance of practicalities in mitigation (Bright & Burtz 2006; Eriksen & Gill, 2010; McCaffrey *et al.,* 2013; Wachinger *et al*., 2013). This also points to the fact that these wildfire hazards will be ordered within daily life (Champ *et al.,* 2013; Cohn *et al*., 2008; Eriksen & Gill, 2010; Koksal *et al.,* 2019; McFarlane *et al.,* 2011; Reid & Beilin, 2013), hence they may become relatively unimportant, especially in economically pressured areas (Cohn *et al*., 2008). Daily life priorities may overshadow wildfire hazards, particularly in economically pressured areas like South Wales Valleys, and could become increasingly relevant across Britain amid the cost-of-living crisis (Webster and Neal, 2022).

Disagreement with the approach of this mitigation strategy also contributed to a disinterest, this included responsibility offloading, and the belief that government or others should act, particularly in arson-prone areas like the Valleys, were notable. Many called for efforts to reduce arson in the Valleys. Negative experiences with forestry agencies in Dorset, particularly during a previous fire and fuel management, highlight the potential for strained community-agency relationships if preparedness is inadequate and agencies are blamed for adverse events.

Beliefs about effectiveness also meant a lacking driving force, with doubts about the benefit noted by interested participants. Opinions on education, personal and community action, reducing ignitions, protecting heaths, and local relevance influenced perceptions. This is where the locally specific nature should be a crucial part of the engagement, where localised schemes addressing specific area problems increase interest (Brenkert-Smith et al., 2012; Christianson et al., 2014; Everett & Fuller 2011; McCaffrey et al., 2011, 2013; Monroe et al., 2006; Steelman et al., 2014; Steelman & McCaffrey 2012; Stidham et al., 2014; Toman et al., 2006). Additionally, not only tailoring the scheme but ensuring it is perceived that influential or trustworthy agencies are involved, to increase the perceived effectiveness.

7.2 Comparing acceptability of prescribed fire across case studies

7.2.1 Highlands' awareness of prescribed fire and the influence of its rurality

There is long-standing presence of fire on the landscapes, particularly of agricultural prescribed fire in the Highlands (Fyfe *et al*., 2003; Dodgshon & Olson, 2006) and persistent deliberately set vegetation fires in the Valleys for decades (Jollands *et al*., 2011). Although with the decline in prescribed fire (Bruce *et al*., 2006; Davies *et al*., 2008) there is largely a disconnect between landscape fire and people in the UK, a portion of residents showed some level of awareness of historic use of fire demonstrated by those that point out the longstanding resistance of the tool in the prescribed fire question in this study.

Attitudes towards prescribed fire were useful to explore how the public may respond to increased use of prescribed fire. There was more of a focus in the Highlands' surveys, where there was a need to ask more about residents' awareness of burning due to its prevalence and the potential influence on wildfire perceptions. These build on some perceptions on the acceptance of prescribed fire investigated in Ireland (Carroll *et al.*, 2021).

Across the questions on muirburn, Highlands' residents exhibited familiarity with its occurrence locally, as well as having an awareness for the purposes and outcomes. Their ecological knowledge varied, with some demonstrating sophisticated understanding and others more general or common-sense awareness. The rural nature of the Highlands likely contributes to this knowledge, as greater place attachment and familiarity, where there is greater place attachment is common in these places in fire-prone areas (Anton & Lawrence, 2016).

Overall, the rurality of the Highlands did certainly mean it differed from other locations. The rurality has already been seen to influence wildfire perceptions with concerns that there would be wider spread impacts, the environment creates challenges for firefighters, and those in the more remote areas feeling particularly vulnerable. This corresponds with UK literature that highlights moorlands as key places of fire risk for the challenges they present in firefighting being large and inaccessible (Albertson *et al.,* 2010; Gazzard *et al.,* 2016). The increased burning was also an artefact of the rural environment of the Highlands, as well as the exposure of people in the area to fire, which potentially explains slightly more tolerance where there were more that had seen wildfire but did not determine them as a problem. The rurality also influenced acceptance of prescribed fire where it was seen as a more useful tool because of the challenges in managing the larger expanses of land without fire.

Additionally, unlike the other areas some Highlands' participants viewed prescribed fire as necessary for the local environment, reflecting their connection to environmental knowledge. Moreover, exposure to prescribed fire led to greater familiarity and acceptance. On the other hands, negative experiences with unsuccessful burns – where burns were blamed for wildfire incidents – resulted in a poor reputation for fire use, fostering discontent and additional barriers to the acceptance of prescribed fire not identified in the other case studies.

7.2.2 Comparing responses to the acceptability of prescribed fire

Examining how resident's from the various locations responded to the potential use of prescribed fire locally shows some divided opinion; approximately half were accepting of prescribed fire, 52% in Dorset, 52% in the Highlands, and 47% in the Valleys (Figure 7.4). The remaining participants were split between disagreement and being undecided. The Valleys had fewer strongly agree and more participants strongly disagree. The Highlands had the most neutral responses and the least amount of disagreement. There was a notion of resistance towards fire on the landscape across all locations with uncertainty around its occurrence and high amount of conditional agreement. In the Valleys, 14% of those that strongly agreed gave conditions, compared to 47% of those that agreed; in Dorset, 18% of those that strongly agreed gave conditions, compared to 71% of those that agreed; and in the Highlands, 8% of those that strongly gave condition, compared to 49% of those that agreed. The proportions that agreed is generally lower than research in mostly wildfire prone areas, where 80% have partial or full acceptance of practice (McCaffrey, 2015). This disparity is potentially rooted in the context that fire is not perceived as natural, so there is more resistance to it, or in that wildfire risk is not sufficient to introduce the risk of burning.

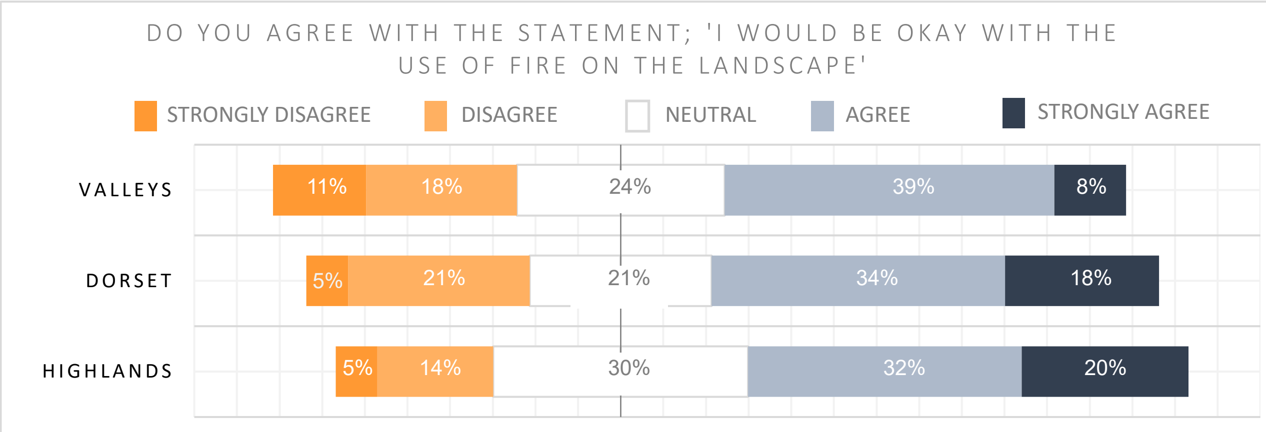


Figure 7.4 - Comparison of agreement with fire use locally across the three case studies. Combined samples for Valleys' follow-up N=119, Dorset follow-up N=64, and Highlands N=185.

The types of justifications given for the opinions on prescribed fire were very similar across the three case studies and provide similar further examples to a study in Ireland (*Carroll et al*., (2021) on the perceptions of prescribed fire in a non-fire-prone country. These are summarised in Figure 7.5. The reasons in favour include the mitigation of wildfire, other benefits, as well as understanding the efficacy or legitimacy of the tool by understanding its successes or knowing it is used elsewhere so must be alright. The concerns revolved around uncertainty on outcomes, the perceived unavoidable negative consequences, a lack of necessity or efficacy (including poor reputation), and a general resistance to fire. The conditions relate mostly to the concerns about the outcomes, including limiting negative outcomes, even the regularity of them, and ensuring they are done properly, controlled, and by trusted personal and authorities.

Reasons for and against acceptability of fire use on British landscapes

REASONS IN FAVOUR

Necessity, wildfire risk concerns	Mitigate wildfires (safer than uncontrolled) Necessary (landscape or issue)
Efficacy	Effective, efficient Not negative impacts
Perceived wider benefits	Beneficial for environment Beneficial for agriculture Reduce ticks
Personal familiarity	Previously participated
Knowledge around establishment of tool	Long standing tool, historic International precedents Scientific grounding

REASONS AGAINST

Concerns	Controllability, safety Unavoidable negative consequences Impact nature Impact people, disruption Air pollution (health, climate change) Potentially encourage arson
Poor reputation of current use	Aware of improper use or mistakes
Not necessary or prefer other options	Not necessary or appropriate Prefer alternatives (fire use last resort)
Simply dislike fire	Dislike idea of fire

AGREE BUT WITH CONDITIONS

If done with regulation and expertise	If controlled, responsibly, properly done, experts or trusted agents involved, proficiency
If not done flippantly	If beneficial , properly planned, part of wider plan, or if small, occasional Only if necessary, right time of year, in appropriate places, or in certain cases (i.e., not grouse)
If done with public notice	If public made aware

NEUTRAL

Both	Arguments both ways
Neither	Neither desire nor oppose
Do not know enough	Do not know enough (benefits, impacts, safety) to judge For science or experts to decide

Figure 7.5 – The variety of reasons given to explain agreement with presence of prescribed fire locally.

7.2.3 Explaining the acceptability of prescribed fire in Britain

First, considering the factor promoting acceptance, the support for prescribed fire was rooted in common themes such as knowledge of benefits, efficacy, and familiarity, demonstrating the tool's perceived success.

Perceived benefits, especially wildfire mitigation, emerged as a crucial factor across all case studies. Participants recognised that controlled burns effectively reduce fuel and wildfire severity, including comments that a controlled fire is preferred over a controlled one. This aligns with literature that emphasises the importance of perceived success and necessity (Toman et al., 2014; Blanchard & Ryan, 2007; Flint, 2007).

The necessity of fire risk and fuel management, particularly in areas with specific landscape needs, also increased acceptance. This was evident in the Highlands, where the landscape was perceived as necessitating such measures. This aligns with research where prescribed fire is more accepted when a fire risk is recognised (Blanchard & Ryan 2007; Flint 2007) especially where fire risk higher (Brenkert-Smith *et al.,* 2013; Mylek and Shirmer, 2020).

The need for fire risk and fuels management was identified as a factor influencing acceptance, especially in areas where it was viewed as necessary. The belief of the necessity of the tool was another reason increasing acceptance, where there was awareness of a fire or fuel problem necessitating its use, in the Highlands this also included a necessity due to the specific landscape. While fire risk was seen as a supporting factor, when examining the relationship between responses to questions about wildfire risk and the acceptability of prescribed fire revealed minimal or mixed relationships between concern about wildfires and acceptance of prescribed fire. In Dorset, there was a suggestion that higher concern about wildfires might increase acceptability. Conversely, in the Valleys, elevated concern about wildfires appeared to decrease acceptability. The Highlands displayed mixed agreement across risk scores. These are potentially explained by the contexts of fire in each location, where in Dorset there was a resistance to the wildfire was more of an emerging risk, it was feared. Whereas in the Highlands, while there was some tolerance to fire and increased connection to fire ecology by some, where the presence of controlled burning was linked to causing wildfire, concern for this problem of wildfire would mean that prescribed fire was not perceived the answer. Then, in the Valleys, there was a lack of tolerance to fire on the landscape, arguably through a 'fatigue' of the impacts where wildfire is so prevalent and linked to intolerable social issues. Therefore, while perceiving a fire risk or recognising the need for fire use may enhance acceptance, it is noteworthy that individuals might harbour concern about fire risk so resisting the idea of using fire as a management tool.

Familiarity with prescribed fire, whether through direct experience or historical use, further promoted acceptance. This aligns with existing literature emphasising the importance of familiarity in public perceptions (McCaffrey *et al*., 2008; Ryan & Wamsley, 2008; Toman *et al*., 2004, 2008; McCaffrey, 2015). Direct experience was mentioned in Dorset by one participant, as well as demonstrated by the high levels of agreement from flagged participants in Highlands, demonstrates that positive familiarity garners acceptance. Crucially, direct experience or exposure may have an opposing affect, where negative experiences will counteract this. This was highlighted by the fact that the presence of muirburn in the Highlands both increased and decreased support, where it had a poor reputation. To clarify then, this supports the assertion that familiarity leads to greater knowledge of benefits, which is what increases support (Ascher *et al.,* 2013; Paveglio *et al*., 2009). This speaks to the notion that to increase support requires knowing successes (Martin *et al*., 2007; Toman *et al.,* 2014), as well as highlighting the need for trust in those carrying out burns (Ascher *et al*., 2013; Fried *et al*. 2006, Kumagai *et al*., 2004; Monroe *et al*. 2006; Mylek & Shirmer, 2020; Olsen & Shindler 2010; Shindler *et al*. 2011; Shindler & Toman, 2003; Toman *et al*. 2011; Toman *et al.,* 2014; Vaske *et al*. 2007; Winter *et al*. 2006; Winter & Cvetkovich 2008). The Highlands case study in particular echoes these findings. Many Highlands' participants did exhibit awareness of the ecological benefits, and it is likely this that increased the strength of support held by those that had direct experience (when explanation was compared to flagged participants), even though this was counteracted in overall agreement by those that focused on the poor reputation of the practitioners themselves.

Moreover, studies have found there to be greater acceptance in rural or remote areas (McCaffrey, 2008; Shindler *et al*., 2011; Toman *et al*., 2011), which there is a subtle increase in the Highlands. This may be influenced by the fact that it is seen a more necessary, as well as reducing the risk to safety where burns are not being carried out near places of high population density. The latter was raised as a concern or condition in Dorset in particular, where it was not perceived as suitable to the area specifically.

Participants also cited the long-standing use of fire, or awareness of foreign countries using this tool, as a reassuring factor, creating a sense of tried-and-tested reliability. This was especially common in the Highlands, which also raised the sense that fire was a 'natural' process. These likely act to reassure individuals that fire will not have a harming effect.

Perceived benefits beyond wildfire also promoted acceptance. This included justification in the Highlands which described other environmental or agricultural advantages, as well as tick reduction. Moreover, this is also evident in the common condition that fire would only be an acceptable tool where it was beneficial to the whole environment or part of a wider plan, not only used with the intention of stopping future wildfires. Overall, a sense that it is effective (and beneficial) was crucial for support.

Conversely, key concerns about prescribed fire included uncertainties about outcomes, controllability, and negative impacts on nature, people, and climate. This resistance was more pronounced in the Valleys, where regular wildfires and their impacts, such as smoke and aesthetics, were significant concerns. In Dorset, pollution and climate change were major issues. In the Highlands, distrust stemmed from the poor reputation of current fire practice and doubts over controllability, highlighting the role of trust in fire management.

The concerns around outcomes of fire use were all similar to those previously raised in literature, including escape, wildlife, aesthetics, safety, air quality, and carbon storage (Bell & Oliveras, 2006; Blanchard & Ryan, 2007; Brunson & Evans, 2005; Carroll *et al*., 2004; Jacobson *et al*., 2001; McCaffrey *et al*., 2008; Ramchunder *et al.,* 2009; Toman & Shindler, 2006; Ward *et al.,* 2007; Wulfhorst & Nielsen-Pincus 2003). Notably, concern for pollution was also raised in all locations especially in the Valleys and Dorset, where Dorset had high proportions raising it. Mostly, the concerns were of climate change and air quality, especially where they have respiratory illness. Studies have noted the nature of inconveniences as a result of smoke are to be mostly minor (Wulfhorst *et al.,* 2006), and these disruptions have been mentioned and seen as unfavourable. It has been noted that while there may have been concerns raised, they have not been deemed a reason not to do it (McCaffrey & Olsen, 2012). However, in this case, especially in the context of climate change there is significant opposition to prescribed fire.

Concerns about controllability were prominent in all locations, especially the Highlands, were past negative experiences reinforced scepticism. Controllability was a key concern in the Highlands especially, although mentioned in all locations. The concern in the Highlands was compounded by the fact participants were aware of bad reputation of current fire use and blaming these partially for the wildfire issue. The Highlands concerns about prescribed fire do reflect literature discussing occurrence in Scotland and highlighting escaped burns as a key ignition (Glaves *et al*., 2020; Luxmoore, 2018). Escape and safety are well-known concerns of the use of prescribed fire for residents (Carroll *et al*. 2004; Blanchard & Ryan 2007; McCaffrey 2006; Monroe *et al*. 2006; Shindler *et al*. 2009; Winter *et al*. 2002). This highlights the role of trust, where it appears low in the Highlands. The ability to control is a crucial concern so to increase actability it has been noted individuals need to be shown successes and believe in the expertise and skill of personnel (Ascher *et al*., 2013; Martin *et al*., 2007). And in the case of Highlands perhaps there would need to be a change or some reassurance about the implications moving forward. Embedded in this hesitation was the notion that negative outcomes were unavoidable, often it was posed that the benefit of wildfire reduction meant damage to nature. Even in cases where participants were aware they were beneficial, they expressed a maintained resistance or belief that they could not see how it would not be negative. In other words, prescribed fire was anti-nature. This sentiment was particularly strong among those unfamiliar with prescribed fire, who focused on assumed negative consequences. This supports research that has argued that increasing support can be garnered where negative assumptions are replaced by positive experiences (Blanchard & Ryan, 2007). This speaks to a fact that where an individual does not know much about it, there may be uncertainty over effectiveness or consequences, generally leading to less acceptance (Altangerel & Kull, 2013).

Balancing outcomes, particularly between biodiversity and fire risk, are often key considerations across studies that have looked at acceptability of prescribed fire (Altangerel & Kull, 2013; Bowker *et al*., 2008; Burns & Cheng 2007; Fischer, 2011; McCaffrey *et al*., 2008; Paveglio *et al*., 2011; Vining & Merrick,2008; Walker *et al*. 2007). This study certainly confirms this, where participants expressed conditions for fire to be beneficial beyond wildfire or was part of wider plan for the environment. Additionally, linking to the voluntariness of risk as raised in the Australian debate of competing priorities off risk reduction and impacts on biodiversity (Altangerel & Kull, 2013), there was a rhetoric of the fact that the risks to wildlife are too great in relation to the benefits, with the idea that it would be environmentally damaging, and that “*we are clever enough and technology advanced enough to find a better means of achieving the same outcome*” (VON74). This exemplifies a resistance to fire in these perceptions. From those in favour, it was noted in the Highlands fire was an ecological and natural phenomenon, aligning with wildfire research literature (Bixby *et al*., 2015; Bowman *et al*., 2009; He *et al*., 2019; Scott, 2000; Scott & Glasspool, 2006), there was no mention in other locations of this concept, although it was understood fire had been historically present. Where there is the balancing of risk and biodiversity impacts, the idea of voluntariness of risk raises questions about the ethics of artificially changing landscapes while risking nature (Eckerburg & Bruizer, 2017). This also raises questions about what is natural in Britain.

Some individuals perceived a lack of benefits when prescribed fire was not seen as necessary, and there was a preference for alternative methods. In the Valleys, some believed prescribed burns would be a waste of resources. While participants were aware of the purpose and benefits of fires, their resistance persisted due to concerns about perceived impacts, uncertainties, or negative outcomes. The hesitation in the Valleys was associated with concerns aligning with the impacts of wildfires, with a reluctance to contribute to existing issues or detract from the landscape's aesthetics, where there a sense the landscape had been “blighted” enough. Additionally, there were concerns about potentially encouraging deliberate fire-setting in the Valleys. This highlights the need for reassurance regarding the absence of negative impacts and tailored information on benefits and uses, especially addressing local concerns.

Conditional acceptance of prescribed fire was common, with nearly half in the Valleys and Highlands (47% and 49%, respectively), and a higher proportion in Dorset (71%), imposing conditions on fire use. Dorset residents had the highest proportion of conditions, emphasising control, benefit, expertise, necessity, and distance from urban areas. Conditions revolved around ensuring no negative impacts, proper control, planning, involvement of experts, and use only when necessary. These conditions mirrored the potential negative outcomes, and risk. This cautious approach reflected a desire to use fire judiciously, balancing risk reduction with environmental protection. Participants stressed the importance of responsible management and reassurance of benefits, highlighting the need for trust in those implementing fire practices.

Notably, building on the idea of resistance was the conditions where they were only used when necessary, or potentially when there is no other alternative. This indicates that there is an idea it is not a tool to be used whenever, it is instead a tool that should be used sparingly. This idea has been found in research elsewhere, in the USA, even where fire is more naturally occurring (Shindler & Toman 2003; Shindler *et al*., 2009, 2011), where perceptions do vary from it being "*a legitimate tool that can be used anywhere*" to "*a tool that can be used infrequently in selected areas*". However, in this case the resistance is potentially more widespread, connected to a fear of fire, a lack of familiarity and uncomfortably with fire, a reduced wildfire risk acting to decrease the magnitude of the perceived benefit, or a lack of perceived naturalness of the occurrence of fire. The uncertainty was exacerbated by negative assumptions about fire (Blanchard & Ryan, 2007).

Where there were questions over the need for fire use where it was not deemed sufficient to 'risk' the use prescribed fire, this insinuated a balance between risk reduction and other environmental outcomes. These findings prompt philosophical reflections on the ethics of impacting the environment for human protection, where the perceived lower severity of risk led to reservations about risking nature. The study suggests the need for more participatory approaches in fire management, considering cultural attitudes and promoting positive fire exposure to garner support.

Moreover, especially where the individual had little knowledge, there was sentiment that it was for science or experts, links to the need for trust in those involved in decisions and carrying them out. Where there was also crucial amount of trust in expert and authorities to determine the appropriateness of the tool, as a common condition raised, this demonstrates the publics reliance on ecological research to inform the benefits and thus the requirement for science to explore the ecological questions around the effects of fire on British ecosystems, especially where it is not fire prone.

Overall, while there is support for prescribed fire based on its benefits and necessity, significant concerns about its controllability and impacts persist. Addressing these concerns through education, responsible management, and reassurance of benefits is crucial for increasing acceptance of prescribed fire as a management tool. Overall, the dynamics on prescribed fire acceptance align very closely to previous research, where very similar factors adding to promote or oppose support were raised in these studies in a non-fire-prone country, as in fire-prone countries. The differences relate to the level of fire risk and the perceived necessity of the tool, as well as resistance to fire where it is not 'natural' or where there is a lack of familiarity with fire, as well as a lack of tolerance to fire. Concerns are heightened in these case studies where there is often a conflation controlled and uncontrolled fire occurrence as more similar than it possibly is in reality, which concurs with research in Ireland (Carroll et al., 2021). It is also heightened by a lack of familiarity with fire in general, and perspectives occurring through a lens where fire is assumed to be negative and ultimately anti-nature. This is probably due to the biases in westernised society perpetuated by disaster narratives in media where a small number of disastrous wildfire events are publicised and the positive stories of the use of fire are not publicised (Bowman *et al*., 2020; Doerr & Santin, 2016; Jacobson *et al*., 2001; Moore, 2019), as well as the systematic disconnect with fire as an ecological process (Pyne, 2007).

Conditions expressing the need for broader planning and necessity indicated a desire to use fire judiciously, highlighting concerns about fire being perceived as anti-nature or uncontrollable. The studies revealed a general lack of familiarity and comfort with fire, akin to sentiments in industrialized areas where fire is often demonised (Pyne, 2016; Scott *et al*. 2014).

The conflation of prescribed and wild landscape fires (Carroll *et al*. 2021; Davies *et al*., 2008), where wildfires are becoming more visible, fuelled uncertainty and controversy over fire use because the impacts were seen as synonymous. This was especially pronounced in the Valleys, possibly due to the highly regular and prolific occurrence, and in the Highlands the association of uncontrolled fires as a result of muirburn was a different but important influence of the link between the two.

7.3 Implications and lessons for stakeholders

Building and maintaining trust between communities and agencies is crucial, especially in areas where wildfires are a new threat. Initial interactions with agencies can significantly influence public perception and cooperation. Negative experiences, as seen in Dorset, highlight the importance of addressing community concerns and knowledge gaps effectively. Moreover, participants themselves have expressed a need for information, where they feel underprepared, especially where they feel particularly vulnerable to wildfire, but also by residents who have never considered the applicability of this hazard before and need more information.

The insights from fire perceptions identified here offer crucial considerations for stakeholders. Key gaps in knowledge, as well as some common misconceptions in understanding are summarised below, as examples of the key learnings identified by this research are below:

Understanding Wildfire Risks

- **Magnitude of Risk:** There is legitimacy in the potential size of wildfire risks in UK despite not being fire prone, and demonstrate how they may be affected, as well as the impacts on nature, where the latter could create indirect care.
- **Timing of Risks:** Be aware that wildfire risks are not confined to the summer, and education on the type of conditions that should be looked out for
- **Influences and Causes:** understanding the influences and causes of risks, while many have specific knowledge, clarifications on how longer-term influence of climate change for example, is moderated by environmental change and ignitions
- **Misconceptions:** Clarify that the country is not ‘too wet’ for wildfires, and that wildfires are not limited to remote areas, and can be started by people and still influenced by climate change.

- **Flooding and Wildfire:** Realise that increased future flooding will not negate the risk of wildfires.
- **False Security:** Avoid complacency; both about the context of fire for UK and minimising risk, as well as specifics such as, the absence of recent wildfires does not mean they are no longer a threat.

Mitigation and Preparedness

- **During a Wildfire:** Educate the public on actions to take during a wildfire, such as closing windows and staying out of affected areas.
- **Property Preparation:** Provide specific guidance on how to prepare properties to mitigate wildfire risk.
- **Effective Communication:** Bridge knowledge gaps by providing clear, actionable information on wildfire risks and mitigation strategies. Including unidirectional communication, where ironing out the misconceptions may need more of a discussion where the British public completely disconnect British wildfires from 'true' foreign wildfires. Debate around language is potentially wasteful, where it would be most prudent, if necessary, to ensure experts used language that the public responds to.

Mitigation and Preparedness

- **Familiarity and trust:** Similar to previous findings, both familiarity and trust are crucial. Perceived benefits are crucial, where better understanding positive outcomes for the environment could improve public acceptance. Moreover, trust in agencies, as well as science, is also crucial for whether the public deem it acceptable.
- **Misconceptions about prescribed fire:** The persistence of notions of fire as wholly negative are pervasive.
- **Balancing opinions:** While a more informed public may be more accepting of prescribed fire, it is crucial to consider what the place of prescribed fire should be, not only from an ecological perspective, but also where there may be widespread resistance, it will be crucial to liaise with the public on what the best options are (considering the prescribed fire may in fact not be). There should be participatory research to achieve this goal.

Notably, some individuals are attentive to wildfire risks in this study, suggesting as Olsen *et al*., (2017) pointed out residents are either keen risk observer or receiving effective. Public education initiatives, such as the Bernie the sheep project in South Wales and DWFRS campaigns in Dorset, have aimed at reducing ignitions. The awareness of these issues in both areas, especially in Dorset where it is more recent, demonstrate that this has likely been effective.

However, knowledge gaps persist, encompassing feasibility barriers, risk levels outside of summer, climate change influence, misconceptions about fire occurrence, and underestimations of risk severity. Addressing misconceptions, such as associating wildfires only with summer and believing they can only be naturally ignited, is crucial. Media plays a vital role in disseminating information, evident in residents citing it as a source. Stakeholders should leverage media outlets, considering the importance of social media for engaging local communities.

Furthermore, a key knowledge gap was awareness of how to protect property. While there were some relevant responses, either where already had knowledge or were using common sense, there were some less relevant answers or rather those which addressed reducing overall risk in area. This knowledge gaps underlines the need for agencies to provide specific and effective mitigation information (Dickinson *et al*., 2015; Wachinger *et al*., 2013). While there is a willingness to address wildfire risk, specific knowledge can enhance residents' preparedness.

Engaging less-aware groups is crucial, where a range of knowledge levels has been identified. Engaging with residents with these varying levels of knowledge will be crucial, as pointed out previously (xx). This includes recognising potential apathy in the wider population. Notably, there is likely an element of non-selection bias in this study (Bird, 2009) so there is possibly more apathy in the wider population than indicated in these samples. Focusing on localities and dispelling misconceptions about fire risk association with the country as a whole is essential for fostering a widespread understanding of wildfire risks on a national scale.

The lack of relevance could on one hand be addressed, encouraging acknowledgment of risk through relatable impacts, such as peer stories about smoke-related disruptions or evacuations, could make the issue more relevant. However, place attachment and care for the area have shown to be equally significant drivers of engagement, even where the individual may have not previously had an awareness of fire risk. Hence tilting outreach to address specific and wider concerns of the whole area could facilitate good engagement. This speaks to the findings in research of both addressing tailored and localised concerns to increase relevance (Brenkert-Smith *et al.,* 2012; Christianson *et al.,* 2014; Everett & Fuller 2011; McCaffrey *et al.,* 2011, 2013; Monroe *et al.,* 2006; Steelman *et al.,* 2014; Steelman & McCaffrey 2012; Stidham *et al.,* 2014), as well as perceiving wider benefits increasing mitigation action (McGee, 2011).

