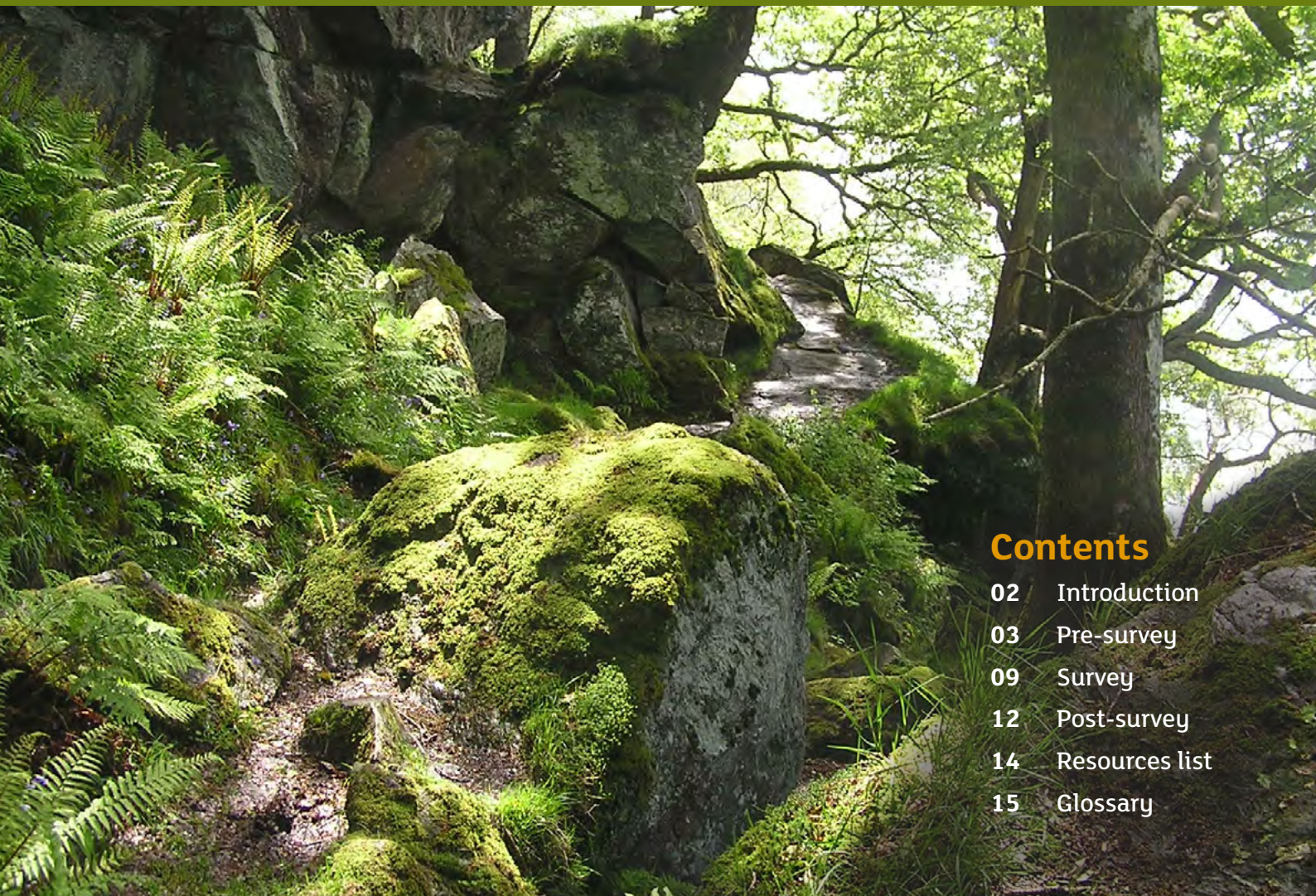


First rate rainforest?

A woodland survey focusing
on Scotland's temperate
rainforest habitat



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First rate rainforest?

