MoorLIFE 2020 Project:

D4, Wildfire Perception and Incidents Questionnaire Report:

October 2021

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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 conservation work can help reduce wildfire risk and severity, by helping to guide which conservation techniques are best suited to high risk locations as identified by Dixon and Chandler (2019) Risk of sustained ignition mapping for the Peak District National Park.

Due to the difficulty in collecting empirical data for wildfires, a pre and post-intervention 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 the effects of these techniques.
2. Helping us to evidence the effects the project has on reducing the risk and severity of wildfire.

In order to gather expert opinion, the before and after questionnaires were administered to the Peak District National Park Authority and South Pennine Fire Operations Group members, using Survey Monkey for the before survey and Smart survey for the after survey. For the before survey there were a total of 27 respondents out of a possible 61 (37% response rate), whereas for the after survey there were 23 respondents out of 54, a response rate of 28%. The response rate differed slightly between questions.

The results of the before survey identified that purple moor grass (*Molina caerulea*) and heather (*Calluna vulgaris*) are perceived to be the habitats with the greatest wildfire risk. For wildfire severity, purple moor grass and bare peat were perceived to be the habitats where the most severe wildfires would occur. Whereas common cotton grass (*Eriophorum angustifolium*) and bilberry (*Vaccinium myrtillus*) were identified to have the smallest wildfire risk and severity.

When looking at the impact our conservation techniques have on reducing wildfire risk and severity, the technique respondents consistently scored as having the largest impact on reducing both wildfire risk and severity was gully blocking, and bunding, however the amount that wildfire risk and severity is reduced by is not determined by the habitat type. Conversely it was thought that techniques that introduced biomass into the habitat (e.g. *Sphagnum* planting, brash spreading) would have the least impact on reducing both wildfire risk and severity, and in some habitats increase the wildfire risk and severity. It was however recognised in the comments that it may not be as simplistic as this, when other factors are taken into account, such as when combining the techniques identified for bare peat restoration, this would help reduce wildfire risk.

Highlights

- The aim of this questionnaire is to establish expert opinion, on which conservation techniques have the biggest impact on reducing wildfire risk and severity.
- The pre and post intervention questionnaires was sent to the Peak District National Park Authority and South Pennine Moors Fire Operations Groups using Survey Monkey for the pre survey and Smart Survey for the post survey, in order to gain expert opinion.
- The pre intervention survey identified that purple moor grass (*Molina caerulea*) and heather (*Calluna vulgaris*) have the greatest wildfire risk.
- The pre intervention survey identified that purple moor grass and bare peat have the most severe wildfires.
- The pre intervention survey identified the habitat with the least wildfire risk and severity is common cotton grass (*Eriophorum angustifolium*) and bilberry (*Vaccinium myrtillus*).
- The post intervention survey indicates that gully blocking / bunding are the techniques thought to have the greatest impact on reducing wildfire risk and severity.
- Conservation techniques that add biomass to the habitat are those techniques that were thought to have the least impact on reducing wildfire risk and severity.
- The amount wildfire risk and severity is reduced for similar conservation techniques isn't determined by the habitat type.

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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), and the many ecosystem services it provides including carbon sequestration, improving biodiversity, and flood attenuation (*Rouquette, 2015*). With wildfires 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. In order to understand the impact our conservation techniques have on reducing wildfire risk and severity a pre and post intervention questionnaire was developed. This methodology was chosen because it is difficult to use empirical data to monitor the impact our conservation work has on wildfires, due to the projects timescales, and the unpredictability of where wildfires occur and the dangers associated with them.

The questionnaire was sent exclusively to the South Pennines and Peak District National Park (PDNPA) Fire Operations Groups (FOG) to ensure that expert opinion was captured. The aim and role of these FOG 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).*

The pre survey was administered to these FOG groups via Survey Monkey in 2017, and focussed on identifying the wildfire risk and severity associated with habitats dominated by single species prior to any conservation work occurring.

With the number of wildfires expected to increase in future years due to climate change *(UK Government, 2019).* It is important to understand which conservation techniques help reduce wildfire risk and severity in different habitats, to reduce the impacts of wildfire. By understanding which technique is most suited to each habitat, it can help land managers maximise the protection from wildfires.

The data looking at the impact of different conservation techniques was collected in 2021, and primarily focuses on conservation techniques applied under MoorLIFE 2020 to the single species habitats, which includes techniques such as gully blocking and sphagnum planting. It should be noted that there are other conservation techniques not covered in this report, these were not included because we have tried to make the questionnaire as user friendly as possible to encourage responses.

For the purposes of this report, a 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. A different definition to that used by the fire and rescue services (FRS) was utilised because the FRS definition excludes smaller wildfires which can be important for land managers deciding on where conservation interventions should be sited.

2. Methodology

The post intervention survey (see appendix 1) was sent to the Peak District National Park Authority (PDNPA) and South Pennine FOG groups using Smart survey. The questionnaire was administered via Smart Survey to ensure that all FOG group members had the opportunity to complete the survey, as not all members attend each meeting. Additionally, attendance at each quarterly FOG 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 Smart Survey.

The survey was sent round to all FOG group members in June 2021, and the survey closed in Mid-July. The timescales were based upon how long it took respondents to complete the pre intervention survey. Additionally, reminders were sent out by e-mail to all those who had not completed the questionnaire to ensure that as many responses were captured as possible.

The reason that the survey platform changed between the pre intervention and post intervention survey, is that the PDNPA has changed their provider from Survey Monkey to Smart Survey. This represents the only change in methodology between the two surveys.

2.2. Sample size

Sending the questionnaire to just the FOG group members limited the population size of the survey, but ensured expert opinion was obtained. Additionally between the pre and post intervention surveys the number of group members on the mailing list decreased from 62 to 54 respondents, further limiting the population size.

2.3. Question design

Respondents were asked to rate the risk and severity of a wildfire occurring in a single species habitat, with just the relevant conservation techniques applied. The scale used to rate the habitats is a modified version of the severity index scale developed by the Met office, see Table 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.

Table 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

This scale remained consistent between the pre and post intervention survey to ensure that a comparison between the two the surveys could be undertaken.

In order for respondents to rate the wildfire risk and severity associated with different conservation techniques associated with the single species habitats, representative photographs were chosen to show the impacts of different conservation techniques in each of the single species habitats. In all single species habitats respondents were told to assume that all factors, e.g. distance to a footpath, were the same for all species in question, so as not add bias to one particular single species habitat.

2.3. Analysis of results

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

For comparison between wildfire risk and severity, Spearman's rank correlation was used to compare the strength of the relationship using the formula in Equation 1.

Equation 1: Spearman's rank correlation formula

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

Barcelona field centre, 2017

3. Results

3.1. Summary of pre survey

The results of the pre intervention survey suggest that the experts thought the areas dominated by purple moor grass *(Molina caerulea)* and *heather (Calluna vulgaris)* have the greatest wildfire risk. Whereas 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 *(Titterton, 2017).*

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 *(Titterton, 2017).*

Additionally, the FOG group thought that most important activity MFFP 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 *(Titterton, 2017).*

Expert opinion identifies that 57.8% of wildfires were started maliciously (*Titterton, 2021),* suggesting that the conservation activities undertaken could have less of an impact on reducing wildfire risk. 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 at picnic locations. Another common scenario could be a single person discarding a cigarette whilst walking or parked up at a layby *(Titterton, 2017).*

The full results of the before survey can be found on https://www.moorsforthefuture.org.uk/our-resources.

3.2 Overall response rate

The overall response rate for the post intervention survey was 28% with 15 respondents completing all questions on the survey. This is slightly below the average response rate of 33% expected from this type of survey *(Customer Thermometer, 2021).*

3.3.1 Wildfire risk

Purple Moor Grass

Figure 1 below identifies that respondents thought the wildfire risk for areas dominated by purple moor grass would vary considerably depending upon the conservation technique used. With 93% of respondents rating just cutting as having a 'high fire risk' or worse. Whereas bunding was thought to have the least wildfire risk with just 20% of respondents rating it as having a 'high fire risk' or worse.

