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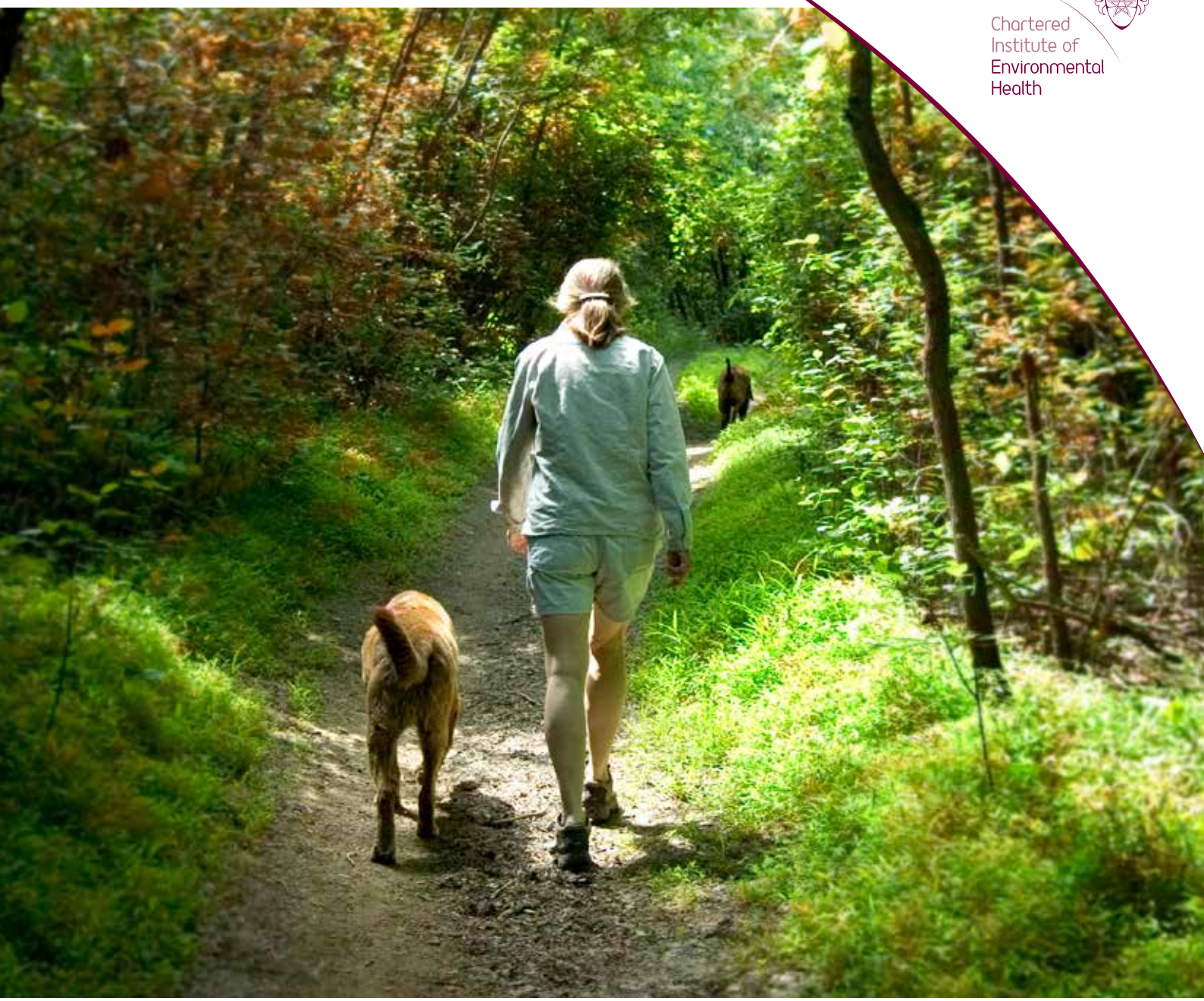