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Introduction

Temperate rainforest is found in western regions of the UK from the very north-west of Scotland down to south-west England. These woodlands include oak, hazel, ash and birch tree species and are a habitat type known as 'coastal temperate rainforest', which covers about 1% of the world's land mass. This makes the habitat much rarer than 'tropical rainforest', that covers about 6% land mass.

This survey is best carried out in native woodland in the west of Scotland (see Figure 1. below for suggested area). However, comparison surveys can be done for example between a plantation versus native woodland in west Scotland or between native woodlands in the central or east, versus the west of Scotland. The major part of this survey can also be done in areas of rainforest in north Wales, Cumbria and south-west England.

Not all woods on the west coast will have the right climatic conditions and topography to be a temperate rainforest (also known as Atlantic Woodland).

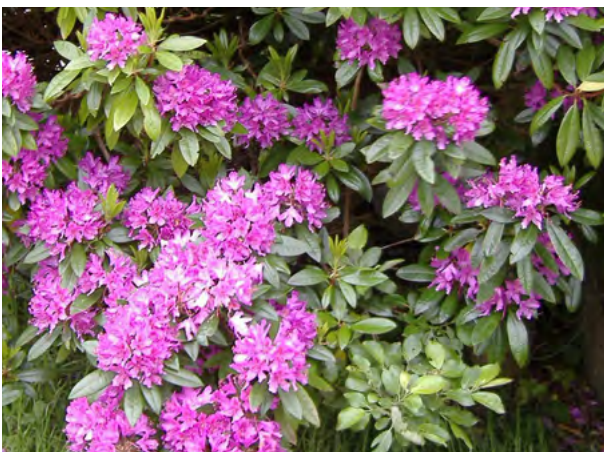
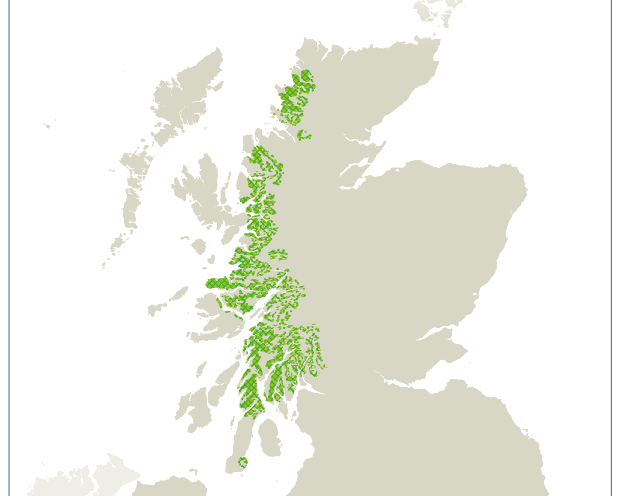
Pre-requisite conditions require:

- a mild climate year round
- over 1,500mm annual rainfall
- a large number of 'wet days' throughout the year (i.e. a day with at least 1mm of precipitation)
- high humidity levels assisted by the forest being situated in a sheltered place e.g. head of a sea loch or a cove.

Therefore this is a patchy habitat across the west of the UK.

Having said this though, there may be woods that have these conditions that are not currently managed to their full potential.

Figure 1. The area within which temperate rainforest can be found in Scotland



Rhododendron

These woodlands are also under threat due to a variety of reasons:

- The invasive non-native shrub *Rhododendron ponticum* which shades out the special smaller plants and fungi.
- The woodlands are becoming increasingly isolated and fragmented from one another, leading to less dispersal of species.
- Management – too little grazing can lead to the woodland becoming shady and choked; but overgrazing leads to more fragmentation and not enough regeneration of young trees.
- Hydropower schemes – these can lower water levels and humidity levels in streams and ravines, which in turn affect the survival of rare mosses and liverworts that need high humidity levels for health and reproduction.

Pre-survey:

This activity provides context and background for doing the survey, enabling students/participants to view 'survey' forests as a whole habitat. Refer to Table 1. on page 4 for background information.

