MoorLIFE 2020 Project:

D4, Baseline Wildfire Perception and Incidents Questionnaire Report:

November 2017

(LIFE14 NAT/UK/000070)

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Executive summary

A key aim of the MoorLIFE 2020 project is to conserve and enhance Active Blanket Bog in the South Pennine Moors Special Area of Conservation. With wildfires being a key threat to this habitat it is important to understand how our communications and conservation work can help reduce wildfire risk and severity, in order to apply the correct conservation actions to high risk locations as identified by McMorrows and Lindley (2006): Modelling the spatial risk of moorland wildfire.

Due to the difficulty in collecting empirical data for wildfires, a before and after questionnaire was developed with the aims of:

1. Establishing expert opinion on the perceived risk and severity of wildfire prior to and after conservation work has been completed to identify what effect these actions have had.
2. Help us to evidence the effects the project has on reducing the risk and severity of wildfire.
3. Inform engagement and communication initiatives and materials to reduce the risk of wildfire.

In order to gather expert opinion a baseline questionnaire was administered to the Peak District National Park Authority and South Pennine Fire Operations Group members using Survey Monkey. In total 27 respondents completed the questionnaire out of a possible 61, giving an overall response rate of 44%, the response rate however does vary by question.

Aim 1 - Establish expert opinion on the perceived risk and severity of wildfires prior to and after our work has been completed to identify what effect our actions have had.

The results of the before questionnaire indicate that areas dominated by Purple Moor Grass *(Molina Caerulea)* and Heather *(Calluna Vulgaris)* have the greatest wildfire risk. The most common reasons cited by respondents for this is the high fuel load and dryer conditions associated with where these species are commonly found. Conversely the single species habitats that have the least wildfire risk is Common Cotton Grass *(Eriophorum Angustifolium)* and Bilberry *(Vaccinium Myrtillus),* as these species are either found predominately in wet habitats as is the case with Common Cotton Grass or have green stems, e.g. Bilberry, suggesting good moisture retention.

Respondents identified that areas dominated by Heather and Bare Peat would cause the most severe wildfires with 89% of respondents ranking both habitats as having a ‘high’ wildfire severity or worse, due to the significant amounts of fuel available, and because both habitats can burn very slowly over a long time period. The single species habitats that were perceived to have the least severe wildfires are Bilberry and Common Cotton Grass, with 26% and 21% of respondents respectively identifying them as having a highly severe wildfire or worst. For Common Cotton Grass the wet habitat associated with this is again the main reason cited, whereas for Bilberry it is due to the stems being green suggesting water retention.

Bare Peat elicited a varied response, as the results suggest that it has a low wildfire risk by itself due to a lack of an above ground ignition source, however if the substrate does ignite then the consequences can be severe as it is a fuel source in its own right.

Analysis of the relationship between wildfire risk and severity using Spearman's rank correlation identifies that the relationship varies depending on species. On average however there is a moderate to strong positive relationship at a 95% confidence level, suggesting that as wildfire risk increases so does severity.

Aim 2 - Help us to evidence the effects the project has on reducing the risk and severity of wildfire.

The results of this questionnaire identifies that the most important activity Moors for the Future Partnership and our partners can undertake to reduce wildfires is to increase the height of the water table, closely followed by engagement with land managers and the public, both being jointly ranked second. This suggests that the following activities would have the biggest impact on reducing wildfire risk and severity:

1. Increase the water table through gully blocking and re-introduce *Sphagnum* Moss *spp*.
2. Cut areas of Purple Moor Grass *(Molina Caerulea)* and Heather *(Calluna Vulgaris)* to reduce the fuel load associated with these habitats.
3. Undertake educational events in communities close to large areas dominated by Purple Moor Grass *(Molina Caerulea)* and Heather *(Calluna Vulgaris)* to make them aware of the risk.
4. Consider the fire risk associated with habitats adjacent to areas of Active Blanket Bog, as respondents identified conifer plantations as a key habitat associated with wildfire risk and severity.

Aim 3 - Inform engagement and communication initiatives and materials to reduce the risk of wildfires.

Expert opinion identifies that most wildfires were started maliciously (57.8%), suggesting that the conservation activities undertaken could have less of an impact on reducing wildfire risk. This data suggest that on average conservation activities could reduce the risk of wildfire in 11 incidents per year, based upon an average of 26 wildfires per year from 2007 – 2016.

Investigating the scenarios behind why accidently started wildfires occur, suggests that discarded materials (e.g. BBQs) by groups of friends are the most common reason a wildfire starts, either at the side of a Public Right Of Way or picnic locations. Another common scenario could be a single person discarding a cigarette whilst walking or parked up at a layby.

From these scenarios it is possible to determine that Moors for the Future Partnership and our partners could undertake the following actions to reduce wildfire risk and severity:

1. Target work areas that have large visitor numbers (e.g. sites adjacent to the Pennine Way) first as they have the highest threat level.
2. Increase awareness at key locations on Public Rights of Way (e.g. at the start of the Pennine Way).
3. Undertake fire awareness events at popular picnic spots or 'honey pot villages'.

Comparison to previous scenarios

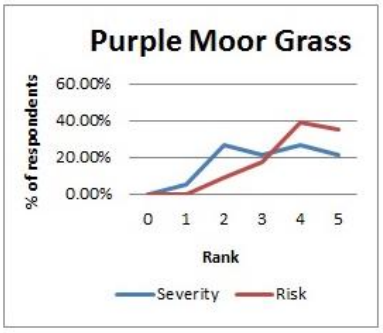
Comparing the results from this questionnaire to the scenarios identified within the 2006 McMorrow and Lindley report suggests there has been a limited change since 2006, as the results of the questionnaire identified similar habitats as having the highest wildfire risk and severity, whilst the reason behind wildfire ignition are similar e.g. Public Rights of Way forming a key risk area.

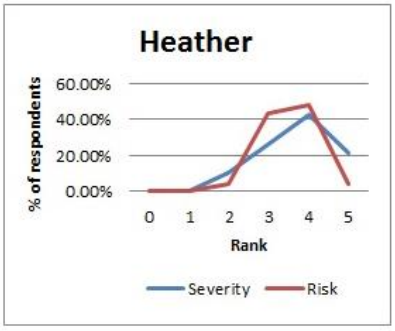
Highlights

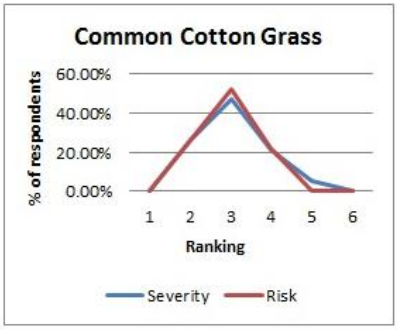
- The aim of this baseline questionnaire is to establish expert opinion on wildfire risk and severity, prior to our conservation led activities taking place, in order to identify which actions within the MoorLIFE 2020 project has the greatest impact on reducing wildfire risk and severity.
- The baseline questionnaire was sent to the Peak District National Park Authority and South Pennine Moors Fire Operations Groups using Survey Monkey in order to gain expert opinion.
- Expert opinion identified that Heather *(Calluna Vulgaris)* and Purple Moor Grass *(Molina Caerulea)* has the greatest wildfire risk, due to the high fuel load and dry conditions the plants normally grow in.
- Wildfires on Heather and Bare Peat were perceived to be the most severe by experts. Respondents thought that this was due to the significant amount of fuel available which is capable of burning very slowly for days.
- Raising the water table was ranked as the most important action for reducing both wildfire risk and severity, closely followed by engagement with land owners and the general public.
- Expert opinion suggests that the most common scenarios behind wildfire ignition is discarded materials like BBQs and cooking materials by groups of friends at the side of a Public Right of Way or a picnic location. Alternatively it could be a single person discarding a cigarette whilst walking or parked up at a layby.
- Comparison to the 2006 McMorrow and Lindley report identifies that the scenarios behind wildfire risk and severity has only changed slightly since the report was undertaken.

