User guide

Hedgerow Biodiversity Protocol 2015

A protocol for monitoring the impacts of harvesting hedges for woodfuel

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Why use this protocol?

The introduction of coppice management for woodfuel production is likely to have both positive and negative impacts on the wildlife of individual hedges and on biodiversity at a landscape scale, but how do we quantify these impacts? This user guide outlines a protocol that can be carried out prior to implementing any new management regime that will assess the likely impacts on biodiversity from managing hedgerows for woodfuel and aid management decisions.

Restoring hedgerows and their functions

Hedgerows are dynamic, living landscape features which without management naturally develop into lines of trees. Efforts to stop this natural development through repeated flailing result in the decline of physical condition, biodiversity value, and eventually loss of the hedge. Equally, the under-management of hedges results in them becoming tall and leggy, losing their shrub layer and eventually they may collapse. A hedgerow that has reached either of these extremes will require rejuvenation through laying or coppicing; both processes yield biomass with the potential for use as woodfuel. Managing hedgerows for woodfuel can therefore provide a financial incentive to rejuvenate old hedges, restoring not only their economic function but their value to biodiversity.

Hedgerows and their related features provide a wide range of ecosystem services. Biodiversity in British hedgerows has been well studied with hedgerows having been found to offer multiple habitats, food sources, refuges, and ecological corridors for a diverse range of flora and fauna. Given their significance in supporting biodiversity and ecosystem services, if hedgerows are to be widely promoted as a source of woodfuel any potential biodiversity impacts need to be assessed.

Protocol objectives

The main objectives of the biodiversity protocol are to:

- Identify the current condition and value of a hedgerow network to biodiversity
- Identify and monitor the potential impacts of altering management
- Aid management decisions for both biodiversity and woodfuel production

How to use this guide

This step-by-step guide is designed to help you implement the protocol, providing recommendations and tips along the way. The guide should be used in conjunction with the **biodiversity protocol assessment tool** and accompanying **survey sheets and notes**. Copies of all of the protocol documents can also be found and downloaded from:

www.twecom.com

or

http://tinyurl/TWECOM

Step 1: Mapping your hedgerow network

Defining your hedgerow network

A hedgerow can be defined as “Any boundary line of trees or shrubs over 20m long and less than 5m wide between major woody stems at the base” (Defra, 2007).

Hedgerows often interconnect across the landscape forming a hedgerow network. To carry out the protocol you will need to define the hedgerow network you are interested in and where each individual hedgerow within that network stops and starts. For the purpose of this protocol the hedgerow network is simply all the hedgerows within an area of interest (e.g. all hedgerows on your farm). An individual hedgerow will be defined as ending where it connects to two or more other hedgerows or to other features such as walls, buildings or ditches; if there is a gap in the hedgerow over 20m; or where a hedgerow connects to a woodland or other semi-natural habitat such as a pond or woodland (Table 1).

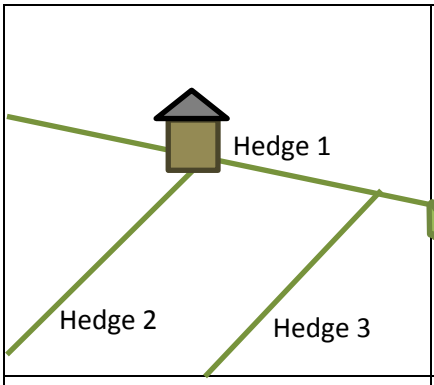
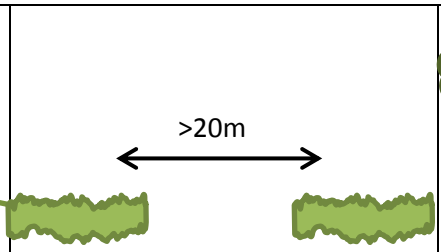
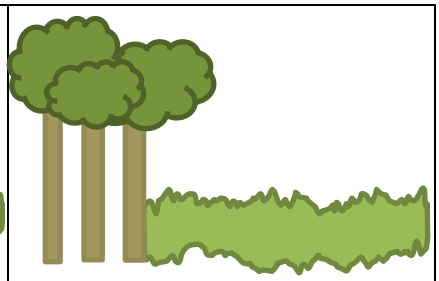
		
Connects to two or more hedges or to other features such as walls, buildings or ditches	If there is a gap in the hedgerow over 20m	Where a hedgerow connects to a woodland or other semi-natural habitat such as a pond

Table 1. Three features that are used to define the end point of an individual hedge

Mapping your hedges

Mapping the hedges on your farm will enable you to examine each hedge in the context of the wider landscape and hedge network. Aerial photographs and farm maps can be used to plot the extent of the hedgerow network. Farm maps from, for example, stewardship agreements or online mapping software (e.g. www.magic.gov.uk) can be used. Alternatively aerial photographs are available from the internet on websites such as Bing maps (www.bing.com/maps), Google Earth (www.earth.google.co.uk) or Google Maps (www.googlemaps.com).

Once you have a map of your area of interest, the next step is to identify and number each individual hedgerow within the network onto the map (Figure 1). This can be done by hand, using a computer

software program such as Microsoft Paint or Word, or through use of a Geographical Information System (GIS) such as Quantum GIS (www.qgis.com). When numbering your hedges it is recommended you use a sequential number system as shown in Figure 1. Other semi-natural features such as woodlands, copses and ponds can also be mapped. When labelling these features use the letter 'H' to identify that they are a semi-natural habitat, followed by a sequential number. For example, the three semi-natural habitats highlighted in Image 1 are labelled H1, H2, and H3.

The length of each hedge can also be measured at the stage using GIS software or an online mapping tool such as Google Maps.

Figure 1. Example of a hedgerow network map and numbering system

Downloading the protocol

The assessment tool is a Microsoft Excel based tool which is made up of a number of sheets for you to enter your data and view the results. The Excel file containing the tool can be downloaded from: **www.twecom.eu** or **http://tinyurl/TWECOM**

The assessment tool also contains the survey sheets for the hedge survey and additional surveys. You will therefore need to download and save the Excel file to your computer to print off the required survey sheets.

Step 2: Hedge survey

After mapping your hedges, walk the hedgerow network and carry out a baseline survey of all the hedges. This survey aims to identify which hedges are likely to support the most biodiversity, are potentially suitable for woodfuel production, and those in need of improved management.

When to survey

The hedge survey can be carried out from **April to October**, however June and July are ideal as many hedgerow shrubs and flowers will be easier to identify.

What to take

To carry out the survey you will need to print out enough copies of the hedge survey sheet for the number of hedges in your hedgerow network. The hedge survey sheet can be found within the biodiversity protocol assessment tool. The survey sheets are designed to make data collection in the field and transfer of data into the assessment tool easy (Step 4).