Pest Control Procedures Manual

Ticks - *Ixodes ricinus and Rhipicephalus sanguineus*

Public Health England

April 2016

Foreward

The National Pest Advisory Panel (NPAP) was established in 2001 to provide a UK strategic focus on pest management and provide objective specialist advice and guidance on the subject The Panel is UK wide with an international reach and brings together National agencies, local authorities and industry experts from the Chartered Institute of Environmental Health (CIEH), National Pest Technicians Association (NPTA), British Pest Control Association (BPCA), Natural England, APHA (Animal & Plant Health Agency), MPH (Manchester Port Health), Public Health England, Local Authorities, Pest Control Servicing Companies, Killgerm Group, University of Surrey and 6 leading industry consultants including representation from the Campaign for Responsible Rodenticide Use (CRRU).

The role of NPAP is; to identify strategic and operational, national, regional and local issues effecting the efficient and effective operation of pest management; to provide guidance and raise awareness about the continuing importance of pest control in the maintenance and protection of public health and; to bring these issues to the attention of Government and other bodies and thereby provide the pest management community with a national voice.

NPAP has undertaken and produced a significant array of projects and publications on pest management since it was established. This document is one of the many that can be found on www.urbanpestbooks.com website.

Introduction

Ticks are important to human and animal health because of the role they play in the transmission of diseases. Knowledge of their biology, ecology and the pathogens they transmit is essential for developing appropriate strategies that can help to reduce exposure to ticks and protect against tick-borne diseases. This document aims to provide information for pest control technicians, environmental health practitioners and others who are required to respond to queries regarding ticks and tick-borne diseases or those responsible for managing areas where ticks may be present. Information on two tick species of public and veterinary health importance is included in this document.

Deer/sheep tick-(*Ixodes ricinus*)

The most common tick species in the United Kingdom (UK) is *Ixodes ricinus* (deer or sheep tick) (Figure 1). This species is the principal vector of Lyme borreliosis, also known as Lyme disease. Because of the importance of this tick in the UK, the following information focuses primarily on this species.

Background to ticks - what are they and where they can be found

Ticks are small blood-feeding ectoparasites that are members of the arachnid family. The UK is home to over 20 tick species and although the majority are associated with specific wildlife hosts, some are less specialist parasites and will feed on a wide variety of mammals, birds and reptiles (Table 1). *Ixodes ricinus* feed on a range of animal hosts and also bite humans. As a result, this species can carry various pathogens which are picked up whilst feeding on wildlife hosts, and on some occasions, can be transmitted to humans through a tick bite.

Figure 1: showing larva, nymph, male and female *Ixodes ricinus* size

Table 1.Tick species recorded in the UK and their common and specialist animal hosts