- Discuss the different 'woodland photocards' on page 5-6, arranging them from perceived 'best' to 'worst' botanical value and ask students to explain their reasoning.
- The 'Factors that make a temperate rainforest' diagram card on page 7 can help inform thinking and answers.
- Alternatively use the 'Factors' photocards on page 8 to see how many features students can find on each 'woodland photocard'. The card with the most features is the 'best'.
- The 'Factors' photocards show Biotic (living) and Abiotic (non-living) factors. An additional activity could be to sort photocards into these two different factors.
- The 'woodland photocards' can be taken out into the field as an aid to help predict the grade of wood prior to surveying.

Pre-survey equipment:

- A5 'woodland photocard' set of 4 different woodlands (1 set per group) (page 5-6)
- 'Factors that make a temperate rainforest' diagram card (1 per group) (page 7)
- Cutting out 'Factors' photocards (1 set per group) (page 8)

Extension ideas / questions for Higher / Advanced higher students:

- Can the survey design be modified to improve reliability and accuracy? How?
- How could other key abiotic factors, such as humidity or rainfall be surveyed?
- Design a method of systematic sampling for multiple transects in one area.
- Compare different woodlands for abiotic factors and invertebrate biodiversity. How would you do this? What would you predict?

Woodland photocard answers:



Worst
Sitka spruce plantation; non-native / same age / monoculture. No interesting features or flora.



Poor
Birch regeneration; native / same age / monoculture. No interesting features/ some moss.



Medium
Old industrial oak plantation; native / a mix of species and ages with even aged oak. Some small boulders / moss.



Best
Mixed species wood; native / range of ages and species. Boulders / sheltered / ferns / moss / big lichens.

Table 1. Factors that contribute to a good quality (functioning and bio-diverse) temperate rainforest.

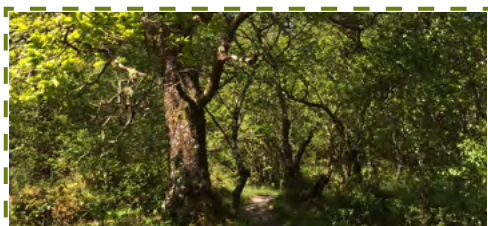
Factor	Why required?
Mild, wet climate	Provides perfect conditions for growth of epiphytes (ferns, mosses, liverworts, lichens), especially bryophytes (mosses and liverworts) that don't have roots, so absorb moisture from the atmosphere.
High humidity levels	Provides perfect conditions for epiphyte growth, especially bryophytes that need water for reproduction. These conditions are maintained by: • Presence of watercourses and ravines • Presence of sheltered areas – e.g. sheltered coastal coves – reducing air movement • Presence of bryophytes (mosses and liverworts) • Presence of lichens • Presence of ferns
Medium light levels	Lichens like light, whilst bryophytes can tolerate shadier conditions. So in reality, over a whole wood, a range of light levels are required to allow for a mix of all species.
Rock faces / boulders	Provide virgin habitat for rare species of mosses and liverworts that are outcompeted by more vigorous bryophytes and lichens in other places – e.g. on woodland floor and trunks of trees.
Topography / ravines and watercourses	These areas – e.g. in the splash zone are also areas where specialist bryophytes can grow, where other species cannot. Bryophytes are able to absorb dissolved minerals from rocks.
Medium levels of management	1 Too much grazing will not allow for regeneration of trees, which are required as a substrate for epiphyte growth 2 Too little grazing will create dense stands of saplings – shading out the light required for epiphyte growth
Age and species of trees	The acidity of tree bark changes with age and with different tree species. For example birch has very acidic bark, whilst hazel is mildly acidic. Some lichen species prefer less acid bark, whilst others prefer acid bark. A mix of tree ages and species allows for an increase in lichen biodiversity.
Presence of different species of epiphytes (lichens, bryophytes, ferns)	1 Maintain high humidity levels – by slow evaporation of water from these plants 2 Create soil, which can eventually benefit other plants and invertebrates 3 Bryophytes hold water, thereby reducing erosion (erosion can wash away soil nutrients, and affect streams) 4 Some lichens can fix atmospheric nitrogen - providing nutrients for other plants once these have died 5 Increases microhabitats and food for invertebrates 6 Provide nesting materials for birds



