Rapid Assessment - How to Design, Undertake and Analyse Monitoring Results

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How to set up a rapid assessment survey

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   - Are the thresholds ambitious enough to create a species-rich grassland in a 'good' state?
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1. Introduction

1.1. What is rapid assessment?

The quality of grasslands is often based on the presence of wild flowers and grasses. Rapid assessment (RA) was developed to be a quick survey method, and provides a snap-shot of the plants present on a site. It is a surveillance method that can feed directly into the management of a grassland using indicator species to inform site management.

This leaflet explains how to set up the method on your grassland including:

- identifying positive and negative indicator species and setting thresholds;
- undertake a survey; and
- interpret the results.

Some knowledge of survey methods, habitat management and of the species present, or those that you wish to be present on your grassland, is required to create a RA for your site.

1.2. When should rapid assessment be carried out?

RA should be undertaken at regular intervals, around every 3 years. However, annual monitoring could be undertaken on grasslands that are being restored using seed. It is designed to assess the presence and absence of common indicator plants. They consist of positive indicator plants, those that we would like to find in a grassland, and negative indicator plants, those that we would not want to find. As it is usually a presence/absence method and only uses a small number of indicator species, RA is ideal for anyone that has not done much botanical survey previously.

To set up the survey you do need to have some knowledge of grassland ecology to be able to identify positive indicator species for your type of grassland. These are plants that are either:

- present at the moment but you would like to become more abundant and have the potential to become more abundant through management or,
- have been sown into your grassland.

See the types of grassland for more information.

1.3. What are indicator plants?

Indicator plants are used to find out whether grasslands are considered to be in ‘good’ or ‘poor’ state. RA is a measure to understand how management is affecting grasslands, particularly causing a decrease in negative indicator species, and whether positive indicator plants are present and spreading throughout a grassland.

The key difference to other methods is that RA is tailored for each site, taking into account soil type and location across the UK. For example, positive indicator plants in calcareous grassland include salad burnet, mouse-ear hawkweed and quaking-grass. Whilst in neutral grassland they are betony, common bird’s-foot-trefoil, oxeye daisy and crested dog’s-tail. Negative indicator plants include common nettle, creeping and spear thistles, docks and bracken. We have provided some species that may be found in different types of grasslands at the end of this booklet, but these will need to be adapted to the species present, or species that have been sown, in your grassland.

1.4. What are thresholds?

Thresholds are a level that you are aiming to achieve in your grassland. The essence of the RA method is to set thresholds for a best-case scenario and monitor how far away the grassland is from it. The results and how far away the grassland is from being considered in a 'good' state, and the management that is already being undertaken (as management may take a while to have an effect on the grassland) can then be used to inform follow-up management actions. The further away from achieving your ideal the more frequently the meadow should be assessed to check that the management you are implementing is having the desired effect. For example, annual monitoring might be suitable in grasslands that have just been sown with wild flower seed to find out how plants colonise the grassland. Monitoring every three years might be suitable where livestock grazing has been introduced to monitor change in abundance of indicator species over time.

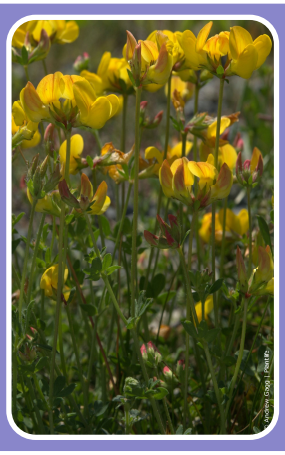
Even though RA uses presence or absence, the percentage number of sample points can be assessed to find out the coverage throughout the sward. This is usually based on the DAFORN scale:

- Dominant - 50-100% of sample points
- Abundant – 30-50% of sample points
- Frequent - 15-30% of sample points
- Occasional – 5-15% of sample points
- Rare -fewer than 5% of sample points
- None – not present in any of the sample points.

Thresholds may be expressed using this terminology, for example '3 positive indicator species should be frequent throughout the grassland and 2 should be occasional'. This can be worked out by identifying the percentage of sample points with indicator species and equating this to the DAFORN scale.

2. Choosing Indicator Species

RA is a surveillance tool. It is based on identifying a number of indicator species, both positive and negative, that tell you whether the habitat is in a 'good' state and/or whether there are problems starting to appear. Indicator species are used to assess whether the species composition of the grassland is progressing in the desired direction. Positive indicator species should become more abundant over time, and negative indicator species should become less frequent over time in response to management. Identifying the right indicator species is key to being able to ascertain the state of your grassland. To start, you might want to identify what might be possible to achieve in terms of the type of grassland, i.e. lowland meadow, calcareous grassland etc., to make it easier to identify indicator species.



Choosing the right **positive indicator species** for your grassland

- Identify species that are present on your site, those you would like to increase and have the potential to increase. You could also use historical survey information, or 'indicators of success' listed in agri-environment scheme prescriptions.
- If relevant, you could also select species that were present in the seed spread on your grassland (either using a species list from the donor site or from the bought seed mixture).
- Write coverage qualifier questions (see page 6) for any positive indicator species that are desirable at a low coverage but undesirable at a higher coverage.
- Ideally you want 10-15 positive indicator species.

Choosing the right **negative indicator species** for your grassland

- Identify species that are undesirable on your site. These might be:
  - nutrient loving (nitrophilous) plants indicating that there are high soil nutrients, such as common nettle;
  - rhizonomous species and creeping plants that can form large and persistent patches, such as bracken, creeping thistle, soft and hard rush;
  - competitive and unpalatable species that restrict the growth of other wild flowers and grasses, such as tor-grass, false brome and tufted hair-grass;
  - species that might indicate an underlying problem like compaction, such as broadleaved dock and curled dock; and
  - a species identified as a pernicious weed, such as common ragwort.
- Write coverage qualifier questions (see page 6) for any negative indicator species that are tolerable at a low coverage but undesirable at a higher coverage.

