The Woodland Herbivore Impact Assessment Method User Guide

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Version 5th April 2023

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Introduction

Historic herbivore impacts have played a major role in shaping the current extent, structure and species composition of woodlands. **Current** herbivore impacts play a major role in determining how an area of woodland, or of potential woodland, will change in the future. The Woodland Herbivore Impact Assessment Method was developed to provide a relatively simple and inexpensive means of assessing the current impact of large herbivores (deer, cattle, sheep, goats, horses, pigs) on areas of woodland and potential woodland. The method is based on observations of the effects of recent trampling, browsing or grazing by large herbivores on ground cover, tree and other plant indicators. The observed effects are used to determine the level of impact (from 'no impact' to 'very high') on each indicator. The results can be used to predict likely future changes in woodland structure and species composition under current impact levels. They can thus help to determine whether or not the management of large herbivores at a site needs to change to achieve woodland objectives.

The method requires users to record **observations** rather than make, and record, detailed measurements. This makes it simpler, and more accessible, than some other methods and means that no statistical analysis of the results is needed. The corollary of this is that the results cannot be used to determine the statistical significance of differences in impact over time or between sites. Although levels of repeatability have been shown to be within acceptable bounds for use in underpinning many management decisions, further checks may be needed if the result needs to be beyond doubt. This can be achieved by carrying out two, or more, independent assessments using different observers or by checking a sample of the observations recorded by the first observer and ensuring that the translation from recorded observations to impact levels was carried out appropriately.

To carry out this method, observers need to be able to make detailed field observations and identify tree and plant species, in all life stages, often in winter. All other information needed to carry out an assessment is contained in this guide. Links are also provided to online documents, web pages and photo galleries that provide additional information. Before carrying out your first survey, we suggest that you read the whole of this guide then copy and paste the Field Sheet and Field Tables (Tables 1-5) into a separate document that you can then tailor, as appropriate, to your specific needs. Although all the elements of the method are covered in this guide, we recommend that, if possible, you attend a training course. This will especially help with learning to identify impacts and assess browsing rates.

Overview of steps required

The steps involved in carrying out the method are as follows:

Before going into the field

1. Decide on the best time of year to carry out your assessment.
2. Mark on a map the boundary of each woodland and /or open ground area for which you want a separate assessment.
3. Decide on the number of locations within each area ('stops') where herbivore impact will be assessed.

4. Decide whether to determine the location of stops before going in the field or when there. If the former, decide on stop locations.
5. Decide whether to record 'optional extras' and, if so, tailor your field sheet/s and field information tables appropriately.
6. Print field sheets and field tables.
7. Gather field equipment.
8. If possible, recruit an assistant.

At the assessment area

9. Plan a route round the assessment area that takes in all stops.

At each stop

10. Mark the centre of the stop, take a GPS reading, take photos facing in four directions and mark four points equally spaced on the edges of a circular area of about 25 m radius.
11. Walk systematically around the stop recording observations of impacts of large herbivores on seven indicators, recording signs of herbivores and noting anything else of relevance. If possible, take photos of unusual, or interesting, examples of impacts.
12. Decide whether to translate the observations into impact levels after completing each stop or when all stops are completed. If the former, translate observations of each indicator into an impact level.

After all stops have been completed

13. If not already done, translate the observations at each stop into an impact level for each indicator.
14. Convert the impact levels at all stops into an overall impact level for the assessment area for each indicator.
15. Map the results for each stop and each indicator separately to look for any spatial patterns. If strong differences exist between areas within the assessment area, consider splitting the assessment area and assessing more stops in one or more of the new assessment areas.
16. Consider whether an overall impact level is needed for the assessment area and, if so, determine the best means of summarizing results for all indicators to produce an overall impact level.
17. If relevant, determine target impact levels and compare the results with the target impact levels.
18. Decide whether, and how frequently, to repeat the assessment.

Detailed guidance on each step

1. Time of year

Current impact is normally, and most easily, assessed on the most recent season's plant growth. Assessing impact at the end of winter, before new growth starts in spring, provides an

assessment of the impact over the previous twelve months. Assessing impact on the current season's growth at the end of summer provides an assessment of summer impact only. The best time of year to carry out an assessment therefore depends on the objective. For example:

- If grazing, by domestic stock and /or deer, is occurring all year round, and the objective is to assess the impact of all large herbivores over the whole year, then the assessment should be carried out **at the end of winter** before new spring growth has started. It can be very instructive, however, to also look informally at the woodland towards the end of the summer to see how much spring /summer browsing has already occurred, as well as to get an idea of the length of unbrowsed shoots. This is particularly useful where winter browsing is heavy and there are few unbrowsed shoots left by the end of winter to compare with browsed shoots. This comparison is needed for the assessment of browsing rates.
- If domestic stock are grazed seasonally where there are no wild deer present and the objective is to assess the impact of the domestic stock, then an assessment should be carried out **at the end of the grazing period**.
- If domestic stock are grazed seasonally in the presence of wild deer and the objective is to assess the impact of both the stock and deer over the grazing period and of the deer at other times of the year, then the assessment should be carried out **at the start and end of the stock grazing period as well as at the end of winter**.

Sometimes the assessment would be best carried out at the end of winter but, for logistical reasons, it is only possible for it to be carried out later in the year, after the start of, or well into, the following growing season. In this case, it is possible to record the impact of large herbivores on the previous season's growth of the relevant indicators (rather than on the most recent season's growth). This is not straightforward, however, since new growth often obscures the previous season's growth. This is therefore only recommended for experienced surveyors who are confident that they can distinguish the current season's growth and impacts from the previous season's (see 'Guidance on assessing browsing rates on tree shoots'). When carrying out an assessment on the previous season's impact after the start of the growing season, include plants that are only visible in spring and /or summer. Although the plant growth you will be looking at occurred in the current growing season, any impacts on these plants can be used as a reasonable substitute for impacts on the same plants in the previous growing season and therefore can be included in the assessment. In fact, being able to assess grazing on spring growing plants provides information that is not available when an assessment is carried out in late winter.

2. Assessment areas

Assessment areas may be defined by land use type and /or land management type and /or habitat type depending on the nature of the site and the objectives of management. See the Woodland Grazing Toolbox for more guidance on defining habitat types. Individual areas may be one discrete patch or may be composed of separate patches e.g. patches of oak woodland within an open pasture. The most important consideration when deciding on the boundaries of assessment areas is that there should be no prior reason to suspect that different parts of any assessment area will be subject to different levels of herbivore impact. Reasons to suspect such differences might include the presence of barriers to deer or, if relevant, stock movement e.g. intact fences, walls, rivers or roads. If, after the assessment has been carried

out, there appear to be discrete parts of an assessment area that have significantly different herbivore impact levels, you may need to sub-divide the area and possibly carry out further assessments (See step 15).

3. Number of stops and field time requirement

There need to be enough stops to adequately represent the impacts in the assessment area. Whilst impact levels can vary considerably within an area, they can also be quite uniform, especially at very high, or very low, impact levels. Ten stops are normally sufficient to gain a good idea of the overall impact in an assessment area even if the impacts vary between stops. If, however, the impacts vary considerably between stops, or insufficient examples of indicators are found at the first ten stops, additional stops may be needed. In very small assessment areas, where ten stops would overlap with each other, the number of stops can be reduced to avoid such overlap. Assessing ten stops is likely to take around one full day in the field but may take less, or more, time depending on the complexity of the assessment area. Where there are a large number of indicators, many examples of each indicator and high variation in impact within, or between, stops, the number of stops that can be assessed in a day may be as low as five. Inexperienced surveyors are also likely to need more time in the field until they become familiar with assessing the indicators. Where the assessment area is less complex and /or the surveyor is experienced, assessing ten stops may require less than one full day in the field.

4. Location of stops

The location of stops can be decided before going out in the field or whilst in the field, whichever is most convenient. Stops do not need to be a set distance apart however they should be fairly evenly spread out so that they provide good coverage of the area to be assessed. The stops may be, but do not have to be, at the same locations as those used for any previous assessment. If deciding the locations before carrying out the field work or repeating an assessment using the same stops as were used previously, load the stop locations onto a GPS before going into the field. If using a phone or tablet in the field, a mapping App can be downloaded and the location of the stops, together with a background map, can be uploaded to the App to assist with navigation.

5. Optional extras

When recommending appropriate herbivore management for a site, as well as knowing current herbivore impact levels, it can be useful to have additional information on other aspects of the current condition of the woodland. The largest time requirement in carrying out field survey work is often the time involved in preparation, travelling to and from the site and in walking between stops. It may, therefore, be worthwhile, in some cases, recording other aspects of woodland condition whilst carrying out your herbivore impact assessment. Some suggestions for additional information that you might consider collecting are provided in the Appendix. This additional information may help you to understand the impact of herbivores on the woodland, both currently and in the past, as well as to predict the long-term effect of different herbivore impact levels on the woodland. If you do decide to add in ‘optional extras’ to your herbivore impact assessment, it may not be necessary to include all, or any, of them every time you repeat the assessment. Woodland structure class (see

Appendix), for example, will not change as rapidly as current herbivore impact so may not need to be assessed at every visit.

6. Field sheets and field reference tables

If you know something about the likely occurrence of different indicators at your site, you may want to tailor the Field Sheet to your site by e.g. increasing the space available to record observations on some indicators and reducing the space for others. For example, you may know that the trees present have a lot of basal shoots, or that seedlings are abundant, so it will be useful to make sure you have enough space to record them. If optional extras are being recorded, you may need to design an additional field sheet. Print out one copy of the Field Sheet for each stop you intend to assess as well as some additional sheets in case they are needed. At a stop with many examples of one or more of the seven indicators, the field sheet may not provide enough space and you will need to continue recording on the reverse of the field sheet or onto a second sheet. Consider printing some, or all, field sheets on waterproof paper. Alternatively, you may choose to record your observations in a field notebook or on a tablet. Also print out the Field Tables (Tables 1-5). Laminate these tables if possible since this makes them more robust and easier to refer to in the field. If this is not possible, print them on waterproof paper.

7. Field equipment

You will need:

- Field Tables (Tables 1-5)
- Field Sheets or waterproof notebook or tablet set up for data entry.
- Landscape WeatherWriter (or equivalent) and pencils if using field sheets
- GPS (either stand alone or an App on a mobile phone or tablet)
- Camera
- Marker tape to mark stops
- Food and drink
- Warm and waterproof clothes, including gloves that are warm but allow writing /touchpad use.

8. Assistant

The method can be used successfully by one person, especially if they are an experienced field surveyor, however having an assistant will often make field recording easier and faster. It can also be very helpful to have two pairs of eyes looking for examples of indicators and two people's opinions on browsing /grazing rates. The final result may, therefore, be more reliable if two people carry out the survey together. However, since this increases the cost, it will not always be possible.

9. Planning a route

Take account of contours to plan a route round the assessment area that minimizes the effort and time needed to either visit all pre-marked stops, or that will allow stops to be located in representative parts of the assessment area.

10. Marking a stop

If a pre-determined stop location turns out to be inaccessible, move it to an adjacent accessible location. Stand at the location of your stop and record the grid reference of the point where you are standing. Take photos facing north, south, east and west. Place something visible e.g. your backpack with some marker tape tied to it, at the location. Visualise a circle with a radius of about 25 m with yourself at the centre. The first few times you assess a stop you may want to pace 25 m in each direction until you get a feel for what 25 m looks like. It may also be useful to attach something bright e.g. marker tape, to trees at 25 m from the centre point at the four points of the compass. This will help you to keep track of your position within the stop.

11. Recording observations

When reading this section, you may find it helpful to refer to the completed field sheet shown in the Worked Example.

Overview

Record the name of the assessment area, stop number, grid reference, date and surveyor(s)' name(s) on the field sheet for the stop. Walk systematically around the stop recording observations of the current impact of mammalian herbivores. You may choose to walk in a series of 'spokes' out from the centre to the edge of the stop and back to the centre. The aim is to cover as much of the stop area as possible. For information on how to distinguish between the effects of different damaging agents (animal, microbial and environmental) on young trees see:

- Distinguishing mammal damage to young trees from damage by other factors
- Woodland damage: Recognition of cause.
- Distinguishing between browsing by different mammal species

Under 'Herbivore species /signs' on the Field Sheet, record all the species of mammalian herbivore that you know, from prior knowledge, have been present in the assessment area during the time period of interest. Also record field signs of any mammalian herbivore species that you come across at the stop, including those of beavers. In the 'Notes' section of the Field Sheet you may also want to record other observations that may be of use in interpreting your results. This may include:

- Dominant plant species in the ground layer.
- Obvious signs of browsing on previous seasons' growth. This may provide useful information on changes in browsing rate over past years.
- Any obvious differences between the species composition of seedlings /saplings and that of more mature trees.
- Browsing on seedlings that are less than 5 cm tall or that have germinated within the last few months.
- The species of tree that have been bark stripped or frayed either recently or in the past.
- The presence of flower stems of preferentially browsed spring herb species (Angelica, Meadowsweet or Valerian). These are usually only present when browsing rates are low.

- The location and state of any fences and /or walls.
- The presence of coppice re-growth from trees felled by beavers and the level of browsing on the re-growth (stems re-growing from coppiced trees are included under the 'Basal shoots' indicator.)

Current herbivore impact is defined as the impact during **all, or part, of the previous twelve months**, depending on the time period of interest (see '1.Time of Year'). At the stop, walk round the area in a systematic manner so that you can look for examples of indicators in as much of the area as possible. As you walk, follow the detailed guidance below to record signs of herbivore impact on:

1. Ground disturbance
2. Bark stripping, fraying and stem breakage
3. Basal shoots
4. Epicormic /lower shoots
5. Seedlings /saplings
6. Preferentially browsed or grazed plants
7. Other plants

If, when walking between stops, you find examples of indicators that were rare at the previous stop, record the signs of herbivore impact and add the records to those from either the previous stop or the next stop, whichever is nearest.

All indicators

Table 1 provides a summary of the observations to be recorded for each indicator. This can be used in the field as an 'aide memoire'. Links to online photos of different impact levels on each indicator can be found in Table 6.

On the Field Sheet, use a 'gate' tally system (mark one stroke per record for the first four records, mark the fifth record as a diagonal line through the first four strokes and record further records in the same way) to record the number of examples of each type of indicator as you find them. If you find more than nine examples of one type at one spot, estimate the number of examples you can see using the following categories: 10-20, 20-50, 50-100 or >100. The final result for any indicator may include observations recorded using both tallies and categories (see the completed field sheet in the Worked Example).

Ground disturbance

Ground disturbance is defined as any disturbance to ground vegetation that has obviously been caused by large herbivores. This includes ground 'poached' by trampling or dug up by rooting of pigs, as well as tracks, wallows and scrapes. Be careful not to include ground that is bare of live or dead vegetation for other reasons. These reasons may include a lack of light or fast decomposition of litter in spring on moist, rich soils. Normally, if large herbivores have caused the bare ground, there will be obvious marks of hoof prints or scraping. If the ground is composed of bare rock, boulders or scree which cannot show signs of disturbance by large herbivores, record 'Not Applicable' under impact level. Record the percentage of ground disturbed by large herbivores in the categories 0, <5, 5-15, 15-30 or >30%. Also record the number of wallows and scrapes and the number of vegetated, and un-vegetated, tracks. On

wet ground, where the vegetation is easily disturbed by trampling, make an initial assessment of the percentage of the ground disturbed before walking around the stop.