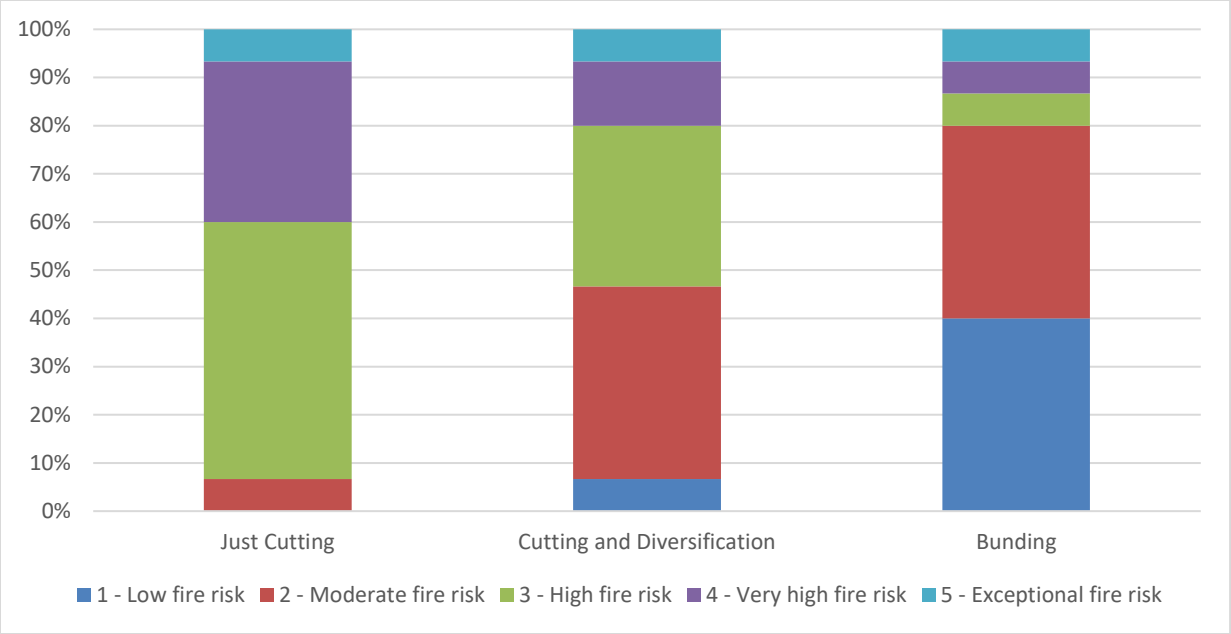

Figure 1 – A graph showing how respondents scored the different conservation techniques for purple moor grass

Comparing no intervention to the three conservation techniques, see Figure 2 below, shows a reduction in the perceived fire risk for all three conservation techniques. The biggest perceived drop in wildfire risk is from both bunding and cutting with diversification, as peak responses drop from a score of 4 (very high fire risk) to a score of 2 (moderate fire risk). Whereas just cutting peak score only drops from 4 (very high fire risk) to 3 (high fire risk).

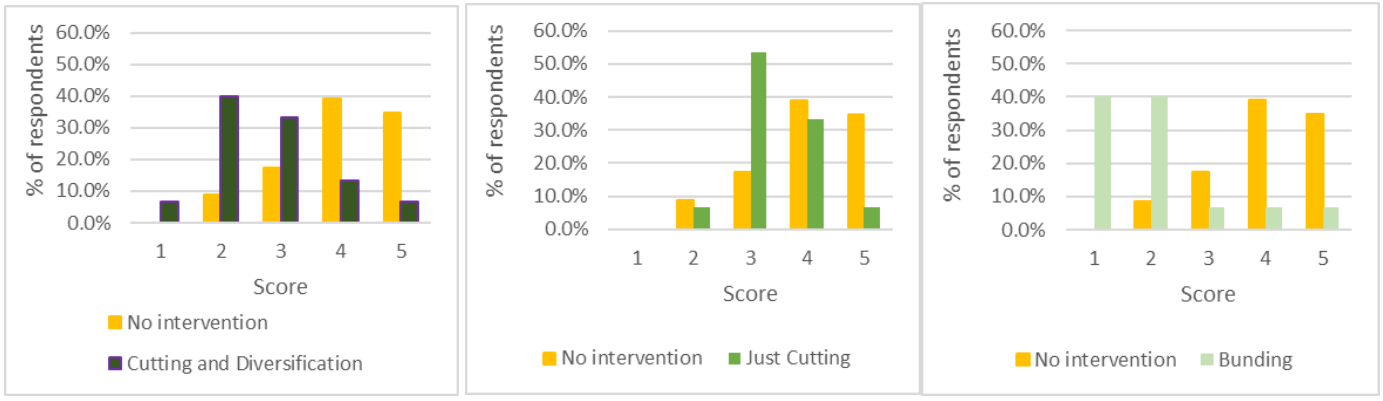

Figure 2 – A graph showing the response profile for the perceived risk of wildfire occurring pre and post intervention different interventions on Purple Moor Grass

Heather

The common restoration techniques associated with heather, identifies that 92% of all respondents thought that a cut heather habitat would have a 'high fire risk' or worse. Whereas 38% of all respondents thought that, the impacts of gully blocking would only have a 'high fire risk' or more as presented in Figure 3 below.

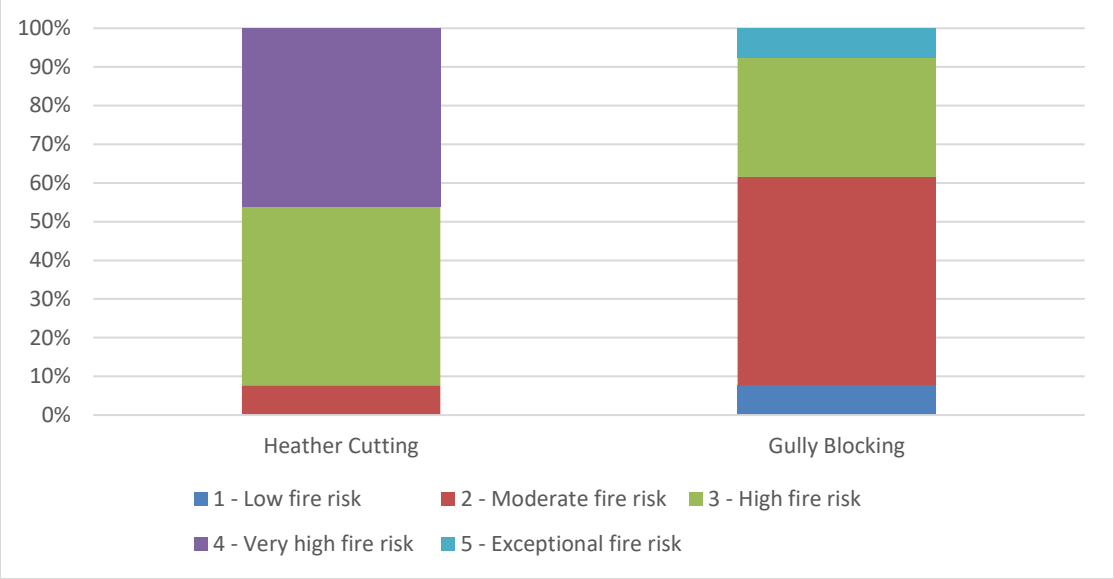

Figure 3 – A graph showing how respondents scored the different conservation techniques for heather

Comparing the perceived risk of these conservation techniques to no interventions, Figure 4 below, shows that cutting heather slightly reduces the perceived risk, dropping from a score of 4 (very high fire risk) to 3 (high fire risk). Whereas gully blocking shows a greater perceived reduction in wildfire risk with a decrease in peak score from 4 (very high fire risk) to a score of 2 (moderate fire risk).

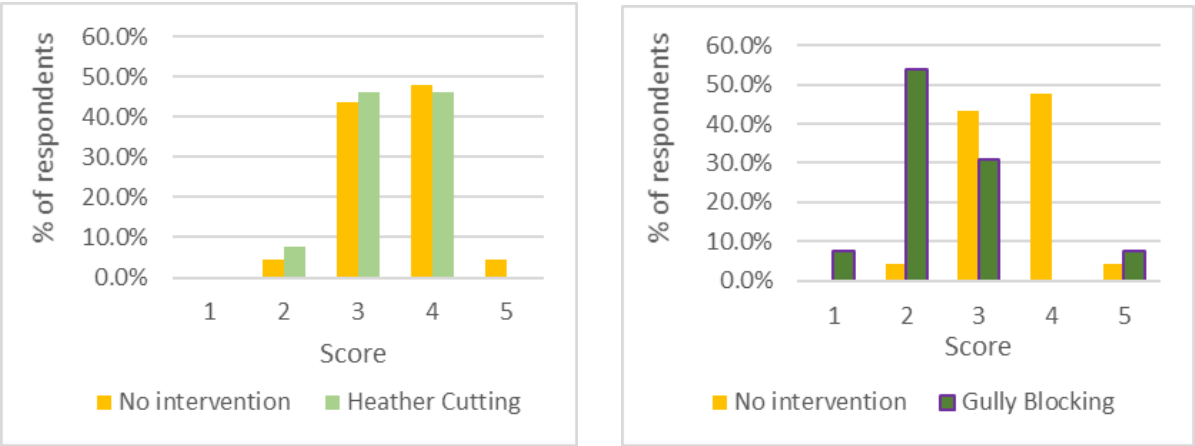

Figure 4 – A graph showing the response profile for the perceived risk of wildfire occurring pre and post intervention for different interventions on heather

Common Cotton Grass

Analysis of the data in Figure 5 shows that 38% and 41% of respondents thought that gully blocking and sphagnum planting respectively as having a 'high fire risk' or worse on a common cotton grass habitat.

