Our line on
climate change

1 Our policy position in short

Climate change is rapidly emerging as one of the most significant issues facing freshwater biodiversity, alongside the major threats of habitat loss and pollution. Global warming is already affecting the UK's freshwater species and habitats and future impacts are expected to be considerable. They include: loss of irreplaceable coastal freshwater habitats to sea-level rise, major changes to the hydrology of many waterbodies, especially those that are shallow or seasonal, and local, regional or national extinction of a wide range of vulnerable plants and animals.

Because the threats to freshwater biodiversity are so significant, a major strand of Freshwater Habitats Trust's strategy over the next 10 years is focussed on helping to 'climate proof' the UK's freshwater environment. We aim to do this through wide-ranging actions that help to improve, extend and link our highest quality sites to create freshwater networks that enable species to move, undertake science to ensure climate change action is knowledge based, and support this with policy and awareness-raising to keep climate change in the news.

1.1 Climate change is….

Climate change is defined by the UK Met Office as the large-scale, long-term shift in our planet's weather patterns or average temperatures[1]. Evidence that the world's climate is now changing rapidly, largely as a results of human activity, is now overwhelming. The main cause is increased greenhouse gasses in the atmosphere, particularly carbon dioxide and methane, exported by burning fossil fuels such as coal, gas and oil. Changes in land-use such as clearing forest (one of the major natural storage 'sinks' for carbon), has also contributed to carbon dioxide levels. With a rapidly warming earth, new feedback mechanisms that could considerably exacerbate climate warming are now coming into play, including the release of large amounts of methane from melting permafrost.[2]

1.2 Climate change thresholds

There is international agreement that the world needs to keep global warming below an average of 2 degrees above pre-industrial levels to avoid dangerous human and ecological impacts. An increasing consensus suggests that we have little chance of achieving this target, even in the short term[1]. The World has already seen just under 1 degree of average warming in the last century and warming close to 1.5°C is likely to be locked into the Earth's atmosphere, and inevitable[3].

Leading up to the December 2015 Paris Climate Conference, countries around the world have suggested self-imposed targets to curb their greenhouse gas emissions over the next decade. Even if these targets are met, the UN's own analysis shows the result will fall far short of what's required: the world will have emitted enough carbon dioxide to warm the planet 2 °C by around 2036, and the International Energy Agency (IEA) and others say that 2.7 degrees of warming is likely by the end of the century, though the estimates range up to 3.5 degrees. [4,5,6,7]

[1] http://www.metoffice.gov.uk/news/in-depth/climate-infographic
[2] Schuur, E. A. G. et al. 2008. Climate change and the permafrost carbon feedback. Nature. 520, 171–179
[3] World Bank Group. 2014. Turn Down the Heat: Confronting the New Climate Normal. World Bank.
[4] http://unfccc.int/resource/docs/2015/cop21/eng/07.pdf
[5] https://www.iea.org/media/news/WEO_INDC_Paper_Final_WEB.PDF
[6] http://climateactiontracker.org/news/224/INDCs-lower-projected-warming-to-2.7C-significant-progress-but-still-above-2C-.html
[7] https://www.climateinteractive.org/tools/scoreboard

1.3 UK Climate effects – what to expect

Warming and wetting trends

Record-breaking high temperatures are now occurring more frequently in the UK. It is predicted that, as climate change continues, all parts of the UK will get warmer particularly during summer. Mean temperatures will be greatest in southern England, and extreme heat events will become more common. Rainfall will become heavier in winter and lower in summer increasing droughts. There will be an increase in the proportion of rain falling in heavy storm events. The extent of all of these changes will be greater with ever higher global greenhouse gas emissions.[8]

Sea level rise

Sea level rise is an inevitable result of rising global temperatures because water expands as it is heated. Since 1900, sea levels have risen by about 10 cm around the UK and about 19 cm globally. The *rate* of sea-level rise is increasing and the Greenland and Antarctic ice sheets, which between them store the majority of the world's fresh water, are both melting at an accelerating rate.[9]

Sea level rise combined with a greater expected number of storm surges could pose a serious threat to the UK's coastal lowlands, particularly to the low-lying areas of Eastern England. Met Office models published in 2009 predicted that sea-level around the UK will rise between 30 and 53 cm between 1990 and 2095, and will continue to increase thereafter.[10,11,12] However, these figures are already out-dated: the IPCC Fifth Assessment Report in 2013 now suggests greater sea level rises, which have yet to be accounted for in UK coastal projections.[13]

1.4 What will stop climate change impacts?

Although further climate change is already locked in to our atmosphere, we can reduce how bad global warming gets. There is widespread agreement that the most urgent requirement is joined up political action at national and international level, to direct, encourage, incentivise and where necessary enforce reduction in greenhouse gas emissions. Specifically: (i) fossil fuels need to be replaced with low-carbon energy sources such as renewables and nuclear power. Carbon-capture technology needs to be rapidly developed, and fitted by fossil fuel power stations (ii) society needs to become much more energy-efficient.