Identifying **other ecological variables** that indicate site condition

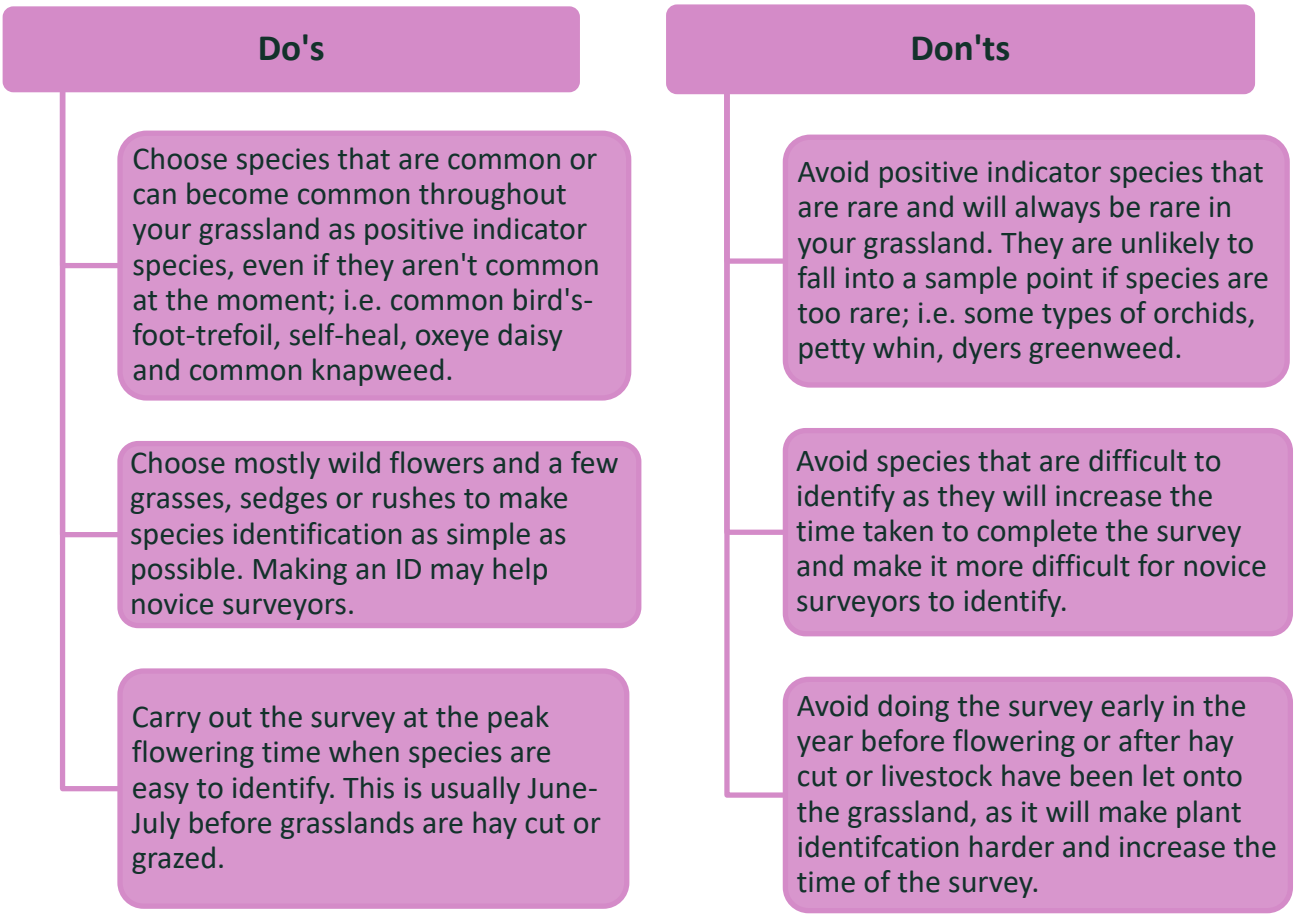
- Take a grid reference for each quadrat so that the data could be projected onto a map.
- Ask coverage qualifier questions (see page 6) about the ecological state of the grassland, such as:
  - the cover of wild flowers, sedges and rushes compared to grasses (known as the forb:grass ratio);
  - the cover of scrub seedlings or height of scrub cover;
  - the amount of leaf litter;
  - the amount of rush and sedge cover;
  - the amount of bare ground.
- Ask other qualifier questions , for example about a particular invertebrate food plant.

2.1. Considerations when identifying indicator species

It can be difficult identifying indicator species, so knowing the plants that are present in your grassland and/or those that you have sown into your grassland will help to construct the RA form.

There are positive indicator species associated with different habitats (see appendix 1 and 2). The tables and recording forms are based on vascular plants, mostly wild flowers with a few wild grasses, which are usually found in these habitats according to the National Vegetation Classification. However, these habitats differ across the UK and the recording forms should be adapted for the species present or those you wish to be present in your grassland.

The indicator species act as a baseline, providing a comparison with future years of surveys. As a consequence, keep the same indicator species after starting the survey as this alters the baseline against which you would be assessing the data.



2.2. Writing coverage qualifier questions

You might decide that a cover qualifier question for some species is better for informing management action rather than a presence/absence question. A positive indicator species may be considered desirable at a low level throughout the grass sward, but if it is competitive and becomes frequent in the sward it might be considered undesirable. For example, meadowsweet is a plant of damp meadows and pasture. Usually, in hay cut meadows, it is spread throughout the sward, but when hay cutting is missed, for example in very wet summers when it is not possible to get machinery onto the grassland, this species can increase. In a sedge pasture, livestock may not eat meadowsweet and it can become dominant in patches. This is also the

case for upright brome, cow parsley, purple-moor grass, heather and western gorse in other types of grassland. These questions can be placed at the beginning or end of the RA form.

The same is true for negative indicator species. For example, a small amount of a negative indicator species, like tor-grass, might be acceptable where this does not affect the other wild flowers and grasses, but a high coverage can prevent other species from growing.

Cover values can be set for competitive species by picking species out in a separate question. For example, the question could be:

- Does meadowsweet cover greater than 30% of the quadrat?
- Is western gorse cover more than 20% of the quadrat?
- Is the cover of purple moor-grass greater than 50% of the quadrat?
- Is tor grass cover more than 20% of the quadrat?
- Is creeping thistle and spear thistle more than 20% of the quadrat?
- Are there any bracken fronds more than 30cm in height?