All tree and plant indicators

Record impacts only on trees /plants, or parts of trees /plants, **that are accessible to the species of large herbivore present in the survey area**. Trees growing in gullies or on root plates or boulders are often inaccessible to large herbivores. Large herbivores also have a maximum height to which they can browse, so any part of a tree or plant that is growing above the maximum browsing height (Table 2) of the largest herbivore species present should be treated as inaccessible. If it is not known which large herbivore species are present, there may be a clear browseline visible on trees, or on climbing plants, that can indicate the maximum browsing height. Note, however, that unbrowsed, mature ivy can develop a growth form that appears to show a definite browseline. Only a clear change with height in the presence of obvious browsing impacts should therefore be taken to indicate a browseline on ivy. On occasion, deer, sheep and goats will also go onto their hind legs to browse so there may be some impacts above the assumed browsing height. On occasion, compacted snow may also allow herbivores to browse to a greater height than normal. Goats can also climb trees. If there are obvious browsing impacts above the normal maximum browsing height, record these impacts.

Bark stripping, fraying and stem breakage

Bark stripping is caused by deer (except roe deer), cattle, sheep, goats or pigs stripping bark from trees with their teeth or by sika deer scoring bark with their antlers. Bark may be stripped from standing, or fallen, trees or branches. Suitable trees are usually those that have smooth bark (broadleaves or conifers) and are >2 m tall (or were before they fell). Record the number of trees that have been bark stripped, as well as the percentage of all suitable trees that have been bark stripped, using the categories 0, 1, <20, 20-50 and >50%. Note that there may be evidence of bark stripping that occurred prior to the time period of interest. Older wounds will be dry and the bark around the edge of the wound will have thickened.

Fraying is the removal of bark from tree saplings by deer rubbing them with their antlers either to scent mark or to remove ‘velvet’ from the antlers. Suitable trees are usually saplings between 50 cm and 2 m tall and of <5 cm diameter at breast height (dbh; = 1.3 m). Record the number of trees, and the percentage of all suitable trees (in categories 0, 1, <20, 20-50, >50%) that have been frayed.

Stem breakage is usually caused by cattle or deer (except roe deer) pushing against saplings or pulling down saplings to reach higher branches (trees 50 – 200 cm tall and <5 cm dbh). Vigorous fraying by roe deer may occasionally also result in stem breakage. Record the number, and percentage (in categories 0, <5, 5-10, 10-20, >20 %) of saplings that have been broken.

Basal shoots, Epicormic /lower shoots and Seedlings /saplings

Definitions
Basal shoots are shoots that grow from the base of intact or felled (by humans or beavers), tree trunks. Conifers do not produce basal shoots and not all individual trees of all broadleaf tree species produce basal shoots.

Epicormic /lower shoots are those growing from the trunks or lower branches of mature standing or fallen trees. As a rule of thumb, basal shoots originate below 'boot height' and epicormic shoots originate above that level. Not all trees have epicormic shoots.

Seedlings and saplings are defined as young trees between 5 and 200 cm tall**.**
Seedlings less than 5 cm tall are excluded from consideration because they are often hidden under vegetation so are not browsed. Observations of browsing on seedlings < 5 cm tall can be recorded under 'Notes'. If the survey is taking place during the growing season, and the aim is to assess impact over the previous twelve months, do not assess tree seedlings that have germinated in the current growing season. These seedlings were not present during the previous winter so were not available to be browsed. Since most browsing often occurs over winter, browsing on these seedlings does not represent the impact over the full twelve months and, in fact, in many cases, most new seedlings 'disappear', for various reasons, over the winter. As a result, new seedlings of even palatable species may be unbrowsed in summer whilst older seedlings and saplings may be heavily browsed. You can make a separate note of the presence of such seedlings and of any observed browsing on them.

Recording
As you walk round the stop, carefully observe all basal and epicormic /lower shoots as well as shoots on seedlings and saplings. For each indicator, record the number of trees of each species that you find that fall into each of the following categories of percentage of shoot biomass browsed: 0, <25, 25-75, 75-90, >90 %.To assess the browsing rate on trees, you will need to estimate the **percentage of the total biomass of the current season's growth of all shoots that are within browsing height** on the tree, that has been removed by herbivores (See 'Guidance on assessing browsing rates on tree shoots'). Determine one overall browsing rate category for all basal shoots or epicormic /lower shoots on each tree and for all shoots on each seedling /sapling. This process becomes faster with time since, once you have assigned a browsing rate category to a number of trees of each species, you will be able to assign categories to a tree by looking at the overall appearance of the shoots on a tree without the need to look in detail at each shoot.

Some additional observations may, in some cases, help you to decide between the 75-90% and the >90% browsed categories:

- **Basal and Epicormic and lower shoots**. If recent growth on shoots of **palatable** tree species is not obvious because most, or all, have been browsed close to the trunk or into old, woody material then the browsing category is likely to be >90%. If some shoots of **unpalatable** tree species have been browsed into older, woody material then the browsing category is likely to be >90%.
- S**eedlings and saplings**. If many shoots of **palatable** tree species have been browsed into woody material, the browsing category is likely to be >90%.

Preferentially browsed /grazed plants and Other plants

Preferentially browsed /grazed plants are those that are listed as 'very palatable' in Table 3. **Other plants** are those listed in Table 3 as moderately or slightly palatable. If grazing /browsing is observed on a plant species that is not listed in Table 3, assume it is slightly palatable. If both cattle and deer are present in an assessment area, and a plant species falls into a different palatability category for each of these types of herbivore, treat the plant species as being in the more palatable of the categories.

The browsing /grazing rate on **both these plant indicators** is assessed by estimating the **percentage of the total number of accessible shoots or leaves** on a plant that have been browsed /grazed. As you walk round the stop, carefully observe all examples of these indicators for signs of browsing /grazing. Record the number of plants of each species that you find that fall into each of the following categories of percentage of shoot biomass browsed /grazed: 0, <25, 25-75, 75-90, >90 %. For **preferentially browsed /grazed plant** species only, for the > 90% category, also record whether browsing /grazing has been of 'just tips' or 'more than just tips'. If there is a large area of one plant species e.g. a carpet of bluebells or blaeberries, where it is impossible to tell one plant from another, record the number of examples as >100. If there are separate patches of a plant where it is not possible to tell one plant from another, record each patch as one example.

12 and 13. Translating observations into impact levels for each stop

Once all observations have been recorded at a stop, these need to be translated into one of five impact levels (from no impact to very high) for each indicator at the stop. This can be done after each stop has been completed however, if time is limiting or the weather is bad, you may prefer to make the translations at the end of the day when not in the field. When reading the rest of this section you may find it helpful to refer to the Worked Example.

Summing numbers of observed examples

If you have made several records of examples of an indicator type and /or browsing /grazing rate category, you will need to sum your records to produce a total for that indicator type and /or browsing /grazing rate. Where the number of examples has been recorded as within a range i.e. 10-20, 20-50, 50-100, use the mid-point of the range i.e. 15, 35, 75, to calculate the total number of examples observed. Assume a value of 100 for the >100 category. This provides one value for the number of examples observed of each indicator type and /or browsing /grazing rate category. Write the final number on the field sheet and circle it.

Summing numbers of examples of palatable and unpalatable tree species

For **basal shoots and epicormic and lower shoots**, assign each species of tree recorded to one of two palatability groups: palatable (classes 1, 2 and 3) or unpalatable (classes 4, 5 and 6; Table 4).

For **seedlings and saplings**, assign each species of tree recorded to one of three palatability groups: palatable (classes 1, 2 and 3), unpalatable, classes 4 and 5 or unpalatable, class 6 (Table 4).

For all tree species in each palatability group, calculate the total number of examples that fall within each browsing rate category.

Summing numbers of examples of slightly palatable and moderately palatable plant species

For 'other plants', assign each species of plant to the 'slightly' or 'moderately' palatable category (Table 3). Calculate the total number of examples recorded for all tree species in each palatability group that fall within in each browsing /grazing rate category.

Determining impact levels

Once the total number of observed examples of each indicator type, palatability type and browsing /grazing category has been determined, the results can be compared with the descriptions in Table 5. From Table 5, choose the impact level that best describes your results for each indicator and record this in the space provided in the field sheet.

- If no examples of an indicator were found at a stop, record the impact as Not Applicable (N/A).
- If the recorded observations for a stop fall between two impact levels, record an intermediate level e.g. Medium-High.
- If your observations for any indicator do not point clearly to an impact level, choose the one that best represents the results and record your reasons for choosing this impact level.
- If the results for different palatability groups of trees or plants point to different impact levels, discard any results where the total number of examples in a palatability group is <5% of the total number of examples of the indicator at the stop. The final impact level is then the highest of those remaining.
- In some cases, the result for a palatability group of trees or plants will point to a number of possible impact levels e.g. if all slightly palatable plants are unbrowsed, this results in three possible impact levels: No Impact, Low or Medium. In this case, see 'Guidance on determining the final impact level when results indicate a number of possible impact levels '.

An example of the application of these rules can be found in the Worked Example.

14. Summarizing Impact levels for each indicator for an assessment area

Use the first blank summary results table to record your results for each indicator at each stop. Then use the second blank summary results table to record the total number of stops where each impact level (and intermediate impact level) was recorded for each indicator. Ignore any stops where Not Applicable was recorded. Choose an overall impact level that best represents the range of impacts across the assessment area. If, for example there are:

- Five Highs and five Mediums, the best summary is Medium-High.
- Five Lows and five Highs, the best summary is Medium.
- Six Highs and four Mediums, the best summary is Medium-High.
- Seven Highs and three Mediums the best summary is High.

If examples of an indicator are particularly abundant, or rare, at a stop you may want to give more, or less, weight to the result from that stop. This is especially true if a stop with very few

examples has provided a result that differs significantly from other results for the indicator. Examples of completed summary forms can be found in the Worked Example.

15. Mapping results

The results can be displayed on either a hard copy map or they can be imported into a GIS and impact levels for each indicator displayed in different colours. The resulting maps will show you if some parts of the assessment area are more heavily impacted by herbivores than are others. If there are discrete parts that have higher, or lower, impact levels, you may want to split up the assessment area and report on each new area separately. If there is high variation between stops in any of the new assessment areas, you may want to assess more stops.

16. Overall impact level for an assessment area

Summarizing the current impact level in an assessment area as one overall result giving equal weight to all indicators can mask important information and occasionally give a misleading result. You are likely to find that not all the indicators give the same result. There are several factors that may account for this, including:

- Roe deer are browsers rather than grazers so may have less impact on ground layer plants than on trees and shrubs. They also do not create much ground disturbance, nor do they bark strip (though they do fray young trees). If roe deer are the main herbivore species present then you may find that the indicators relating to preferentially grazed species, seedlings and saplings, epicormic and basal shoots indicate a high impact whereas those relating to ground disturbance, other plants and bark stripping indicate a low impact.
- Cattle and pigs are more likely than other large herbivores to create ground disturbance, especially around feeding areas or pig shelters. If cattle and /or pigs are the main herbivores, then the ground disturbance indicator may be relatively high whilst the other indicators are relatively low.

Where an overall impact result may be misleading or may obscure important information, it may be better not to attempt to summarize current impact across all indicators. Instead consider recording, mapping and tracking the impact levels for each indicator separately. If it is necessary, however, to provide an overall impact level for the assessment area, consider the objectives for the area. For example:

- If the objective is to increase the number of palatable seedlings and saplings and these are being heavily browsed, then the overall current impact should be recorded as ‘high’ even if the ground layer and bark stripping impacts are ‘low’.
- If there are no, or few, seedlings and saplings, take the overall result from other browsing /grazing indicators.
- If the browsing /grazing indicators don’t agree, use the one/s with most examples.
- If there are no, or very few, browsing /grazing indicators, use results for ground disturbance and bark stripping, fraying and stem breakage.
- If the objective is to improve the diversity, or the flowering, fruiting and seed setting, of non-tree plants then you may want to give more weight to the impacts recorded on non-tree plants.

17. Target impact levels

Once you have completed your Herbivore Impact Assessment you may want to compare your result with a target impact level. Table 7 provides a summary of the effect of each of the impact levels, if maintained over the long term, on the condition of established woodlands (woodland structure types 4 to 10; Table A1). Whether the condition is desirable or not depends on the objectives for the woodland. In Table 7, the long-term implications of each impact level are compared with some common natural heritage objectives. This information may help with setting a target impact level for the woodland. In predicting the effect of a given browsing level on future tree species composition of the woodland, it may also be useful to know how resilient seedlings and saplings of different tree species are to browsing (Table 8). For more detail on the long-term effects of different impact levels on different woodland types see Table A4. The Woodland Grazing Toolbox provides more information on setting woodland management objectives.

18. Frequency of assessments

Monitoring every year, or as frequently as is possible, can provide useful information on how impacts are changing over time. This can be especially useful for tracking the effect on impact levels of changes in herbivore management e.g. changes in deer culling rates or stocking rates of domestic animals. Management can then be tailored to achieve the desired level of herbivore impact. If herbivore management is not changing then it may not be worthwhile carrying out regular impact assessments unless high annual variation in herbivore impact levels is expected for another reason e.g. variation in weather patterns between years.