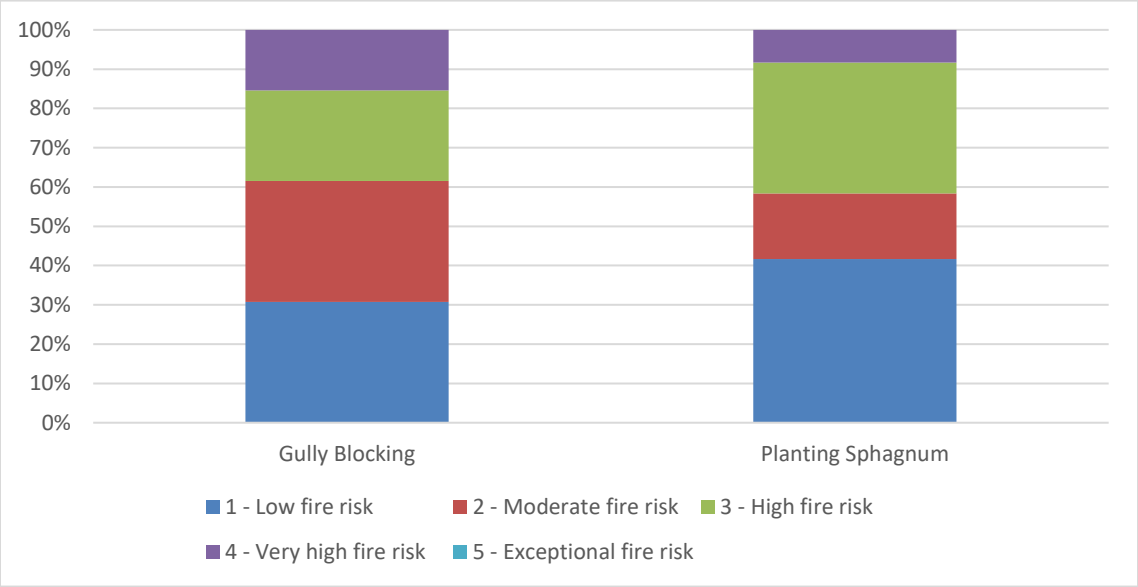

Figure 5 - A graph showing how respondents scored the different conservation techniques for common cotton grass

Comparing the conservation techniques for common cotton grass against no intervention (see Figure 6 below) shows that gully blocking would have a minimal impact upon reducing the perceived risk of wildfire, with a peak score of 2 (moderate fire risk) in the post intervention survey. Whereas the peak response for gully blocking plateaus at 1 (low fire risk) and 2 (moderate fire risk). Conversely planting sphagnum moss would help to reduce the perceived wildfire risk with a peak score of 2 (moderate fire risk) in the pre intervention survey dropping to 1 (low fire risk) in the post intervention survey.

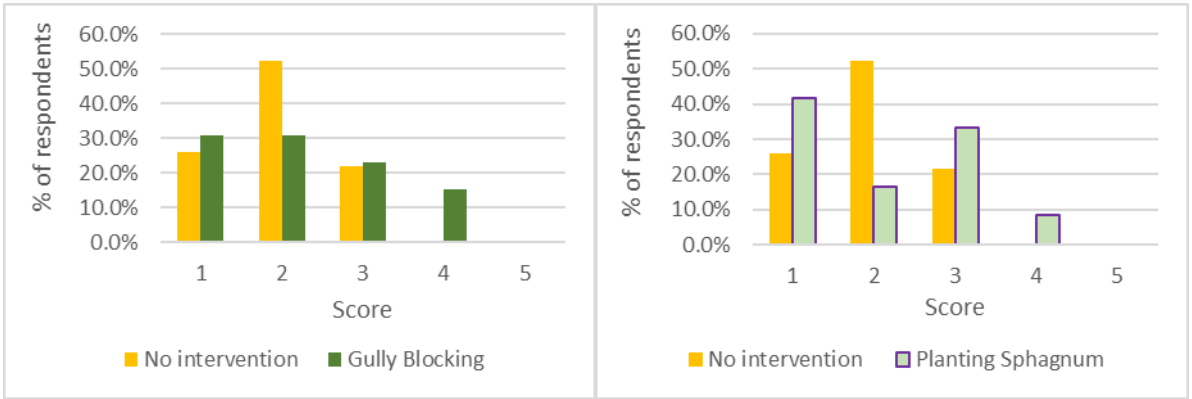

Figure 6 – A graph showing the response profile for the perceived risk of wildfire occurring pre and post intervention for different interventions on common cotton grass

Bilberry

Sixty-six percent of the FOG group members thought that diversification would have a 'high wildfire risk' or worse, see Figure 7.

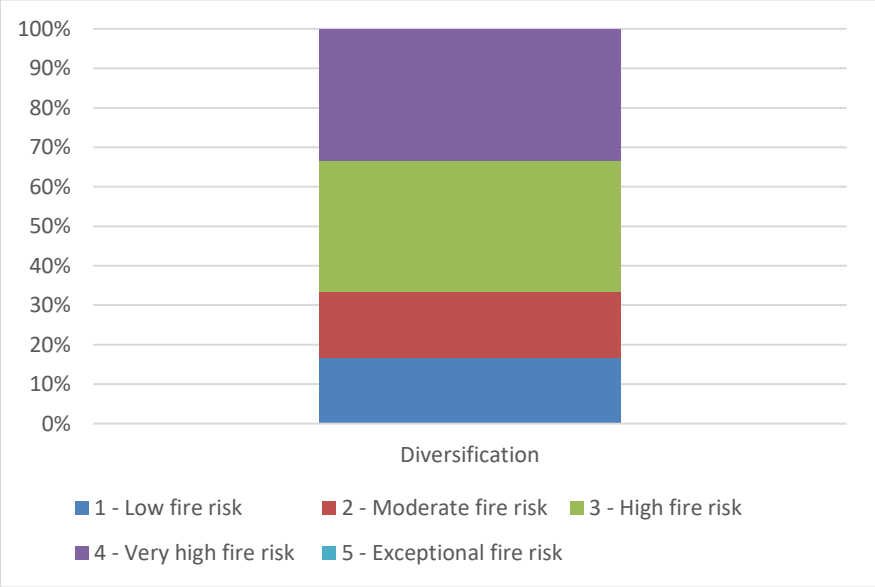

Figure 7 – A graph showing how respondents scored the different conservation techniques for bilberry

Figure 8 below indicates that the peak number of response for diversification is 3 (high fire risk), whereas the peak response for no intervention is 2 (moderate fire risk). This suggests that this conservation technique has increased the fire risk associated with the habitat.

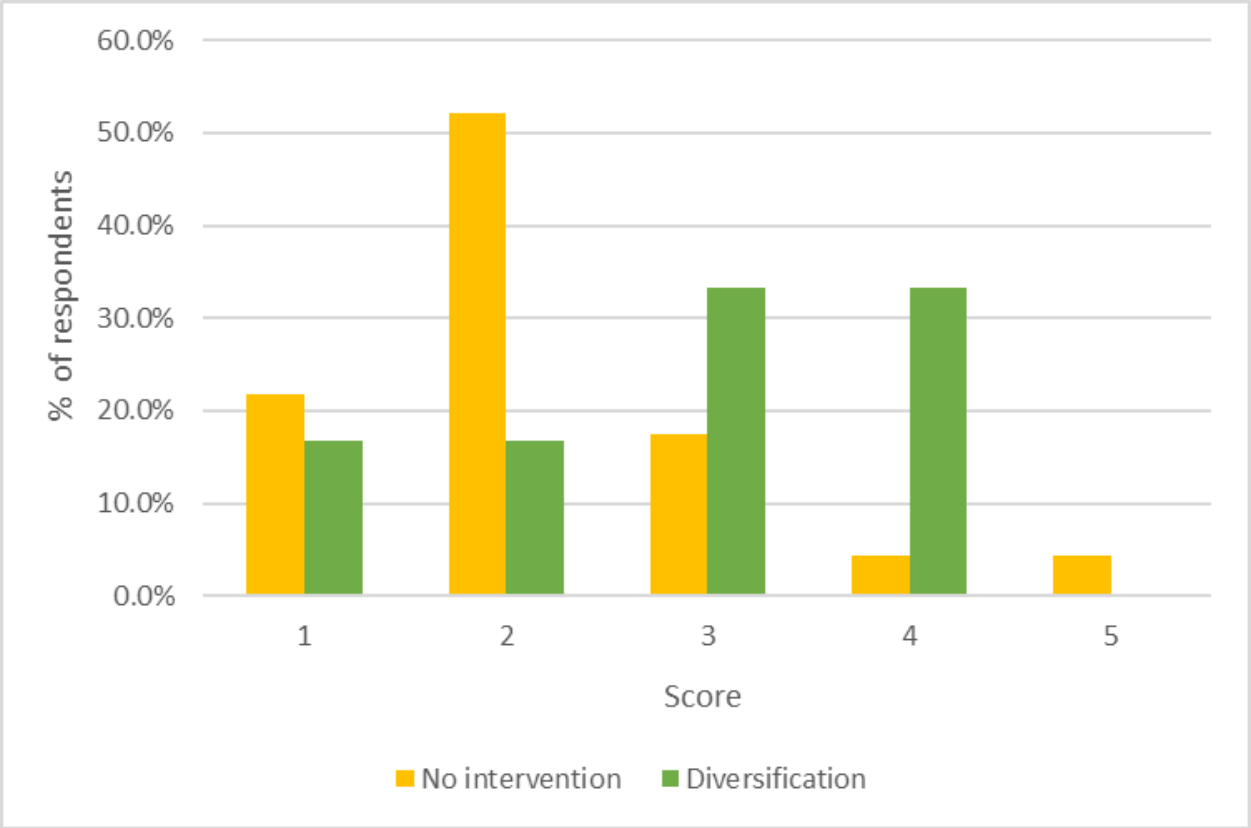

Figure 8 - A graph showing the response profile for the perceived risk of wildfire occurring pre and post intervention for different interventions on bilberry