For wildlife, we can do much to help climate-proof the environment so that it is as resilient as possible to climate change, whatever the future may hold.

2 Evidence of risks and benefits to the water environment

There is a considerable and growing body of research showing the current and likely future impact of climate change on biodiversity.[14] The overwhelming conclusion from these studies is that climate change will have a large and predominantly damaging, impact on the environment. Freshwater habitats are amongst the most vulnerable to climate change with the impacts of heat, drought, flooding, sea level rise and societal change likely to degrade and in some cases destroy important waterbodies and wetlands and their communities.

A very brief summary outlining some of the main impacts on UK habitats and species is given below.

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[8] http://ukclimateprojections.metoffice.gov.uk/22549
[9] http://www.metoffice.gov.uk/climate-guide/climate-change
[10] Nicholls, R.J. *et al*. 2011. Sea-level rise and its possible impacts given a 'beyond 4 °C world' in the twenty-first century. *Phil. Trans. R. Soc A*, 369, 161-181.
[11] http://www.ukcip.org.uk/wordpress/wp-content/PDFs/UKCIP_sea-level.pdf
[12] file:///C:/Users/p0010022/Downloads/NE114R-TheBroads-report_tcm6-10436.pdf
[13] IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.
[14] See, for example, reviews at http://www.climate-and-freshwater.info/climate_change and Clarke S (2009) Adapting to climate change: implications for freshwater biodiversity and management in the UK Freshwater Reviews. 2. 51-64

2.1 Sea level rise

Some of our most important freshwaters and wetlands lie in coastal areas where sea level rise poses a very significant threat. Defra estimates that at least 32,000 ha of protected wetlands are vulnerable to incursions from the sea, including the Somerset levels, Norfolk Broads, Gwent levels, Humberhead levels and the Solway firth[15]. Our coastal lowlands were once river floodplains, crossed by many slow flowing channels and pools with their own very distinctive wildlife. Although now drained, the remaining ditches still support an exceptional flora and fauna and are amongst the richest freshwater habitats in the UK. Some areas, including the Norfolk Broads are already showing impacts; with the number of saline intrusions along Broadland rivers and ditches increasing significantly in the since the 1970s linked to storm surges [16] Catastrophic events that overtop sea defences could permanently damage the internationally important fens, lakes grazing marsh ditches and wet woodlands here. [17] The Broad's freshwater pools an mires in coastal dune systems which support uncommon plants and the rare natterjack toad are also at risk through "coastal squeeze" because these habitats are prevented from moving landward in response to sea level rise by floodplain and coastal defences.

2.2 Higher temperatures and drought

There is already evidence that rising temperatures are affecting freshwater wildlife. For example, amphibians are breeding earlier in the year and freshwater phytoplankton and zooplankton blooms are appearing earlier. In some cases higher temperature may be beneficial for individual species, for example, the first case of frogs breeding twice in a year has recently been observed in Cornwall. However, higher temperatures are a concern for many species and habitats. Aquatic invertebrates and fish are susceptible to thermal stress, in part because higher temperatures reduce the amount of dissolved oxygen in the water and climate-related extinctions have already been observed in the invertebrates of small streams in Wales. Predictions from this study suggest that in some cases the abundance of macroinvertebrate is likely to decline by over 20% for every 1°the C rise, and that up to 12% of species may be locally extinct by the 2050s.[18] [19]

For lakes, higher temperatures are likely to lead to higher primary productivity with more intense algal blooms, and greater spread of some alien species and disease. Alder trees in the Broads and elsewhere are already suffering from the effects of the fungi *Phytopthora*; warming temperatures are likely to result in an increased its spread, particularly since trees stressed by drought are also more vulnerable to *Phytopthora*. Similarly, the exotic invasive plant Curly Waterweed *Lagarosiphon major*, which is already widespread in some areas, is favoured by warmer conditions and may extend its abundance and range.[20]