You will need the following items:

- Enough copies of the hedge survey sheet for the number of hedges in your hedgerow network
- A copy of your hedgerow network map (Step 1)
- Hedge survey notes (available form www.twecom.eu or http://tinyurl/TWECOM)
- Pencil or pen
- Field guide for tree identification
- Measuring tape or wheel (optional)
- Two meter long pole or stick for estimating hedge height and width (optional)
- Camera (optional)

Health and safety

All individuals carrying out this protocol have a responsibility for their own health and safety. Make sure you are aware of any potential hazards and their associated risks.

Top tips:

- Let someone know when and where you are going out and when you will return (let them know when you have returned)
- Work in pairs where possible
- Wear appropriate footwear and clothing for the terrain and weather
- Take a mobile phone with you, and water and sunblock as necessary
- Take a first aid kit including tweezers (for thorns)

How to carry out the survey

For each hedge on your map repeat the following survey method using the hedge survey sheet and hedge survey notes for further guidance.

1) Using the hedge survey sheet record the hedgerow reference number and the side of the hedgerow being surveyed.

2) Walk the entire length of the hedge in question, paying particular attention to its species composition, structural character and any associated features such as ditches and banks. Then estimate the length of the hedgerow by either counting paces of roughly 1 metre or using a measuring wheel. Record total hedgerow length. Alternatively, the length of each hedge can be measured beforehand using GIS software or an online mapping tool such as Google Maps.

3) Standing back from the hedgerow, complete all sections of hedge survey sheet (hedgerow characteristics, associated features, margins, management, and wildlife). There is additional space on the survey sheet for you to write notes, for example, what evidence of wildlife you can see and whether you already know of any species using the hedge.

4) The accompanying Hedge Survey Notes explain what to measure, the accuracy required and options for each question and should be printed off and used alongside the survey sheets.

Data collected from the hedge survey can then be entered into the hedge survey data entry sheet of the biodiversity protocol (Step 4).

Photographs

It may be helpful for your own records to take a photo of the hedgerow when surveying for future reference. Remember to make note of the photo number and associated hedge reference number.

Tree Identification

Recommended field guides to help identify woody species during completion of the hedge survey include:

- 'Collins Tree Guide' by Owen Johnson (2006)
- 'The Wild Flower Key: How to Identify Wild Flowers, Trees and Shrubs in Britain and Ireland' by Francis Rose (2006)
- 'Leaf identification swatch book' by The Woodland Trust

Smart phone apps such as Isoperla (www.isoperla.co.uk) and Leafsnap (www.leafsnap.com) are also available and can provide a quick and easy way of identifying hedge shrubs and trees.

Improving your map

Having walked and surveyed your hedgerow network in detail there may be changes you wish to make to your initial hedgerow network map such as dividing a hedge into two or altering the start and end point of certain hedges. Additional information such as hedges you believe to be of good biodiversity value, those with potential for woodfuel production or hedges you know certain protected species use, can also be displayed on your map (e.g. highlighted in a different colour).

Step 3: Additional surveys (optional)

Depending on time, resources and skills there are a number of additional surveys you may wish to carry out. These additional surveys provide a more direct measure of biodiversity value through recording birds, butterflies, bees, and ground flora. These surveys could be carried out on all of your hedges or on a subset of hedges such as those suspected to be of particular importance to wildlife, those earmarked for management, or a random selection for ongoing monitoring. Abundance-only surveys, where just the total number of birds, bees, butterflies or distinctly different plant types are recorded, can also be used if short of time or unsure of your identification skills. All additional survey sheets can be found within the biodiversity protocol assessment tool.

TOP TIP: Weather conditions can affect the accuracy of your survey results (birds, bees and butterflies are more likely to be flying on still sunny days) so it is advised not to survey in bad weather.

Bird survey

Hedgerows are one of the most important surviving semi-natural landscape features for birds. They provide nesting, foraging and roosting sites and provide cover and facilitate movement across the landscape. Birds can be used as bioindicators due to their ecology being well understood and the existence of links between bird community, vegetation associations and territories. Birds are also easily detected giving not only presence but also abundance.

When to survey

The survey should ideally be carried out once in April/May and once in May/June, between 6am and 9am.

What to take

- Enough bird survey sheets for the number of hedges being surveyed
- Pen or pencil
- Binoculars
- Bird identification guide

How to carry out the survey

Preferably on a sunny day, walk each hedge at a slow, methodical pace noting down any birds you see. Note down the start and finish time for each survey. Do not linger in hotspots to improve your count, as this will bias results. The bird survey sheet lists common farmland bird species and Biodiversity Action Plan (BAP) bird species associated with hedgerows. Additional species can also be added. The data collected should then be entered into the bird data entry sheet of the biodiversity protocol assessment tool (Step 4).

Survey Tips

It is recommended that you take a pair of binoculars and a field guide on birds to help identify those you see. Recommended field guides include:

- 'RSPB Birds of Britain and Europe' by Rob Hume (2014)
- 'Collins Bird Guide' by Lars Svensson and Killian Mullarney (2010)

There are a number of smart phone apps available to help you identify birds such as the Collins Bird Guide app (www.collinsbirdguideapp.com) or Isoperla (www.isoperla.co.uk). A free farmland bird ID guide is also available from the Game and Wildlife Conservation Trust's website: www.gwct.org.uk/farming/big-farmland-bird-count/farmland-bird-id-guide

Butterfly survey

Hedgerows are an important nectar source for a number of butterfly species. Butterflies also react very quickly to change in their environment which makes them good biodiversity indicators. Pressures such as agricultural intensification and loss of habitat have resulted in many common butterfly species having undergone serious declines.

When to survey

The survey should ideally be carried out once in July and once in August (with at least 10 days between the two visits) and between 11am and 5pm on a still sunny day.

What to take

- Enough butterfly survey sheets for the number of hedges being surveyed
- Pen or pencil
- Butterfly identification guide (optional)

How to carry out the survey

Walk each hedge at a slow, methodical pace noting down any butterflies you see within 2.5m either side of the survey line, 5m ahead and 5m from ground level up. Try to avoid double counting where possible, for example when an individual butterfly repeatedly flies in and out of your recording area. Do not linger in hotspots to improve your count, as this will bias results and do not count butterflies behind you. Note down the start and finish time for each survey. This data should then be entered into the butterfly data entry sheet of the biodiversity protocol assessment tool (Step 4).