Guidance on assessing browsing rates on tree shoots

At the end of winter

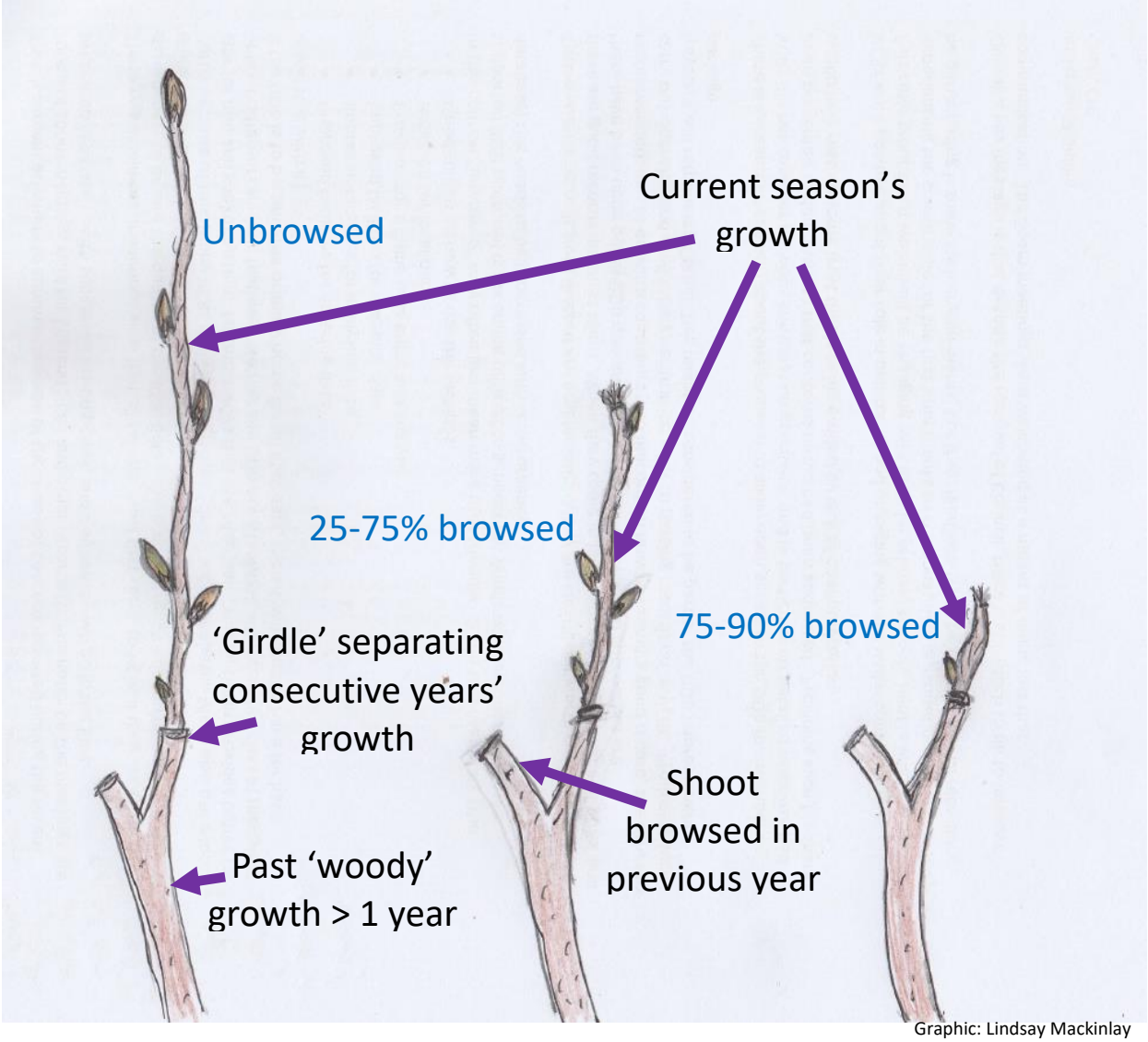
The most recent season's growth on all shoots can be identified by looking for the 'girdle' that separates recent growth from previous growth (Figure 1), You will then need to visualise the length of shoot that would have been present if it had not been browsed. This can be estimated by looking at the length of any existing unbrowsed shoots that are of a similar diameter to browsed shoots. If trees are heavily browsed, you may need to look for unbrowsed shoots that are beyond the reach of browsing animals e.g. in nearby deer-proof exclosures or on inaccessible ledges. The length of the most recent season's growth of an unbrowsed shoot is usually the distance between the tip of the shoot to the 'girdle' that separates the most recent growth from the previous season's growth (Figure 1) although a 'girdle' is not clear on birch. Older growth is also normally more 'woody' than recent growth.

In summer

If you are doing the assessment in summer but want to assess herbivore impact on the previous summer's growth, you will need to look past the current season's growth. When assessing shoots in the growing season, it is usually obvious which is the current year's growth due to the pliable and soft nature of the new shoot. Hazel and downy birch shoots are also hairy in their first year. There are often also strong differences in colour. For example, spruce changes from green in the current year to orange in previous year's stem. Newly grown willow

stems are glossy whilst older stems are more matt. If the shoot was browsed in the previous year then the current growth will be from a side shoot. If the shoot was unbrowsed then the leader will have continued to grow and the girdle separating the growth in the two years will also often be visible.

Figure 1. Diagram of browsed, and unbrowsed, tree shoots at the end of summer showing different percentages of shoot biomass removed. Also shown is a browsed shoot from the previous year's growth, the 'girdle' that separates growth of a shoot in two consecutive years and past 'woody' growth.



Graphic: Lindsay Mackinlay

At any time

If seedlings /saplings have unbrowsed side shoots of less than 2 cm in length (Figure 2), do not count these as unbrowsed if they are adjacent to an older, browsed shoot. Such short shoots may be the result of side shoot growth later in the growing season after the original shoot has been browsed. As such, they are not reliable indicators of the length of unbrowsed shoots that have grown throughout the growing season. If, however, the short shoot is a continuation of an unbrowsed shoot, i.e. there is an obvious 'girdle' between the most recent growth and older growth, then it can be assumed that the tree was only capable of producing such very short shoots. This may be because it has been heavily browsed for many years so

has limited stored resources to draw on to produce shoot growth even if there has been no browsing in the most recent growing season. In this case, these shoots can be used as examples of unbrowsed shoots for the particular tree on which they occurred.

Figure 2. Ash seedling showing short, side shoots that have may have grown in late summer after the main shoots had been browsed. Only assume that a side shoot represents a whole season's growth if there is a clear girdle separating it from shoot growth in the previous season.

Guidance on determining the final impact level when results indicate more than one possible impact level

For four indicators (basal shoots, epicormic /lower shoots, seedlings and saplings and other plants), browsing rates on the more unpalatable class /classes can point to two, or more, impact levels. For example, unpalatable basal shoots will be unbrowsed at both No Impact and at Low impact levels (Table 5) so if the only basal shoots present are of unpalatable tree species, and these are unbrowsed, we know only that the impact level is either No Impact or Low. The tables below provide a summary of the rules provided in Table 5 for translating browsing category into impact level for these four indicators. The conditions under which the browsing category result does not allow us to distinguish between two, or three, different impact levels are highlighted in red. The rules to use to determine the impact level to record are provided below each table. If the result is that more than one impact level is possible, record this as e.g. 'No impact OR Low'.

Basal shoots

Browsing category (%)	***Impact level*** ***Palatable Species***	***Unpalatable species***
>90	Very High	Very High
75-90	High	Very High
25-75	Medium	High
<25	Low	Medium
0	No impact	No Impact OR Low

1. If there has been no browsing on basal shoots of any species, the final impact level is that indicated by the Palatable species i.e. 'No Impact'.
2. If there are no Palatable species present, the final impact level is that indicated by the Unpalatable species i.e. 'No impact OR Low'.

Epicormic /lower shoots

Browsing category (%)	***Impact level*** ***Palatable species***	***Unpalatable species***
>90	Very High	Very High
75-90	High	High OR Very High
25-75	Medium	High OR Very High
<25	Low	Medium
0	No impact	No impact OR Low OR Medium

1. If the impact level of the Unpalatable species is a number of possible impact levels, the final impact level is that of the Palatable species UNLESS:
2. the impact level of the Palatable species is lower than the lowest of the possible impact levels of the Unpalatable species. In this case, the final impact level is the lowest of the possible impact levels of the Unpalatable class.
3. If there are only Unpalatable species present, and the final result is a number of possible impact levels, record the possible impact levels as e.g. 'No impact OR Low OR Medium'.

Seedlings & saplings

Browsing category (%)	***Impact level*** ***Palatable species***	***Unpalatable species (Class 4,5)***	***Unpalatable species (Class 6)***
>90	Very High	Very High	Very High
75-90	High	Very High	Very High
25-75	Medium	High	Very High
<25	Low	Medium	High
0	No impact	No impact OR Low	No impact OR Low OR Medium

1. If no browsing has been recorded on any species, the final impact level is the impact indicated by the Palatable species i.e. 'No impact'.
2. If no Palatable species are present, the final impact is that indicated by the Unpalatable (Class 4,5) species i.e. 'No impact OR Low'
3. If no Palatable or Unpalatable (Class 4,5) species are present then the final impact is that indicated by the Unpalatable (class 6) species i.e. 'No impact OR Low OR Medium'.

Other plants

Browsing category (%)	***Impact level*** ***Moderately palatable species***	***Slightly palatable species*** ***Grazing all year***	***Grazing only in autumn /winter***
>90	Very High	Very High	Very High
75-90	Very High	Very High	Very High
25-75	High	Very High	Very High
<25	Medium	High	High OR Very High
0	No impact OR Low	No Impact OR Low OR Medium	No Impact OR Low OR Medium OR High

1. If the impact level indicated by the Slightly palatable species (Grazing only in autumn /winter) is 'High OR Very High', the final impact level is that indicated by the Moderately palatable species UNLESS:
2. the impact level indicated by the Moderately palatable species is Medium, in which case the final impact level is the lowest of those indicated by the Slightly palatable species i.e. High.
3. If no browsing has been recorded on any species, the final impact level is that indicated by the Moderately palatable species i.e. 'No impact OR Low' UNLESS:
4. Only Slightly palatable specie are present in which case the final impact level is 'No impact OR Low OR Medium' if grazing is all year and 'No impact OR Low OR Medium OR High' if grazing is in autumn /winter only.

Recording forms and information tables

This section contains the three blank forms that are needed to record observations and impact levels. These can be tailored to individual site requirements. There are also tables that list the information to be recorded, provide the rules needed to convert observations to impact levels and provide links to photos of different impacts, and browsing /grazing rates, on indicators.

Field sheet (next page).

Site:	Stop no.:	Grid ref:	Date:	Surveyor:

Indicator	Impact	Observations
Ground disturbance 0, <5, 5-15, 15-30, >30 %		
Bark stripping, fraying 0, <5, 5-20,20-50,>50 % **& stem breakage** 0, <5, 5-10, 10-20, >20 %		
Basal shoots 0, <25, 25-75, 75-90, >90 %		
Epicormic and lower shoots 0, <25, 25-75, 75-90, >90 %		
Seedlings and saplings 0, <25, 25-75, 75-90, >90 %		
Preferentially browsed or grazed plants 0, <25, 25-75, 75-90, >90 (just tips), >90 (more than tips) %		
Other plants 0, <25, 25-75, 75-90, >90 %		
Herbivore species /signs		
Notes		

Table 1. Field recording 'aide memoire'.

General:	Record examples of indicators in each category as: **exact number up to 9, 10-20, 20-50, 50-100, >100** Browsing on **trees**: **Percentage of a tree's current year's shoot biomass** browsed Grazing /browsing on non-tree plants: **Percentage of the total number of a plant's shoots or leaves** grazed /browsed		
	Definition:	**Record:**	**Not Applicable if:**
Ground disturbance	Ground 'poached' by trampling or rooting. Pathways Wallows Scrapes	Percentage of ground disturbed by large herbivores (**0, <5, 5-15, 15-30, >30 %**) No. of wallows, scrapes No. of pathways (unvegetated, partially vegetated or totally vegetated)	The ground is composed of rock, boulders or scree that cannot show signs of disturbance by large herbivores.
Bark stripping, fraying & stem breakage	***Bark stripping***: bark stripped from susceptible trees or fallen branches. Trees > 2 m tall, smooth barked ***Fraying***: bark removed by deer using antlers Trees 50-200 cm tall, < 5 cm dbh ***Stem breakage***: live stems broken by being pushed over by cattle or red deer Trees < 5 cm dbh	No. & % of susceptible trees bark stripped and frayed (**0, <5, 5-20, 20-50, >50 %**) No. & % of susceptible trees broken (**0, <5, 5-10, 10-20, >20 %**)	No trees present are susceptible to bark stripping fraying or stem breakage. All damage occurred prior to the time period of interest.
Basal shoots	Shoots growing from the base of intact or felled (by humans or beavers) tree trunks.	No. of trees of each species in each browsing category **(0, <25, 25-75, 75-90, >90 %**)	No trees present with basal shoots. It is unclear whether basal shoots have been browsed or have died and broken off. All shoots are inaccessible, or are too large in diameter, to be browsed.
Epicormic and lower shoots	Shoots growing from tree trunks, lower branches or fallen trees.	No. of trees of each species in each browsing category (**0, <25, 25-75, 75-90, >90 %**) Current year's shoots hard to find? Shoots browsed into woody growth?	No trees present with epicormic or lower shoots. All shoots are inaccessible to large herbivores.
Seedlings and saplings	Trees 5 – 200 cm tall Exclude unbrowsed shoots < 2 cm in length Exclude 'new' seedlings if assessing previous 12-month impact in summer.	No. of trees of each species in each browsing category (**0, <25, 25-75, 75-90, >90 %**) Shoots browsed into woody growth?	Seedlings and saplings are absent or are inaccessible to large herbivores.
Preferentially browsed or grazed plants	Plants listed as "***very palatable***" in Table 2.	No. of plants of each species in each grazing /browsing category (**0, <25, 25-75, 75-90, >90 just tips, >90 more than just tips %**)	Preferentially browsed or grazed plants, or parts of plants, are absent or are inaccessible to large herbivores.
Other plants	Plants listed as "***moderately***" or "***slightly***" palatable in Table 3. Also plant species not listed in Table 3 but that have been grazed.	No. of plants of each species in each grazing /browsing category (**0, <25, 25-75, 75-90, >90 %**)	'Other' plants, or parts of plants, are absent or are inaccessible to large herbivores.
Signs of herbivores	e.g. wool, hair, pellet groups, hoof prints, species-specific bite marks		
Notes	e.g. dominant plant species /vegetation type, browsing on seedlings < 5 cm tall, presence of indicators in inaccessible places. past impacts		

Table 2. Approximate maximum browsing /fraying height of large herbivore species[1,2]. Applies to animals not on their hind legs.

Large herbivore species	Max. browsing /bark stripping height (m)	Large herbivore species	Max. browsing /bark stripping height (m)	Max. fraying height (m)
Horses	2.5	Red deer	1.8	1.8
Cattle	2.0	Fallow deer	1.8	0.8
Sheep	1.5	Sika deer	1.8	1.6
Goats	1.5	Roe deer	1.1	0.5

[1] Mayle B (1999) Managing deer in the countryside. Practice Note 6. Forestry Commission. Edinburgh

[2] Hodge S, Pepper HW (1998) The prevention of mammal damage to trees in woodland. Practice Note 3. Forestry Commission. Edinburgh.

Table 3. Relative palatability of non-tree plant species[1].

Season	Very palatable	Moderately palatable	Slightly palatable
All year	Blaeberry, Bramble, Broom, Common Bent, Dog rose, **Great woodrush,** Honeysuckle, Ivy, Red Fescue	Bell heather, Bog myrtle, Cotoneaster, Hard fern, Heather (Ling), Sheep's fescue, Yorkshire fog	Cross-leaved heath, Gorse[2], Great woodrush, **Hard fern,** Mat grass, Purple moor-grass, Soft and Sharp-flowered rush, Tufted hair-grass[2]
Spring - Summer (in addition to those listed above)	Angelica, Male fern, *Buckler ferns,* Meadowsweet, Raspberry, Valerian	Devil's-bit scabious, *Great woodrush (especially flower shoots), Lemon-scented fern, Lady fern,* **Purple moor-grass, Soft and Sharp-flowered rush**	Bluebell, Buckler ferns, Lady fern, Lemon-scented fern, Primrose

[1] Normal font = all large herbivore species, except where also listed in bold or italics. **Bold = cattle only**, *italics = deer only*. More detailed information can be found here.

[2] At the beginning of the growing season (April, May), treat Tufted hair-grass and Gorse as Moderately Palatable.

Table 4. Relative palatability of different tree species[1].