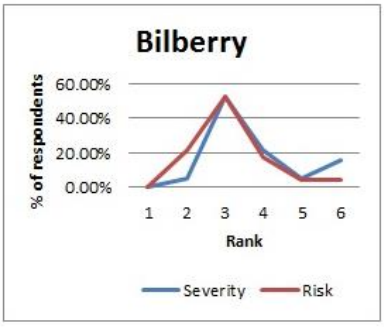
Graphical representation

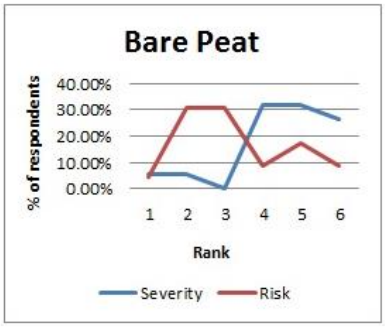
A comparison of how respondent's ranked wildfire risk and severity for all five habitats. A rating of 0 is low and a rating of 6 is very exceptional.











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1. Introduction

The aim of the MoorLIFE 2020 project is to conserve and protect the EU priority habitat, Active Blanket Bog (ABB) within the South Pennine Moors (SPM) Special Area of Conservation (SAC), due to the many ecosystem services it provides including; carbon sequestration, improving biodiversity and flood attenuation. With wildfire forming a significant threat to ABB, Moors for the Future Partnership (MFFP) aims to monitor and reduce the impact wildfire has on ABB under action D4 of the MoorLIFE 2020 project. For the purposes of this report wildfire is defined as any fire that is burning strongly and out of control on an area of grass or bush in the countryside (Cambridge University, 2017) excluding managed burns. In order to reduce the risk and severity of wildfire, MFFP is undertaking conservation actions in order to reduce the risk and severity of wildfires that occur, including gully blocking and sphagnum planting which raise the water table helping to retain water.

Using empirical data to monitor the impact our conservation work has on reducing wildfire risk and severity is difficult given the projects timescales and the dangers associated with wildfire. It was therefore decided that a before and after questionnaire would be developed to:

Aim 1 - Establish expert opinion on the perceived risk and severity of wildfires prior to and after our work has been completed to identify what effect our actions have had.

Aim 2 - Help evidence the effects the project has on reducing the risk and severity of wildfire.

Aim 3 - Inform engagement and communication initiatives and materials to reduce the risk of wildfires.

This report focuses on the results obtained from the baseline questionnaire administered in 2017 to both Fire Operations Groups (F.O.G) located within the SPM SAC, and identifies ways in which our actions can help reduce wildfire risk and severity. Additionally, this report broadly compares the wildfire ignition scenarios detailed in the 2006 report: Modelling the spatial risk of Moorland wildfire by McMorrow and Lindley, and uses the Climate Change and the Visitor Economy (CCVE) spatial model to map the impacts of both natural and human influences on where wildfires are likely to start, it concludes that;

- Wildfire incident frequency peaks between 4km and 7km away from a settlement.
- Instances of wildfire increase the closer you get to a minor road.
- No correlation was identified between the distance from a car park and frequency of wildfire.
- Footpaths are the primary human factor affecting wildfire.

The 2006 report by McMorrow and Lindley also models the impacts of wildfire risk on single species habitats using stakeholder consultation scores and empirical evidence, it suggests that wildfire risk is high within the following habitats:

- Bare peat / Bare Ground
- Coniferous Plantation

- Bracken
- Cotton Grass Moorland
- Dry Bog
- Dry Dwarf Shrub Heath
- Dry Grassland
- Eroding Moorland

In March 2020 an after survey will be sent out to the same F.O.G groups in order to identify what impact our conservation work has had on reducing the wildfire risk and severity of single species habitats, once the results from the after survey has been obtained all aims will be answered fully.

The aim and role of the F.O.G groups is to bring together the Fire and Rescue Services (FRS), key organisations, (e.g. National Trust), and land owners with the aim of; drawing up fire plans, training, education and overseeing the reduction in moorland wildfires (Peak District National Park Authority, 2017).

2. Methodology

The questionnaire was designed to meet the aims of the study and can be found here – N:\Projects\MoorLIFE 2020\Science\Data\D4 Fire awearness\Questionnaire\Final - before wildfire questionnaire.docx

In order for respondents to rate the wildfire risk and severity associated with the single species habitats, two representative photographs were chosen to identify the different states of each species, and the respondents asked to provide an average rating for risk and severity across all states. Additionally respondents were told to assume that all factors, e.g. distance to a footpath was the same for all species in question, so as not add bias to one particular single species habitat.

Respondents were asked to rate the risk of a wildfire occurring in single species habitats using a modified version of the severity index scale developed by the Met office, see Figure 1 below (Met office, 2017). Additionally a comments section was provided for the respondent to justify why they rated the single species habitat as they did.

Figure 1 - Risk / Severity scoring system

Score	Wildfire risk / severity
0	No fire risk / severity
1	Low fire risk / severity
2	Moderate fire risk / severity
3	High fire risk / severity
4	Very high fire risk / severity
5	Exceptional fire risk / severity

2.1. Survey distribution

The before survey was sent to the Peak District National Park Authority (PDNPA) and South Pennine F.O.G groups using Survey Monkey. The questionnaire was administered via Survey Monkey to ensure that all F.O.G group members had the opportunity to complete the survey, as not all members attend each meeting. Additionally, attendance at each quarterly F.O.G group meeting varies from between 10 and 20 attendees; therefore, if the questionnaire was administered at each group, the response rate is likely to be lower than that achieved using Survey Monkey.

The survey was sent round to all F.O.G group members at the end of June 2017, and the survey closed in early September 2017. The survey was left open for 4 months to a) ensure that all members had ample opportunities to complete the survey and b) it allowed a reminder to be sent round at a later F.O.G group. Additionally, reminders were sent out by e-mail to all those who had not completed the questionnaire.

2.2. Sample size

Sending the questionnaire to the different F.O.G group members limited the population size to 61 respondents, but ensures that expert professional opinions were obtained. In order to check if the sample size is robust enough a margin of error was calculated using standard deviation for all questions where an average was used.

2.3. Analysis of results

Analysis was undertaken by MFFP using the raw data, as the analysis in Survey Monkey was not sufficient to meet the aims of the survey. Additionally, where a respondent did not answer a question the data was removed from the analysis.