Survey Tips

Although the butterfly survey sheet includes photos of a number of common butterflies you may wish to take an additional field guide with you. Recommended guides include:

- 'Guide to the Butterflies of Britain' by John Bebbington

- ‘Collins Butterfly Guide: The Most Complete Field Guide to the Butterflies of Britain and Europe’ by Tom Tolman and Richard Lewington (2008)

A free, downloadable ID guide is available from: www.bigbutterflycount.org. There are a number smart phone apps available such as Isoperla (www.isoperla.co.uk) and iRecord Butterflies (www. butterfly-conservation.org/3114-5502/butterfly-recording-gets-smart.html).

Bumblebee survey

Although bumblebees contribute over £400 million a year to the British economy through pollinating crops, they are facing large declines across the country. Hedgerows are particularly important in providing forage plants for bumblebees at the start and end of the nesting season, when flower-rich grassland areas are being grazed or cut.

When to survey

The survey should ideally be carried out once in July and once in August (with at least 10 days between the two visits) and between 11am and 5pm on a still sunny day.

What to take

- Enough bumblebee survey sheets for the number of hedges being surveyed
- Pen or pencil
- Bumblebee identification guide (optional)

How to carry out the survey

Walk each hedge at a slow, methodical pace. Note down all bumblebees seen within 2.5m either side of the survey line, 5m ahead and 5m from ground level up. Try to avoid double counting where possible for example when an individual bumblebee repeatedly flies in and out of your recording area. Do not linger in hotspots to improve your count, as this will bias results and do not count bumblebees behind you. Space is provided for the seven most common species on the bumblebee survey sheet although more species can be added. Honeybees should also be noted if possible. The data collected should then be entered into the bumblebee data entry sheet of the biodiversity protocol assessment tool (Step 4).

Survey Tips

Although the bumblebee survey sheet includes illustrations of a number of common bumblebees you may wish to take an additional field guide with you. Recommended guides include

- ‘Field Guide to the Bumblebees of Great Britain and Ireland’ by Mike Edwards and Martin Jenner (2009)
- ‘A Pocket Guide to the Bumblebees of Britain and Ireland’ by Pinchen (2006)
- ‘What’s that Bumblebee?’ by Bumblebee Conservation Trust (2010)

There are a number smart phone apps available such as the Bumblebees of Britain & Ireland app (www.natureguides.com).

Ground flora survey

The ground flora is an important component of hedgerows and can contribute significantly to species diversity. Ground flora also provides an important food resource to a wide range of wildlife such as butterflies and bees.

When to survey

The survey should ideally be carried out between May and June.

What to take

- Enough ground flora survey sheets for the number of hedges being surveyed
- Pen or pencil
- A 2m x 1m quadrat (this can be made using lengths of plastic piping or with tent pegs and string).
- Ground flora identification guide

How to carry out the survey

First identify a representative section of hedge, long enough to place two 2m x 1m quadrats 10m apart (see Figure 2). Aim to survey the ground flora influenced by the hedgerow rather than by the adjoining land use, by placing the quadrats under the canopy and as close to the woody stems as possible.

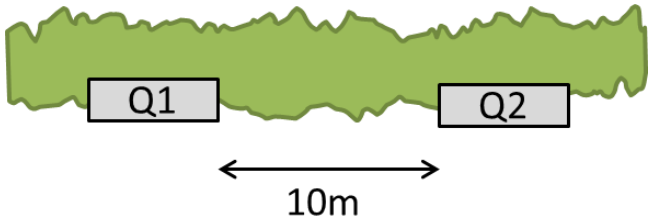


Figure 2. Quadrat positions for the ground flora surveys

For each quadrat, record which species are present with a cross or tick mark on the ground flora survey sheet. As with the other survey sheets, the species list on the ground flora survey sheet is not exclusive. The list may need to be adapted to include frequently occurring species in your locality. Space has been left to record other species present.

Survey Tips

Recommended guides for identifying ground flora species include:

- 'The Wild Flower Key: How to Identify Wild Flowers, Trees and Shrubs in Britain and Ireland' by Francis Rose (2006)
- 'Grasses, Sedges, Rushes and Ferns of Britain and Northern Europe' a Collins Pocket Guide by Richard Fitter and Alastair Fitter (1984)

There are also a number of smart phone apps to help you identify plants out in the field such as FlowerChecker (www.flowerchecker.com), Plantsnap (www.plantsnap.com) and Leafsnap (www.plantsnap.com).

Abundance only surveys

If short of time and resources, abundance only surveys, where just the total number of individual birds, bees, butterflies or distinctly different plant types are recorded, can be carried out as an alternative to the full additional surveys.

The abundance only surveys follow the same survey methods but use the abundance only survey sheet found within the biodiversity protocol assessment tool. The collected data can then be entered into the relevant data entry sheets (butterfly data entry, bumblebee data entry, bird data entry, and ground flora data entry).

Hedgelink's Flagship Species

Hedgelink, a partnership that has responsibility for helping to deliver the Habitat Action Plan part of the UK's Hedgerow Biodiversity Action Plan, have identified 12 flagships species against to which to measure the impact of its policies, action and advice.

1. Purple ramping fumitory (*Fumaria purpurea)*
2. Orange-fruited elm-lichen (*Caloplaca luteoalba)*
3. Large (Moss) Carder bee (*Bombus muscorum)*
4. Brown hairstreak butterfly (*Thecla betulae)*
5. Goat moth (*Cossus cossus)*
6. Common lizard (*Zootoca vivipara)*
7. Bullfinch (*Pyrrhula pyrrhula)*
8. Tree sparrow *Passer (montanus)*
9. Yellowhammer (*Emberiza citronella)*
10. Soprano pipistrelle (*Pipistrellus pygmaeus)*
11. Hedgehog (*Erinaceus europaeus)*
12. Dormouse (*Muscardinus avellanarius)*

Collectively these species use each of the main structural components of hedgerows (tree, shrub, bank, base, and margin), and include representatives of each of the main taxonomic groups.

Although no survey is required, the assessment tool allows you to enter whether or not you are aware of any of these 12 species being present on your farm, so keep an eye out for these species when surveying!

TOP TIP: Keep an eye out for Hedgelink's Flagship species when carrying out surveys on your hedges and make a note of any you see or any evidence (e.g. hazel nuts gnawed by dormouse).

Step 4: Data entry and using the biodiversity protocol assessment tool

Once you have mapped your hedges and carried out your surveys it is then time to enter your data into the biodiversity protocol assessment tool. The assessment tool is a Microsoft Excel based tool which is made up of a number of sheets for you to enter your data and view the results. The Excel file containing the tool can be downloaded from: **www.twecom.eu** or **http://tinyurl/TWECOM**

Introduction

After downloading and saving the Excel file to your computer, open the file to access the assessment tool. The first sheet of the tool named "Introduction" (Figure 3) gives a short overview of what the tool is, how to use it and where a copy of this user guide can be downloaded from.