It might be useful to ask questions about the state of the grassland, such as:

- the cover of wild flowers compared to grasses (technically known as the forb:grass ratio) - high grass cover can restrict wild flowers, and so the cover of wild flowers (also known as forbs) is a useful indicator of the condition of the grassland. Sedges and some rushes (excluding soft rush and hard rush which may be considered negative indicator species) are often combined with wild flowers for this measure;
- the cover of scrub seedlings or height of scrub cover – scrub is a positive element in pasture and is beneficial for a range of invertebrates. However, when the level of scrub becomes high covering much of the grassland this shades out the low-growing wild flowers resulting in their decline. Also, many invertebrates, including butterflies, prefer the edge of scrub and do not penetrate into thick scrub. There are different ways of phrasing this question, such as asking whether there is more than a specific level of scrub seedling cover, or asking whether scrub cover is more than 1m in height if this is considered an indicator of more established scrub patches;
- the amount of leaf litter on the ground – litter can collect and smother low-growing plants causing them to decline over time. Often an increase in litter is a sign of lack of management.
- the amount of rush and sedge cover – generally sedges and rushes, except for those which are considered negative indicator species, are considered honorary forbs. Some grasslands, like purple-moor grass and rush pasture, have a naturally high cover of rushes and sedges and this cover should be maintained against some of the more dominant grasses, but should still lie below a certain level.
- the amount of bare ground – large areas of bare ground in the middle of summer when the RA would be undertaken is considered a sign of over-management, particularly high livestock levels. However, small areas of bare ground might be acceptable. A question asking about the area of bare ground may initiate a management response.

There are some additional factors that you might want to collect information on. For example, marsh fritillary caterpillars feed solely on devil's-bit scabious, and the cover of this food plant is important for the survival of colonies. At the end of the form, it might be useful to ask some questions about cover of this particular species to monitor the suitability of the habitat for the butterfly. However, there is also species-specific monitoring, like counting flower spikes or patches of plants, or larval food webs for marsh fritillary, which might provide better surveillance. The use of these additional questions may help determine whether the habitat is suitable for a particular species.

2.3. Constructing your monitoring form

Leave a space for the site name, date of survey and surveyors at the top of the form

Put in the questions about the cover of individual species, height of vegetation and/or cover of scrub at the start of the form

Follow with the positive and negative indicator species

Put any coverage qualifier questions at the end of the form – in this example the amount of devil's-bit scabious to collect data on whether the habitat is suitable for marsh fritillary butterflies

Site: *Spring meadow*		Date:*28-06-2015*				Surveyors:																					
						Positive indicator spp													Negative indicator spp						Devil's-bit Scabious			
Sample number	Grid reference	Is the sward height less than 5cm?	Is a single species covering more than 70%	Are flowers present in more than 40% of the quadrat?	Is the cover of scrub seedlings less than 5%	Betony	Field scabious	Self-heal	Common bird's-foot-trefoil	Yellow rattle	Bulbous buttercup	Meadow buttercup	Oxeye daisy	Common / black knapweed	Yellow rattle	Crested dog's-tail	Cuckoo flower / Lady's-smock	Yellow vetchling	Common nettle	Broadleaved dock / curled-leaf dock	Creeping thistle / spear thistle	Ragwort	Soft rush / hard rush	Bracken	No scabious	Is there 1-5% scabious cover	Is there 6-10% scabious cover	Is there more than 10% scabious cover
1	*SPxxxxxxxxxx*	*Y*	*N*	*Y*	*Y*	*Y*	*N*	*N*	*Y*	*Y*	*Y*	*N*	*Y*	*Y*	*Y*	*Y*	*N*	*Y*	*N*	*N*	*N*	*Y*	*N*	*N*	*Y*	*N*	*N*	*N*
2	*SPxxxxxxxxxx*	*Y*	*N*	*Y*	*N*	*Y*	*N*	*Y*	*Y*	*Y*	*Y*	*N*	*N*	*Y*	*Y*	*Y*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*Y*	*N*
3	*SPxxxxxxxxxx*	*Y*	*N*	*Y*	*N*	*N*	*Y*	*N*	*Y*	*Y*	*Y*	*N*	*Y*	*Y*	*Y*	*Y*	*N*	*Y*	*N*	*N*	*N*	*Y*	*N*	*N*	*N*	*Y*	*N*	*N*
4	*SPxxxxxxxxxx*	*N*	*N*	*Y*	*N*	*N*	*Y*	*Y*	*Y*	*N*	*Y*	*N*	*Y*	*Y*	*Y*	*Y*	*N*	*N*	*Y*	*N*	*Y*	*N*	*N*	*N*	*Y*	*N*	*N*	*N*

This is the sample point along the 'W' walk or grid pattern

Using the grid reference, we can locate each recording point and see if there are any plants in particular parts of the grassland. This may help target management such as scrub and bracken control.

N indicates that the 1m² has more than one species covering more than 70% of the ground. If a single species was covering 70% of the quadrat then this would change to a *Y*.

Y indicates that the quadrat was covered by more than 40% flowering plants

Y indicates that there is oxeye daisy in the quadrat

N indicates that there is no cuckoo flower in the quadrat

N indicates that there is no ragwort in the quadrat

Y indicates that the quadrat was covered by 1-5% devil's-bit scabious

3. Setting thresholds

Grasslands are a managed habitat. The purpose of setting thresholds is to interpret the data gathered through the survey and identify where, what and when management should be changed. Thresholds may not be set in every case; it might be useful enough to know whether the site is progressing in the desired direction.

In a nutshell, work out what you want your grassland to be and set your thresholds to reflect the aim. Think about:

- What you want your grassland to be?
- What is there? or has been sown into the site?
- What to do to get what you want?
- How often to monitor that the grassland is going in the right direction?

How to set thresholds for maintaining species-rich grasslands

Defining limits

Setting thresholds is about defining the lower limit that is acceptable for the number and cover of positive indicator species, and defining the upper limit that is acceptable for the number and cover of negative indicator species.

Identify ambitious but achievable thresholds for the cover of positive indicator species per quadrat

i.e. a threshold could be set stating 'the grassland is in a good condition if there are more than five positive indicator species frequent throughout the sward'. This can be interpreted as, if five or more positive indicator species are found in 15% or more of sample points the site is in good state. If there are fewer positive indicator species then the grassland is considered in a poor state and management action might be required.

Identify the highest tolerable cover of negative indicator species per quadrat

i.e. a threshold could be set stating 'the grassland can have rare creeping thistle to be in a good state'. This can be interpreted that up to 5% of sample points can have creeping thistle for the condition of the grassland to be maintained. If 5% or more of sample points have creeping thistle then the grassland is considered to be in poor condition and management action may be required. This may not be achievable in some circumstances, and this would mean raising the threshold to occassional or frequent creeping thistle.

Identify the percentage of sample points for the species in cover qualifier questions

i.e. a threshold may be set 'if tor grass cover is more than rare in 30% of each sample point the site is considered in good state'. This can be interpreted that tor grass cannot be more than 30% in less than 20% of quadrats for the grassland to be in a good state, and if tor grass has higher cover in more than 21% of quadrats, the grassland is considered to be in a poor state and management action may be required.