Palatability class (Innate attraction of shoots to browsing animals)		
Palatable	**1 – Most palatable**	Aspen, Ash, Elder[2], Willow
	2	Elm, Hazel, Holly, Oak, Rowan
	3	Blackthorn, Douglas Fir, Gean, Hawthorn, Larches, Sycamore, Yew[3]
Unpalatable	**4**	Birch, Beech, Lodgepole Pine, Scots Pine
	5	Bird cherry, Juniper, Norway Spruce, Western Hemlock
	6 – Least palatable	Alder, Rhododendron, Sitka Spruce

[1] Based largely on observations by the authors, and others, supported by limited published information. Note that relative palatability can change with season and can differ, to some degree, between sites and between browsing species. More information can be found here.

[2] Elder is unpalatable to rabbits.

[3] Yew is palatable to deer but variably palatable (and can be toxic) to domestic stock.

Table 5. Current Herbivore Impact. **Current = within all, or part, of the preceding twelve months, depending on the time period of interest[1].**

Note. If palatable and unpalatable species are present and the impacts on both do not match the descriptions below, use the higher impact, whether on the palatable or unpalatable species. However, discount the highest impact palatability group if <5% of the total number of examples of the indicator are in this group.

Indicator	Not Applicable	Very High	High	Medium	Low	No impact
Ground disturbance Disturbance by large herbivores = poached ground, pathways, scrapes or wallows created within the time period of interest.	The ground is composed of bare rock, boulders or scree. N.B. plant litter is very quickly mineralised in moist, very rich woodlands and soil may be bare in spring. The lack of vegetation in these cases is not due to animal disturbance	>30% of ground showing signs of disturbance by large herbivores. And /or ***Deer and /or livestock***: pathways frequent wide, heavily used, and wholly unvegetated and /or, on wet, open ground, there may be kicked out clods of turf and *Sphagnum* as well as well-defined deer wallows. ***Livestock***: there may also be substantial areas of bare ground caused by poaching especially if the ground is wet. There may be heavier disturbance around feeding areas and pig shelters.	15-30% of ground showing signs of disturbance by large herbivores. And /or ***Deer and /or livestock***: pathways frequent and partially, or mostly, unvegetated. ***Livestoc***k: disturbance may be more widely distributed with some poached and /or unvegetated ground especially if the ground is wet. There may be heavier disturbance around feeding areas and pig shelters.	5-15% of ground showing signs of disturbance by large herbivores. And /or ***Deer and /or livestock***: pathways frequent but largely vegetated or pathways rare but unvegetated. ***Livestock***: There may be heavier disturbance around feeding areas and pig shelters.	<5% of ground showing signs of disturbance by large herbivores. And /or ***Deer and /or livestock***: pathways rare and almost completely vegetated.	No areas of ground showing signs of disturbance by large herbivores. And /or No recognisable pathways.
Bark stripping, fraying & stem breakage Bark stripping = removal of bark from older trees using teeth (all herbivore species except roe deer). Fraying = bark removal from saplings by deer rubbing their antlers on stems. [2]dbh = diameter at breast height (1.3 m above ground).	There are no trees susceptible to bark stripping or stem breakage or if all damage occurred prior to the time period of interest.	>50% of susceptible live stems, and recently fallen branches, showing recent bark stripping and /or fraying that may be severe. And /or >20% of live stems of saplings <5 cm dbh[2] snapped.	20-50% of susceptible live stems, and recently fallen branches, showing recent bark stripping and /or fraying. And /or 10-20% of live stems of saplings <5cm dbh[2] snapped.	5-20% of susceptible live stems, and recently fallen branches, showing signs of bark stripping and /or fraying. And /or 5-10% live stems of saplings <5 cm dbh[2] snapped.	<5% of susceptible live stems, and recently fallen branches, showing signs of bark stripping and /or fraying. And /or < 5% of live stems of saplings <5 cm dbh[2] snapped.	No recent bark stripping or fraying or stems snapped by large herbivores.

[1]The time period of interest depends on the objective of the assessment as well as on the time of year that the assessment is carried out. For example, if the assessment is to determine impacts solely over the summer e.g. from summer cattle grazing, and it is carried out at the end of the summer, only the impacts occurring during the previous summer months would be considered. If the assessment is to determine impacts over a whole year, then impacts occurring during the whole of the previous year would be considered. For end-of-summer assessments, this will mean looking at over-winter browsing on the previous summer growth (recommended only for experienced surveyors) as well as browsing on the current year's summer growth. If the assessment is being carried out at the end of winter, it would only be necessary, and possible, to look at browsing on the previous summer's growth.

***Table 5. Current Herbivore Impacts (continued)*. Current = within all, or part, of the preceding twelve months depending on the time period of interest.**

Note: if palatable and unpalatable species are present and the impacts on both do not match the descriptions below, use the higher impact, whether on the palatable or unpalatable species. However, discount the highest impact palatability group if <5% of the total number of examples of the indicator are in this group.

Indicator	Not Applicable	Very High	High	Medium	Low	No impact
Basal shoots Includes all accessible shoots sprouting from tree bases.	There are no trees with basal shoots or it is unclear whether shoots have been browsed or have died, and broken off, for other reasons e.g. frost, drought or lack of light (this may be an issue especially for birch). Shoots are inaccessible or are too large a diameter to be browsed.	***Palatable*** species >90% browsed. ***Unpalatable*** species 75-90% or >90% browsed. If shoots are browsed at >90%, all of the current year's growth may have been removed, possibly along with some of the previous year's growth.	***Palatable*** species generally 75-90% browsed; a few may be >90% browsed. ***Unpalatable*** species 25-75% browsed; a few may be 75-90% browsed.	***Palatable*** species generally 25-75% browsed; a few may be 75-90% browsed. ***Unpalatable*** species generally <25% browsed; a few may be 25-75% browsed.	***Palatable*** species generally <25% browsed; a few may be 25-75% browsed. ***Unpalatable*** species generally unbrowsed; a few may be <25% browsed.	***Palatable*** species unbrowsed. ***Unpalatable*** species unbrowsed.
Epicormic & lower shoots Includes all shoots growing from tree trunks (epicormic), lower branches or fallen trees that are within reach of herbivores. [3] If only unpalatable species are present, and browsing rates are 25-75% or 75-90%, record the impact as High – Very High.	There are no trees with epicormic or lower shoots or, if there are, they are not accessible to large herbivores.	***Palatable*** species >90% browsed. ***Unpalatable*** species[3] 25-75%, 75-90% or >90% browsed. If shoots are browsed at >90%, all of the current year's growth may have been removed, possibly along with some of the previous year's growth.	***Palatable*** species 75-90% browsed. ***Unpalatable*** species[2] 25-75% or 75-90% browsed.	***Palatable*** species 25-75% browsed. ***Unpalatable*** species unbrowsed or <25% browsed.	***Palatable*** species <25% browsed. ***Unpalatable*** species unbrowsed.	**Palatable** and **unpalatable** species unbrowsed.
Seedlings & saplings Trees 5 - 200 cm tall. Seedlings less than 5 cm tall are not included because these are often hidden by vegetation so are unreliable indicators. A note can be made of observations of browsing on seedlings < 5 cm tall. See Table 4 for palatability classes of trees.	Seedlings and saplings are absent or seedlings & saplings are inaccessible to large herbivores	***Palatable*** species, if present, >90% browsed. ***Unpalatable, class 4 or 5***: 75-90% or >90% browsed. ***Unpalatable, class 6*:** 25-75%, 75-90% or >90% browsed. If shoots are browsed at >90%, all of the current year's growth may have been removed, possibly along with some of the previous year's growth.	***Palatable*** species, if present, 75-90% browsed. ***Unpalatable, class 4 or 5***: 25-75% browsed. ***Unpalatable, class 6***: <25% browsed.	***Palatable*** species generally 25-75% browsed; a few may be 75-90% browsed. ***Unpalatable, class 4 or 5***: <25% browsed. ***Unpalatable, class 6***: unbrowsed.	P***alatable*** species generally <25% browsed; a few may be 25-75% browsed. ***Unpalatable***: all species unbrowsed.	All species unbrowsed.

***Table 5. Current Herbivore Impacts (continued*). Current = within all, or part, of the preceding twelve months, depending on the time period of interest.**

Note: if palatable and unpalatable species are present and the impacts on both do not match the descriptions, use the higher impact, whether on the palatable or unpalatable species. However, discount the highest impact palatability group if <5% of the total number of examples of the indicator are in this group.

Indicator	Not Applicable	Very High	High	Medium	Low	No impact
Preferentially browsed or grazed plants Vegetation other than trees; that are listed as "very palatable" in Table 3.	No accessible preferentially browsed /grazed plants, or parts of plants, can be found.	>90% browsed /grazed. More than just the tips of shoots or leaves have been browsed /grazed.	Either 75-90% browsed /grazed or >90% browsed /grazed but the latter with only the tips of shoots or leaves removed.	Generally 25-75% browsed /grazed. Some of the most palatable species may be >75% browsed /grazed while others are unbrowsed /ungrazed e.g. bramble browsed but blaeberry unbrowsed.	Generally <25% browsed /grazed but there may be some shoots or individual species that are 25-75% browsed /grazed or are unbrowsed /ungrazed.	No browsing /grazing on shoots /leaves.
Other plants Vegetation, other than trees, that are listed as "moderately" or "slightly" palatable in Table 3. Assume plant species not listed in Table 3 are in the "slightly palatable" category if they have been grazed.	No accessible 'other' plants, or parts of plants, can be found.	***Moderately palatable*** species 75-90% or >90% browsed /grazed. ***Slightly palatable*** species 25-75%, 75-90% or >90% browsed /grazed. If grazing limited to autumn /winter, slightly palatable species may be <25% browsed /grazed.	***Moderately palatable*** species 25-75% browsed /grazed. ***Slightly palatable*** species <25% browsed /grazed. If grazing is limited to autumn /winter, slightly palatable species may be unbrowsed /ungrazed.	***Moderately palatable*** species <25% browsed /grazed. ***Slightly palatable*** species unbrowsed /ungrazed.	***Moderately and slightly palatable*** species unbrowsed /ungrazed.	***Moderately and slightly palatable*** species unbrowsed /ungrazed.

Summary results tables

	Impact level at each stop									
Indicator	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ground disturbance										
Bark stripping and stem breakage										
Basal shoots										
Epicormic and lower shoots										
Seedlings and saplings										
Preferentially browsed or grazed plants										
Other plants										

	Number of stops at each Impact level									
Indicator	**NI**	**NI-L**	**L**	**L-M**	**M**	**M-H**	**H**	**H-VH**	**VH**	**Overall impact**
Ground disturbance										
Bark stripping and stem breakage										
Basal shoots										
Epicormic and lower shoots										
Seedlings and saplings										
Preferentially browsed or grazed plants										
Other plants										

Table 6. Links to current herbivore impact photos. Once you have followed the link, click on individual photos for more information about the photo.

Impact Type	Impact Level	Link
Ground Disturbance	Low	https://goo.gl/photos/BTRDEJVjptPDwcGu5
	Medium	No photos yet.
	High	https://goo.gl/photos/xv931wuyzy5yyU787
	Very High	https://goo.gl/photos/Tq3PWfns96Xhcimf9
Bark stripping	Low	https://photos.app.goo.gl/K7uKmrRtRRYZiQqH3
	Medium	No photos yet.
	High	https://photos.app.goo.gl/Ktco3QAtHgM5HaYf2
	Very High	https://photos.app.goo.gl/4uuJHwPT7R6SLFUO2
	Not Applicable	https://photos.app.goo.gl/ynkorMpXKjtBEZH92
Basal shoots	No Impact	https://goo.gl/photos/8PyrcPqpB7s4UgVu7
	Low	https://goo.gl/photos/4VFGvHqPNgrZGe68A
	Medium	https://goo.gl/photos/dvTxuHnKqScan85G6
	High	https://goo.gl/photos/rFDZ1w9GvpNaqTwQ8
	Very High	https://goo.gl/photos/w2KJ5i6TfcHienev6
	Not Applicable	https://goo.gl/photos/X5Hj6sAvMZ7F35m5A
Epicormic and Lower shoots	No Impact	https://goo.gl/photos/MEfujp1HebExJgsZ7
	Low	https://goo.gl/photos/RfMvELTrwM4JPYS18
	Medium	https://goo.gl/photos/atSAHqaUVygkZoEE7
	High	https://goo.gl/photos/e49WqKTHBB4a19zr9
	Very High	https://goo.gl/photos/SujPofNUnHevvbQ49
Seedlings and saplings	No Impact	https://goo.gl/photos/8oYC3JxDKwzjr9hM8
	Low	https://goo.gl/photos/PDV5tVJQDJhp1y4e7
	Medium	https://goo.gl/photos/g2f3K3soyVfagNTs8
	High	https://goo.gl/photos/gfrLbHfw4wXd6L8y7
	Very High	https://goo.gl/photos/9vdAxpUYSfqzXZ5CA
Preferentially browsed plants	No Impact	https://goo.gl/photos/37HCp8ic8zWvfMnG6
	Low	https://goo.gl/photos/GbZWQpMSCnBromhv8
	Medium	https://goo.gl/photos/pGAQ8n3BVEja3HNaA
	High	https://goo.gl/photos/GATqfGeuwi4YBK5M9
	Very High	https://goo.gl/photos/WBRp4E3PohqVSxSa9
	Not Applicable	https://goo.gl/photos/pqrnwL75pkL44kNh8
Other plants	No Impact	https://goo.gl/photos/Akd5dkrM3CXc4smE6
	Low	https://goo.gl/photos/DJ2ZKsHzYPMEfBYz7
	Medium	No photos yet.
	High	https://goo.gl/photos/YcVXKmYgriDkjL7z7
	Very High	https://goo.gl/photos/GNdqtCC8KAnFTRWe8
	Not Applicable	https://photos.app.goo.gl/wJrMncVIv9vHjuEn2

Table 7. Implications of current impact level on established woodland (structure types 5-10)[1] if maintained over the long term[2].

	Very High	High	Medium	Low	No Impact
Bark stripping, stem breakage and ground disturbance	This level of ground disturbance will result in a severely reduced cover of ground flora with consequently low populations of invertebrate, bird and mammal species that require ground cover. Some mature trees of species susceptible to bark stripping are likely to die. Height growth of a high proportion of saplings will be reduced if stem breakage is high.	This level of ground disturbance will result in a reduced cover of ground flora with consequent reductions in populations of invertebrate, bird and mammal species that require ground cover. Some mature trees of species susceptible to bark stripping may die. Height growth of a considerable proportion of saplings will be reduced if stem breakage is high.	Ground disturbance will create significant regeneration niches for tree, shrub and ground flora species. This may result in increased plant species diversity, especially of less palatable species. There may be an occasional tree that dies due to bark stripping or stem breakage. In general, height growth of saplings will not be hindered by stem breakage.	The small amount of ground disturbance may provide regeneration niches for tree, shrub and ground flora species which may result in increased plant species diversity. There will be no tree mortality due to bark stripping or stem breakage. Height growth of saplings will not be hindered by stem breakage.	With no ground disturbance, it is possible that, particularly in woodlands on nutrient rich sites, the ground vegetation cover will be complete and there will be few regeneration niches. This may result in reduced plant species diversity. Seedlings of some tree species will be able to establish within closed vegetation if it is not too tall and dense. There will be no tree mortality due to bark stripping or stem breakage. Height growth of saplings will not be hindered by stem breakage.

