

POSTbrief

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Climate Change and Infectious Disease in Humans in the UK

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Climate Change and Infectious Disease in Humans

A possible consequence of long-term change to the UK climate is that species which are vectors (organisms that transmit pathogens that cause infectious diseases) for several diseases that are not native to the UK could establish populations here, or that the geographical ranges and abundance of native species increase. Climate change could therefore influence the prevalence of diseases transmitted by blood-sucking vectors, such as mosquitoes and ticks, but might also include other species. However this is complex, with considerable uncertainties about the potential public health effects. There are theoretical models to predict the influence of increased average temperature and other climate variables on the geographical distribution and size of vector populations. However the transmission of vector-borne disease is not solely dependent on climate change, with other factors such as land use, international trade and travel, and socio-economic factors also relevant, as well as the populations of wild animals, such as deer and birds which are hosts for some vectors.

A report by The International Panel on Climate Change¹ noted that many studies have reported associations between climate and vector-borne diseases. However, while the geographic range of vectors may shift (for example in North America, there has been a northward expansion of ticks that can transmit Lyme disease) there is not always a concomitant increase in the distribution of vector-borne disease. In cases where the prevalence of disease increases, climate change may not be the sole factor driving it. In recognition of the risks to public health, the World Health Organisation recently published a report outlining approaches to harmonise surveillance, prevention and control of invasive non-native mosquitoes.²

Species of Concern for the UK

Mosquitoes

Tropical mosquitoes thrive in warm, wet environments and are very sensitive to changes in rainfall and temperature. A mosquito species (*Culex modestus*) that can transmit West Nile Virus³ was reported in southern England in 2010⁴, although according to an academic study in *Lancet Infectious Disease*, the UK has other endemic *Culex* species that could potentially act as vectors⁵. The

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- 1 [Smith KR et al, 2014, Human Health: Impacts, Adaptation and Co-benefits. In Climate Change 2014: Impacts, Adaptation and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, pp 709-754](#)
 - 2 [Regional Framework for Surveillance and Control of Invasive Mosquito Vectors and Re-emerging Vector-Borne Diseases 2014–2020, World Health Organisation](#)
 - 3 [West Nile Virus - NHS Choices](#)
 - 4 [Golding et al, West Nile Virus Vector *Culex modestus* established in Southern England, *Parasites and Vectors*, 2012, 5:32](#)
 - 5 [Medlock & Leach, Effect of Climate Change on Vector-Borne Disease risk in the UK, *Lancet Infectious Disease* 2015; 15: 721–30](#)

non-native mosquito species *Aedes albopictus* is a vector for dengue fever and chikungunya (a viral infection with malaria-like symptoms). It has already established in temperate parts of Europe (but not yet in the UK), increasing the incidence of these diseases in Europe. *Aedes albopictus* is “expected to become established in northern France (including Paris) in the next few years, creating potential new routes for their importation into the UK”.⁴ The main routes for their movement into Europe are through used tyre imports, along road networks and in the trade of ornamental plants.⁴ Public Health England (PHE) has published a detailed assessment of the risk that chikungunya virus poses to the UK population.⁶ No cases have been locally acquired in the UK so far, but Public Health England have assessed that if mosquito species that can transmit the virus were to establish in the UK the human health impact would be significant. While *Aedes albopictus* could establish in the UK now, some studies involving complex theoretical models indicate that the climate will be more suitable by 2030.⁴ Furthermore, climate change could also make habitats more favourable for other mosquito populations – some of which are native to the UK – as well as the disease-causing pathogens they carry.

Ticks

Some ticks (namely, *Ixodes* species or “hard ticks”) carry the bacterium *Borrelia burgdorferi*. The most common tick is *Ixodes ricinus*, which feeds on livestock, deer, horses, other small mammals and birds. It is commonly found in humid, deciduous woodland, scrubland, urban parks and gardens. A bite from a tick carrying this bacterium can cause the infection Lyme borreliosis (Lyme disease) in humans. This can be treated with antibiotics, but no vaccine is available.

The geographical distribution of other diseases such as tick-borne encephalitis (for which a vaccine is available) and Crimean-Congo haemorrhagic fever virus may also change. The latter is endemic in Africa, Asia, the Middle East, eastern Europe, as well as some parts of southern Europe. A tick species (*Hyalomma* species) that transmits Crimean-Congo haemorrhagic fever is imported into the UK by birds migrating from sub-Saharan Africa, a pattern that has been observed for the last 50 years. Unable to survive in the UK’s current climate, limited by either cooler temperatures or precipitation, it is anticipated by some academics that a drier or warmer UK climate could allow it to establish.⁷