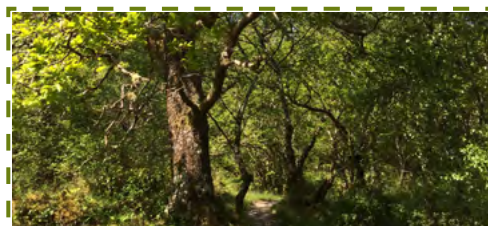




Cutting out 'Factors' photocards



Trees - mix of ages



Trees - mix of native species



Fungi



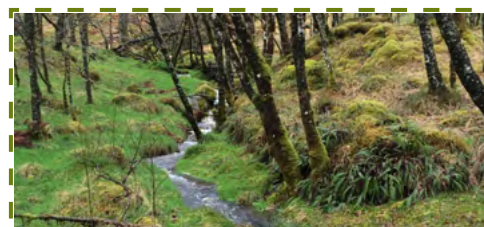
Ferns



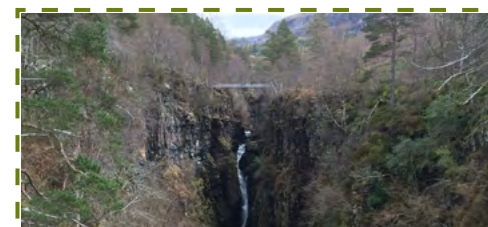
Mosses - different types



Lichens - different types



Waterfalls / streams



Ravines / steep valleys



Sheltered valleys / bays



Rockface / boulders

A couple of red herrings!



A viewpoint



Tree frogs

Other factors needed are shown below – these can't be seen on woodland photos, but could be discussed

What type of climate?

What types of animals?
What roles do they play?

What levels of humidity?

What levels of light?

Survey:

It is best to do this survey between and including the months of May and September, when the leaves are on the trees. The survey can still be done outside these months but clear sky cover scores will be skewed.

How to complete the survey:

- Set out a 10 metre transect with the measuring tape through a patch of wood.
- Identify three trees along the transect (those closest to the 0, 5 and 10 metre points on the transect) and record the species of each.
- Follow the activities on the 'First rate rainforest?' scorecard.

Equipment:

- Survey scorecard
- 10 metre measuring tape or rope
- Small measuring tape to record tree girth
- Canopy scope for measuring % clear sky - (instructions for making page 11)
- Tree ID card (see Resources list page 14)
- Magnifying glass
- Clipboard
- Pencil

Optional:

- Camera (or smart phone camera)
- Hand held GPS (or smart phone GPS)

1 Tree species

Use a native tree guide to assist. Examples can be found from the Resources list page 14.

2 Age of trees

The girth of a tree is the circumference of the tree trunk. This needs to be measured at a height of 1.3 metres. Hazel trees naturally have many thin trunks growing from one base at the ground level. This makes ageing a hazel difficult, so instead measure around the base of the tree.

3a Lichens

Put simply, lichens are a combination of at least two organisms in one; a fungus and a photosynthetic partner, most commonly an alga. The fungus provides the structure of the lichen (protecting the alga), whilst the alga makes the food via photosynthesis. This close relationship is known as mutualism, where each party benefits. There are 3 main types/structures of lichen to look out for on your trees:



Crusty – These are closely attached to the bark.



Shrubby – Attached to the bark at a base from which the lichen branches out and looks shrub like.



Leafy – Leaf-like lobes either closely or loosely attached to tree bark. Lobes tend to have a distinct upper and lower surface.

N.B. Lichens can be confused with:
Moss / Green algae / Orange algae

3b Lichens

Using the identification photos on the scorecard see if you can find the four lichen species on your trees.

Tip: The two leafy species (Tree lungwort and Green satin lichen) tend to be found on oak, hazel, willow and ash.

The shrubby Coral lichen tends to be found on birch and alder trees.

The crusty Barnacle lichen tends to be found on hazel and other smooth barked trees.

4 Mosses

Mosses and liverworts (collectively called 'Mosses' here) are small, green non-flowering plants, which produce spores. For this activity students record as many different shapes, shades and textures of moss surrounding the base of the tree trunk up to a height of 1 metre. For help there are some photos showing common moss shapes on the scorecard to focus searching.