For comparison between wildfire risk and severity, Spearman's rank correlation was used to compare the strength of the relationship using the formula in Figure 2.

Figure 2 – Spearman's rank correlation formula

$$(R) = 1 - \frac{6\sum d^2}{n^3 - n}$$

Barcelona field centre, 2017

3. Results and discussion

3.1 Overall response rate

The surveys overall response rate was 42%, with a total of 27 respondents completing at least 1 question, which is slightly above average for an internal survey (Surveygizmo, 2017). This can be attributed to the fact that MFFP sits on both F.O.G groups and a presentation was given to both groups prior to the administration of the survey. Additionally, the response rates change per question as some respondents did not answer all questions.

3.2 Aim 1 - Establish expert opinion on the perceived risk and severity of wildfires prior to and after our work has been completed to identify what effect our actions have had

3.2.1 Wildfire risk

Figure 3 and Figure 4 below identifies that Purple Moor Grass *(Molina Caerulea)* and Heather *(Calluna Vulgaris*) have the highest wildfire risk, with 91% and 95% of respondents respectively identifying these single species habitats as having a 'high wildfire risk' or worse. The main reasons cited for this is the high fuel load associated with these species (16% and 35% of respondents respectively) and dry conditions (25% and 15% of responses respectively) allowing these species to burn fiercely and quickly when ignited (16% and 15% respectively).

The species that were rated as having the least wildfire risk was Bilberry *(Vaccinium Myrtillus)* and Common Cotton Grass *(Eriophorum angustifolium)* with 26% and 21% of respondents respectively rating the wildfire risk as high or worse. The main reasons identified for this reduced wildfire risk varies depending on the single species habitat, for Common Cotton Grass the primary reason cited by respondents (52%) was the wetter conditions associated with where this species grows. For Bilberry however 33% of respondents said they would not expect wildfire to occur on Bilberry because the leaves and stem appear green suggesting water retention in the plant.

Bare Peat elicited the most varied response out of all the single species habitats, as it is the only habitat which had a response in all 6 risk levels. Additionally, 5% of respondents indicated that they were 'unsure' of why they rated the wildfire risk this way. The most popular comment for Bare Peat indicates that it would be very difficult to ignite with 35% of respondents identifying that there is no surface content to burn, furthermore 4% of respondents identified that the risk increased when situated next to other vegetation. This supports the outcomes identified within the McMorrow and Lindley report (2006), in which bare peat / bare ground (which is defined as including 75% vegetation) is identified as the highest risk habitat suggesting that it is the vegetation not the bare peat that burns.

The results obtained from the questionnaire generally support the findings within the McMorrow and Lindley report (2006), with Heather being perceived as a high wildfire risk. Differences between the findings were identified; this includes Bilberry being identified as a high wildfire risk in the 2006 report but not in this questionnaire.

Figure 3 - Potential wildfire risk associated with single species habitats

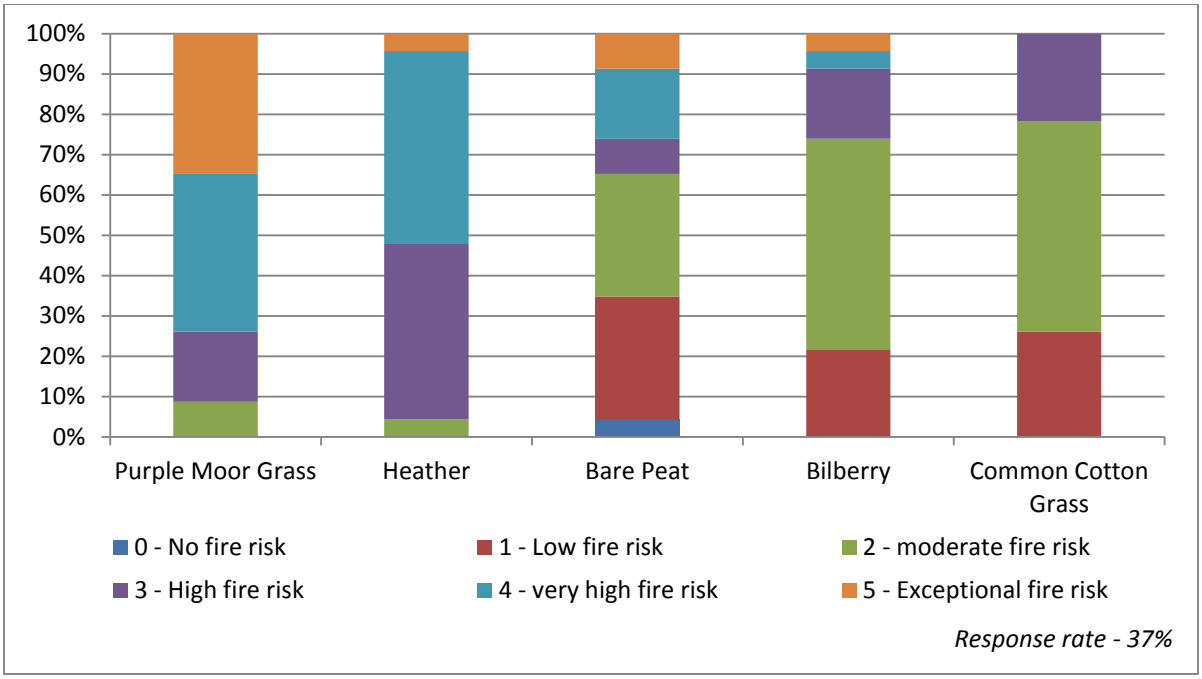
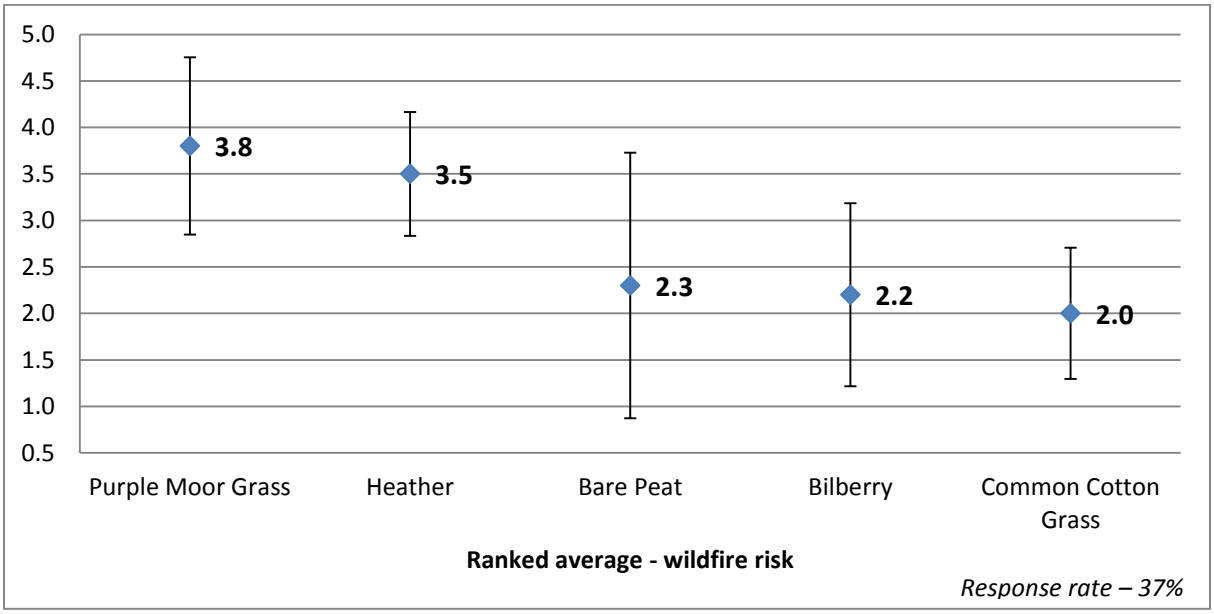


