

Advisory Note 5

An introduction to Climate Change

In this Advisory Note we unpack some of the issues underlying “climate change”. The climate is a complex system. Projections of future global climate are based on models with all the inherent uncertainties that these entail, and cannot possibly predict with complete accuracy. Scaled down to a local level, predictions become even harder. However, these models are useful in that they can help us to anticipate change and to build flexibility into our environmental management systems. The important issue here is that change is happening and that we need to be ready to respond.

What is climate change?

The climate is the average weather in a place recorded over long periods of time. The climate is generally described in terms of the amount of rainfall, minimum and maximum temperatures, the relative humidity and wind speed and direction. The earth's climate is a dynamic system, it is always changing. However, human activity has influenced this system and is driving it in a rather worrying direction. Land use change such as deforestation to make way for agriculture, heavy industrial processes such as cement production and parents doing the daily school run in the car, all these things and more influence the climate. Why? Because they change the dynamics of the global climate system in many ways. Of these, the one most often associated with the “climate change” debate is the release of “greenhouse gases” into the atmosphere.

Greenhouse gases such as carbon dioxide and methane absorb heat and when they accumulate in the atmosphere they act as an insulating blanket preventing heat from leaving the planet, so the earth gradually heats up, hence the term “global warming”. Since the climate system is so complex, it is hard to predict exactly how it will react to warming and changes to atmospheric composition. All we can do is to build models as best we can to generate predictions. At the present time all forecasts suggest significant and damaging changes, possibly even if we reduce our emissions to zero now.

How do we know that climate change is actually happening?

The Intergovernmental Panel on Climate Change (IPCC), is a global group of scientists tasked with

evaluating the risks posed by climate change. The IPCC evaluates scientific research and has built up a picture of the link between human activity and the global climate system. They have assessed the scale of our contribution to climate change, the impact of anticipated changes on the planet and our options for mitigation and adaptation (see below). However, when we talk of climate, we are not talking about the weather you experience but long term changes to averages and the patterns of weather. The IPCC are continually monitoring and they conclude that long term trends show our planet is heating up. Evidence for this is in the faster rate of glacial melting, the reduction in Arctic ice during the summer months, spreading desertification, the increase in devastating floods and sea level rise, to mention a few.

Summer floods are predicted to become more frequent



So, the run of cold winters and miserable summers we experienced in Britain during 2008-2011 does not mean global warming isn't happening – it is in fact more likely to be a consequence of warming changing the northern hemisphere jet stream which in turn, is bringing cold air from the Arctic over northern Europe. The recent spate of floods and summer storms are also likely to be a consequence of increasingly violent weather driven by warmer air. But don't get distracted by debate about local details – it's the big picture we need to consider. The UK Climate Impacts Programme (UKCIP) uses much of the data produced by the IPCC and information collected from the UK Meteorological Office, to build models to create projections of climate change for the UK. These are then used to influence

planning decisions and to implement measures to reduce our greenhouse gas emissions.

Intergovernmental Panel on Climate Change (IPCC):
www.ipcc.ch

UK Climate Impacts Programme (UKCIP):
www.ukcip.org.ukreduce

The big freeze! Winter 2010-11



Mitigation and Adaptation

Broadly speaking, we have two main options faced with a changing climate: we can try to reduce the worst impacts by reducing the level of greenhouse gas emissions released by human activity, a process known as mitigation. We can also prepare for the changes that will come (and are already happening) by adapting society and supporting and nurturing ecosystems to make them more resilient to climate (and other sources of) change. Both mitigation and adaptation measures will influence the way we manage woodlands in Wales.

In terms of climate change, mitigation is a human intervention in the levels of greenhouse gas emissions to and from the atmosphere. This intervention can be in the form of reduced emissions, for example, moving to renewable sources of energy that emit less carbon dioxide. Or, mitigation can be working to increase the absorption of carbon dioxide in the earth's natural sinks, such as forests (see carbon sequestration below).

Adaptation can be seen as an adjustment to rather than an intervention in the drivers of climate change. These adjustments can be proactive or reactive to threats posed by climate change and other changes. Examples of adaptation measures are improving coastal defences in Wales to cope with changes in sea levels and increased storms or increasing habitat connectivity to allow species to move as the climate changes.