Every time the protocol surveys are carried out it is advised that you make a copy of the tool and save it under a name which includes the year the surveys were carried out. This insures you are able to view and compare the results from previous years and monitor any changes.

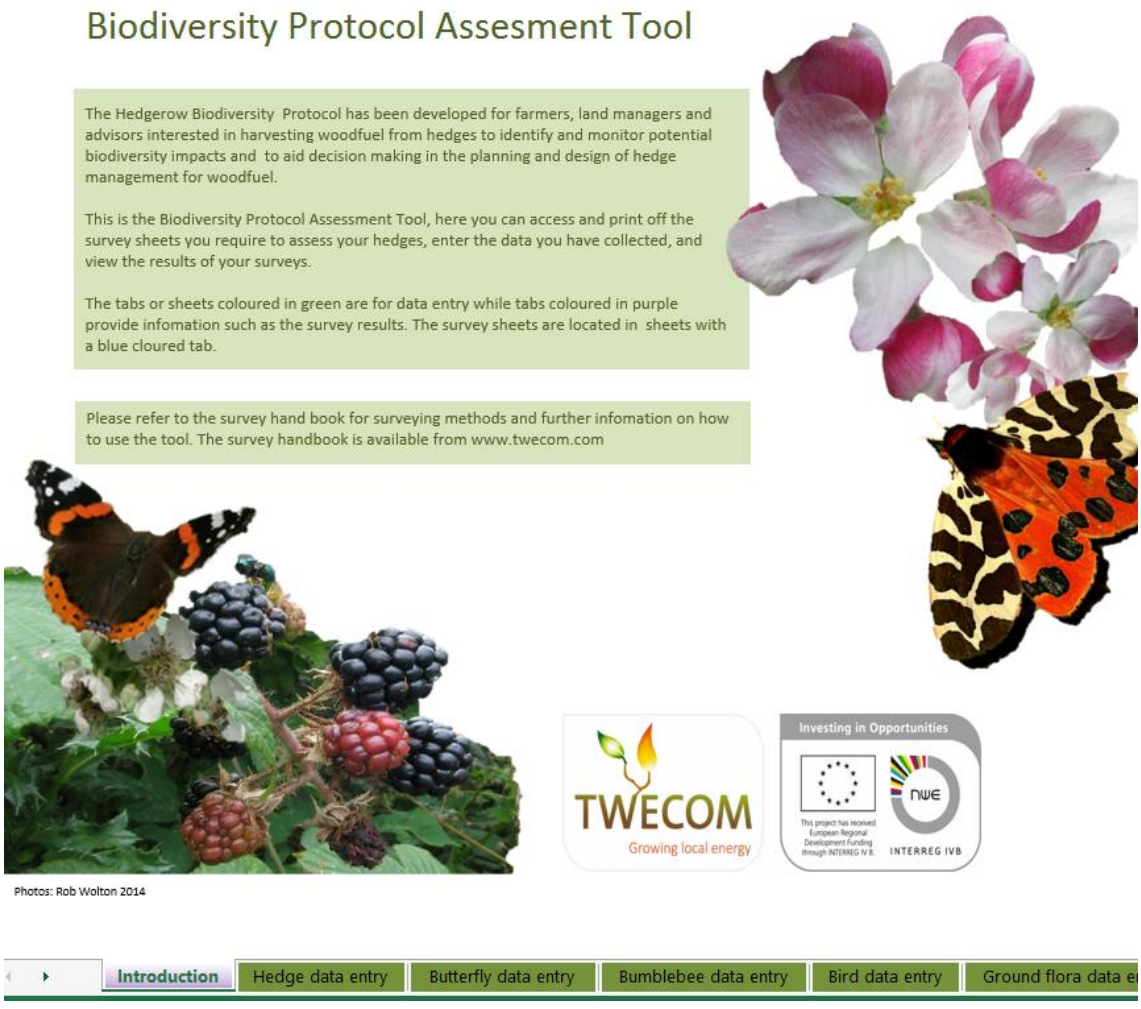


Figure 3. First sheet of the Excel based biodiversity protocol assessment tool. This sheet gives a brief introduction to the tool and how to use it.

Data entry

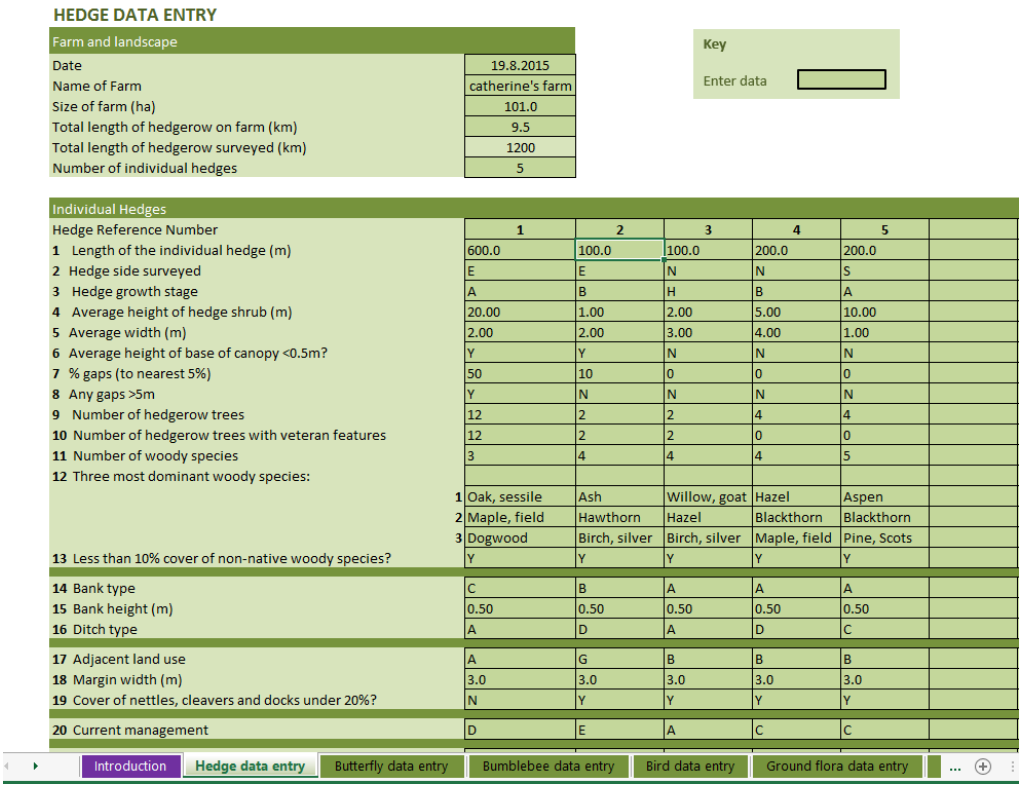
The next sheet named “Hedge data entry” allows you to enter the data you collected during the hedge surveys. Sheets “Butterfly data entry”, “Bumblebee data entry”, “Bird data entry” and “Ground flora data entry” allow you to enter the data for the additional surveys and abundance only surveys. The data entry sheet named “Hedgelink species data entry” allows you to record which of the 12 flagship species are known to be present on your farm.