Incorporating climate change messaging in wildfire information requires careful consideration, especially where wildfire is a poetic symbol of climate change. While linking wildfire to climate change can elevate concern levels, it is vital to avoid entangling wildfire discourse with political controversies surrounding climate change (Gavin *et al*., 2011). Clear and nuanced messaging is essential for effective communication.

Localising information is key to enhancing public understanding and acknowledgment of wildfire risk (Kent *et al*., 2003; McCaffrey, 2004b). Residents often trust their local knowledge over experts (Siegrist & Cvetkovich, 2000&), emphasising the need for information tailored to specific locales to make it as relevant as possible, and ensure it is taken on board. Providing local context can bridge the gap, transforming what is potentially perceived foreign and infrequent risk into something more relevant and familiar. Tailored information on personal mitigation and the necessity of prescribed fire is essential.

CHAPTER 8 CONCLUSION

8.1 Summary of study

This highly exploratory study presents primary risk perception data from areas across Britain. It has collected broad cross sections of areas and compared findings in-depth with local context. It is the first dedicated, comprehensive, and detailed empirical evidence of the perceptions to wildfire, and another case of prescribed fire perceptions in a non-fire-prone context.

The main aim of this research was to discover the social perceptions of wildfire in Great Britain, including the risk and level of knowledge, as well as comparing to climate change belief and prescribed fire acceptance. Utilising three localised case studies it has identified common attitudes to wildfire hazards and towards prescribed fire. It also began to explore attitudes and awareness of personal wildfire mitigations and the awareness of prescribed fire in the Highlands. Through 8 specific research questions this thesis has generated a varied and insightful exploration of perceptions in Britain:

RQ1: How much, and what risks do residents associate with local wildfire?

RQ2: How much do residents know about local wildfires, specifically, how aware of it are they and what did they think it entails?

RQ6: How aware were Valleys' residents of foreign wildfire events, and where did they get this information from? (Valleys)

RQ4: What do the three case studies begin to suggest about wildfire perception across Great Britain?

RQ7: What do Dorset residents already know about personal property protection, and how willing are they to take part in Firewise? (Dorset)

RQ3: What was resident's sentiment towards having fire in the landscape?

RQ8: How aware are Highlands' residents of the use of fire on their landscapes, and what was their understanding of it? (Highlands)

RQ5: How did the two data collection methods compare?

8.2 Summary of findings

8.2.1 Wildfire risk perception and awareness

Regarding RQ1, the study findings illuminate that risk awareness is predominantly present within a specific subgroup of the population, a trend consistent across various locations. This subgroup is defined by a notable apprehension regarding wildfires in the region and then to a lesser degree of concern regarding personal exposure. The study crucially identified a group that exhibited little or no concern, some apathetic or denying the applicability of the term "wildfire" to the British context. Some were disputatious with the term wildfire, where the occurrence was deemed too close to urban areas, too small, human-caused, to be considered "true" wildfire. There was also a disconnect where wildfires in Britain are not comparable to the large disasters in fire-prone areas, hence become insignificant, potentially in an optimistic way (Armour & Taylor, 2002; McKenna, 1993). Some individuals downplayed the severity of wildfires, attributing it to a disconnect with the term "wildfire" in comparison to foreign contexts. Additionally, the study highlighted significant barriers influencing the perceived feasibility of wildfires in Britain. These barriers encompass the tendency to minimise wildfire risk when severity is perceived as low, it is inconsequential, or it is infrequent meaning probability is perceived as too low.

Notably there exists a more pronounced acceptance of the wildfire issue in the area in the Valleys, with the lowest in the Highlands. There was a link between acknowledgement of a local problem and the visibility of fire, where those that had seen fire were more likely to recognise a problem – either because witnessing wildfire increases awareness of a problem or because awareness of a problem means an individual is more likely to notice wildfire evidence. The Highlands differed slightly from the other cases, with high visibility of wildfires but less recognition of them as a problem. This might be due to greater tolerance of fire from prescribed burning or familiarity with wildfire, which was often seen as inconsequential. In contrast, the Valleys had high wildfire visibility and regularity, similar to the Highlands, but a higher proportion considered it problematic. This was likely due to the association of wildfires with deliberate arson and anti-social behaviour, making them more intolerable and problematic despite potentially small unwanted impacts.

Generally, there is a greater acceptance of the risk for the area than the individual, where being considered spatially relevant (exposed) was crucial. This difference was most pronounced in Dorset where there very both very urban and high fire risk areas. Association of particular areas with fire risk was based on being next to vegetation, as well as previous history of wildfire occurrence.

The magnitude and type of consequences were also crucial to whether wildfires were deemed relevant and hence risky. The predominant sentiment was concern for “other’s” and typically the non-human. The types of consequences associated with wildfire include damage to nature, wildlife, plants, aesthetics, property, healthy, safety, infrastructure, disruption to area, and economic loss. Despite a lack of direct impacts, consequences were not entirely negated, through care for the area and nature; this indirect concern presents an avenue for fostering engagement.

Generally, the perception of wildfire risk was associated with summertime, but heightened awareness in spring could influence opinions. The strong associations of summer with hot, dry conditions, coupled with extreme events like heatwaves, likely contribute to this perception. Notably, news events during this season are more memorable, shaping public perception.

Regarding RQ2, the perception of wildfire risk was found to be firmly founded in local knowledge or awareness. There was evidence that visibility as well as social amplification by both peer networks and media, or by effective risk messaging from agencies. Generally, many in area were connected to the locality, although this could be function of those more likely to take part in a survey. The knowledge was generally accurate knowledge and somewhat widespread. In all areas there were also those that were disconnected from any of this knowledge and hence entirely unaware. Hence the lack of recognition of risk was both due to being uninformed or unaware, as well as minimising the risk by personal judgement. Increased knowledge and visibility tended to elevate the perceived probability of wildfire risk. Those who had witnessed wildfires demonstrated greater awareness of the problem in the area and a heightened understanding of the risk, including more being aware of spring months occurrence.

There was generally agreement with the belief that climate change had, but more so will, affect wildfire activity. However, there was a level of uncertainty over the level of influence of climate change, as well as lacking knowledge or observation for being able to judge, and to a much lesser extent (from the follow-up questions) that climate change was not affecting the area at all. A key finding was that where wildfires were perceived as started by people, climate change was not have an influence. Supporting both the fact that individuals trusted their own knowledge about factors other than weather or their own personal observations over experts (Siegrist & Cvetkovich, 2000; Whitmarsh, 2008), and that there is widespread misconception about the 'causes' of wildfire (Jones *et al*., 2023)

On the other hand, for those that agreed with an influence of climate change, concern about this, or awareness of global changes, were found to amplify perceived wildfire risk, possibly driven by fear induced through media framing, awareness of consequences, or the portrayal of uncontrollable or unfamiliar risks. This links to RQ6 where there were high levels of awareness in both samples of Australian wildfire where television and social media were key influences. Aligning with other comments made speaks to the fact that media – especially local where it is more relevant, but also global in that it shares awareness of possible consequences – is a key information source regarding wildfires for those in Britain, where there is a lack other sources of information. Certainly, there was emphasis of concern on nature, and it is possibly a consequence of affective stories of previous wildfire events.

Notably, while wildfire incidents may enhance the sense of climate change, caution is advised against using it solely as a poetic symbol. Such symbolism may lead to controversies about risk, where wildfire is further distinguished as 'natural', as well as misunderstandings of the 'causes' of wildfire. Additionally, emphasising uncontrollability and natural forcings rather than acknowledging anthropogenic influences, may mean they are perceived as unchangeable and make mitigation futile.

Next, regarding RQ4, the exploration of risk perception across the three locations has provided insights into how varying landscapes understand risk in Britain. Variations exist in specific contexts, such as more frequent exposure in the Valleys, less immediate risk in Dorset, and the impact of prescribed fire in the Highlands. However, overarching similarities prevail in the way risks are perceived. Drawing particularly from the insights provided in the Highlands, it becomes evident that a crucial initial step is acknowledging the feasibility of wildfires in Britain, particularly within the specified area. This study has also identified various barriers in perceptions to recognising wildfires a relevant hazard in Britain. These include the perception of a climate that is 'too wet', the idea that anthropogenic ignitions negate the concept of [natural] 'wild' fires, and the perceived small scale of British wildfires contribute to apathy and a disconnect from the perceived 'true' wildfires in fire-prone regions.

Once this acknowledgment is established, factors influencing probability become pivotal in shaping the perceived level of risk. Recognising the feasibility is likely instrumental in understanding why the visibility of fires tends to enhance the acknowledgment of a problem. This visibility transforms what might be considered an underrated or foreign risk into a localised and relevant concern.

Beyond establishing feasibility, an essential aspect of risk perception lies in its spatial relevance. The study locations here had a variety of objective risks hence, varied in the perceived relevance. There was some indication that people were keen observers of their surroundings and understanding fire occurrence. Moreover, also crucial to the sense of relevance is the perceived consequence, and whether they are direct. There was a sense that the more direct or severe impacts are othered to the environment; so, wildfire is a hazard for the environment more than people. Having said that there was both acknowledge and concern for indirect impacts, varying from aesthetics, disruptions, economic impact, or long-term health, as well as significant concern for wildlife and nature. The novelty of the risk, where there is a lack of precedents of impacts, means the exposure mostly lacks severity and hence means less memorable events (Halpern *et al*., 2001).

Personal judgements, as well as characteristics of the risk also influenced perception. This includes a fear dynamic where the unfamiliarity of the risk created a discomfort thus the severity may be exacerbated. The lack of familiarity where occurrence was not regular conversely meant the risk was minimised. Hence, where it was more intermittent or sporadic it became less relevant. Moreover, the hazard competed with daily life, as well as other juxtaposing hazards such as flooding, where more prominent occurrence of flooding negated the presence from wildfire.

In addressing RQ7, the Dorset Firewise questions have proven instrumental in unravelling the motivations and barriers that influence participation in mitigation efforts concerning wildfire risk in Britain. A predominant motivator identified was a lack of knowledge, with respondents expressing a sense of being unprepared before encountering the survey. Others admitted to not considering the risk until it was brought to their attention.

An interesting finding was the motivations other than concern about wildfire risk existed. These concerns about the environment and local spaces, coupled with a sense of place attachment, are evident among community members who express a willingness to contribute to mitigation efforts. However, for the broader public, the extent to which they actively engage with wildfire risk mitigation measures may be minimal. Addressing these nuanced motivations and barriers is essential for developing targeted and effective strategies to enhance community resilience to wildfires.

To effectively address these insights, it becomes crucial to target specific groups at risk, where they are more likely to remain engaged. However, where mitigation may be framed with broader outcomes, or potentially where wildfire mitigation is a secondary aim or where hazards are grouped together, may be a valuable approach for stakeholders to take to make engagement more wide-reaching.

Overall, there are many gaps in public knowledge that the public and stakeholders would significantly benefit from closing. There is desire shared by people across the locations for access to information, particularly among those with a direct concern about vulnerability—such as residents near Sites of Special Scientific Interest (SSSI) land or in close proximity to high-risk spots like campsites in the Highlands. Spaces for public education include, awareness of the type of impacts, timing of wildfires, long-term and short-term causes, possible actions to protect property, and what to do in the event of a wildfire.

8.2.2 Acceptability of the use of fire

Regarding RQ3, the findings showed that residents were more agreeable to the use of fire. Where there is familiarity or comfortability with the tool, including in the Highlands, there was stronger agreement, likely through having knowledge of purposes and benefits (Ascher *et al.,* 2013; Paveglio *et al*., 2009), and understanding that it can be done without negative impacts. The study identified consistent reasons supporting prescribed fire across locations, emphasising benefits, efficacy, and familiarity. Mitigating wildfires emerged as a common motivator, alongside historical use and belief in the necessity of the tool. Perceived benefits and efficacy were pivotal in promoting acceptance, aligning with existing literature (Blanchard & Ryan 2007; Flint 2007) especially where fire risk higher (Brenkert-Smith *et al.,* 2013; Mylek and Shirmer, 2020; Toman *et al*., 2014). Moreover, this highlights other findings that knowledge of successes and positive exposure would help to increase acceptance (McCaffrey *et al*., 2008; Toman *et al*. 2004, 2008).

There was, however, certainly a rhetoric of resistance and conditionality to the use. By most it was seen as a tool to be used sparsely and specifically, rather than a legitimate tool to be used universally (Shindler & Toman 2003; Shindler *et al*., 2009, 2011). Concerns about outcomes, controllability, negative consequences, and anti-nature sentiments were prevalent among those against prescribed fire. Resistance was particularly notable in the Valleys, tied to wildfire impacts and aesthetic concerns. This highlights the importance of confusion between the two (Carroll *et al*. 2021; Davies *et al*., 2008). Pollution worries, especially related to climate change and air quality, were widespread, with specific concerns in Dorset. Controllability issues, rooted in distrust and perceived poor reputation, were prominent in the Highlands. Residents exhibited uncertainties, leading to conditional agreements with various stipulations, reflecting concerns about negative outcomes, risk, and ecological impact. The study highlighted the need for reassurance, tailored information, and positive fire exposure to address public hesitations. It raised questions about the balance of fire risk and biodiversity although in a context with lower fire risk (Alterangal, & Kull, 2013) Philosophically, it raised questions about ethics (Eckerburg & Bruizer 2017), interference with nature, and the definition of "natural" landscapes in Britain. Participatory approaches, considering cultural attitudes toward fire, were suggested to enhance public understanding. Gaps in knowledge and concerns about ecological impact, especially in the Valleys and Dorset, emphasized the need for more comprehensive discourse on alternatives and risk-balancing strategies.

Regarding RQ8, Highlands' residents showed familiarity with the term muirburn, as well as knowledge of the uses and benefits of agricultural fire. There was also awareness where it was visible or known of in the area by a majority. Moreover, Highlands' residents exhibited a strong awareness of local prescribed fire practices, reflecting diverse ecological knowledge levels that may be influenced by their rural surroundings and deep sense of place attachment. Overall, there was reasonable level of understanding, ranging from basic to more advanced, including individuals with personal hands-on experience.

The rurality of Highlands shaped key differences in perceptions of wildfire, as well as prescribed fire, compared to the other locations. The rural nature of the Highlands amplified concerns about fire risks, especially in expansive and challenging moorlands, consistent with existing UK literature highlighting moorlands as high-risk areas due to firefighting complexities. In terms of attitudes toward prescribed fire, the rurality, where there had been poor implementation of muirburn leading to a negative reputation there was additional resistance to it by some. On the other hand, because of the environment, some felt that there was no alternative to fire where it was necessary for the type of landscape, as well as the exposure to prescribed fire meaning greater understanding of the benefits and more sophisticated ecological knowledge regarding the tool. This dynamic underscores the nuanced nature to perceptions of fire, and the complexities of this social research.

8.3 Evaluating the study

8.3.1 Reflecting on the study

8.3.1.1 Successes

The study successfully explored general attitudes toward wildfire and prescribed fire in Britain, generating a large and diverse dataset. The survey tool was effective in gathering broad views without overburdening participants, though its length may have discouraged less interested respondents. The mix of short and long-form responses provided valuable insights, with in-person data collection adding depth where nuance was lacking. However, not asking participants in all locations to explain risk scores was a missed opportunity.

The study's breadth of topics was appropriate, balancing risk awareness with knowledge assessment. Including questions on prescribed fire added valuable context to wildfire perceptions. Recruitment strategies captured a diverse range of participants, though the online survey faced limitations typical of internet-based research, such as excluding older participants and introducing concern bias due to self-selection.

In summary, this exploratory study successfully captured generalised attitudes toward wildfire and prescribed fire in Britain. Utilising a survey approach it was about to gather diverse opinions while being mindful of participants' time, where there was a large volume of data and a range of opinions with repetition of ideas suggesting it has worked towards saturation of the variety of possible opinions. The research provided valuable insights into risk perception, knowledge, and acceptance of prescribed fire. It has been able to gauge a level of awareness in the population rather than complete apathy. The risk was firmly related to local issues, showing there is a connection to local places. It does indicate that those that are concerned are a sub-group, however all those connected to their local area show some level of interest or concern.

This original piece of work added crucial empirical evidence to the UK literature base, as well as making key comparisons in the context of global wildfire literature. Despite not being fire prone there is relatively widespread concern for the problem at a local level, although this is more limited at a personal level. The study identified key barriers to acknowledgement of risk, as well as key knowledge gaps of the public.

There is remarkable similarity in the reasoning and attitudes compared to previous literature, despite being a different fire context. Thus, this proves that lessons elsewhere will be crucial for Britain. Outreach should be designed around the locale, tailored and unidirectional. This will be especially important in Britain as there are barriers in understanding the feasibility of the risk where it is underrated. There is less familiarity with fire, lack of knowledge about how to prepare, potentially a lack of awareness that wildfires can happen and thus how to be fire safe.

This study has also continued to demonstrate the nuanced findings of social wildfire research (McCaffrey, 2015), where any general attitude, may be opposing by others. For example, foreign fire on one hand acted to increase awareness of consequences or create affect and a fear; while others used foreign comparisons to minimise local risk, where there was a disconnect between what was possible in a fire-prone environment and what was possible in a British environment. Another example being, on one hand the presence of fire in the Highlands increase awareness and knowledge of prescribed fire to increase acceptability; whereas on the other, through distrust and poor reputation it creates barriers to its acceptability.

8.3.1.2 Limitations

There were some limitations to this research, some borne out of limited resources of the project, and others where reflections on the results provide perspective. Key methodological limitations included the weak sampling frame, small sample sizes, and the lack of participant characteristics, all of which hindered statistical analysis and the representativeness of findings.

The sampling was done mostly out of convenience, and while did capture a variety of the public, with various opinions, there was biases in the samples as well as a lack of knowledge available on who completed the study as well as participants that did not. Biases in surveys include significant gender bias, where there were predominantly women across all samples; a concern bias to the responses in online as a function of self-selection bias; and a non-response bias (Bird, 2009) must be considered where there were those, especially online, with less interest in this issue, that did not respond. Moreover, a key oversight was the lack of measure of objective risk of participants, where the postcode districts were ultimately too arbitrary and coarse to locate residents within the study area. This therefore was not able to judge how well participants were observing hazardous conditions or the extent to which there was unrealistic optimism rather than a genuine lack of relevance of the hazard.

The study's reliance on descriptive statistics still offered valuable insights, but the findings should be considered preliminary, serving as a foundation for further research. Potential avenues for future exploration include understanding how risk perception changes over time, comparing wildfire hazards to other risks, and investigating perceptions among those outside fire-prone areas.

The content of research was useful, with broad cover of both risks perceived and knowledge. However, as with survey research in general there was a lack of nuance and depth to aptly explore the specifics on influences on perceptions on wildfire with robustness. Having said that, reasonable depth was balanced with the high number of responses, where there is range and enough repetition to indicate that there is a saturation of ideas.

The topics covered were perhaps too broad, where could have perhaps explored one aspect more coherently, such as understanding how they frame likelihood and severity, to perhaps compare to stakeholder opinions in in the analysis of CRRs by McMorrow (2011). However, the breadth was arguably useful where no other research existed, and instead positions this work as a preliminary exploratory study which serves best as a stepping stone for future research, rather than as stand-alone definitive answers to the research questions.

The follow-up survey provided some additional perspective but was limited by small sample sizes. It highlighted the importance of understanding how wildfire risk is perceived over time and in relation to other hazards.

Furthermore, another key methodological point to reflect was the use of a follow-up survey. The follow-up survey provided some additional perspective but was limited by small sample sizes. It did provide an opportunity to re-address climate change questions which was extremely insightful for the findings. However, further investigation of wildfire risks over time is needed.

Lastly, the study was significantly impacted by COVID-19, which delayed data collection, altered the study's focus, and increased the workload. Despite these challenges, the inclusion of the Highlands case study enriched the research by offering diverse environments and contexts for comparison, particularly regarding prescribed fire.

8.3.1.3 Evaluating the use of two sampling techniques

Addressing RQ5 the dual approach of in-person and online recruitment provided a valuable opportunity to engage with the public through different channels. Despite the effectiveness of the sampling strategies in generating diverse responses, a noticeable gender bias, with under-representation of men, was evident across all samples. The online sample exhibited a potential selection bias, leading to a skewed perception of greater concern. This bias extended to the participants' residential postcodes, posing challenges in data analysis and result presentation. However, these differences offered unique insights, revealing a subgroup characterized by heightened concern. The online was also fruitful where participants generally gave more detailed answers and additional comments at the end. This provided greater insight, despite this was more from those more concerned and biased, it was valuable data on perceptions. Furthermore, a non-response bias (Bird, 2009) must be considered where there were those, especially online, with less interest in this issue, that did not respond. For instance, those that feel it is less relevant, would not click, as well as those that would hear the topic of the survey in-person and decline taking part.

Furthermore, the study highlighted the efficacy of social media platforms in reaching engaged individuals, particularly those interested in education and outreach. This was evident in the distinctions between online and in-person samples, notably in the risk perception questions across all studies and Firewise questions in Dorset. While online recruitment proved efficient with minimal effort, in-person data collection proved time-consuming and labour-intensive, albeit yielding a more representative sample.

8.3.2 Future possibilities of social wildfire research

Key opportunities for future work include, comparing the perceptions here to objective or technical measures of risk, to ascertain how perceptions compare to reality where there may be for example, unrealistic optimism or simply a lack of relevance. Moreover, more explicitly comparing urban and rural environments would shed light on some of the differences in extent of wildfire risk perceived across places that were identified here. Additionally, more detailed research to clarify how probability and severity is weighted in risk assessments would investigate key initial observations made here.

Exploring the tourist and local perceptions would be vital in demonstrating what appears to be a crucial foundation of wildfire risk in local knowledge. This would also ascertain consequences on fire safe behaviours by ‘tourists’, especially where areas of higher risk are often places of recreation and tourism which may itself exacerbate fire risk, especially camping. Investigating more specifically how the media influences wildfire knowledge and awareness would also be an interesting avenue.

Placing the risks into the context of daily life, including in comparison to other hazards would put these results into perspective, where there is potentially an element of response bias as participants may be more agreeable when answering questions. This could also place mitigation in more realistic perspective and help prioritise engagement efforts.

To clarify the follow-up results further investigation into how perceptions of wildfire risk fluctuate throughout the year. Alternatively, investigation into demographic influences would be needed where comparisons with gender were inclusive (likely owing to the underrepresentation of men) as well as in explaining why there was such significant bias in response rate from women. This could also clarify the influence of age, by probing more questions, as well as including more distinct ‘older’ participant categories.

Lastly, to clarify perceptions of prescribed fire, further examination of how to integrate ecological research and cultural perspectives on fire would inform both prescribed fire practices and public acceptance.

In conclusion, this research has laid a valuable foundation for understanding wildfire perceptions in the UK. Future studies should broaden the demographic scope, compare perceptions across different populations, and consider a wider range of environmental risks to enhance national preparedness and awareness.

BIBLIOGRAPHY

Abatzoglou, J. T., Williams, A. P., & Barbero, R. (2019). Global Emergence of Anthropogenic Climate Change in Fire Weather Indices. *Geophysical Research Letters*, *46*(1), 326–336. https://doi.org/10.1029/2018GL080959

Absher, J. D., & Vaske, J. J. (2006). An Analysis of Homeowner and Agency Wildland Fire Mitigation Strategies. In J. G. Peden & R. M. Schuster (Eds.), *Proceedings of the 2005 Northeastern Recreation Research Symposium, 10-12 April 2005* (pp. 231–237). USDA Forest Service, Northeastern Research Station. Retrieved 09.10.23, from https://www.fs.usda.gov/research/treesearch/22297

AIDR (Australian Institute for Disaster Resilience). (n.d.). *Bushfire*. Australian Disaster Resilience Knowledge Hub. Retrieved 26.03.23, from https://knowledge.aidr.org.au/resources/bushfire/

Albertson, K., Aylen, J., Cavan, G., & McMorrow, J. (2009). Forecasting the outbreak of moorland wildfires in the English Peak District. *Journal of Environmental Management*, *90*(8), 2642–2651. https://doi.org/10.1016/j.jenvman.2009.02.011

Albertson, K., Aylen, J., Cavan, G., & McMorrow, J. (2010). Climate change and the future occurrence of moorland wildfires in the Peak District of the UK. *Climate Research*, *45*(1), 105–118. https://doi.org/10.3354/cr00926

Allen, G. M., & Gould, E. M. (1984). Complexity, Wickedness, and Public Forests. *Journal of Forestry*, *84*(4), 20–23. https://doi.org/10.1093/jof/84.4.20

Allen, K. A., Harris, M. P. K., & H., M. R. (2013). Matrix modelling of prescribed burning in Calluna vilgaris-dominated moorland: short burning rotations minimize carbon loss at increased wildfire frequencies. *Journal of Applied Ecology*, *50*, 614–624. https://doi.org/10.1111/1365-2664.12075

Altangerel, K., & Kull, C. A. (2013). The prescribed burning debate in Australia: conflicts and compatibilities. *Journal of Environmental Planning and Management*, *56*(1), 103–120. https://doi.org/10.1080/09640568.2011.652831

Andela, N., Morton, D. C., Giglio, L., Chen, Y., Werf, G. R. Van Der, Kasibhatla, P. S., Collatz, G. J., Hantson, S., Kloster, S., Bachelet, D., Forrest, M., Lasslop, G., Mangeon, S., Melton, J. R., Yue, C., Randerson, J. T., Amsterdam, V. U., Biology, E., Biodiversity, S., & Canada, E. (2017). A human-driven decline in global burned area. *Science*, *356*(6345), 1356–1362. https://doi.org/10.1126/science.aal4108

Anderson, D., Chubb, P., & Djerf-Pierre, M. (2018). Fanning the Blame: Media Accountability, Climate and Crisis on the Australian "Fire Continent." *Environmental Communication*, *12*(7), 928–941. https://doi.org/10.1080/17524032.2018.1424008

Anon. (2021). *South Wales Valleys Map*. Kiddle. Retrieved 12.06.23, from https://kids.kiddle.co/Image:South_Wales_Valleys_Map.png

Anton, C. E., & Lawrence, C. (2014). Home is where the heart is: The effect of place of residence on place attachment and community participation. *Journal of Environmental Psychology*, *40*, 451–461. https://doi.org/10.1016/j.jenvp.2014.10.007

Anton, C. E., & Lawrence, C. (2016). Does Place Attachment Predict Wildfire Mitigation and Preparedness? A Comparison of Wildland–Urban Interface and Rural Communities. *Environmental Management*, *57*(1), 148–162. https://doi.org/10.1007/s00267-015-0597-7

Archibald, S., Staver, A. C., & Levin, S. A. (2012). Evolution of human-driven fire regimes in Africa. *Proceedings of the National Academy of Sciences of the United States of America*, *109*(3), 847–852. https://doi.org/10.1073/pnas.1118648109

Arguedas Ortiz, D. (2023, June 7). Five myths about wildfires. *BBC Future*. Retrieved 01.12.23, from https://www.bbc.com/future/article/20181113-five-myths-about-wildfires

Armor, D. A., & Taylor, S. E. (2002). The dilemma of unrealistic optimism. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgment* (pp. 334–347). Cambridge University Press. https://doi.org/10.1017/CBO9780511808098.021

Arnell, N. W., Freeman, A., & Gazzard, R. (2021a). The effect of climate change on indicators of fire danger in the UK. *Environmental Research Letters*, *16*(044027), 1–21. https://doi.org/10.1088/1748-9326/abd9f2

Arnell, N. W., Kay, A. L., Freeman, A., Rudd, A. C., & Lowe, J. A. (2021b). Changing climate risk in the UK: A multi-sectoral analysis using policy-relevant indicators. *Climate Risk Management*, *31*(100265), 1–25. https://doi.org/10.1016/j.crm.2020.100265

Ascher, T. J., Wilson, R. S., & Toman, E. (2013). The importance of affect, perceived risk and perceived benefit in understanding support for fuels management among wildland-urban interface residents. *International Journal of Wildland Fire*, *22*(3), 267–276. https://doi.org/10.1071/WF12026

Aylen, J., Cavan, G., & Albertson, K. (2006). *The Best Strategy for Mitigating Moorland Wildfire Risk A Report to Moors for the Future*. 1–23. Moors for the Future, Edale. Retrieved 15.07.23, from https://www.moorsforthefuture.org.uk/__data/assets/pdf_file/0033/87639/Best-stratgey-for-Mitigating-Moorland-Wildfire-risk-Report.pdf

Bain, C. G., Bonn, A., Stoneman, R., Chapman, S., Coupar, A., Evans, M., Geary, B., Howat, M., Joosten, H., Keenleyside, C., Labadz, J., Lindsay, R., Littlewood, N., Lunt, P., Miller, C. J., Moxey, A., Orr, H., Reed, M., Smith, P., … Worrall, F. (2011). *IUCN UK Commission of Inquiry on Peatlands*. IUCN UK Peatland Programme, Edinburgh. Retrieved 20.10.23, from https://www.iucn-uk-peatlandprogramme.org/sites/default/files/2019-07/IUCN UK Commission of Inquiry on Peatlands Full Report spv web_0.pdf

Balch, J. K., Bradley, B. A., Abatzoglou, J. T., Chelsea Nagy, R., Fusco, E. J., & Mahood, A. L. (2017). Human-started wildfires expand the fire niche across the United States. *Proceedings of the National Academy of Sciences of the United States of America*, *114*(11), 2946–2951. https://doi.org/10.1073/pnas.1617394114

Bannon, C. (2020). Large grass fire rages near homes in Rhondda as it “covers whole mountain.” *Wales Online*. Retrieved 17.07.23, from https://www.walesonline.co.uk/news/wales-news/large-grass-fire-rages-near-18122030