Figure 4 - Average wildfire risk score by respondents and standard deviation from the mean



3.2.2 Wildfire severity

Heather and Bare Peat were rated as the single species habitats where the most severe wildfires would occur, with 89% of respondents ranking both single species habitats as being susceptible to a highly severe or worse wildfire, see Figure 5 and

Figure 6 below. The reason cited for both species is the significant amount of fuel available (7% and 21% of respondents respectively) which is capable of burning very slowly for days (18% and 21% respondents respectively). In the case of Heather 18% of respondents identified that severity can be exacerbated by creating conditions in which the underlying peat can be ignited, which once started can be very difficult to extinguish (21% of respondents).

Whilst not as high as Heather or Bare Peat, 68% of respondents identified that Purple Moor Grass would cause a highly severe or worse wildfire. The primary reason attributed to this with 57% of all comments is the speed in which Purple Moor Grass can burn. The reason why severity was not rated higher is because 5% of respondents identified that the damage caused to this single species habitat is not long lasting due to the quick regrowth associated with the plant.

The two single species habitats that were perceived least likely to have a severe wildfire is Bilberry and Common Cotton Grass, with only 26% and 21% respectively of respondents rating them as having a highly severe wildfire or worse. The primary reasons for this is that Common Cotton Grass is found in wet habitats (62% of respondents) and has a low fuel load (10% of responses), whereas for Bilberry it is primarily down to the fact that it has green shoots (19% of respondents) and has a low fuel load (25% of respondents) which is the same reasons cited for the low wildfire risk.

Figure 5 – Perceived wildfire severity of single species habitats

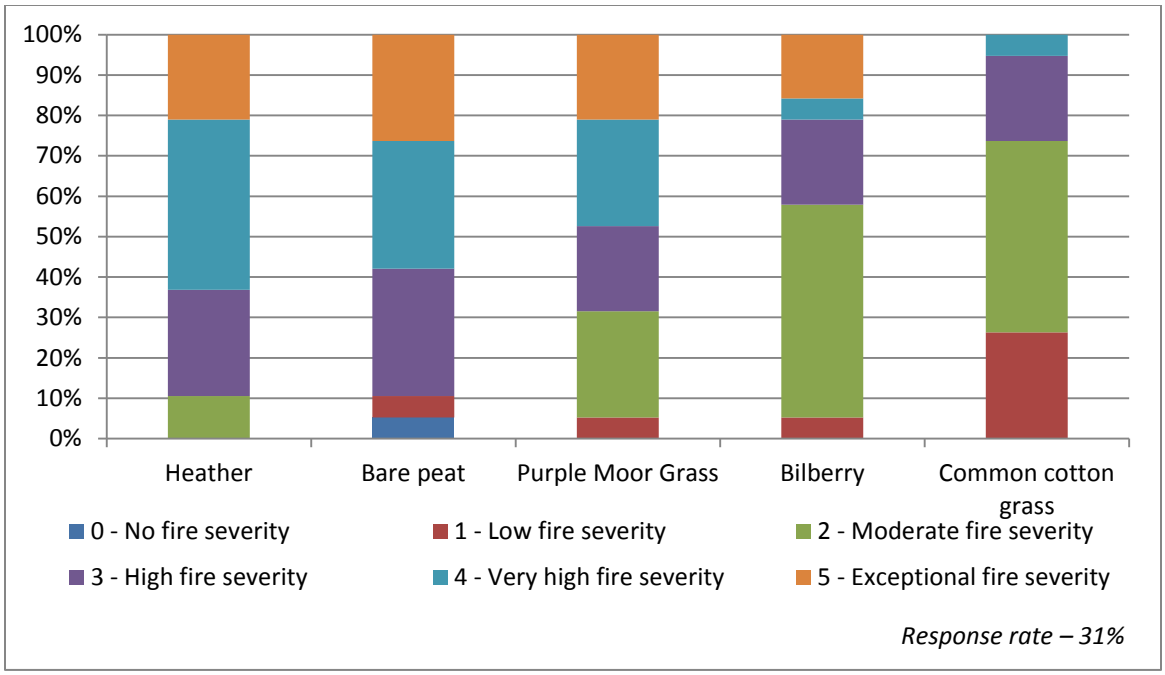
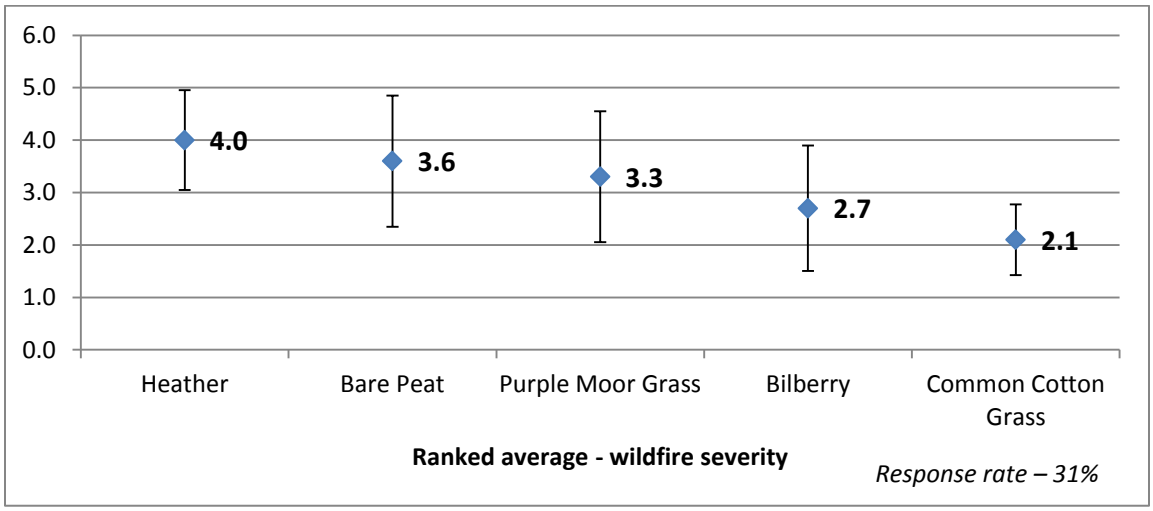


