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Ticks and Tickborne Diseases

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key points

- Ticks are blood sucking obligate (i.e. they require a host to survive) ectoparasites with at least 20 species indigenous to the UK, the majority only parasitising specific wildlife hosts.
- Ticks are spreading geographically and increasing in numbers, most likely because of climate change.
- Ticks are generally inactive in the winter and only start looking for a host when the mean weekly temperature exceeds 7°C, although some are increasingly becoming tolerant to low temperatures.
- Ticks have a life cycle of up to three years (sometimes can be longer) with each stage requiring only one blood meal (one host).
- The three-host life cycle of sheep ticks makes it possible for them to transmit diseases to their host during nymph and adult stages, or for some pathogens through eggs and larvae.
- The most common tick in the British Isles is *Ixodes ricinus*, the sheep tick, which is the vector for: Louping ill, tickborne fever, babesiosis (redwater fever), tick pyaemia, Lyme disease (Borrelia) and more recently tickborne encephalitis (TBEV).
- *Ixodes ricinus* can be infected and transmit more than one pathogen at the same time explaining the variations seen in clinical signs and response to treatment.
- Louping ill most commonly affects sheep and red grouse, but can also affect cattle, horses, dogs and humans. The disease in sheep can be controlled by vaccination (if available) or mitigated by management practices in the absence of a vaccine.
- Tickborne fever is prevalent where sheep and ticks are common and sheep should be exposed to ticks well in advance of mating for the first time.
- Tick pyaemia affects lambs (2–12 wks old) and causes significant economic loss through debilitation and death.
- Lyme disease is a zoonotic disease which can be treated if diagnosed quickly. All farmers, gamekeepers and those who use the countryside for recreation should be aware of the symptoms of Lyme disease and consult their doctor immediately if they are worried at all.
- Redwater fever is a tickborne cattle disease common in the south of England, which is, however, spreading north. Characteristic dark-stained urine is a hallmark of the disease.
- Tick control should be planned for individual farms as part of your livestock health plans in consultation with your vet.
- Generally, for most sheep livestock grazing in high risk areas, acaricides are the main form of tick control, although sheep and environmental grazing management is encouraged to produce more sustainable control systems.

introduction

Recently ticks and the diseases they transmit have become of increasing public concern. While louping ill is the tick-transmitted disease with the greatest economic impact, other infections spread by ticks can cause serious disease in animals as well as humans.

In addition to the common sheep tick (see Figure 1) other tick species may be found on domestic animals. These include *Ixodes hexagonus* which primarily parasitises hedgehogs, and *Ixodes canisuga* which can infest dog kennels or can be picked up from fox dens. Both *I. hexagonous* and *I. canisuga* are of concern as they may be confused with *I. ricinus*.

The two other ticks, *Haemaphysalis punctata* (coastal red tick) and *Dermacentor reticulatus* (marsh tick) will use any host. They are found in southern England and Wales, mainly on sheep and cattle, and are less associated with the transmission of any disease in the UK. As climate change could impact on the distribution and abundance of these ticks, it is essential that livestock owners are aware of the possibility that they may become more important in disease transmission and report the presence of ticks with an unusual appearance. If in doubt, ticks can be submitted to the Tick Surveillance Scheme (https://www.gov.uk/guidance/tick-surveillance-scheme).

In addition to the potential spread of louping ill, redwater fever and tickborne fever, heavy tick infestations in livestock can cause irritation, anaemia and loss of production. Tick infestations are of significant economic importance in hill sheep due to upland grazing being the preferred habitat of the sheep tick.

Figure 1:
Engorged tick.

