The OPAL Air Survey

By OPAL Air Centre, Imperial College London and British Lichen Society

Introduction

Good air quality is important. It is essential for our health and for the health of the natural environment. Although air quality in Britain is better today than it has been for many decades, pollutants can still reach levels which can cause harm to human health, food supplies, water quality and biological diversity.

About the Air Survey

By joining in the OPAL Air Survey, and submitting your results to the OPAL website (www.OPALexplorenature.org), you will be helping to build up a detailed picture of the impact of air quality in your local area and across the country.

The OPAL Air Survey has two parts:

- Activity 1 uses lichens on trees
- Activity 2 uses a fungus (*Rhytisma*) that causes black spots on sycamore leaves

These activities do not have to be carried out in the same place or at the same time.

Instructions for carrying out both parts of the OPAL Air Survey are on this chart. The A4 workbook includes tables in which to enter your results. This symbol indicates when you need to write something down.

Before you start the survey please refer to the workbook where you will find more detailed instructions and background information.

Record in the workbook any insects or other creatures you find on the tree during your survey.

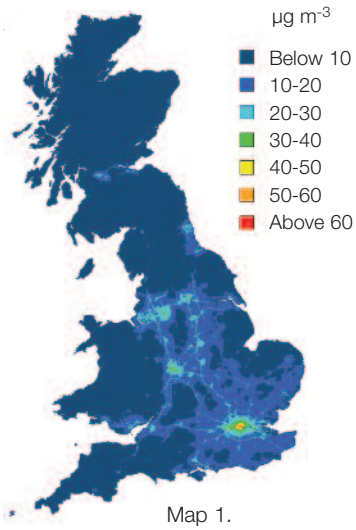
Air pollution

We are particularly interested in two types of pollution which contain nitrogen: ammonia and oxides of nitrogen (nitric oxide and nitrogen dioxide).

Look at the national maps for nitrogen dioxide and ammonia (Maps 1 and 2). Are levels of nitrogen dioxide and ammonia high or low in your area?

You can find out more information on air quality where you live or work by visiting the website www.airquality.co.uk

See page 2 of the workbook to find out more about the sources of these pollutants.



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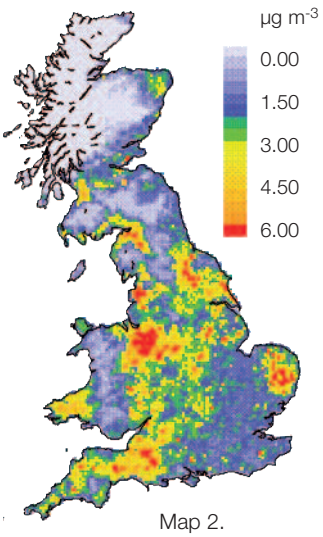
Map 1.
Nitrogen dioxide in Britain
(average concentrations for 2007)



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Map 2.
Ammonia in Britain
(average concentrations for 2005)

The survey starts here

Safe fieldwork

We don't advise you to work on your own. Take a responsible friend who can help with your survey, and in case things go wrong. Make sure that you know what to do in an emergency. Be careful not to trip over tree roots. Watch out for low-hanging branches and falling branches. Take care to avoid twigs in the eye, and be sure not to damage any tree, its twigs or branches.

Try to carry out the survey when the weather is dry (as some lichens change colour in the rain).

Essential equipment to take outside with you

- This pack which contains: the fold-out chart, workbook, Tree Chart, OPAL magnifier
- A tape measure (or string and the ruler below)
- A pencil or waterproof pen

Useful items to take outside (if you have them)

- A map and GPS device if available
- A mobile phone
- A camera

When you are ready to start the survey, turn over the chart for instructions on how to begin the first activity

Guide to **indicator lichens**

Can you find any of these lichens?