Entering the hedge survey data

First, click on the tab named ‘Hedge data entry’. In the top left data entry box labelled ‘Farm and landscape’ (Figure 4) enter the date you carried out the hedge surveys (if the surveys were carried out over a number of days use the date of the first survey), followed by the name of the farm, total size of the farm in hectares, total length of hedgerows on the farm in kilometres, and number of individual hedges on the farm. The length of hedge and number of hedges surveyed will be calculated automatically based on the data you enter. Then for each hedge surveyed, enter the hedge reference number at the top of the main data entry form and fill in the answers to the 21 questions. Any notes you took during the surveys can also be included.

Remember to save the file regularly during data entry

For many of the data entry cells a drop down menu will appear with the different options available for that question (Figure 5), simply select the correct answer.



HEDGE DATA ENTRY

Farm and landscape	
Date	19.8.2015
Name of Farm	catherine's farm
Size of farm (ha)	101.0
Total length of hedgerow on farm (km)	9.5
Total length of hedgerow surveyed (km)	1200
Number of individual hedges	5

Key: Enter data

Individual Hedges						
Hedge Reference Number		1	2	3	4	5
1 Length of the individual hedge (m)		600.0	100.0	100.0	200.0	200.0
2 Hedge side surveyed		E	E	N	N	S
3 Hedge growth stage		A	B	H	B	A
4 Average height of hedge shrub (m)		20.00	1.00	2.00	5.00	10.00
5 Average width (m)		2.00	2.00	3.00	4.00	1.00
6 Average height of base of canopy <0.5m?		Y	Y	N	N	N
7 % gaps (to nearest 5%)		50	10	0	0	0
8 Any gaps >5m		Y	N	N	N	N
9 Number of hedgerow trees		12	2	2	4	4
10 Number of hedgerow trees with veteran features		12	2	2	0	0
11 Number of woody species		3	4	4	4	5
12 Three most dominant woody species:						
	1	Oak, sessile	Ash	Willow, goat	Hazel	Aspen
	2	Maple, field	Hawthorn	Hazel	Blackthorn	Blackthorn
	3	Dogwood	Birch, silver	Birch, silver	Maple, field	Pine, Scots
13 Less than 10% cover of non-native woody species?		Y	Y	Y	Y	Y
14 Bank type		C	B	A	A	A
15 Bank height (m)		0.50	0.50	0.50	0.50	0.50
16 Ditch type		A	D	A	D	C
17 Adjacent land use		A	G	B	B	B
18 Margin width (m)		3.0	3.0	3.0	3.0	3.0
19 Cover of nettles, cleavers and docks under 20%?		N	Y	Y	Y	Y
20 Current management		D	E	A	C	C

Introduction | Hedge data entry | Butterfly data entry | Bumblebee data entry | Bird data entry | Ground flora data entry | ...

Figure 4. A screen shot of the “Hedge data entry” sheet of the assessment tool. This is where you can enter the data collected during the hedge survey.

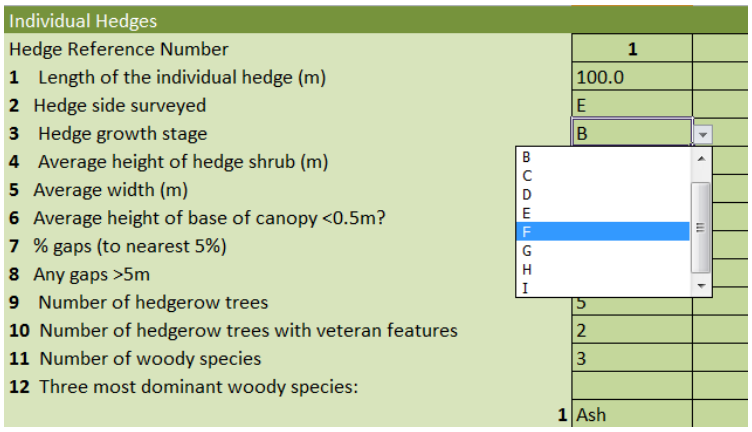


Figure 5. Example of the drop down menus within the "Hedge data entry" sheet of the assessment tool.

Entering the additional and abundance only survey data

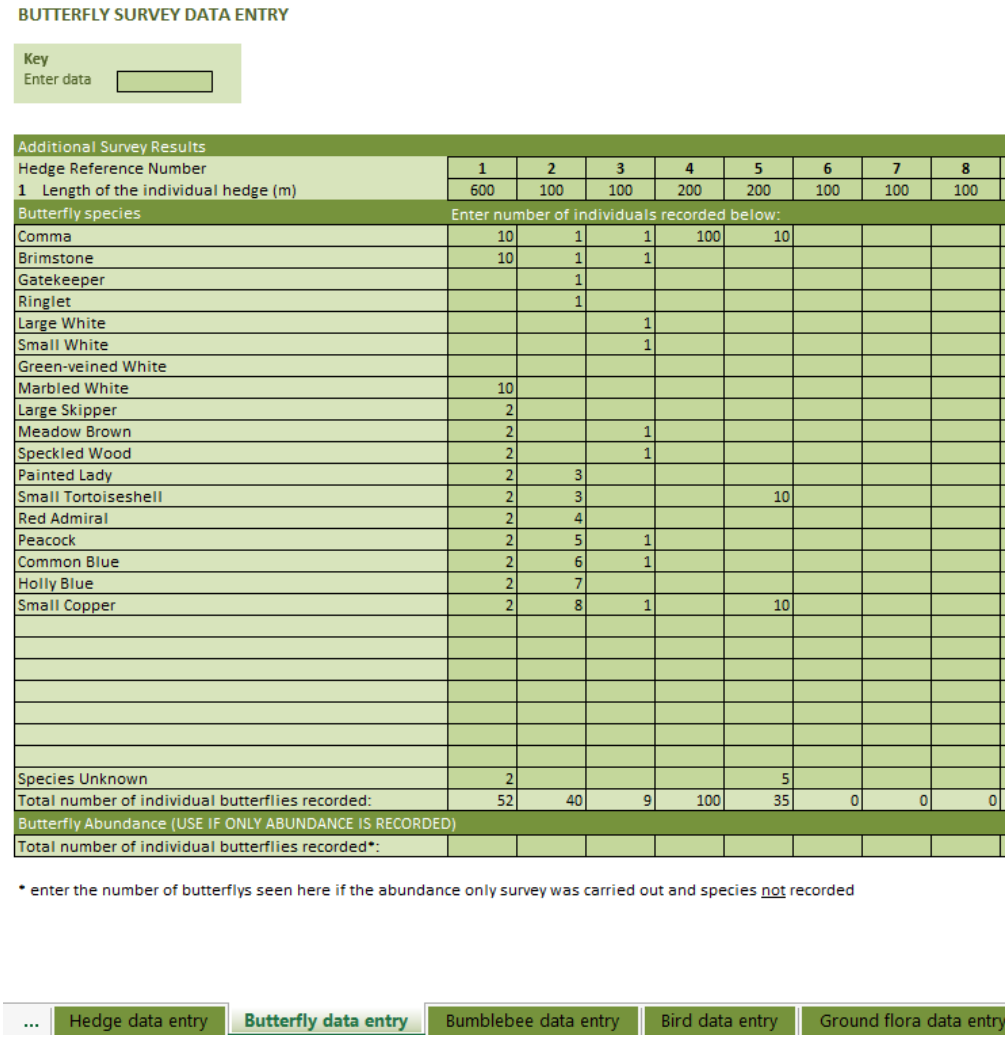
The additional survey data entry sheets are very similar to the hedge survey data entry sheet. There is a separate Excel sheet for each survey: Butterfly data entry, Bumblebee data entry, Bird data entry, and Ground flora data entry.