Consequences for Public Health - Lyme Disease

Ixodes ticks are found across the UK. Lyme disease is the major vector-borne disease currently affecting humans in the UK, with an estimated 1,000–2,000 cases of every year. Less common tick-borne infections include some rickettsias and louping ill virus. Public Health England’s Rare and Imported Pathogens Laboratory provides microbiology services to confirm suspected cases of

6 [Qualitative Assessment of the Risk of Chikungunya Virus presents to the UK Population](#), Human Animal Infections and Risk Surveillance Group, 2015, Public Health England

7 Jameson et al, [Importation of *Hyalomma marginatum*, Vector of Crimean-Congo Haemorrhagic Fever Virus, into the United Kingdom by Migratory Birds](#), *Ticks and Tick-borne Diseases* 3 (2012) 95– 99

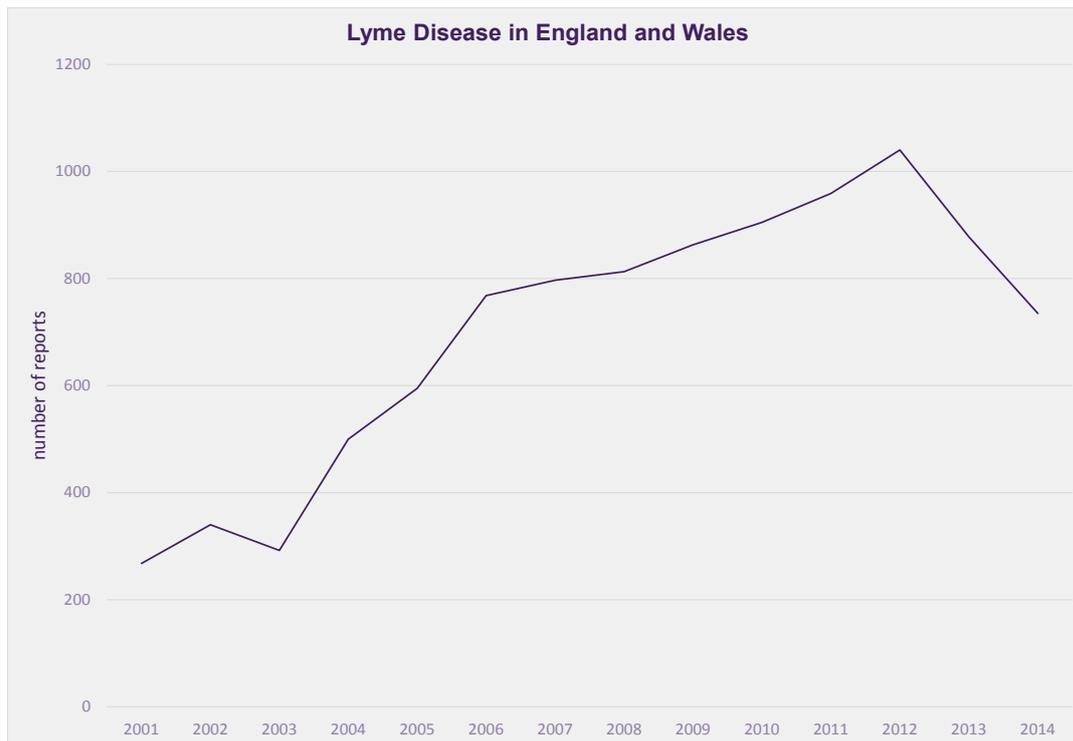


Figure 1. Laboratory confirmed cases of Lyme disease in England and Wales (2001-2014)

Lyme disease in England and Wales. PHE reviews and publishes [quarterly⁸](#) and [annual⁹](#) data on disease epidemiology, demographic information and where known, travel histories, clinical symptoms and exposure to ticks/presence of tick bites.

Figure 1 shows the trend in reported cases that have been confirmed with laboratory tests since 2001 in England and Wales. Data on the mean annual rate per 100,000 population showed an increase from 0.38 in 1997 to 1.73 in 2011.¹⁰ However, rates can be as high as 50 per 100,000 population in some Scottish regions where ticks are more common.¹¹ Data comes from national surveillance (mandatory reporting of reference laboratory diagnoses began in 2010), but the true scale is likely to be higher as many suspected cases are treated clinically, usually by GPs, but are not confirmed with a laboratory test.