Under prolonged summer drought seasonal waterbodies and their distinctive species are under particular threat. This includes stream headwater communities and the suite of rare mud plants and animals like Yellow Centaury, Coral Necklace, Penny-royal and Fairy Shrimp, which live in ephemerals pools and ruts in traditionally grazed landscapes.[21] Under drought conditions, fire is an increasing threat to wetlands including raised mires and bogs and this risk could be exacerbated by increased recreation or arson attacks, such as the Thorne Moor fires during a prolonged dry spell in 1995 and in 2010.[22]

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15 Defra. 2000. National evaluation of the costs of meeting coastal environmental requirements. R&D Technical Report FD2017/TR. Department for Environment, Food and Rural Affairs, London.

16 Doarks 1990

17 Responding to the impacts of climate change on the natural environment: The Broads NE114R 37

18 Durance & Ormerod SJ. 2007. Climate change effects on upland stream macroinvertebrates over a 25-year period. Global Change Biology. 13 942–957

19 Durance & Ormerod SJ. 2010. Evidence for the role of climate in the local extinction of a cool-water triclad. Journal of the North American Benthological Society. *29 1367-1378*

20 Mckee D.et al. 2002. Effects of simulated climate warming on macrophytes in freshwater microcosm communities. Aquatic Botany. 74 71-83

21 http://freshwaterhabitats.org.uk/projects/million-ponds/pond-creation-toolkit/#Species%20dossiers

22 Wilson R. et al 2013. Assessing the potential consequences of climate change for England's landscapes: Humberhead Levels. Natural England Research Report NERR050

2.3 Flooding

An increase in intense rainfall events will increase the rate of erosion throughout river catchments. This will increase deposition of fine sediments in river channels, with detrimental effects on invertebrates and fish that live or spawn in sands and gravels. Flooding increases the runoff of nutrients causing eutrophication not just in rivers, but in water bodies on the floodplain, polluted during more frequent flood events: an effect that will be compounded in summer by lower water levels and warm temperatures. In more upland areas, flooding may increase the risk of 'bog burst', where the edges of raised bogs or other peatlands slide away.[23]

2.4 Human impacts

The way society responds to climate change will itself have a major impact on freshwater biodiversity. Warmer weather and a longer growing season will inevitably affect the type of crops and amount of land used by agriculture. Research indicates that, in the UK, climate change will increase the area of cropland suitable for agriculture, potentially reducing areas of lower intensity grasslands which are more important for freshwater biodiversity.[24,25] However, there may also be conservation gains if, for example, flood land becomes un-economic for crops and reverts to floodplain grazing marsh.[22] With drier summers, agricultural irrigation demands will be increasingly hard to satisfy, potentially impacting on all groundwater fed waterbodies from shallow ponds, springs and headwaters to lakes and rivers.

In a world of increasing climate stress we don't know what changes in public attitude will be towards wetlands and other wild places. Greater realisation of the importance of the natural world to human health and well-being may bring greater focus on the value of the semi-natural landscapes that are so important for freshwater biodiversity. However, the likely scale and severity of climate-change impacts upon society means that it is inevitable that policy makers and politicians will need to make difficult choices. Ensuring that biodiversity is not neglected when critical decisions are made about managing water resource demands or dealing with increased flood risk is certain to become a major challenge. This may be compounded by concerns (real or otherwise) about the role of wetlands in disease, such as the northward spread of waterborne diseases such as malaria.

2.5 On top of everything else……

One of the greatest concerns about climate change is that its effects come on top of many other stresses to the freshwater environment. Human activities that cause pollution, isolation, habitat change and loss are already degrading aquatic habitats and wetlands to an unprecedented level and compound the vulnerability and difficulties of freshwater ecosystems to cope with, or absorb, impacts of climate change.

2.6 Wildlife responses to climate change

In the face of climate change wildlife can respond in four main ways: species can absorb or take advantage of the new conditions, they can move to more appropriate areas elsewhere, they can adapt or they can decline and die-out.