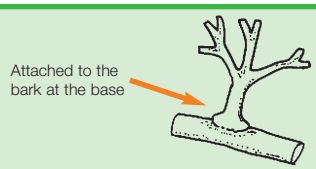
Look for the nine lichens in the photographs

Nitrogen-sensitive lichens are outlined in **blue**

Nitrogen-loving lichens are outlined in **red**

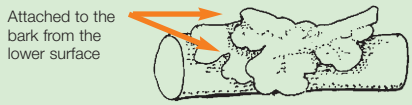
Intermediate lichens can be found in clean and polluted conditions and are outlined in **grey**

The nine types of lichen shown in the photographs are all bushy or leafy.



Bushy lichen

Branched and shrub-like, attached to the bark at the base

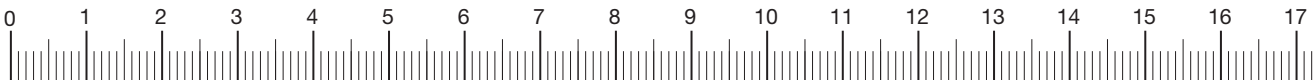


Leafy lichen

Leaf-like lobes closely or loosely attached to the bark from the lower surface

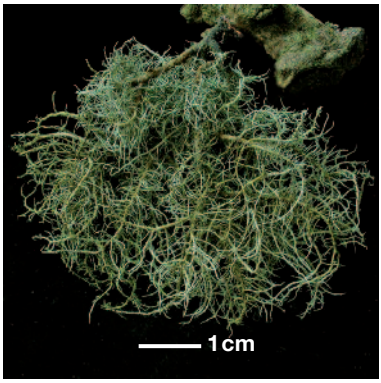
Crusty lichen

Closely attached as if pressed on the bark. Crusty lichens are difficult to identify, so are not included in this survey, but you can find pictures of some on the OPAL and iSpot websites



Nitrogen-sensitive

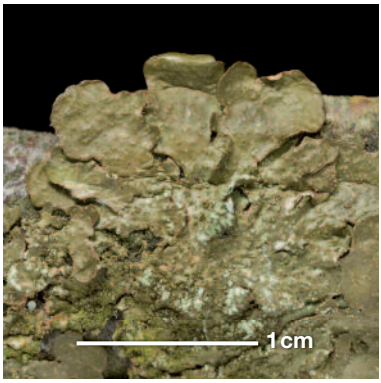
1. *Usnea*



- branches thread-like
- grey-green all round

Intermediate

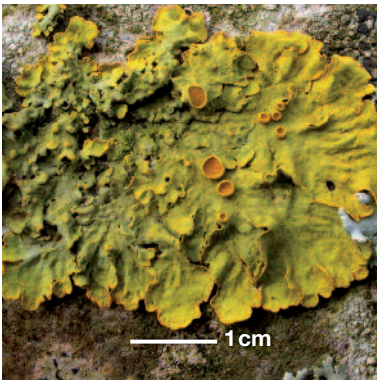
4. *Melanelixia*



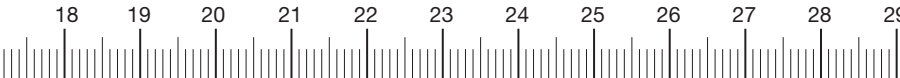
- dull brown lobes, closely attached to the bark
- paler areas show when surface is rubbed

Nitrogen-loving

7. Leafy *Xanthoria*



- lobes broad and spreading
- lobes yellow/orange to greenish yellow
- orange fruiting bodies often present



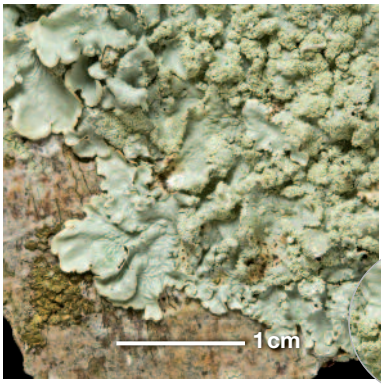
Nitrogen-sensitive

2. *Evernia*

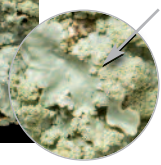
- lobes flattened, strap-like
- grey-green on top, white below