Both actions are important as we need to control the levels of emissions created by human activity and

build climate change into our planning and future strategies.

Carbon Sequestration

Carbon sequestration is the absorption of carbon dioxide from the air. Plants effectively capture gaseous carbon and turn it into wood, leaves, roots and fruit. Some of this material acts as a store of carbon - classically as wood, while some ends up stored in soils as humus and peat. Carbon sequestration therefore has a role to play in mitigation if we can manage plants to reduce atmospheric levels of carbon dioxide. Basically, using plants to take carbon out of the air and turn it into a solid form. Trees are central to much discussion on sequestration as wood is carbon rich, represents a carbon store as standing trees and when used as timber for construction, sequesters carbon in the built environment over long periods of time. However, although conceptually simple and appealing, valuing the contribution that forests make to climate change mitigation has been the subject of much controversy and debate.

Carbon Trading

Carbon trading is a market based response to climate change. It is the buying and selling of carbon. The basic principle is that if you want to emit carbon dioxide (from say a coal-fired power station) then you can offset this by paying someone else to store the equivalent amount of carbon (e.g. from a re-forestation project). Carbon trading is a prominent feature of international mechanisms to reduce emissions such as the Kyoto Protocol and much of the latest UN talks have focused on ways of bringing forestry into the carbon market. There are huge problems here with monitoring, policing and the legitimacy of green projects, not to mention the impact on indigenous forest peoples. Carbon trading has turned carbon into a tradable commodity but has yet to demonstrate any large scale impact on carbon stores.

For more information on carbon sequestration and trading:

Forestry Commission Wales, Woodland Carbon Code:
www.forestry.gov.uk/forestry/infd-84hl57

FERN publication on Carbon Trading:
www.fern.org/tradingcarbonChange

What does climate change mean for woodlands in Wales?

According to the climate models provided by the UKCIP, the future climate scenario for Wales is warmer, drier summers and milder, wetter winters (the winters of 2009-2010 being an exception!). The

likelihood of summer drought may increase, particularly in the south of the country. There may be increased frequency of high-intensity rainfall with a greater chance of flooding, landslides, soil erosion and the sedimentation of water courses. Coastal areas and estuaries could be affected by rising sea levels. The chances of extreme weather events such as intense storms could increase.

So, what does a changing climate mean for trees, forests and woodlands in Wales? Well, a warmer climate and increased CO₂ in the atmosphere could create better conditions for tree growth in Wales. However, extreme weather events such as severe floods or drought could create adverse growing conditions and put more stress on trees. The warmer, wetter conditions could also be ideal for new pests and diseases and these combined with summer drought and winter flood stress could spell disaster for our forests, whether they are conifer or broadleaves. However, there is a lot of uncertainty within climate models, so we do not know exactly what will happen or how trees themselves will respond, but the best thing to be is prepared for change.

Forestry Commission Wales:

[http://www.forestry.gov.uk/pdf/fcrn301.pdf/\\$FILE/fcrn301.pdf](http://www.forestry.gov.uk/pdf/fcrn301.pdf/$FILE/fcrn301.pdf)

Warmer years and colder winters

The big winter freeze of 2010 spells disaster for the global warming theory! Many have used this cold winter to discredit the science of climate change, it is hard to believe in a warming planet when the streets are covered in ice. Such a cold season challenges the UKCIP data that predicts warmer, wetter winters.