BBC. (2018, June 27). Saddleworth Moor fire: Homes evacuated as blaze continues to rage. *BBC News*. Retrieved 17.07.23, from https://www.bbc.co.uk/news/uk-england-manchester-44624021

BBC. (2020, July 1). Dorset Council plans disposable BBQs ban. *BBC News*. Retrieved 17.07.23, from https://www.bbc.co.uk/news/uk-england-dorset-53247125

BBC. (2021, April 26). Welsh mountain fires continue to burn as culprits sought. *BBC News*. Retrieved 17.07.23, from https://www.bbc.co.uk/news/uk-wales-56884968

BBC. (2022a, August 13). UK heatwave: Studland fire caused by barbecue - fire service. *BBC News*. Retrieved 17.07.23, from https://www.bbc.co.uk/news/uk-england-dorset-62532328

BBC. (2022b, April 28). Crews battle wildfire near west Highlands village. *BBC News*. Retrieved 17.07.23, from https://www.bbc.co.uk/news/uk-scotland-highlands-islands-61255891

BBC. (2022c, May 18). Wareham Forest fire: Smouldering BBQs still being discarded. *BBC News*. Retrieved 17.07.23, from https://www.bbc.co.uk/news/uk-england-dorset-61479131

BBC. (2022d, August 19). Dorset firefighter says BBQ use on heathland is incredibly stupid. *BBC News*. Retrieved 17.07.23, from https://www.bbc.co.uk/news/uk-england-dorset-62594894

BBC. (2023, June 14). Wildfire size of 300 football pitches on mountain. *BBC News*. Retrieved 17.07.23, from https://www.bbc.co.uk/news/articles/c4n4zjmzpego%0A

Bedia, J., Herrera, S., Gutiérrez, J. M., Benali, A., Brands, S., Mota, B., & Moreno, J. M. (2015). Global patterns in the sensitivity of burned area to fire-weather: Implications for climate change. *Agricultural and Forest Meteorology*, *214–215*, 369–379. https://doi.org/10.1016/j.agrformet.2015.09.002

Beebe, G. S., & Omi, P. N. (1993). Wildland Burning: The Perception of Risk. *Journal of Forestry*, *91*(9), 19–24. https://doi.org/10.1093/jof/91.9.19

Belcher, C., Brown, I., Clay, G., Doerr, S., Elliott, A., Gazzard, R., Kettridge, N., Morison, J., Perry, M., Santin, C., & Smith, T. (2022). *UK Wildfires and their Climate Challenges. Expert Led Report Prepared for the Third UK Climate Change Risk Assessment (CCRA3).* Retrieved 17.07.23, from https://www.ukclimaterisk.org/wp-content/uploads/2021/06/UK-Wildfires-and-their-Climate-Challenges.pdf

Bell, T., & Oliveras, I. (2006). Perceptions of prescribed burning in a local forest community in Victoria, Australia. *Environmental Management*, *38*(5), 867–878. https://doi.org/10.1007/s00267-005-0290-3

Benson, R. P., Roads, J. O., & Weise, D. R. (2008). Chapter 2 Climatic and Weather Factors Affecting Fire Occurrence and Behavior. In Elsevier (Ed.), *Developments in Environmental Science* (Vol. 8, pp. 37–59). https://doi.org/10.1016/S1474-8177(08)00002-8

Berglez, P., & Lidskog, R. (2019). Foreign, Domestic, and Cultural Factors in Climate Change Reporting: Swedish Media's Coverage of Wildfires in Three Continents. *Environmental Communication*, *13*(3), 381–394. https://doi.org/10.1080/17524032.2017.1397040

Bergquist, M., Nilsson, A., & Wesley Schultz, P. (2019). Experiencing a severe weather event increases concern about climate change. *Frontiers in Psychology*, *10*(FEB), 1–6. https://doi.org/10.3389/fpsyg.2019.00220

Best, S. J., & Krueger, B. (2002). New Approaches to Assessing Opinion: The Prospects for Electronic Mail Surveys. *International Journal of Public Opinion Research*, *14*(1), 73–92. https://doi.org/10.1093/ijpor/14.1.73

Bhutta, C. B. (2012). Not by the Book: Facebook as a Sampling Frame. *Sociological Methods and Research*, *41*(1), 57–88. https://doi.org/10.1177/0049124112440795

Billig, M. (2006). Is my home my castle? Place attachment, risk perception, and religious faith. *Environment and Behavior*, *38*(2), 248–265. https://doi.org/10.1177/0013916505277608

Bird, D. K. (2009). The use of questionnaires for acquiring information on public perception of natural hazards and risk mitigation – a review of current knowledge and practice. *Natural Hazards and Earth System Science*, *9*(4), 1307–1. https://doi.org/10.5194/nhess-9-1307-2009

Birot, Y., Rigolot, E., & Goldammer, J. G. (2009). Living with wildfires: what science can tell us. A contribution of the science-policy dialogue. Conclusions. European Forest Institute, Joensuu, Finland.

Blanchard, B., & Ryan, R. L. (2007). Managing the Wildland-Urban Interface in the Northeast Perceptions of Fire Risk and Hazard Reduction Strategies. *Northern Journal of Applied Forestry*, *24*(3), 203–208. https://doi.org/10.1093/njaf/24.3.203

Bodas, M., Giuliani, F., Ripoll-Gallardo, A., Caviglia, M., Dell'aringa, M. F., Linty, M., Della Corte, F., & Ragazzoni, L. (2019). Threat Perception and Public Preparedness for Earthquakes in Italy. *Prehospital and Disaster Medicine*, *34*(2), 114–124. https://doi.org/10.1017/S1049023X19000116

Bond, W. J., & Keeley, J. E. (2005). Fire as a global "herbivore": The ecology and evolution of flammable ecosystems. *Trends in Ecology and Evolution*, *20*(7), 387–394. https://doi.org/10.1016/j.tree.2005.04.025

Bord, R. J., O'Connor, R. E., & Fischer, A. (2000). In what sense does the public need to understand global climate change? Public Understanding of Science, 9(3), 205–218. https://doi.org/10.1088/0963-6625/9/3/301

Borick, C. P., & Rabe, B. G. (2017). Personal Experience, Extreme Weather Events, and Perceptions of Climate Change. *Oxford Research Encyclopedia of Climate Science*. https://doi.org/10.1093/acrefore/9780190228620.013.311

Bowker, J. M., Lim, S. H., Cordell, H. K., Green, G. T., Rideout-Hanzak, S., & Johnson, C. Y. (2008). Wildland fire, risk, and recovery: Results of a national survey with regional and racial perspectives. *Journal of Forestry*, *106*(5), 268–276. https://doi.org/10.1093/jof/106.5.268

Bowman, D. (2005). Understanding a flammable planet - climate, fire and global vegetation patterns. *New Phytologist*, *165*, 2, 341–345. https://doi.org/10.1111/j.1469-8137.2004.01301.x

Bowman, D. M. J. S., Balch, J. K., Bond, W. J., Carlson, J. M., Cochrane, M. A., D'Antonio, C. M., DeFries, R. S., Doyle, J. C., Harrison, S. P., Johnston, F. H., Keeley, J. E., Krawchuk, M. A., Kull, C. A., Marston, J. B., Moritz, M. A., Prentice, C., Roos, C. I., Scott, A. C., Swetnam, T. W., … Pyne, S. J. (2009). Fire in the Earth System. *Science*, *324*(5926), 481–484. https://doi.org/10.1126/science.1163886

Bowman, D. M. J. S., Balch, J., Artaxo, P., Bond, W. J., Cochrane, M. A., D'Antonio, C. M., DeFries, R., Johnston, F. H., Keeley, J. E., Krawchuk, M. A., Kull, C. A., Mack, M., Moritz, M. A., Pyne, S., Roos, C. I., Scott, A. C., Sodhi, N. S., & Swetnam, T. W. (2011). The human dimension of fire regimes on Earth. *Journal of Biogeography*, *38*(12), 2223–2236. https://doi.org/10.1111/j.1365-2699.2011.02595.x

Bowman, D. M. J. S., Kolden, C. A., Abatzoglou, J. T., Johnston, F. H., van der Werf, G. R., & Flannigan, M. (2020). Vegetation fires in the Anthropocene. *Nature Reviews Earth & Environment*. https://doi.org/10.1038/s43017-020-0085-3

Bowman, D. M. J. S., Williamson, G. J., Abatzoglou, J. T., Kolden, C. A., Cochrane, M. A., & Smith, A. M. S. (2017). Human exposure and sensitivity to globally extreme wildfire events. *Nature Ecology and Evolution*, *1*(3), 1–6. https://doi.org/10.1038/s41559-016-0058

Brain, C. K., & Sillent, A. (1988). Evidence from the Swartkrans cave for the earliest use of fire. *Nature*, *336*, 464–466.

Brenkert-Smith, H. (2006). The Place of Fire. *Natural Hazards Review*, *7*(3), 105–113. https://doi.org/10.1061/(asce)1527-6988(2006)7:3(105)

Brenkert-Smith, H. (2010). Building bridges to fight fire: The role of informal social interactions in six Colorado wildland-urban interface communities. *International Journal of Wildland Fire*, *19*(6), 689–697. https://doi.org/10.1071/WF09063

Brenkert-Smith, H., Champ, P. A., & Flores, N. (2006). Insights into wildfire mitigation decisions among wildland-urban interface residents. *Society and Natural Resources*, *19*(8), 759–768. https://doi.org/10.1080/08941920600801207

Brenkert-Smith, H., Champ, P. A., & Flores, N. (2012). Trying not to get burned: Understanding homeowners' wildfire risk-mitigation behaviors. *Environmental Management*, *50*(6), 1139–1151. https://doi.org/10.1007/s00267-012-9949-8

Brenkert-Smith, H., Dickinson, K. L., Champ, P. A., & Flores, N. (2013). Social Amplification of Wildfire Risk: The Role of Social Interactions and Information Sources. *Risk Analysis*, *33*(5), 800–817. https://doi.org/10.1111/j.1539-6924.2012.01917.x

Bright, A. D., & Burtz, R. T. (2006). Firewise activities of full-time versus seasonal residents in the Wildland-Urban Interface. *Journal of Forestry*, *104*(6), 307–315. https://doi.org/10.1093/jof/104.6.307

Brown, L. E., Holden, J., & Palmer, S. M. (2016). Moorland vegetation burning debates should avoid contextomy and anachronism: a comment on Davies *et al*. (2016). *Phil. Trans. R. Soc. B*, *371*(20160432). https://doi.org/10.1098/rstb.2016.0432

Bruce, M. A. (2000). Country report for the United Kingdom. *BALTEX FIRE 2000. The Second Baltic Seminar and Exercise in Forest Fire and Information and Resources Exchange.* 5-9 June, Kuopio, Finland.

Bruce, M. A., Legg, C. J., & Davies, G. M. (2006). Country Report for the United Kingdom. *International Forest Fire News*, *34*. Retrieved 01.12.23, from https://gfmc.online/wp-content/uploads/13-IFFN-34-United-Kingdom-1.pdf

Brunson, M. W., & Evans, J. (2005). Badly burned? Effects of an escaped prescribed burn on social acceptability of wildland fuels treatments. *Journal of Forestry*, *103*(3), 134–138. https://doi.org/10.1080/08941920490480688

Brunson, M. W., & Shindler, B. A. (2004). Geographic Variation in Social Acceptability of Wildland Fuels Management in the Western United States. *Society and Natural Resources Natural Resources*, *17*(8). https://doi.org/10.1080/08941920490480688

Burns, M., & Cheng, A. S. (2007). Framing the need for active management for wildfire mitigation and forest restoration. *Society and Natural Resources*, *20*(3), 245–259. https://doi.org/10.1080/08941920601117348

Burton, I., Kates, R. W., & White, G. F. (1993). *The Environment As Hazard* (2nd ed.). Guilford Press, New York.

Busenberg, G., (2004). Wildfire Management in the United States: The Evolution of a Policy Failure. *Review of Policy Research*, *21*(2), 145–156. http://dx.doi.org/10.1111/j.1541-1338.2004.00066.x

Butler, A., Knez, I., Åkerskog, A., Sarlöv Herlin, I., Ode Sang, Å., & Ångman, E. (2019). Foraging for identity: the relationships between landscape activities and landscape identity after catastrophic landscape change. *Landscape Research*, *44*(3), 303–319. https://doi.org/10.1080/01426397.2019.1580352

Cabinet Office. (2013). *National Risk Register of Civil Emergencies: 2013 edition*. UK Government, London. Retrieved 06.06.23, from https://www.gov.uk/government/publications/national-risk-register-for-civil-emergencies-2013-edition

Cabinet Office. (2015). National Risk Register of Civil Emergencies: 2015 edition. UK Government, London. Retrieved 06.06.23, from https://www.gov.uk/government/publications/national-risk-register-for-civil-emergencies-2015-edition

Cabinet Office. (2017). *National Risk Register of Civil Emergencies: 2017 edition*. UK Government, London. Retrieved 06.06.23, from https://www.gov.uk/government/publications/national-risk-register-for-civil-emergencies-2015-edition

Cabinet Office. (2020). *National Risk Register: 2020 edition*. UK Government, London. Retrieved 06.10.23, from https://www.gov.uk/government/publications/national-risk-register-2020

Calkin, D. E., Cohen, J. D., Finney, M. A., & Thompson, M. P. (2014b). How risk management can prevent future wildfire disasters in the wildland-urban interface. *Proceedings of the National Academy of Sciences of the United States of America*, *111*(2), 746–751. https://doi.org/10.1073/pnas.1315088111

Calkin, D. E., Stonesifer, C. S., Thompson, M. P., & McHugh, C. W. (2014a). Large airtanker use and outcomes in suppressing wildland fires in the United States. *International Journal of Wildland Fire*, *23*(2), 259–271. https://doi.org/10.1071/WF13031

Calkin, D. E., Thompson, M. P., & Finney, M. A. (2015). Negative consequences of positive feedbacks in US wildfire management. *Forest Ecosystems*, *2*(1). https://doi.org/10.1186/s40663-015-0033-8

Canadian Interagency Forest Fire Centre Inc. [CIFFC] (2017). *Canadian Wildland Fire Management Glossary*. CIFFC Glossary Task Team and Training Working Group. https://www.ciffc.ca/sites/default/files/2019-03/CIFFC_Canadian_Wildland_Fire_Mgmt_Glossary_2017_10_24.pdf

Capstick, S. B., Demski, C. C., Sposato, R. G., Pidgeon, N. F., Spence, A., & Corner, A. (2015). Public perceptions of climate change in Britain following the winter 2013/2014 flooding. *Understanding Risk Research Group Working Paper 15-01*, 71.

Carroll, J., Anderson, P., Caporn, S., Eades, P., O'Rielly, C., & Bonn, A. (2009). Sphagnum in the Peak District. Current status and potential for restoration. Moors for the Future Report No 16. Moors for the Future Partnership, Edale, UK.

Carroll, M. S., Blatner, K. A., Cohn, P. J., & Morgan, T. (2007). Managing fire danger in the forests of the US inland northwest: A classic "wicked problem" in public land policy. *Journal of Forestry*, *105*(5), 239–244. https://doi.org/10.1093/jof/105.5.239

Carroll, M. S., Cohn, P. J., & Blatner, K. A. (2004). Private and tribal forest landowners and fire risk: A two-county case study in Washington State. *Canadian Journal of Forest Research*, *34*(10), 2148–2158. https://doi.org/10.1139/X04-085

Carroll, M. S., Edgeley, C. M., & Nugent, C. (2021). Traditional use of field burning in Ireland: History, culture and contemporary practice in the uplands. *International Journal of Wildland Fire*, *30*(6), 399–409. https://doi.org/10.1071/WF20127

Cavan, G., & Mcmorrow, J. (2009). Interdisciplinary Research on Ecosystem Services: Fire and Climate Change in UK Moorlands and Heaths. Summary report prepared for Scottish Natural Heritage. In *FIRES seminar series, University of Manchester.* Retrieved 26.04.23, from https://pure.manchester.ac.uk/ws/portalfiles/portal/55614263/SNH_website_report_for_web_v1.pdf

Champ, P. A., & Brenkert-Smith, H. (2016). Is Seeing Believing? Perceptions of Wildfire Risk Over Time. *Risk Analysis*, *36*(4), 816–830. https://doi.org/10.1111/risa.12465

Champp, P. A., Donovan, G. H., & Barth, C. M. (2013). Living in a tinderbox: Wildfire risk perceptions and mitigating behaviours. *International Journal of Wildland Fire*, *22*(6), 832–840. https://doi.org/10.1071/WF12093

Christianson, A., Mcgee, T. K., & L'Hirondelle, L. (2014). The Influence of Culture on Wildfire Mitigation at Peavine Métis Settlement, Alberta, Canada. *Society & Natural Resources*, *27*(9), 931–947. https://doi.org/10.1080/08941920.2014.905886

Chuvieco, E., Giglio, L., & Justice, C. (2008). Global characterization of fire activity: Toward defining fire regimes from Earth observation data. *Global Change Biology*, *14*(7), 1488–1502. https://doi.org/10.1111/j.1365-2486.2008.01585.x

Clay, G. D., & Worrall, F. (2015). Carbon stocks and carbon fluxes from a 10 year prescribed burning chronosequence on a UK blanket peat. *Soil Use and Management*, *31*(1), 39–51. https://doi.org/10.1111/sum.12164

Cochrane, M. A., & Bowman, D. M. J. S. (2021). Manage fire regimes, not fires. *Nature Geoscience*, *14*(7), 454–455. https://doi.org/10.1038/s41561-021-00791-4

Cohen, J. D. (2000). Preventing disaster: Home ignitability in the wildland-urban interface. *Journal of Forestry*, *98*(3), 15–21. https://doi.org/10.1093/jof/98.3.15

Cohen, J. D. (2008,). The wildland-urban interface fire problem: a consequence of the fire exclusion paradigm. *Forest History Today, Fall*, 20–26.

Cohn, P. J., Williams, D. R., & Carroll, M. S. (2008). Wildland-urban interface residents' views on risk and attribution. In W. E. Martin, C. Raish, & B. Kent (Eds.), *Wildfire Risk: Human Perceptions and Management Implications* (pp. 23–43). Routledge. https://doi.org/10.4324/9781936331611

Collins, R. D., de Neufville, R., Claro, J., Oliveira, T., & Pacheco, A. P. (2013). Forest fire management to avoid unintended consequences: A case study of Portugal using system dynamics. *Journal of Environmental Management*, *130*, 1–9. https://doi.org/10.1016/j.jenvman.2013.08.033

Collins, T. (2008). What influences hazard mitigation? Household decision making about wildfire risks in Arizona's white mountains. *Professional Geographer*, *60*(4), 508–526. https://doi.org/10.1080/00330120802211737

Collins, T. W. (2012). Spatial Scale and Hazard Perception: An Exploratory Analysis. *Society and Natural Resources*, *25*, 1134–1151. https://doi.org/10.1080/08941920.2012.665985

Cologna, V., Bark, R. H., & Paavola, J. (2017). Flood risk perceptions and the UK media: Moving beyond "once in a lifetime" to "Be Prepared" reporting. *Climate Risk Management*, *17*, 1–10. https://doi.org/10.1016/j.crm.2017.04.005

Cordingley, J. E., Newton, A. C., Rose, R. J., Clarke, R. T., & Bullock, J. M. (2015). Habitat fragmentation intensifies trade-offs between biodiversity and ecosystem services in a heathland ecosystem in southern England. *PLoS ONE*, *10*(6), 1–15. https://doi.org/10.1371/journal.pone.0130004

Cortner, H. J., & Field, D. R. (2004). Introduction to the special issue: Humans, fire, and forests: The reemergence of research on human dimensions. *Society and Natural Resources*, *17*(6), 473–475. https://doi.org/10.1080/08941920490452418

Cortner, H. J., Zwolinksi, M. J., Carpenter, E. H., & Taylor, J. G. (1984). Public Support for Fire-Management Policies. *Journal of Forestry*, *82*(6), 359–361. https://doi.org/10.1093/jof/82.6.359

Costa, H., de Rigo, D., Libertà, G., Houston Durrant, T., & San-Miguel-Ayanz, J. (2020). *European wildfire danger and vulnerability in a changing climate: towards integrating risk dimensions*. Publications Office of the European Union, Luxembourg. https://doi.org/10.2760/46951

Coughlan, M. R., & Petty, A. M. (2012). Linking humans and fire: A proposal for a transdisciplinary fire ecology. *International Journal of Wildland Fire*, *21*(5), 477–487. https://doi.org/10.1071/WF11048

Coughlan, M. R., & Petty, A. M. (2013). Fire as a dimension of historical ecology: A response to Bowman *et al*. (2011). *Journal of Biogeography*, *40*(5), 1010–1012. https://doi.org/10.1111/j.1365-2699.2012.02767.x

Couper, M. P., Kapteyn, A., Schonlau, M., & Winter, J. (2007). Noncoverage and nonresponse in an Internet survey. *Social Science Research*, *36*(1), 131–148. https://doi.org/10.1016/j.ssresearch.2005.10.002

Critchley, T., & McMorrow, J. (2015). Wildfire distribution in Scotland: a comparison of the Fire Service's Incident Recording System and MODIS-detected vegetation fires. *Wildfires 2015 - Cambuslang, Glasgow, 10-11 Nov*. Retrieved 27.08.23, from http://www.kfwf.org.uk/resources/presentations/

Crofting Commission. (2023). *Facts and Figures: 2020/21 Crofting Statistics*. Retrieved 27.11.23, from https://www.crofting.scotland.gov.uk/facts-and-figures

Cvetkovich, G., & Winter, P. (2008). The experience of community residents in a fire-prone ecosystem: A case study on the San Bernardino national forest. In *Research Paper PSW-RP-257*. https://www.fs.usda.gov/psw/publications/documents/psw_rp257/index.shtml

Daniel, T. (2007). Perceptions of wildfire risk. In TC Daniel, M. Carroll, C. Moseley, & C. Raish (Eds.), *People, fire, and forests: a synthesis of wildfire social science* (pp. 55–69). Oregon State University Press.

Daniel, T. C., Weidemann, E., & Hines, D. (2002). Assessing public tradeoffs between fire hazard and scenic beauty in the wildland-urban interface. In P. J. Jakes (Ed.), *Homeowners, Communities, and Wildfire: Science Findings from the National Fire Plan: Proceedings of the Ninth International Symposium on Society and Resource Management* (pp. 36–44). General Technical Report NC-231. St. Paul, Minnesota: USDA Forest Service, North Central Research Station.

David, R., Blewitt, N., Johnston, E., & Grazier, S. (2004). The Socio-Economic Characteristics of the South Wales Valleys in a Broader Context: A Report for the Welsh Assembly. *Institute of Welsh Affairs, June, Cardiff.* Retrieved 10.10.23, from https://www.iwa.wales/our-work/work/socio-economic-characteristics-of-the-south-wales-valleys-in-a-broader-context/

Davies, G. M., & Legg, C. J. (2008). The effect of traditional management burning on lichen diversity. *Applied Vegetation Science*, *11*(4), 529–538. https://doi.org/10.3170/2008-7-18566

Davies, G. M., & Legg, C. J. (2011). Fuel Moisture Thresholds in the Flammability of Calluna vulgaris. *Fire Technology*, *47*(2), 421–436. https://doi.org/10.1007/s10694-010-0162-0

Davies, G. M., & Legg, C. J. (2016). Regional variation in fire weather controls the reported occurrence of Scottish wildfires. *PeerJ*, *2016*(11), 1–25. https://doi.org/10.7717/peerj.2649

Davies, G. M., Gray, A., Hamilton, A., & Legg, C. J. (2008). The future of fire management in the British uplands. *International Journal of Biodiversity Science and Management*, *4*(3), 127–147. https://doi.org/10.3843/biodiv.4.3:1

Davies, G. M., Gray, A., Rein, G., & Legg, C. J. (2013). Peat consumption and carbon loss due to smouldering wildfire in a temperate peatland. *Forest Ecology and Management*, *308*, 169–177. https://doi.org/10.1016/j.foreco.2013.07.051

Davies, G. M., Kettridge, N., Stoof, C. R., Gray, A., Marrs, R., Ascoli, D., Fernandes, P. M., Allen, K. A., Doerr, S. H., Clay, G. D., McMorrow, J., & Vandvik, V. (2016b). Informed debate on the use of fire for peatland management means acknowledging the complexity of socio-ecological systems. *Nature Conservation*, *16*(2016), 59–77. https://doi.org/10.3897/natureconservation.16.10739

Davies, G., Kettridge, N., Stoof, C., Gray, A., Ascoli, D., Fernandes, P., Marrs, R., Allen, K., Doerr, S., Clay, G., McMorrow, J., & Vandvik, V. (2016a). The role of fire in UK peatland and moorland management: the need for informed, unbiased debate. *Phil. Trans. R. Soc. B*, *371*(20150342). https://doi.org/10.1098/rstb.2015.0342

Davies, M. G., Smith, A., MacDonald, A. J., Bakker, J. D., & Legg, C. J. (2010). Fire intensity, fire severity and ecosystem response in heathlands: Factors affecting the regeneration of Calluna vulgaris. *Journal of Applied Ecology*, *47*, 356–365. https://doi.org/10.1111/j.1365-2664.2010.01774.x

Davies, M., Kettridge, N., Stoof, C. R., Gray, A., Marrs, R., Ascoli, D., Fernandes, P. M., Allen, K. A., Doerr, S., Clay, G. D., Mcmorrow, J., & Vandvik, V. (2016c). The peatland vegetation burning debate: keep scientific critique in perspective. A response to Brown *et al*. and Douglas *et al*. *Phil. Trans. R. Soc. B*. https://doi.org/10.1098/rstb.2016.0434

De Jong, M. C., Wooster, M. J., Kitchen, K., Manley, C., Gazzard, R., & McCall, F. F. (2016). Calibration and evaluation of the Canadian Forest Fire Weather Index (FWI) System for improved wildland fire danger rating in the United Kingdom. *Natural Hazards and Earth System Sciences*, *16*(5), 1217–1237. https://doi.org/10.5194/nhess-16-1217-2016

de Leeuw, E. (2008). Self-Administered Questionnaires and Standardized Interviews. In *The SAGE handbook of social research methods* (pp. 313–327).

DEFRA. (2010). *Assembling UK-wide data on soil carbon (and greenhouse gas fluxes) in the context of land management.* (p. 93). Defra Project - SP0562. Retrieved 10.11.23, from https://sciencesearch.defra.gov.uk/ProjectDetails?ProjectId=15981

Dickinson, K., Brenkert-Smith, H., Champ, P., & Flores, N. (2015). Catching Fire? Social Interactions, Beliefs, and Wildfire Risk Mitigation Behaviors. *Society and Natural Resources*, *28*(8), 807–824. https://doi.org/10.1080/08941920.2015.1037034

Dixon, S. G., & Chandler, D. (2019). *Risk of sustained ignition mapping for the Peak District National Park*. Moors for the Future, Edale, UK. Retrieved 10.09.23, from https://www.moorsforthefuture.org.uk/__data/assets/pdf_file/0017/97001/2019-Wildfire-Ignition-Risk-Mapping-Report.pdf

Dodgshon, R. A., & Olsson, G. A. (2006). Heather moorland in the Scottish Highlands: The history of a cultural landscape, 1600-1880. *Journal of Historical Geography*, *32*(1), 21–37. https://doi.org/10.1016/j.jhg.2005.01.002

Doerr, S., & Santín, C. (2016). Global trends in wildfire and its impacts: perceptions versus realities in a changing world. *Phil. Trans. R. Soc. B*, *371*(20150345). https://doi.org/10.1098/rstb.2015.0345

Dohle, S., Keller, C., & Siegrist, M. (2010). Examining the relationship between affect and implicit associations: Implications for risk perception. *Risk Analysis*, *30*(7), 1116–1128. https://doi.org/10.1111/j.1539-6924.2010.01404.x

Dorset & Wiltshire Fire and Rescue Service [DWFRS]. (2022). *DWFRS launch wildfire prevention campaign #BringAPicnicNotABBQ*. Retrieved 17.07.23, from https://www.dwfire.org.uk/news/dwfrs-launch-wildfire-prevention-campaign-bringapicnicnotabbq

Dorset Council. (2023a). *Dorset heaths conservation issues*. Retrieved 17.07.23, from https://www.dorsetcouncil.gov.uk/-/dorset-heaths-conservation-issues

Dorset Council. (2023b). *Monitoring the Dorset heaths*. Retrieved 17.07.23, from https://www.dorsetcouncil.gov.uk/countryside-coast-parks/dorset-heaths/monitoring-dorset-heaths

Dorset Council. (2023c). *Protecting and managing the heaths*. Retrieved 17.07.23, from https://www.dorsetcouncil.gov.uk/countryside-coast-parks/dorset-heaths/protecting-and-managing-the-heaths

Dorset Environmental Records Centre [DERC]. (2023). *Dorset Environmental Records Centre: Urban Heaths LIFE Project and the Urban Heaths Partnership*. Retrieved 17.07.23, from https://derc.org.uk/urban-heaths-life-project-and-urban-heaths-partnership/

Dougill, A. J., Fraser, E. D. G., Holden, J., Hubacek, K., Prell, C., Reed, M. S., Stagl, S., & Stringer, L. C. (2006). Learning from doing participatory rural research: Lessons from the Peak District National Park. *Journal of Agricultural Economics*, *57*(2), 259–275. https://doi.org/10.1111/j.1477-9552.2006.00051.x

Douglas, D. J. T., Buchanan, G. M., Thompson, P., & Wilson, J. D. (2016). The role of fire in UK upland management: the need for informed challenge to conventional wisdoms: a comment on Davies *et al*. (2016). *Philosophical Transactions of the Royal Society B: Biological Sciences*, *371*. https://doi.org/10.1098/rstb.2016.0433

Douglas, D. J. T., Buchanan, G. M., Thompson, P., Amar, A., Fielding, D. A., Redpath, S. M., & Wilson, J. D. (2015). Vegetation burning for game management in the UK uplands is increasing and overlaps spatially with soil carbon and protected areas. *Biological Conservation*, *191*, 243–250. https://doi.org/10.1016/j.biocon.2015.06.014

Downs, A. (1972). Up and Down with Ecology - The “issue–attention cycle”. *The Public Interest*, *28*(Spring), 38–50.