Bare Peat

Figure 9 indicates that 41.7% of respondents thought that Lime Seed and Fertiliser (LSF) would have a 'high fire risk' or more. Whereas heather brash was thought to be the worse for reducing wildfire risk, with 91% of respondents identified the technique as having a 'high fire risk' or worse.

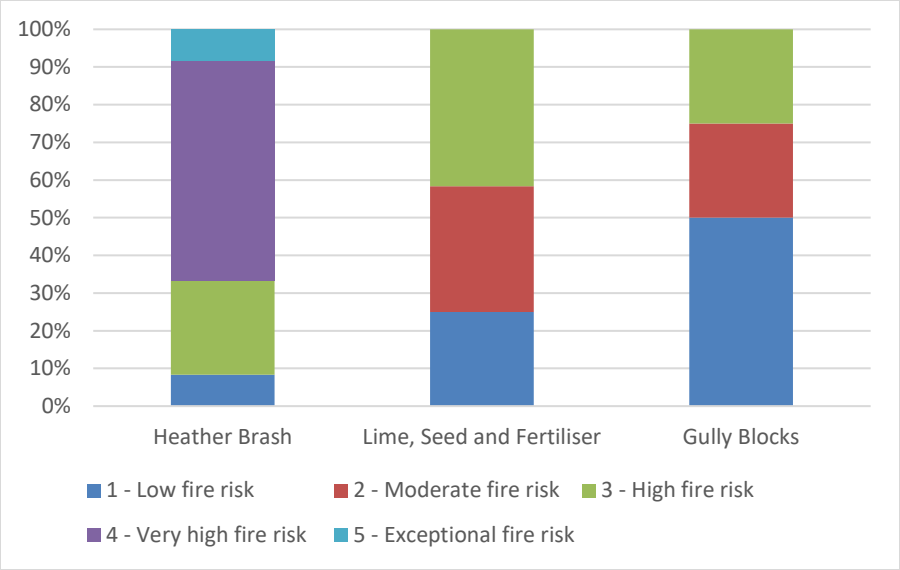

Figure 9 - A graph showing how respondents scored the different conservation techniques for Bare Peat

Analysis of the pre and post intervention data, see Figure 10, identifies that both heather brash and LSF show a perceived worsening of the fire risk after the conservation techniques were applied. With the peak respondents being at 1 (no fire risk) and 2 (moderate fire risk) respectively for no intervention, but increasing to a score of 4 (very high fire risk) for heather brash and 3 (high fire risk) for LSF. For gully blocking we see a slight perceived improvements in peak respondents due to the presence of the water.

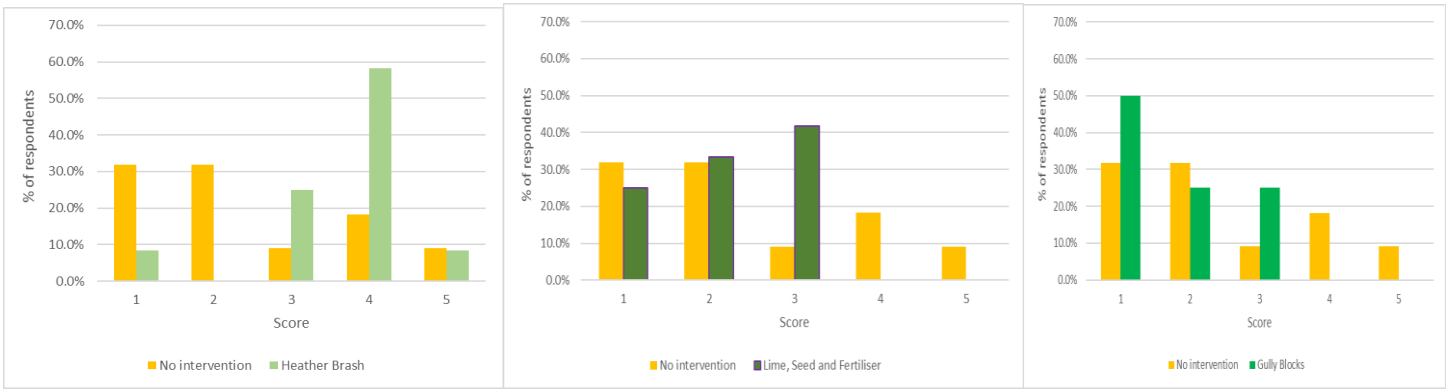

Figure 10 - A graph showing the response rate of the perceived risk of wildfire occurring pre and post different interventions on bare peat

3.3.2 Wildfire severity

Purple Moor Grass

Figure 11 identifies that respondents thought the severity of wildfires would differ depending on the conservation technique used with 92% of respondents thinking just cutting would have a 'high wildfire severity' or more. Whereas only 23% of respondents thought that a habitat with bunds present would have a 'high fire severity' or worse.

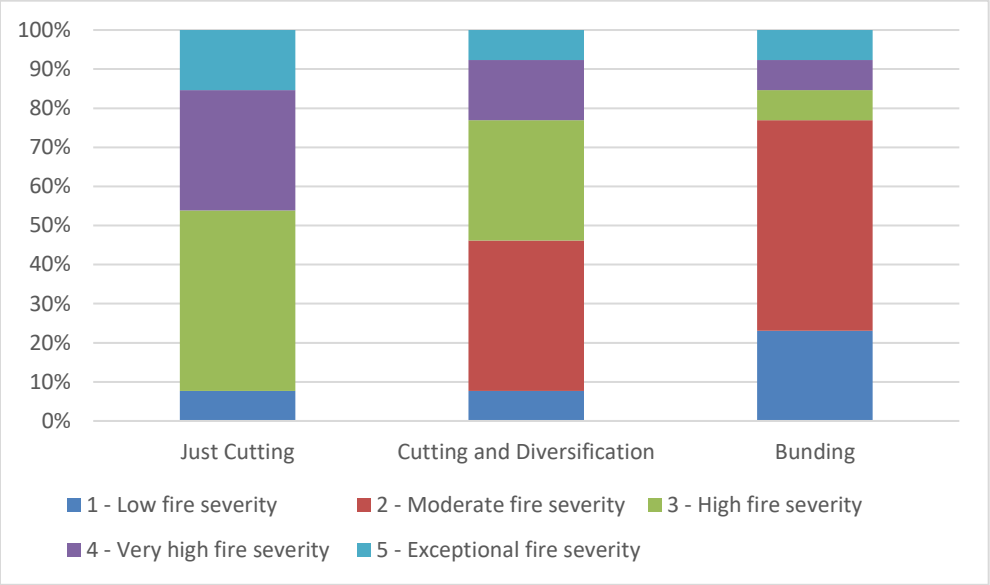

Figure 11 - A graph showing how respondents scored the wildfire severity for different conservation techniques associated with purple moor grass

Examining the results of the pre and post intervention surveys for the severity of purple moor grass, see Figure 12, identifies that it is difficult to identify what the perceived impact has on reducing the severity of wildfires. This is because there are two peaks in the pre intervention data (2 – moderate fire severity, 4 – very high fire severity), making it difficult to see the potential change as the peak for just cutting has a score of 3 (high fire severity).