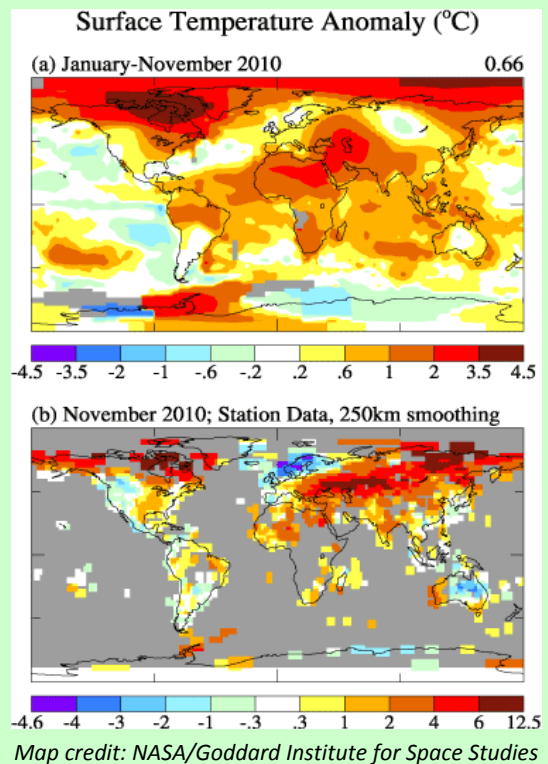
However, if you look a little deeper and wider, the cold of 2010 was most likely a consequence of climate change, not in spite of it. The Goddard Institute for Space Studies, a NASA department that carries out a lot of research into climate change, states that globally, January to November 2010 was in fact the warmest for this period in the 131 years of measurement.

If you look at the maps below you will see the frozen white and blue of Northern Europe surrounded by dark red high temperatures over Northern Canada and the Middle East. What we experienced is a relatively small pocket of cold – what could have caused this? Winter weather in the UK is controlled by two areas of pressure, the Azores High and the Icelandic Low, the changes in pressure between these two zones is known as the North Atlantic Oscillation. When the pressure difference between these two is great, winds are sucked in from the South West, bringing milder, wet weather in from over the Atlantic. When the pressure difference is much lower, the Atlantic jet stream is weakened and cold weather can be drawn down from the North, the Arctic.

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In November 2010, warming of the Arctic meant there was less sea ice that normally reflects light and heat back into space. This increased the air pressure in the Icelandic low and reduced the pressure difference between the Azores High and the Icelandic low. This in turn weakened the Atlantic jet stream which drew down cold Arctic air causing freezing conditions in the UK.



For more information on this very complex subject see:
<http://data.giss.nasa.gov/gistemp/2010november/>

Things we can be (almost) certain about are:

Direct impacts of Climate Change:

- Drought induced water stress could slow down a tree's metabolism, reducing the rate of photosynthesis, slowing down the absorption of vital nutrients from the soil and generally reduce growth rates
- Changes in average temperatures could create better conditions for growth but could also mean that seasonal events happen out of sequence with behaviours triggered by daylength such as bud break or the arrival of migratory birds. A process which is termed ecological decoupling.
- Changes in storm intensity mean a greater likelihood of strong winds. This will increase the

risk of storm damage to trees such as wind snap or wind blow.

BUT it is also possible that we will continue to experience colder weather as the global air circulation patterns shift as they did in 2009-10.

Indirect impacts of Climate Change:

- Changing weather patterns may favour the survival and spread of new pests and diseases. Pests such as Spruce Bark Beetle and diseases such as Sudden oak death (*Phytophthora ramorum*) are on the rise and new species could move in to exploit the changing climate.
- A milder climate could lead to an increase in the populations of woodland mammals whose population growth is limited by harsh winters. Deer and grey squirrels can be particularly damaging to trees and woodlands through browsing and bark stripping.
- There will be an increased risk of forest fire, especially if summers become hotter and drier. Severe forest fires have plagued several Mediterranean countries in recent years.

Forest fire in Sitka spruce stand



Woodland management and silvicultural practices will need to change in order to minimise the negative impacts of these changes and to utilise the potential that trees provide for mitigation and adaptation.

What can community woodland groups do?

Read up

Climate change is something to be prepared for but the high levels of uncertainty make it difficult to know what to do. A first step is to find out more about climate change and its impact on woodlands, there's lots of good information out there. Llais y Goedwig has produced a Climate Change Reader that contains more than 40 reports and articles on climate change and woodlands. It's available for purchase on a wooden memory stick or through the Llais y Goedwig website. See the web links for some more reading tips.

Observe

Observation plays a very important role in assessing change in your woods - monitor your woodland. See if there are any changes in the seasonality of events. For example, when does oak bud burst happen? Which species do you have which depend on oak? Are there any changes in these relationships? Monitoring woodland biodiversity can be a great way to get the local community involved and will help you to notice changes in the numbers of or arrival/departure of certain species. However, remember that climate change is about long-term averages so you will need a long series of data to reliably identify trends. But as a community group you are perhaps better placed than most others to set up monitoring which can be continued for long periods of time. As you accumulate your data you will also be learning a lot about the ecology of your woods and there is great satisfaction to be gained from close observation of nature. You can get advice on key species to look out for and contribute your records to the Woodland Trust's Natures Calendar project.