Doyle, J. K. (2005). Face-to-Face Surveys. *Encyclopedia of Statistics in Behavioral Science*. https://doi.org/10.1002/0470013192.bsa215

Drisko, J. W., & Maschi, T. (2016). *Content Analysis*. Oxford University Press.

Drottz-Sjöberg, B. M. (1991). Non-experts Definitions of Risk and Risk Perception. In *RHIZIKON: Risk Research Report No.3*. Centre for Risk Research, Stockholm.

Drottz-Sjöberg, B. M. (1999). Risk Perception by the Public and by Experts: A Dilemma in Risk Management. *Human Ecology Review*, *6*(2), 1–9.

Dunn, C. J., Calkin, D. E., & Thompson, M. P. (2017). Towards enhanced risk management: Planning, decision making and monitoring of US wildfire response. *International Journal of Wildland Fire*, *26*, 551–556. https://doi.org/10.1071/WF17089

Dupey, L. N., & Smith, J. W. (2018). An integrative review of empirical research on perceptions and behaviors related to prescribed burning and wildfire in the United States. *Environmental Management*, *61*(6), 1002–1018. https://doi.org/10.1007/s00267-018-1031-8

DWFRS. (2019). *Be Firewise*. https://www.dwfire.org.uk/safety/safety-outdoors/heath-fires-and-countryside-safety/firewise/be-firewise/

Eckerberg, K., & Buizer, M. (2017). Promises and dilemmas in forest fire management decision-making: Exploring conditions for community engagement in Australia and Sweden. *Forest Policy and Economics*, *80*, 133–140. https://doi.org/10.1016/j.forpol.2017.03.020

Edgeley, C. M., & Paveglio, T. B. (2016). Influences on stakeholder support for a wildfire early warning system in a UK protected area. *Environmental Hazards*, *15*(4), 327–342. https://doi.org/10.1080/17477891.2016.1209155

EDINA. (2021a). *Boundary-Line™ [SHAPE geospatial data], Scale 1:10000, Tiles: GB* (Version: 7 September 2021). Digimap Ordnance Survey Service. Ordnance Survey (GB). Downloaded: 20.01.2022. https://digimap.edina.ac.uk

EDINA. (2021b). *Code-Point® with Polygons [SHAPE geospatial data], Scale 1:10000* (Version: 19 April 2021). Digimap Ordnance Survey Service. Ordnance Survey (GB). Downloaded: 20.01.2022 https://digimap.edina.ac.uk

EDINA. (2021c). *Digimap download: Map product: Land Cover Map 2021*, *Map date 2021, Default print scale 1:375000, Map projection EPSG:27700, Map extent: c.347102,* *219180 and 259257,167256*. Digimap Roam Service. Downloaded: 01.07.2023. https://digimap.edina.ac.uk

EDINA. (2021d). *Digimap download: Map product: Land Cover Map 2021*, *Map date 2021, Default print scale 1:375300, Map projection EPSG:27700, Map extent: c.319599, 55507 and 450303,132237*. Digimap Roam Service. Downloaded: 01.07.23. https://digimap.edina.ac.uk

EDINA. (2021e). *Digimap download: Map product: Land Cover Map 2021*, *Map date 2021, Default print scale 1:625000, Map projection EPSG:27700, Map extent: c.319599, 55507 and 450303,132237*. Digimap Roam Service. Downloaded: 01.07.23. https://digimap.edina.ac.uk

Eriksen, C. (2014). Gendered risk engagement: Challenging the embedded vulnerability, social norms and power relations in conventional Australian bushfire education. *Geographical Research*, *52*(1), 23–33. https://doi.org/10.1111/1745-5871.12046

Eriksen, C., & Gill, N. (2010). Bushfire and everyday life: Examining the awareness-action “gap” in changing rural landscapes. *Geoforum*, *41*(5), 814–825. https://doi.org/10.1016/j.geoforum.2010.05.004

Eriksen, C., & Prior, T. (2011). The art of learning: Wildfire, amenity migration and local environmental knowledge. *International Journal of Wildland Fire*, *20*(4), 612–624. https://doi.org/10.1071/WF10018

Eriksen, C., & Prior, T. (2011). The art of learning: Wildfire, amenity migration and local environmental knowledge. *International Journal of Wildland Fire*, *20*(4), 612–624. https://doi.org/10.1071/WF10018

Eriksen, C., Gill, N., & Head, L. (2010). The gendered dimensions of bushfire in changing rural landscapes in Australia. *Journal of Rural Studies*, *26*(4), 332–342. https://doi.org/10.1016/j.jrurstud.2010.06.001

European Commission, (2023). *European Forest Fire Information System Current Situation*. Copernicus. Retrieved 29.09.23, from https://effis.jrc.ec.europa.eu/apps/effis_current_situation/

Evans, J. R., & Mathur, A. (2005). The value of online surveys. *Internet Research*, *15*(2), 195–219. https://doi.org/10.1108/10662240510590360

Everett, Y., & Fuller, M. (2011). Fire Safe Councils in the Interface. *Society & Natural Resources*, *24*(4), 319–333. https://doi.org/10.1080/08941920903313835

EWWF. (n.d.). *England & Wales Wildfire Forum*. Northumberland Fire & Rescue Service. Retrieved 23.07.23, from https://www.northumberlandfireandrescue.gov.uk/ewwf

Fairbrother, P., Tyler, M., Hart, A., Mees, B., Phillips, R., Stratford, J., & Toh, K. (2013). Creating “community”? Preparing for bushfire in rural Victoria. *Rural Sociology*, *78*(2), 186–209. https://doi.org/10.1111/ruso.12006

Faivre, N., Vallejo Calzada, V. R., Cardoso Castro Rego, F. M., Moreno Rodriquez, J. M., & Xanthopoulos, G. (2018). *Forest Fires - Sparking firesmart policies in the EU*. https://doi.org/10.2777/181450

FAO. (1999). *1999 Revision of the FAO Wildland Fire Management Terminology by the Global Fire Monitoring Centre (GFMC)*. Retrieved 02.03.23, from https://gfmc.online/wp-content/uploads/GFMC-FAO-Fire-Management-Glossary-1999-edited-2018.pdf

FAO. (2007). Fire management - global assessment 2006. A thematic study prepared in the framework of the Global Forest Resources Assessment 2005. In *FAO Forestry Paper*.

Felson, M., & Cohen, L. E. (1980). *Human Ecology and Crime: A Routine Activity Approach*. *8*, 389–406. https://doi.org/10.1007/BF01561001

Ferreira-Leite, F., Bento-Gonçalves, A., Vieira, A., & da Vinha, L. (2015). Mega-fires around the world: A literature review. In A. Bento- Gonçalves & A. Vieira (Eds.), *Wildland Fires: A Worldwide Reality* (pp. 15–34). Nova Science Publishers.

Ffitch, H. (2020, May 21). Barbecue or camp fire likely cause of Wareham Forest fire. *Swanage News*. Retrieved 23.05.23, from https://www.swanage.news/barbecue-or-camp-fire-likely-cause-of-wareham-forest-fire/

Ffitch, H. (2022, August 12). Four fold increase in fires triggers a red alert for Dorset. *Swanage News*. Retrieved 17.09.23, from https://www.swanage.news/four-fold-increase-in-fires-triggers-a-red-alert-for-dorset

Fischer, A. P. (2011). Reducing hazardous fuels on nonindustrial private forests: Factors influencing landowner decisions. *Journal of Forestry*, *109*(5), 260–266. https://doi.org/10.1093/jof/109.5.260

Fischer, A. P., & Jasny, L. (2017). Capacity to adapt to environmental change: Evidence from a network of organizations concerned with increasing wildfire risk. *Ecology and Society*, *22*(1). https://doi.org/10.5751/ES-08867-220123

Fischer, A. P., Spies, T. A., Steelman, T. A., Moseley, C., Johnson, B. R., Bailey, J. D., Ager, A. A., Bourgeron, P., Charnley, S., Collins, B. M., Kline, J. D., Leahy, J. E., Littell, J. S., Millington, J. D. A., Nielsen-Pincus, M., Olsen, C. S., Paveglio, T. B., Roos, C. I., Steen-Adams, M. M., … Bowman, D. M. J. S. (2016). Wildfire risk as a socioecological pathology. In *Frontiers in Ecology and the Environment* (Vol. 14, Issue 5, pp. 276–284). https://doi.org/10.1002/fee.1283

Fischhoff, B., Watson, S. R., & Hope, C. (1984). Defining risk. *Policy Science*, *17*(123–139). https://doi.org/10.1007/BF00146924

Flannigan, M. D., Krawchuk, M. A., De Groot, W. J., Wotton, B. M., & Gowman, L. M. (2009). Implications of changing climate for global wildland fire. *International Journal of Wildland Fire*, *18*(5), 483–507. https://doi.org/10.1071/WF08187

Flannigan, M. D., Logan, K. A., Amiro, B. D., Skinner, W. R., & Stocks, B. J. (2005). Future area burned in Canada. *Climatic Change*, *72*(1–2), 1–16. https://doi.org/10.1007/s10584-005-5935-y

Flannigan, M., Cantin, A. S., De Groot, W. J., Wotton, M., Newbery, A., & Gowman, L. M. (2013). Global wildland fire season severity in the 21st century. *Forest Ecology and Management*, *294*, 54–61. https://doi.org/10.1016/j.foreco.2012.10.022

Flint, C. G. (2007). Changing forest disturbance regimes and risk perceptions in Homer, Alaska. *Risk Analysis*, *27*(6), 1597–1608. https://doi.org/10.1111/j.1539-6924.2007.00991.x

Ford, A. (2020, June 29). *Firewise Communities – helping neighbourhoods prepare and respond to wildfires (Interview with Linda Kettley)*. Leverhulme Centre for Wildfires, Environment and Society. Retrieved 20.02.23, from https://centreforwildfires.org/news/firewise-communities-helping-neighbourhoods-prepare-and-respond-to-wildfires/

Forestry Commission England. (2019). *Wildfire statistics for England 2009-2010 to 2016-2017*. Forestry Commission England, Bristol. Retrieved 03.08.23, from https://www.gov.uk/government/publications/forestry-commission-england-wildfire-statistics-for-england-2009-10-to-2016-17

Forestry Commission England. (2023). *Wildfire statistics for England: Report to 2020-2021*. Retrieved 10.11.23, from https://www.gov.uk/government/publications/forestry-commission-wildfire-statistics-for-england-report-to-2020-21

Forkel, M., Dorigo, W., Lasslop, G., Chuvieco, E., Hantson, S., Heil, A., Teubner, I., Thonicke, K., & Harrison, S. P. (2019). Recent global and regional trends in burned area and their compensating environmental controls. *Environmental Research Communications*, *1*(5). https://doi.org/10.1088/2515-7620/ab25d2

Fowler, F. J. (2013). *Survey Research Methods*. SAGE.

Fried, J. S., Gatziolis, D., Gilless, J. K., Vogt, C. A., & Winter, G. (2006). Changing beliefs and building trust at the wildland/urban interface. *Fire Management Today*, *66*(3), 51–55.

Fyfe, R. M., Brown, A. G., & Rippon, S. J. (2003). Mid- to late-Holocene vegetation history of Greater Exmoor, UK: Estimating the spatial extent of human-induced vegetation change. *Vegetation History and Archaeobotany*, *12*(4), 215–232. https://doi.org/10.1007/s00334-003-0018-3

Gable, G. G. (1994). Integrating case study and survey research methods: an example in information systems. *European Journal of Information Systems*, *3*(2), 112–126. https://doi.org/10.1057/ejis.1994.12

Gagkas, Z., Campbell, G., Owen, J., & Davies, M. (2021). *Provision of Analyses of Scottish Fire and Rescue Service (SFRS) Incident Reporting System (IRS) Data in Relation to Wildfire Incidents.* Retrieved 22.09.23, from https://www.gov.scot/publications/provision-analyses-scottish-fire-rescue-service-sfrs-incident-reporting-system-irs-data-relation-wildfire-incidents/

Galloway, A. (2005). Non-Probability Sampling. *Encyclopedia of Social Measurement*, 859–864. https://doi.org/10.1016/B0-12-369398-5/00382-0

Ganteaume, A., & Jappiot, M. (2013). What causes large fires in Southern France. *Forest Ecology and Management*, *294*, 76–85. https://doi.org/10.1016/j.foreco.2012.06.055

Gardner, P. D., Cortner, H. J., & Widaman, K. (1987). The risk perceptions and policy response toward wildland fire hazards by urban home-owners. *Landscape and Urban Planning*, *14*(C), 163–172. https://doi.org/10.1016/0169-2046(87)90021-1

Gavin, N. T., Leonard-Milsom, L., & Montgomery, J. (2011). Climate change, flooding and the media in Britain. *Public Understanding of Science*, *20*(3), 422–438. https://doi.org/10.1177/0963662509353377

Gazzard, R. (2014). *Summary of Forestry Commission analysis of IRS for Wildfire evidence*. Forestry Commission. Retrieved 22.09.23, from https://www.frsug.org/reports/Wildfire_IRS_2014.pdf

Gazzard, R., McMorrow, J., & Aylen, J. (2016). Wildfire policy and management in England: An evolving response from fire and Rescue Services, forestry and cross-sector groups. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *371*(1696). https://doi.org/10.1098/rstb.2015.0341

Ghazi, A. N., Petersen, K., Reddy, S. S. V. R., & Nekkanti, H. (2019). Survey research in software engineering: Problems and mitigation strategies. *IEEE Access*, *7*, 24703–24718. https://doi.org/10.1109/ACCESS.2018.2881041

Giglio, L., Randerson, J. T., & van der Werf, G. R. (2013). Analysis of daily, monthly, and annual burned area using the fourth-generation global fire emissions database (GFED4). *Journal of Geophysical Research: Biogeosciences*, *118*, 317–328. https://doi.org/10.1002/fgrg.20042

Gill, A. M., Stephens, S. L., & Cary, G. J. (2013). The worldwide “wildfire” problem. Ecological Applications, *23*(2), 438–454. https://doi.org/10.1890/10-2213.1

Gill, M., & Stephens, S. (2009). Scientific and social challenges for the management of fire-prone wildland-urban interface. *Environmental Research Letters*, *4*. https://doi.org/10.1088/1748-9326/4/3/034014

Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory: strategies for qualitative research*. Aldine de Gruyter.

Glaves, D. J., Crowle, A. J. W., Bruemmer, C., & Lenaghan, S. A. (2020). *The causes and prevention of wildfire on heathlands and peatlands in England (NEER014)*. Natural England.

Glaves, D. J., Morecroft, M., Fitzgibbon, C., Owen, M., Phillips, S., & Lepitt, P. (2013). *Natural England Review of Upland Evidence 2012 - The effects of managed burning on upland peatland biodiversity, carbon and water. (NEER004)*. Natural England.

Gonzales, A., Schofield, R., & Hart, S. (2005). *Mapping Crime: Understanding Hot Spots*. US Department of Justice.

Gordon, J. S., Willis, J. L., & Grala, R. K. (2020). Public and forest landowner attitudes towards longleaf pine ecosystem restoration using prescribed fire. *Canadian Journal of Forest Research*, *50*(9), 917–924. https://doi.org/10.1139/cjfr-2019-0415

Gosling, S. D., Vazire, S., Srivastaba, S., & John, O. P. (2004). Should We Trust Web-Based Studies? A Comparative Analysis of Six Preconceptions About Internet Questionnaires. *American Psychologist*, *59*(2), 93–104. https://doi.org/10.1037/0003-066X.59.2.93

Gowlett, J. A. J. (2016). The discovery of fire by humans: a long and convoluted process. *Phil. Trans. R. Soc. B*, *371*(20150164). https://doi.org/10.1098/rstb.2015.0164

Grant, M., Mallord, J., Stephen, L., & Thompson, P. S. (2012). *The costs and benefits of grouse moor management to biodiversity and aspects of the wider environment: A Review*. RSPB, Sandy, UK.

Grau-Andrés, R., Davies, G. M., Gray, A., Scott, E. M., & Waldron, S. (2018). Fire severity is more sensitive to low fuel moisture content on Calluna heathlands than on peat bogs. *Science of the Total Environment*, *616–617*(October 2017), 1261–1269. https://doi.org/10.1016/j.scitotenv.2017.10.192

Gray, A., Davies, G. M., Domènech, R., Taylor, E., & Levy, P. E. (2021). Peatland Wildfire Severity and Post-fire Gaseous Carbon Fluxes. *Ecosystems*, *24*(3), 713–725. https://doi.org/10.1007/s10021-020-00545-0

Greenacre, Z. A. (2016). The Importance of Selection Bias in Internet Surveys. *Open Journal of Statistics*, *6*(3), 397–404. https://doi.org/10.4236/ojs.2016.63035

Grundy, S., & Mcmorrow, J. (2013). Using the Incident Recording System (IRS) to define wildfire in GB. *Presented at Wildfire 2015, Cambuslang, Scotland, 10-11 November 2015*. Knowledge for Wildfire.

Gustafson, P. E. (1998). Gender differences in risk perception: Theoretical and methodological perspectives. *Risk Analysis*, *18*(6), 805–811. https://doi.org/10.1023/B:RIAN.0000005926.03250.c0

Haer, T., Botzen, W. J. W., de Moel, H., & Aerts, J. C. J. H. (2017). Integrating Household Risk Mitigation Behavior in Flood Risk Analysis: An Agent-Based Model Approach. *Risk Analysis*, *37*(10), 1977–1992. https://doi.org/10.1111/risa.12740

Halpern-Felsher, B. L., Millstein, S. G., Ellen, J. M., Adler, N. E., Tschann, J. M., & Biehl, M. (2001). The role of behavioral experience in judging risks. *Health Psychology*, *20*(2), 120–126. https://doi.org/10.1037/0278-6133.20.2.120

Hardwood, T. G., & Garry, T. (2003). An overview of content analysis. *The Marketing Review*, *3*(4), 479–498. https://doi.org/10.1362/146934703771910080

Hargrove, W. W., Gardner, R. H., Turner, M. G., Romme, W. H., & Despain, D. G. (2000). Simulating fire patterns in heterogeneous landscapes. *Ecological Modelling*, *135*(2–3), 243–263. https://doi.org/10.1016/S0304-3800(00)00368-9

Harper, A. R., Doerr, S. H., Santin, C., Froyd, C. A., & Sinnadurai, P. (2018). Prescribed fire and its impacts on ecosystem services in the UK. *Science of The Total Environment*, *624*, 691–703. https://doi.org/10.1016/j.scitotenv.2017.12.161

He, T., Lamont, B. B., & Pausas, J. G. (2019). Fire as a key driver of Earth's biodiversity. In *Biological Reviews* (Vol. 94, Issue 6). https://doi.org/10.1111/brv.12544

Herd Digital. (2023). *Facebook Statistics You Must Know in 2023*. Digital Marketing News. Retrieved 10.11.23, from https://herd.digital/blog/facebook-statistics-2022/

Highlands and Islands Enterprise [HIE]. (n.d.). *Tourism*. Our Growth Sectors. Retrieved 06.06.23, from https://www.hie.co.uk/our-region/our-growth-sectors/tourism/

Holling, C. S., & Meffe, G. K. (1996). Command and Control and the Pathology of Natural Research Management. *Conservation Biology*, *10*(2), 328–337.

IAWF. (2019). IAWF Issue Paper: Extreme Fires. *Wildfire Magazine*, *April*. Retrieved 10.03.23, from https://www.iawfonline.org/article/iawf-issue-paper-extreme-fires/

Ingalsbee, T. (2017). Whither the paradigm shift? Large wildland fires and the wildfire paradox offer opportunities for a new paradigm of ecological fire management. *International Journal of Wildland Fire*, *26*(7), 557–561. https://doi.org/10.1071/WF17062

ITV. (2020, April 16). Footage shows extent of “deliberately started wildfires” around south Wales. *ITV News*. Retrieved 23.05.23, from https://www.itv.com/news/wales/2020-04-16/firefighter-s-pictures-show-extent-of-deliberately-started-wildfires

Jacobson, S. K., Monroe, M. C., & Marynowski, S. (2001). Fire at the wildland interface: The influence of experience and mass media on public knowledge, attitudes, and behavioral intentions. *Wildlife Society Bulletin*, *29*(3), 929–937.

Jakes, P. J., & Langer, E. R. L. (2012). The adaptive capacity of New Zealand communities to wildfire. *International Journal of Wildland Fire*, *21*(6), 764–772. https://doi.org/10.1071/WF11086

Jakes, P. J., Burns, S., Cheng, A., Saeli, E., Nelson, K., Brummel, R., Grayzeck, S., Sturtevant, V., & Williams, D. (2007). Critical Elements in the Development and Implementation of Community Wildfire Protection Plans (CWPPs). In: *The Fire Environment—Innovations, Management, and Policy; Conference Proceedings. 26-30 March 2007; Destin, FL.*, 613–624.

Jarrett, A., Gan, J., Johnson, C., & Munn, I. A. (2009). Landowner awareness and adoption of wildfire programs in the southern United States. *Journal of Forestry*, *107*(3), 113–118. https://doi.org/10.1093/jof/107.3.113

Jenkins, G. J., Murphy, J. M., Sexton, D. S., Lowe, J. A., Jones, P., & Kilsby, C. G. (2009). UK Climate Projections: Briefing report. Met Office Hadley Centre, Exeter, UK.

Jenkins, J., & Woodcock, S. (2019). *Healthy Hillsides Partnership*. Northumberland Fire and Rescue Service (NFRS), EWWF: Healthy Hillsides. Retrieved 20.01.23, from https://www.northumberland.gov.uk/NorthumberlandCountyCouncil/media/Fire-and-Rescue/Wildfire Prevention Manual/Healthy-Hillsides-Partnership-S-Woodcock.pdf

Jennings, C. (1999). Socioeconomic characteristics and their relationship to fire incidence: A review of the literature. *Fire Technology*, *35*(1), 7–34.

Johnson, J. F., Bengston, D. N., Nelson, K. C., & Fan, D. P. (2006). Defensible space in the news: public discussion of a neglected topic (pp. 169-174). In *The public and wildland fire management: social science findings for managers. General Technical Report*

NRS-GTR-1.U.S. Department of Agriculture, Forest Service, Northern Research Station, Newtown Square, PA.

Jollands, M., Morris, J., & Moffat, A. (2011). *Wildfires in Wales*. Report to Forestry Commission Wales. Forestry Research, Farnham. Retrieved 10.10.22, from https://www.forestresearch.gov.uk/research/wildfires-in-wales-social-drivers-and-mitigation-measures/

Jolly, W. M., Cochrane, M. A., Freeborn, P. H., Holden, Z. A., Brown, T. J., Williamson, G. J., & Bowman, D. M. J. S. (2015). Climate-induced variations in global wildfire danger from 1979 to 2013. *Nature Communications*, *6*. https://doi.org/10.1038/ncomms8537

Jones, M. W., Burton, C., Kelley, D., & Doerr, S. (2023, July). Greece wildfires: how climate change is involved, and what we can do about it. *The Conversation*. Retrieved 11.11.23, from https://theconversation.com/greece-wildfires-how-climate-change-is-involved-and-what-we-can-do-about-it-210404

Jones, M. W., Smith, A., Betts, R., Canadell, J. G., Prentice, I. C., & Le Quéré, C. (2020). Climate change increases the risk of wildfires. *The Science Brief*. Retrieved 10.09.23, from https://www.preventionweb.net/files/73797_wildfiresbriefingnote.pdf

Kasperson, R. E., Renn, O., Slovic, P., Brown, H. S., Emel, J., Goble, R., Kasperson, J. X., & Ratick, S. (1988). The Social Amplification of Risk: A Conceptual Framework. *Risk Analysis*, *8*(2), 177–187. https://doi.org/10.1111/j.1539-6924.1988.tb01168.x

Kaval, P. (2009). Perceived and actual wildfire danger: An economic and spatial analysis study in Colorado (USA). *Journal of Environmental Management*, *90*(5), 1862–1867. https://doi.org/10.1016/j.jenvman.2008.12.009

Kendra, J. M. (2007). Geography's contributions to understanding hazards and disasters. In D. McEntire (Ed.), *Disciplines, Disasters and Emergency Management: The Convergence of Concepts Issues and Trends From the Research Literature* (pp. 15–30). Charles C Thomas Publisher.

Kent, B., Gebert, K., McCaffrey, S., Martin, W., Calkin, D., Schuster, E., Martin, I., Bender, H. W., Alward, G., Kumagai, Y., Cohn, P. J., Carroll, M., Williams, D., & Ekarius, C. (2003). Social and Economic Issues of the Hayman Fire. In R. T. Graham (Ed.), *Hayman Fire Case Study (pp. 315-388). USDA Forest Service Gen. Tech. Rep., Rocky Mountain Research Station, RMRS-GTR-114.*

Kirby, A. (1990). *Nothing to Fear: Risks and Hazards in American Society*. University of Arizona Press.

Knowledge for Wildfire [KfWf]. (n.d.). *Knowledge for Wildfire Homepage*. Retrieved 17.07.23, from www.kfwf.org.uk

Koksal, K., McLennan, J., Every, D., & Bearman, C. (2019). Australian wildland-urban interface householders' wildfire safety preparations: 'Everyday life' project priorities and perceptions of wildfire risk. *International Journal of Disaster Risk Reduction*, *33*(October 2018), 142–154. https://doi.org/10.1016/j.ijdrr.2018.09.017

Komac, B., Migliorini, M., Schwarze, R., Sigmund, Z., Awad, C., Chatelon, F. J., Goldammerd, J. G., Marcelli, T., Movan, D., Simeoni, A., & Benni, T. (2020). *Evolving*

Risk of Wildfires in Europe: The changing nature of wildfire risk calls for a shift in policy focus from suppression to prevention. Sendai Framework for Disaster Risk Reduction 2015-2030. European Science & Technology Advisory Group.

Krawchuk, M. A., Moritz, M. A., Parisien, M. A., Van Dorn, J., & Hayhoe, K. (2009). Global pyrogeography: The current and future distribution of wildfire. *PLoS ONE*, *4*(4). https://doi.org/10.1371/journal.pone.0005102

Krippendorff, K. (2004). *Content Analysis: An Introduction to Its Methodology* (Second). SAGE.

Kumagai, Y., Bliss, J. C., Daniels, S. E., & Carroll, M. S. (2004). Research on Causal Attribution of Wildfire: An Exploratory Multiple-Methods Approach. *Society & Natural Resources*. https://doi.org/10.1080/08941920490261249

Kyle, G. T., Theodori, G. L., Absher, J. D., & Jun, J. (2010). The influence of home and community attachment on firewise behavior. *Society and Natural Resources*, *23*, 1–18. https://doi.org/0.1080/08941920902724974

Lacroix, K., Gifford, R., & Rush, J. (2020). Climate change beliefs shape the interpretation of forest fire events. *Climatic Change*, *159*(1), 103–120. https://doi.org/10.1007/s10584-019-02584-6

Lavorel, S., Flannigan, M. D., Lambin, E. F., & Scholes, M. C. (2007). Vulnerability of land systems to fire: Interactions among humans, climate, the atmosphere, and ecosystems. *Mitigation and Adaptation Strategies for Global Change*, *12*, 33–53. https://doi.org/10.1007/s11027-006-9046-5

Lee, H., Alday, J. G., Rose, R. J., O'Reilly, J., & Marrs, R. H. (2013). Long-term effects of rotational prescribed burning and low-intensity sheep grazing on blanket-bog plant communities. *Journal of Applied Ecology*, *50*(3), 625–635. https://doi.org/10.1111/1365-2664.12078

Legg, C. J., & Davies, G. M. (2009). What determines fire occurrence, fire behaviour and fire effects in heathlands? *Proceedings of the 10th National Heathland Conference - Managing Heathlands in the Face of Climate Change (pp. 45-55).* Natural England Commissioned Report, NECR014. Natural England.

Leimbach, T., & Palmer, J. (2022). #AustraliaOnFire: Hashtag Activism and Collective Affect in the Black Summer Fires. *Journal of Australian Studies*, *46*(4), 496–511. https://doi.org/10.1080/14443058.2022.2121744

Lerner, J. S., Gonzalez, R. M., Small, D. A., & Fischhoff, B. (2003). Effects of Fear and Anger on Perceived Risks of Terrorism: A National Field Experiment. *Psychological Science*, *14*(2), 144–150. https://doi.org/10.1111/1467-9280.01433

Lewicka, M. (2011). Place attachment: How far have we come in the last 40 years? *Journal of Environmental Psychology*, *31*(3), 207–230. https://doi.org/10.1016/j.jenvp.2010.10.001

Lewis, C. (2018). *Firewise Communities Project Monitoring Summary 2018* (Issue July). Urban Heaths Partnership, Dorset.