[1] See Table A1.

[2] Some impacts will take several years to become apparent, others may take several decades.

Table 7. Implications of current impact level on established woodland (structure types 5-10) if maintained over the long term (continued). Note that if grazing is largely in winter, vernal plants will be little affected.

	Very High	High	Medium	Low	No Impact
Basal and epicormic shoots, seedlings and saplings, preferentially grazed plants and other plants	No shoots of any tree or shrub species, that are within browsing height, will be able to grow. Trees dying though natural senescence or disease cannot therefore regenerate from basal or epicormic shoots. No seedlings will be present and saplings will only survive browsing if the leading shoot is above browsing height. There will therefore usually be a complete lack of trees and shrubs below browsing height. There may be occasional old, 'topiaried' seedlings present. Preferentially grazed plants are likely not to be present or, if present, are likely to be confined to places inaccessible to large herbivores. Very little, if any, flowering or seeding of any plant species will be taking place. Invertebrate, bird and mammal diversity will be, consequently, low.	Very few, if any, shoots of palatable tree and shrub species, that are within browsing height, will be able to grow even where there is sufficient light reaching them. The number of shoots of unpalatable species that are able to grow will be limited. Seedlings and saplings of palatable tree species will be absent generally although there may be some seedlings present during their first growing season (none will survive winter browsing). Seedlings of unpalatable tree species are likely to be present and there may be a few unpalatable saplings. Preferentially grazed plant species will be either confined to places inaccessible to herbivores or will be low-growing and will not flower or set seed. Plant species that are not preferentially grazed are likely to dominate the sward but even they will have reduced flowering and seed set. This will adversely affect invertebrate, bird and mammal populations.	Where sufficient light reaches them, basal and epicormic shoots of unpalatable tree and shrub species will be long and growing well. Those of palatable species will generally be shorter. Seedlings and saplings of unpalatable tree species will be growing well whereas browsing will be preventing height growth of many seedlings of palatable species and, as a result, there will be few saplings of these species. Growth, spread, flowering and seeding of preferentially grazed plant species will be restricted by grazing. Less preferentially grazed plant species will be able to grow to their full height and ground cover and to achieve their full flowering and seeding potential. The lack of plant diversity may adversely affect some invertebrate, bird and mammal species but the relatively high cover and height of the field /ground layer, and the presence of some flowers and seeds, albeit of a limited number of species, may be beneficial for others.	Where sufficient light reaches them, basal and epicormic shoots of all tree and shrub species capable of producing these will be generally long and growing well. There will, however, be some basal and epicormic shoots of palatable tree and shrub species whose growth is reduced by browsing. Seedlings and saplings of all tree species will be growing well and generally achieving a height above browsing level. The abundance of established saplings of more palatable species will, however, be reduced by browsing. Growth, spread, flowering and seeding of preferentially grazed plant species will be slightly restricted. This may lead to some areas of shorter vegetation as well as to some suppression of long runners of species such as bramble and raspberry that might otherwise come to dominate. This will provide structural diversity that will, in turn, lead to a diversity of both plant and animal species. Less preferentially grazed plant species will be able to grow to their full height and ground cover and to achieve their full flowering and seeding potential. The high structural and plant species diversity will benefit many species of invertebrate, bird and mammal although there will be some that will not benefit from the relatively dense understorey.	Where sufficient light reaches them, basal and epicormic shoots will be long and growing well, as will seedlings and saplings. In the long term the woodland is likely to have a high density of trees and shrubs and a largely closed canopy. Seedlings of light-demanding species are unlikely to reach the sapling stage unless they are growing under a canopy gap. Even under a light canopy, birch seedlings will rarely reach sapling stage. Shade-tolerant species, such as holly, may come to dominate the shrub layer. On more nutrient-rich sites a dense under-storey of bramble or raspberry is likely to develop. Honeysuckle and ivy are likely to become abundant. On nutrient poor sites "stands" of tall hard fern, great woodrush or blaeberry are likely to develop with tall heather in canopy gaps.

Table 7. Implications of current impact level on established woodland (structure types 5-10) if maintained over the long term (continued).

	Very High	High	Medium	Low	No Impact
Overall	There will be no tree or shrub regeneration either from seed or from shoots. The ground flora will be of low species diversity, with no preferentially grazed plant species present and no, or very little, flowering or seed setting. The woodland will be very open with no shrub layer, no climbing plant species and a very short, moss /unpalatable grass-dominated or missing, field /ground layer. Even species, such as lichens that live on the bark of mature trees in open woodland, will not flourish in the long term due to the gradual death of mature trees and a lack of replacements. Food and habitat for invertebrates, birds and small mammals will be very limited. Deadwood invertebrates will benefit from the large volumes of deadwood present as the woodland senesces but the woodland, and the deadwood, will not persist in the long term.	There will be very little, if any, successful regeneration of palatable tree and shrub species, either from seed or from shoots, and little regeneration of unpalatable tree and shrub species. The ground flora will be of low species diversity with few preferentially grazed plant species present. There will be little flowering and seed setting. The woodland will be open with a short ground layer, a very sparse, if any, shrub layer, no climbing plant species and a short field /ground layer dominated by a few plant species. Food and habitat for invertebrates, birds and small mammals will be limited. The woodland, if it persists at all in the long term, will lose its palatable tree and shrub component.	There will be little successful regeneration of palatable tree and shrub species. Unpalatable tree and shrub species will be regenerating well, given suitable light conditions. The ground flora will be of moderate species diversity with some preferentially grazed species present but in low abundance and producing very few, if any, flowers or seeds. There may be abundant flowering and seed setting of plant species that are not preferentially grazed. There will be few, if any, climbing plants. Food and habitat for invertebrates, birds and small mammals will be favourable for those species able to use the moderately open and diverse woodland structure and limited range of tree, shrub and ground flora species. It will be unfavourable for species that require very open woodland or very abundant glades. In the long term the woodland will lose its palatable tree and shrub component.	All species of tree and shrub with seed sources will be successfully regenerating given suitable light conditions although the abundance of young trees of more palatable species may be lower than if there were no browsing. The ground flora will be of high species diversity and all species will be able to flower and set seed to some degree. Climbing plants will be abundant. The diverse structure, frequently higher plant species diversity, and greater flowering and seeding, will provide food and habitat for many species of invertebrate, bird and mammal but will be unfavourable for those species that require open woodland and /or abundant glades. In the long term the woodland is likely to remain in a similar condition.	All species of tree and shrub will be regenerating well given suitable light conditions. A closed canopy and dense understorey of young and small trees, shrubs and tall ground vegetation may, however, limit the amount of light reaching the ground layer leading to much reduced regeneration of light-demanding tree and shrub species. However, unless the canopy is very dense, in most cases all life stages of trees and shrubs of all species for which there is a seed source will, in time, be present. The ground flora may be of high species diversity although its diversity may be limited by a lack of light and /or regeneration niches e.g. where there is a dense understorey of holly. Field /ground layer plants present will not be prevented by herbivory from flowering and setting seed and climbing plant species are likely to be abundant. The diverse structure and, where there is sufficient light, high plant species diversity and abundant flowering and seeding, will provide food and habitat for many species of invertebrate, bird and mammal but will be unfavourable for those species that require open woodland and /or glades. In the long term the woodland may lose more light-demanding tree, shrub and field /ground layer plant species as well as bark living lichens. This, together with the loss of open woodland and glades may result in some invertebrate, bird and /or mammal species being much reduced in number or completely lost.

Table 7. Implications of current impact level on established woodland (structure types 5-10) if maintained over the long term (continued).

	Very High	**High**	**Medium**	**Low**	**No Impact**
Condition summary	*Overall structural and vascular plant species diversity*: **Very Poor**. *Species that need open woodland or deadwood*: **Good** until adult trees die and rot away, thereafter **Very Poor**.	*Overall structural and vascular plant species diversity*: **Poor**. *Species that need open woodland*: **Good** until adult trees die /rot, thereafter **Poor** unless palatable tree species are also required in which case **Very Poor**. *Species that need deadwood*: **Good** until adult trees die and rot away, thereafter **Very Poor**.	*Overall structural and vascular plant species diversity*: **Fair**. *Species that need open woodland /glades:* **Fair** unless palatable tree or shrub species are also required, in which case, when mature trees die, **Poor**. *Species that need deadwood*: **Good**	*Overall structural and vascular plant species diversity*: **Good** *Species that need open woodland /glades*: **Poor or Fair** *Species that need deadwood*: **Good**	*Overall structural diversity*: **Fair** *Vascular plant species diversity*: Where little light reaches the woodland floor: **Poor** Where abundant light reaches the woodland floor **Good** *Species that need open woodland /glades*: **Very Poor** *Species that need deadwood*: **Good**

Table 8. Relative resilience of different species of seedling /sapling to browsing. Resilience is the ability of seedlings /saplings to survive being browsed and continue to grow. 1 = most resilient, 4 = lest resilient.

Resilience class	Species
1	Alder, Birch, Bird cherry, Eared Willow, Hawthorn
2	Blackthorn, Holly, Juniper,
3	Ash, Elm, Hazel, Oak, Rowan, Sycamore
4	Scots pine and non-native conifers

Worked example

The example used here is fictional, although elements have been taken from real examples. The results in the worked example have been chosen to illustrate a range of different scenarios for converting results to impact levels. In most cases, the conversion of results to impact levels will be more straightforward than that illustrated here.

Pre-planning

In this example, the location of stops was decided before going into the field. The site was divided into two assessment areas since it was thought that there may be differences in herbivore impact between the two sides of the river. Ten stops were located approximately evenly within the area to the west of the river (Figure 3a). In the smaller area, to the east of the river, it was decided that five stops would likely be sufficient (Figure 3a). The stop locations were plotted using GIS with both Open Street Map and a Bing satellite image backdrops (Figures 3a and b respectively). The maps provided a means of checking that the stops were located evenly throughout the assessment areas. The satellite image was useful in ensuring that, as well as the wooded areas, any open areas were also sampled since open areas may provide different indicators.

Summing results for a stop

Figure 4a shows the completed field sheet for stop number 3 in the assessment area to the west of the river. Where nine, or fewer, examples of any single indicator were recorded using the gate tally system, the total number of examples has been written on the sheet next to the tally and circled (Figure 4b). Where the number of examples seen has been recorded as a range, the mid-point of the range has been taken as the best estimate of the number of examples and has been circled (Figure 4b). For example, the number of observations of holly seedlings and saplings that were <25% browsed was in the range 10-20. The mid-point of this range (15) was written next to the result and circled. Similarly, the number of ungrazed buckler ferns seen was in the range 20-50. The mid-point of this range (35) was also written next to the result and circled. The total number of palatable and unpalatable examples in each browsing category has then been calculated for basal shoots and for epicormic and lower shoots and the results written on the field sheet (Figure 4b). The same has then been done for 'palatable' and 'unpalatable category 4' examples of seedlings and saplings (no 'unpalatable category 5' tree species were found), for all preferentially grazed and browsed plants and for all 'slightly palatable' other plants (no 'moderately palatable' plant species were found; Figure 4b).

Converting summed results to impact levels for a stop

By comparing the summed results for each indicator with the descriptions of impact levels in Table 5, the summed results were then converted into an impact level for each indicator. The results were then written in the 'Impact' column on the field sheet (Figure 4b). The process of allocating an impact level to each indicator is detailed in Table 9.

Determining impact levels for each indicator for the assessment area

Table 10a shows impact levels for all indicators and all ten stops located in the assessment area to the west of the river (Figure 3a). The impact levels for three indicators at three stops were unusual compared to the results for these indicators at other stops (Table 10a). Checking the relevant field sheets revealed that there were very few examples recorded for two of these indicators at these stops. These results were therefore given less weight when assigning an overall impact level for these indicators to the assessment area. Table 10b provides a summary of the number of stops where each impact level was recorded. The impact level that best represented the spread of impact levels between stops was chosen and recorded in the table. Any stops where an indicator was not present (denoted by N/A in Table 10b) were excluded from this process. For most of the indicators, the most representative impact level was between two levels e.g. Medium to High.

Determining an overall impact level for the assessment area

In this case, only ground disturbance showed an impact level of Low or lower. The only large herbivore species present at the site was roe deer and, since roe deer do not generally cause much ground disturbance, this result is not incompatible with the results for the other indicators. The Medium impact level for bark stripping, fraying and stem breakage results solely from fraying since roe deer do not strip bark and rarely break stems. The remaining indicators showed results varying between Medium to High and Very High. Mapping of the results showed that there was no obvious spatial pattern to the distribution of impact levels (see Figure 5 for a map showing the impact levels recorded at each stop for basal shoots).

Comparing results with the target impact level

Since achieving regeneration of a wide range of tree species was the objective for this assessment area, the most important indicator was seedlings and saplings. The **target** impact level for seedlings and saplings was 'not higher than Low – Medium'. The **recorded** impact level for this indicator was Medium – High which was, therefore, higher than the target level. The result for seedlings and saplings was based on only seven stops since seedlings and saplings were not found at three stops. Further evidence that browsing levels in the assessment area were above the target level is, however, provided by the results for the other indicators all of which, apart from ground disturbance (which would not be expected to show a high impact from roe deer), were also higher than Low-Medium.

Frequency of assessments

Since the impact level in the assessment area was above the target level, it was decided to repeat the impact assessment the following year to see if impacts had fallen in response to an intended increase in roe deer control effort.

Figure 3a. Example of a site map with stop locations marked for two assessment areas. The red line marks the boundary of the site. Stops are evenly spread out across the site.