5 Moss and lichen cover

Looking around the immediate area of your trees, estimate the amount of moss and lichen cover.

6 % Clear sky

Use the canopy scope to record the percentage of clear sky above the transect, halfway along. Hold the scope 20cm from your eyes (using the attached string to gauge this) and count

the number of dots that coincide with clear sky. Canopy scopes can be made easily by using the template on page 11. There are 25 dots on the canopy scope, so once you have the number of dots, multiply this score by 4 to give you the percentage score.

WARNING: If the sun is directly overhead it is better to skip this activity than look directly at the sun.

7 Rocks and boulders

Look around the surrounding area of your transect - if you can see rock faces and boulders from here, record the relative amount.

8 Watercourses

If you can see some sort of water body or stream from your transect, record what you see.

Once you have completed all the activities on the scorecard, work out your score to discover the botanical value of your rainforest!

Staying safe:

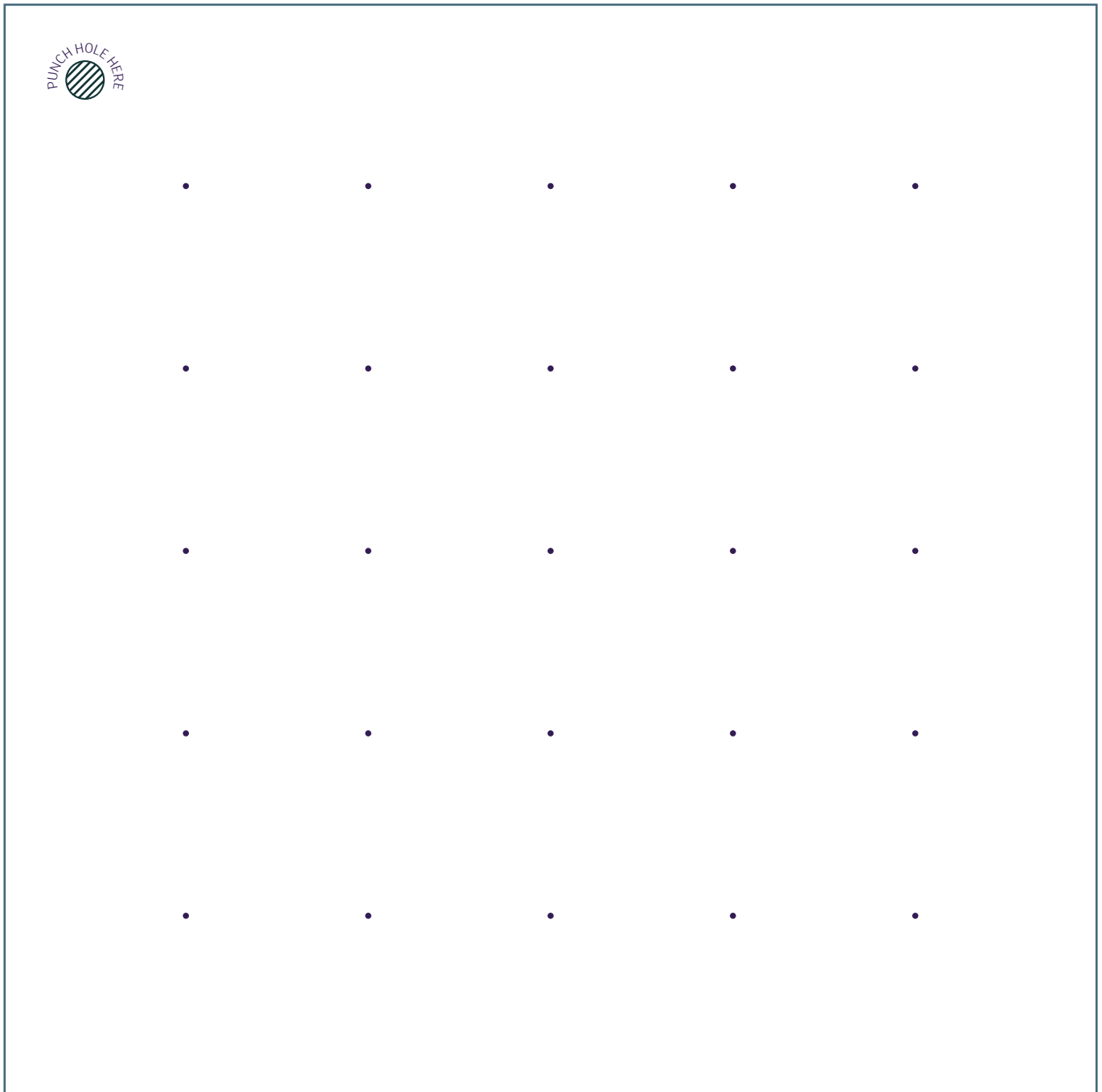
- Wear appropriate clothing when doing fieldwork – long trousers and sturdy footwear.
- Be prepared for the weather – take a raincoat, woolly hat for cold, wet weather; Take sun cream and a sunhat if sunny.
- Beware of beasties – Midges; take midge repellent and midge headnet. Ticks; wear long trousers and possibly wellies, carry a tick remover, be sure to check for ticks when you get home.
- Carry a first aid kit
- Make sure someone else knows where you are going and what time you will return.
- Avoid the woods if there is a storm and it is very windy.
- Do not look directly at the sun when using the canopy scope.