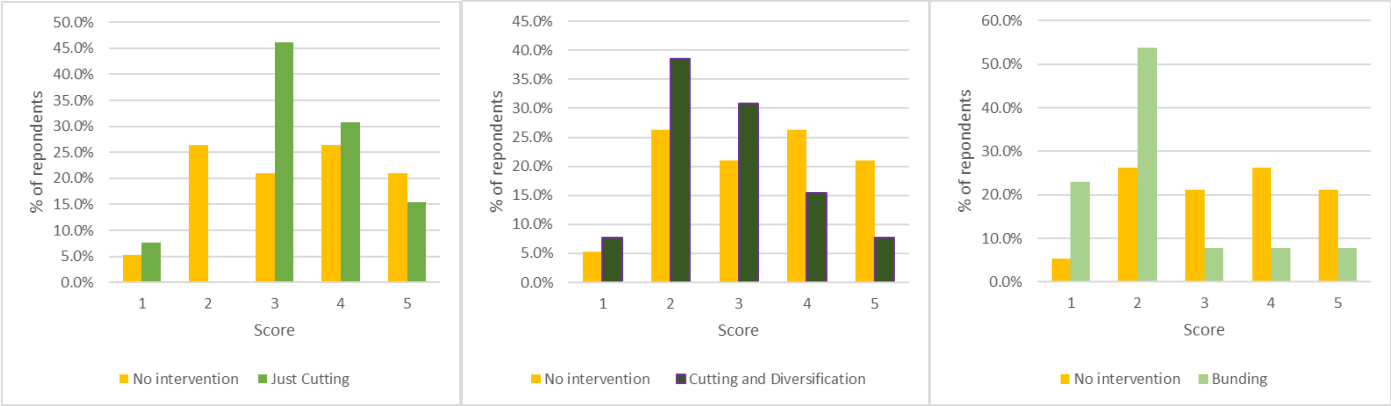

Figure 12 – A graph showing the response profile for the perceived severity of wildfire occurring pre and post different interventions on purple moor grass

Heather

For the severity of heather, 83% of respondents thought that cutting heather had a 'high fire severity' or more. Whereas 41% of respondents thought that gully blocking would have a 'high fire severity' or more as identified in Figure 13.

Figure 13 – A graph showing how the respondents scored the different restoration techniques impact on severity for heather

Comparing experts opinion on these techniques to no intervention indicates that there is no change in how respondents scored heather cutting with both responses peaking at a score of 4 (very high wildfire severity). Whereas for gully blocking we see a significant reduction in how respondents scored against no

intervention. With a fall from 4 (very high fire severity) to a score of 2 (moderate fire severity) see Figure 14 below.

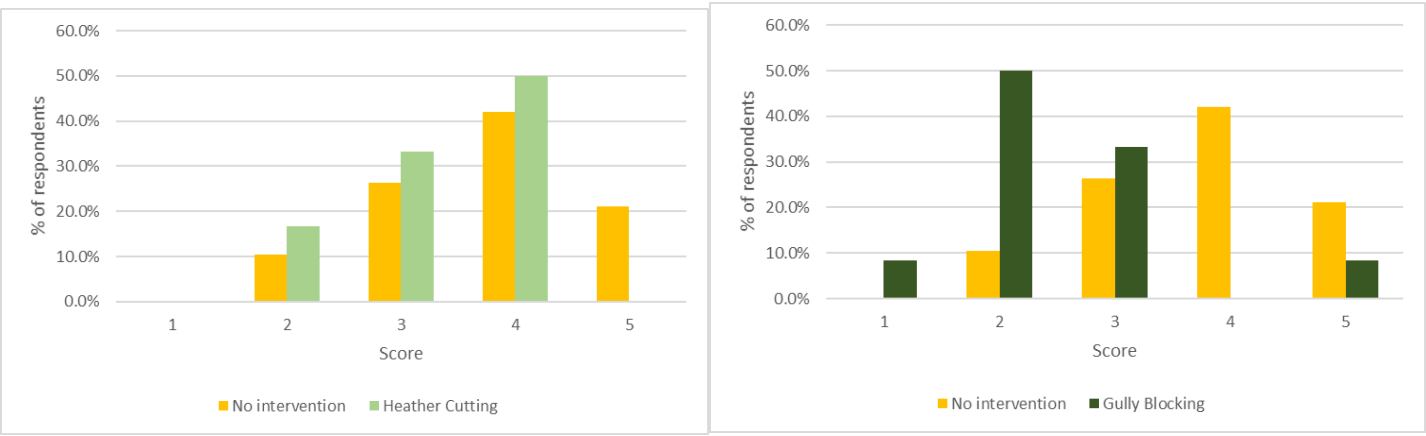

Figure 14 – A graph showing the response profile for the perceived severity of wildfire occurring pre and post different interventions on heather

Cottongrass

The graph below, Figure 15, identifies that 33% of respondents thought that gully blocking would have a 'high fire severity' or worse, compared to 50% of respondents thinking that Sphagnum planting would have a 'high fire severity' or worse.

Figure 15 - A graph showing how the respondents scored the different restoration techniques impact on severity for common cotton grass

Respondents thought that both conservation techniques would decrease the fire severity on cotton grass habitats, with a drop in the score from 2 (moderate fire severity) to 1 (low fire severity), as identified in Figure 16 below.

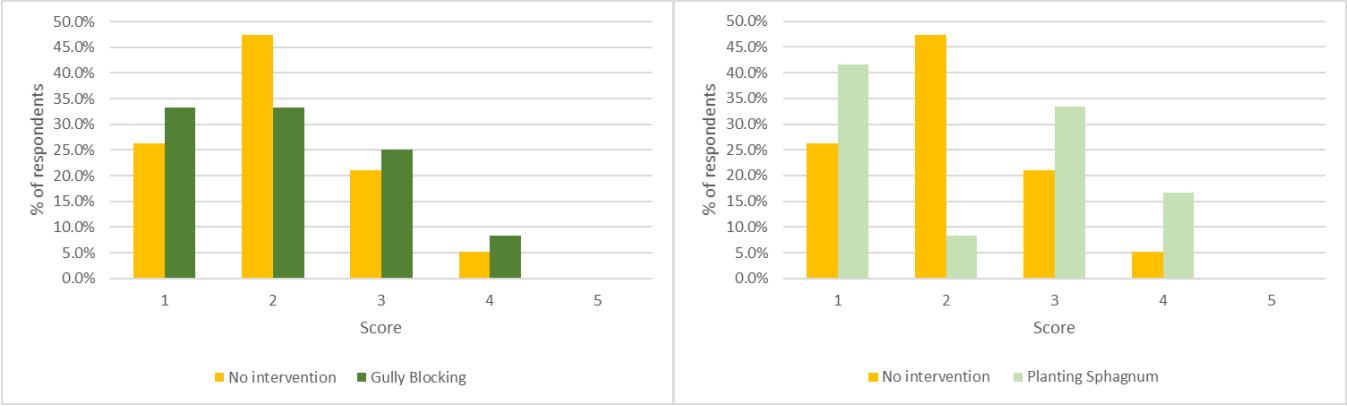

Figure 16 – A graph showing the response profile for the perceived severity of wildfire occurring pre and post different interventions on common cotton grass

Bilberry

Figure 17 below indicates that 66% of respondents identified that diversifying a bilberry habitat would have a 'high fire severity' or less.

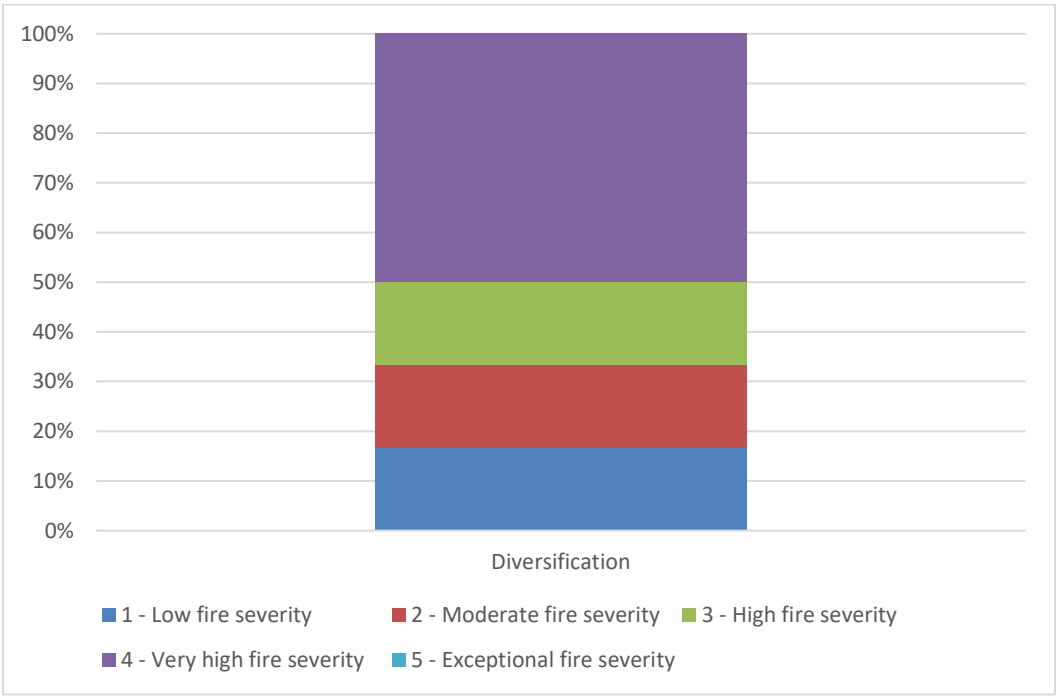

Figure 17 – A graph showing how the respondents scored the different restoration techniques impact on severity for bilberry

The respondents thought that undertaking diversification of bilberry would actually show a significant increase in the wildfire severity with no intervention scoring a 2 ‘moderate fire severity’ which increases to a score of 4 ‘very high fire severity’ once the diversification has taken place.