Tick Species	Common Host Species in Britain
Ixodes arboricola (Tree-hole tick)	Favours tree-hole nesting birds like Great Tit *Parus major* and Blue Tit *Cyanistes caeruleus*
Ixodes caledonicus (Northern bird tick)	Birds nesting on cliffs and buildings, like pigeons and corvids
Ixodes frontalis (Passerine tick)	Passerine birds which pick up the ticks during ground feeding under roosts. Also responsible for avian tick-related haemorrhagic syndrome
Ixodes lividus (Sand martin tick)	Occurs solely on Sand Martin *Riparia Riparia*, remaining in their colonies over winter
Ixodes rothschildi (Puffin tick)	Infests burrow-nesting coastal birds such as Puffin *Fratercula arctica*
Ixodes unicavatus (Cormorant tick)	Only been recorded from Cormorant *Phalacrocorax carbo* and Shag *Phalacrocorax aristotelis*
Ixodes uriae (Seabird tick)	Parasitize sea-birds and is ubiquitous from Shetland to Cornwall
Ixodes acuminatus (Southern rodent tick)	Inhabits the burrows of small rodents, with records only from the Scillies, coastal Cornwall/Devon
Ixodes apronophorus (Marsh tick)	Prefers wetland habitats where it parasitizes Water Vole *Arvicola terrestris*, and historically, Coypu *Myocastor coypus*; with records centred on the Norfolk Broads and Wicken Fen
Ixodes canisuga (Fox tick)	Widely distributed on Badger *Meles meles*, Fox *Vulpes vulpes* and domestic dog
Ixodes ventalloi (Rabbit tick)	Infest Rabbit *Oryctolagus cuniculus* and several of its predators, with records only from the Scillies and Lundy
Ixodes trianguliceps (Shrew tick)	Nidiculous: infests the nests of burrowing small mammals
Ixodes vespertilionis (Long-legged bat tick)	Has particularly long legs and appears to favour horseshoe bats
Ixodes hexagonus (Hedgehog tick)	Ubiquitous tick of Hedgehog *Erinaceous europaeus*. Can be a significant parasite of humans and companion animals, and is increasingly being reported in gardens
Ixodes ricinus (Deer/Sheep tick)	Ubiquitous distribution and diverse range of hosts including many wild and domestic animals, birds
Dermacentor reticulatus (Ornate cow tick)	Dogs, cattle, sheep, horses, mostly in Wales and Devon recently reported from Essex
Haemaphysalis punctata (Coastal red tick)	Passerine birds, sheep, cattle. Mostly from the south-east, also Wales
Argas reflexus (Pigeon tick)	Associated with long-standing populations of Pigeon *Columba livia domestica*, with records almost exclusively from Canterbury Cathedral, Rochester Castle and King's College, Cambridge
Argas vespertilionis (Blyborough tick)	Hemi-spherical in shape and widely distributed on vespertilionid bats, with most records from pipistrelles
Ornithodoros maritimus (Marine argasid)	Parasitize sea-birds; ostensibly a tropical species and has only been recorded from off-shore islands of west Wales
Rhipicephalus sanguineus (Brown dog tick)	Increasingly imported on travelling and imported dogs, currently only reported indoors. Recently associated with house infestations
Hyalomma marginatum (Two-host tick)	Occasionally imported on migratory birds

Throughout its life cycle, *Ixodes ricinus* only spends a small amount of time attached to an animal host upon which it feeds. The remainder of its life is spent mostly resting in vegetation at ground level, except for periods when they are searching (referred to as 'questing') for a host, digesting a blood meal, moulting or producing eggs . During the period of time off the host, ticks are exposed to environmental conditions where temperature and humidity can have a direct impact on their survival and determine their seasonal activity.

The optimum conditions for ticks are often provided in the vegetation layer that covers the ground, in areas that also support appropriate hosts for ticks to obtain a blood meal. *Ixodes ricinus* is therefore present in habitats such as woodland, woodland edge, rough grassland and meadows, heathland, urban green spaces and gardens. Within these habitats, ticks are often highly abundant in ecotonal habitats i.e. transition zones between different habitat types that are often used by wildlife.

The Tick Surveillance Scheme, operated by Public Health England, has reported an increase in tick distribution in the UK. The main drivers for this spread are thought to be linked to climate and habitat factors, but also increasing numbers and spread of deer (principally roe and red deer). In addition to increases in tick abundance in rural areas, the development of wildlife corridors and green space within towns and cities have allowed for the movement of wildlife and ticks into urban areas. Local authorities may need to develop plans to mitigate tick issues through environmental magement and tick awareness strategies.