Woodland Trust: www.naturescalendar.org.uk

Manage

Keep your management plans flexible. By observing changes closely, your community group will be able to respond by adapting your management plan to react to what is happening and make your woodland more resilient. It has been shown that woodlands with mixed ages and species of trees are better able to survive shocks than even-aged, single-species stands of trees. Gradual changes to stand structure to favour greater complexity, would be a good step to increase resilience. Think about some of the direct and indirect impacts that climate change will bring. How prepared is your woodland for these? Other Advisory Notes in this series can help you to write a management plan for your woodland.

Promote and plant local provenance trees

Trees grown from local seed (local provenance) are better adapted to local climate and conditions. But what will happen when the local climate changes? Well, it's still worth using local provenance trees. Remember that all native trees have successfully survived the changes that have occurred since the last ice age but this was when forests were bigger and naturally more resilient – they now need our help. Our woodlands are a lot smaller and fragmented so you may wish to hedge your bets and include some trees from other provenances. A well organised tree nursery could also be an ideal place to introduce new provenances in a controlled and monitored way in order to introduce more genetic diversity to your woodland.

<http://www.nativetrees.org.uk/>

http://www.floralocale.org/content_view.asp?did=24093

Decoupling: Oak leaves, caterpillars and Great tits

Great tits lay their eggs at the same time every year triggered by day length and feed their chicks on the caterpillars of winter moths which feed on young oak leaves both of which respond to temperature. In a long term study in De Hoge Veluwe National

Park in the Netherlands commencing in 1985, an increase in average temperature of 2°C at the time of Great tit hatching was observed over a 20 year period. By the end of this period oak buds were breaking 10 days earlier and the caterpillars emerging 15 days earlier than in 1985. So the peak availability of caterpillars is past by the time the Great tits need them and the caterpillars themselves have less to feed on. So the populations of both moths and birds are declining.

Cotton P.A. (2003) Avian migration phenology and global climate change PNAS, October 14, 2003; 100(21): 12219 - 12222.



Baby Blue tits in project bird box. Photo: Bryan Dickinson

The Coetir Mynydd community woodland group is working with Bangor University on the Beacon for Wales funded 'Fast-food birds' project which is helping to answer questions about whether supplementary feeding of Blue and Great tits can improve breeding success. Early results are that access to woodlands is important even if birds are given supplementary food so it may be difficult to compensate for decoupling.

<http://www.engagingwales.org/projects/climate-and-sustainability-rural-communities/fast-food-birds>

Woodland products

One change that we can anticipate is that people will want to buy more products sourced from local woodland. Firewood is an obvious option. What other forest products can your woodland provide? Do you have some good timber trees that could be sold locally? Maybe you are lucky enough to have a bilberry understorey in your woods that could provide the raw material for jam making - it all cuts down on those food miles!

Influence your community (and beyond)

A community group can be the ideal forum for taking action to mitigate and adapt to climate change. If people can see the adverse effects on their local woodland, they might be more inspired to reduce their carbon emissions. Home insulation, choosing renewable energy, sharing resources locally; your community woodland group could become a real low-carbon hub. You could also take things further and lobby your Assembly Member, make a noise about climate change mitigation and adaptation!

Welsh Government:

<http://www.wales.gov.uk/topics/environmentcountryside/climatechange/?lang=en>

More reading: Climate change reader available on memory stick for £7 from address below or online

<http://llaisgoedwig.org.uk/what-we-do/reader/E>



This Advisory Note has been prepared for Llais y Goedwig by Adam Thorogood of Coetiroedd Dyfi Woodlands and Jenny Wong of Coetir Mynydd to accompany Climate change reader.

These are a growing series of Advisory Notes that focus on different aspects that we hope will be useful to our members and others interested in community woodlands in Wales.

Llais y Goedwig is a voluntary association of community woodland groups that formed in November 2009 to provide a voice for community woodlands. We want to share experiences, support each other and enhance local woodlands to benefit the people of Wales.

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