Peer-reviewed evidence on tick bite prevention and tick removal has been published in the *British Medical Journal*.¹² Public Health England has several resources on Lyme Disease¹³, including information to increase public awareness of tick bites, recognition of symptoms of Lyme disease and how to minimise the risks of acquiring tick-borne infections.¹⁴

8 [Common Animal Associated Infections \(provisional quarterly figures\)](#), Quarterly Reports 2015, part of the Health Protection Report, Public Health England

9 [Zoonoses Report UK 2013](#), Department for Food, Environment and Rural Affairs and Public Health England, 2015

10 [Lyme Borreliosis Epidemiology and Surveillance, 1 May 2013](#), Public Health England

11 [Epidemiology of Lyme borreliosis](#), Public Health Scotland, 2011

12 [Logan et al, Tick Bite Prevention and Tick Removal](#), *British Medical Journal*, 2013;347:f7123

13 [Lyme Disease: Guidance, Data and Analysis](#), Public Health England

14 [Lyme Disease: Signs and Symptoms](#), Public Health England

Guidance for clinicians has been published by the National Institute for Health and Care Excellence. A Clinical Knowledge Summary outlines the management of tick bites, from tick removal to the clinical treatment of disease with antibiotics and health prevention advice on preventing tick bites.¹⁵ These clinical knowledge summaries are widely used by GPs. As part of national policy to restrict the prescribing of antibiotics, only patients reporting a tick bite alongside clinical symptoms suggestive of Lyme disease should receive antibiotics, in order to prevent progression of the infection while minimising the use of antibiotics.¹⁶

National Surveillance of Vectors

Comprehensive surveillance of species underpins any process that aims to determine the likely risk to public health and how the level of risk might be predicted to change over time. However, without an adequate baseline, it is impossible to monitor changes over time accurately. In addition to surveillance, a detailed understanding is needed of both vector ecology in the UK and of invasive species which are likely to enter the country.

Public Health England's enhanced tick recording scheme and the national mosquito recording scheme, established in 2005, aim to establish the size, distribution and seasonality of populations. These can combine both passive and active approaches. For example, the tick programme asks that people send specimens to the government's Rare and Imported Pathogens Laboratory at Porton Down. However a passive approach alone cannot ensure adequate vector surveillance. Active surveillance programmes between Public Health England and Port Health Authorities are in place to detect invasive mosquito species and targeted at those locations and routes through which they are most likely to arrive. These include airports, seaports and used tyre importers.

Data from academic research is valuable but is sporadic and not comprehensive because of a lack of research funding. The Government collaborates with academic researchers to collect data on vector populations, as well as developing methods for trapping and classifying specimens, measuring the ecological conditions that correlate closely with population presence and abundance, the routes by which species establish in the UK, and identifying the proportion of populations that carry micro-organisms of interest.

The University of Liverpool is collaborating with Public Health England on a [tick surveillance study](#) across England and Wales in 2016. The research is being funded by the [National Institute for Health Research's Health Protection Research Unit in Emerging and Zoonotic Infections](#). A recent academic study of tick prevalence in south London public parks over a two month period in summer 2013, found *Ixodes ricinus* ticks in Bushy Park and Richmond Park, with infected ticks found in the latter, in locations likely to be frequented by the public.¹⁷ This and other studies can inform the development of public health awareness campaigns and target them to those locations where the risk

15 [NICE Clinical Knowledge Summaries, Lyme Disease](#)

16 [Letter from the Lord Prior of Brampton to Lord Patel](#), House of Lords Deposited Paper, DEP2015-0843, 3 November 2015

17 [Nelson et al. 2015, Tick abundances in South London parks and the potential risk for Lyme borreliosis to the general public](#), Medical and Veterinary Entomology, 29, 448-452

to the public is highest.

Correspondence to Lord Greaves from the Parliamentary Under-Secretary of State for Health following a [debate about Lyme disease in the House of Lords](#) on 22 October 2015, indicated that Public Health England would be reviewing the options for enhancing the surveillance of Lyme disease.¹⁸

The use of genetically modified insects to control such populations is the subject of a recent inquiry by the [House of Lords Science and Technology Select Committee](#) and has been the subject of previous briefings by the Parliamentary Office of Science and Technology.^{19,20} However a GM control programme for mosquitoes in the UK is extremely unlikely in the short to medium term.

Strategies to control vectors include the use of insecticides, larvicides, screening, trapping and repellents, all of which could be used if there was an outbreak of a vector-borne disease. However it is not clear how effective these tools would be in the UK, compared with their use in those countries in which such diseases are endemic.

Summary

It is generally accepted that predicting likely risks of vector-borne disease related to average increased temperature with any certainty is extremely difficult, largely because of the complex interactions between vectors and their lifecycles and other ecological and social factors. However there is a consensus in the academic literature that the Government should strengthen and widen existing surveillance mechanisms to monitor species of concern and the mechanisms by which invasive species arrive in the UK. Furthermore, assessing a broad range of factors that give rise to changes in the distribution and abundance of species is needed in order to inform policies to mitigate their effects, particularly from a public health perspective.

18 [Letter from the Lord Prior of Brampton to Lord Greaves](#), House of Lords Deposited Paper, DEP2015-0840, 3 November 2015

19 [Genetically Modified Insects](#), POSTnote 360, 2010

20 [GM Insects and Disease Control](#), POSTnote 483, 2014