Possible impact of climate change on tick activity in the UK

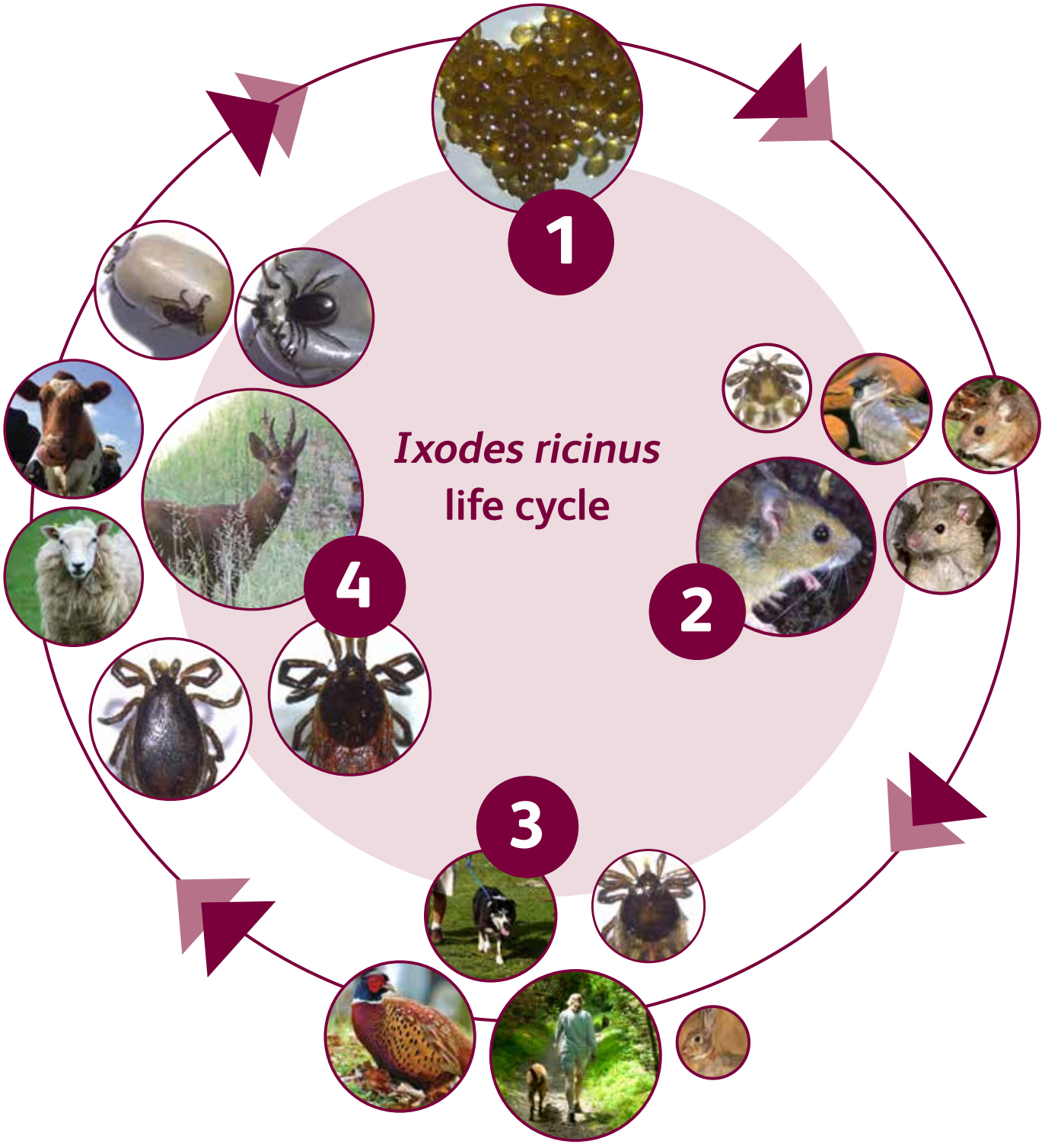
The life cycle of *Ixodes ricinus* is complex and seasonal variation in host infestation by ticks varies between animals and geographical location. In addition, the variability of microclimate in the microhabitats in which ticks spend much of their lifecycle can impact upon tick activity and abundance. In England, nymphal activity increases during spring, peaking during April to June, with reduced activity during the hot summer months, and continued activity in early autumn. Adults can be active at all times of year, but are more active in summer. Although peaks in tick activity can vary, ticks can be found questing in some areas all year round.

Changes in weather, particularly extreme weather, can also affect tick activity and abundance. *Ixodes ricinus* is acutely responsive to changes in humidity and temperature. Hot, dry summers can make some habitats unsuitable for this tick species but mild, wet winters might prolong winter tick activity, and warmer springs may lengthen the period of tick activity and increase tick densities. This makes the impact of climate change on the distribution and abundance of *Ixodes ricinus* in the UK hard to quantify.