Butterfly data entry

To enter the data collected from either the full butterfly survey or abundance only survey click on the sheet named "Butterfly data entry" (Figure 6). Here you can enter the hedge reference number of each of the hedges surveyed and their length. If the full survey was carried out where the species of each individual butterfly was recorded, enter the total number of individuals spotted for each species. If no individuals were seen for a species, it is important to leave the cell blank, do not enter "0". The total number of butterfly individuals will automatically be calculated for you. If you saw any additional species not listed on the survey sheet, enter them in the blank cells in the left-hand column headed 'Butterfly species'.

If you carried out the abundance only survey for butterflies simply enter the hedge reference number and hedge length at the top of the data entry form as before and the total number of individual butterflies recorded at the bottom of the entry form.

Remember to save the file regularly during data entry



BUTTERFLY SURVEY DATA ENTRY

Key
Enter data

Additional Survey Results								
Hedge Reference Number	1	2	3	4	5	6	7	8
1 Length of the individual hedge (m)	600	100	100	200	200	100	100	100
Butterfly species	Enter number of individuals recorded below:							
Comma	10	1	1	100	10			
Brimstone	10	1	1					
Gatekeeper		1						
Ringlet		1						
Large White			1					
Small White			1					
Green-veined White								
Marbled White	10							
Large Skipper	2							
Meadow Brown	2		1					
Speckled Wood	2		1					
Painted Lady	2	3						
Small Tortoiseshell	2	3			10			
Red Admiral	2	4						
Peacock	2	5	1					
Common Blue	2	6	1					
Holly Blue	2	7						
Small Copper	2	8	1		10			
Species Unknown	2				5			
Total number of individual butterflies recorded:	52	40	9	100	35	0	0	0
Butterfly Abundance (USE IF ONLY ABUNDANCE IS RECORDED)								
Total number of individual butterflies recorded*:								

* enter the number of butterflys seen here if the abundance only survey was carried out and species not recorded

... | Hedge data entry | Butterfly data entry | Bumblebee data entry | Bird data entry | Ground flora data entry

Figure 6. A screen shot of the "Butterfly data entry" sheet of the assessment tool. This is where you can enter the data collected during both the full butterfly survey and abundance only survey.

Bumblebee and bird data entry

The bumblebee and bird data entry sheets are identical to the butterfly data entry sheet, simply follow the same instructions for each taxa.

Ground flora data entry

The ground flora data entry sheet is very similar to the three other additional survey data entry sheets however, due to the ground flora survey being undertaken within two quadrats per hedge there is a difference in how to transfer the survey results into the data entry form. If a plant species was recorded to be present in either of the two quadrats enter a "1" in the relevant data entry cell. This indicates that that species was present. If a species was not recorded in either of the quadrats leave the cell blank; do not enter a "0". Figure 7 gives an example of how the data collected for a hedge is entered into the data entry form.

Additional Survey Results	
Hedge Reference Number	1
1 Length of the individual hedge (m)	100
Ground flora species	
Bluebell	1
Bracken	1
Bramble	1
Bush vetch	1
Cleavers **	
Common knapweed	1
Common nettle**	1
Common vetch	1
Cow parsley	1
Creeping buttercup	
Creeping cinquefoil	1
Creeping thistle	
Cut-leaved cranesbill	
Docks **	

Ground Flora Survey Sheet

Date:		
	1	
Plants	Q1	Q2
Bluebell	X	X
Bracken	X	
Bramble		X
Bush vetch	X	
Cleavers **		
Common knapweed		X
Common nettle**	X	
Common vetch	X	
Cow parsley	X	
Creeping buttercup		
Creeping cinquefoil		X
Creeping thistle		
Cut-leaved cranesbill		
Docks **		

Figure 7. An example of how the recorded ground flora presence for a hedge (on the left) is entered into the ground flora data entry sheet (on the right).

Hedgelink species data entry

The Hedgelink species data entry sheet is set out differently to the other data entry sheets as a survey of each hedge is not required. This sheet is simply a record of which flagship species you are aware are on your farm. Use the drop down lists to select a status as shown in Figure 8.

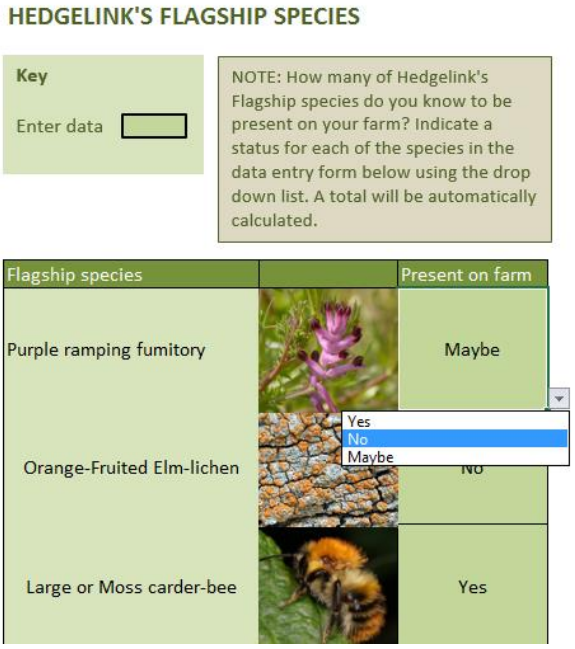


Figure 8. An example of how to enter a status for each of the 12 Hedgelink flagship species using the drop down lists provided on sheet "Hedgelink species data entry".