Figure 6 - Average wildfire severity score and standard deviation from the mean

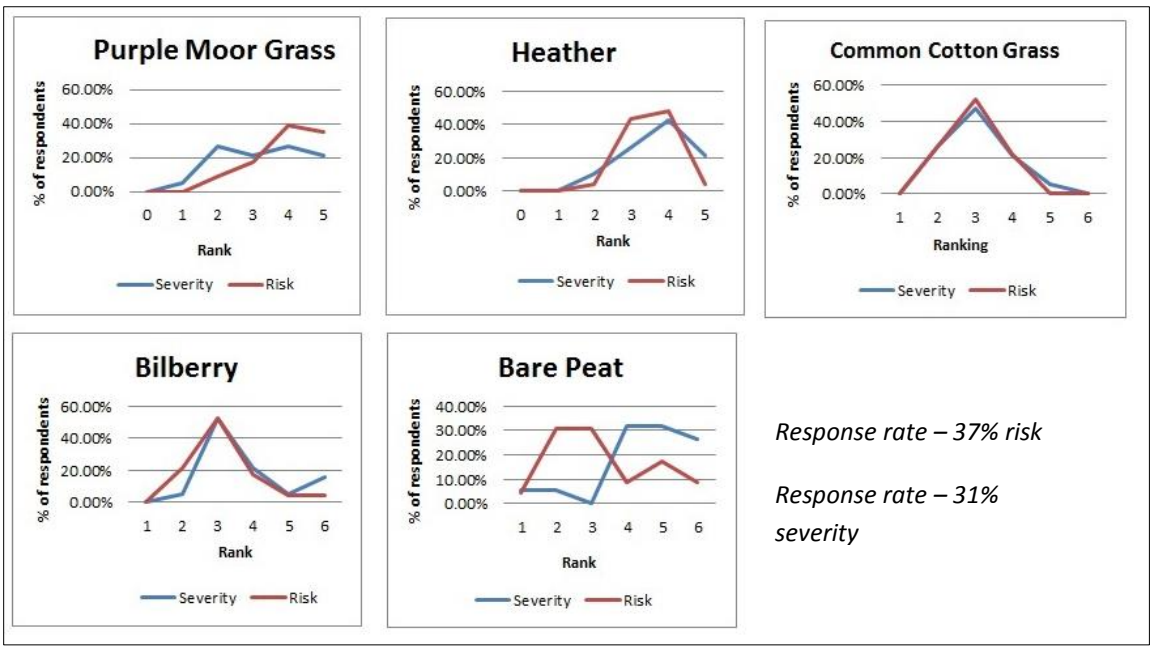


3.2.3 Comparison of wildfire risk and severity

Comparing the results of wildfire risk and severity identifies that overall single species habitats with the highest risk are ranked in the same order for severity. Furthermore, Figure 7 identifies that the range of results for each single species habitat generally follow the same pattern. One possible reason for this could be that the same characteristics that make single species habitats a fire risk also increase the severity of wildfire. The comments received would support this with 4 out of 5 single species habitats having at least 1 similar remark within the top 3 responses.

Bare Peat was the only habitat where there was a noticeable difference between risk and severity, with a very low risk but a high severity.

Figure 7 - Comparison of wildfire risk vs severity by species type



Spearman's rank correlation was used; see Table 1 below, to test the strength of the relationship between wildfire risk and severity. The results indicate that two out of five single species habitats (Purple Moor Grass and Heather) exhibited a moderately strong positive relationship at a 95% confidence level. Bilberry has the strongest relationship between wildfire risk and severity with a significantly positive relationship, at a 99% confidence level. Again this can be seen in the similarity of the comments and results obtained. Additionally with this being a positive relationship it suggests that as perceived wildfire risk increase so does the severity.

Two of the single species habitats (Bare Peat and Common Cotton Grass) exhibited no relationship between wildfire risk and severity. For Bare Peat this can be explained by the varied comments and ratings received for both risk and severity. However, this does not explain why no relationship was found for Common Cotton Grass as the results and comments appear very similar.

Table 1 - Spearman's rank correlation values

Habitat type	Co-efficient	Degree of freedom	Relationship	Reliability
Purple Moor Grass	0.52	17	Moderately positive	95% reliable
Heather	0.58	17	Moderately positive	95% reliable
Bilberry	0.77	17	Significantly positive	99% reliable
Common cotton grass	0.15	17	No relationship	
Bare Peat	0.44	17	No relationship	
All habitat types combined	0.66	93	Significantly positive	99% reliable

3.2.4 Other single species habitats with a perceived wildfire risk and severity

In addition to the 5 single species habitats identified above, respondents were also asked to identify any other habitats that they considered to have a significant wildfire risk and severity. The most common response for risk and severity was Bracken with 64% of respondents identifying it as an important single species habitat for wildfire risk, and 35% of respondents identifying it as a key single species habitat for wildfire severity.

Conifer plantations had the second highest response with 11% of respondents identifying this species as a wildfire risk and 17% of respondents identifying this species as having a highly severe wildfire. Both of these habitats were identified as having a high wildfire risk within the 2006 McMorrow and Lindley report again suggesting that ignition scenarios have not changed in the intervening period.

3.3 – Aim 2 Help us to evidence the effects the project has on reducing the risk and severity of wildfire

Figure 8 and

Figure 9 identifies which of our conservation led activities the experts thought would have the biggest impact on reducing wildfire risk and severity. For both wildfire risk and severity, rewetting a site is identified as having the greatest impact. This suggests that actions like gully blocking and cutting vegetation with sphagnum inoculation would have the greatest impact on reducing wildfire risk and severity. Additionally, engagement with land managers is ranked highly joint first for risk and joint second for severity.

Respondents thought that one of the least effective methods for reducing wildfire risk and severity was stabilising areas of Bare Peat, which was ranked last for reducing wildfire severity and second last for reducing wildfire risk. This indicates that actions including brash spreading and application of geo jute materials would not significantly reduce wildfire risk and severity. This question however takes no account of timeframe, as although these actions may not significantly reduce the risk and severity in the short term, it does prepare the area for works which help reduce wildfire risk and severity in the future, (e.g. increasing the number and variety of species present).

The action with the greatest difference between risk and severity is increasing species diversity, as this is ranked least likely to impact risk but joint second highest for reducing wildfire severity. This maybe because increasing the number of species helps to increase surface wetness, (e.g. through adding *Sphagnum* onto a site etc.), or some species (e.g. Bilberry) have green stems which suggests water retention.