Life cycle of *Ixodes ricinus*

The tick life cycle usually takes 2-3 years to complete and consists of three active stages (Figure 2). Generally, each stage feeds only once and over one continuous period of several days. All stages quest for a suitable host by climbing to the tips of vegetation and extending their legs in response to cues from animal hosts including vibrations, movement and carbon dioxide. They will then crawl onto a passing host, take a single blood-meal and after a period of time (several days to 1 week) drop off into the vegetation and moult to the next stage or in the case of fertilised females, lay a batch of eggs at ground level. If they are unable to attach to a passing host, they will return to the vegetation to rehydrate before questing again.

Figure 2– Lifecycle of *Ixodes ricinus* - 1: a gravid female lays approximately 2000 eggs in the vegetation. 2. Larvae hatch within 6 weeks and quest for a suitable host, usually small mammals and birds and then moult into a nymph. 3. Nymphs then quest for a larger host and then moult into either an adult male or female. 4. Females and males will quest for a host; females do this to acquire a blood meal which increases her body weight by 100x her unfed weight, males do this to locate a female to mate with. Once mated and fully fed, the female then drops off into the vegetation to lay her eggs. Once she has laid her eggs, the female dies.



Human disease risks posed by ticks

The ability of *Ixodes ricinus* to feed on a wide range of hosts makes them efficient disease vectors. The most important tick-borne pathogen in the UK is *Borrelia burgdorferi sensu lato*, which causes Lyme disease in humans.

Following an initial infection, which is localised to the site of the tick bite and commonly characterised by an expanding red rash (erythema migrans) (Figure 3), the bacteria may spread to other sites in the body. In the UK, the commonest secondary sites of infection with Lyme borreliosis are associated with the nervous system (neuroborreliosis).

Clinical presentations include facial palsy, meningitis and radiculopathy (spinal nerve root inflammation) occurring within weeks or months of infection. Up to a third of cases in the UK may present with localised or general symptoms without evidence of a rash. Lyme arthritis is a rare complication of infections acquired in the UK, but is more common in patients who have been infected in North America or central Europe. Acrodermatitis chronica atrophicans (ACA), a skin condition caused by long-standing infection, which occurs in Scandinavia and central Europe, is seen occasionally in the UK.

Overview of Lyme borreliosis

Lyme borreliosis, also known as Lyme disease, is the most significant tick-borne infection in Europe. In England and Wales, approximately 1000 laboratory-confirmed cases of Lyme disease are reported every year, with an additional 2000 cases thought to receive treatment from a GP based on clinical diagnosis (the latter are not formally reported). Since 2001, laboratory-confirmed case numbers have increased in England and Wales (Table 2). This is likely due to increased awareness and improved testing and reporting, increased participation in outdoor leisure activities, but also increased abundance and distribution of ticks.

Table 2 – Diagnosed cases of Lyme disease in England and Wales 1997-2014

Years	Total reports received
1997 to 2000	803
2001	268
2002	340
2003	292
2004	500
2005	595
2006	768
2007	797
2008	813
2009	863
2010	905
2011	959
2012	1040
2013	878
2014	730*

*provisional data

Ecology of Lyme borreliosis in the UK – genospecies and host relationships

Bacteria that cause Lyme borreliosis belong to the *Borrelia burgdorferi sensu lato* complex, and there are many different pathogenic species present worldwide. Important species in the UK include *Borrelia garinii* and *Borrelia afzelii.* Both species are maintained in the UK in natural cycles involving ticks, mainly *Ixodes ricinus*, and wildlife hosts they feed on; known as reservoirs of infection.

Borrelia garinii exists within bird-tick cycles, with high infection rates in pheasant and ground-feeding passerines, such as blackbird and robin. *Borrelia afzelii* occurs within small-mammal-tick cycles, with high infection rates in wood mice, bank voles and yellow-necked mice. Larger hosts such as deer are not thought to be able to act as reservoir hosts, meaning ticks feeding on them may not acquire any bacteria. However, larger wildlife hosts such as deer are often needed to sustain high tick abundance.

The potential impact of climate change on Lyme disease transmission in the UK is hard to quantify. Changes in climate can affect tick host activity, distribution and abundance which in turn can affect pathogen prevalence rates within ticks.