Step 5: Interpreting your survey results

Once you have entered all of the survey data into the biodiversity protocol assessment tool the results can be viewed in the Excel sheet named “Results”.

Indicators

Since surveying individual taxa is time consuming and knowledge intensive, it is nearly impossible for you to directly quantify biodiversity on your farm. The assessment tool therefore uses a number of indicators derived from your survey results to provide quantitative links between landscape patterns, such as habitat diversity and quality, and biodiversity. The report on the development on this protocol provides further explanation of why these indicators were chosen and how their scores are calculated and is available from **www.twecom.eu** or **http://tinyurl/TWECOM**.

Hedge survey results

The six indicators derived from the hedge survey include: the percentage of hedges with good continuity (connectivity), The average km of hedge per ha of land (hedge network density), the average number of hedgerow trees per km of hedge (density of hedgerow trees), number of hedge growth stages present on the farm (structural diversity of hedges), the percentage of hedges in favourable condition (hedges in favourable condition), and the percentage of hedges providing a good food resource (food resources).

The result and score for each of these indicators can be seen in the “Results” sheet of the tool in the table labelled “Hedge survey indicators” as shown in Figure 9. Each indicator is scored from 1 to 5 with 5 being the best score possible. These scores are then represented visually using a radar diagram (Figure 10) which can be seen under the heading “Graphs” in the results sheet.

Scores lower than 5 indicate there may be room for improvement. However it is important to remember it may be difficult to score highly on some indicators depending on where in the country you are located. For example, in the UK upland farms are likely to have a lower density of hedges per ha compared to farms in the south west, this is simply a characteristic of the region and not necessarily a reflection on bad management or farming practices. Recommendations on how to improve your score for each indicator can be found in the sheet named “Recommendations” along with general management advice on how to reduce the impact of harvesting hedges for woodfuel on wildlife.

Hedge survey indicators

Indicator	Measurement	Result	Score
Connectivity	% of hedges with good continuity	15.47	1
Hedge network density	average km of hedge per ha	0.094059	4
Density of hedgerow trees	average number of trees per km of hedge	16.81076	4
Structural diversity of hedges	number of hedge growth stages present on the farm (out of 9)	5	3
Hedges in favourable condition	% of hedge network in favourable condition	39.48	2
Food resources	% of hedge network providing a good food resource	43.71	3

Figure 9. The Hedge survey indicator table where the results from the hedge survey and scores are displayed. These scores then feed into a radar diagram as shown in Figure 10.

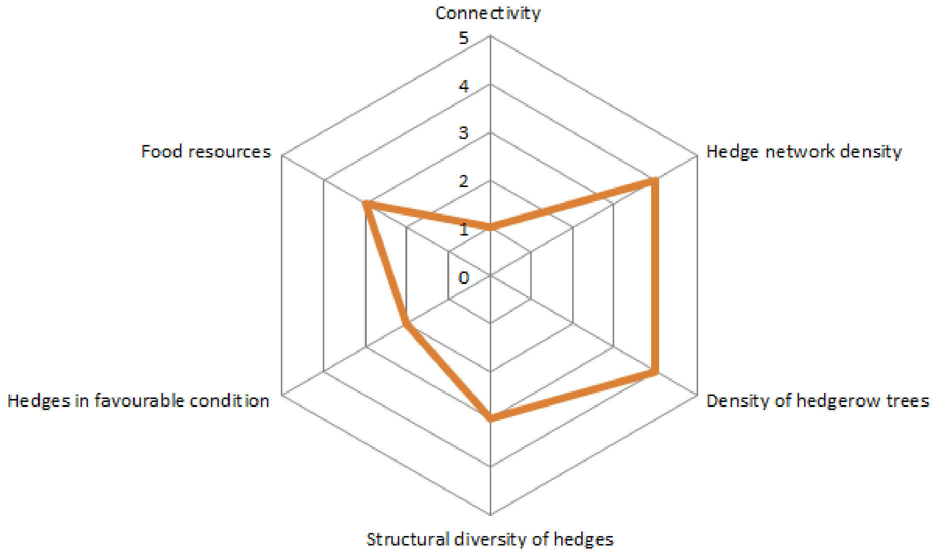


Figure 10. An example radar diagram of the hedge survey indicator results.

The table named “Hedge management” (Figure 11) located below the indicator results, gives the reference numbers of hedges that are: potentially suitable for coppicing based on their growth stage and species composition; providing a good food resource based on their species composition and current management; in favourable condition; and in unfavourable condition. These categories are designed to help you make management decisions such as which hedges need rejuvenating or may be suitable for coppicing. The report on the development on this protocol provides further explanation of the criteria for these categories and is available from:

www.twecom.eu or **http://tinyurl/TWECOM**

Hedge management

Categories	Hedge reference numbers
Hedges potentially suitable for coppicing	3,
Hedges providing a good food resource	4,21,13,
Hedges in favourable condition	3,21,
Hedges in unfavourable condition	4,8,13,14,,

Figure 11. The hedge management table is where you can view which hedges are potentially suitable for coppicing; providing a good food resource; in favourable condition; and in unfavourable condition. These categories are designed to help you make management decisions.

Additional and abundance only survey results

The results of the additional surveys are shown at both a hedge and farm scale (Figure 12). The table labelled “Hedge scale – additional surveys” shows the survey results for each hedge surveyed. If a full additional survey was carried out the total number of individuals (if species recorded), number of species, and a diversity score is given for each taxa. If an abundance only survey was carried out, only the total number of individuals (abundance only) will be shown. For both ground flora and woody species (derived from the hedge survey not the additional surveys) only the number of different species is shown.

The diversity score is based on the Simpson's Index of Diversity, an index commonly used in ecology to quantify biodiversity. The score represents the probability that two individuals randomly selected from the hedge will belong to different species. Scores can range from 0 to 1; the closer the score to 1, the greater the hedges diversity. The table showing the results at a hedge scale enables you to compare the diversity score of different hedges and to see whether one hedge has a higher biodiversity than another. For example Hedge 1 in Figure 12 has a butterfly diversity score of 0.95; this score is higher than that of Hedge 2 which scored 0.90. This indicates that hedge 1 has a higher diversity of butterflies than hedge 2. Similar comparisons between hedges can be made for the total number of individuals and number of species.

The table showing the results of the additional surveys at a farm scale displays the abundance (total number of individuals), number of species and a diversity score for all the hedges surveyed as a whole. If the biodiversity protocol is carried out every few years, these scores can be used to compare the farms current scores to previous years, allowing you to monitor the impact of changes in hedgerow management (e.g. managing hedges for woodfuel though coppicing). Scores can also be used to compare the overall biodiversity of different farms.