Balancing ambition and achivability

Raising the number and/or cover of indictor species makes achieving the threshold more difficult. Reducing the number and/or cover of indicator species makes achieving the threshold easier. A balance between ambition and achieveability is required and the thresholds may need to be revised several times before they are finalised depending on the potential of each grassland site.

A consideration of thresholds along with the survey results can inform your management actions. For example, if the number of positive indicator species and forb cover across the desired number of sample points fall below the threshold, this might indicate that the grass cover is too high. Management action to increase the number of positive indicator species and forb cover may include an increase in the number of livestock, or grazing over a longer period of time, or change in type of livestock to reduce the grasses and provide more niches for wild flower seeds to germinate.

Another example would be an increase in a negative indicator species above the threshold, for example creeping thistle, which may result in management action to control the plant.

Setting thresholds is difficult, and it might require several years of RA and adjustment before thresholds are finally defined. It may also take several years for management to take effect, and patience is required to be able to find out whether the condition of a grassland is moving in a desirable direction.

Information that you might find useful to help set thresholds includes:

- cover estimates in historical survey reports,
- cover of ‘indicators of success’ in agri-environment scheme prescriptions,
- cover of indicator species in a donor site (identified by undertaking a rapid assessment in the donor site and working out the cover of positive indicator species)

When managing to increase the botanical diversity of a grassland, it is often useful to know that the positive indicator species are increasing over time across the site rather than setting thresholds that may lead to the conclusion that the restoration has failed. Often, any increase in species diversity has huge benefits for wildlife and there may be other factors why some seed do not germinate.

4. Undertaking the survey

- An RA can be completed by an individual or as part of a small group ideally with a maximum of 3-4 people. If there are more people, perhaps split into several groups to complete the survey faster.

- Roughly 20 sample points (usually quadrats) are needed per field or grassland area.

- The name is slightly misleading, and although only a small number of species are surveyed it can take quite a while. It takes approximately half a day to complete 20 quadrats depending on experience and number of people in the group.

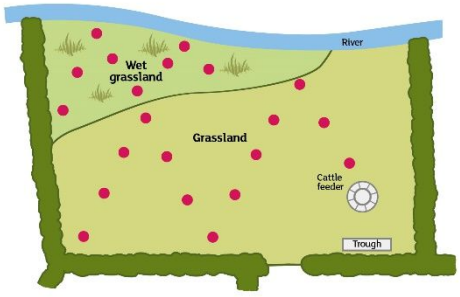
- As RA uses indicator species, it is possible for both novice and experienced surveyors to take part as long as adequate species identification training is provided.

- Each sample point in a grassland is usually a 1x1 m quadrat. Larger 2x2 m quadrats are more difficult to see into the centre and identify species. Circular sample points can be used with a radius of 1 m or 2 m with the surveyor in the middle.

- The quadrats can either be arranged in a grid or a W-shaped walk through the field (figure 1). The sampling pattern is important. For example, if it is thought that there might be fertiliser drift from a nearby field affecting the positive indicator species, then it might be useful to have a grid pattern so that there are some sample points close to this field boundary to monitor any change in vegetation. However, if the grassland is an uneven shape, has been used for supplementary feeding, or there are large stands of scrub, a W-shaped walk may be more practical.

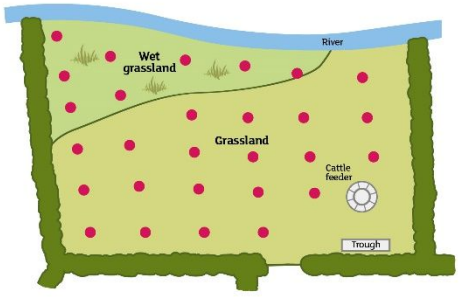
- The quadrats should be spaced evenly along whichever sampling point pattern. If the surveyors find that they need to undertake more quadrats to cover the entire area evenly then these should be undertaken rather than leaving a portion of the field un-surveyed or spreading the quadrats out more which will make a portion of the field less well covered with sample points.

'W' Sampling pattern



'W' sampling pattern. The wet and dry areas of the field may be surveyed seperately using different Rapid Assessment record forms with different indicator plants.

Grid sampling pattern



Grid sampling pattern. The wet and dry areas of the field may be surveyed seperately using different Rapid Assessment record forms with different indicator plants.

Figure 1: Diagrams showing a W-shaped or grid layout for the sampling points (quadrats).

Much of the following information is taken from the leaflet about how to carry out a RA survey.

4.1. Equipment

The surveyors should have the following equipment for the survey

- Map of the site showing the area to be monitored.
- RA record form suitable for the site on a clipboard with a pencil or pen.
- ID book and hand lens (if required).
- GPS or mobile grid reference app.
- Plant ID books (or make your own identification guide of the indicator species).

4.2. Method

Points 1-5 below describe how to do the survey.

1. Go to the area marked on the map to be surveyed. Make sure that you have the right RA record form for this area.

2. Start the survey in a logical manner either at one corner or at the entrance to the site. Before starting the survey think of the method in which you wish to survey the grassland. This could either be done by walking a 'W' through the grassland or in a grid pattern. This may have already been determined before the survey, and if this is a repeat survey it is useful to use a similar sampling pattern to historical surveys to make them comparable. However, there is no need to find the exact location of previous sampling points.

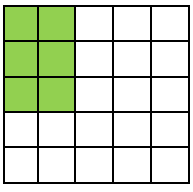
3. At regular intervals along the walk, or at points along the grid, stop and fill in the record form. Each stop is a quadrat sampling point. You could stop every 10, 20, 30 or more paces depending on the size of the field. An estimated 20 sample points should be undertaken in each grassland.

4. At each quadrat imagine that you are at the edge of a 1x1 m square (or 2x2 m if using this size of quadrat). Fill in one row of the record form for each quadrat, starting with a grid reference. For each species mark whether it is present or absent (this could be in the form of a Y for present and N for absent) and answer any cover questions.

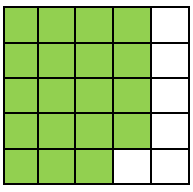
5. Carry on surveying until you have reached the end of your 'W' walk or grid pattern and have evenly covered the entire survey area with quadrats.

4.3. How to assess species cover

If a question asks whether a species covers more than a certain percentage, the easiest way to decide whether this is true or not is to imagine the plant is grouped into a corner of the quadrat. The coverage can then be estimated depending on the number of squares filled by the plant on an imaginary 5 x 5 grid of the quadrat. Each square represents 4%.