Within host competition between different strains of *Borrelia* further complicates this. Nevertheless, a more favourable climate that increases tick densities could increase the exposure of people to infected ticks. Human behaviour also changes as a result of a warmer climate; as people spend more time outdoors, wearing fewer clothes, with consequent exposure to ticks and Lyme disease potentially increasing.

Figure 3: images of a typical erythema migrans rash, showing a 'bull's eye' appearance

How the public may come into contact with ticks and how tick bites can be avoided

Ticks are widely distributed and abundant in many areas across the UK, including some urban parks and gardens in some parts of the country. Habitats that are suitable for ticks and their hosts that are used for recreational purposes may present a risk to members of the public (Figure 4). The following guidance can be used to reduce the chance of being bitten:

- Walk on clearly defined paths to avoid brushing against vegetation. Ticks seek hosts by climbing onto the tips of vegetation (Figure 5) and attaching to a host as it brushes past. They do not jump. Ticks use sensory organs located on their legs to detect carbon dioxide, vibrations, heat and changes in light, to detect a passing host. When the host brushes against the vegetation, the ticks climb on and walk over the host to find a suitable location at which to begin feeding.
- Wear light coloured clothing. This will help to detect ticks that attach to clothing, making it easier to brush them off before they attach to feed.
- Use an insect repellent. Various products are available that repel ticks and prevent them from attaching to either clothing or skin - always follow the manufacturer's guidance.
- Wear long trousers and long sleeved tops. This will reduce the direct exposure of skin to ticks and make it more difficult for them to attach. However, ticks can remain undetected in clothing and be transported, allowing them to attach later in the day/at home.

Figure 4: typical tick habitat showing transition zones either side of the paths. Walking on clearly defined paths and avoiding brushing against vegetation will help avoid questing ticks

Figure 5: *Ixodes ricinus* female on a blade of grass

Performing a tick check

In addition to carrying out the prevention measures outlined above, it is important to carry out a regular ***tick check*** after participating in outdoor activities (walking, running, gardening, camping, working, picnicking etc.). A tick check is carried out by looking and feeling for ticks that may have attached to the skin. By performing a tick check, the chance of infection is reduced by spotting and removing ticks promptly.

It may be helpful to make a tick check part of a daily routine, carefully examining all over the head and body. Although ticks can attach to any part of the body, they prefer warm moist areas such as behind the knees, along the waistline and the groin area. Children are more commonly bitten on the head, so need to be carefully checked on and behind the ears, along the hairline and around the neck **(Figure 6)**. Pay particular attention to any skin creases. Ticks are very small and may be mistaken for a speck of dirt, a freckle or a small scab. The larvae are particularly hard to see.

Figure 6: *Ixodes ricinus* nymphs attached during feeding

How to successfully remove attached ticks

Any ticks found should be removed as soon as possible after being detected. This can reduce the chance of an infection being passed on from the tick. The safest way to remove a tick is to use a pair of fine-tipped tweezers (or a tick removal tool), grasping the tick mouthparts as close to the skin as possible and pulling firmly upwards. Ticks insert a barbed feeding tube into the skin and produce a cement-like substance to anchor it into place (Figure 7). This can cause resistance during tick removal. If possible, by pressing down on the skin surrounding the tick's attachment site, the skin can be held in place whilst pulling the tick out to provide a greater force with which to remove it.

Ticks are difficult to squash or kill, especially if unfed, and are capable of surviving even a seemingly rough removal process. Once the tick has been removed, place it in a securely fastened container or dispose of it in a safe place from where it cannot escape (e.g. flushing down the toilet) and risk reattaching to humans or pets. Wash the bite site with soap and water or clean it with an antiseptic wipe to minimise the chance of a localised infection (which can sometimes develop due to the break in the skin caused by the tick bite).

In addition to a localised infection, a rash may develop where the tick has bitten the skin so it is important to monitor this area. This may be a symptom of Lyme disease, but because a rash can be faint or not appear at all, it is important to also watch out of other signs of infection.