How to make a canopy scope

Canopy scopes are used to estimate the amount of light that reaches the forest floor and is therefore available to forest plants. They can easily be made using the template below:

- Take an acetate sheet and trace over the dots and square outline on the template below with a permanent marker pen. Please make sure you print the template on A4 size paper, at 100% with no scaling (the square outline should be 18cm x18cm).
- Cut out the square.
- Punch a hole in one corner and then attach a 20cm length of string through the hole.



Reference: Brown, N., Jennings, S., Wheeler, P. & Nabe-Nielson, J. 2000. An improved method for the rapid assessment of forest understorey light environments. *Journal of Applied Ecology*, 37, 1044-1053.

Post-survey:

Post-survey activities:

- 1 Assess the rainforest scores
- 2 Enter lichen data into iRecord, page 13

Assess the rainforest scores

If 'woodland photocards' were used for predictions before surveying, did the students' predictions tally with their woodland scores? To improve accuracy of scores, class results could be pooled. A discussion about the rainforest scores can suggest ways to improve scores. The notes below can aid these discussions:

There are no quick fixes in conservation management, so to increase scores and increase species diversity the best methods will take time.

Low score for 'Tree species' and 'Age of trees':

How do you increase the amount of species and mixture of ages of native species?

Natural regeneration of trees from seeds already in the soil is the best choice, but also the slowest choice. By allowing natural regeneration the local gene pool is retained and these are the genes that will be best adapted to this site. Planting tree saplings is a faster option which would speed things up, so in some circumstances this may be beneficial. However bringing in genes from other areas dilutes the local gene pool, and could lead to the loss of some local genes. These genes could be the very ones that could help a species adapt to climate change in the future. Bringing in tree saplings from other areas might also bring in diseases that the present trees cannot cope with.

How do we encourage natural regeneration?

- 1 By providing balanced grazing within the area. Too much grazing (from deer, sheep, voles etc) will discourage regeneration of trees, whilst too little grazing will encourage fast growing tree species (e.g. birch, sitka spruce) to take over the area (as in photocards B and D), smothering the regeneration of slower growing species (e.g. oak, hazel).
- 2 By allowing more light to reach the ground to allow regeneration growth. This can be done by thinning trees (especially if there is a dense stand of young birch or conifers).

Low scores for 'Lichens' and 'Mosses':

How to increase the abundance and diversity of lichens and mosses:

- 1 By increasing the diversity and ages of tree species (see Table 1. 'Age and species of trees', re. bark acidity page 4).
- 2 By ensuring balanced/medium grazing levels. Too much grazing will reduce humidity levels, needed for the health of lichens and mosses, but too little grazing will shade out lichens and mosses, so they cannot photosynthesise (produce food).