Photo: www.pixabay.com

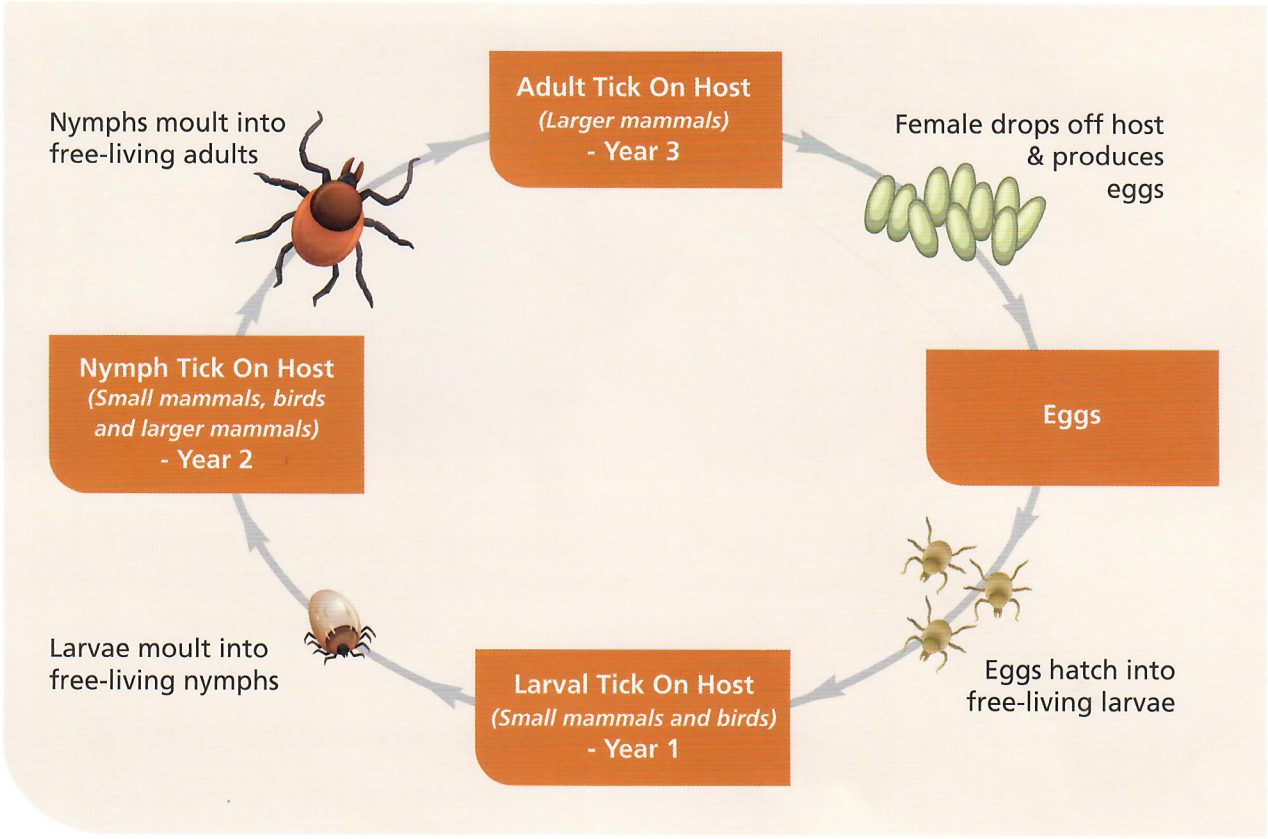
There is increasing awareness of ticks amidst reports of ticks spreading geographically and increasing in numbers. Factors which may contribute to this are:

- Climate change in particular relatively wet summers and milder winters.
- Sheep farming economics and a reduction in sheep dipping in some areas.
- Environmental biodiversity management strategies in relation to habitat.
- The marked increase in deer numbers acting as tick maintenance hosts.

Q1 How do ticks survive in our climate?

The sheep tick is distributed widely all over the UK but prefers dense vegetation and warm, wet conditions to support the free-living stages of its life cycle (see Figure 2).

- Ticks are blood sucking obligate ectoparasites (i.e. they require a host to complete their life cycle).
- Blood feeding stages last: 2-3 days (larvae); 5-7 days (nymph); up to 10 days (adult).
- Blood feeding stages are followed by longer free-living stages and each free living stage takes about one year to complete.
- Ticks need humidity of greater than 85% when off host and generally a temperature above 7°C before they become active (peak times spring and autumn).
- Ticks survive well in dense vegetation mats, such as those found in upland pastures (heather, bracken and permanent pasture) and woodland floors.
- Well drained pasture will not allow ticks to survive due to low humidity.
- Current climate change towards more humid and warm conditions favour tick survival and activity.