Results from the Monarch study (Walmsley and others 2007) indicate that certain species will gain suitable climatic space in the North and West whilst losing it in the South. Broadly speaking climate change will encourage species to move to higher ground and to north facing slopes. For example – Dragonfly species at the northern edge of their range in the English midlands have already been able to extend their range northwards, whilst southern European species have colonised for the first time. However at least one northern European species, the White-faced Darter has now become extinct in southern Britain.

[23] http://www.gov.scot/Publications/2006/12/21162303/2
[24] http://www.climateadaptation.eu/united-kingdom/agriculture-and-horticulture
[25] Alcamo J JM. et al. 2007. Europe. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK.

The speed and scale of current climate change is too quick for many species to either move or adapt *in situ*. Species that are particularly vulnerable are cold water species such as some white fish (*Coregonus* spp.), which have survived in upland lakes since the last ice age. However, because of the fragmented and degraded nature of many semi-natural habitats in the UK, a wide range of plants and animals are likely to be vulnerable as their historical habitats become increasingly hostile, and they need to move to new habitats or territories but may not be able to do so. [26] For example: ditch, lake, pond, fen and bog species in the Broads (see 2.1 above) may find themselves unable to move inland because suitable habitats are not available and habitats such a fen and alder woodlands on deep peat soils may well be un-recreatable.[27] There are additional concerns that for species that survive by genetic adaption - i.e. evolve – in response to climate change, there is a cost, because the process slashes genetic diversity which can render species much more vulnerable to extinction.[26, 28, 29]

3. Freshwater Habitats Trust's position

Freshwater Habitats Trust's aim is to ensure that the UK has healthy, diverse freshwater habitats for everyone to enjoy. To achieve this we need to directly address the impacts of climate change so that natural systems can better absorb and adapt to a rapidly warming world. The principles we will follow to ensure that our climate change work is effective are outlined below, based in part on Hopkins et al. 2007 and Lawton et al. 2010.[30,31]

3.1 Our principles

1. Integration. We will ensure that our climate change principles are integrated into all our work, particularly aiming to ameliorate threats, such as pollution and habitat damage that weaken the ability of species to cope with climate change.

2. Working large-scale. Our approach to climate change will focus on promoting large scale responses that build resilience across whole landscapes. This includes:

- *Conserving biodiversity hotspots*, particularly high quality semi-natural habitats that will always remain important because they have characteristics which favour high biodiversity: e.g., low-nutrient soils. Within these areas it is important to ensure that:
  - the full range of species is conserved, together with the broadest spectrum of habitat types (big and small) and their natural physico-chemical, hydrological and ecological variation.
  - the condition of protected landscapes are themselves improved: there is evidence that some (possibly many) high quality and wetland areas are rapidly degrading.
- *Increasing the area of high quality and protected wetland landscapes*: a range of studies show that climate change will require existing protected areas to expand if species are to be saved.[32]
- *Establish regional and national ecological networks.* We need better protection, restoration and creation of semi-natural areas to link existing high quality wetland areas and enable species to move. This includes creation of a wide range of new habitats from clean-water ponds to extensive areas like the Great Fen.[33]

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26 Climate Change Adaptation Manual. 2014. Evidence to support nature conservation in a changing climate. Natural England NE546
27 Natural England. 2008. Responding to the impacts of climate change on the natural environment: The Broads NE114R 56
28 https://www.newscientist.com/article/dn22042-climate-change-drives-salmon-evolution
29 https://www.newscientist.com/article/mg21028102-000-unnatural-selection-the-race-against-climate-change
30 Lawton JH et al. 2010. Making space for nature.
31 Hopkins JJ et al. 2007. Conserving biodiversity in a changing climate: guidance on building capacity to adapt. Published by Defra on behalf of the UK Biodiversity Partnership
32 Shaw et al. DOI: 10.1111/j.1523-1739.2012.01824.x, Wise et al DOI: 10.1111/j.1523-1739.2012.01841.x, Busch et al DOI: 10.1111/j.1523-1739.2012.01838.x

3. **We will adopt a long-term, evidence-based approach to:**

1. Ensure our work is sustainable. For example, that we do not undertake habitat re-creation projects for species or areas which are likely to be lost as a result of climate change. This includes for example (a) species at southern edge of their range and (b) freshwater coastal ditches that are bound to be lost to sea-level rise and where it would be more appropriate to ensure that valuable brackish or saline habitats are created.