Figure 8 - Ranked mean rating for actions to reduce wildfire risk and standard deviation away from the mean

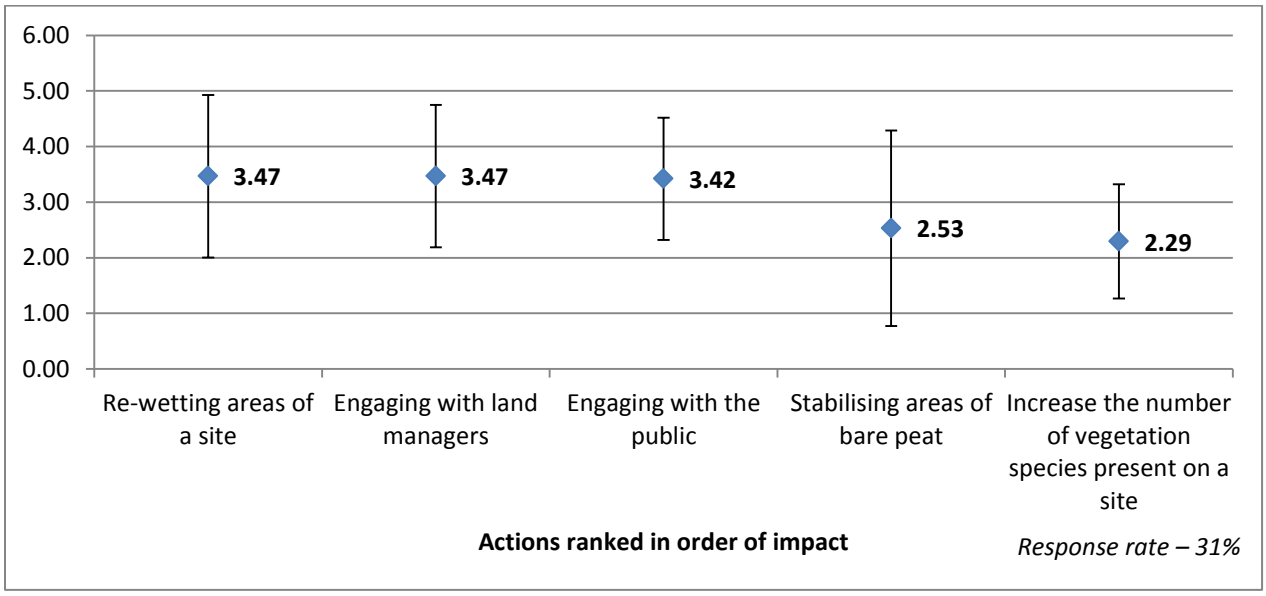
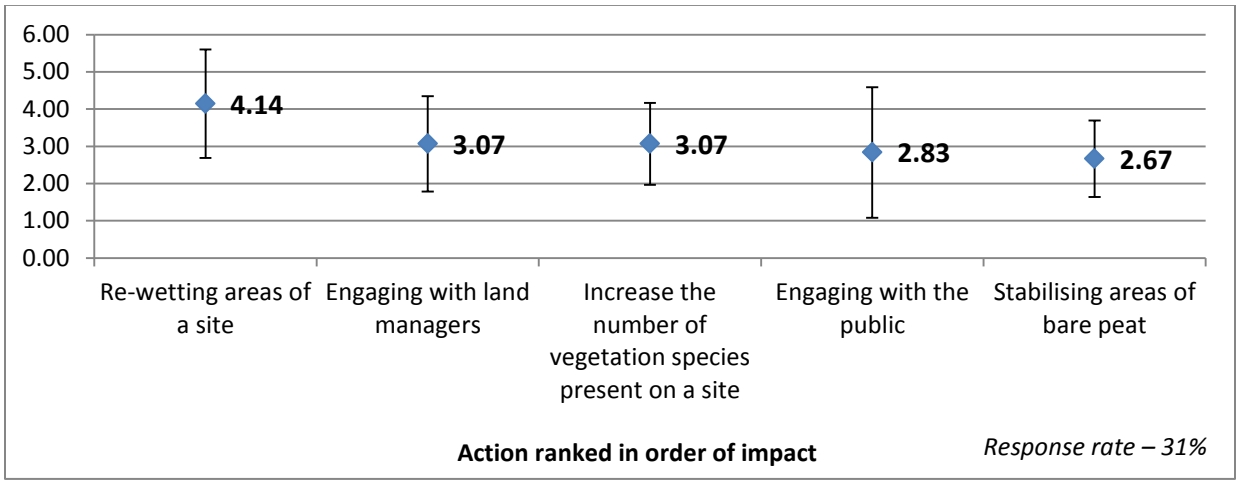


Figure 9 - Ranked mean rating for actions to reduce wildfire severity and standard deviation away from the mean



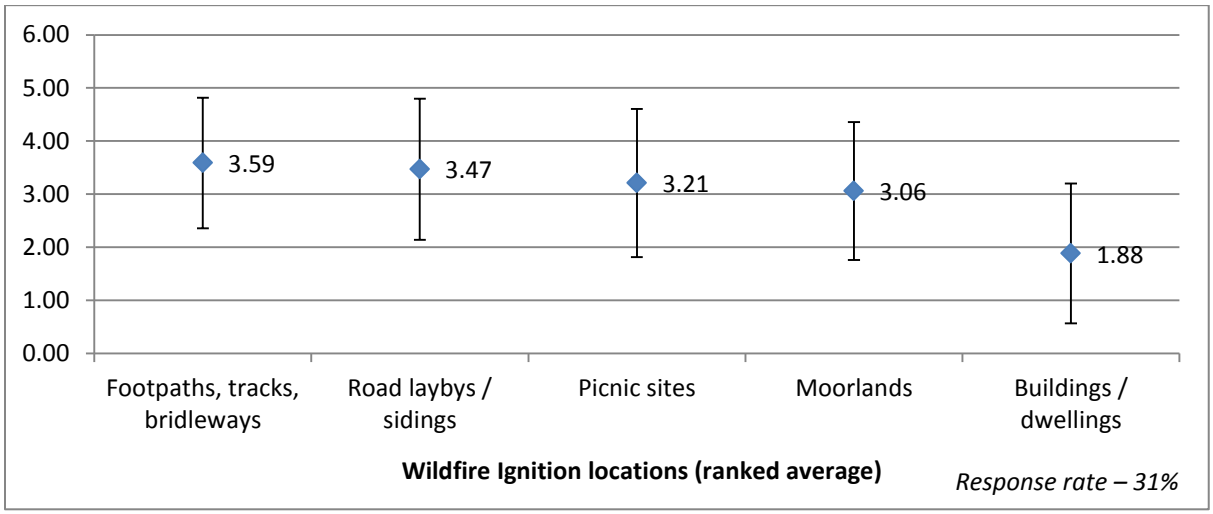
3.4 - Aim 3 Inform engagement and communication initiatives and materials to reduce the risk of wildfires

3.4.1 What is the most common ignition points for wildfire

Figure 10 identifies that footpaths, tracks and bridleways etc. are perceived as the most common ignition point for wildfires being rated 3.59 on average. This could be because 58% of respondents thought that wildfires were started maliciously, with Public Rights of Way (P.R.O.W) representing easy access to these areas for arsonists, it also explains why respondents thought that open moorland was one of the least likely ignition points, and supports the findings within the 2006 McMorrow and Lindley report, suggesting that this scenario hasn't changed since the report was commissioned.

The least common ignition point is buildings and dwellings with an average rating of 1.88. One possible explanation for this is that there are a limited number of buildings present on ABB, reducing the opportunity for a wildfire to begin.