Lidskog, R., Johansson, J., & Sjödin, D. (2019). Wildfires, responsibility and trust: public understanding of Sweden’s largest wildfire. *Scandinavian Journal of Forest Research*, *34*(4), 319–328. https://doi.org/10.1080/02827581.2019.1598483

Lijeblad, A., Borrie, W. T., & Watson, A. E. (2009). Determinants of trust for public lands: Fire and fuels management on the bitterroot national forest. *Environmental Management*, *43*(4), 571–584. https://doi.org/10.1007/s00267-008-9230-3

Lim, S. H., Bowker, J. M., Johnson, C. Y., & Cordell, H. K. (2009). Perspectives on prescribed fire in the south: Does ethnicity matter? *Southern Journal of Applied Forestry*, *33*(1), 17–24. https://doi.org/10.1093/sjaf/33.1.17

Lindley, S., Mcmorrow, J., & Bonn, A. (2009). Moorland wildfires in the UK Peak District. In J. Settele, L. Penev, T. Georgiev, R. Grabaum, V, Grobelnik (Eds.) *Atlas of biodiversity risk* (pp. 30–31). Pensoft Publishers.

Lo, A. Y., & Chan, F. (2017). Preparing for flooding in England and Wales: the role of risk perception and the social context in driving individual action. *Natural Hazards*, *88*(1), 367–387. https://doi.org/10.1007/s11069-017-2870-y

Luxmoore, R. (2018). *Wildfire and Prescribed burning*. National Trust Scotland, Edinburgh. Scottish Fire and Rescue Service. Retrieved 20.08.23, from https://www.firescotland.gov.uk/media/901470/Luxmoore_Wildfires_and_prescribed_burning_2015.pdf

Mabry, L. (2008). Case study in social research. In P. Alasuutari, L. Bickman, & J. Brannen (Eds.), *The SAGE handbook of social research methods* (pp. 214–227). SAGE Publications.

Mabry, L. (2008). The SAGE handbook of social research methods. In P. Alasuutari, L. Bickman, & J. Brannen (Eds.), *The SAGE handbook of social research methods* (pp. 214–227). SAGE Publications.

Macdougall, C., Gibbs, L., & Clark, R. (2014). Community-based preparedness programmes and the 2009 Australian bushfires: Policy implications derived from applying theory. *Disasters*, *38*(2), 249–266. https://doi.org/10.1111/disa.12049

Madge, C. (2007). Developing a geographers’ agenda for online research ethics. *Progress in Human Geography*, *31*(5), 654–674. https://doi.org/10.1177/0309132507081496

Manchester University. (n.d.). *Fires Interdisciplinary Research on Ecosystem Services (FIRES); fire and climate change in UK moorlands and heaths*. McMorrow, J. Retrieved 25.04.23, from https://research.manchester.ac.uk/en/projects/fire-interdisciplinary-research-on-ecosystem-services-fire-and-cl

Martin, I. M., Bender, H., & Raish, C. (2007). What motivates individuals to protect themselves from risks: The case of wildland fires. *Risk Analysis*, *27*(4), 887–900. https://doi.org/10.1111/j.1539-6924.2007.00930.x

Martin, W. E., Martin, I. M., & Kent, B. (2009). The role of risk perceptions in the risk mitigation process: The case of wildfire in high risk communities. *Journal of Environmental Management*, *91*(2), 489–498. https://doi.org/10.1016/j.jenvman.2009.09.007

Matthews, K., Fielding, D., Miller, D., Gandossi, G., Newey, S., & Thomson, S. (2020, October). Mapping the areas and management intensity of moorland actively managed for grouse Part 3: Research to assess socioeconomic and biodiversity impacts of driven grouse moors and to understand the rights. *Commissioned Report to the Scottish Government*.

McCaffrey, S. (2004a). Thinking of wildfire as a natural hazard. *Society and Natural Resources*, *17*(6), 509–516. https://doi.org/10.1080/08941920490452445

McCaffrey, S. (2004b). Fighting fire with science. *Journal of Forestry*, *102*(5), 12–19. https://doi.org/10.1093/jof/102.5.12

McCaffrey, S. (2008). Understanding public perspectives of wildfire risk. In W. E. Martin, C. Raish, & B. Kent (Eds.), *Wildfire Risk: Human Perceptions and Management Implications* (pp. 11–22). Routledge. https://doi.org/10.4324/9781936331611

McCaffrey, S. (2015). Community wildfire preparedness: A global state-of-the-knowledge summary of social science research. *Current Forestry Reports*, *1*(2), 81–90. https://doi.org/10.1007/s40725-015-0015-7

McCaffrey, S. M. (2006). *The public and wildland fire management: social science findings for managers*. Gen. Tech. Rep. NRS-1. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station.

McCaffrey, S. M., Stidham, M., Toman, E., & Shindler, B. (2011). Outreach programs, peer pressure, and common sense: What motivates homeowners to mitigate wildfire risk? *Environmental Management*, *48*(3), 475–488. https://doi.org/10.1007/s00267-011-9704-6

McCaffrey, S., & Kumagai, Y. (2007). No need to reinvent the wheel: applying existing social science theories to wildfire. In P. D. Daniel, M. S. Carroll, C. Moseley, & C. Raish (Eds.), *People, Fire and Forests: A Synthesis of Wildfire Social Science* (pp. 12–36). Oregon State University Press.

McCaffrey, S., & Olsen, C. (2012). Research Perspectives on the Public and Fire Management: A Synthesis of Current Social Science on Eight Essential Questions. *JFSP Synthesis Reports* (Vol. 17). University of Nebraska, Lincoln.

McCaffrey, S., Toman, E., Stidham, M., & Shindler, B. (2013). Social science research related to wildfire management: An overview of recent findings and future research needs. *International Journal of Wildland Fire*, *22*(1), 15–24. https://doi.org/10.1071/WF11115

McCarroll, D. (2016). *Simple Statistical Tests for Geography*. Routledge.

McDowell, C. P., Andrade, L., O'Neill, E., O'Malley, K., O'dwyer, J., & Hynds, P. D. (2020). Gender-related differences in flood risk perception and behaviours among private groundwater users in the Republic of Ireland. *International Journal of Environmental Research and Public Health*, *17*(6). https://doi.org/10.3390/ijerph17062072

McEvoy, D., Cavan, G., Handley, J., McMorrow, J., & Lindley, S. (2008). Changes to climate and visitor behaviour: Implications for vulnerable landscapes in the north west region of

England. *Journal of Sustainable Tourism*, *16*(1), 101–121. https://doi.org/10.2167/jost676.0

McEvoy, D., Handley, J. F., Cavan, G., Aylen, J., Lindley, S., McMorrow, J., & Glynn, S. (2006). *Climate Change and the Visitor Economy: the challenges and opportunities for England's Northwest*. DEFRA, Northwest Regional Development Agency, Environment Agency, UK Climate Impacts Programme. *Manchester University.*

McFarlane, B. L., McGee, T. K., & Faulkner, H. (2011). Complexity of homeowner wildfire risk mitigation: An integration of hazard theories. *International Journal of Wildland Fire*, *20*(8), 921–931. https://doi.org/10.1071/WF10096

McGee, T. K. (2005). Completion of recommended WUI fire mitigation measures within urban households in Edmonton, Canada. *Environmental Hazards*, *6*, 147–157. https://doi.org/10.1016/j.hazards.2006.05.002

McGee, T. K. (2011). Public engagement in neighbourhood level wildfire mitigation and preparedness: Case studies from Canada, the US and Australia. *Journal of Environmental Management*, *92*(10), 2524–2532. https://doi.org/10.1016/j.jenvman.2011.05.017

McGee, T. K., & Russell, S. (2003). "It's just a natural way of life..." an investigation of wildfire preparedness in rural Australia. *Environmental Communication*, *5*, 1–12. https://doi.org/10.1016/j.hazards.2003.04.001

McGee, T., McFarlane, B., & Varghese, V. (2009). An examination of the influence of hazard experience on wildfire risk perceptions and adoption of mitigation measures. *Society & Natural Resources*, *22*, 303–323. https://doi.org/10.1080/08941920801910765

McGuirk, P. M., & O'Neill, P. (2016). Using Questionnaires in Qualitative Human Geography. In I. Hay (Ed.), *Qualitative Research Methods in Human Geography* (Fourth, pp. 246–273). Oxford University Press.

McGuirk, P. M., & O'Neill, P. (2016). Using Questionnaires in Qualitative Human Geography. In I. Hay (Ed.), *Qualitative Research Methods in Human Geography* (Fourth, pp. 246–273). Oxford University Press.

McKenna, F. P. (1993). It won't happen to me: Unrealistic optimism or illusion of control? *British Journal of Psychology*, *84*(1), 39–50. https://doi.org/10.1111/j.2044-8295.1993.tb02461.x

McLafferty, S. L. (2010). Conducting Questionnaire Surveys. In N. Clifford, S. French, & G. Valentine (Eds.), *Key Methods in Geography* (2nd ed., pp. 77–88). SAGE.

McLennan, J., Paton, D., & Wright, L. (2015). At-risk householders' responses to potential and actual bushfire threat: An analysis of findings from seven Australian post-bushfire interview studies 2009-2014. *International Journal of Disaster Risk Reduction*, *12*, 319–327. https://doi.org/10.1016/j.ijdrr.2015.02.007

McMorrow, J. (2009). FIRES: Fire Interdisciplinary Research on Ecosystem Services: Fire and Climate Change in UK Moorlands and Heaths. *Creating a New Prosperity: Fresh Approaches to Ecosystem Services and Human Well-Being, FRESH Seminar 6 - Royal Geographical Society, London*. Manchester University.

McMorrow, J. (2011). Wildfire in the United Kingdom: Status and Key Issues. *Proceedings of the Second Conference on the Human Dimensions of Wildland Fire.* USDA Forest Service*. GTR-NRS-P-84*, 44–56.

Mcmorrow, J., & Aylen, J. (2018, August 9). UK wildfires: prevention is more than a fire service issue. *The Conversation*, *August*. Retrieved 19.11.23, from https://theconversation.com/uk-wildfires-prevention-is-more-than-a-fire-service-issue-100127

McMorrow, J., & Lindley, S. (2006). *Modelling the spatial risk of Moorland wildfire*. Final report. Moors for the Future small grant. Manchester University.

McMorrow, J., Aylen, J., Alberston, K., Cavan, G., Lindley, S., Handley, J., & Karooni, R. (2006). *Moorland WildFires in the Peak District National Park, Technical Report 3*. Manchester University.

McMorrow, J., Cavan, G., Walker, J., Aylen, J., Legg, C., Quinn, C., Hubacek, K., Thorp, S., Thomson, M., & Jones, M. (2010). FIRES: Fire and Climate Change in UK Moorlands and Heaths Policy Brief. In *FIRES seminar series, University of Manchester.* https://doi.org/10.1177/0022146512469014

McMorrow, J., Lindley, S., Aylen, J., Cavan, G., Alberston, K., & Boys, D. (2009). Moorland wildfire risk, visitors and climate change: Patterns, prevention and policy. In A. Bonn, T. Allott, K. Hubacek, & J. Stewart (Eds.), *Drivers of Environmental Change in Uplands* (pp. 404–431). Routledge. https://doi.org/10.4324/9780203886724

McNeill, I. M., Dunlop, P. D., Heath, J. B., Skinner, T. C., & Morrison, D. L. (2013). Expecting the unexpected: Predicting physiological and psychological wildfire preparedness from perceived risk, responsibility, and obstacles. *Risk Analysis*, *33*(10), 1829–1843. https://doi.org/10.1111/risa.12037

McWethy, D. B., Schoennagel, T., Higuera, P. E., Krawchuk, M., Harvey, B. J., Metcalf, E. C., Schultz, C., Miller, C., Metcalf, A. L., Buma, B., Virapongse, A., Kulig, J. C., Stedman, R. C., Ratajczak, Z., Nelson, C. R., & Kolden, C. (2019). Rethinking resilience to wildfire. *Nature Sustainability*, *2*(9). https://doi.org/10.1038/s41893-019-0353-8

Meldrum, J. R., Champ, P. A., Brenkert-Smith, H., Warziniack, T., Barth, C. M., & Falk, L. C. (2015). Understanding Gaps Between the Risk Perceptions of Wildland-Urban Interface (WUI) Residents and Wildfire Professionals. *Risk Analysis*, *35*(9), 1746–1761. https://doi.org/10.1111/risa.12370

Mell, W., Manzello, S., Maranghides, A., Butry, D., & Rehm, R. (2010). The wildland-urban interface fire problem - current approaches and research needs. *International Journal of Wildland Fire*, *19*, 2, 238–251. https://doi.org/10.1071/WF07131

Meyn, A., White, P. S., Buhk, C., & Jentsch, A. (2007). Environmental drivers of large, infrequent wildfires: The emerging conceptual model. *Progress in Physical Geography*, *31*(3), 287–312. https://doi.org/10.1177/0309133307079365

Mitchell, J. K. (1974). Natural Hazards Research. In I. R. Manners & M. W. Mikesell (Eds.), *Perspectives on Environment* (pp. 311–341). Commission on College Geography, Washington DC.

Modugno, S., Balzter, H., Cole, B., & Borrelli, P. (2016). Mapping regional patterns of large forest fires in Wildland-Urban Interface areas in Europe. *Journal of Environmental Management*, *172*, 112–126. https://doi.org/10.1016/j.jenvman.2016.02.013

Monroe, M. C., & Nelson, K. C. (2004). The Value of Assessing Public Perceptions : Wildland Fire and Defensible Space. *Applied Environmental Education & Communication*, *3*(2), 109–117. https://doi.org/10.1080/15330150490472781

Monroe, M. C., Nelson, K. C., & Payton, M. (2006). Communicating with homeowners in the interface about defensible space. In S. McCaffrey (Ed.), *The public and wildland fire management: social science findings for managers* (pp. 99–109). USDA Forest Service NRS-GTR-1, General Technical Report, Northern Research Station.

Moore, P. F. (2019). Global Wildland Fire Management Research Needs. *Current Forestry Reports*, *5*, 210–225. https://doi.org/10.1007/s40725-019-00099-y

Moors for the Future Partnership [MFFP]. (n.d.). *Moors for the Future Partnership Resources Search*. Retrieved 27.04.23, from https://www.moorsforthefuture.org.uk/our-resources/reports/_search-listings?queries_search_query=wildfire&search_page_1497983_submit_button=Submit&current_result_page=1&results_per_page=20&submitted_search_category=&mode=

Moreira, F., Viedma, O., Arianoutsou, M., Curt, T., Koutsias, N., Rigolot, E., Barbati, A., Corona, P., Vaz, P., Xanthopoulos, G., Mouillot, F., & Bilgili, E. (2011). Landscape - wildfire interactions in southern Europe: Implications for landscape management. *Journal of Environmental Management*, *92*(10), 2389–2402. https://doi.org/10.1016/j.jenvman.2011.06.028

Morgan, M. G., Fischoff, B., Bostrom, A., & Atman, C. J. (2001). *A Mental Models Approach to Risk Communication*. Cambridge University Press.

Moritz, M. A., Batllori, E., Bradstock, R. A., Gill, A. M., Handmer, J., Hessburg, P. F., Leonard, J., McCaffrey, S., Odion, D. C., Schoennagel, T., & Syphard, A. D. (2014). Learning to coexist with wildfire. *Nature*, *515*(7525), 58–66. https://doi.org/10.1038/nature13946

Mouillot, F., & Field, C. B. (2005). Fire history and the global carbon budget: A 1° × 1° fire history reconstruction for the 20th century. *Global Change Biology*, *11*(3), 398–420. https://doi.org/10.1111/j.1365-2486.2005.00920.x

Myers, R. L. (2006). Living with Fire—Sustaining Ecosystems & Livelihoods through Integrated Fire Management. The Nature Conservancy, Global Fire Initiative, Tallahassee.

Mylek, M. R., & Schirmer, J. (2020). Exploring the 'Issue-Attention Cycle': Does Length of Time Since Wildfire Predict Social Acceptability of Prescribed Burning? *Environmental Management*. https://doi.org/10.1007/s00267-019-01251-x

National Farming Union Scotland [NFUS]. (n.d.). *Crofting*. https://www.nfus.org.uk/policy/crofting.aspx

National Fire Protection Association [NFPA]. (2023). *Firewise USA*. Retrieved 07.11.23, from https://www.nfpa.org/education-and-research/wildfire/firewise-usa

National Parks Service [NPS] (n.d.). *Wildfires, Prescribed Fires, and Fuels*. Retrieved 12.09.23, from https://www.nps.gov/orgs/1965/wildfires-prescribed-fires-fuels.htm

National Records of Scotland. (n.d.). *Highland Council Area Profile: Population Estimates*. Retrieved 23.05.23, from https://www.nrscotland.gov.uk/files/statistics/council-area-data-sheets/highland-council-profile.html

Natural England. (2001). *The upland management handbook (SC26)*. Natural England. Retrieved 10.11.23, from https://publications.naturalengland.org.uk/publication/82050

Natural England. (2010). *England's peatlands carbon storage and greenhouse gases*. Natural England. Retrieved 10.11.23, from https://publications.naturalengland.org.uk/publication/30021

Natural England. (2013). *National Character Area Profile 135. Dorset Heaths*. Natural England. Retrieved 10.11.23, from https://publications.naturalengland.org.uk/publication/6271645295575040

Natural England. (2020). *Areas of Outstanding Natural Beauty (England)* (Version 01 September 2020). Retrieved 10.05.23, from https://www.data.gov.uk/dataset/8e3ae3b9-a827-47f1-b025-f08527a4e84e/areas-of-outstanding-natural-beauty-england

Natural England. (2022a). *National Parks England* (Version 08 June 2022). Retrieved 10.05.23, from https://www.data.gov.uk/dataset/334e1b27-e193-4ef5-b14e-696b58bb7e95/national-parks-england

Natural England. (2022b). *Special Protection Areas (England)* (Version 23 March 2022). Retrieved 10.05.23, from https://www.data.gov.uk/dataset/174f4e23-acb6-4305-9365-1e33c8d0e455/special-protection-areas-england

Natural England. (2023a). *Sites of Special Scientific Interest (England)* (Version 07 September 2023). Retrieved 10.05.23, from https://www.data.gov.uk/dataset/5b632bd7-9838-4ef2-9101-ea9384421b0d/sites-of-special-scientific-interest-england

Natural England. (2023b). *Special Areas of Conservation (England)* (Version 26 July 2023). Retrieved 10.05.23, from https://www.data.gov.uk/dataset/a85e64d9-d0f1-4500-9080-b0e29b81fbc8/special-areas-of-conservation-england

Natural Resources Wales [NRW]. (2014). National Landscape Character: South Wales Valleys. *NLCA37*. Natural Resources Wales.

Natural Resources Wales [NRW]. (2016). *Rhondda Trial Case Study - Healthy Hillsides*. Natural Resources Wales.

Nelson, K. C., Monroe, M. C., & Johnson, J. F. (2005). The look of the land: Homeowner landscape management and wildfire preparedness in Minnesota and Florida. *Society and Natural Resources*, *18*, 321–336. https://doi.org/10.1080/08941920590915233

Newman, S. M., Carroll, M. S., Jakes, P. J., Williams, D. R., & Higgins, L. L. (2014). Earth, Wind, and Fire: Wildfire Risk Perceptions in a Hurricane-Prone Environment. *Society and Natural Resources*, *27*(11), 1161–1176. https://doi.org/10.1080/08941920.2014.918234

Newman-Thacker, F. E. N., Ribau, M. C., Bartholomeus, H., & Stoof, C. R. (2023). What is a fire resilient landscape? Towards an integrated definition. *Ambio*, *52*(10), 1592–1602. https://doi.org/10.1007/s13280-023-01891-8

North, B. M. P., Stephens, S. L., Collins, B. M., Agee, J. K., Aplet, G., Franklin, J. F., & Fulé, P. Z. (2015). Reform Forest Fire Management. *Science*, *349*(6254), 1280–1281. https://doi.org/10.1126/science.aab2356

Office for National Statistics [ONS]. (2021). *Internet users, UK: 2020*. Census 2021. Retrieved 20.11.23, from https://www.ons.gov.uk/businessindustryandtrade/itandinternetindustry/bulletins/internetusers/2020

Office for National Statistics [ONS]. (2023). *Census Maps: Household Deprivation*. Census 2021. Retrieved 15.07.23, from https://www.ons.gov.uk/census/maps/choropleth/population/household-deprivation/hh-deprivation/household-is-deprived-in-one-dimension (last accessed: 06.10.23)

Office for National Statistics [ONS]. (n.d.). *Nomis: official census and labour market statistics*. Retrieved 28.06.23, from https://www.nomisweb.co.uk/query/select/getdatasetbytheme.asp?opt=3&theme=&subgrp=

Olsen, C. S., & Sharp, E. (2013). Building community-agency trust in fire-affected communities in Australia and the United States. *International Journal of Wildland Fire*, *22*(6), 822–831. https://doi.org/10.1071/WF12086

Olsen, C. S., & Shindler, B. A. (2010). Trust, acceptance, and citizen agency interactions after large fires: Influences on planning processes. *International Journal of Wildland Fire*, *19*(1), 137–147. https://doi.org/10.1071/WF08168

Olsen, C. S., Kline, J. D., Ager, A. A., Olsen, K. A., & Short, K. C. (2017). Examining the influence of biophysical conditions on wildland–urban interface homeowners' wildfire risk mitigation activities in fire-prone landscapes. *Ecology and Society*, *22*(1). https://doi.org/10.5751/ES-09054-220121

Oltedal, S., Moen, B.-J., Klempe, H., & Rundmo, T. (2004). Explaining risk perception: an empirical evaluation of cultural theory. Rotunde. Trodheim, Norway.

ONS. (2017a). *Rural Urban Classification (2011) map of the OAs in Wales*. Office for National Statistics licensed under the Open Government Licence v.3.0 - Contains OS data © Crown copyright 2017. Retrieved 02.04.23, from https://geoportal.statistics.gov.uk/documents/ons::rural-urban-classification-2011-map-of-the-oas-in-wales-1/explore

ONS. (2017b). *Rural Urban Classification (2011) map of the OAs in the South West Region*. Office for National Statistics licensed under the Open Government Licence v.3.0 - Contains OS data © Crown copyright 2017. Retrieved 02.04.23, from https://geoportal.statistics.gov.uk/documents/ons::rural-urban-classification-2011-map-of-the-oas-in-the-south-west-region-1/explore

ONS. (2017c). *Rural Urban Classification (2011) map of the OAs in the South East Region*. Office for National Statistics licensed under the Open Government Licence v.3.0 -

Contains OS data © Crown copyright 2017. Retrieved 02.04.23, from https://geoportal.statistics.gov.uk/documents/ons::rural-urban-classification-2011-map-of-the-oas-in-the-south-east-region-1/explore

Oppenheim, A. N. (2000). *Questionnaire design, interviewing and attitude measurement* (2nd ed.). Bloomsbury Publishing.

Oxborough, N., & Gazzard, R. (2011). Swinley Forest Fire Berkshire. *Fire Risk Management, 11–15 October*. Knowledge for Wildfire.

Palm, R. (1990). *Natural hazards: An integrative framework for research and planning*. John Hopkins University Press, Baltimore.

Panter, C. (2018). *Urban Heaths Partnership Annual Monitoring Report 2017-2018*. Unpublished report by Footprint Ecology for the Urban Heaths Partnership. Footprint Contract Reference: 449.

Panter, C., & Caals, Z. (2023). *UHP Annual Monitoring Report April 2020 - December 2021*. Unpublished report by Footprint Ecology for Urban Heaths Partnership. Footprint Contract Reference: 692.

Parfitt, J. (2005). Questionnaire design and sampling. In *Methods in Human Geography: a Guide For Students Doing a Research Project* (2nd ed., pp. 78–109). Pearson, Harlow.

Parkinson, T. M., Force, J. E., & Smith, J. K. (2003). Hands-on Learning. *Journal of Forestry*, *101*(7), 21–26. https://doi.org/10.1093/jof/101.7.21

Paton, D. (2008). Risk communication and natural hazard mitigation: How trust influences its effectiveness. *International Journal of Global Environmental Issues*, *8*(1–2), 2–16. https://doi.org/10.1504/IJGENVI.2008.017256

Paveglio, T. B., Carroll, M. S., Stasiewicz, A. M., & Edgeley, C. M. (2019). Social fragmentation and wildfire management: Exploring the scale of adaptive action. *International Journal of Disaster Risk Reduction*, *33*(October 2018), 131–141. https://doi.org/10.1016/j.ijdrr.2018.09.016

Paveglio, T. B., Moseley, C., Carroll, M. S., Williams, D. R., Davis, E. J., & Fischer, A. P. (2015). Categorizing the social context of the wildland urban interface: Adaptive capacity for wildfire and community “Archetypes.” *Forest Science*, *61*(2), 298–310. https://doi.org/10.5849/forsci.14-036

Paveglio, T., Carroll, M. S., Absher, J. D., & Norton, T. (2009). Just Blowing Smoke? Residents’ Social Construction of Communication about Wildfire. *Environmental Communication*, *3*(1), 76–94. https://doi.org/10.1080/17524030802704971

Paveglio, T., Norton, T., & Carroll, M. S. (2011). Fanning the Flames? Media Coverage during Wildfire Events and its Relation to Broader Societal Understandings of the Hazard. *Human Ecology Review*, *18*(1), 41–52.

Peattie, S., Peattie, K., & Thomas, R. (2012). Social Marketing as Transformational Marketing in Public Services: The Case of Project Bernie. *Public Management Review*, *14*(7), 987–1010. https://doi.org/10.1080/14719037.2012.662444

Perry, M. C., Vanvyve, E., Betts, R. A., & Palin, E. J. (2022). Past and future trends in fire weather for the UK. *Natural Hazards and Earth System Sciences*, *22*(2), 559–575. https://doi.org/10.5194/nhess-22-559-2022

Plough, A., & Krimsky, S. (1990). The Emergence of Risk Communication Studies: Social and Political Context. In T. S. Glickman & M. Gough (Eds.), *Readings in Risk* (pp. 223–231). Resources for the Future, Washington, DC.

Popping, R. (2015). Analyzing Open-ended Questions by Means of Text Analysis Procedures. *Bulletin de Methodologie Sociologique*, *128*(1), 23–39. https://doi.org/10.1177/0759106315597389

Prat-Guitart, N., Nugent, C., Mullen, E., Mitchell, F. J. G., Hawthorne, D., Belcher, C. M., & Yearsley, J. M. (2019). Peat Fires of Ireland. In G. B. Glenn (Ed.), *Coal and Peat Fires: A Global Perspective* (Volume 5:, pp. 451–479). Elsevier. https://doi.org/10.1016/B978-0-12-849885-9.00020-2

Prestemon, J. P., Pye, J. M., Butry, D. T., Holmes, T. P., & Mercer, D. E. (2002). Understanding broadscale wildfire risks in a human-dominated landscape. *Forest Science*, *48*(4), 685–693. https://doi.org/10.1093/forestscience/48.4.685

Price, E. (2003). *Lowland Grassland and Heathland Habitats*. Routledge, London.

Prior, T., & Eriksen, C. (2013). Wildfire preparedness, community cohesion and social-ecological systems. *Global Environmental Change*, *23*(6), 1575–1586. https://doi.org/10.1016/j.gloenvcha.2013.09.016

Prior, T., & Eriksen, C. (2013). Wildfire preparedness, community cohesion and social-ecological systems. *Global Environmental Change*, *23*(6), 1575–1586. https://doi.org/10.1016/j.gloenvcha.2013.09.016

Putnam, R. D. (2000). *Bowling Alone: The Collapse and Revival of American Community*. Simon and Schuster, New York.

Pyne, S. (1997). *Vestal fire an environmental history, told through fire, of Europe and Europe's encounter with the world*. University of Washington Press.

Pyne, S. (2001). *Fire: A Brief History. Environmental Books. Cycle of Fire Series*. University of Washington Press.

Pyne, S. J. (2007). Problems, paradoxes, paradigms: triangulating fire research. *International Journal of Wildland Fire*, *16*(3), 271. https://doi.org/10.1071/wf06041

Pyne, S. J. (2009). The human geography of fire: a research agenda. *Progress in Human Geography*, *33*(4), 443–446. https://doi.org/10.1177/0309132508101598

Pyne, S. J. (2016). Fire in the mind: changing understandings of fire in Western civilization. *Phil. Trans. R. Soc. B*, *371*(20150166). https://doi.org/10.1098/rstb.2015.0166

Pyne, S. J., & Goldammer, J. G. (1997). The Culture of Fire: An Introduction to Anthropogenic Fire History. In J. S. Clark, H. Cachier, J. G. Goldammer, & B. Stocks (Eds.), *Sediment Records of Biomass Burning and Global Change* (NATO ASI S, pp. 71–114). Springer. https://doi.org/10.1007/978-3-642-59171-6_5

Rackham, O. (1986). *History of the Countryside* (First). Pheonix, London.

Ramchunder, S. J., Brown, L. E., & Holden, J. (2009). Environmental effects of drainage, drain-blocking and prescribed vegetation burning in UK upland peatlands. *Progress in Physical Geography*, *33*(1), 49–79. https://doi.org/10.1177/0309133309105245

Randerson, J. T., Chen, Y., van der Werf, G. R., Rogers, B. M., & Morton, D. C. (2012). Global burned area and biomass burning emissions from small fires. *Journal of Geophysical Research*, *117*. https://doi.org/10.1029/2012JG002128

Rasch, R., & McCaffrey, S. (2019). Exploring Wildfire-Prone Community Trust in Wildfire Management Agencies. *Forest Science*, *65*(5), 652–663. https://doi.org/10.1093/forsci/fxz027

RCT County Borough Council. (2018). *Pen-pych Mountain By Tracy Purnell – Ordnance Survey Get Outside Champion*. Visit RCT. Retrieved: 17.09.23, from https://www.rctcbc.gov.uk/EN/Tourism/TourismBlogNews/BlogPosts/2017/December/PenpychMountain.aspx

Reed, M. S., Bonn, A., Slee, W., Beharry-Borg, N., Birch, J., Brown, I., Burt, T. P., Chapman, D., Chapman, P. J., Clay, G. D., Cornell, S. J., Fraser, E. D. G., Glass, J. H., Holden, J., Hodgson, J. A., Hubacek, K., Irvine, B., Jin, N., Kirkby, M. J., … Worrall, F. (2009). The future of the uplands. *Land Use Policy*, *26*(SUPPL. 1), 204–216. https://doi.org/10.1016/j.landusepol.2009.09.013

Rego, F., Rigolot, E., Fernandes, P., Montiel, C., & Silva, S. S. (2010). Towards Integrated Fire Management. In *EFI Policy Brief 4*. European Forest Institute.