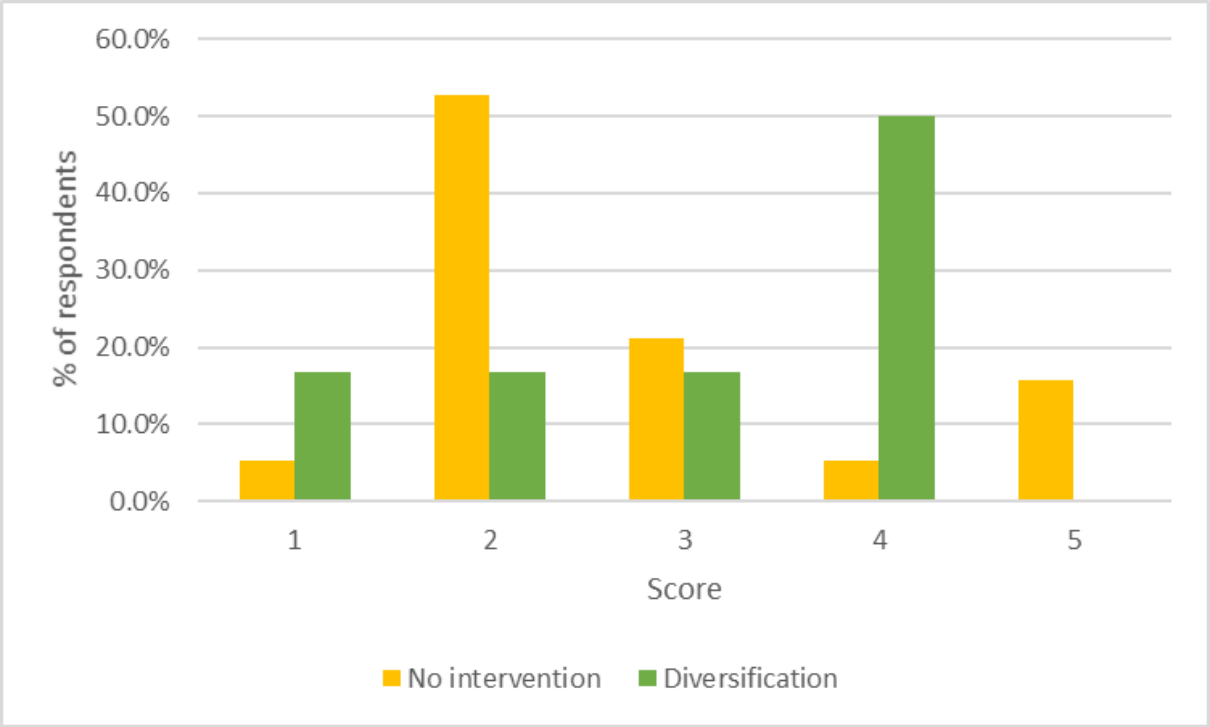

Figure 18 - A graph showing the response profile for the perceived severity of wildfire occurring pre and post different interventions on bilberry

Bare Peat

Figure 19 below shows that all respondents perceived heather brash as having a ‘high fire severity’ or worse. Which is high when compared to the other conservation techniques used on bare peat, with 50% of respondents rating LSF as having a ‘high fire severity’ or more and 40% for gully blocking.

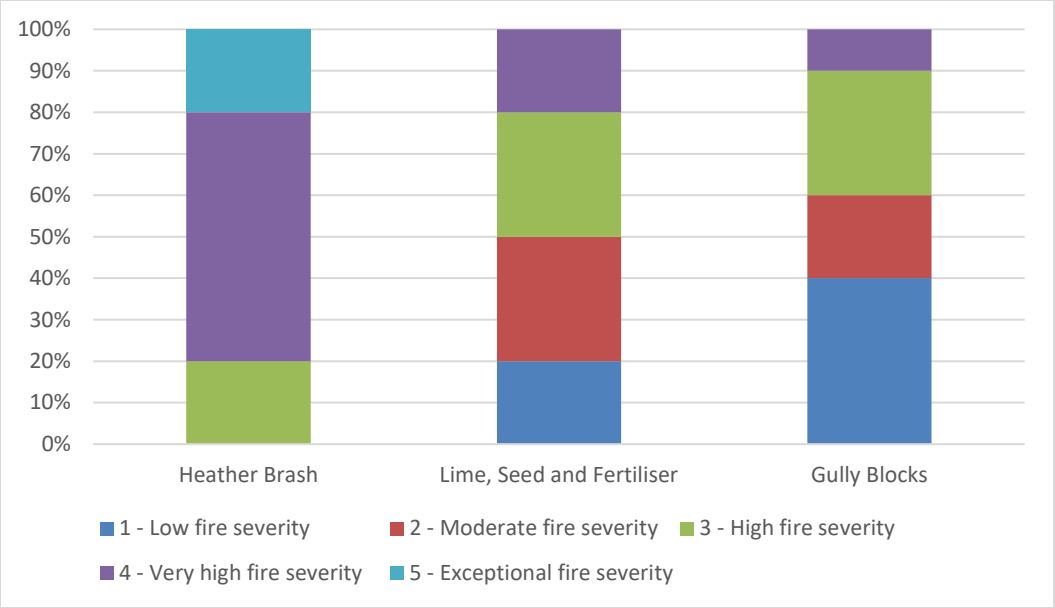

Figure 19 – A graph showing how the respondents scored the different restoration techniques impact on severity for bare peat

Analyses of the techniques used on bare peat sites in Figure 20 show that respondents though adding heather brash would slightly increase the severity of wildfires, with the peak no intervention score being 3 (high fire severity) and 4 (very high fire severity), whereas adding heather brash scores 4 (very high fire severity). This contrasts with the other two common conservation techniques (LSF and gully blocking) which experts though would slightly decrease to a peak of 3 (high fire severity) for LSF but a significant decrease for gully blocking with the peak score being 1 (no fire severity).

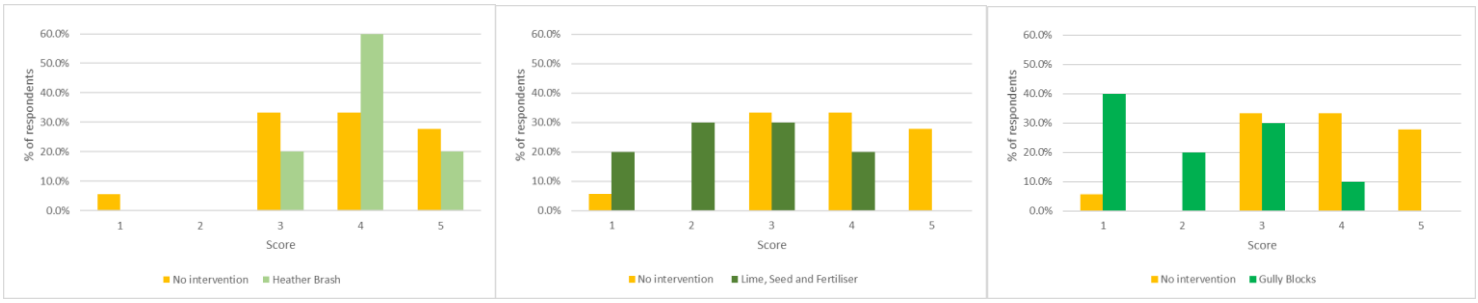

Figure 20 - A graph showing the response profile of the perceived severity of wildfire occurring pre and post different interventions on bare peat

3.3.3 Comparison of wildfire risk and severity

Spearman's rank correlation was used, see Table 2 below, to test the strength of the relationship between wildfire risk and severity for the different conservation techniques. The results indicate that for all the different variables there exists either a strong or a very strong positive relationship between wildfire risk and wildfire severity.

Table 2 - Spearman's rank correlation values

Habitat	Conservation Technique	Co-efficient	Degrees of freedom	Relationship	Reliability
Purple Moor Grass	Just cutting	0.77	13	Strong positive relationship	95%
	Cutting and diversification	0.78	13	Strong positive relationship	95%
	Bunding	0.83	13	Very strong positive relationship	95%
Heather	Cutting	0.82	13	Very strong positive relationship	95%
	Gully blocking	0.80	13	Very strong positive relationship	95%
Bilberry	Diversification	0.89	13	Very strong positive relationship	95%
Common cotton grass	Gully blocking	0.93	13	Very strong positive relationship	95%
	Planting Sphagnum	0.82	13	Very strong positive relationship	95%
Bare peat	Heather Brash	0.89	10	Very strong positive relationship	95%
	LSF	0.92	10	Very strong positive relationship	95%
	Gully Blocking	0.96	10	Very strong positive relationship	95%

4 Discussion

Overall, the perceived opinion from respondents is that conservation techniques which increased the water table such as bunding and gully blocking had the biggest impact on reducing both wildfire risk and severity across all five single species habitats. This is consistent with the results of the pre-intervention survey, in which respondents thought that increasing the water table would help. This is because these techniques create pools of water which act as firebreaks, as well as making the habitat wetter which in turn makes it more difficult for fires to start. There is some evidence to support this hypothesis from the wildfire that took place on the Roaches in 2018, whereby the impact of the fire was reduced around the bunds that are situated on site. It should be noted that this would not completely stop wildfires occurring, as identified by five respondents, who thought that these techniques only re-wet the peat leaving the above ground vegetation dry.