Illustrations: Shutterstock.com

Figure 2:
The tick life cycle.

Q2 What is louping ill?

Louping ill (LI) is an acute tick-transmitted viral disease affecting the central nervous system. It is principally found in sheep and red grouse, but occasionally causes disease in humans, cattle, horses, goats, dogs, pigs, deer (red and roe), llamas and alpacas.

Tick infection

Ticks become infected with LI when they feed on a host which was previously infected with the virus from an infected tick. The virus establishes in the salivary gland of the tick and is injected into another host when the tick feeds again after moulting. Thus only nymphs or adults can transmit louping ill virus (LIV), having become infected as larvae or nymphs respectively. Of all the species that can be infected with LI, only sheep and red grouse can transmit LIV infection to ticks. Although mountain hares have been shown to also have this capability, this remains controversial.

Acquired immunity in sheep

When a tick injects LIV into a sheep, the virus multiplies in lymph nodes and other tissues before being released into the blood stream. The amount of virus in the blood of the infected sheep is high for only a few days after infection. This is the infection window for other ticks feeding on that sheep. From 6 to 19 days later, some of the infected animals may show clinical signs. However, in areas where the disease is constantly present, many animals develop mild infections with only a few progressing towards neurological signs. After this, the antibody response in the host eliminates the virus from the bloodstream and provides strong immunity for up to six months, or longer if the sheep is naturally challenged with LIV again.

Death is common in animals with neurological signs, although recovery has been observed in a few cases. Surviving animals may show neurological deficits. In a few animals, mostly cattle, clinical signs can become persistent resulting in partial paralysis and an inability to rise for several weeks.

Clinical signs in sheep:

- The incubation time for louping ill in sheep is 6-19 days.
- Initially the animals develop fever accompanied by depression and lack of appetite. The fever is biphasic, with the first peak in temperature associated with the virus entering the blood stream and the second as it invades the nervous system.
- Later, during the acute phase of the disease, muscular trembling often develops.
- Unsteady or high stepping gait, particularly of the hind legs, can be present.
- In animals with the above symptoms, seizures and paralysis might develop with a typical posture being the head thrown back over the shoulder.
- Coma and death occurs in a proportion of animals (5-60% in affected flocks).
- A feature of infection is that clinical disease only occurs in some sheep and is frequently associated with exercise, transport, handling and other stressors.

In areas where LI is present, the mortality rate is 5-10% and most frequently occurs in animals less than 2 years old. When sheep which have not been exposed to tick-infested ground are bought in, heavy losses may be experienced as they can become simultaneously infected with tickborne fever and LIV (up to 60%).

Diagnosis of LI can be confirmed by looking for specific antibody in the serum, detecting the presence of virus in the brains from dead animals and/or typical microscopic lesions.

The importance of maternal colostrum from hefted sheep

Young lambs are protected by antibodies via maternal colostrum, which will provide solid protection for the lamb up to 3 months old, as long as the lamb receives enough colostrum at birth and the ewe has either been vaccinated or previously been naturally infected. Most cases of LI are seen in weaned lambs due to autumn tick activity when the level of colostral antibodies has decreased.

A serological test is available at Moredun for the confirmation of LIV exposure. The same test can be used for confirmation of recent infection in acute cases. Contact SAC consulting, APHA or Moredun (infovsu@moredun.ac.uk) to access the test.

Q3 Do I still need to vaccinate against louping ill?

Up until 2018, there was an effective vaccine available to sheep farmers in areas where LIV was prevalent to protect sheep against disease. However, this vaccine was technically difficult and expensive to produce and was withdrawn from the market in 2018.

When a vaccine is available, as LI is maintained mainly through the sheep-tick cycle, eliminating infection in sheep (therefore reducing subsequent tick infection levels) aids the eradication of the virus from an area through a sustained programme of vaccination control. This programme must be long term due to the long lifecycle of the tick and the time taken for viraemia levels in the sheep flock to fall.