Intermediate

5. *Flavoparmelia*



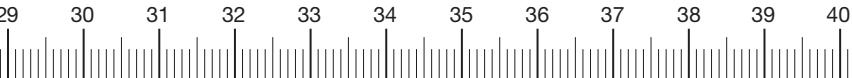
- broad, apple-green lobes
- wrinkled surface on which powdery spots may develop



Nitrogen-loving

8. Cushion *Xanthoria*

- lobes small and clustered
- lobes yellow to green-grey
- orange fruiting bodies usually present



Nitrogen-sensitive

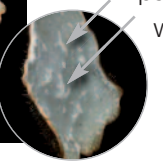
3. *Hypogymnia*

- lobes greyish on top, pale brown below
- lobe ends often become powdery
- lobes puffed up and hollow

Intermediate

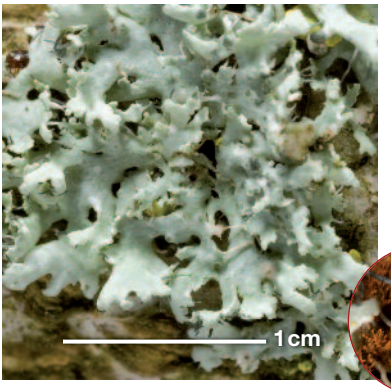
6. *Parmelia*

- lobes thin, loosely attached to the bark
- lobes grey on top, dark brown below
- pattern of white lines on the surface

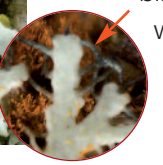


Nitrogen-loving

9. *Physcia*



- lobes grey on top, whitish below
- lobe ends raised up becoming powdery
- black-tipped whiskers on the lobe edges



FSC

Activity 1: Lichens on trees

Why lichens?

Lichens have long been known to be sensitive indicators of air quality. They were used in the past to map areas affected by sulphur dioxide pollution from industrial and domestic sources. Today, lichens occur widely in our towns, cities and countryside, on a diverse range of surfaces from concrete pavements to park and woodland trees. This survey will help us find out how lichens are being influenced by current atmospheric conditions.

Indicator lichens we are looking for

We have selected nine lichens that can be used as indicators of local air quality. We know that some lichens are sensitive to nitrogen in the form of ammonia or nitrogen oxides (so called 'nitrogen-sensitive' lichens), and that they are unable to survive in areas with high levels of these pollutants. Others thrive with increased levels of nitrogen compounds ('nitrogen-loving' lichens), and yet others (intermediates) can be found in both clean and polluted conditions. Help us to map these indicator lichens on trees across the country.

Lichens on trees

Lichens on trees will vary with bark type and the age of the bark, as well as with air quality and climate. Lichens on the trunks of older trees may have been there for many years, while young trees or twigs may support lichens that have recently colonised new bark. We would like you to help us find out if the lichens on the trunk (the oldest part of the tree) are different from the lichens on the twigs (youngest part of the tree). Do trunks or twigs have more pollution-sensitive indicator species?

Record your results in the workbook (pages 6–7) as you carry out your survey, and do not forget to enter them into the OPAL website at the end.

A Site characteristics

First choose your site. Look for a site with deciduous trees (use the enclosed Tree Guide) and lots of light. We suggest oak, ash or sycamore. Avoid evergreen trees and trees which are heavily shaded (e.g. beech and horse chestnut) or covered in ivy. If sampling in woodland, use trees at the edge rather than the centre. Choose 2–4 trees of the same type if possible.

Answer Questions 1–7.

B Tree characteristics

Record for each tree:

- the type (species) of tree, or answer 'unknown' if you are not sure
- the girth of the trunk at 1 m above the ground

Measuring girth

C Record indicator lichens on the trunk

Choose the side of the trunk with the most lichens. Focus just on the lichens at 50–200 cm above ground level.