For example, answering the question on the example form 'does meadowsweet cover more than 30% of the quadrat?' would be a 'No' if 6 squares are filled, as cover is 24%.



For example, answering the question on the example form 'does purple moor-grass cover more than 50% of the quadrat?' would be a 'Yes' if 19 squares are filled, as cover is 76%.

4.4. How to take a grid reference

There are several ways of taking a grid reference. A 10-figure grid reference is needed for the most detailed fix on the location. However, you can note down a 6-figure grid reference using a close-up map of the site. Ordnance Survey has a webpage about how to read a grid reference.

An alternative way to get a more detailed grid reference is to use a handheld GPS unit. These can give up to 10 figure grid references with varying degrees of accuracy depending on the satellites available. Each GPS unit is different, and you may need to read the instructions to find out how to use it.

There are good mobile apps that can provide a 6-, 8- or 10-figure grid reference. Search either the Android or Apple stores for Ordnance Survey British National Grid Reference apps.

5. Analysing the results and revising thresholds

The first thing to do is digitise the results onto a spreadsheet so that they can be analysed. Often this is better to use '1' for present or yes and '0' for absent or no. This means that it is possible to add up the total number of positive indicators per quadrat and then identify how many sample points had enough positive indicator species to pass the threshold. Examples are used to explain some of the analysis of positive indicator species, negative indicator species and other ecological factors.

5.1 Assessing positive indicator species

This is often the most basic question – how many positive indicator species were there found on average throughout the grassland? At this example site, twenty positive indicator species were chosen, and the surveyors were able to survey 20 quadrats. The site was known to be species-rich, and so it was expected that the number and cover of positive indicator species would be high.

Common bird's-foot-trefoil	Ribwort plantain	Salad burnet	Glaucous sedge	Sheep's / Red fescue	Common / Black knapweed	Fairy-flax	Field scabious	Kidney vetch	Lady's bedstraw	Orchid sp.	Oxeye daisy	Red clover	Rough hawk's-bit	Sainfoin	Self-heal	Yellow oat-grass	Yellow rattle	Quaking-grass	Sweet vernal grass	**Positive indicators**
1	1	1	1	1	1	0	1	0	0	0	1	1	0	0	0	1	1	0	1	**12**
1	1	1	1	1	1	1	0	0	0	0	1	1	1	1	0	1	1	0	1	**14**
1	1	1	0	1	0	0	0	0	0	0	1	1	0	1	0	1	1	1	1	**11**
1	1	1	0	1	1	1	1	0	0	0	1	1	0	0	0	1	1	0	1	**12**
1	1	1	0	1	0	0	0	0	0	0	0	1	0	1	0	1	1	0	1	**9**
1	1	0	1	1	0	1	0	0	1	1	1	1	1	1	0	1	1	1	1	**15**
1	1	1	1	1	0	1	0	1	0	0	1	1	0	1	0	1	1	1	1	**14**
0	1	1	1	1	0	1	0	0	0	0	1	1	0	1	0	1	1	1	1	**12**
0	1	0	0	1	0	1	0	0	0	0	0	1	1	1	0	1	1	1	1	**10**
1	1	1	0	1	1	1	0	0	0	0	0	1	0	1	0	1	1	0	1	**11**
1	1	1	0	1	1	0	0	0	0	0	1	1	1	1	0	1	1	0	1	**12**
1	1	1	1	1	0	1	0	0	0	0	0	1	0	1	0	1	1	1	1	**12**
0	1	1	0	1	1	1	0	0	0	0	1	1	1	1	0	1	1	1	1	**13**
1	1	0	0	1	0	0	0	0	0	0	1	1	1	1	0	1	1	0	1	**10**
1	1	1	0	1	0	1	0	0	0	0	0	1	0	1	0	1	1	1	1	**11**
0	1	0	0	1	1	1	0	1	0	0	1	0	1	1	0	1	1	0	1	**11**
0	1	0	0	1	0	1	0	1	0	0	1	0	0	1	0	1	1	1	1	**10**
1	1	1	1	1	0	1	0	0	1	0	1	0	0	1	0	1	1	1	1	**13**
1	1	1	0	1	0	1	0	0	0	0	0	0	0	1	0	1	1	0	1	**9**
1	1	1	0	1	0	0	0	0	0	1	0	1	1	1	0	1	1	1	1	**12**
15	**20**	**15**	**7**	**20**	**7**	**14**	**2**	**3**	**2**	**2**	**13**	**16**	**8**	**18**	**0**	**20**	**20**	**11**	**20**	

The results found that:

- between 9-15 positive indicator species were found in each 1x1 m quadrat.

- On average 11.65 positive indicator species were found per sample point / quadrat.
- 18 sample points out of 20 (90% of sample points) had 10 or more positive indicator species present.

If a threshold had been set that 70% of sample points should have 10 or more positive indicator, then this survey indicated that the average number of positive indicator species passes this threshold. The next time this survey is undertaken, the average number of species per sample point can be surveyed again and compared.

Using this survey, the threshold could be made more ambitious by increasing the number of positive indicator species per quadrat, or increasing the percentage of sample points. For example, 60% of quadrats with at least 12 positive indicator species or 90% of quadrats with at least 10 positive indicator species. Both of these new thresholds were achieved in this survey, but this is the top of the threshold, and in other years where weather conditions or management factors could affect the cover of positive indicator species this threshold may be too high and unachievable. Thus, the original threshold of 70% of sample points with 10 or more positive indicator species could be considered an achievable threshold. Further surveys of this grassland would help understand whether this result is higher than normal, around average, or a low level of positive indicator species!

If this is the result of a RA undertaken on a donor site, then these thresholds could act as a baseline to measure the recipient site against. For example, it would be hoped that over time the same frequencies of species would be found, such as yellow rattle, red clover and sainfoin to be present across most of the recipient field and eventually, after quite a long period of time, that at least 70% of the sample points would have at least 10 positive indicator species.

5.2 Assessing negative Indicator species

Assessing negative indicator species is based on what is considered a tolerable level of a problem species. This is very much a site-specific question and the thresholds do differ between grasslands.

For example, if a recipient site was being sown, there may be higher levels of negative indicators in the few years following creating bare ground. This may be tolerable if there is a downwards trend in negative indicators over time. However, where the cover of a negative indicator species remains stable at a high level or increases, management action may need to be taken.

There may also be management issues in grasslands, such as high levels of common nettle in areas that have had ring feeders in the past, or rushes in areas around gateways that have been trodden (poached) by livestock. Taking a grid reference of the sample points would enable each sample location to be mapped and may highlight areas where there is high cover of negative indicator species. This may then become a focus for management. Free programmes that allow you to map sample points include QGIS.