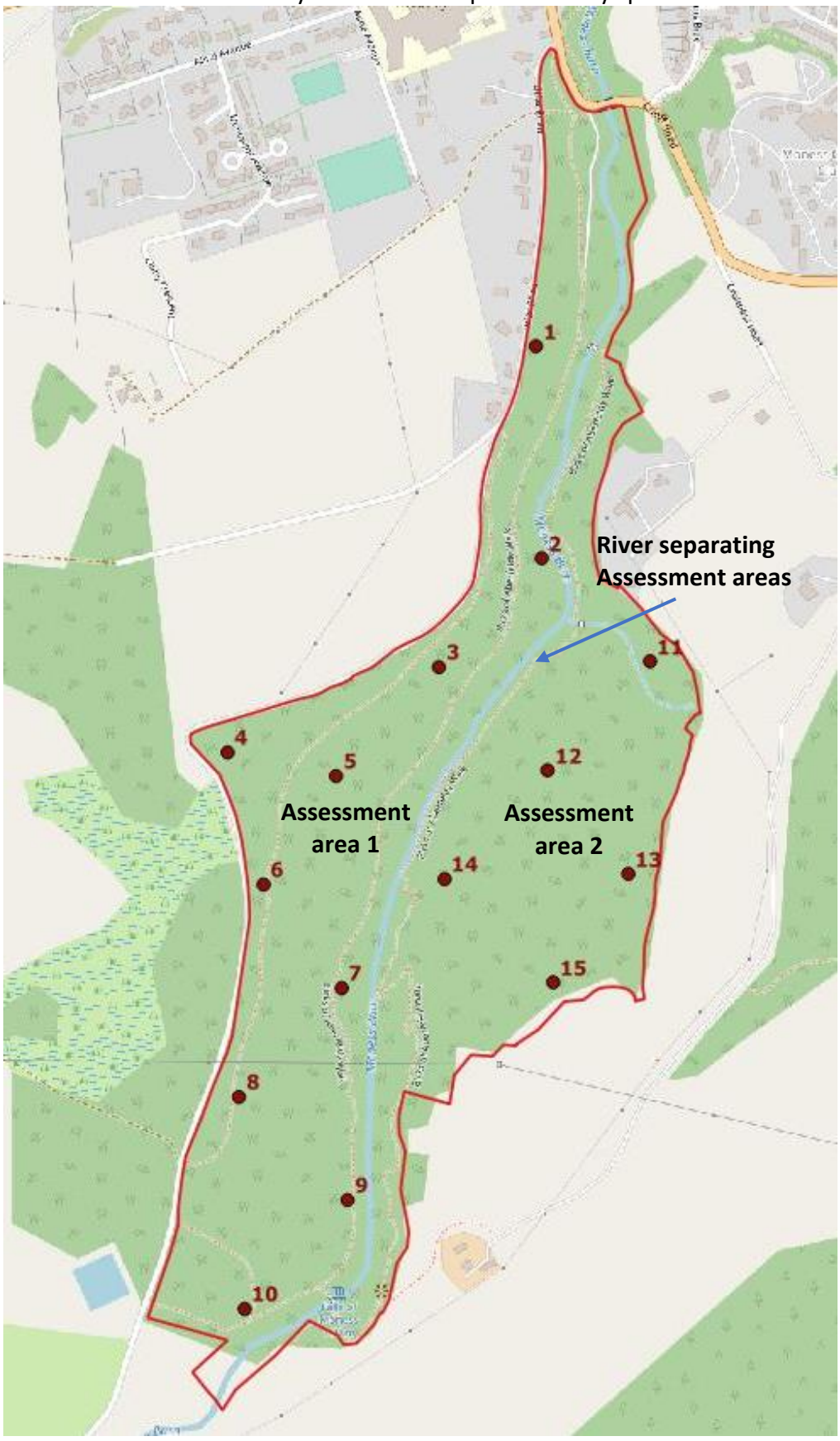


Figure 3b. Stops plotted against a satellite image backdrop.

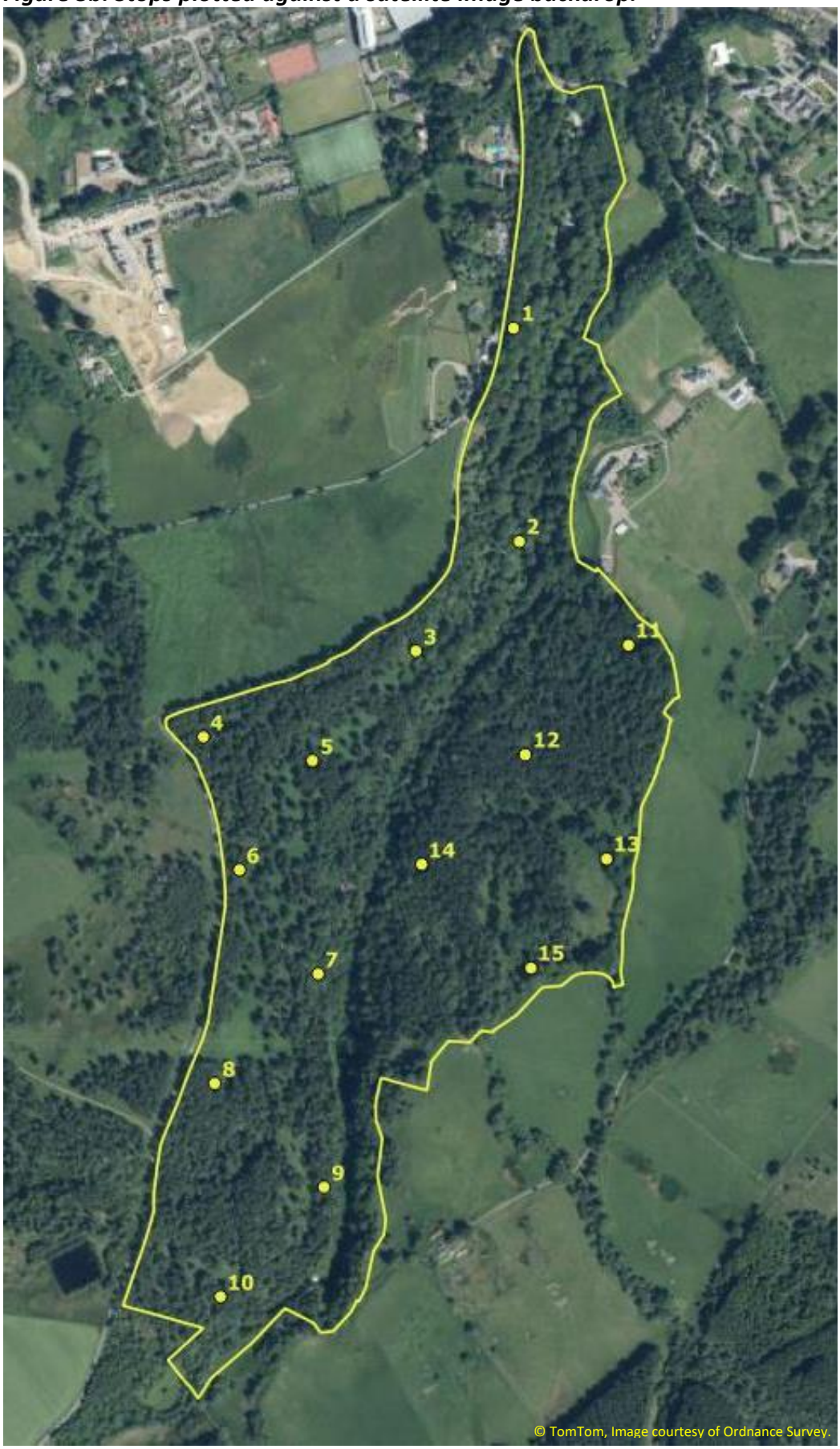


Figure 4a. Completed field sheet for the worked example.

Site: DEER WOOD (AREA 1)	Stop no.: 3	Grid ref: NH 600500	Date: 08/04/22	Surveyor: A. N. OTHER

Indicator	Impact	Observations
Ground disturbance 0, <5, 5-15, 15-30, >30 %		% DISTURBED: <5 · PATHS (VEG): 2 · PATHS (NO VEG): 0 · WALLOWS: 0 · SCRAPES: IIII 1
Bark stripping, fraying 0, 1, <20,20-50,>50 **& stem breakage** 0, <5, 5-10, 10-20, >20 %		BARK STRIPPING No. 0, % 0 · FRAYING No. 2, % <5 · STEM BREAKAGE No. 0, % 0
Basal shoots 0, <25, 25-75, 75-90, >90 %		SYCAMORE: <25 III, 75-90 1 · ROWAN: <25 1 · BIRCH: <25 1, 25-75 1
Epicormic and lower shoots 0, <25, 25-75, 75-90, >90 %		SYCAMORE: 25-75 II · HOLLY: <25 II, 25-75 II, 75-90 1 · BIRCH: 0 1 · BEECH: 75-90 1
Seedlings and saplings 0, <25, 25-75, 75-90, >90 %		HOLLY: 0 III, <25 10-20, 25-75 1, 75-90 1 · SYCAMORE: 0 1 · BIRCH: <25 1 · HAWTHORN: 75-90 1
Preferentially browsed or grazed plants 0, <25, 25-75, 75-90, >90 (just tips), >90 (more than tips) %		IVY: >90+ II · BRAMBLE: 0 1, 25-75 1, >90 TIPS 1, >90+ 1 · HONEYSUCKLE: >90 TIPS IIII IIII, >90+ 1 · BUCKLER FERN: 0 20-50, <25 1
Other plants 0, <25, 25-75, 75-90, >90 %		BLUEBELLS: <25 50-100
Herbivore species /signs	DEER HAIR, 2 ROE DEER PELLET GROUPS	
Notes	GROUND VEG: BRACKEN, BLUEBELLS, FERNS	

Figure 4b. Completed field sheet for the worked example, including result summaries and impact levels.

Site: DEER WOOD (AREA 1) | **Stop no.:** 3 | **Grid ref:** NH 600500 | **Date:** 08/04/22 | **Surveyor:** A. N. OTHER

Indicator	Impact	Observations
Ground disturbance 0, <5, 5-15, 15-30, >30 %	L	% DISTURBED: <5 PATHS (VEG): 2 PATHS (NO VEG): 0 WALLOWS: 0 SCRAPES: IIII I (6)
Bark stripping, fraying 0, 1, <20,20-50,>50 **& stem breakage** 0, <5, 5-10, 10-20, >20 %	L	BARK STRIPPING No. 0, % 0 FRAYING No. 2, % <5 STEM BREAKAGE No. 0, % 0
Basal shoots 0, <25, 25-75, 75-90, >90 %	M	SYCAMORE (P): <25 III (3), 75-90 I ROWAN (P): <25 I BIRCH (UP): <25 I, 25-75 I
Epicormic and lower shoots 0, <25, 25-75, 75-90, >90 %	M-H	SYCAMORE (P): 25-75 II (2) HOLLY (P): <25 II (2), 25-75 II (2), 75-90 I BIRCH (UP): 0 I BEECH (UP): 75-90 I
Seedlings and saplings 0, <25, 25-75, 75-90, >90 %	L	HOLLY (P): 0 III (3), <25 10-20 (15), 25-75 I, 75-90 I SYCAMORE (P): 0 I BIRCH (UP4): <25 I HAWTHORN (P): 75-90 I
Preferentially browsed or grazed plants 0, <25, 25-75, 75-90, >90 (just tips), >90 (more than tips) %	M	IVY: >90+ II (2) BRAMBLE: 0 I, 25-75 I, >90 TIPS I, >90+ I HONEYSUCKLE: >90 TIPS IIII IIII (10), >90+ I BUCKLER FERN: 0 20-50 (35), <25 I
Other plants 0, <25, 25-75, 75-90, >90 %	H	BLUEBELLS: <25 50-100 (75)
Herbivore species /signs		DEER HAIR, 2 ROE DEER PELLET GROUPS
Notes		GROUND VEG: BRACKEN, BLUEBELLS, FERNS

	P	UP
<25	4	1
25-75		1
75-90	1	

	P	UP
0		
<25	2	
25-75	4	
75-90	1	1

	P	UP4
0	4	
<25	15	1
25-75	1	
75-90	2	

TOTAL	
0	36
<25	1
25-75	1
>90 TIPS	11
>90+	4

Sp	
<25	75

Table 9. Conversion of worked example results to impact levels for each indicator. *P = Palatable, UP = Unpalatable, UP4 = Unpalatable, category 4. SP = Slightly palatable. >90 tips = >90% browsed but only the tips of leaves /shoots have been removed, >90+ = >90% browsed and more than just the tips of leaves /shoots have been removed.*

<table>
<tr><th>Indicator</th><th>Summary of observations</th><th colspan="2">Potential best fit impact level/s</th><th>Explanation of impact level</th><th>Impact level</th></tr>
<tr><td>Ground disturbance</td><td>Disturbed: <5%
Paths (vegetated): 2
Paths (unvegetated): 0
Wallows: 0
Scrapes: 6</td><td colspan="2">Low
<5% of ground showing signs of disturbance by large herbivores.
And /or
Deer and /or livestock: pathways rare and almost completely vegetated.</td><td>Although six scrapes were found, all other observations indicated a Low impact level.</td><td>Low</td></tr>
<tr><td>Bark stripping, fraying and stem breakage</td><td>Bark stripping No.:0, 0%
Fraying: No.: 2, <5%
Stem breakage: No.: 0, 0%</td><td colspan="2">Low
<5% of susceptible live stems showing signs of bark stripping and /or fraying.
And /or
< 5% of live stems of saplings <5 cm dbh snapped.</td><td>Two frayed trees were found but this represented only <5% of suitable trees for fraying so this fits the description of a Low impact level.</td><td>Low</td></tr>
<tr><td>Basal shoots</td><td>% Browsed | P | UP
<25 | 4 | 1
25-75 | | 1
75-90 | 1 |</td><td>Medium
Palatable species generally 25-75% browsed; a few may be 75-90% browsed.
Unpalatable species generally <25% browsed; a few may be 25-75% browsed</td><td>Low
Palatable species generally <25% browsed; a few may be 25-75% browsed.
Unpalatable species generally unbrowsed; a few may be <25% browsed.</td><td>The best description of the results for Palatable species is probably Low-Medium and for Unpalatable species is probably Medium. The rule is to go for the palatability class giving the highest impact unless <5% of all examples are in this palatability class. Since >5% of all examples (2/7=28%) are Unpalatable, the final impact level is Medium.</td><td>Medium</td></tr>
</table>

Table 9 Conversion of worked example results to impact levels for each indicator (continued). *P = Palatable, UP = Unpalatable, UP4 = Unpalatable, category 4. SP = Slightly palatable. >90 tips = >90% browsed but only the tips of leaves /shoots have been removed, >90+ = >90% browsed and more than just the tips of leaves /shoots have been removed.*

Indicator	Summary of observations			Potential best fit impact level/s		Explanation of impact level	Impact level
Epicormic and lower shoots	**% browsed**	**P**	**UP**	**Medium** *Palatable* species 25-75% browsed. *Unpalatable* species unbrowsed or <25% browsed.	**High** *Unpalatable* species 25-75% or 75-90% browsed.	Although some browsing rates for Palatable species were recorded both lower and higher than the 25-75% given in the description for a Medium impact level, on average the browsing rate is 25-75% so the Palatable species indicate a Medium impact level. The result for the Unpalatable species could indicate a Medium or a High impact level so the best description of the impact is Medium-High. The rule is to go for the palatability class giving the highest impact unless <5% of all examples are in this palatability class. Since >5% of all examples (2/9=22%) are Unpalatable, the final impact level is Medium-High.	**Medium-High**
	0		1				
	<25	2					
	25-75	4					
	75-90	1	1				
Seedlings and saplings	**% browsed**	**P**	**UP4**	**Medium** *Palatable* species generally 25-75% browsed; a few may be 75-90% browsed. *Unpalatable, class 4 or 5*: <25% browsed. *Unpalatable, class 6*: unbrowsed.	**Low** P*alatable* species generally <25% browsed; a few may be 25-75% browsed. *Unpalatable*: all species unbrowsed.	The results for the Palatable species show a wide range of impacts but with most being <25% browsed. This puts the impact level at Low. The one example of an Unpalatable species, however, points to a Medium impact. If the Unpalatable examples made up more than 5% of the total number of examples then we would take the higher impact i.e. Medium. Since, in this case, the Unpalatable examples made up <5% of the total number of examples, the final impact level is the one indicated by the Palatable species i.e. Low.	**Low**
	0	4					
	<25	15	1				
	25-75	1					
	75-90	2					

Table 9. Conversion of worked example results to impact levels for each indicator (continued). *P = Palatable, UP = Unpalatable, UP4 = Unpalatable, category 4. SP = Slightly palatable. >90 tips = >90% browsed but only the tips of leaves /shoots have been removed, >90+ = >90% browsed and more than just the tips of leaves /shoots have been removed.*

Indicator	Summary of observations		Potential best fit impact level/s	Explanation of impact level	Impact level
Preferentially browsed or grazed plants	**% browsed**	**Total no.**	**Medium** Generally 25-75% browsed /grazed. Some of the most palatable species may be >75% browsed /grazed while others are unbrowsed /ungrazed e.g. bramble browsed but blaeberry unbrowsed.	The browsing rates are very variable, ranging from 0 to >90+. Even though the description of a Medium impact is 'generally 25-75% browsed' and there is only one example of this browsing rate, 25-75% is a reasonable 'average' of the browsing rates. The Medium impact description also describes the wide spread of the results between browsing rates. The best fit impact level is therefore Medium.	**Medium**
	0	36			
	<25	1			
	25-75	1			
	>90 tips	11			
	>90+	4			
Other plants	**% browsed**	**SP**	**High** *Moderately palatable* species 25-75% browsed /grazed. *Slightly palatable* species <25% browsed /grazed. If grazing is limited to autumn /winter, slightly palatable species may be ungrazed.	Only one Slightly Palatable 'other plant' species was found at this site and all examples were <25% browsed. This fits well with the description of a High impact.	**High**
	<25	75			

Table 10a. Impact levels recorded at each stop for each indicator. NI = No impact, L = Low, M = Medium, H = High, VH = Very High, N/A = Not Applicable. Unusual results have been circled; a green background to the circle means that very few examples were recorded at this stop.