2. Ensure that climate change adaption measures are appropriate. For example, although it may seem attractive to develop multi-functional wetlands to provide "water storage, reduce flooding risk and benefit biodiversity", this needs to be approached carefully to ensure there is not net biodiversity damage by polluting existing high quality ponds and wetlands with poor water quality from main rivers, which almost inevitable have high nutrient levels.

3. Include monitoring both of our work and the work of others, to ensure that the effectiveness of climate change mitigation measures is assessed, and that lessons-learnt are rapidly disseminated.

4. Partnership. We will work in partnerships wherever possible – including landowners, other NGOs, statutory organisations and government – to ensure that money, expertise, clout, consensus and vision are brought to the table to support large-scale action for climate change.

3.2 What we'll do

Because of the importance of climate change threats to the freshwater environment, helping to climate-proof the UK's freshwater environment will form a major strand of Freshwater Habitats Trust's work over the next 10 years.

Our main response will be through practical action on the ground which will aim to increase the resilience of the freshwater environment by helping to better protect existing high quality sites, and develop a national freshwater network as outlined in 3.1(2) above. We also think it is important that people everywhere have the chance to see, appreciate and enjoy freshwater habitats and species. This means that we may prioritise our climate change work in areas where newly created or protected habitats can be accessible to many people and widely enjoyed.

In the short term (1 year) our main priorities are:

1. Creating the information tools

Providing biodiversity information: Amazingly there is no database or GIS layer that can show anyone where our most vulnerable aquatic plant and animal species can be found. Making this information widely available is fundamental to protecting these species from climate change impacts and is our first priority.

Identify important freshwater areas (IFAs): Once the location of vulnerable wetland species is superimposed, it's possible to identify areas that are particularly important for wildlife. IFAs provide powerful information that not only shows areas that are a priority for protection, but also identify the biodiversity hubs that can be reinforced and extended to provide landscapes that are more robust to climate change.

Identify national and regional networks: In the long term, the best way to protect freshwater biodiversity from climate change is through a *functioning network* of high quality freshwater habitats. Our aim is to promote the development of such a network across the UK, focussing on building out from the hubs created by IFAs.

2. Practical projects

1. *Protecting the best freshwater sites:* we are already starting to work at 70 of the highest quality sites in England and Wales to ensure that they maintained in good condition, and that their populations of rare species more secure.

2. The next stage is to use these as hubs to build upon the considerable on-the-ground opportunities we already have at these sites to build-out and create larger and more sustainable areas.

3. Our Million Ponds Project is helping to create new clean biodiverse waterbodies that are valuable habitats in their own right, and also act as stepping stones for the future.

4. Our next important goal is to use information from the IFAs (above) to develop and promote major partnership projects with high-level backing to create regional and national habitat networks.

3. Research to provide an evidence base

Monitoring biodiversity, habitat change and the effectiveness of adaptation measures are critical to find out what is happening. Small waterbodies like ponds have been largely ignored in climate change monitoring and our volunteer-based national monitoring network *PondNet* is beginning to fill this gap. In future we intend to extend this information network (WaterNet) to other freshwater habitats, including ditches which are a critical and much undervalued waterbody type. A key element of this work is to make the data available to all, so that its use can be maximised.

Studies that assess the response of the environment to mitigation work are needed across all waterbody types at a landscape level. We have already established monitoring in three catchments to do this as part of our Water Friendly Farming partnership project which looks at biodiversity and water quality, and their response to waterbody improvement measures. We will continue with this work to build the long term data sets that are critical for understanding the effect of climate on the water landscape.

4. Policy

We will continue to work at the highest levels with strategic NGOs, statutory bodies and government to promote large-scale strategic thinking and action on the ground in response to climate change.

We will respond to major consultations relating to water and climate change issues either on our own behalf, or through our NGO umbrella organisation, Blueprint.

5. Housekeeping

We will ensure that our own house is in order so that we minimise our contribution to the high carbon industries that cause climate change.

- we will continue to ensure that our statutory organisational pension scheme does not include investment in fossil fuel companies,
- we will not tacitly support developments that add greenhouse gasses to the atmosphere (e.g. fracking) by endorsing or contributing to mitigation proposals for these projects (see our Fracking Policy Position Statement)
- we will continue to minimise our own use of fossil fuels by using technology such as teleconferencing to avoid travel to meetings, and encouraging staff to use trains and bikes rather than cars and planes.
- we will maintain our knowledge about climate change and its impact on the freshwater environment, and will update this policy statement as appropriate.