5.3 Assessing other ecological variables

If other ecological variables have been set, such as the cover of wild flowers or whether there is any scrub in the sample point, these will also need assessing against thresholds to determine whether the cover results in management action.

Is the sward height more than 10cm in June/July?	Is there more than 50% herbs?	Is any scrub more than 10cm high?
1	0	0
1	1	0
1	1	0
1	1	0
1	1	0
1	1	0
1	1	0
1	1	0
0	1	0
1	1	0
1	1	0
1	1	0
1	1	0
1	1	0
1	1	0
1	1	0
1	1	0
1	1	0
1	1	0
1	1	0
19	**19**	**0**

The results for the grassland above suggest:

- 95% of sample points had more than 50% herb cover.
- none of the quadrats had any scrub more than 10 cm high.
- the height of the sward was more than 10cm in June and July at 95% of sample points.

These ecological variables may also help determine whether the grassland is in a ‘good’ state. Some examples of ecological questions are present on the example forms in appendix 2.

Appendix 1 – indicator species lists for different types of grassland

Lowland meadow species		Comment
Common bird's-foot trefoil	*Lotus corniculatus*	Common in most lowland meadows
Common / black knapweed	*Centaurea nigra*	Common in most lowland meadows
Meadow vetchling	*Lathyrus pratensis*	Common in most lowland meadows
Lady's bedstraw	*Galium verum*	Common in more calcareous lowland meadows, and base-rich flushes and rock outcrops
Meadow buttercup	*Ranunculus acris*	Common in most damper lowland meadows
Bulbous buttercup	*Ranunculus bulbosus*	Common in most drier lowland meadows
Betony	*Betonica officinalis*	Common in more acid lowland meadows
Devil's-bit scabious	*Succisa pratensis*	Common in more acid lowland meadows
Field scabious	*Knautia arvensis*	Common in most lowland meadows
Hawkbits	*Leontodon* sp.	Common in most lowland meadows. Not separated out to ease identification, but could be separated into autumn hawkbit *Leontodon autumnalis* and rough hawkbit *Leontodon hispidus*
Oxeye daisy	*Leucanthemum vulgare*	Common in most lowland meadows
Salad burnet	*Poterium sanguisorba*	Common in more calcareous lowland meadows and base-rich flushes and rock outcrops
Self-heal	*Prunella vulgaris*	Common in most lowland meadows
Yellow rattle	*Rhinanthus minor*	Common in most lowland meadows
Tufted vetch	*Vicia cracca*	Common in most lowland meadows
Crested dog's-tail	*Cynosurus cristatus*	Common in most lowland meadows
Sweet vernal grass	*Anthoxanthum odoratum*	Common in most lowland meadows
Quaking-grass	*Briza media*	Common in more calcareous lowland meadows and base-rich flushes and rock outcrops
Yellow oat-grass	*Trisetum flavescens*	Common in more calcareous lowland meadows and base-rich flushes and rock outcrops

Upland hay meadow species		Comment
Meadow buttercup	*Ranunculus acris*	Common in most upland hay meadows
Wood crane's-bill	*Geranium sylvaticum*	Common in most upland hay meadows
Pignut	*Conopodium majus*	Common in most upland hay meadows
Ladies'-mantle	*Alchemilla sp.*	Common in most upland hay meadows
Great burnet	*Sanguisorba officinalis*	Common in most upland hay meadows
Yellow rattle	*Rhinanthus minor*	Common in most upland hay meadows
Bulbous buttercup	*Ranunculus bulbosus*	Common in most upland hay meadows
Hawkbits	*Leontodon* sp.	Common in most upland hay meadows. Not separated out to ease identification, but could be separated into autumn hawkbit *Leontodon autumnalis* and rough hawkbit *Leontodon hispidus*
Red clover	*Trifolium pratense*	Common in most upland hay meadows
Cat's-ear	*Hypochaeris radicata*	Common in most upland hay meadows
Common bird's-foot trefoil	*Lotus corniculatus*	Common in most upland hay meadows
Common / black knapweed	*Centaurea nigra*	Can be common in some upland hay meadows but might not be present or at low levels
Meadow vetchling	*Lathyrus pratensis*	Common in most upland hay meadows
Oxeye daisy	*Leucanthemum vulgare*	Can be common in some upland hay meadows but might not be present or at low levels
Self-heal	*Prunella vulgaris*	Can be common in some upland hay meadows but might not be present or at low levels
Sweet vernal grass	*Anthoxanthum odoratum*	Common in most upland hay meadows
Crested dog's-tail	*Cynosurus cristatus*	Common in most upland hay meadows

Floodplain meadow species		Comment
Great burnet	*Sanguisorba officinalis*	Common in most floodplain meadows
Meadow buttercup	*Ranunculus acris*	Common in most floodplain meadows
Meadow vetchling	*Lathyrus pratensis*	Common in most floodplain meadows
Red clover	*Trifolium pratense*	Common in most floodplain meadows
Common / black knapweed	*Centaurea nigra*	Common in most floodplain meadows
Common sorrel	*Rumex acetosa*	Common in most floodplain meadows
Common bird's-foot trefoil	*Lotus corniculatus*	Can be common in some floodplain meadows but might not be present or at low levels
Yellow rattle	*Rhinanthus minor*	Can be common in some floodplain meadows but might not be present or at low levels
Cuckoo-flower / Ladies'-smock	*Cardamine pratensis*	Can be common in some floodplain meadows but might not be present or at low levels
Hawkbits	*Leontodon* sp.	Common in most floodplain meadows. Not separated out to ease identification, but could be separated into autumn hawkbit *Leontodon autumnalis* and rough hawkbit *Leontodon hispidus*
Oxeye daisy	*Leucanthemum vulgare*	Can be common in some floodplain meadows but might not be present or at low levels
Pepper-saxifrage	*Silaum silaus*	Can be common in some floodplain meadows but might not be present or at low levels
Self-heal	*Prunella vulgaris*	Can be common in some floodplain meadows but might not be present or at low levels
Sweet vernal grass	*Anthoxanthum odoratum*	Common in most floodplain meadows
Crested dog's-tail	*Cynosurus cristatus*	Common in most floodplain meadows
Meadow foxtail	*Alopecurus pratensis*	Can be common in some floodplain meadows but might not be present or at low levels