	Impact level at each stop									
Indicator	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ground disturbance	NI	L	L	NI	NI	NI	NI	NI	L	L
Bark stripping and stem breakage	M	H	(L)	M	H	M	M	M	M	M
Basal shoots	VH	H	M	M	VH	VH	VH	H	M	N/A
Epicormic and lower shoots	M	M	M-H	M	H	H	H	M	M	M
Seedlings and saplings	H	N/A	L	N/A	N/A	H	(VH)	L	M	M
Preferentially browsed or grazed plants	M	N/A	M	M	N/A	N/A	L	N/A	M	M
Other plants	H	H	H	H	N/A	H	M	(NI)	M	M

Table 10b. Number of stops where each impact level was recorded. Abbreviations and circles as for Table 10a. Shaded cells denote the overall impact level that best represents the spread of impact levels between stops. When making the assessment of overall impact, unusual results from stops where very few examples of the indicator were recorded (in green circles), were given less weight than were the other results.

	Number of stops at each Impact level										
Indicator	**N/A**	**NI**	**NI-L**	**L**	**L-M**	**M**	**M-H**	**H**	**H-VH**	**VH**	**Overall impact**
Ground disturbance		6		4							**NI-L**
Bark stripping and stem breakage				(1)		7		2			**M**
Basal shoots	1					3		2		4	**H-VH**
Epicormic and lower shoots						6	1	3			**M-H**
Seedlings and saplings	3			2		2		2		(1)	**M-H**
Preferentially browsed or grazed plants	4			1		5					**M**
Other plants	1	(1)				3		5			**M-H**

Figure 5. Map of the Impact level results for basal shoots for Assessment Area 1 of the worked example. Red = Very High, Orange = High, Yellow = Medium, Grey = Not Applicable.

Acknowledgements

We are grateful to:

- NatureScot, Scottish Forestry, and Forestry and Land Scotland (and their predecessor bodies) for funding the development of this method over many years.
- A number of people who have provided invaluable advice and assistance, including: Andy Acton, Mick Drury, Jeanette Hall, Nick Mainprize, Lindsay Mackinlay, Alan McDonnell, Meg Pollock, Mike Smith and Lucy Sumsion.
- The many other people who have tried the method in the field and provided us with invaluable feedback.

Appendix. Optional extras

Sometimes there is benefit in recording additional information along with the basic herbivore impact assessment. Some optional additions that you may find useful are given below. You will need to modify the basic field sheet and /or produce an additional field sheet, to record your results.

Woodland structure

Woodland structure reflects current and past impacts on the woodland, including those of large herbivores, and is a good indicator of current habitat condition. Table A1 provides definitions of the ten woodland and open ground structure classes used in the Woodland Grazing Toolbox. Structure classes 1 and 2 are open ground , classes 3 to 8 are woodland and classes 9 and 10 are wood pasture and parkland. These definitions can be used to determine the structure class of any area of woodland or open ground. Links to photos of each class can be found in Table A2. Historic herbivore impacts will, in many cases, have played a major role in determining current structure class.

Seedling and sapling density

To predict the future density of mature trees and shrubs, it can be useful to know the current density of seedlings and saplings. Use Table A3 to determine a density class (D, A, F, O or R) for seedlings and saplings of each tree and shrub species of interest at each stop. Note that the density values in the table are point values. Observed densities may therefore fall between the density classes given.

Assessing browsing impact on previous seasons' woody shoot growth

Noting any obvious browsing on previous seasons' growth can help to give a broader picture of impacts since, due to weather or other factors, impacts can vary between years even where there has been no change in numbers of herbivores using an area. Assessing browsing impact on growth in previous seasons can be done by careful observation of epicormic and lower shoots, basal shoots, seedlings and saplings and some of the more woody non-tree species. The previous season's shoots will be more woody than the current season's growth but it should still be possible to assess rates of browsing on these older, woody, shoots. Browsing impact can then be recorded separately for the current, previous, and possibly older, season's growth.

Historic herbivore impacts

Sometimes the browsing /grazing pressure has been high for so long that most of the indicators of current herbivore impacts have been eliminated. In this case, it may be informative to assess longer term impacts (over the last 10 years or more) using different indicators. Since these indicators include the presence, absence or condition of particular ground and shrub layer species, they differ between woodland types. You can assess historic herbivore impacts on five native woodland types using the information provided in Table A4.

Impacts on bracken

Cattle are sometimes used to reduce the density and rate of spread of bracken. When this is the case, it can be useful to assess both the current and historic impacts of the cattle on the bracken. The indicators described in Table A5 can be used to assess both current and historic (Tables A5 a and b respectively) impacts of cattle, and other large herbivores, on bracken growing on favourable sites i.e. fairly sheltered sites where soils are deep, reasonably fertile and dry to moist. For reasons other than disturbance by large herbivores, bracken on less favourable sites will have sparser stem density and height, sparser litter cover and a greater understorey cover of grasses, herbs, mosses and /or heath species. In the spring, areas of dense bracken on reasonably fertile soils may have a well-developed seasonal cover of bluebells or wood sorrel that becomes hard to detect at other times of year. Note that there is a distinction made in Table A5 between the most recent growth of bracken stems that have died and collapsed over winter and the ground cover of litter that is made up of several years' worth of dead bracken fronds.

Cover of dominant plant species

Sometimes the reason for changing the grazing regime is to achieve a change in the cover of a dominant plant species such as bracken, purple moor grass or bog myrtle. A simple means of recording the cover of these species at each stop is to use the categories 'sparse', 'open stand' and 'dense stand'. Alternatively, different categories could be used depending on objectives.

Table A1. Woodland Structure Classes.

See Table A2 for links to photos that illustrate the Woodland Structure Classes.

	Description
Class 1: Open ground, simple	Any open ground vegetation with a simple structure. May be open because of high herbivore impacts, because seed trees are absent or because the ground is very wet, very poor or rocky. Can include a deep field /shrub layer of unpalatable species e.g. bracken or rhododendron.
Class 2: Open ground, complex	Any open ground vegetation progressing towards woodland. Includes sparse tree regeneration and /or a low field layer that includes very palatable species e.g. bramble. This suggests a period of low herbivore impacts within the last decade.
Class 3: Dense regeneration on previously open ground	Clumped patches of tree and /or shrub regeneration up to 3 m in height. This suggests that herbivore impacts have been low or absent for several years.
Class 4: Young, dense woodland in the stem exclusion or early maturity stage	Young woodland with a closed canopy >3 m in height and too dense to allow new saplings to grow into it. Contains dead, suppressed stems and may contain small seedlings but normally these die due to a lack of light. This suggests that impacts over the last decade or more have been low or absent. Current herbivore impacts may vary.
Class 5: Mature woodland, understorey regeneration	Older woodland with small canopy gaps or where competition between canopy trees is minimal. The field layer is becoming well established. A dense understorey of e.g. long basal shoots and /or frequent, well-established saplings are present. This suggests a period of low herbivore impacts within the last decade.
Class 6: Mature woodland, no understorey regeneration	Older woodland with small canopy gaps or where competition between canopy trees is minimal. Mature trees with an understorey that is absent or not thriving and a short field layer, or a tall and dense field layer of unpalatable species such as bracken or purple moor-grass. Few or no woody species. This suggests medium to very high herbivore impacts over the last decade or more.
Class 7: Post-mature woodland, dead canopy trees, complex	Open canopy with senescent and dead canopy trees. The field layer is likely to be tall and dense e.g. rank blaeberry or bramble and /or tree seedlings. An understorey is present, including frequent, well established saplings and often pole stage trees in canopy gaps. This suggests a period of low herbivore impacts within the last decade.
Class 8: Post-mature woodland, dead canopy trees, simple	Open woodland with senescent and dead canopy trees, a very senescent or absent understorey and little, if any, woody growth in the field layer. This suggests high, or very high, herbivore impacts over the last decade or more and a declining woodland cover.
Class 9: Open canopy, open-grown trees, complex	Wood pasture. Scattered, open-grown trees that are mature or post-mature, with tree regeneration and a tall, dense field layer that includes palatable species. This suggests a period of low herbivore impacts within the last decade.
Class 10: Open canopy, open-grown trees, simple	Wood pasture. Scattered, open-grown trees that are mature or post-mature, with a short field layer or a tall, dense field layer of unpalatable species such as bracken or purple moor-grass. Little or no tree regeneration. This suggests several decades of high or very high herbivore impacts and the potential for long-term decline in the woodland component.

Table A2. Links to Woodland Structure Class photos.

Woodland Structure Class	Link
1	https://goo.gl/photos/67SN2roGDTWd9mk79
2	https://goo.gl/photos/hueQa917Tpad2CQQ9
3	https://goo.gl/photos/FXMk6rtyDohZULGr9
4	https://goo.gl/photos/i5edpExutHq8YMU66
5	https://goo.gl/photos/VLvTssisn8ZBBJGo7
6	https://goo.gl/photos/WbxGCx4NnnntKKyj8
7	https://goo.gl/photos/HWaQvWj9bPvRCTFm8
8	https://goo.gl/photos/4nkjTmieeRj3cQveA
9	https://goo.gl/photos/SumRTjX5WjJGUp649
10	https://goo.gl/photos/f7YNKWhLFQ3bCKty5

Table A3. Seedling and sapling density.

	Seedlings (<50 cm tall)[1]			Saplings (50 – 200 cm tall)		
Density Class	**Average space between trees (m)**	**Density (Number /ha)**	**Number in a 20 m radius plot**	**Average space between trees (m)**	**Density (Number /ha)**	**Number in a 20 m radius plot**
Dominant (D)	≤ 1	≥ 10,000	≥ 1,250	≤ 1.5	≥ 5,000	≥ 620
Abundant (A)	2	2,500	310	3	1,100	140
Frequent (F)	3	1,100	140	5	400	50
Occasional (O)	10	80	10	16	40	5
Rare (R)	20	25	3	35	8	1

[1] Do not include seedlings that have germinated in the most recent season since many, if not all, of these may disappear due to a wide range of factors, before they reach one-year-old

Table A4. Historic Herbivore Impacts **(Historic = over the last 10 or more years, except for canopy changes that relate to longer timescales)**				
Woodland Type	**Very High or High**	**Medium**	**Low**	**Absent for 20 years plus**
Acidic dry (relatively well-drained oak, birch and/or pine woodland on acid soils)	The canopy is open with mature, senescent and dead canopy trees and fallen, large diameter deadwood. There is no, or a very limited, understorey. Where broadleaves or juniper are present there is a very sparse understorey of young trees /shrubs of relatively unpalatable species such as birch and juniper with a very prominent browseline. A browseline is also obvious on epicormic shoots where these are abundant on canopy trees. Canopy trees of oak and birch have no noticeable basal shoots. When living, mature trees fall over, all side branches within reach of herbivores are heavily browsed. 'Phoenix'[1] trees therefore only result where a tree falls over that has a crown that is sufficiently large that the side branches are above browsing height when the tree falls. If no large crowned trees have been present, there will be no phoenix trees. The field layer is very short and is dominated by herbs and grasses such as tormentil, tufted hair-grass, sweet vernal-grass, common bent and /or bryophytes. Rocky areas are bare apart from bryophytes. Preferentially browsed species (predominantly dwarf shrubs and honeysuckle) are restricted to areas inaccessible to herbivores.	The canopy has frequent gaps. Where broadleaves or juniper are present there is a light understorey of young trees /shrubs of relatively unpalatable species such as birch and juniper with an indistinct browseline. Where epicormic shoots of canopy trees of oak and birch are present they are obvious below browsing height though shorter, and less numerous, than those above browsing height. These trees also have some short basal shoots. When living, mature trees fall over, side branches of the relatively unpalatable birch and pine that are below browsing height are not heavily browsed so 'phoenix'[1] trees can result. Other species are heavily browsed but some 'phoenix' trees may, nevertheless, result if the bole of the tree is above browse height. The field layer is short and there is a greater diversity of plant species than under high historic impacts. It includes a little blaeberry (and cowberry in pinewoods) and low-growing honeysuckle.	The canopy is full with few gaps. Understorey trees /shrubs are numerous and can include birch, rowan, holly, some hazel and juniper. Understorey trees have unbrowsed, low growing branches. Canopy trees of oak and birch have unbrowsed epicormic shoots below the browseline where these are present and have abundant basal shoots <1 m in length. When living, mature trees fall over, side branches of all species of tree that are below browsing height are lightly browsed, or unbrowsed, so 'phoenix'[1] trees can result. The field layer is dominated by dense and tall blaeberry and, where the canopy is more open, tall, spindly heather. In oak /birch woods, there can be frequent, but not abundant, honeysuckle and bramble (the latter typically limited to rocky areas).	The canopy is full with very few, if any, gaps. On very poor soils, tree regeneration is likely to be less dense resulting in a light underwood that includes the full suite of seed producing tree species present, including the most palatable e.g. rowan, very tall blaeberry and occasional, well-developed, climbing honeysuckle. On relatively good soils, especially where grazing levels were once high and the canopy was open, dense tree regeneration of the full suite of seed producing tree species present is likely to have occurred. Light levels are generally too low for epicormic or basal shoots to develop, however, where there is enough light, both are abundant and long. When living, mature trees fall over, side branches of all species of tree are unbrowsed so 'phoenix'[1] trees can result. Where there is dense tree regeneration, this reduces light levels at the woodland floor resulting in a field /ground layer vegetation of sparse blaeberry /cowberry and abundant bryophytes.