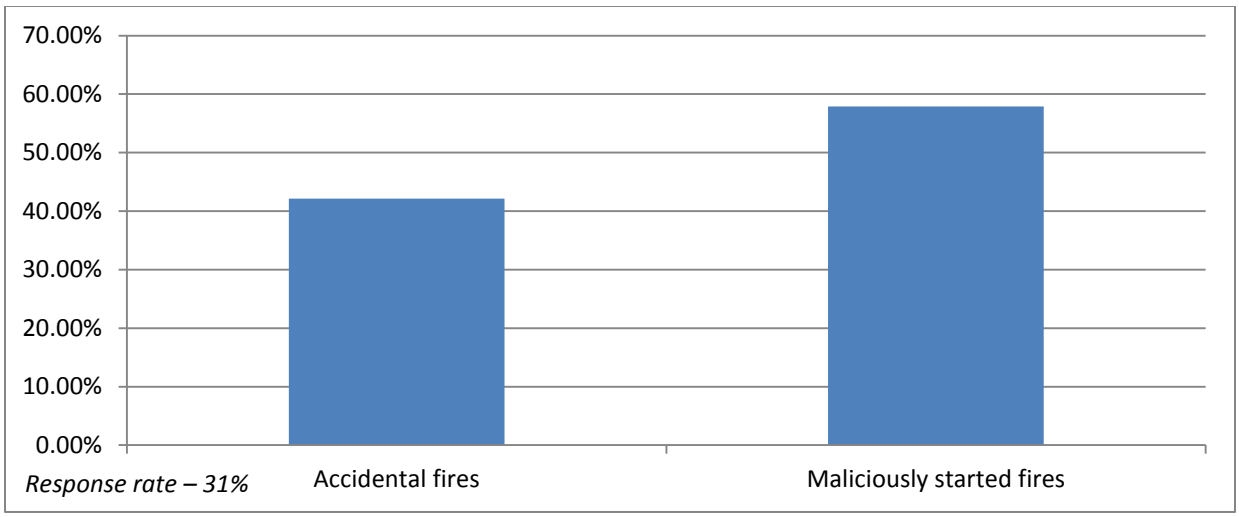
Figure 10 - Ranked average, locations of the most common wildfire ignition points



3.4.2 What do you consider to be the primary cause of wildfire

Figure 11 below indicates that 57.8% of respondents thought that wildfires were most commonly caused maliciously. This suggest that for the majority of wildfires that occur our conservation activities may only be able to reduce the risk of wildfires occurring in 42.2% of instances, which equates to 11 wildfires per year based upon the average of 26 wildfires per year between 2007 and 2016 across the SPM SAC. However, where the conservation work could have major benefits is in reducing the severity of the wildfires that occur through reducing the scope and extent of the damage.

Figure 11 - What do you consider the most common cause of wildfire



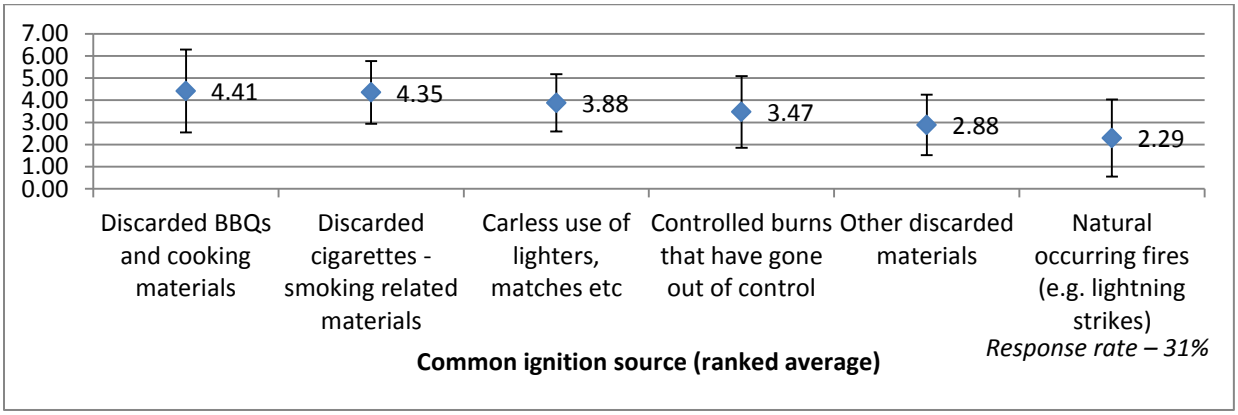
3.4.3 What is the most common ignition source for accidentally started wildfires

Respondents thought that discarded BBQ's / cooking materials and discarded cigarettes / smoking related material are the main causes of accidental wildfires, see Figure 12 below. This result is similar to the information identified within wildfire database, (which is a database collating key variables (e.g. cause, location, damage etc) for of all wildfires within the SPM SAC since 2007), as of the known causes recorded in the database, smoking related materials (e.g. cigarettes) are the most common reason identified.

As discarded materials forms the main ignition source for wildfires, it would suggest that better education and warning notices at key locations e.g. P.R.O.W, may help to reduce the number of wildfires as identified in Figure 8 and

Figure 9. The least common ignition source is naturally occurring wildfires. Of those wildfires which involve human activity the least common would be other discarded materials (e.g. discarded batteries).

Figure 12 - What is the most common ignition source for accidentally started wildfires including standard deviation away from the mean

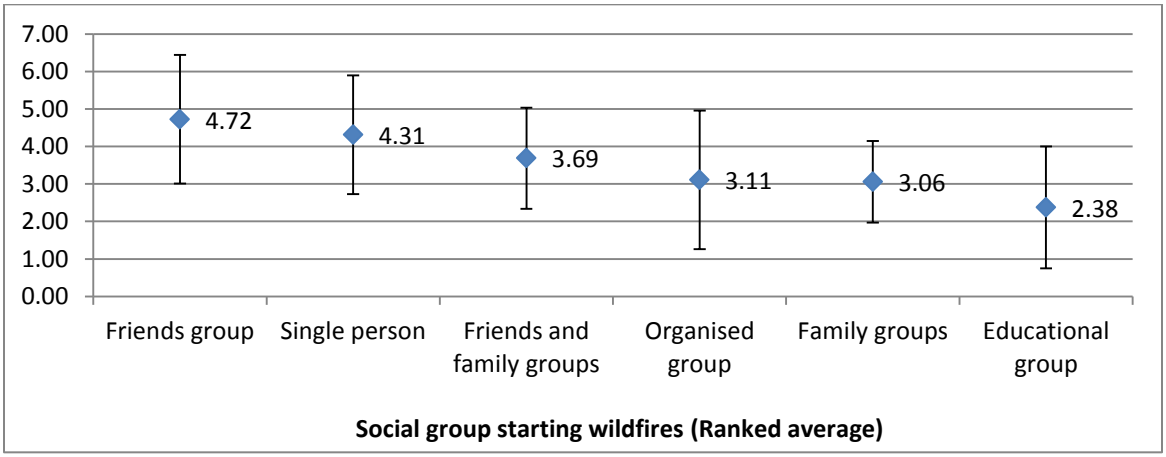


3.4.4 Which social groups do you think start the most wildfires

Respondents thought that 'friend groups' was the social group most likely to start wildfires with an average ranking of 4.72, this would be in keeping with the most common reason accidental wildfires occurred, discarded BBQ's and cooking material. Single persons were the second most identified social group which is likely to start wildfires with an average ranking of 4.31.

The least most common social group is those persons out on an education trip with an average ranking of 2.38.

Figure 13 - Which social groups do you think starts most wildfires and standard deviation away from the mean



6. Conclusion

This questionnaire aims to establish a baseline for wildfire risk and severity using expert opinion to rate key single species habitats prior to our communication and conservation actions being implemented. Due to the design of the questionnaire it means the aims will primarily be answered on completion of the after questionnaire administered in 2020.