Marsh marigold (kingcup) sedge pasture species		Comment
Meadow buttercup	*Ranunculus acris*	Common in most sedge pastures
Meadowsweet	*Filipendula ulmaria*	Common in most sedge pastures, but can be a sign of lack of grazing so a qualifier might need to be put on this, or it could be included as both a positive and negative indicator species
Great burnet	*Sanguisorba officinalis*	Can be common in some sedge pastures but might not be present or at low levels
Common / black knapweed	*Centaurea nigra*	Can be common in some sedge pastures but might not be present or at low levels
Devil's-bit scabious	*Succisa pratensis*	Can be common in some sedge pastures but might not be present or at low levels
Self-heal	*Prunella vulgaris*	Can be common in some sedge pastures but might not be present or at low levels
Common bird's-foot trefoil	*Lotus corniculatus*	Can be common in some sedge pastures but might not be present or at low levels
Ragged-robin	*Lychnis flos-cuculi*	Can be common in some sedge pastures but might not be present or at low levels
Lesser spearwort	*Ranunculus flammula*	Can be common in some sedge pastures but might not be present or at low levels
Hawkbits	*Leontodon* sp.	Can be common in some sedge pastures but might not be present or at low levels. Not separated out to ease identification, but could be separated into autumn hawkbit *Leontodon autumnalis* and rough hawkbit *Leontodon hispidus*
Yellow rattle	*Rhinanthus minor*	Can be common in some sedge pastures but might not be present, or at low levels, or in patches
Marsh marigold / Kingcup	*Caltha palustris*	Can be common in some sedge pastures but might not be present or at low levels
Red clover	*Trifolium pratense*	Common in most sedge pastures
Eyebright	*Euphrasia officinalis* agg.	Can be common in some sedge pastures but might not be present or at low levels
Cuckoo-flower / Ladies'-smock	*Cardamine pratensis*	Common in most sedge pastures
Meadow vetchling	*Lathyrus pratensis*	Can be common in some sedge pastures but might not be present or at low levels
Sweet vernal grass	*Anthoxanthum odoratum*	Common in most sedge pastures
Crested dog's-tail	*Cynosurus cristatus*	Common in most sedge pastures
Meadow foxtail	*Alopecurus pratensis*	Can be common in some sedge pastures but might not be present or at low levels
Carnation sedge	*Carex panicea*	Common in most sedge pastures
Sharp-flowered rush	*Juncus acutiflorus*	Can be common in some sedge pastures but might not be present or at low levels

Calcareous grassland species		Comment
Salad burnet	*Poterium sanguisorba*	Can be common in calcareous grassland
Wild thyme	*Thymus praecox*	Can be common in short calcareous grassland but might not be present or at low levels depending on sward height
Common bird's-foot trefoil	*Lotus corniculatus*	Can be common in short calcareous grassland but might not be present or at low levels depending on sward height
Common rockrose	*Helianthemum nummularium*	Can be common in short calcareous grassland but might not be present or at low levels depending on sward height
Fairy-flax	*Linium catharticum*	Can be common in calcareous grassland
Common / black knapweed	*Centaurea nigra*	Can be common in calcareous grassland
Greater knapweed	*Centaurea scabiosa*	Can be common in calcareous grassland but might not be present or at low levels
Bulbous buttercup	*Ranunculus bulbosus*	Can be common in calcareous grassland
Hawkbits	*Leontodon sp.*	Can be common in some calcareous grasslands. Not separated out to ease identification, but could be separated into rough hawkbit *Leontodon hispidus* and lesser hawkbit *Leontodon saxatilis*
Hoary plantain	*Plantago media*	Can be common in calcareous grassland
Harebell	*Campanula rotundifolia*	Can be common in calcareous grassland
Eyebright	*Euphrasia officinalis agg.*	Can be common in calcareous grassland
Lady's bedstraw	*Galium verum*	Can be common in calcareous grassland
Cat’s-ear	*Hypochaeris radicata*	Can be common in calcareous grassland but might not be present or at low levels
Dropwort	*Filipendula vulgaris*	Can be common in calcareous grassland but might not be present or at low levels
Self-heal	*Prunella vulgaris*	Can be common in calcareous grassland but might not be present or at low levels
Devil's-bit scabious	*Succisa pratensis*	Can be common in calcareous grassland but might not be present or at low levels
Field scabious	*Knautia arvensis*	Can be common in calcareous grassland but might not be present or at low levels
Small scabious	*Knautia columbaria*	Can be common in calcareous grassland but might not be present or at low levels
Sainfoin	*Onobrychis viciifolia*	Can be common in calcareous grassland but might not be present or at low levels
Oxeye daisy	*Leucanthemum vulgare*	Can be common in calcareous grassland but might not be present or at low levels
Betony	*Betonica officinalis*	Can be common in calcareous grassland but might not be present or at low levels
Kidney vetch	*Anthyllis vulneraria*	Can be common in calcareous grassland but might not be present or at low levels
Horseshoe vetch	*Hippocrepis comosa*	Can be common in calcareous grassland but might not be present or at low levels
Wild carrot	*Daucus carota*	Can be common in calcareous grassland but might not be present or at low levels
Common restharrow	*Ononis repens*	Can be common in calcareous grassland but might not be present or at low levels
Common-spotted orchid		Can be common in calcareous grassland but might not be present or at low levels
Pyramidal orchid	*Anacamptis pyramidalis*	Can be common in calcareous grassland but might not be present or at low levels
Bee orchid	*Ophrys apifera*	Can be common in calcareous grassland but might not be present or at low levels
Common milkwort	*Polygala vulgaris*	Can be common in calcareous grassland but might not be present or at low levels
Yellow-wort	*Blackstonia perfoliata*	Can be common in calcareous grassland but might not be present or at low levels

Calcareous grassland species		Comment
Crosswort	*Cruciata laevipes*	Can be common in calcareous grassland but might not be present or at low levels
Wild marjoram	*Origanum vulgare*	Can be common in calcareous grassland but might not be present or at low levels
Wild basil	*Clinopodium vulgare*	Can be common in calcareous grassland but might not be present or at low levels
Crested dog's-tail	*Cynosurus cristatus*	Can be common in calcareous grassland
Sweet vernal grass	*Anthoxanthum odoratum*	Can be common in calcareous grassland
Quaking-grass	*Briza media*	Can be common in calcareous grassland
Yellow oat-grass	*Trisetum flavescens*	Can be common in calcareous grassland
Upright brome	*Bromus erectus*	Common in most calcareous grassland, but can be a sign of lack of grazing so a qualifier might need to be put on this, or it could be included as both a positive and negative indicator species
Glaucous sedge	*Carex flacca*	Can be common in calcareous grassland
Carnation sedge	*Carex panicea*	Can be common in calcareous grassland
Common / black sedge	*Carex nigra*	Can be common in calcareous grassland