Although there may be many different types of lichen growing on the trunk, we are only interested in the nine indicator lichens shown in the photographs overleaf.

Don't spend more than about 10 minutes on each tree trunk.

Examining lichens 50–200 cm above the ground

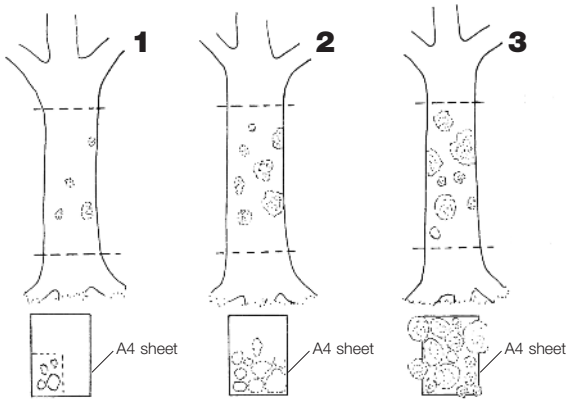
Record the total amount of each indicator lichen you see on the side of the trunk you have chosen as follows:

0 None (this is an important result)

1 Small amount overall (amounting to less than ¼ of an A4 sheet of paper in total)

2 Medium amount overall (amounting to between ¼ up to one A4 sheet in total)

3 Large amount overall (more than one A4 sheet in total)

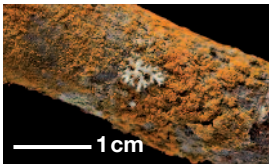


Count how many other types of lichen there are.

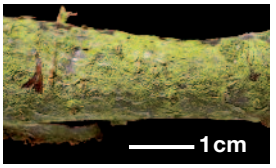
Record this number in the table.

Look for green or orange algae on the trunk.

Record in the table any algae you find.



Orange alga



Green alga

Record any insects or other organisms you find on the tree (illustrated on page 7 of the workbook). You can find more information and help with identification on the OPAL website.

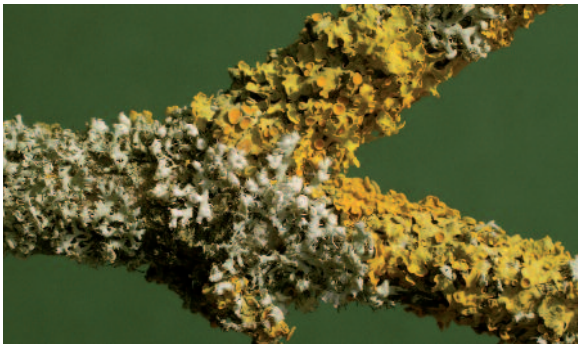
D Record lichens on twigs

Can you reach the twigs? If so, check if any of the indicator lichens are present. Don't spend more than 5 minutes looking.

- Avoid dead or fallen twigs
- Only record from twigs under 2 cm in diameter up to a length of 1 m

Take care to avoid twigs in the eye!

Nitrogen-sensitive lichens



Nitrogen-tolerant lichens

Record the presence of indicator lichens with a tick (✓). Enter zero (0) for each indicator species which was not present when you looked.

If there are green or orange algae on the twigs enter a tick in the box.

E Complete your survey

Upload your results to the OPAL website

www.OPALexplorenature.org

There is a map on the OPAL website to help you find your location and postcode.

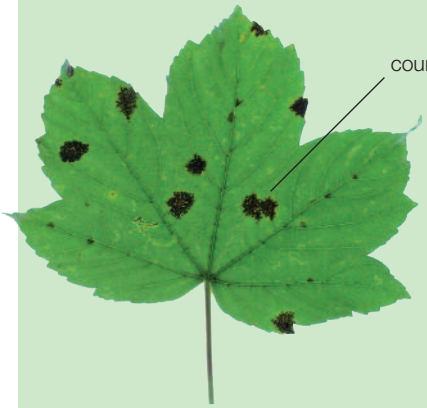
End of Activity 1

Activity 2: Tar spot of sycamore

You may have seen 'tar spots' on the leaves of sycamore trees. These are caused by the parasitic fungus *Rhytisma acerinum*.