On farms where LI is endemic, all lambs retained as replacements should be vaccinated in the autumn and all bought in sheep should also be vaccinated (ideally one month before exposure to high tick associated areas on the farm).

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In absence of a vaccine, lambs should be exposed to ticks in the spring in areas of the farm where LIV is present, while they are still protected by maternal antibodies. If necessary, to prevent tick numbers building up, acaricide treatments can also be used in lambs.

Moredun and partners have produced useful reference guidelines on how to control LIV in the absence of a vaccine (www.moredun.org.uk/wp-content/uploads/2021/10/louping-ill-best-practice-booklet.pdf)

Moredun have recently developed a new vaccine against LIV, which in research trials has been shown to be highly effective at protecting sheep against LIV. We are working with commercial partners and the Veterinary Medicines Directorate to bring this vaccine to market. In the absence of a vaccine, there have been reports from many areas of the UK that ticks and LIV has spread into areas where the disease has not been seen before. This has caused large losses in sheep flocks and huge stress for the farmers involved, therefore it is critical that the commercialisation and licensing of this vaccine happens with urgency. Increasing prevalence of LIV in red grouse has also been reported in many areas of Scotland and northern England.

Use of the LI vaccine, when available, along with targeted acaricidal treatments and land management options, are the most effective methods for control of LI in sheep flocks.

Louping ill in red grouse:

Larval and nymph stages of sheep ticks feed on wild birds including red grouse, where losses can be as high as 80% in grouse chicks. Nymph stages can transmit LIV to grouse, and transmission can also occur if chicks eat LIV infected nymphs. Where sheep are present on grouse moors, regular treatment with acaricides are usually essential in preventing losses in grouse chicks. For further information: https://moredun.org.uk/research/diseases/louping-ill-best-practice

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Tickborne Encephalitis Virus (TBEV)

TBEV is a viral disease transmitted primarily through the bite of infected ticks of the genus *Ixodes* and is closely related to LIV. It is not endemic in the United Kingdom and is typically found in certain regions of Europe, Asia, and parts of Russia, where it is the most important viral tickborne zoonosis. However, since 2019, TBEV has been found in ticks collected from deer in the Norfolk/Suffolk areas and there have been 3 human cases of probable or confirmed tickborne encephalitis acquired in England. However, currently, surveillance suggests that TBEV is very uncommon in the UK and that the risk to the general population is very low.

The primary reservoir for TBEV is usually small mammals, particularly rodents. Ticks become infected during feeding on an infected animal and, as TBEV can cross into the egg, larvae as well as nymphs and adults may potentially be infected. Rodents, deer and birds may serve as hosts for the virus, but they typically do not exhibit symptoms of encephalitis. In other species, such as dogs and horses, the disease is rare and can range from asymptomatic to the presence of neurological signs such as incoordination, circling, head pressing, and, in severe cases, paralysis. In some severe dog cases, the disease caused by TBEV can be indistinguishable from that caused by LIV. In ruminants, TBEV infections are typically asymptomatic (only a very few cases of neurological signs reported) and generally do not cause health problems in the infected hosts.

In humans, the infection can range from asymptomatic to severe. Common symptoms include fever, headache, muscle pain, and fatigue. In more severe cases, it can lead to neurological symptoms such as meningitis or encephalitis. A human vaccine is available in some countries and is recommended for individuals living in or travelling to areas where TBEV is endemic. Avoiding tick bites is crucial in preventing disease.

Please visit https://www.gov.uk/guidance/tick-borne-encephalitis-epidemiology-diagnosis-and-prevention for further information.

Q4 What can I do about tickborne fever (TBF)?

- TBF in sheep is caused by the bacteria *Anaplasma phagocytophilum* and affects the immune system (white blood cells).
- TBF is prevalent wherever ticks and sheep are present.
- All ages of animal are susceptible and maternal antibody in colostrum provides no protection.
- From as early as 24 hours after infection, and lasting up to 3 weeks, clinical signs include: a sustained high temperature, lack of appetite and depression.
- TBF is important as it suppresses the animal's immune system predisposing it to further diseases.
- In lambs this can lead to more severe cases of louping ill, tick pyaemia, respiratory disease and Orf virus.
- Pregnant sheep exposed to infected ticks for the first time are likely to abort and may develop severe metritis (inflammation of the uterus) if untreated.
- Pregnant cattle may abort if they become infected for the first time (pasture fever) and all cattle may act as reservoirs of infection.