The conservation techniques that respondents identified as being the least effective at reducing wildfire risk and severity were those that introduced a fuel source into the habitat, including planting sphagnum or adding heather brash to stabilise bare peat. This would also explain why wildfire risk and severity increased for bilberry between the pre and post-intervention survey. These types of conservation techniques consistently scored the highest for both perceived fire risk and severity. In fact, adding heather brash to stabilise bare peat scored the worst for the perceived wildfire risk and severity across all identified techniques for all single species habitats. Although it is not quite as simple as this, as adding heather brash is a transitionary technique that helps stabilise the bare peat allowing the vegetation to cover the brash up. This complexity is recognised by one respondent in the comments. Additionally sphagnum moss is known to retain water (*Wildlife Trust 2021*) which would reduce wildfire severity, as noted by one respondent and therefore would help reduce wildfire in the longer term as sphagnum takes time to colonise the site, which was noted by another respondent. Additionally, in terms of biomass we received two comments which indicated that cutting would only have an impact if the cuttings were removed from site as the fuel load is still there otherwise.

Looking at the scores for similar conservation techniques across the different single species habitat types, generally indicate that the type of habitat doesn't have a significant impact upon the effectiveness of the technique. This is because for wildfire risk, 20% of respondents scored diversification as having a 'very high fire risk' or above for purple moor grass, compared to 33% for bilberry, a 13% difference. A paired T Test was undertaken to check the strength of the relationship and a P value of 0.59 at 95% confidence level was calculated, suggesting that there is not a significant difference between the habitat types. This is reflected in the results and comments of the post-intervention survey with respondents providing similar comments across the habitat types.

The wet ground where common cotton grass is found may explain why the impacts of gully blocking is not as significant when compared to the other habitats. As common cotton grass grows in wet environments and therefore gully blocking wouldn't may not significantly increase the wetness of the habitat, or effect the above ground vegetation.

Analysis of the comments suggest some mixed reactions to how important the conservation techniques are. A good of example of this is the diversification of the sward. This is because some respondents suggested that a more diverse sward would lead to a reduction in wildfire risk and severity as it would help create a more varied habitat making it more difficult to burn, or help to protect the peat. Whereas other respondents seem to suggest that diversification would be bad for fire risk and severity by adding additional biomass to the habitat creating more fuel for the fire. Some of this difference may depend upon what is used for diversification, with species like sphagnum being better than woody species such as heather. Additionally, the results for purple moor grass suggest that in this habitat diversification is much better than just cutting for both perceived risk and severity, with diversification and cutting scoring 93% (risk) and 92% (severity) for a high fire risk/severity or greater compared to 53% (risk) and 54% (severity) for just cutting a 40% difference in scores.

It should also be noted that these techniques are just being considered in terms of the impact on reducing wildfire risk and severity, and that the techniques can help other ecosystem services.

5. Conclusion

This questionnaire compares the baseline for wildfire risk and severity established in the pre-intervention survey to wildfire risk and severity associated with the different conservation techniques applied to single species habitats, to identify what impact the conservation work has had on reducing wildfire.

The questionnaire was sent to the South Pennine and Peak District FOG groups, to obtain expert opinion on the fire risk and severity of single species habitats and the most common restoration techniques associated with the habitats. The approach was taken due to the difficulty in obtaining empirical data on wildfires.

The pre-intervention survey indicated that the single species habitats that are most at risk / severity of wildfires are purple moor grass and heather, whereas the habitat with the least wildfire risk and severity is common cotton grass and bilberry.

The results indicate that those conservation techniques that increased the water table such as bunding and gully blocking have the biggest impact on reducing both wildfire risk and severity across all five habitats. The main reason given for this is that it creates pools of water, which make it harder for wildfires to start whilst creating firebreaks, which stop the spread of the fire. Whereas those techniques that add biomass, such as planting sphagnum moss and spreading heather brash, to a single species habitats were perceived to have the least impact on reducing wildfire risk and severity, and in some instances (e.g. adding heather brash to bare peat) actually increasing the wildfire risk and severity . The reason for this is because respondents thought that it would add an additional fuel source to the habitat. It should be noted that it can be more complex than this as, whilst planting sphagnum would add biomass in the short term, once it has had chance to colonise the area it could help reduce wildfire risk because sphagnum is known to retain water.

Furthermore, the size of the impact these techniques have on reducing wildfire risk and severity are not impacted upon by habitat type. Which is as expected based upon similar comments received for the different single species habitats.

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Appendix 1 – Copy of post intervention questionnaire sent of FOG groups

Introduction

Moors for the Future Partnership have received funding from the EU LIFE fund, which supports environmental, nature conservation and climate action projects throughout Europe, to deliver the MoorLIFE 2020 project. The aim of MoorLIFE 2020 is to conserve and protect the EU priority habitat of Active Blanket Bog within the South Pennine Moors Special area of Conservation. It is important to conserve this habitat because of the many ecosystem services it provides, including biodiversity, carbon storage, drinking water and flood attenuation.

A key objective of the MoorLIFE 2020 project is to reduce wildfire risk and severity. Which will be achieved by:

- Restoring the hydrology (e.g. raising the water table) of a site.
- Increasing the number of plant species present on a site.
- Providing protection to the peat surface from wildfire.
- Engaging and educating the public and land managers.
- Developing tools to create better information sharing between organisations.

This is the second questionnaire, which asks participants to rate the perceived fire risk and severity associated with different species dominated habitats following the common types of restoration techniques we undertake. The results from this survey will be compared to those given in the first survey to gauge what impact the different restoration techniques have on reducing fire risk and severity, through using expert opinion on the perceived risk and severity of wildfires. This can help us identify which conservation techniques are best applied in different situations to help manage fire risk and severity in the future. The techniques identified below are those techniques that are most commonly applied to each species dominated habitat.

This short questionnaire should take approximately 10 – 15 minutes to complete.

Thank you to all those who undertook the first survey and for your continued support with this work.

Questionnaire

1. Which organisation do you work for? _____

2. What type of experience do you have of dealing with moorland wildfires *(please highlight all answers that are appropriate)*?

   a. First hand firefighting experience

   b. Co-ordinating the firefighting response

   c. Monitoring the impacts of wildfire afterwards

   d. None of the above

   e. Other (please specify) _____

Question 3 which focuses on wildfire risk and question 4 which focuses on wildfire severity uses the scale below, therefore please rate the wildfire risk and severity based upon your experience and knowledge, using the wildfire risk / severity scale below:

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

For questions 3 (wildfire risk) and 4 (wildfire severity) photos are provided showing examples of the typical conservation techniques that would be used in the species dominated habitats identified. Please note that these are intended to act as a guide to what the technique does. When considering the fire risk and severity associated with this habitat, please assume that the conservation technique has been applied to the landscape as a whole. Additionally please assume that when assessing the wildfire risk all factors relating to the habitats are the same (e.g. distance from pedestrian access). Please don't score the photos, they are only intended as examples.

3. Using the photos and text provided please rate the potential **wildfire risk** for the different habitats after the following interventions have been applied, and provide any comments regarding why you assessed the **fire risk** as you did?

3a. Purple Moor Grass *(Molinia caerulea)*

Cutting - Purple moor grass is cut to reduce biomass and dominance of the species.

Diversification - Sphagnum Moss can then planted into the cut areas to create a more diverse community.

Bunds – Semi-circular raised mounds are created out of peat, in order to trap water and raise the water table.

		None	Low	Mod	High	V. High	E. High
Just Cutting	*(Please tick)*	0 ☐	1☐	2☐	3☐	4☐	5☐
Cutting and Diversification	*(Please tick)*	0 ☐	1☐	2☐	3☐	4☐	5☐
Bunding	(Please tick)	0 ☐	1☐	2☐	3☐	4☐	5☐

Comments

3b. Heather *(Calluna vulgaris)*

Heather Cutting – Heather is cut and the cuttings removed to be used as heather brash. Sphagnum Moss can also be planted in the cuts to aid diversification.

Gully Blocking – Channels are blocked to retain water in the habitat and help restore the sites hydrology.

		None	Low	Mod	High	V. High	E. High
Heather Cutting	*(Please tick)*	0 ☐	1☐	2☐	3☐	4☐	5☐
Gully Blocking	*(Please tick)*	0 ☐	1☐	2☐	3☐	4☐	5☐

Comments

3c. Common cotton grass *(Eriophorum angustifolium)*

Gully blocks - Channels are blocked to retain water in the habitat and help restore the sites hydrology.