These can include flu-like symptoms or feeling unwell following a tick bite. In such cases, advice should be sought from a GP who should be informed of any recent tick bites or outdoor activity. Many people who develop Lyme disease do not recall a tick bite and symptoms may take several weeks to develop.

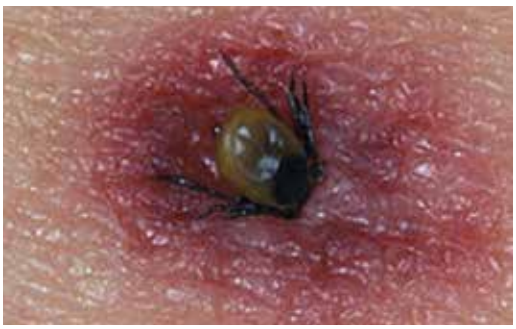
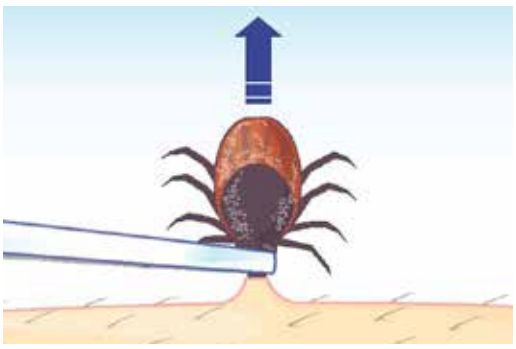


Image credit to U.S. Centers for Disease Control and Prevention



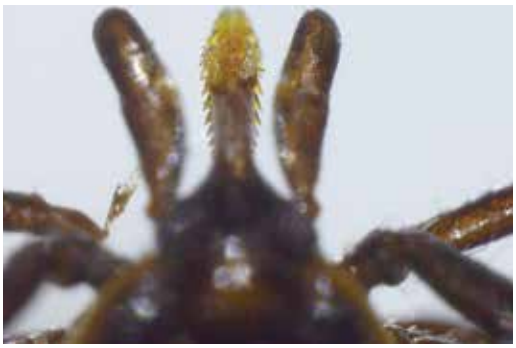


Figure 7: tick removal using tweezers (above) barbed feeding tube (hypostome) used to anchor feeding ticks into the skin.

Image credit to Rodney Calvert, Natural England

Can we manage vegetation to reduce tick exposure?

Vegetation management in woodland rides or urban parks can be used as a strategy for reducing public exposure to *Ixodes ricinus* ticks by reducing human exposure to questing nymph activity particularly during spring, or by reducing the chances for ticks to survive in the environment. The following guidance can be used to help manage exposure to ticks in highly accessed areas of woodland and parks e.g. paths, picnic areas, or even in gardens.

- Regular mowing and raking of lawns and providing a 1m path-side strip along woodland footpaths in spring should be promoted to reduce exposure to questing ticks in these areas, and to reduce their chances of survival in the environment. Lower swards of vegetation limit opportunities for questing ticks to find a human host; it also increases the exposure of quiescent ticks in the litter to desiccation from the sun. The management of woodland rides that favour increased direct sunlight may promote nymph activity, at least in spring, and therefore, additional ride vegetation management might be required to overcome this effect. Sward height, vegetation type (bracken and bramble), and ride size are also important factors.
- Mat or mulch management should be encouraged, not only as a biodiversity objective, but also in areas of high tick abundance to limit tick survival and activity. Raking and stacking leaf litter should be used to negate these sites and the possible use of herbicide in rides for bracken management could be explored, if deemed acceptable and necessary. Raking leaf litter in garden beds can also minimise tick survival.
- Reducing ride-side stands of bramble is less favourable for biodiversity as it provides a nectar resource. However, an adjacent mown strip next to the path should reduce tick exposure. Ideally, these woodland rides and path edges could be managed as scalloped rides to widen the interface between bramble and paths.
- In the case of gardens, ensuring that deer are excluded (e.g. using fencing) will reduce the chances of ticks dropping off a deer and into a garden area, thereby reducing the likelihood of questing ticks appearing.