Control of tickborne fever:

A variety of strategies have been used to control TBF in lambs including the use of antibiotics. However, this is not sustainable.

- TBF reduction is best achieved through suppressing the number of ticks by using acaricidal treatments, combined with animal and environmental management.
- No vaccine to protect against TBF is available.
- Purchase tups that have been pre-exposed to ticks whenever possible.
- If this is not possible, expose bought in tups to ticks at least 60 days prior to tupping, as TBF will cause temporary infertility.
- Treat for ticks before releasing on to the hill.

A molecular test is now available at Moredun for the diagnosis of acute cases. Contact SAC consulting, APHA or Moredun (infovsu@moredun.ac.uk) to access the test.

Tick pyaemia: 'crippled lambs'

In tick infested areas, symptoms of severe lameness, paralysis of the backend, ill thrift and death in young lambs may be due to tick pyaemia, caused by infection with bacteria, most commonly *Staphylococcus, Pasteurella* and *Mannhemia*. Symptoms are due to the formation of abscesses in various parts of the body (e.g. tendons, joints, muscles and also brain). In some cases up to 30% of the lambs in the group can be affected.

Tick pyaemia treatment

Prevention is the best approach to avoid tick pyaemia, by controlling ticks. Antibiotics might be successful if given during the acute bacteraemic phase, but this is unlikely to ever happen in practice. Once there is infection of a joint it is VERY unlikely that antibiotic treatment will be successful, so please consider, before using antibiotics in this scenario, that this is not responsible use of antibiotics.

Q5 Do I need to worry about redwater fever (babesiosis) in cattle?

The disease

This cattle disease is caused by a protozoan parasite *(Babesia divergens)* that lives in the red blood cells and is transmitted by the sheep tick. Though widely distributed where ticks and cattle are present, generally it is not a serious problem. This is because cattle under nine months of age do not develop clinical disease and become solidly immune following infection.

A resident herd of cattle will seldom experience disease problems and it is only when older susceptible animals are introduced to a tick infested area for the first time, or infected ticks encroach into new areas, or into the margins between cultivated ground and infected hill areas, that disease occurs.

Infection in cattle may cause mild sub-clinical disease, although a proportion will develop severe disease which may be fatal if untreated. Currently, an increase in the number of *Babesia/Anaplasma* co-infections are being reported in cattle, which can escalate disease severity.

Clinical signs

Clinical signs will usually begin two weeks after infection and include the sudden appearance of high fever, lack of appetite, depression and weakness with rapid breathing, pipe-stem diarrhoea and blood-red urine (giving the disease its popular name "redwater"). This is accompanied by anaemia due to the rapid destruction of red blood cells by the parasite and pale mucous membranes. Pregnant animals may abort. If left untreated, the animal becomes comatose and dies.

Photo: www.pixabay.com

Control of redwater fever

Consult your vet immediately if you suspect redwater fever

Diagnosis can be confirmed by examining blood smears under the microscope or by molecular tests. As the drugs effective against *Babesia* may be toxic, it is essential they are administered by your vet. Treatment for anaemia may also be required.

Animals that recover from infection, or experience infection as calves, have long lasting immunity to further infection. However, in the absence of any further challenge, immunity may diminish over a period of years. A vaccine to protect against redwater fever is available for import to the UK using a Special Import Certificate obtained by a vet from the Veterinary Medicines Directorate (VMD).

Q6 What are my options for tick control?

Where vaccines are available for specific tickborne diseases (TBD), they should be the first priority for controlling those diseases. However, where there are mixed infections and/or no vaccines available, a more holistic approach is needed to manage the risk from ticks and TBD.