The fungus is widely distributed across England; fungal spores spend the winter in dead leaves on the ground and infect the tree's new leaves in late spring. After infection the disease develops into large, easily identified black spots ('tar spots'), up to 15 mm wide, in July and August.

Many factors affect the performance of fungi, including climate and air pollution. Studies have shown that tar spot fungus is reduced by sulphur dioxide and oxides of nitrogen. This means that where there are more tar spots, it is likely that the levels of these pollutants will be lower.



Sycamore leaf with few tar spots (number of tar spots = 9)

Sycamore leaf with heavy tar spot infection (number of tar spots = 46)

Record your results as you carry out your survey (Page 8 in the workbook)

A Site characteristics

Choose 2–4 sycamore trees. Use the enclosed Tree Guide to help you. There is no need to remove any of the leaves. Either choose leaves still attached to the tree or collect fallen leaves from under the tree. You do not have to carry out the tar spot survey in the same place as the lichen survey.

Answer Questions 1–3.

B Tree characteristics

Record for each sycamore tree:

- the girth of each trunk at 1 m above the ground
- the amount of fallen leaves lying under each tree (0 = no fallen leaves, 1 = a small amount of fallen leaves, 2 = lots of fallen leaves) – see photographs below

C Record leaf information

Choose 10 leaves randomly from each tree. Record for each leaf:

- the number of tar spots, including any partial (not full) spots
- the width of the leaf (in cm) at its widest point – use the ruler on the other side of this chart

D Complete your survey

Upload your results to the OPAL website

www.OPALexplorenature.org

End of Activity 2

Designed by FSC Publications
www.field-studies-council.org

What do your results mean?

Activities 1 and 2 give us new information about species that are sensitive to two different types of air pollution – ammonia (mainly from agriculture) and oxides of nitrogen (mainly from traffic and energy generation).

For lichens, when you enter results on **www.OPALexplorenature.org**, a score is calculated which can be compared with a national scale.

Where there are plenty of nitrogen-sensitive lichens on tree trunks, there is likely to be no intensive farming, dense traffic or heavy industry.

In contrast, in areas where nitrogen-loving species (like *Xanthoria* and *Physcia*) are abundant, levels of nitrogen-containing pollutants are likely to be higher.

High numbers of tar spots on sycamore leaves may also indicate relatively clean air.

More information about what your results mean can be found in the accompanying workbook.

If you would like help with lichen identification visit the iSpot website (**www.iSpot.org.uk**) or use the links on the OPAL webpages.

Tree trunk at the edge of a field fertilised by cow manure. Nitrogen-containing pollutants from the manure have increased the abundance of nitrogen-loving species of lichen

Tree trunk on the edge of woodland away from sources of nitrogen, where the air is relatively clean. Nitrogen-sensitive species of lichen are abundant

OPAL EXPLORE NATURE

Open Air Laboratories (OPAL) is a partnership initiative which is encouraging people to spend more time outside understanding the world around them. OPAL wants to get everybody involved in exploring, studying but most of all enjoying their local environment. OPAL will be running a programme of events and activities until the end of 2012. To find out more about events in your region please visit the website: **www.OPALexplorenature.org**

Supported by The National Lottery® through the Big Lottery Fund

Photographs by: Harry Taylor[2], William Purvis[2], Barbara Hilton[2], Ann Allen[2], James Cook[1], Emma Green[1]. Text by: Sally Power[1], Pat Wolseley[2,3], Barbara Hilton[2], Linda Davies[1,2], Nigel Bell[1], Nathan Callaghan[1], Emma Green[1]. [1] Imperial College London [2] British Lichen Society [3] Natural History Museum

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