Reid, K., & Beilin, R. (2014). Where's the Fire? Co-Constructing Bushfire in the Everyday Landscape. *Society and Natural Resources*, *27*, 140–154. https://doi.org/10.1080/08941920.2013.840815

Reis, S., Liska, T., Steinle, S., Carnell, E., Leaver, D., Roberts, E., Vieno, M., Beck, R., & Dragosits, U. (2017). *UK Gridded Population 2011 based on Census 2011 and Land Cover Map 2015*. NERC Environmental Information Data Centre. https://doi.org/10.5285/0995e94d-6d42-40c1-8ed4-5090d82471e1

Renn, O. (2008). *Risk Governance: Coping with Uncertainty in a Complex World*. Routledge Earthscan, London.

Rhode, R. F. (2010). Written on the surface of the soil: Northwest Highland crofting landscapes of Scotland during the twentieth century. In R. H. Webb, D. E. Boyer, & R. M. Turner (Eds.), *Repeat Photography: Methods and Applications in the Natural Sciences* (pp. 247–264). Island Press.

Robinne, F.-N., Burns, J., Kant, P., Flannigan, M. D., Kleine, M., de Groot, B., & Wotton, M. (2018). *Global Fire Challenges in a Warming World* (IUFRO Occasional Paper No. 32). IUFRO, Vienna.

Rolland, N. (2004). Was the emergence of home bases and domestic fire a punctuated event? A Review of the Middle Pleistocene record in Eurasia. *Asian Perspectives*, *43*(2), 248–280. https://doi.org/10.1353/asi.2004.0027

Roos, C. I., Bowman, D. M. J. S., Balch, J., Artaxo, P., Bond, W. J., Cochrane, M., D'Antonio, C. M., Defries, R., Mack, M., Johnston, F. H., Krawchuk, M. A., Kull, C. A., Moritz, M. A., Pyne, S., Scott, A. C., & Swetnam, T. W. (2014). Pyrogeography, historical ecology, and the human dimensions of fire regimes. *Journal of Biogeography*, *41*(4), 833–836. https://doi.org/10.1111/jbi.12285

Roos, C. I., Scott, A. C., Belcher, C. M., Chaloner, W. G., Aylen, J., Bird, R. B., Coughlan, M. R., Johnson, B. R., Johnston, F. H., McMorrow, J., Steelman, T., & Group, T. F. and M. D. (2016). Living on a flammable planet: interdisciplinary, cross-scalar and varied cultural lessons, prospects and challenges. *Phil. Trans. R. Soc. B*, *371*(20150469). https://doi.org/10.1098/rstb.2015.0469

RSPB Scotland. (2021). How to prevent nature and carbon going up in smoke: Licensing Muirburn. In *RSPB Report* (Issue September). Retrieved: 17.09.23, from https://www.rspb.org.uk/globalassets/downloads/nature-recovery-plan---scotland/rspbscotland_report_muirburnlicensing_oct2021.pdf

RSPB. (n.d.). *Ffridd - a habitat on the edge*. Working together to give nature a home RSPB, NRW. Retrieved: 17.09.23, from https://www.biodiversitywales.org.uk/File/481/en-GB

Russell-Smith, J., Yates, C. P., Whitehead, P. J., Smith, R., Craig, R., Allan, G. E., Thackway, R., Frakes, I., Cridland, S., Meyer, M. C. P., & Gill, A. M. (2007). Bushfires "down under": Patterns and implications of contemporary Australian landscape burning. *International Journal of Wildland Fire*, *16*(4), 361–377. https://doi.org/10.1071/WF07018

Ryan, R. L., & Wamsley, M. B. (2006). Perceptions of Wildfire Threat and Mitigation Measures by Residents of Fire-Prone Communities in the Northeast: Survey Results and Wildland Fire Management Implications. In S. M. McCaffrey (Ed.), *The public and wildland fire management: social science findings for managers. Gen. Tech. Rep. NRS-1.* (pp. 11–17). Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station.

Sande Silva, J., Rego, F., Fernandes, P., & Rigolot, E. (2010). Towards Integrated Fire Management - Outcomes of the European Project Fire Paradox. In *European Forest Institute Research Report 23*. European Forest Institute, Joensuu, Finland.

Santín, C., & Doerr, S. (2016). Fire effects on soils: the human dimension. *Phil. Trans. R. Soc. B*, *371*(20150171). https://doi.org/10.1098/rstb.2015.0171

Sarantakos, S. (2013). *Social Research* (4th ed.). Palgrave Macmillan.

Sattler, D. N., Adams, M. G., & Watts, B. (1995). Effects of Personal Experience on Judgments about Natural Disasters. *Journal of Social Behavior & Personality*, *10*(4), 891–898.

Schulte, S., & Miller, K. A. (2010). Wildfire risk and climate change: The influence on homeowner mitigation behavior in the wildland-urban interface. *Society and Natural Resources*, *23*(5), 417–435. https://doi.org/10.1080/08941920903431298

Scott, A. C. (2000). The Pre-Quaternary history of fire. *Palaeogeography, Palaeoclimatology, Palaeoecology*, *164*(1–4), 281–329. https://doi.org/10.1016/S0031-0182(00)00192-9

Scott, A. C., & Glasspool, I. J. (2006). The diversification of Paleozoic fire systems and fluctuations in atmospheric oxygen concentration. *Proceedings of the National Academy of Sciences of the United States of America*, *103*(29), 10861–10865. https://doi.org/10.1073/pnas.0604090103

Scott, A. C., Bowman, D. M. J. S., Bond, W. J., Pyne, S. J., & Alexander, M. E. (2014). *Fire on Earth: An introduction*. Wiley-Blackwell.

Scott, A. C., Chaloner, W. G., Belcher, C. M., & Roos, C. I. (2016b). Preface: The interaction of fire and mankind. *Phil. Trans. R. Soc. B*, *371*(20160149). https://doi.org/10.1098/rstb.2016.0149

Scott, A. C., Chaloner, W. G., Belcher, C. M., & Roos, C. I. (2016a). The interaction of fire and mankind: Introduction. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *371*(1696). https://doi.org/10.1098/rstb.2015.0162

Scottish Fire and Rescue Service [SFRS] (n.d.) Find a station. Retrieved 31.07.2024 from https://www.firescotland.gov.uk/contact-us/find-a-fire-station/

Scottish Government. (2013). *Wildfire Operational Guidance*. Produced for the Scottish Government by APS Group Scotland DPPAS12819, Edinburgh.

Scottish Government. (2020a). *Map 2.1: Scottish Government 8-fold Urban Rural Classification 2020*. Retrieved: 10.10.23, from https://www.gov.scot/publications/scottish-government-urban-rural-classification-2020/pages/2/

Scottish Government. (2020b). The Scottish Index of Multiple Deprivation 2020: introduction. In *The Scottish Index of Multiple Deprivation (SIMD)*. Retrieved: 10.10.23, from https://www.gov.scot/publications/scottish-index-multiple-deprivation-2020/documents/

Scottish Government. (2021). *The Muirburn Code*. Nature Scot and Scottish Government. Nature Scot, Inverness.

Scottish Government. (2022a). *Scottish Fire and Rescue Service (SFRS) - wildfire: incident reporting system - data analyses*. Scottish Government ISBN 9781804350744. Retrieved: 10.10.23, from https://www.gov.scot/publications/provision-analyses-scottish-fire-rescue-service-sfrs-incident-reporting-system-irs-data-relation-wildfire-incidents/pages/2/

Scottish Government. (2022b). *Scottish Government Urban Rural Classification 2020* (p. 2). Scottish Government ISBN 9781804354810. Retrieved: 10.10.23, from https://www.gov.scot/publications/scottish-government-urban-rural-classification-2020/pages/2/

Scottish Wildlife Trust. (2016). *Muirburn*. https://scottishwildlifetrust.org.uk

Shafran, A. P. (2008). Risk externalities and the problem of wildfire risk. *Journal of Urban Economics*, *64*(2), 488–495. https://doi.org/10.1016/j.jue.2008.05.001

Shindler, B. (2007). Public Acceptance of Wildland Fire Conditions and Fuel Reduction Practices: Challenges for Federal Forest Managers. In T. C. Daniel, M. S. Carroll, C.

Moseley, & C. Raish (Eds.), *People, fire, and forests: a synthesis of wildfire social science* (pp. 37–54). Oregon State University Press.

Shindler, B. A., Toman, E., & McCaffrey, S. M. (2009). Public perspectives of fire, fuels and the Forest Service in the Great Lakes Region: A survey of citizen-agency communication and trust. *International Journal of Wildland Fire*, *18*(2), 157–164. https://doi.org/10.1071/WF07135

Shindler, B. A., Toman, E., & McCaffrey, S. M. (2009). Public perspectives of fire, fuels and the Forest Service in the Great Lakes Region: A survey of citizen-agency communication and trust. *International Journal of Wildland Fire*, *18*(2), 157–164. https://doi.org/10.1071/WF07135

Shindler, B., Gordon, R., Brunson, M. W., & Olsen, C. (2011). Public perceptions of sagebrush ecosystem management in the great basin. *Rangeland Ecology and Management*, *64*(4), 335–343. https://doi.org/10.2111/REM-D-10-00012.1

Siegrist, M., & Cvetkovich, G. (2000). Perception of hazards: The role of social trust and knowledge. *Risk Analysis*, *20*(5), 713–720. https://doi.org/10.1111/0272-4332.205064

Simmons, I. (2003). *The Moorlands of England and Wales: An Environmental History 8000BC - AD2000*. Edinburgh University Press.

Sjöberg, L., Moen, E., & Rundmo, T. (2004). Explaining risk perception. An evaluation of the psychometric paradigm in risk perception research. In *Explaining risk perception*. Rotunde, Norway.

Sjöberg, L., Moen, E., & Rundmo, T. (2004). Explaining risk perception. An evaluation of the psychometric paradigm in risk perception research. In *Explaining risk perception*. Rotunde.

Skerratt, S., Atterton, J., McCracken, D., McMorran, R., & Thomson, S. G. (2016). *Rural Scotland in Focus*. Scotland's Rural College, Edinburgh.

Slovic, P. (1987). Perception of Risk. *Science*, *236*(4799), 280–285. https://doi.org/10.1126/science.3563507

Slovic, P. (1992). Perception of risk: reflections on the psychometric paradigm. In S. Krimsky & D. Golding (Eds.), *Social Theories of Risk* (pp. 117–152). Praeger.

Slovic, P. (1999). Are trivial risks the greatest risks of all? *Journal of Risk Research*, *2*(4), 281–288. https://doi.org/10.1080/136698799376727

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2004). Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk and rationality. *Risk Analysis*, *24*(2), 311–322. https://doi.org/10.1111/j.0272-4332.2004.00433.x

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2010). Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk and rationality. In P. Slovic (Ed.), *The Feeling of Risk* (pp. 21–36). Routledge. https://doi.org/10.4324/9781849776677

Slovic, P., Fischhoff, B., & Lichtenstein, S. (1990). Rating the risks. In T. S. Glickman & M. Gough (Eds.), *Readings in risk* (pp. 61–74). Resources for the Future. https://doi.org/10.1080/00139157.1979.9933091

Slovic, P., Fischhoff, B., Lichtenstein, S., Corrigan, B., & Combs, B. (1977). Preference for Insuring against Probable Small Losses: Insurance Implications. *The Journal of Risk and Insurance*, *44*(2), 237–258. https://doi.org/10.2307/252136

Smith, A. M. S., Kolden, C. A., Paveglio, T. B., Cochrane, M. A., Bowman, D. M. J. S., Moritz, M. A., Kliskey, A. D., Alessa, L., Hudak, A. T., Hoffman, C. M., Lutz, J. A., Queen, L. P., Goetz, S. J., Higuera, P. E., Boschetti, L., Flannigan, M., Yedinak, K. M., Watts, A. C., Strand, E. K., … Abatzoglou, J. T. (2016). The Science of Firescapes: Achieving Fire-Resilient Communities. *BioScience*, *66*(2). https://doi.org/10.1093/biosci/biv182

Smith, K. (2013). *Environmental hazards assessing risk and reducing disaster* (6th ed.). Routledge.

Smith, M. A., & Leigh, B. (1997). Virtual subjects: Using the Internet as an alternative source of subjects and research environment. *Behavior Research Methods, Instruments, and Computers*, *29*(4), 496–505. https://doi.org/10.3758/BF03210601

Sommers, W. T., Coloff, S. G., & Conard, S. G. (2011). *Synthesis of Knowledge: Fire History and Climate Change* (Vol. 19). Retrieved 10.07.23, from https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1018&context=jfspsynthesis

Šotic, A., & Rajic, R. (2015). The review of the definition of risk. *Online J. Appl. Knowl. Manage.*, *3*, 17–26.

South Wales Fire & Rescue Service [SWFRS]. (2019). SWFRS Wildfire Toolbox. EWWF, Northumberland Fire and Rescue Service. Retrieved 23.04.23, from https://www.northumberland.gov.uk/NorthumberlandCountyCouncil/media/Fire-and-Rescue/South-Wales-FRS-Wildfire-Toolbox-2019_v2-2.pdf

South Wales Fire & Rescue Service [SWFRS]. (2023). *Healthy Hillsides*. Your Safety & Wellbeing: Your Community. Retrieved 10.11.23, from https://www.southwales-fire.gov.uk/your-safety-wellbeing/your-community/healthy-hillsides/

Stacey, R., Gibson, S., & Hedley, P. (2012). *European Glossary for Wildfires and Forest Fires*. Retrieved 23.04.23, from https://gfmc.online/literature/EUFOFINET-Fire-Glossary.pdf

Steelman, T. (2016). U.S. wildfire governance as social-ecological problem. *Ecology and Society*, *21*(4). https://doi.org/10.5751/ES-08681-210403

Steelman, T. A. (2008). Addressing the mitigation paradox at the community level. In W. E. Martin, C. Raish, & B. Kent (Eds.), *Wildfire Risk: Human Perceptions and Management Implications* (pp. 64–80). Routledge. https://doi.org/10.4324/9781936331611

Steelman, T. A., & McCaffrey, S. (2012). Best practices in risk and crisis communication: Implications for natural hazards management. *Natural Hazards*, *65*(1), 683–705. https://doi.org/10.1007/s11069-012-0386-z

Steelman, T. A., McCaffrey, S. M., Velez, A. L. K., & Briefel, J. A. (2014). What information do people use, trust, and find useful during a disaster? Evidence from five large wildfires. *Natural Hazards*, *76*(1), 615–634. https://doi.org/10.1007/s11069-014-1512-x

Steelman, T., & McCaffrey, S. (2011). What is Limiting More Flexible Fire Management - Public or Agency Pressure? *Journal of Forestry*, *109*(8), 454–461. https://doi.org/10.1093/jof/109.8.454

Stidham, M., McCaffrey, S., Toman, E., & Shindler, B. (2014). Policy tools to encourage community-level defensible space in the United States: A tale of six communities. *Journal of Rural Studies*, *35*, 59–69. https://doi.org/10.1016/j.jrurstud.2014.04.006

Stoof, C. R., & Kettridge, N. (2022). Living With Fire and the Need for Diversity. *Earth's Future*, *10*(4). https://doi.org/10.1029/2021EF002528

Stoof, C., Langer, L., Mcmorrow, J., & Oswald, B. (2012). Global wildfire awareness. *Wildfire Magazine*, *21*(5), 12. Retrieved 10.10.23, from https://pure.manchester.ac.uk/ws/portalfiles/portal/32380283/FULL_TEXT.PDF

Swetnam, T. W., & Betancourt, J. L. (1998). Mesoscale Disturbance and Ecological Response to Decadal Climatic Variability in the American Southwest. *Journal of Climate*, *11*, 3128–3147. https://doi.org/10.1175/1520-0442(1998)011<3128:MDAERT>2.0.CO;2

Syphard, A. D., Keeley, J. E., Pfaff, A. H., & Ferschweiler, K. (2017). Human presence diminishes the importance of climate in driving fire activity across the United States. *Proceedings of the National Academy of Sciences of the United States of America*, *114*(52), 13750–13755. https://doi.org/10.1073/pnas.1713885114

Syphard, A. D., Radeloff, V. C., Keeley, J. E., Hawbaker, T. J., Clayton, M. K., Stewart, S. I., & Hammer, R. B. (2007). Human influence on California fire regimes. *Ecological Applications*, *17*(5), 1388–1402. https://doi.org/10.1890/06-1128.1

Taylor, A. L., Dessai, S., & Bruine de Bruin, W. (2014). Public perception of climate risk and adaptation in the UK: A review of the literature. *Climate Risk Management*, *4*, 1–16. https://doi.org/10.1016/j.crm.2014.09.001

Tedim, F., & Leone, V. (2020). The Dilemma of Wildfire Definition: What It Reveals and What It Implies. In *Frontiers in Forests and Global Change* (Vol. 3, Issue December). https://doi.org/10.3389/ffgc.2020.553116

Tedim, F., Leone, V., & Xanthopoulos, G. (2015b). Wildfire risk management in Europe: the challenge of seeing the "forest" and not just the "trees." *Proceedings of the 13th International Wildland Fire Safety Summit & 4th Human Dimensions of Wildland Fire, April 20-24, Noise, Idaho*. 213–238. International Association of Wildland Fire, Montana.

Tedim, F., Leone, V., & Xanthopoulos, G. (2016). A wildfire risk management concept based on a social-ecological approach in the European Union: Fire Smart Territory. *International Journal of Disaster Risk Reduction*, *18*, 138–153. https://doi.org/10.1016/j.ijdrr.2016.06.005

Tedim, F., Xanthopoulos, G., & Leone, V. (2015a). Forest Fires in Europe: Facts and Challenges. In D. Paton, P. T. Buergelt, S. McCaffrey, & F. Tedim (Eds.), *Wildfire hazards, risks, and disasters*. Elsevier.

Tharme, A. P., Green, R. E., Baines, D., Bainbridge, I. P., & O'Brien, M. (2001). The effect of management for red grouse shooting on the population density of breeding birds on heather-dominated moorland. *Journal of Applied Ecology*, *38*, 439–457. https://doi.org/10.1046/j.1365-2664.2001.00597.x

The Future Generations Commissioner for Wales. (n.d.). *Well-being of Future Generations (Wales) Act*. Retrieved 10.12.23, from https://www.futuregenerations.wales/about-us/future-generations-act/

The James Hutton Institute [JHI]. (2023). *Land Capability for Agriculture in Scotland*. Retrieved 08.11.23, from https://www.hutton.ac.uk/learning/exploringscotland/land-capability-agriculture-scotland

The Southwest Research Company Ltd [TSWRC]. (2020). The Economic Impact of Dorset's Visitor Economy 2019. In *Visit Dorset* (Issue November). Retrieved 06.10.23, from https://www.visit-dorset.com/industry/research/destination-performance/

Thieken, A. H., Kreibich, H., Müller, M., & Merz, B. (2007). Coping with floods: Preparedness, response and recovery of flood-affected residents in Germany in 2002. *Hydrological Sciences Journal*, *52*(5), 1016–1037. https://doi.org/10.1623/hysj.52.5.1016

Thomson, J. (2016). Rural deprivation Evidence summary, Scottish Index of Multiple Deprivation. Communities Analysis Division, Scottish Government. Retrieved 06.07.23, from https://www2.gov.scot/Resource/0051/00514495.pdf

Thomson, S., McMorran, R., Newey, S., Matthews, K., Fielding, D., Miller, D., Glass, J., Gandossi, G., McMillan, J., Spencer, M. (2020). *The socioeconomic and biodiversity impacts of driven grouse moors and the employment rights of gamekeepers: summary report*. Scottish Government, & APS Group Scotland.

Tobin, G. A., & Montz, B. E. (1997). *Natural hazards: explanation and integration*. Guilford Press, New York.

Toman, E., & Shindler, B. (2006). Communicating the Wildland Fire Message: Influences on Knowledge and Attitude Change in Two Case Studies Related Research. *USDA Forest Service Proceedings RMRS-P-41*, 715–728.

Toman, E., Shindler, B., & Brunson, M. (2006). Fire and Fuel Management Communication Strategies: Citizen Evaluations of Agency Outreach Activities. *Society and Natural Resources*, *19*(4), 321–336. https://doi.org/10.1080/08941920500519206

Toman, E., Shindler, B., & Reed, M. (2004). Prescribed fire: the influence of site visits on citizen attitudes. *The Journal of Environmental Education*, *35*(4), 13–17. https://doi.org/10.3200/JOEE.35.3.13-33

Toman, E., Shindler, B., McCaffrey, S., & Bennett, J. (2014). Public acceptance of wildland fire and fuel management: Panel responses in seven locations. *Environmental Management*, *54*(3), 557–570. https://doi.org/10.1007/s00267-014-0327-6

Toman, E., Stidham, M., McCaffrey, S., & Shindler, B. (2013). *Social Science at the Wildland-Urban Interface: a Compendium of Research Results to Create Fire-Adapted Communities*. General Technical Report NRS-111. USDA Forest Service, Northern Research Station, Newton Square.

Toman, E., Stidham, M., Shindler, B., & McCaffrey, S. (2011). Reducing fuels in the wildland–urban interface: community perceptions of agency fuels treatments. *International Journal of Wildland Fire*, *20*, 340–349. https://doi.org/10.1071/WF10042

Trup, N. (2019, December 8). Best things to do in Fort William, Scotland: a weekend itinerary. *The Times*. Retrieved 17.07.23, from https://www.thetimes.co.uk/article/best-things-to-do-in-fort-william-scotland-a-weekend-itinerary-nhnmlfndn

Tucker, G. (2003). *Review of impacts of heather and grassland burning in the uplands on soils, hydrology and biodiversity*. Natural England. https://publications.naturalengland.org.uk/publication/142001

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, *5*(2), 207–232. https://doi.org/10.1016/0010-0285(73)90033-9

Tyler, M., & Fairbrother, P. (2013). Bushfires are “men’s business”: The importance of gender and rural hegemonic masculinity. *Journal of Rural Studies*, *30*, 110–119. https://doi.org/10.1016/j.jrurstud.2013.01.002

Tyler, M., & Fairbrother, P. (2013). Gender, masculinity and bushfire: Australia in an international context. *Australian Journal of Emergency Management*, *28*(2), 20–25.

Tyler, M., & Fairbrother, P. (2018). Gender, households, and decision-making for wildfire safety. *Disasters*, *42*(4), 697–718. https://doi.org/10.1111/disa.12285

Tymstra, C., Stocks, B. J., Cai, X., & Flannigan, M. D. (2020). Wildfire management in Canada: Review, challenges and opportunities. *Progress in Disaster Science*, *5*, 100045. https://doi.org/10.1016/j.pdisas.2019.100045

Urban Heath Partnership [UHP]. (2018). *Urban Heaths Partnership Heathland Mitigation Delivery Report 2017-2018*.

Urban Heath Partnership [UHP]. (2022). *History of the Heaths*. Retrieved 17.09.23, from https://www.dorsetheaths.org.uk/history/

Urban Heath Partnership [UHP]. (2022). *Urban Heaths Partnership*. Retrieved 17.09.23, from https://www.dorsetheaths.org.uk/

US Forest Service (2023). *Living with wildfire: Homeowners’ firewise guide for Arizona..* https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5339207.pdf

Van Der Werf, G. R., Randerson, J. T., Giglio, L., Collatz, G. J., Kasibhatla, P. S., & Arellano, A. F. (2006). Interannual variability in global biomass burning emissions from 1997 to 2004. *Atmospheric Chemistry and Physics*, *6*(11), 3423–3441. https://doi.org/10.5194/acp-6-3423-2006

Van Selm, M., & Jankowski, N. W. (2006). Conducting online surveys. *Quality and Quantity*, *40*(3), 435–456. https://doi.org/10.1007/s11135-005-8081-8

Vanha-Majamaa, I. (2006). *Global Forest Resources Assessment 2005 – Report on fires in the Baltic Region and adjacent countries. Fire Management Working Paper 7*. FAO, Rome, Italy.

Vaske, J., Bright, A. D., & Absher, J. D. (2008). Salient Value Similarity, Social Trust, and Attitudes Tiwards Wildland Fire Management Strategies. *Gen. Tech. Rep. PSW GTR-209. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 251 P*.

Vining, J., & Merrick, M. S. (2008). The influence of proximity to a national forest on emotions and fire-management decisions. *Environmental Management*, *41*(2), 155–167. https://doi.org/10.1007/s00267-007-9041-y

Visit Dorset. (2023a). Homepage. Retrieved 17.10.23, from https://www.visit-dorset.com/

Visit Scotland. (2020). *Insight Department: Highland Factsheet 2019*. Retrieved 20.10.23, from https://www.visitscotland.org/research-insights/regions/highlands

Vogt, C. A., Winter, G., & Fried, J. S. (2005). Predicting homeowners' approval of fuel management at the wildland-urban interface using the theory of reasoned action. *Society and Natural Resources*, *18*(4), 337–354. https://doi.org/10.1080/08941920590915242

Vogt, C., Winter, G., & McCaffrey, S. (2007). Community Views of Fuels Management: Are National Forest Local Recreation Users More Supportive? *Proceedings of the 2006 Northeastern Recreation Research Symposium, GTR-NRS-P-14*.

Wachinger, G., & Renn, O. (2010). Risk perception and natural hazards. In *Natural Hazards*. CapHaz-Net WP3 Report. DIALOGIK Non-Profit Institute for Communication and Cooperative Research, Stuttgart

Wachinger, G., Renn, O., Begg, C., & Kuhlicke, C. (2013). The risk perception paradox-implications for governance and communication of natural hazards. *Risk Analysis*, *33*(6), 1049–1065. https://doi.org/10.1111/j.1539-6924.2012.01942.x

Walker, J., Hewson, W., & Mcmorrow, J. (2009). *Spatial pattern of wildfire distribution on the moorlands of the South Pennines*. Moors for the Future Partnership.

Walker, S. H., Rideout, D. B., Loomis, J. B., & Reich, R. (2007). Comparing the value of fuel treatment options in northern Colorado's urban and wildland-urban interface areas. *Forest Policy and Economics*, *9*(6), 694–703. https://doi.org/10.1016/j.forpol.2006.06.001

Weber, D., Nasim, M., Falzon, L., & Mitchell, L. (2020). #ArsonEmergency and Australia's "Black Summer": Polarisation and Misinformation on Social Media. *MISDOOM 2020: Disinformation in Open Online Media. The Netherlands, October 26–27, 2020.*, 159–173. https://doi.org/10.1007/978-3-030-61841-4_11

Webster, P., & Neal, K. (2022). The 'cost of living crisis.' *Journal of Public Health*, *44*(3), 475–476. https://doi.org/10.1093/pubmed/fdac080

Welsh Government. (2019a). *Statistical Bulletin, Grassland fires 2018-19*. Statistics for Wales. Retrieved 18.09.23, from https://www.gov.wales/grassland-fires-april-2018-march-2019

Welsh Government. (2019b). *Welsh Index of Multiple Deprivation (WIMD) 2019: Results report*. Statistics for Wales, Cardiff. Retrieved 18.09.23, from https://gov.wales/sites/default/files/statistics-and-research/2019-11/welsh-index-multiple-deprivation-2019-results-report-024.pdf

Welsh Government. (2020). *Statistical Bulletin, Grassland fires 2019-20*. Statistics for Wales. Retrieved 18.09.23, from https://www.gov.wales/grassland-fires-april-2020-march-2021

Welsh Government. (2021). *Statistical Bulletin, Grassland fires 2020-21*. Statistics for Wales. https://www.gov.wales/grassland-fires-april-2020-march-2021

Welsh Government. (2022). *Statistical Bulletin, Grassland fires 2021-22*. Statistics for Wales. Retrieved 18.09.23, from https://www.gov.wales/grassland-fires-april-2021-march-2022

Werrity, A., Hester, A., Jameson, A., Newton, I., Oddy, M., & Reid, C. (2019). *Grouse moor management review group: Report to the Scottish Government*. *November*, 93. Retrieved 22.11.23, from https://www.gov.scot/publications/grouse-moor-management-group-report-scottish-government/pages/3/

White, G. F. (1974). *Natural Hazards: Local, National and Global*. Oxford University Press, New York.