Diversification – Sphagnum Moss is planted to help diversify the habitat and help retain water.

		None	Low	Mod	High	V. High	E. High
Gully Blocking	*(Please tick)*	0 ☐	1☐	2☐	3☐	4☐	5☐
Planting Sphagnum	*(Please tick)*	0 ☐	1☐	2☐	3☐	4☐	5☐

Comments

3d. Bilberry *(Vaccinium Myrtillus)*

Diversification - Other plants are planted into Bilberry dominated habitats to help diversify the sward.

	None	Low	Mod	High	V. High	E. High
Diversification *(Please tick)*	0 ☐	1☐	2☐	3☐	4☐	5☐

Comments

3e. Bare Peat

Heather Brash (dead chopped up heather stalks) is applied to bare peat in order to stabilize the peat

Lime, Seed and Fertiliser is applied to stimulate growth of hardy grasses to begin revegetation back to an active blanket bog

Gully blocks - Channels are blocked to retain water in the habitat and help restore the sites hydrology

						None	Low	Mod	High	V. High	E. High
Heather Brash *(Please tick)*	0 ☐	1☐	2☐	3☐	4☐	5☐					
Lime, seed and fertiliser	*(Please tick)*					0 ☐	1☐	2☐	3☐	4☐	5☐
Gully blocks	*(Please tick)*					0 ☐	1☐	2☐	3☐	4☐	5☐

Comments

4. Using the photos and text provided, please rate the potential **wildfire severity** for the different habitats after the following intervention have been applied, and provide any comments regarding why you rated the **fire severity** as you did?

Purple Moor Grass *(Molinia caerulea)*

Cutting – The grass is cut to reduce biomass and dominance of the species.

Diversification - Sphagnum Moss can be planted into the cut areas to create a more diverse community.

Bunds – Semi-circular raised mounds are created out of peat, in order to trap water and raise the water table.

			None	Low	Mod	High	V. High	E. High
Justcutting	(Please tick)	0 ☐	1☐	2☐	3☐	4☐	5☐	
Cutting and diversification	*(Please tick)*		0 ☐	1☐	2☐	3☐	4☐	5☐
Bunds	*(Please tick)*		0 ☐	1☐	2☐	3☐	4☐	5☐

Comments

4b. Heather *(Calluna vulgaris)*

Heather Cutting – Heather is cut and the cuttings removed for heather brash. Sphagnum Moss can also be planted in the cuts to aid diversification.

Gully Blocking – Channels are blocked to retain water in the habitat and help restore the sites hydrology.

		None	Low	Mod	High	V. High	E. High
Heather Cutting	*(Please tick)*	0 ☐	1☐	2☐	3☐	4☐	5☐
Gully Blocking	*(Please tick)*	0 ☐	1☐	2☐	3☐	4☐	5☐

Comments

4c. Common cotton grass *(Eriophorum angustifolium)*

Gully blocks - Channels are blocked to retain water in the habitat and help restore the sites hydrology.

Diversification – Sphagnum Moss is planted to help diversify the habitat and help retain water.

	None	Low	Mod	High	V. High	E. High
Gully blocks *(Please tick)*	0 ☐	1☐	2☐	3☐	4☐	5☐
Diversification *(Please tick)*	0 ☐	1☐	2☐	3☐	4☐	5☐

Comments

4d. Bilberry *(Vaccinium Myrtillus)*

Diversification - Other plants are planted into Bilberry dominated habitats to help diversify the sward.

	None	Low	Mod	High	V. High	E. High
Diversification *(Please tick)*	0 ☐	1☐	2☐	3☐	4☐	5☐

Comments

4e. Bare Peat

Heather Brash (dead chopped up heather stalks) is applied to bare peat in order to stabilize the peat

Lime, Seed and Fertiliser is applied to stimulate growth of hardy grasses to begin revegetation back to an active blanket bog

Gully blocks - Channels are blocked to retain water in the habitat and help restore the sites hydrology

		None	Low	Mod	High	V. High	E. High
Heather Brash	*(Please tick)*	0 ☐	1☐	2☐	3☐	4☐	5☐
Lime seed and fertiliser	(Please tick)	0 ☐	1☐	2☐	3☐	4☐	5☐
Gully blocks	*(Please tick)*	0 ☐	1☐	2☐	3☐	4☐	5☐

Comments

Thank you for taking the time to complete the questionnaire

Appendix 2 - All comments received from the post intervention survey, associated with single species habitats for risk and severity

Risk

Purple Moor Grass

Comment	Number of occurrences
Planting Sphagnum adds biomass to the habitat	1
Sphagnum will takes time to grow and before it has an impact on reducing fire risk	3
Cutting reduces biomass	3
Cutting creates firebreaks	1
Regular cutting is required to keep the fire risk low	3
Effectiveness of cutting varies depending on areas and machinery etc.	2
Veg still there so can burn in dry conditions	4
Bunding will rewet the habitat making it more difficult for a fire to start	7
Bunding creates firebreaks	1
Wet willow scrub should be considered around the moorland edge to help create wet conditions	1
Seasonality is key to determining when wildfires will start	1

Heather

Comment	Number of occurrences
Cutting reduces the biomass helping to reduce the potential risk of wildfire	4
Cutting will only reduce biomass if the arising's are removed	1
Making the habitat wetter will reduce the likely hood and severity of the wildfire occurring	4
The above ground vegetation can still burn even if the peat is wet	2
Gully blocking help create fire breaks	1
Fire can still start in wet conditions	1
Cutting needs to be well planned to be effective	1

Common Cotton grass

Comment	Number of occurrences
Increasing water table helps to reduce wildfire risk	5
Sphagnum has limited impacts	1
Sphagnum takes time to grow before it can reduce wildfire risk	1
Sphagnum adds biomass / fine fuels	1
Raising the water table doesn’t stop the vegetation from burning	1
Diversification doesn't work	1
Areas of cotton grass less susceptible	2
Diverse swards difficult to burn	1
Increasing water table	5

Bilberry

Comment	Number of occurrences
Diversification increase biomass	3
Diversification has little impact	2
Wet woodland considered	1
In drought the vegetation will burn	1
Unsure of what impact this will have on wildfire risk	2
Diversification increase biomass	3

Bare Peat

Comment	Number of occurrences
Collectively all three techniques will work	1
Brash adds fuel to the habitat	2
Growing vegetation adds fuel to the habitat	2
Size of the site will have an impact on the severity of the fire	1
LSF on its own works well	1
Gully blocking alleviates fire risk	1
Wetter conditions reduces fire risk	1

Severity

Purple Moor Grass

Comment	Number of occurrences
Cutting creates firebreaks which stops the spread	3
Effectiveness dependent on how the cutting is done	1
Bunding creates firebreaks stopping the spread of wildfire	2
Bunding creates a wetter habitat making it more difficult for the fire to spread	2
Bunding will only have a localised effect, reducing its effectiveness across the landscape	1
Sphagnum will takes time to grow reducing the effectiveness in the short term	1
Diversification won't help reduce wildfire severity	1
Wet willow scrub should be considered	2
Multiple factors affect severity	1
Diversification provides a varied sward helping to shield the peat	1
Variable habitats will help contain fire by restricting it to that block of habitat	1
Cutting is a short term solutions	1
Regular cutting is required for long term effectiveness	1

Purple Moor Grass

Comment	Number of occurrences
Wet ground means fire can't spread	1
Cutting creates firebreaks which stops the spread	1
Gully blocking increases the water table reducing the severity of the wildfire	2
Sphagnum and grass will protect peat from fire	1
Cutting needs to be done correctly to have any impact of reducing wildfire severity	1
Arising need to be removed when cutting undertaken to be effective	1

Common cotton grass

Comment	Number of occurrences
Gully blocking creates a wetter habitat making it more difficult for the fire to spread	3
Gully blocking creates fire breaks which stop the spread of fires	2
Gully blocking better for severity than risk	1
Sphagnum takes time to have an impact on the overall wetness of a habitat	1
If the water table is raised, the vegetation on top can still burn	3
Regardless of what we do people will still set fire to the moorland	1
A diverse sward helps to protects soil	1
When the habitat is dry it is still susceptible to fire	2

Bilberry

Comment	Number of occurrences
Diversification provides more biomass, which in turn provide more fuel for the fire	2
Bilberry is likely to cause a hotter fire due to location and plant type	1
More vegetation will lead to the fire spreading more quickly	1
The habitat will still burn in a drought	1
Vegetation chosen for diversification important. E.g. those species with a bigger leaf, will allow more moisture to be retained reducing the fire severity	1

Bare Peat

Comment	Number of occurrences
More biomass will lead to a more severe fire	4
Gully blocking creates a wetter habitat reducing the spread of the fire	3

Size of the habitat is important in determining fire severity	1