The primary aim for any tick control program is to reduce the exposure of livestock to tick bites far enough to break the disease infection cycle, so aiming for few infected animals with so few tick bites that the infection rate for the next generation of animals is reduced. This is a long term project and requires action on five main fronts:

- Vaccination for specific diseases where possible.
- Appropriate acaricide treatment for grazing livestock.
- Habitat management to reduce/minimise areas of ideal tick habitat.
- Grazing management to avoid high tick density areas/areas of ideal tick habitat.
- Wildlife management to reduce the number of ticks supported/imported by the movement of other non-farmed animals.

Tick control programmes have been attempted, with some degree of success, focusing mainly on frequent acaricide treatment of livestock (i.e. using sheep as "tick mops"). However, this is unlikely to be sustainable in the long term as tick populations will inevitably adapt and become resistant to the available treatments when these are used frequently over a long period of time.

1. Vaccination

This has been covered under the individual disease headings.

2. Acaricide treatments

- There are two groups of chemicals licensed for use in sheep – organophosphate (OP) dips, containing diazinon, and synthetic pyrethroid (SP) pour-on/spot-on preparations containing cypermethrin, alphacypermethrin or deltamethrin.
- Both groups are broad spectrum insecticides, must be applied correctly and at the right dose rate for the right parasite being targeted to be fully effective.
- These products have the potential to cause significant environmental damage if used or disposed of carelessly.
- There are currently no products licensed for use in cattle to treat ticks in the UK. Cattle treatments will require a veterinary prescription for "off label" use in a food producing animal.
- Treatment programmes should include both SP and OP treatments for sheep and appropriate cattle treatments so that all livestock grazing tick areas are covered.

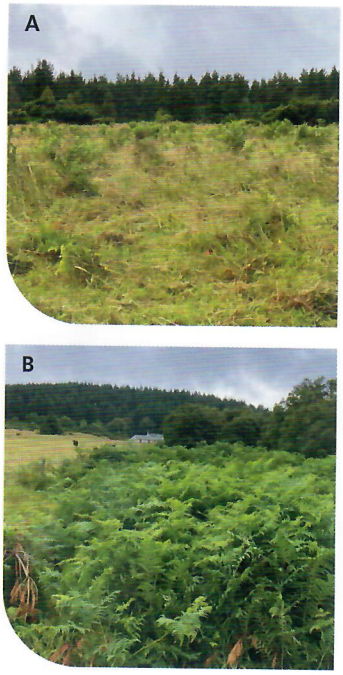

Figure 3:
A) Bracken reduction from trampling by grazing cattle

B) Strong growth of bracken from no trampling by cattle

3. Habitat management

Ticks require high humidity levels to survive in the environment. Reducing the amount of dense vegetation and the thick vegetation matt it produces, lowers humidity in the microclimate and reduces tick survival rates. Bracken produces ideal conditions for ticks with far higher tick populations than where bracken is controlled (Bracken control group briefing no. 7 (www.brackencontrol.co.uk/briefings))

Bracken control is an essential part of tick management and can be achieved in a variety of ways (see www.brackencontrol.co.uk) including grazing with cattle. Cattle trampling is an effective way to control bracken, but care must be taken to ensure cattle have sufficient feeding so they do not consume the bracken, which can be toxic (Figure 3).

4. Grazing management

The aim here is to avoid grazing areas of high tick densities with (the most) susceptible stock in order to reduce disease impacts. Mapping tick densities (blanket drags or counting ticks on untreated sheep) will give a guide to which areas to avoid and when. Technologies such as GPS collars (particularly useful for cattle) will allow controlled grazing areas without fencing.

5. Wildlife management

Any progress made by managing farmed livestock can be undone if there are large populations of "unmanaged" wildlife. Deer in particular can both travel long distances and carry large numbers of ticks, which will drop into the environment when they have finished feeding. Managing wildlife tick hosts is therefore a necessary, but difficult, part of any tick management plan.

There are many variables at play, so any tick management plan must be specific for the farm/land area in question, tackle all five key areas, and will need to be funded and manageable for the long term. If the tick control program stops, the ticks will return!

Q7 What is Lyme disease and how do I recognise the symptoms?

