

Ticks and Tickborne Diseases



Mara Rocchi PhD, MRCVS, MISTR | Moredun Research Institute

Hugh Reid MBE, BVM&S, DipTVM, PhD, MRCVS | Moredun Research Institute

Neil Sargison VetMB, BA, PhD, DSHP, DipECSRHM, FRCVS | Royal (Dick) School of Veterinary Studies,
University of Edinburgh

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
- Ticks have a three year life cycle (or 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 and Lyme Disease (Borrelia)
- *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, but can also affect cattle, red grouse, horses, dogs and humans. The disease in sheep can be controlled by vaccination or mitigated by management practices in absence of vaccine
- Tickborne fever is prevalent where sheep and ticks are common and sheep should be exposed to ticks prior to mating for the first time
- Tick pyaemia affects lambs (2–12 wk 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
- Tick control should be planned for individual farms as part of your flock health plans in consultation with your vet
- Generally, for most sheep flocks in high risk areas, acaricides are the main form of control



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) five 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. hexagonus* 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 have not been associated with the transmission of any disease in the UK. However, 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 disease transmitting 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.



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
- Sheep farming economics and a reduction in sheep dipping
- Environmental biodiversity management strategies in relation to habitat
- The marked increase in deer numbers acting as tick maintenance hosts



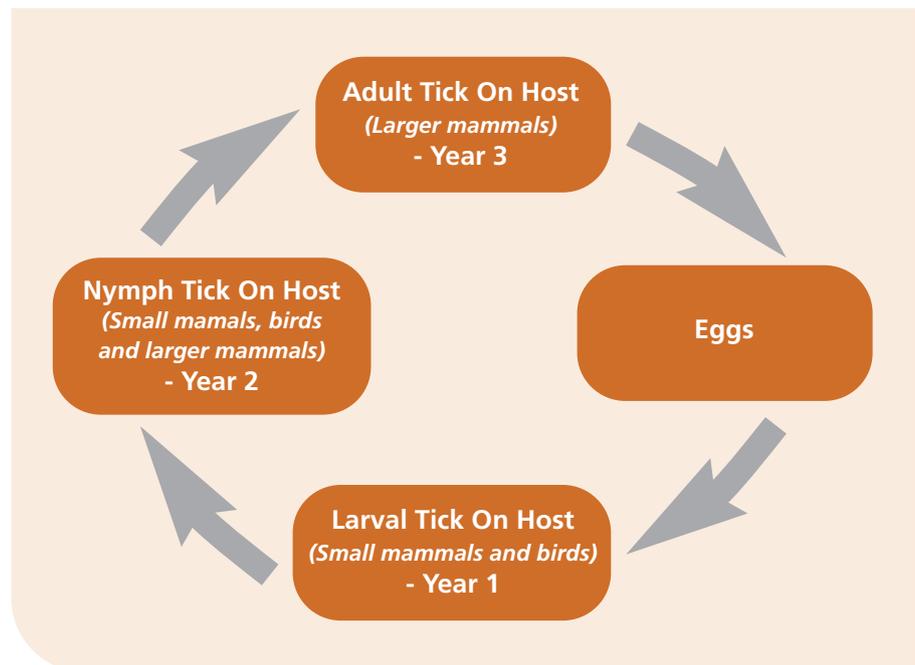
Q1

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

*Figure 2:
The tick life cycle.*





Q2

What is louping ill?

Louping ill is an acute tick transmitted viral disease affecting the central nervous system and principally found in sheep but also occasionally causing disease in humans, cattle, horses, goats, dogs, pigs, red grouse, llamas and alpacas.

Tick infection

Ticks become infected 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, having become infected as larvae or nymphs respectively.

Acquired immunity in sheep

When a tick injects the louping ill virus into a sheep, the virus multiplies in lymph nodes and other tissues before being released into the blood stream. The amount of virus in blood is high for only a few days after infection and this is the window for infection of other ticks feeding on an infected sheep. Later, some of the 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 the rest of the sheep's life.

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 6-18 days
- Initially the animals develop fever accompanied by depression and lack of appetite
- Later, during the acute phase of the disease, muscular trembling often develops
- Unsteady or high stepping gait particularly of the rear 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 associated with exercise, transport, handling and other stress



In areas where louping ill is present the mortality rate is 5-10% and 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 louping ill virus (up to 60%).

Diagnosis of louping ill 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 colostrum which will provide solid protection as long as the lamb receives enough colostrum at birth. Most cases of louping ill are seen in weaned lambs due to autumn tick activity when the level of colostrum antibodies has decreased.

Q3

Do I still need to vaccinate against louping ill?