Purple-moor grass and rush pasture species		Comment
Greater bird's-foot trefoil	*Lotus uliginosus*	Can be common in purple-moor grass and rush pasture
Lesser skullcap	*Scutellaria minor*	Can be common in purple-moor grass and rush pasture but might not be present or at low levels
Marsh bedstraw	*Galium palustre*	Can be common in purple-moor grass and rush pasture
Ragged-robin	*Lychnis flos-cuculi*	Can be common in purple-moor grass and rush pasture but might not be present or at low levels
Sneezewort	*Achillea ptarmica*	Can be common in purple-moor grass and rush pasture but might not be present or at low levels
Tormentil	*Potentilla erecta*	Can be common in purple-moor grass and rush pasture
Whorled caraway	*Carum verticillatum*	Can be common in purple-moor grass and rush pasture but might not be present or at low levels
Cross-leaved heath	*Erica tetralix*	Can be common in purple-moor grass and rush pasture but might not be present or at low levels
Heather / ling	*Calluna vulgaris*	Can be common in purple-moor grass and rush pasture but might not be present or at low levels
Western gorse	*Ulex gallii*	Can be common in purple-moor grass and rush pasture but might not be present or at low levels
Lesser spearwort	*Ranunculus flammula*	Can be common in purple-moor grass and rush pasture
Meadow buttercup	*Ranunculus acris*	Can be common in purple-moor grass and rush pasture
Meadowsweet	*Filipendula ulmaria*	Can be common in purple-moor grass and rush pasture but might not be present or at low levels
Common lousewort	*Pedicularis sylvatica*	Can be common in purple-moor grass and rush pasture but might not be present or at low levels
Water mint	*Mentha aquatic*	Can be common in purple-moor grass and rush pasture
Common sorrel	*Rumex acetosa*	Can be common in purple-moor grass and rush pasture
Cuckoo-flower / Ladies'-smock	*Cardamine pratensis*	Can be common in purple-moor grass and rush pasture
Self-heal	*Prunella vulgaris*	Can be common in purple-moor grass and rush pasture but might not be present or at low levels
Devil's-bit scabious	*Succisa pratensis*	Can be common in purple-moor grass and rush pasture but might not be present or at low levels
Saw-wort	*Serratula tinctoria*	Can be common in purple-moor grass and rush pasture but might not be present or at low levels
Purple-moor grass	*Molinia caerula*	Can be common in purple-moor grass and rush pasture
Sweet vernal grass	*Anthoxanthum odoratum*	Can be common in purple-moor grass and rush pasture
Sharp-flowered rush	*Juncus acutiflorus*	Can be common in purple-moor grass and rush pasture
Carnation sedge	*Carex panicea*	Can be common in purple-moor grass and rush pasture

Lowland Meadow RA

Site:	Date:	Surveyors:
	Time for survey:	

Sample number	Grid reference	Is the sward height more than 10cm in June/July?	Is the cover of herbs great than 40%?	Is there less than 5% scrub?	Positive indicators														Negative indicators				
					Bulbous buttercup	Common bird's-foot trefoil	Common / black knapweed	Devil's-bit scabious	Field scabious	Hawkbits	Lady's bedstraw	Meadow buttercup	Meadow vetchling	Oxeye daisy	Self-heal	Yellow rattle	Crested dog's-tail	Quaking-grass	Sweet vernal grass	Common nettle	Creeping thistle / spear thistle	Docks (excluding common sorrel)	Ragwort	Soft rush / hard rush
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Floodplain Meadow RA

Site:		Date:					Surveyors:																						
		Time for survey:																											
							Positive indicators																	Negative indicators				
Sample number	Grid reference	Is the sward height more than 10cm in June/July?	Is herb cover greater than 30%?	Is scrub cover less than 1%?	Is there less than 5% bare ground in June/July?	Is the cover of meadowsweet less than 25%?	Common bird's-foot trefoil	Common / black knapweed	Common sorrel	Devil's-bit scabious	Great burnet	Meadow buttercup	Meadow vetchling	Oxeye daisy	Pepper-saxifrage	Self-heal	Tufted vetch	Yellow rattle	Crested dog's-tail	Meadow foxtail	Sweet vernal grass	Common nettle	Docks (excluding common sorrel)	Creeping thistle / spear thistle	Ragwort	Soft rush / hard rush
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Calcareous Grassland RA

Site:	Date:	Surveyors:
	Time for survey:	

									Positive indicators																				Negative indicators				
Sample number	Grid reference	Is the sward height less than 15cm in June/July?	Is the cover of herbs and sedges more than 50%?	Are there any scrub seedlings?	Is there any scrub that is over 50cm high?	Is there less than 5% bare ground in June/July?	Is there less than 33% upright brome?	Common bird's-foot-trefoil	Common / Black knapweed	Common rock-rose	Dwarf thistle	Fairy-flax	Field scabious	Harebell	Lady's bedstraw	Milkwort sp.	Red clover	Ribwort plantain	Rough hawk's-bit	Salad burnet	Self-heal	Thyme	Wild basil	Quaking-grass	Sheep's / Red fescue	Glaucous sedge	Common nettle	Docks (excluding common sorrel)	Creeping thistle / spear thistle	Ragwort	Is there less than 10% false wood brome and/or tor-grass?
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Purple Moor-grass and Rush Pasture RA

Site:	Date:	Surveyors:
	Time for survey:	

Sample number	Grid reference	Is sward height less than 30cm in June/July?	Is sedge cover more than 40%?	Is rush cover more than 30%? (exc. soft and hard rush)	Is there less than 5% scrub seedlings?	Positive indicators														Negative indicator					PMG			Scabious			
						Common lousewort	Cotton-grass	Greater bird's-foot trefoil	Heath milkwort	Lesser skullcap	Marsh bedstraw	Ragged robin	Sneezewort	Sweet vernal grass	Tormentil	Whorled caraway	Cross-leaved heath	Heather / ling	Western gorse	Is there any European gorse more than 20cm in height?	Creeping thistle / spear thistle	Docks (exc. common sorrel)	Ragwort	Soft rush / hard rush	0-25% Purple moor grass cover	26-80% Purple moor grass cover	>80% Purple moor grass cover	No Devil's-bit scabious	0-5% Devil's-bit scabious cover	6-10% Devil's-bit scabious cover	>10% Devil's-bit scabious cover
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