Low scores for '% Clear sky':

Low scores for % clear sky either means there is a very high or very low canopy cover.

How to achieve a medium canopy cover:

To decrease the percentage of clear sky you need to increase regeneration.

To increase the percentage of clear sky you would need to thin out the trees.

In general, medium light levels ensure a good mixture of both lichens (which like the light and are readily found on woodland edges like paths and glades) and mosses (which prefer more shady conditions). However across a whole wood we actually need a good range of light levels, from low to high – allowing for a mixture of plant and invertebrate species.

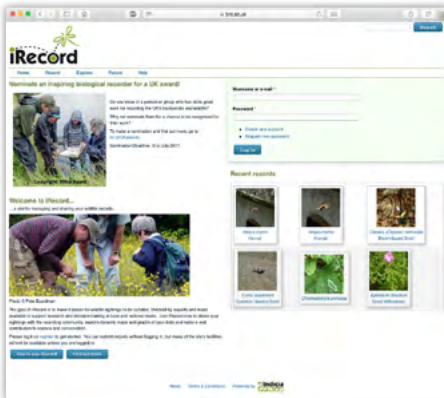
One score gives a very localised result as % clear sky can vary within a few metres. So discuss how you could improve the accuracy of this result (e.g. pooling class results).

This score will vary depending on when you do the survey – between May and September when the trees are in leaf is best.

Low scores for 'Watercourses' and 'Rocks/boulders':

Re-landscaping a habitat would be time consuming, costly and could harm the forest more than help it. Unfortunately, these scores cannot be increased. But a good conversation can be had around whether we could bring in boulders / re-divert streams? Is it economical? Is it ethical? What would the consequences be?

As previously mentioned there will be some woods that will never be able to achieve maximum marks due to not having these pre-requisites. But that does not mean that management cannot be altered to increase diversity if that is required. Not having boulders and watercourses does not mean that the woodland is not good. It might mean it is not able to provide conditions for the rarest moss species, but it can still be a good habitat for the commoner rainforest mosses and lichens.



Enter lichen data into iRecord

How to enter your lichen species results into the 'Scottish Epiphyte Community Survey':

- 1 Go to: <https://www.brc.ac.uk/irecord>
- 2 Create a **New Account**
- 3 Once registered click the '**Record**' tab
- 4 Then click '**Activities**' tab
- 5 Then click '**Browse all activities**' tab
- 6 Enter '**Scottish Epiphyte Community Survey**'
- 7 Click '**Enter epiphyte records**' button
- 8 At this point you can enter the details of the lichens that were found during the survey. One record is required for each tree that had one or more of the four highlighted lichens on it. Multiple records from different trees can be added for the same location, one at a time. If you found more than one type of lichen on the same tree, you can record all those lichens under the same record
- 9 For each record submit:
 - Date of survey
 - Location name (recognisable from an Ordnance Survey map)
 - Spatial reference – i.e. a six figure grid reference using the British National Grid system (BNG). If not recorded in the field you can use the digital map supplied to help you
 - Species of the tree that lichen/s was/were found on
 - Girth of tree trunk (in cm) at a height of 1.3 metres
 - Upload photo of tree if you have one
 - List the species of lichen/s found on your tree
 - Where they were found (trunk or branches)
 - Upload photos of the lichens
 - **SUBMIT** your record!
- 10 If you want to 'Join' the Scottish Epiphyte Community Survey and view other people's lichen records and distribution maps; when 'browsing all activities' (points 5 - 6.), instead of 'Enter epiphyte records' hit the '**star**' icon in '**Actions**' which will take you to a page where you can '**Join**'.