Figure 8 – PHE information poster on imported ticks on recently travelled/ imported pets.

Brown Dog Tick - (*Rhipicephalus sanguineus*)
Recently in the UK, there have been increasing reports of non-native ticks imported on dogs and the subsequent infestation of owner's houses. The tick species associated with these infestations is the brown dog tick. Unlike ticks commonly found in the UK, this species can survive indoors, which can lead to infestations if left untreated. Infestations also present a potential health risk to animals and humans, due to the ability of this tick species to transmit diseases.

Pet owners should be vigilant and inspect their animal(s) for tick activity, particularly dogs that have recently travelled abroad or been imported (Figure 8); areas of the animal prone to tick bites are - the ears, where the hind leg meets the body and the paws. However, a thorough check of the whole dog is required to ensure that all feeding ticks are found and removed with a tick remover tool/tweezers as soon as possible.

The host animal should be treated with an appropriate approved control product if ticks are present; pet owners should discuss treatment options with their veterinarian. The owner of the animal or a veterinary surgeon should carry out this treatment.

Sometimes UK tick species can be found in dog bedding. However ticks found in furniture, on curtains, or climbing walls are likely to be the non-native species and require further investigation and control. Should tick infestation in a dwelling be suspected, pet owners should seek out expert identification via Public Health England, so it is clear which species of tick is being dealt with. This accurate identification is important to determine what course of action may be needed regarding control.

Control of ticks in the home should be undertaken by a professional pest control operator (PCO). Treatment by a PCO would mainly involve the application of residual insecticides (acaricides) approved for tick control both indoors and around buildings. Such products can be sprayed directly on to ticks or to surfaces. Certain desiccant powders and UltraLow Volume (ULV) cold fog products / techniques are also approved for tick control.

PCOs are trained to use these products and they would likely treat wall-floor-junctions, cracks & crevices where ticks may be harbouring and also apply the appropriate product as a perimeter treatment around the outside of the house if justified.
Furniture and soft furnishings may also need to be treated. The brown dog tick can be difficult to control when active in great numbers. The female is capable of laying up to 4,000 eggs and can survive for up to 18 months without a blood meal. Therefore, repeated treatments are recommended and often needed. This tick species may be able to live on the walls outside the affected house and also out buildings (especially if dogs spend time in such buildings) so these areas may also require treatment.

Amateur use products from supermarkets and DIY stores etc. are unlikely to be the best route so a professional should always be consulted in cases of brown dog tick activity in domestic properties.

Pest control measures should not be applied in isolation. The dogs within the property must also be treated with appropriate tick treatments and daily tick checking/removal carried out, to ensure that fully fed females cannot lay eggs in the property and start the infestation process again. Interruption of the life cycle using this multi-pronged approach will give the greatest chance of success in terms of controlling brown dog ticks in dwellings.

Brown Dog Tick

Control and prevention in domestic situations

Chartered Institute of Environmental Health

Public Health England

Killgerm®

Brown Dog Tick

(*Rhipicephalus sanguineus*)

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CIEH 10822

Sources of further information /advice

PHE fact sheet – ticks and your health: information about tick bite risk and prevention
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/411747/20150305_PHE_factsheet__TICKBITEdocx.pdf
https://www.gov.uk/government/publications/lyme-disease-signs-and-symptoms

PHE Tick Surveillance Scheme and tick information
https://www.gov.uk/guidance/tick-surveillance-scheme

PHE Lyme disease guidance, data analysis
https://www.gov.uk/government/collections/lyme-disease-guidance-data-and-analysis

NHS choices – Lyme disease
http://www.nhs.uk/Conditions/Lyme-disease/Pages/Introduction.aspx

PHE Public Health matters blog – Tips and tricks to stay safe from ticks
https://publichealthmatters.blog.gov.uk/2014/03/24/tips-and-tricks-to-stay-safe-from-ticks/

PHE Public health matter blog – Tick Recording Scheme: being vigilant for new UK species
https://publichealthmatters.blog.gov.uk/2015/03/04/tick-recording-scheme-being-vigilant-for-new-uk-species/

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