Farm scale - additional surveys

Indicator	Abundance	Abundance (species NOT recorded)	Number of species	Diversity score
Butterflies	100	0	18	0.97
Bumblebees	60	0	9	0.94
Birds	160	0	24	0.98
Ground flora	N/A	N/A	15	N/A

Hedge scale - additional surveys

	Hedge refernce number			
Butterflies	1	2	3	4
Total number of individuals (if species recorded)	29	37	9	5
Total number of individuals (abundance only)	0	0	0	0
Number of species	14	11	9	1
Diversity score	0.95	0.90	1.00	0.00
Bumblebees	1	2	3	4
Total number of individuals (if species recorded)	18	10	24	7
Total number of individuals (abundance only)	0	0	0	0
Number of species	9	2	3	7
Diversity score	0.94	0.56	0.70	1.00
Birds	1	2	3	4
Total number of individuals (if species recorded)	43	37	25	16
Total number of individuals (abundance only)	0	0	0	0
Number of species	17	7	8	4
Diversity score	0.95	0.87	0.89	0.80
Ground flora	1	2	3	4
Number of different plants (if species recorded)	9	2	3	1
Number of different plants (species not recorded)	0	0	0	0
Woody species	4	8	3	21
Number of woody species	3	4	4	4

Figure 12. Results of the additional surveys are shown at both a hedge and farm scale. The hedge scale results can be used to compare the biodiversity of individual hedges and the farm scale results to compare different farms or the same farm over a period of time.

The hedge scale results are also presented in the form of bubble graphs for each taxa, except ground flora as a diversity score is not calculated. These graphs can be found under the heading “Graphs” below the radar diagram.

These bubble graphs plot the number of species along the Y axis and diversity score along the X axis (Figure 13). Each bubble represents a hedge and the size of the bubble is determined by the number of individuals counted including all species. These graphs can be used to indicate the overall biodiversity status of your hedges. The better the biodiversity of your hedges the closer the bubbles will be to the top right hand corner of the graphs and the bigger the bubble will be - this shows your hedges support a high number of individuals , species and have a high diversity score. If your hedges support a low level of diversity then the closer the bubbles will be to the bottom left hand corner of the graphs as shown in Figure 13.

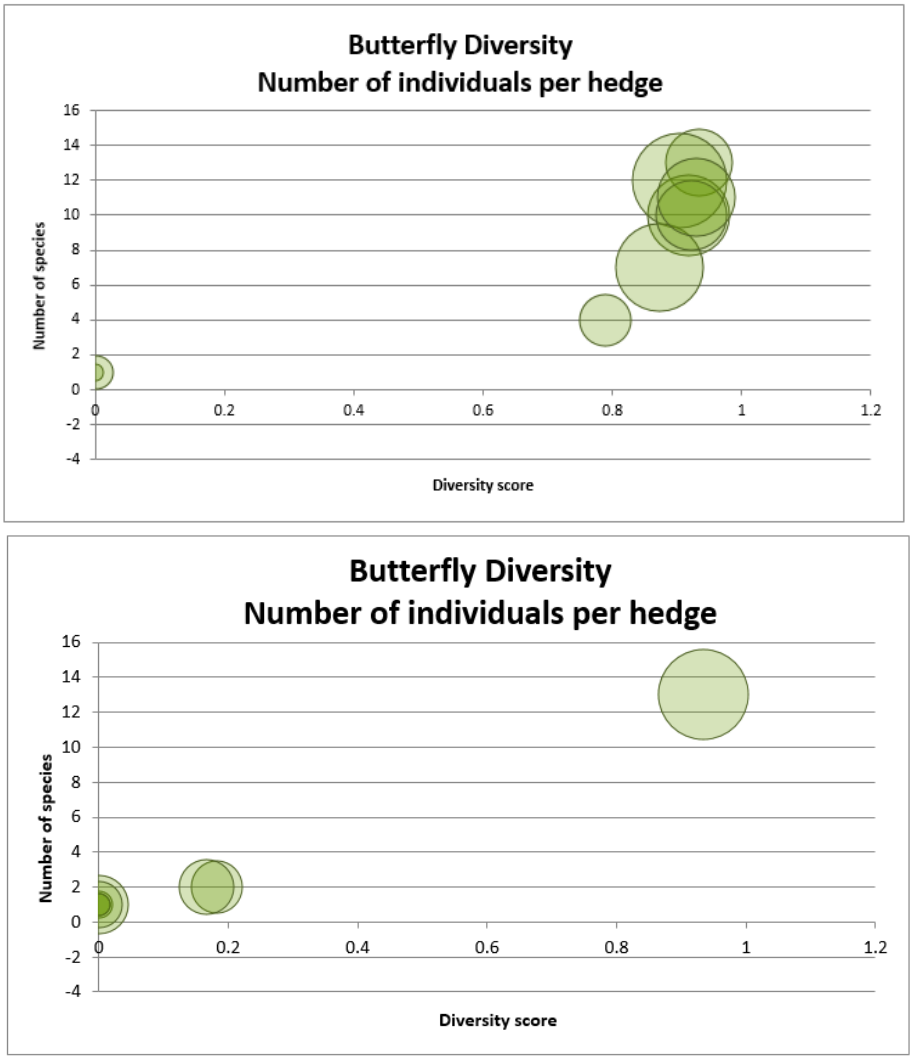


Figure 13. Example bubble graphs for the additional butterfly survey. The top graph shows a farm where the majority of his hedges are have a high level of biodiversity. The lower graph shows the survey results for a farm where most of the hedges have a low level of biodiversity.

Hedgelink species results

The table named “Hedgelink’s flagship species” (Figure 14) displays the results from the data entered in to the Hedgelink species data entry sheet and the total number of species known to be present on the farm.

Hedgelink's flagship species

Flagship species	Present on farm
Purple ramping fumitory	Maybe
Orange-Fruited Elm-lichen	No
Large or Moss carder-bee	Yes
Brown hairstreak	Yes
Goat moth	No
Common lizard	Maybe
Tree sparrow	No
Bullfinch	No
Yellowhammer	No
Soprano pipistrelle	No
Hedgehog	No
Dormouse	No
TOTAL (out of 12)	2

Figure 14. Table displaying the status of the 12 Hedgelink flagship species on the farm and the total number known to be present on the farm.

Step 6: Management recommendations

Based on your survey results you may have identified indicators you wish to improve on or specific hedges that require management changes to bring them back into favourable condition. A selection of management recommendations and useful resources based on the hedge survey indicators can be found in the sheet named “Recommendations”. More general information on hedge management for biodiversity and how to reduce the impacts of coppicing hedges for woodfuel on wildlife can also be found here.