Lyme disease is a zoonotic disease transmitted by the bite of a sheep tick infected with the bacteria *Borrelia burgdorferi.* The disease can be found over most of the UK although it is more prevalent in areas with high tick populations, such as the Scottish Highlands, Exmoor, Yorkshire moors, etc. All mammals can be infected but small mammals and birds (usually from forested woodland or heathland areas) are considered to be the main reservoirs of infection. Lyme disease affects mainly humans, but can also affect horses, dogs and probably cats.

Fact file: Lyme disease is an important zoonotic disease and Public Health England data indicates that there is an average of 1250 laboratory confirmed cases of Lyme disease in England and Wales each year. The average trend is a rise in numbers and they estimate that there are a further 1000-2000 cases per year that are not laboratory confirmed (www.gov.uk/government/publications/lyme-borreliosis-epidemiology/lyme-borreliosis-epidemiology-and-surveillance).

In Scotland the proportion per number of inhabitants is slightly higher, as between 200 and 300 cases are diagnosed per year (Public Health Scotland) and the trend, as in England and Wales, has been the number of cases have been rising over the past decade.

Photo:Baciu@Shutterstock.com

Figure 4:
Typical rash forming around a tick bite infected with Lyme disease. Note concentric rings typical of 'bulls-eye' appearance.

Symptoms, diagnosis and treatment of Lyme disease in humans:

- The earliest and most common symptom of Lyme disease is a pink or red circular rash (Figure 4) that develops 3 to 30 days after an infected tick bite. The rash is often described as looking like a bulls-eye on a dart board. **Note: about one third of all reported cases do not have a rash.**
- Other clinical signs may include flu-like symptoms such as tiredness, swelling of the lymph nodes, headaches and muscle or joint pain including swelling of one or more weight-bearing joints.
- Unless in its early stages when a rash is present, diagnosing Lyme disease is often difficult. If Lyme disease is suspected, blood tests may be able to confirm the diagnosis. This is important as this will aid your GP in deciding if antibiotic treatment is necessary.
- Diagnosed cases of Lyme disease can be treated with antibiotics but be vigilant as the disease may reoccur after treatment.
- Do not leave suspected Lyme disease undiagnosed as chronic disease may develop and last for months, or even years, resulting in muscle and joint pain, chronic fatigue, cardiac disease and neurological symptoms.
- Removing ticks as soon as possible can reduce the risk of developing Lyme disease.
- The best way of preventing Lyme disease is to avoid tick bites by covering exposed skin which may come into contact with vegetation. If you have been in a tick area check yourself thoroughly for ticks each evening, removing any you find using a tick remover tool (www.lymediseaseaction.org.uk/about-ticks/tick-removal/) to ensure the entire parasite is removed.

If you suspect Lyme disease, talk to your GP as soon as possible. Additional information can be found on the NHS website: www.nhs.uk/conditions/lyme-disease/

Moredun ticks and tickborne diseases research update

The Surveillance Unit at Moredun is currently looking at better ways to diagnose tick transmitted disease both in animals and in ticks. Climate change has resulted in increased tick activity and louping ill has now been diagnosed in Scotland in every month of the year except January.

Moredun's Surveillance Unit can test for louping ill antibody (serology) or for the presence of the virus' nucleic acid in tissues (molecular methods). Serological tests can be used to monitor the immune status of a flock or to check disease distribution, whereas the molecular tests and pathology are generally used as *post-mortem* diagnostics.

The same tick can be infected with, and possibly transmit, more than one infectious agent. Therefore we are investigating the possibility of testing for more than one disease at a time. As the previous serological test for tickborne fever has been discontinued and no previous molecular test was available, we have recently developed a new molecular test for the diagnosis of acute cases of tickborne fever and a serological test is currently in development. The combination of both tests should give insight into the prevalence of tickborne fever in Scotland, which is currently unknown.

Further work will include testing animal samples and ticks from different geographical areas of Scotland (in collaboration with the James Hutton Institute) to quantify the prevalence of tickborne pathogens in distinct geographical locations. Additionally we are expanding the number of tests to include other diseases and to investigate the presence and impact of possible mixed infections.

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