Whitehead, S., Weald, H., & Baines, D. (2021). Post-burning responses by vegetation on blanket bog peatland sites on a Scottish grouse moor. *Ecological Indicators*, *123*, 107336. https://doi.org/10.1016/j.ecolind.2021.107336

Whitelocks, S. (2017, April 27). Dreamy Dorset! A landscape of dramatic rock arches, turquoise waters and rolling fields captured in stunning aerial shots. *Mail Online*. Retrieved 17.07.23, from https://www.dailymail.co.uk/travel/travel_news/article-4450906/Dreamy-Dorset-Landscapes-captured-stunning-shots.html

Whitmarsh, L. (2008). Are flood victims more concerned about climate change than other people? the role of direct experience in risk perception and behavioural response. *Journal of Risk Research*, *11*(3), 351–374. https://doi.org/10.1080/13669870701552235

WHO. (n.d.). *Wildfires*. Health Topics. Retrieved 23.03.23, from https://www.who.int/health-topics/wildfires#tab=tab_1

Whyte, A. (1986). From hazard perception to human ecology. In R. Kates & I. Burton (Eds.), *Themes from the work of Gilbert F. White. Vol. 2, Geography, resources, and environment* (pp. 240–271). University of Chicago Press, Chicago.

Willis, M. (2004). Bushfire arson: a review of the literature. In S. Christensen (Ed.), *Australian Institute of Criminology Research and Public Policy Series* (Issue 61). Australian Institute of Criminology. http://www.aic.gov.au/publications/rpp/61/RPP61.pdf

Wilson, H. F., & Darling, J. (2020). *Research Ethics for Human Geography: A Handbook for Students*. SAGE. https://doi.org/10.4135/9781529739947

Wilson, R. S., Zwickle, A., & Walpole, H. (2019). Developing a Broadly Applicable Measure of Risk Perception. *Risk Analysis*, *39*(4), 777–791. https://doi.org/10.1111/risa.13207

Winter, G., & Fried, J. S. (2000). Homeowner Perspectives on Fire Hazard, Responsibility, and Management Strategies at the Wildland-Urban Interface. *Society and Natural Resources*, *13*, 33–49. https://doi.org/10.1080/089419200279225

Winter, G., Vogt, C. A., & Fried, J. S. (2002). Fuel Treatments at the Wildland-Urban-Interface Common Concerns in Diverse Regions. *Journal of Forestry*, *1*, 15–21. https://doi.org/10.1093/jof/100.1.15

Winter, G., Vogt, C. A., & McCaffrey, S. (2004). Examining Social Trust in Fuels Management Strategies. *Journal of Forestry*, *102*(6). https://doi.org/10.1093/jof/102.6.8

Winter, G., Vogt, C., & McCaffrey, S. (2006). Residents warming up to fuels management: homeowners' acceptance of wildfire and fuels management in the wildland-urban interface. In *The public and wildland fire management: social science findings for managers. Gen. Tech. Rep. NRS-1.* (pp. 19–32). Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station.

Winter, P. L., & Cvetkovich, G. T. (2008). Diversity of southwesterners' views of Forest Service fire management. In W. Martin, C. Raish, & B. Kents (Eds.), *Wildfire Risk: Human Perceptions and Management Implications* (pp. 156–170). Resources for the Future.

Wolters, E. A., Steel, B. S., Weston, D., & Brunson, M. (2017). Determinants of residential Firewise behaviors in Central Oregon. *Social Science Journal*, *54*(2), 168–178. https://doi.org/10.1016/j.soscij.2016.12.004

Worrall, F., Clay, G., Marrs, R., & Reed, M. (2010). Impacts of Burning Management on Peatlands: Review. *IUCN, UK Peatland Programme, Durham*.

Wu, M., Knorr, W., Thonicke, K., Schurgers, G., Camia, A., & Arneth, A. (2015). Sensitivity of burned area in Europe to climate change, atmospheric CO2 levels, and demography: A comparison of two fire-vegetation models. *Journal of Geophysical Research: Biogeosciences*, *120*, 2256–2272. https://doi.org/10.1002/2015JG003036

Wulfhorst, J. D., & Nielsen-Pincus, M. (2003). Negotiating public health: A theoretical perspective on agricultural burning and community conflict in northern Idaho. *Applied Environmental Science and Public Health*, *1*(1), 33–43.

Wulfhorst, J. D., Kane, S. L., Tassell, L. W. Van, Alvarez, B., Johnson, B., Peterson, K., & Afatchao, R. (2006). *Public Attitudes and Perceptions of Air Quality and Bluegrass Seed Residue Burning in Northern Idaho*. Idaho Agricultural Experiment Station, Moscow, Idaho.

Wunder, S., Calkin, D. E., Charlton, V., Feder, S., Martínez de Arano, I., Moore, P., Rodríguez y Silva, F., Tacconi, L., & Vega-García, C. (2021). Resilient landscapes to prevent catastrophic forest fires: Socioeconomic insights towards a new paradigm. *Forest Policy and Economics*, *128*(September 2020), 102458. https://doi.org/10.1016/j.forpol.2021.102458

Xanthopoulos, G., & Athanasiou, M. (2019). Attica Region, Greece July 2018: A tale of two fires and a seaside tragedy. *Wildfire*, *28*(2), 18–21.

Yallop, A. R., Thacker, J. I., Thomas, G., Stephens, M., Clutterbuck, B., Brewer, T., & Sannier, C. A. D. (2006). The extent and intensity of management burning in the English uplands. *Journal of Applied Ecology*, *43*(6), 1138–1148. https://doi.org/10.1111/j.1365-2664.2006.01222.x

APPENDIX 1: DATA COLLECTION INSTRUMENTS

i) Survey structure

First, presented here is an outline of the surveys.

Table i.1: Main survey structure

MAIN SURVEY QUESTIONS					
Section	**Questions**	**Case study**			**Theme**
1	First half of postcode				Participant characteristics
2	*(Gave the UK definition of wildfire to clarify what is being referred to in the survey.)* Whether seen a wildfire in local area Whether consider wildfire a problem in local area Individual wildfire risk score Reason for risk score Top concerns of local wildfires Two months of highest wildfire risk Two factors influencing local wildfires Climate change effect on current and future wildfire				Risk and awareness
3	Heard of Australia black summer bushfires and sources of this news				*Foreign wildfire*
Or 3	Whether heard of Firewise Whether interested in taking part in Firewise and reason for this Suggestions of wildfire mitigation for their property				*Preparedness*
Or 3	Whether heard of muirburn term and what it means Whether aware of a use of fire for local area Whether agree to use of fire as tool and reason for this				*Prescribed fire*
4	Age group, gender, occupation Whether they do work related to wildfire Willing to be contacted for a short follow-up				Participant characteristics

Table i.2: Follow-up survey structure

FOLLOW-UP SURVEY QUESTIONS (VALLEYS AND DORSET)				
Question				**Theme**
Whether consider wildfire a problem (duplicate)				Risk and awareness
Individual wildfire risk score (duplicate)				
Belief that climate change will affect area or wildfire				
Whether agree to use of fire as tool and reason for this				Prescribed fire

ii) Approaching participants

When in-person a short, hopefully noticeable phrase was used to approach potential participants. This included lines such as: "*Do you have a moment to talk about wildfires in* *the area?*” and “*I’m a University student researching wildfires, can I ask you some questions?*”.

For online, adverts posted to social media pages were the way the majority of participants were approached. The rest potentially through snowball sampling where the survey was encouraged to be shared. The advert served as a key introduction to the survey as well as the plea to get the right people [local residents, with no need of specialised knowledge] filling in the survey.

Figure ii.1) Examples of adverts from each of the three case studies, for A) the Valleys, B) Dorset, and C) Highlands.

At the beginning of the survey some basic information was given; that is information on the survey, introducing the researcher, and the research. Such as that included in the welcome page of the online survey.

Figure ii.2) Example of welcome page for the online survey.

iii) Full in-person survey instrument

The three surveys, for each of the case studies are presented here; for the South Wales Valleys, Dorset, and the west Highlands.

Table iii.1) Valleys in-person full survey

Valleys In-Person Survey	
1	Do you live locally to the Valleys – Rhondda, Cynon, Taf, Merthyr? If yes, what is the first half of your postcode? CF…
	Wildfires are formally defined as: "any uncontrolled vegetation fire". In the UK they are mostly grassfires or moorlands fire. And wildfires do not necessarily need to start 'naturally', in fact in the UK they are mostly caused by people.
2	Have you ever seen for yourself a wildfire (an uncontrolled vegetation fire) **in your local area?** If so, how many roughly? No, none | No, only remains | Yes, just one | Yes, a couple | Yes, many (potentially every year)
3	In your opinion, would you consider there to be a problem with wildfires in the Valleys? Yes | No
4	On a scale of 0 to 4, what level of risk do you think wildfires in the Valleys pose **to you, or your property, personally**? *Where 0 is no risk, and 4 is very high level of risk.* 0 None | 1 Low | 2 Moderate | 3 High | 4 Very High
4b	Please explain this score. Open…
5	What would be your two biggest concerns if a wildfire happens **local to you**? *So, what impacts of wildfires would you be most worried about…*

	Concern 1:			Concern 2:		
6	In your opinion, what is the most important influencing factor of local wildfires?			*There is no right answer, just in your mind, what has the biggest influence on whether wildfires happen, or how big they are.*		
	Hot weather	Dry weather	Build-up of vegetation	People (ignitions)	Time of year	Other:
7	In your opinion, in what 2 months of the year do you think wildfires are most likely to happen around here/in the Valleys?					
	Month 1:			Month 2:		
8a	Do you think **current UK** wildfire activity has been affected by climate change up to now?					
	Yes		I don't know		No	
8b	Do you think **future UK** wildfire activity has been affected by climate change up to now?					
	Yes		I don't know		No	
	Now, we will move onto your awareness of a foreign wildfire…					
9	Did you hear about the 2019/2020 Australian wildfires?					
	Yes			No		
	If yes, where do you remember hearing this from?					
	Social media	Television news	Radio	Online news	Newspaper	Other
	Lastly, just a couple of questions about you…					
17	What age range do you fit into?					
	18-24	25-34	35-44	45-54	55-64	65+
18	How would you describe your gender?					
	Woman	Man	Non-binary	In another way	Prefer not to say	
19	What is your occupation?					
	Open:					
20	Are you employed by an organisation that has any involvement with wildfires or their management?					
	Yes			No		
	If yes, please specify:					
21	Lastly, would you be willing to be contacted in 6 months time for a couple short follow-up questions.					
	Contact:					

Table iii.2) Dorset in-person full survey

Dorset In-Person Survey					
1	Do you live locally to Dorset? If yes, what is the first half of your postcode?				
	BH… DT…				
Wildfires are formally defined as: "any uncontrolled vegetation fire". In the UK they are mostly grassfires or moorlands fire. And wildfires do not necessarily need to start 'naturally', in fact in the UK they are mostly caused by people.					
2	Have you ever seen for yourself a wildfire (an uncontrolled vegetation fire) **in your local area?** If so, how many roughly?				
	No, none	No, only remains	Yes, just one	Yes, a couple	Yes, many (potentially every year)

3	In your opinion, would you consider there to be a problem with wildfires in Dorset?					
	Yes			No		
4	On a scale of 0 to 4, what level of risk do you think wildfires in Dorset pose **<u>to you, or your property, personally</u>**?			*Where 0 is no risk, and 4 is very high level of risk.*		
	0 None	1 Low	2 Moderate	3 High	4 Very High	
4b	Please explain this score.					
	Open…					
5	What would be your two biggest concerns if a wildfire happens **local to you**?			*So, what impacts of wildfires would you be most worried about…*		
	Concern 1:			Concern 2:		
6	In your opinion, what is the most important influencing factor of local wildfires?			*There is no right answer, just in your mind, what has the biggest influence on whether wildfires happen, or how big they are.*		
	Hot weather	Dry weather	Build-up of vegetation	People (ignitions)	Time of year	Other:
7	In your opinion, in what 2 months of the year do you think wildfires are most likely to happen around here/in Dorset?					
	Month 1:			Month 2:		
8a	Do you think **current UK** wildfire activity has been affected by climate change up to now?					
	Yes	I don't know	No			
8b	Do you think **future UK** wildfire activity has been affected by climate change up to now?					
	Yes	I don't know	No			
	Now, we will move onto your awareness of preparing for wildfire…					
9	Have you heard of Firewise UK, or Firewise USA?					
	Yes, both	Yes, only UK	Yes, only USA	No		
10	Would you be interested in taking part in a Firewise like scheme if one was set up in your local area?					
	Yes			No		
10b	What was your reason for this answer?					
	Open…					
11	What are two actions you could undertake to prepare your own property?			*If you are not aware of any, please put 'Not sure'.*		
	Action 1:			Action 2:		
	Lastly, just a couple of questions about you…					
17	What age range do you fit into?					
	18-24	25-34	35-44	45-54	55-64	65+
18	How would you describe your gender?					
	Woman	Man	Non-binary	In another way	Prefer not to say	
19	What is your occupation?					
	Open:					
20	Are you employed by an organisation that has any involvement with wildfires or their management?					
	Yes			No		

	If yes, please specify:	
21	Lastly, would you be willing to be contacted in 6 months time for a couple short follow-up questions. Contact:	

Table iii.3) Highlands in-person full survey

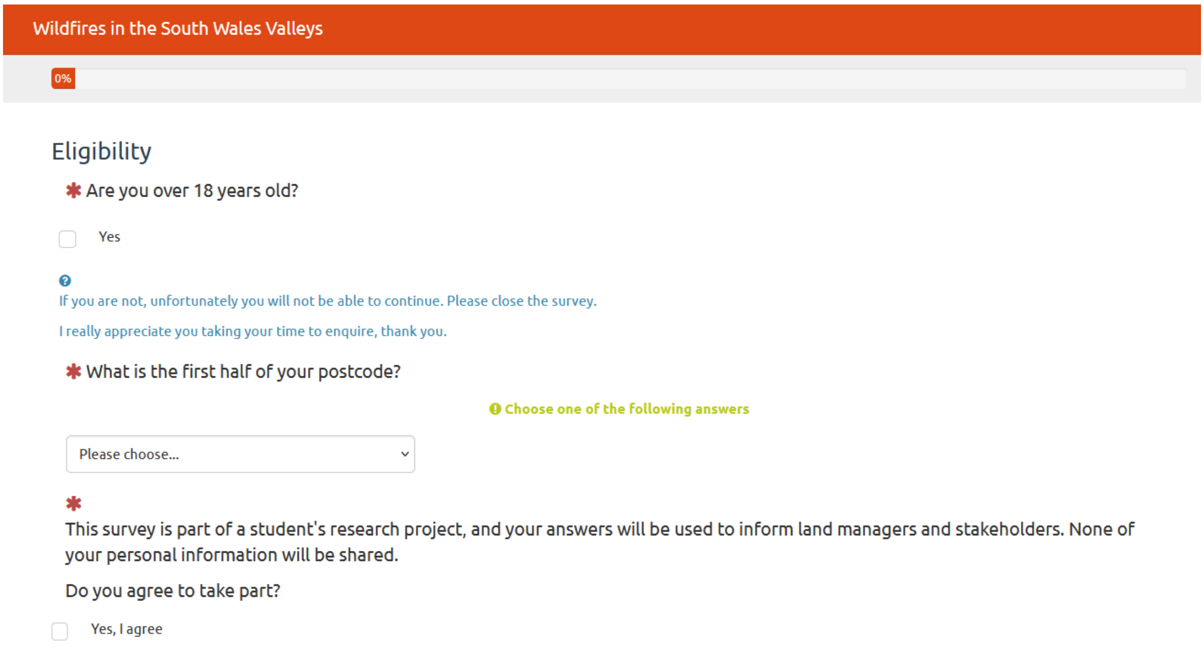
Highlands In-Person Survey						
1	Do you live locally to the West Highlands? If yes, what is the first half of your postcode? PH18-46					
Wildfires are formally defined as: "any uncontrolled vegetation fire". In the UK they are mostly grassfires or moorlands fire. And wildfires do not necessarily need to start 'naturally', in fact in the UK they are mostly caused by people.						
2	Have you ever seen for yourself a wildfire (an uncontrolled vegetation fire) **in your local area?** If so, how many roughly?					
	No, none	No, only remains	Yes, just one	Yes, a couple	Yes, many (potentially every year)	
3	In your opinion, would you consider there to be a problem with wildfires in the West Highlands?					
	Yes	No				
4	On a scale of 0 to 4, what level of risk do you think wildfires in the Highlands pose **<u>to you, or your property, personally</u>**?	*Where 0 is no risk, and 4 is very high level of risk.*				
	0 None	1 Low	2 Moderate	3 High	4 Very High	
4b	Please explain this score. Open…					
5	What would be your two biggest concerns if a wildfire happens **local to you**?	*So, what impacts of wildfires would you be most worried about…*				
	Concern 1:	Concern 2:				
6	In your opinion, what is the most important influencing factor of local wildfires?	*There is no right answer, just in your mind, what has the biggest influence on whether wildfires happen, or how big they are.*				
	Hot weather	Dry weather	Build-up of vegetation	People (ignitions)	Time of year	Other:
7	In your opinion, in what 2 months of the year do you think wildfires are most likely to happen around here/in the west Highlands?					
	Month 1:	Month 2:				
8a	Do you think **current UK** wildfire activity has been affected by climate change up to now?					
	Yes	I don't know	No			
8b	Do you think **future UK** wildfire activity has been affected by climate change up to now?					
	Yes	I don't know	No			
Now, we will move onto some of your opinions about fire on the landscape…						
9	How much do you agree with the statement, "*All vegetation fires are bad*"?					
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	

10	Have you ever heard the term ‘muirburn’ before? Yes, I am familiar | Yes, but I am not sure what it means | No	*If you are only familiar the term but are not sure, put ‘yes, but not sure’.*
10b	If yes, what do you think it means… Open…	
15	Are you aware of any uses of fire on your local landscape, if so, what are they? Yes | No ……	*This means any time where fire is used intentionally.*
16	To what extent do you agree with this statement? **“I would be okay with the use of fire as a management tool on the local landscape.”** Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree	
	Lastly, just a couple of questions about you…	
17	What age range do you fit into? 18-24 | 25-34 | 35-44 | 45-54 | 55-64 | 65+	
18	How would you describe your gender? Woman | Man | Non-binary | In another way | Prefer not to say	
19	What is your occupation? Open:	
20	Are you employed by an organisation that has any involvement with wildfires or their management? Yes | No If yes, please specify:	
21	Lastly, would you be willing to be contacted in 6 months time for a few short follow-up questions. Contact:	

iv) Full online survey instrument

Next, the online surveys, identical in structure to their in-person counterparts, but nonetheless important to show here to exemplify the interface and design. Here the full survey for the Valleys case study will be shown as the main example. Then, the location specific section for the remaining two case studies will be shown.

Figure iv.1) Valleys online survey section 1 – eligibility


Wildfires in the South Wales Valleys

0%

Eligibility

* Are you over 18 years old?

Yes

If you are not, unfortunately you will not be able to continue. Please close the survey.

I really appreciate you taking your time to enquire, thank you.

* What is the first half of your postcode?

Choose one of the following answers

Please choose...

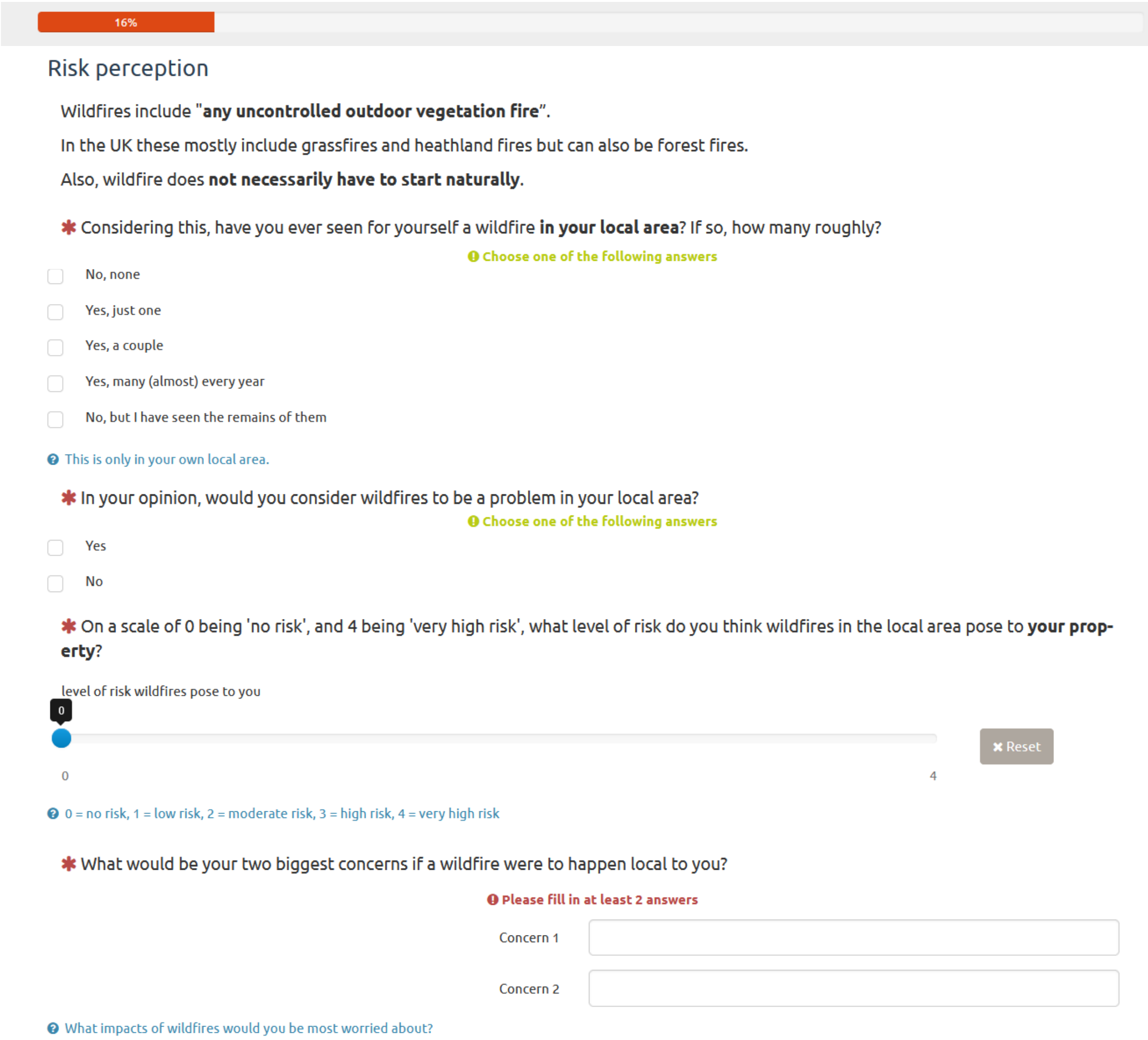
*

This survey is part of a student's research project, and your answers will be used to inform land managers and stakeholders. None of your personal information will be shared.

Do you agree to take part?

Yes, I agree

Figure iv.2) Valleys online survey section 2 – risk perception



16%

Risk perception

Wildfires include "**any uncontrolled outdoor vegetation fire**".

In the UK these mostly include grassfires and heathland fires but can also be forest fires.

Also, wildfire does **not necessarily have to start naturally**.

✱ Considering this, have you ever seen for yourself a wildfire **in your local area**? If so, how many roughly?

Choose one of the following answers

- No, none
- Yes, just one
- Yes, a couple
- Yes, many (almost) every year
- No, but I have seen the remains of them

This is only in your own local area.

✱ In your opinion, would you consider wildfires to be a problem in your local area?

Choose one of the following answers

- Yes
- No

✱ On a scale of 0 being 'no risk', and 4 being 'very high risk', what level of risk do you think wildfires in the local area pose to **your property**?

level of risk wildfires pose to you

0

Reset

0 4

0 = no risk, 1 = low risk, 2 = moderate risk, 3 = high risk, 4 = very high risk

✱ What would be your two biggest concerns if a wildfire were to happen local to you?

Please fill in at least 2 answers

Concern 1

Concern 2

What impacts of wildfires would you be most worried about?

Figure iv.3) Valleys online survey section 3 – wildfire awareness

33%

Wildfire knowledge

* In your opinion, what is most important to bring about wildfires?

Please select at most 2 answers

- Hot weather
- Dry weather
- Build-up of dead vegetation
- People (ignitions)
- Time of year
- Other:

There is no right answer here. Just in your mind, what increases the risk of wildfire the most?

* In which **2 months** of the year do you think most wildfires occur in your local area?

Please select 2 answers

- January
- February
- March
- April
- May
- June
- July
- August
- September
- October
- November
- December

50%

Climate change

* Do you think current wildfire activity in the UK has been affected by climate change?

Choose one of the following answers

- Yes
- No
- I don't know

* Do you think wildfires in the UK will be affected by climate change in the future?

Choose one of the following answers

- Yes
- No
- I don't know

Figure iv.4) Valleys online survey section 4 – foreign wildfire (case study specific section)

66%

Foreign wildfire

*

Did you hear about the bushfires, in the winter 2019/20, in Australia?

Choose one of the following answers

- [ ] Yes
- [ ] No

If yes, where did you hear the most about them?

Please select at most 2 answers

- [ ] Social media
- [ ] Television news
- [ ] Radio
- [ ] Online news
- [ ] Newspaper
- [ ] Other:

Figure iv.5) Valleys online survey section 5 – participant demographics

83%

A bit about you

* What age range do you fit into?

Choose one of the following answers

- [ ] 18-24
- [ ] 25-34
- [ ] 35-44
- [ ] 45-54
- [ ] 55-64
- [ ] 65+

* How do you describe your gender?

Choose one of the following answers

- [ ] Woman
- [ ] Man
- [ ] Non-binary
- [ ] In another way
- [ ] Prefer not to say

* What is / was your most recent occupation?

* Are you employed by an organisation which has any involvement with wildfires or their management?

- [ ] Yes
- [ ] No

For example, a Fire and Rescue Service, Forestry Commission, Natural Resources Wales etc.

Or are a farmer or landowner in the area.

If yes, please give detail...

Lastly, would you be willing to be contacted in 6 months for a couple of short follow up questions (*nothing long or demanding, I promise*)?

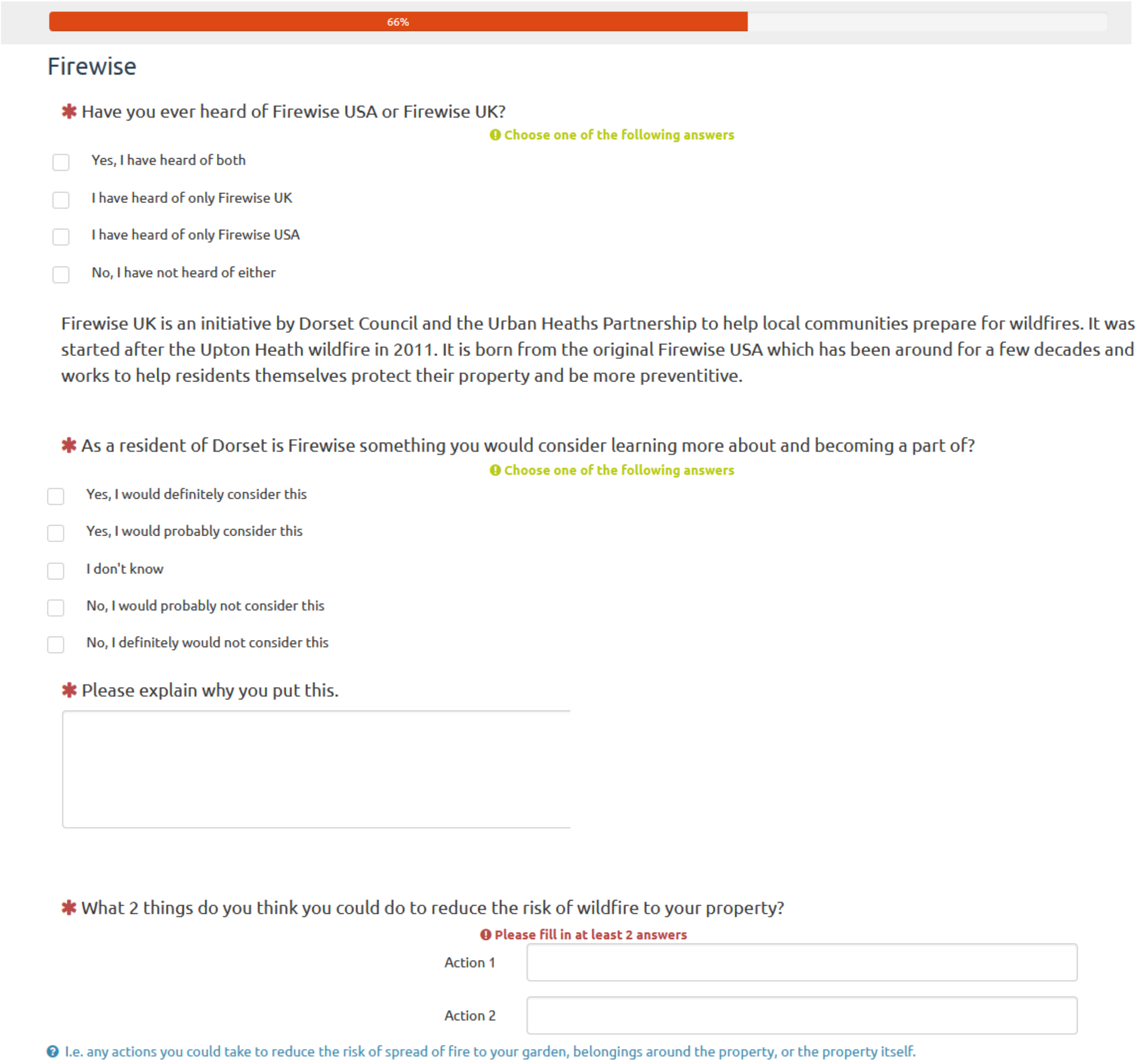
If yes, please write either your contact number or email here:

Please note these contact details will **not** be shared. They will **only** be used to distribute the follow up questions to you.