Aim 1 – Establish expert opinion on the perceived risk and severity of wildfires prior to and after our work has been completed to identify what effect our actions have had.

In conclusion it is possible to determine that Purple Moor Grass and Heather are the single species habitats that were perceived to pose the highest wildfire risk, with 91% and 95% of respondents respectively ranking them as having a high or worse wildfire risk, primarily due to the high fuel load and dryer habitats associated with these single species habitats.

The single species habitats perceived to have the least wildfire risk is Bilberry and Common Cotton Grass, with only 26% and 21% of respondents respectively rating the wildfire risk as high of worse. For Common Cotton Grass this was due to the wet habitat associated with it. Whereas for Bilberry the green stem indicates water retention.

Analysis of the questions on wildfire severity identify that 89% of respondents thought Heather and 68% of Purple Moor Grass would have a high severity wildfire or worse, due to the large fuel load available and because these plant species can burn very slowly.

The strength of the relationship between wildfire risk and severity varies depending on the single species habitat, with Bilberry having a strong positive relationship at a 99% confidence interval whereas Bare Peat and Common Cotton Grass has no relationship when applying Spearman's rank correlation. The majority of single species habitats indicate a moderately positive relationship suggesting that as wildfire risk increase so too does severity.

Aim 2 – Help MFFP to evidence the effects the project has on reducing wildfire risk and severity.

The results of the questionnaire identify that the most important activities that MFFP can undertake to reduce wildfire risk and severity is to increase the height of the water table, with an average ranking of 4.14 and engage with land managers and the public to raise awareness both have an average ranking of 3.07.

To reduce the impact wildfire has on ABB the key measures MFFP and our partners can undertake is to reduce wildfire risk and severity is:

1. Increase the water table through gully blocking and the re-introduction of *Sphagnum* Moss *spp* on our work sites in order to increase the wetness of the habitat.

2. Cut areas of Purple Moor Grass and Heather to reduce the fuel load associated with these habitats.
3. Undertake educational events in communities close to large areas dominated by Purple Moor Grass and Heather to make them aware of the risk, based upon locations from the land cover map.
4. Consider the fire risk associated with habitats adjacent to Active Blanket Bog areas, as wildfire could spread from these habitats e.g. Bracken and Conifer Plantations.

Aim 3 – Inform engagement and communication initiatives and materials to reduce the risk of wildfires.

Looking at the scenarios associated with wildfire ignition respondents identified that most wildfires are started maliciously (57.8%). This means that our conservation led actions could only help reduce the risk of wildfires in 11 incidents per year based upon an average of 26 wildfires per year from 2007 – 2016. Our conservation led activities would still help reduce the severity of all wildfires that occur.

P.R.O.W was ranked as the primary location where wildfires are most likely to start. This supports the findings identified in the 2006 McMorrow and Lindley report, suggesting this scenario has not changed in the intervening time period. The least likely place where wildfire ignition begins is buildings.

The most likely cause of accidental wildfires is discarded BBQ's and cooking materials, closely followed by discarded cigarettes. This outcome is supported by the wildfire database which identifies that smoking is the most common ignition source from the available data.

This suggests that MFFP could undertake the following work to reduce wildfire risk and severity.

1. Target work areas that have large visitor numbers e.g. sites adjacent to the Pennine Way first as they have the highest threat level.
2. Increase awareness at key locations on public rights of way e.g. at the start of the Pennine Way.
3. Undertake fire awareness events at popular picnic spots or 'honey pot villages' which attract a lot of tourists.

7. References

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Appendix 1 – All comments received associated with single species habitats for risk and severity

Comments received on the risk associated with Purple Moor Grass

Comment	Number of Occurrence
Dry, dead grass	6
Varies based upon time of year	6
Large fuel load	4
Fast to catch, and burns quickly	4
Many fires	1
Tussocks increase likeliness	1
Easy to access	1
Perception is that it should be burnt	1

Comments received on the risk associated with Heather

Comment	Number of occurrences
Large fuel load	7
Combustible when dry	3
Burns fiercely	3
Hard to extinguish	2
Dry surface enabling rapid expansion	1
Slow to catch fire	1
Dense strands making it more vulnerable in winter	1
Increase dryness in spring and summer	1
Patchier growth	1

Comments received on the risk associated with Common Cotton Grass

Comment	Number of occurrences
Wet habitat	11
Small fire load	5
Rapid fire in correct conditions	2
Generally resistant to fires	1
Moderate risk in summer	1
Low risk due to location and wildfire	1

Comments received on the risk associated with Bilberry

Comment	Number of occurrences
Rarely expect a fire to start in bilberry due to it being green, which shows water retention	7
Less fuel load	3
Burns well when dry	2
Reduced burn time	2
Rarely dries out	2
Unsure	1
Potentially high fire load	1
Low fire risk during summer periods	1
Highly flammable	1
Similar to heather	1

Comments received on the risk associated with Bare Peat

Comment	Number of occurrences
Difficult to ignite, no surface content	9
significant fire risk / fire risk when dry	5
Difficult to extinguish	4
Pure fuel source	2
Unsure	2
Low risk	1
Dependant on conditions	1
Will burn for a long time	1
Risk increases adjacent to veg	1

Comments received on the severity associated with Purple Moor Grass

Comment	Number of occurrences
Quick burn	10
Burns above ground	3
Immediate regrowth	1
Dried tussocks flammable	1
High risk in summer	1
Less risk when new growth	1
Desiccated in winter	1
Less impact	1

Comments received on the severity associated with Heather

Comment	Number of occurrences
Can create conditions where fire goes into peat	5
Slow / long burn	5
Hot burn	3
Significant fuel load	2
Poses a severe risk to flora and fauna	2
Can dry vegetation out in front of fire	1
Increases water run off	1
Spreads quickly	1
Dependant on how dry the plant is	1
Risk of re-igniting	1
Past experience	1
Difficult to ignite accidently	1
Requires large amount of water for extinguishing fire	1
Dry summer months	1
Very flammable, plus prone to spreading in dense continuous strands	1

Comments received on the severity associated with Common Cotton Grass

Comment	Number of occurrences
Wet habitat / dry surfaces required	12
Low fuel load	2
Hard to get going	1
Varied species	1
Higher risk in combination with other habitats	1
Essential habitat for insects and wildlife	1
Quick burn	1

Comments received on the severity associated with Bilberry

Comment	Number of occurrences
Low fuel loading	4
Evergreen Shrub	3
Similar to heather	2
Higher risk in combination with other habitats	1
Dependant on growth stage	1
Unsure	1
Flammable, past experience	1
Woody	1
Can burn with great intensity	1
Essential for flora and fauna	1

Comments received on the severity associated with Bare Peat

Comment	Number of occurrences
Lots of fuel therefore lingers for days	4
Very bad damage due to damaged substrate	3
Difficult to extinguish	2
Only put out with water	2
Increases water pollution	1
Difficult to ignite	1
Dryer = higher risk	1
Unlikely to burn without vegetation	1
Essential for trapping CO2	1
Impact could become v significant if fire becomes established	1
Burns very hot	1
Travels underground	1