Table A4. Historic Herbivore Impacts (continued)	**(Historic = over the last 10 or more years, except for canopy changes that relate to longer timescales)**			
Woodland Type	**Very High or High**	**Medium**	**Low**	**Absent for 20 years plus**
Acidic wet (wet birch woodland)	The canopy is open with mature, senescent and dead canopy trees. Fallen large-diameter deadwood may be present but birch and willow rot quickly. There is no young tree /shrub understorey. Eared willows, where present, have sparse canopies that are heavily browsed below browsing heights When living, mature trees fall over, all side branches within reach of herbivores are heavily browsed. 'Phoenix'[1] trees therefore only result where a tree falls over that has a crown that is sufficiently large that the side branches are above browsing height when the tree falls. If no large crowned trees have been present, there will be no phoenix trees. Canopy birch trees have no basal shoots, or have shoots that are browsed down to the bole, no epicormic shoots below browsing height and a prominent browse line on the lower branches. The field layer is dominated by purple moor-grass that is grazed too heavily to be tussock forming. Similarly, trampling inhibits the development of Sphagnum moss mounds.	The canopy has frequent gaps. There is a sparse young tree /shrub understorey, largely of birch. Eared willows, where present, are moderately browsed below browsing height. Canopy birch trees have no basal shoots, or have shoots browsed down to the bole, no obvious epicormic shoots below browsing height and a prominent browse line on the lower branches. When living, mature trees fall over, side branches of the relatively unpalatable birch that are below browsing height, are not heavily browsed so 'phoenix'[1] trees can result. Other species are more heavily browsed but some 'phoenix' trees may, nevertheless, result if the bole of the tree is above browse height. Purple moor-grass is growing in well-defined clumps though not tussocky. Sphagnum moss shows signs of trampling damage.	The canopy is full with few gaps. Understorey trees /shrubs of birch and willow are frequent. Canopy birch trees have unbrowsed epicormic shoots below the browseline and have abundant basal shoots <1 m in length. Willows have moderately browsed lower branches however there is no obvious browseline. When living, mature trees fall over, side branches of the all species of tree that are below browsing height are not heavily browsed so 'phoenix'[1] trees can result. Purple moor-grass grows tall, dense and in obvious clumps with abundant leaf litter and may be tussocky. Well-developed cushions of, mainly Sphagnum, mosses.	The canopy is full with very few, if any, gaps. Understorey trees /shrubs of birch and willow are numerous and can form a dense understorey especially where previously the canopy has been open and grazing pressure high. Canopy birch trees have abundant basal shoots, although they are never long or thick. Willows can form thickets with branches down to ground level. When living, mature trees fall over, side branches of all species of tree are unbrowsed so 'phoenix'[1] trees can result. There are tall purple moor-grass tussocks and Sphagnum mounds. Drier communities contain occasional bramble, forming localised thickets with long runners, and frequent broad buckler ferns.

Table A4. Historic Herbivore Impacts (continued)	**(Historic = over the last 10 or more years, except for canopy changes that relate to longer timescales)**			
Woodland Type	**Very High or High**	**Medium**	**Low**	**Absent for 20 years plus**
Base Rich Dry (upland mixed ashwoods, Atlantic hazelwoods, lowland mixed broadleaved woodland)	The canopy is open with mature, senescent and dead canopy trees and fallen large-diameter deadwood. **T**here may be evidence of past heavy bark stripping. An understorey of hazel or bird cherry is absent or very sparse. Where present there is a prominent browseline. In Atlantic hazelwoods, single stemmed hazel trees survive but have very sparse crowns and no vegetative reproduction When living, mature trees fall over, all side branches within reach of herbivores are heavily browsed. 'Phoenix'[1] trees therefore only result where a tree falls over that has a crown that is sufficiently large that the side branches are above browsing height when the tree falls. If no large crowned trees have been present, there will be no phoenix trees. Boles of canopy trees often have basal swelling, (particularly ash) but no basal shoots. No epicormic shoots within browsing height are visible. Long-established small trees and saplings that have been 'topiaried' by browsing may be present. The field /ground layer is dominated by a rich, probably productive, grass sward, with more graze-sensitive species, such as meadowsweet, restricted to low vegetative growth. Where deer are abundant, buckler ferns are restricted to areas inaccessible to herbivores. There may be nettle patches where grazing animals lie up, e.g. under open grown tree canopies. Disturbed sites at the wetter end of this woodland type can have frequent to abundant, non-tussocky tufted hair-grass.	The canopy has frequent gaps. There is a thorny understorey (especially in lowland woods) of holly, bramble, blackthorn and hawthorn, with an indistinct browseline. Other, more palatable, species e.g. hazel, show a more obvious browseline. Basal shoots, and epicormic shoots within browsing height, of the more palatable tree species are short, and those of the less palatable species are long. When living, mature trees fall over, side branches of the relatively unpalatable tree species, such as bird cherry or birch, that are below browsing height are not heavily browsed so 'phoenix'[1] trees can result. Other species are heavily browsed but some 'phoenix' trees may, nevertheless, result if the bole of the tree is above browse height. The field layer includes buckler ferns and meadowsweet, all or many of which show signs of grazing. Where only deer present, great woodrush may be abundant with deep litter layers. Bramble is occasional to frequent but is browsed. Tufted hair-grass may be abundant but in tall, ungrazed tussocks. There is a diverse range of plant species, including dog's mercury, wood or water avens and occasional wood cranesbill but most of these are browsed to the height of the ground layer.	The canopy is full with few gaps. The shrub layer is dense and understorey trees are frequent with branches down to the ground. Basal shoots and epicormic shoots within browsing height, where they are present, are long. When living, mature trees fall over, side branches of tall species of tree that are below browsing height are not heavily browsed so 'phoenix'[1] trees can result. There is a tall herb and fern community (particularly buckler ferns and meadowsweet), well developed where there is sufficient light. Bramble may be abundant, forming a dense underscrub with honeysuckle.	The canopy is full with very few, if any, gaps. There is a complex woodland structure, even where there is a full canopy, with shade-tolerant tree and shrub species present. Hazel is capable of producing abundant basal shoots that grow into the canopy despite relatively low light levels. The absence of herbivores for 5 years or more causes death of large diameter single stemmed hazel and abundant regrowth of basal shoots. It is difficult to see far through the wood. Older hazel stems layer when they fall over, creating the impression that the trees are "walking" down slopes. Where there is an open canopy, palatable species such as ash and hazel have very large basal shoots (>5 cm diameter and exceeding 2 m in length). Epicormic shoots within browsing height, where they are present, are long. When living, mature trees fall over, side branches of all species of tree are unbrowsed so 'phoenix'[1] trees can result. Herbs, such as water avens or wood avens and meadowsweet, are still frequent despite the dense canopy. There are long, trailing runners of bramble that have developed into thickets in canopy gaps. In lowland woods there may be a ground cover of ivy.

Table A4. Historic Herbivore Impacts (continued)	**(Historic = over the last 10 or more years, except for canopy changes that relate to longer timescales)**			
Woodland Type	**Very High or High**	**Medium**	**Low**	**Absent for 20 years plus**
Neutral dry (oakwood, birchwood and lowland mixed broadleaved woodland)	The canopy is open with mature, senescent and dead canopy trees and fallen, large-diameter deadwood. There is no, or a very sparse, understorey. There is a very obvious browseline on any understorey as well as on any trees that have abundant epicormic shoots. When living, mature trees fall over, all side branches within reach of herbivores are heavily browsed. 'Phoenix'[1] trees therefore only result where a tree falls over that has a crown that is sufficiently large that the side branches are above browsing height when the tree falls. If no large crowned trees have been present, there will be no phoenix trees. Basal shoots are absent. There is a very species poor ground /field layer dominated by closely grazed grasses such as sweet vernal-grass, common bent, cocksfoot and *Holcus* species. It may be dominated by bracken. In some cases there may be no field layer. In the NVC sub-community W11b, primrose may be the only obvious herb as it is unpalatable. Preferentially grazed species are restricted to areas inaccessible to herbivores.	The canopy has frequent gaps. There is a sparse to moderately dense understorey with an obvious browseline. Basal shoots are present but short. When living, mature trees fall over, side branches of the relatively unpalatable tree species, such as birch, that are below browsing height are not heavily browsed so 'phoenix'[1] trees can result. Other species are heavily browsed but some 'phoenix' trees may, nevertheless, result if the bole of the tree is above browse height. The field layer may be dominated by bracken with abundant bluebell in the spring, otherwise a short, grassy sward or a sparse to moderate field layer depending on the herbivore species present i.e. where there are no deer, buckler ferns may be occasional to frequent and where there are no livestock, great woodrush may be frequent. Preferentially grazed species are present but largely restricted to areas inaccessible to herbivores.	The canopy is full with few gaps. There is a dense understorey of shade-tolerant tree species, e.g. hazel, rowan and holly, that have branches down to the ground. Basal shoots are present and long. When living, mature trees fall over, side branches of all species of tree that are below browsing height are not heavily browsed so 'phoenix'[1] trees can result. The field layer is tall and includes abundant ferns (typically broad buckler fern) and honeysuckle. It can be dominated by tall, dense great woodrush with deep litter layers. There are frequent preferentially browsed species including bramble, ivy and honeysuckle.	The canopy is full with very few, if any, gaps. There is a dense understorey of hazel, rowan or holly, that have branches down to the ground. Where canopy gaps do occur, they are occupied by saplings of more light-demanding tree species e.g. birch and oak, and a tall, dense field layer. Basal shoots are present and long. When living, mature trees fall over, side branches of all species of tree are unbrowsed so 'phoenix'[1] trees can result. There is a rich vernal field flora but a more limited field flora in summer /autumn due to low light levels at this time of year. Where holly is dominant in the understorey or canopy, the field layer will be very sparse due to constant heavy shade.

Table A4. Historic Herbivore Impacts (continued)	**(Historic = over the last 10 or more years, except for canopy changes that relate to longer timescales)**			
Woodland Type	**Very High or High**	**Medium**	**Low**	**Absent for 20 years plus**
Neutral to base rich wet (alder woodland. including slope alderwoods, and willow carr)	The canopy is open with mature, senescent and dead canopy trees but little fallen, large-diameter deadwood since it rots quickly. Woodland structure can range from topiaried stands of eared willow to open alder woodland. In the latter case, tree bases are often broad, with closely browsed basal shoots. Unpoached parts of drier communities have a short sward, dominated by grazed tufted hair-grass and rushes. Swards with repeated winter poaching contain thistles, dock and cocksfoot in the summer. When living, mature trees fall over, all side branches within reach of herbivores are heavily browsed. 'Phoenix'[1] trees therefore only result where a tree falls over that has a crown that is sufficiently large that the side branches are above browsing height when the tree falls. If there no large crowned trees been present, there will be no phoenix trees.	The canopy has frequent gaps. Alder basal shoots are long and unbrowsed and can form an understorey. Those of more palatable tree species are shorter and browsed. When living, mature trees fall over, side branches of the relatively unpalatable tree species, such as alder and birch, that are below browsing height, are not heavily browsed so 'phoenix'[1] trees can result. Other species are heavily browsed but some 'phoenix' trees may, nevertheless, result. Drier communities may have abundant, grazed broad buckler fern and male fern.	The canopy is full with few gaps. Alder, ash and /or sycamore saplings may be frequent as an understorey. Basal shoots of all tree species are present and long. When living, mature trees fall over, side branches of all species of tree, that are below browsing height, are not heavily browsed so 'phoenix'[1] trees can result. Where present, ferns and tall herbs will be well-developed. Opposite-leaved golden saxifrage may be widespread.	The canopy is full with very few, if any, gaps. A variable woodland structure. Impenetrable willow carr may be present. Basal shoots of all tree species are present and long. When living, mature trees fall over, side branches of all species of tree are unbrowsed so 'phoenix'[1] trees can result. A variable field layer, depending on light availability and the degree of wetness. Species may include angelica, opposite-leaved golden saxifrage, remote sedge, common valerian, iris, meadowsweet, marsh thistle and marsh hawksbeard. Patches of dense nettle may occur.

[1] **'phoenix'** trees are new, young trees that have developed from the side shoots or branches of fallen adult trees. This is a particularly important process for ensuring the continuation of woodland on steep slopes where mature trees are liable to fall over when they become too large to support their own weight. They are also important for continuity of habitat for lichens in heavily browsed sites that have large canopied trees that, when they fall over, produce side branches that are out of reach of herbivores.

Table A5a. Current Herbivore Impacts on Bracken[1] **(current = within the last 12 months)**				
Very High	**High**	**Medium**	**Low**	**Absent**
Frequent pathways and obvious poached ground. 30% or more of the bracken stand disturbed by large herbivores. In summer-growing bracken fronds will be broken and trampled and, in winter, the collapsed stems and litter will be disturbed. If wild boar or pigs are present there may be localised patches of much higher disturbance. If present, palatable climbers, (e.g. honeysuckle, bramble) and seedlings /saplings very heavily browsed.	Frequent pathways with some poached ground likely. 10-30% of the bracken stand disturbed by large herbivores. In summer growing bracken fronds will be broken and trampled and, in winter, the collapsed stems and litter will be disturbed. If wild boar or pigs are present there may be localised patches of much higher disturbance. If present, palatable climbers (e.g. honeysuckle, bramble) and seedlings /saplings heavily browsed.	Occasional pathways through otherwise intact bracken stands. No poached ground. <10% of the growing bracken fronds broken and trampled by large herbivores in summer. In winter, there may be little evidence of disturbance other than the pathways. If present, palatable climbers (e.g. honeysuckle, bramble) and seedlings /saplings moderately browsed.	Pathways through otherwise intact bracken stands rare or absent. If present, palatable climbers (e.g. honeysuckle, bramble) and seedlings /saplings occasionally browsed.	No large herbivore pathways. Intact bracken stands with no obvious signs of disturbance by herbivores. If present, palatable climbers (e.g. honeysuckle, bramble) and seedlings /saplings unbrowsed. Winter only: Trailing, unbrowsed stems of palatable climbers and procumbent saplings, if present, flattened by collapsed stems.

Table A5b. Historic Herbivore Impacts on Bracken[1] **(historic = over the last 10 or more years)**				
Very High	**High**	**Medium**	**Low**	**Absent**
No palatable climbers or tree saplings. Bracken cover <50%. Reduced bracken height.. Bracken litter sparse. Winter only: Collapsed bracken stems present over up to 60% of the ground	No palatable climbers or tree saplings. Bracken cover 50-80%. Reduced bracken height. Bracken litter sparse to moderately dense. Winter only: Collapsed bracken stems present over 60-80% of the ground.	No palatable climbers or tree saplings. Bracken cover 80-100%. Reduced bracken height. Bracken litter moderately dense. Winter only: Collapsed bracken stems present over >80% of the ground.	Occasional palatable climbers and tree saplings. Bracken cover 100%. Bracken attaining full potential height. Dense bracken litter. Winter only: Collapsed bracken stems present over >90% of the ground.	Abundant palatable climbers growing over the top of bracken stands and occasional established tree saplings on the edges of bracken stands. Bracken cover 100%. Bracken attaining full potential height. Dense bracken litter. Winter only: Collapsed bracken stems present over 90-100% of the ground.

[1] Applies only to sites that are favourable for bracken i.e. where soils are deep, reasonably fertile and dry to moist, since bracken on less favourable sites will have lower cover, stem density and height for reasons other than disturbance by cattle.