Your contact details will not be connected to other personal information given here.

Where the surveys had a basic comparable structure between case studies, section 4 was the only one that differed (except Highlands additional explanation question for risk). The changeable section 4 was specified to each location. Above the Valleys section 4 asked questions about awareness of wildfires abroad. For Dorset this uncluded a section about preparing for wildfire.

Figure iv.6) Dorset online survey section 5 – Firewise and preparedness



66%

Firewise

* Have you ever heard of Firewise USA or Firewise UK?

Choose one of the following answers

- Yes, I have heard of both
- I have heard of only Firewise UK
- I have heard of only Firewise USA
- No, I have not heard of either

Firewise UK is an initiative by Dorset Council and the Urban Heaths Partnership to help local communities prepare for wildfires. It was started after the Upton Heath wildfire in 2011. It is born from the original Firewise USA which has been around for a few decades and works to help residents themselves protect their property and be more preventitive.

* As a resident of Dorset is Firewise something you would consider learning more about and becoming a part of?

Choose one of the following answers

- Yes, I would definitely consider this
- Yes, I would probably consider this
- I don't know
- No, I would probably not consider this
- No, I definitely would not consider this

* Please explain why you put this.

* What 2 things do you think you could do to reduce the risk of wildfire to your property?

Please fill in at least 2 answers

Action 1

Action 2

I.e. any actions you could take to reduce the risk of spread of fire to your garden, belongings around the property, or the property itself.

Lastly, for the Highlands this included a section about fire use in the Highlands and muirburn.

Figure iv.7) Highlands online survey section 5 – vegetation fire and muirburn

42%

Vegetation fires

*

How much do you agree with the following statement:

"All vegetation fires are bad"

Choose one of the following answers

- [ ] Strongly Agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

Vegetation fires being all outdoor fires on vegetation.

* Are you familiar with the term 'muirburn'?

Choose one of the following answers

- [ ] Yes, I am familiar with it
- [ ] Yes, but I'm not sure what it means
- [ ] No, I have not aware of this term

If yes, what do you think it means?

(If you are not sure, please write "Not sure")

*

Are you aware of any 'fire use' in the local landscape?

Choose one of the following answers

- [ ] Yes
- [ ] No

'Fire use' refers to occasions where fires are intentionally set for a variety of reasons. Also known as 'controlled fire'.

If yes, please explain.

*

How much do you agree with the following statement:

"I would be okay with the use of fire as a management tool on the landscape."

Choose one of the following answers

- [ ] Strongly Agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

*

Please explain this answer.

APPENDIX 2: SUPPLEMENTARY MATERIAL

v) Methodological note

The participant identification numbers are constructed using this code. The first letter signifies the case study, where “V” signifies the South Wales Valleys, “D” signifies Dorset, and “H” signifies West Highlands. Next, is a code for the survey sample, where “IP” signifies the in-person survey and “ON” signifies online. And lastly is the number in order of collection.

Case study		Sample		Number	Examples
V	+	IP or ON	+	1, 2, 3….	VON100
D	+	IP or ON	+	1, 2, 3….	DIP50
H	+	IP or ON	+	1, 2, 3….	HON10

vi) Supplementary material: Chapter 4 South Wales Valleys

Responses for separated in-person and online samples

Where samples have been combined in the main thesis for the sake of succinctness the separated versions are presented here. The additional material for Chapter 4 includes: the original survey climate change questions; the follow-up survey climate change questions; and the follow-up survey question about their agreeability to the use of fire on the landscape.

Table vi.1: Frequency of themed concerns of wildfire locally raised participants, split sample

VALLEYS CONCERNS (GROUPED)			
	IN-PERSON	ONLINE	COMBINED
Nature	20%	22%	22%
Nature and concern about fire	7%	5%	5%
Nature and the fire problem	4%	4%	4%
Nature and Humans	46%	57%	55%
Humans	19%	8%	10%
Humans and concern about fire	2%	3%	3%
Humans and fire problem	0%	0%	0%
Fire increasing	0%	0%	0%
Wider fire problem	1%	1%	1%
Fire increasing	0%	0%	0%
None	2%	0%	0%
The fire and the fire problem	0%	0%	0%

Table vi.2: Current influence of climate change, split sample [original survey]

BELIEF THAT CLIMATE CHANGE HAS AFFECTED CURRENT WILDFIRE ACTIVITY LOCALLY [V]				
	Yes	I don’t know	No	
COMBINED	27%	30%	43%	(N=119)
IN-PERSON	29%	32%	39%	(N=22)
ONLINE	27%	30%	44%	(N=97)
Difference	*3%*	*2%*	*-4%*	

Table vi.3: Future influence of climate change, split sample [original survey]

BELIEF THAT CLIMATE CHANGE WILL AFFECT FUTURE WILDFIRE ACTIVITY LOCALLY [V]				
	Yes	I don't know	No	
COMBINED	52%	29%	18%	(N=119)
IN-PERSON	57%	25%	18%	(N=22)
ONLINE	51%	31%	18%	(N=97)
Difference	*6%*	*-6%*	*0%*	

Table vi.4: Influence of climate change on area, split sample [follow-up survey]

TO WHAT EXTENT DO YOU AGREE WITH THE STATEMENT: "CLIMATE CHANGE HAS AFFECTED IN THE LOCAL AREA"? [V]						
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
COMBINED	62%	26%	6%	3%	3%	(N=119)
IN-PERSON	59%	27%	5%	5%	5%	(N=22)
ONLINE	63%	26%	6%	3%	2%	(N=97)
Difference	*-4%*	*1%*	*-2%*	*1%*	*2%*	

Table vi.5: Influence of climate change on wildfire in area, split sample [follow-up survey]

TO WHAT EXTENT DO YOU AGREE WITH THE STATEMENT: "CLIMATE CHANGE HAS AFFECTED WILDFIRE IN THE LOCAL AREA"? [V]						
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
COMBINED	26%	32%	18%	17%	7%	(N=119)
IN-PERSON	23%	36%	14%	18%	9%	(N=22)
ONLINE	27%	31%	20%	16%	6%	(N=97)
Difference	*-4%*	*5%*	*-6%*	*2%*	*3%*	

Table vi.6: Agreement with the use of tool, split sample [follow-up survey]

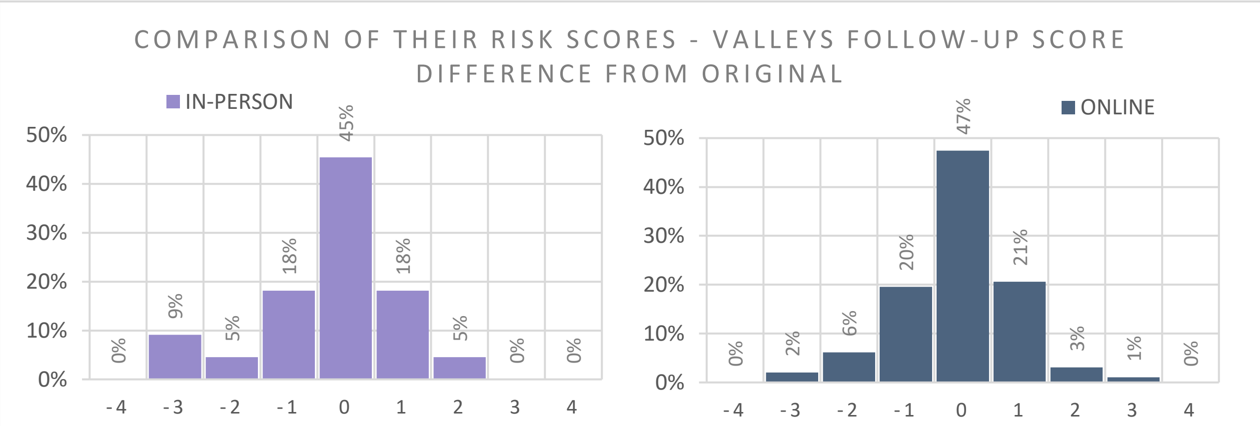
TO WHAT EXTENT DO YOU AGREE WITH THE STATEMENT: "I WOULD BE OKAY WITH THE USE OF FIRE ON THE LANDSCAPE"? [Valleys]						
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
COMBINED	8%	39%	24%	18%	11%	(N=119)
IN-PERSON	9%	36%	23%	18%	14%	(N=22)
ONLINE	8%	39%	25%	18%	10%	(N=97)
Difference	*1%*	*-3%*	*-2%*	*1%*	*3%*	

Additionally, comparisons were made between the responses of the participants that went onto reply to the follow-up compared to the overall original responses. This was to ensure that there were not overwhelming biases in who went onto complete the follow-up. The differences of the Valleys follow-up samples are mostly small and do not suggest bias.

Table vi.7: Comparison of responses to survey between follow-up sample and original sample

COMPARING THE FOLLOW-UP PARTICIPANTS PROPORTIONS TO THE ORIGINAL SAMPLES [Valleys]						
	Original IP proportions	Those that replied from IP	*Difference*	Original ON proportions	Those that replied from ON	*Difference*
PROBLEM						
Yes	71%	68%	*-2%*	92%	94%	*2%*
No	29%	32%	*2%*	8%	6%	*-2%*
RISK						
0	29%	27%	*-2%*	19%	21%	*2%*
1	28%	27%	*-1%*	35%	37%	*2%*
2	24%	27%	*3%*	20%	24%	*4%*
3	14%	9%	*-5%*	12%	7%	*-5%*
4	4%	9%	*5%*	14%	11%	*-3%*
SEEN						
Yes, many / annually	35%	27%	*-8%*	75%	86%	*10%*
Yes, a couple	35%	41%	*6%*	18%	10%	*-7%*
Yes, just one	7%	9%	*3%*	2%	2%	*0%*
No, only remains	11%	9%	*-2%*	2%	0%	*-2%*
No, none	13%	14%	*1%*	3%	2%	*-1%*

Figure vi.1: Difference between original and follow-up risk scores



vii) Supplementary material: Chapter 5 Dorset

UHP records show that have been recurrent fires on the heaths, the records from 2008 to present (2023) demonstrating the effect on urban heaths. UHP recorded wildfire locations (provided by DERC). Note these are only incidents in places monitored by UHP, ergot fires on the urban heaths.

Figure vii.1: UHP records of wildfires on monitored (Dorset) urban heaths.

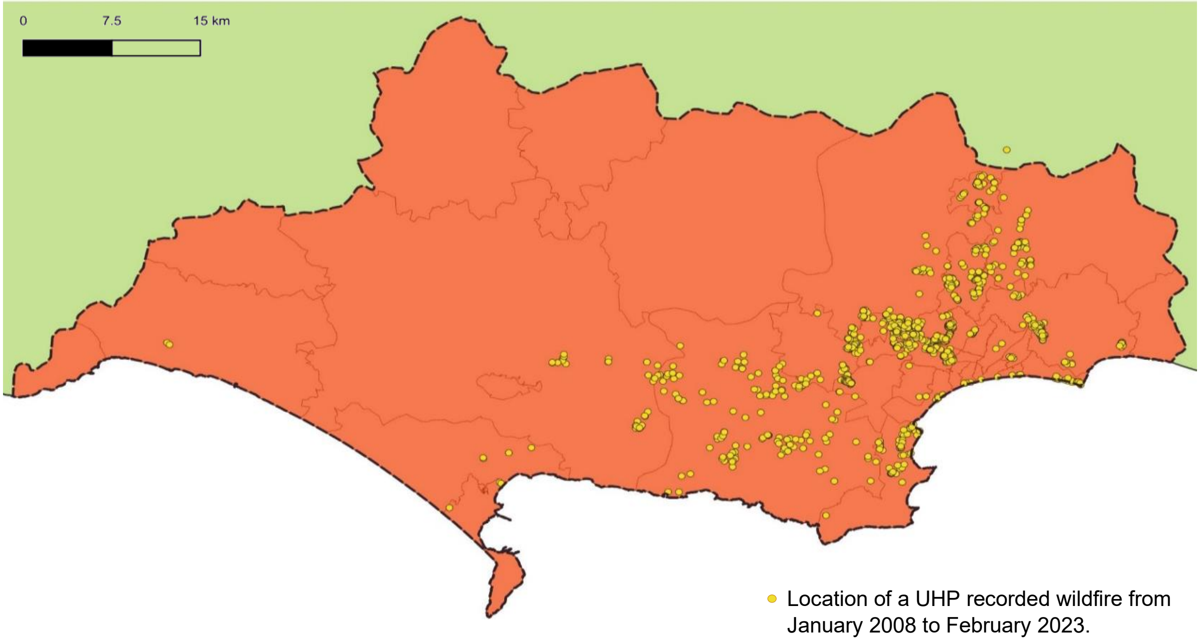
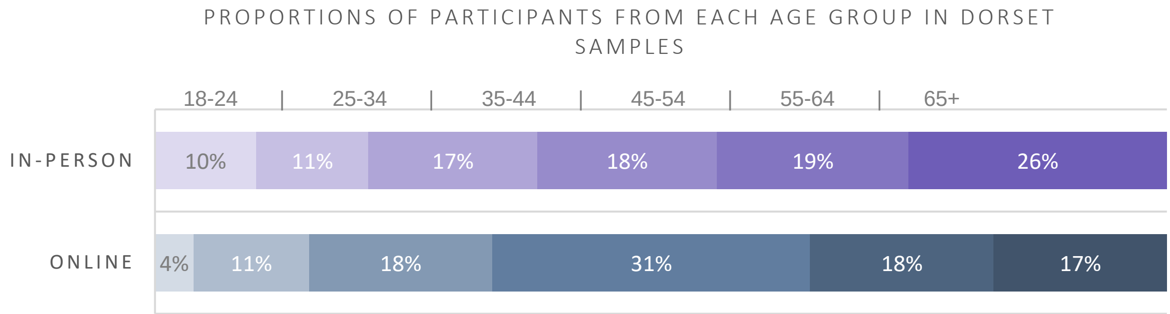


Figure vii.2: Age group of samples



Where samples have been combined in the main thesis for the sake of succinctness the separated versions are presented here. The additional material for Chapter 5 includes: the original survey climate change questions; the follow-up survey climate change questions; and the follow-up survey question about their agreeability to the use of fire on the landscape.

Table vii.1: Frequency of themed concerns of wildfire locally raised participants, split sample

DORSET CONCERNS (GROUPED)			
	IN-PERSON	ONLINE	COMBINED
Nature and Humans	57%	48%	52%
Nature	23%	31%	27%
Humans	10%	13%	12%
Nature and concern about fire	3%	5%	4%
Humans and concern about fire	2%	2%	2%

Humans and fire problem	1%	1%	2%
Fire increasing	1%	1%	1%
Nature and the fire problem	1%	1%	1%
None	0%	1%	1%

Table vii.2: Current influence of climate change, split sample [original survey]

BELIEF THAT CLIMATE CHANGE HAS AFFECTED CURRENT WILDFIRE ACTIVITY LOCALLY [D]				
	Yes	I don't know	No	
COMBINED	54%	24%	22%	(N=64)
IN-PERSON	52%	26%	22%	(N=28)
ONLINE	52%	26%	22%	(N=36)
Difference	*0%*	*0%*	*0%*	

Table vii.3: Future influence of climate change, split sample [original survey]

BELIEF THAT CLIMATE CHANGE WILL AFFECT FUTURE WILDFIRE ACTIVITY LOCALLY [D]				
	Yes	I don't know	No	
COMBINED	74%	15%	11%	(N=64)
IN-PERSON	76%	16%	9%	(N=28)
ONLINE	73%	15%	12%	(N=36)
Difference	*2%*	*1%*	*-3%*	

Table vii.4: Influence of climate change on area, split sample [follow-up survey]

TO WHAT EXTENT DO YOU AGREE WITH THE STATEMENT: "CLIMATE CHANGE HAS AFFECTED IN THE LOCAL AREA"? [D]						
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
COMBINED	66%	27%	3%	2%	3%	(N=64)
IN-PERSON	68%	29%	0%	0%	4%	(N=28)
ONLINE	64%	25%	6%	3%	3%	(N=36)
Difference	*4%*	*4%*	*-6%*	*-3%*	*1%*	

Table vii.5: Influence of climate change on wildfire in area, split sample [follow-up survey]

TO WHAT EXTENT DO YOU AGREE WITH THE STATEMENT: "CLIMATE CHANGE HAS AFFECTED WILDFIRE IN THE LOCAL AREA"? [D]						
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
COMBINED	41%	31%	13%	13%	3%	(N=64)
IN-PERSON	36%	32%	14%	14%	4%	(N=28)
ONLINE	44%	31%	11%	11%	3%	(N=36)

Difference	*-9%*	*2%*	*3%*	*3%*	*1%*	

Table vii.6: Agreement with the use of tool, split sample [follow-up]

TO WHAT EXTENT DO YOU AGREE WITH THE STATEMENT: "I WOULD BE OKAY WITH THE USE OF FIRE ON THE LANDSCAPE"? [Dorset]						
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
COMBINED	18%	34%	21%	21%	5%	(N=64)
IN-PERSON	14%	39%	21%	21%	4%	(N=28)
ONLINE	19%	33%	22%	19%	6%	(N=36)
Difference	*-5%*	*6%*	*-1%*	*2%*	*-2%*	

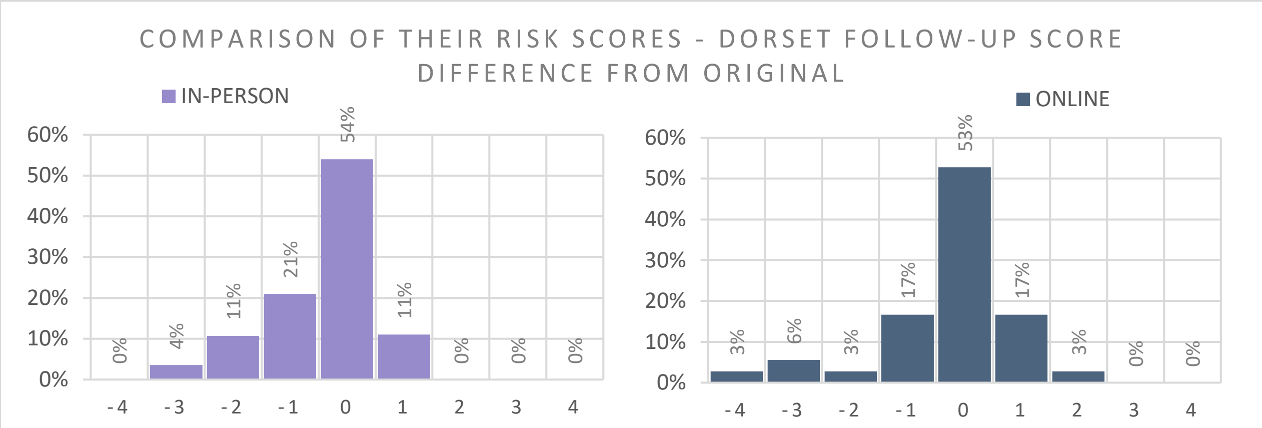
Additionally, comparisons were made between the responses of the participants that went onto reply to the follow-up compared to the overall original responses. This was to ensure that there were not overwhelming biases in who went onto complete the follow-up. The differences of the Dorset follow-up samples are mostly small and do not suggest bias.

Table vii.7: Comparison of responses to survey between follow-up sample and original sample

COMPARING THE FOLLOW-UP PARTICIPANTS PROPORTIONS TO THE ORIGINAL SAMPLES [D}						
	Original IP proportion s	Those that replied from IP	*Differenc e*	Original ON proportion s	Those that replied from ON	*Differenc e*
PROBLEM						
Yes	58%	65%	*8%*	71%	77%	*6%*
No	42%	35%	*-8%*	29%	23%	*-6%*
RISK						
0	50%	46%	*-4%*	46%	40%	*-6%*
1	28%	27%	*-1%*	23%	23%	*0%*
2	13%	15%	*2%*	10%	17%	*7%*
3	4%	4%	*-1%*	7%	0%	*-7%*
4	4%	8%	*3%*	13%	20%	*7%*
SEEN						
Yes, many / annually	9%	8%	*-1%*	15%	14%	*-1%*
Yes, a couple	14%	15%	*1%*	30%	23%	*-7%*
Yes, just one	26%	27%	*1%*	21%	23%	*2%*
No, only remains	12%	12%	*-1%*	11%	6%	*-5%*
No, none	39%	38%	*0%*	23%	34%	*11%*

Participants paired scores reveal that half gave the same scores, and there were more that decreased than increased. There were some participants giving a higher score, but there were generally larger decreases than there were increases.

Figure vii.3: Difference between original and follow-up risk scores



viii) Supplementary material: Chapter 6 Highlands

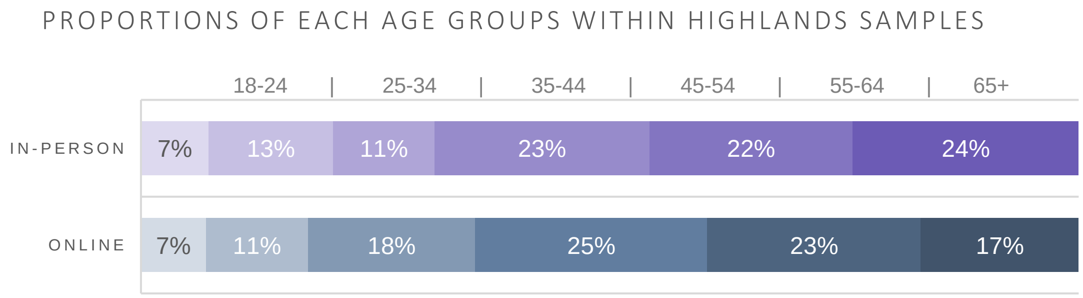
Table viii.1: Evidence from stakeholder consultation.

SUMMARY EVIDENCE OF CONSULTATION WITH SFRS FIREFIGHTERS	
POINT	EXAMPLES OF EVIDENCE
Most recognised a problem. Recognising the problem fairly regularly throughout May to September, even February to October. Can have smaller events but focus on significant handful of events.	"*Not that often, have attended a few this year however in Argyle*" (East Renfrewshire fire fighter) "*I have been based at a station with a wildfire response unit, therefore we attend wildfires on a regular basis, this can start as early as February and run into late October*" (Ayrshire fire fighter) "*Every year we get a good going wildfire. We are called to many small wildfires throughout the year*" (Aviemore fire fighter) "*I would estimate attending 5-6 significant Wildfires per year between the months of May and September, however operational crews across the Lanarkshire area during Q1 and Q2 of last five years (2016-17 to 2020-21) have attended 327 Grass, Wood, Heath and Moorland Fires*" (Lanarkshire fire fighter) "20-30 a year, mostly in the Spring but also in the Summer depending on the weather." (Stornoway fire fighter)
Varying degree of concern	Some thought less of a problem as most small, and certainly likely due to their various locations. Some particular issues in what they were saying show that rurality certainly part of it. Fact that often happen away from people and property made less of a problem. The challenges in fighting, exhausting, resource intensive, pull from elsewhere, happen in rural where part-time personnel…
Escaped burns focus as ignition risk. The issues being that they	"*I would say wildfires can become a problem if not observed correctly by the landowner.*" (Newton Stewart fire fighter)

are done improperly or do not have enough people supervising. As well as some blurred lines in the use of the term wildfire to include fire use. Like wildfire is the term for fires that happen in rural areas despite motive.	"*This all depends on the locality. Unless there is risk to life, property, forestry, etc, 'controlled' wildfires provide many benefits to the undergrowth, The problems occur when a wildfire becomes uncontrolled. This can be due to an increase in wind speed (or a change of direction) or not enough personnel engaged in stopping the spread of fire, resulting in the assistance of the fire service*." (Appin fire fighter)
Recreational fires mentioned by a few	"*Especially at Loch Morlich in the Cairngorm national park where no fires are allowed but we are forever getting called to small camp wildfires*." (Aviemore fire fighter)
Having to travel to attend various fires across the area, spread of firefighting resources.	"*Approximately 10 times each year as a Flexi Duty Officer often for 8-10 hours on each occasion and often a considerable travel distance e.g. 100 miles from my home/workplace*" (Inverness fire fighter) "*I'm based in Aberdeen City, however, in my call group, I'm the furthest north in the region, so generally cover the northern half of the Grampian region. (From the city upwards to the coast, including Peterhead, fraserburgh and as far west as Ballindalloch and Craigellachie etc.)*" (Aberdeen fire fighter)
Challenges for fighting: • can happen far away, • resource intensive, • pose different challenges than structural fires	"Yes, dealing with wildfires is inherently challenging due to factors such as remote locations , topography, having the appropriate equipment to hand and in the right locations to deploy when needed. PPE for personnel and the physical aspect of tackling a wildfire safely has a huge drain on resources and personnel" (Ayrshire fire fighter) Consume resources, exhausting, rural areas only have retained firefighters: "a) In my opinion they are a problem for several reasons. They consume resources over an extended period of time like no other type of incident we deal with. When you consider that they occur primarily in rural areas where stations are already understaffed and covering large geographic areas, that's a problem. b) They're exhausting. One that we had in March saw me and my crew on scene a total of 30 hours in 3 days, which meant that if we'd had a house fire or something equally serious through the nights we'd have been dead on our feet. In rural areas like ours we're retained so there are no shifts to relieve you at different times of day c) Having said that, it is different since they are rarely a serious danger to property and very, very rarely a danger to life in that we can usually get water from the pumps onto the fire if it's coming near property." (Stornoway fire fighter)

	"*As the process can be lengthy and at times labour intensive, fire cover can be restricted, when appliances are brought in from other areas. It can, at times, be physically demanding, with challenges regarding sufficient hydration.* *Wilful fire-raising can unnecessarily result in all of the above and in addition, endanger wildlife*." (Appin fire fighter) "*They are: extremely demanding in terms of resource allocation, often in rural, semi-rural areas with limited options for strategic cover; physically arduous for attending personnel; deeply damaging to the landscape, rural environment and wildlife; high risk events for life and preservation of property; economically damaging to rural communities; and tactically challenging to extinguish*." (Lanarkshire fire fighter)
Changes to problem • less muirburn and fuel build up • climate change (various agreement)	"*Only if near a property! If controlled muirburns were as common as used to be in the past as part of proper management of hill/heathland there would be less rank vegetation to dry out and fuel the fires*." (Orkney fire fighter) "*Not too much really. I think they are getting worse but the weather isn't any drier, that's for sure, so I think it's more to do with a lack of grazing and controlled burning leading to a build-up of fuel*" (Stornoway fire fighter) "*As climate change impacts on our weather system, these types of incident will become more common, leading to a higher chance of crews being hurt while attending. The service will need to adapt their firefighting techniques and response model, to be able to resource more of these types of incident in the future*." (Aberdeen fire fighter)
Other concerns	"*Yes, educational piece to be done with farmers, walkers, landowners to make more people more aware with the dangers of Wildfires*." (East Renfrewshire fire fighter) "*My main concerns about wildfires are that they increase air pollution and can effect regional air quality.* *These calls also take us away from more urgent calls*." (Aviemore fire fighter) "*Yes, I am concerned about Firefighter safety. Wildfires can be dangerous and although we have good training, equipment and safe systems of work, Firefighters are working in arduous conditions and accidents can happen especially where conditions are extremely warm, arduous, fast moving and exhausting. Re-Wilding in the Scottish Highlands also concerns me as falling land management standards have in more recent years seen Wildfires be more intense (increased fuel loading) and difficult to extinguish (lack of fire breaks) etc*." (Inverness fire fighter)

Figure viii.1: Age groups of samples



Where samples have been combined in the main thesis for the sake of succinctness the separated versions are presented here. The additional material for Chapter 6 includes: the climate change questions; the responses to whether they believed all fire to be negative; the responses to agreeability to the use of fire on the landscape. As well as the separated samples comparison of responses to whether they agreed with the use of fire to with the fact that all fire is negative.

Table viii.2: Frequency of themed concerns of wildfire locally raised participants, split sample

HIGHLANDS CONCERNS (GROUPED)			
	IN-PERSON	ONLINE	COMBINED
Nature and Humans	40%	40%	40%
Nature	25%	28%	27%
Humans and concern about fire	14%	10%	12%
Humans	10%	9%	9%
Nature and concern about fire	8%	10%	9%
Fire increasing	2%	-	3%

Table viii.3: Current climate change influence on wildfire, split sample

BELIEF THAT CLIMATE CHANGE HAS AFFECTED CURRENT WILDFIRE ACTIVITY LOCALLY [H]				
	Yes	I don't know	No	
COMBINED	44%	31%	25%	(N=185)
IN-PERSON	43%	33%	24%	(N=83)
ONLINE	45%	29%	26%	(N=102)
Difference	*-1%*	*3%*	*-2%*	

Table viii.4: Future climate change influence on wildfire, split sample

BELIEF THAT CLIMATE CHANGE WILL AFFECT FUTURE WILDFIRE ACTIVITY LOCALLY [H]				
	Yes	I don't know	No	
COMBINED	66%	23%	11%	(N=185)

IN-PERSON	63%	25%	12%	(N=83)
ONLINE	68%	21%	11%	(N=102)
Difference	*-5%*	*4%*	*1%*	

Table viii.5: Agreement with use of tool, split sample

TO WHAT EXTENT DO YOU AGREE WITH THE STATEMENT: "ALL LANDSCAPE FIRE IS BAD"? [Highlands]						
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
COMBINED	15%	18%	22%	31%	14%	(N=185)
IN-PERSON	16%	18%	25%	30%	11%	(N=83)
ONLINE	15%	18%	20%	32%	16%	(N=102)
Difference	*1%*	*0%*	*6%*	*-2%*	*-5%*	