Resources list

Tree Guides

- <https://www.opalexplorenature.org/treesurvey> and scroll down to 'Tree Identification Guide'
- <http://www.woodlandtrust.org.uk/naturedetectives/activities/2015/09/leaf-id/>
- <http://www.woodlandtrust.org.uk/naturedetectives/activities/2015/06/leaf-idial/>
- <http://www.woodlandtrust.org.uk/naturedetectives/activities/2015/09/twig-id/>
- A tree ID app to use on your mobile phone: <http://www.woodlandtrust.org.uk/visiting-woods/trees-woods-and-wildlife/british-trees/identify-trees-with-our-tree-id-app/>
- <http://www.field-studies-council.org/publications/fold-out-charts.aspx> and scroll down to find the 'Tree Name Trail'

Lichen Guides

- Scotland - Atlantic woodland lichens found on ash, hazel, willow, rowan and old oak. <https://www.plantlife.org.uk/uk/our-work/publications/lichens-atlantic-woodlands-guide-1-lichens-ash-hazel-willow-rowan-and-old-oak>
- Scotland - Atlantic woodland lichens found on birch, alder and young oak. <https://www.plantlife.org.uk/uk/our-work/publications/lichens-atlantic-woodlands-guide-2-lichens-birch-alder-and-oak>
- Wales - Atlantic woodland lichens found on ash, hazel, willow, rowan and old oak. <https://www.plantlife.org.uk/uk/our-work/publications/lobarion-lichens-welsh-atlantic-woodlands>
- Wales - Atlantic woodland lichens found on birch, alder and young oak. <https://www.plantlife.org.uk/wales/our-work/plantlife-library/parmelion-lichens-welsh-atlantic-woodlands>
- South-west England - Atlantic woodland lichens found on ash, hazel, willow, rowan and old oak. <https://www.plantlife.org.uk/uk/our-work/publications/lichens-of-atlantic-woodlands-in-the-south-west-guide-1>
- South-west England - Atlantic woodland lichens found on birch, alder and young oak. <https://www.plantlife.org.uk/uk/our-work/publications/lichens-of-atlantic-woodlands-in-the-south-west-guide-2>

Bryophyte Guide

- Scotland – Mosses and liverworts in Atlantic woodlands <https://www.plantlife.org.uk/uk/our-work/publications/bryophytes-atlantic-woodlands-guide-1-woodland>



Glossary

Ancient Woodland – this is land that has been continuously forested since 1600 in England and Wales and 1750 in Scotland and these forests have a high biodiversity value.

Ancient Woodland Indicator – certain plant and lichen species have a strong link to ancient woodlands and are useful as biological indicators. The number and abundance of these species in a wood can help assess the age of the wood. They are slow to colonise an area and are therefore less likely to be found in new woodlands.

Biodiversity – the variety of plant and animal species in a habitat.

British National Grid (BNG) – this is the map reference system used on all Ordnance Survey maps. It is used to identify the position of a feature on the map.

Bryophyte – collective name for mosses and liverworts – small, green non-flowering plants that produce spores. These plants are also non-vascular, meaning they do not have a transport system for carrying water and minerals like other plants.

Canopy – this refers to the upper living layer of a forest; i.e. the upper leaves of the trees and can be used collectively for all the trees, or just for one tree.

Epiphyte – A plant that grows on another plant. Unlike a parasite, it does not harm the other plant; it just uses it for support to grow on.

Lichen – Lichens are a combination of at least two organisms in one; a fungus and a photosynthetic partner, most commonly an alga. The fungus provides the structure of the lichen (protecting the alga), whilst the alga makes the food via photosynthesis. This close relationship is known as mutualism, where each party benefits.

Liverwort – a small green non-flowering plant that can either have a leafy moss-like structure or a flat structure. Leafy liverworts have two ranks of leaves either side of their stem.

Moss – a small green non-flowering plant that grows in mats or clumps. Mosses have small leaves that grow all around their stems.

Photosynthesis – the process by which plants are able to harness the sun's energy to make sugars, i.e., food.

Predation – the act of one animal hunting and feeding on another animal. This is an important role within an ecosystem as it keeps prey species at sustainable numbers.

Regeneration – the process by which shrubs and trees naturally grow from seedlings in a forest.

Temperate Rainforest – a pre-dominantly (but not exclusively) coastal forest found within a mild, wet climate, between the tropical and polar zones of Earth.

Topography – the surface features of the land e.g. hills, ravines.



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Red eyed tree frog (page 8): MD Wazid Hossain/iStockphoto.com

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