LIV vaccine is technically difficult to produce and periodically there can be shortages or lack of supply. Moredun has produced best practice guidelines for LIV control in sheep flocks and grouse moors in the absence of a vaccine:

https://www.moredun.org.uk/sites/default/files/documents/diseases/louping_ill_best_practice_booklet.pdf

When the vaccine is available, as louping ill is maintained through the sheep-tick cycle (although hares, rabbits and deer play a role) eliminating infection in sheep (therefore reducing subsequent tick infection levels) should aid the eradication of the virus from an area through a sustained programme of control. This programme should be at least 3 years long due to the long life of the tick.

On farms where louping ill 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).

In absence of a vaccine, lambs should be exposed to ticks in the spring, when they are still covered by maternal antibodies. If necessary to prevent tick numbers building up acaricide treatments can also be used in lambs.

Use of the louping ill vaccine along with targeted acaricidal treatments (see Q6) are the most effective methods for control of louping ill 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 if the louping ill virus is present. Where sheep are present on grouse moors, regular treatment with acaricides can be essential in preventing losses in grouse chicks. For further information: https://www.moredun.org.uk/sites/default/files/documents/diseases/louping_ill_best_practice_booklet.pdf

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 animals immune system predisposing it to further diseases
- In lambs this can lead to more severe cases of louping ill, tick pyaemia and respiratory disease
- 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
- Purchase tups whenever possible pre-exposed to ticks; if not possible expose them to ticks at least 60 days prior to tupping as TBF will cause temporary infertility. Treat for ticks before releasing on to the hill
- Pregnant cattle may abort if they become infected for the first time when pregnant (pasture fever) and all cattle but may act as reservoirs of infection

Control of tickborne fever:

A variety of strategies have been used to control the disease in lambs including the use of long acting antibiotics. Most frequently, disease reduction is achieved through suppressing the number of ticks by use of acaricidal treatments. No vaccine is available. 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 (eg tendons, joints, muscles and also brain). In some cases up to 30% of the lambs in the group can be affected. Prevention depends on tick control and there is no successful treatment.

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 but 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 in the margins between cultivated ground and infected hill areas, that disease occurs.

Ticks become infected during feeding on an infected animal and as parasites can cross into the egg, thus larvae as well as nymphs and adults may potentially be infected.

Infection in cattle may cause mild sub-clinical disease, although a proportion will develop severe disease which may be fatal if untreated.

Clinical signs

Clinical signs will usually begin two weeks after infection and include the sudden appearance of a 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.

Control of redwater fever

Consult your vet immediately if you suspect redwater fever

Diagnosis can be confirmed by examining blood smears under the microscope. 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.



Q6

What are my options for tick control?

- Tick control, including optimal products to use and timing of application, is best planned for individual farms and circumstances as part of your animal health plan in consultation with your vet
- Generally, for most sheep flocks and cattle herds in high risk areas, acaricides are the main form of control
- Diazinon (an organo-phosphate or "OP") is the active ingredient contained in plunge dips licensed for use in the UK
- Topical (pour-on or spot-on) treatments include the active compounds deltamethrin, alpha-cypermethrin and cypermethrin
- The correct method of application is critical for the product used and the product data sheet should always be consulted for details of meat withdrawal periods and duration of protection as these vary between active ingredients and brands
- Animal age should also be taken in to consideration: spot-on treatments can be used in lambs from birth and pour-on if the lamb is over a week old
- Use suitable personal protective equipment when using these products

Advantages and disadvantages of treatment types

Product type	Advantages	Disadvantages
Plunge dips	Immediate and effective treatment. Protects against sheep scab, blowfly strike, lice and keds	Operator safety, environmental toxicity and legal controls on use and disposal
Pour -on treatments	Longer protection and easier to administer	No immediate tick kill

Q7

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

Lyme disease is transmitted by the bite of an ixodid 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 can also affect horses, dogs and probably cats.



Fact file: Lyme disease is an important zoonotic disease and Public Health England estimates there are between 2,000 and 3,000 cases of Lyme disease in England and Wales each year. In Scotland the proportion per number of inhabitants is slightly higher, as between 200 and 300 cases are diagnosed per year (Public Health Scotland).

Baciu@Shutterstock.com



Figure 3:
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 3) 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 many GPs have limited experience of this disease
- 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
- As transmission of the bacteria causing Lyme disease does not take place until at least 24 hours after the tick has attached to its host, early removal of ticks 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 (<http://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: <http://www.nhs.uk/Conditions/Lyme-disease/Pages/Introduction.aspx>



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 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 harbor 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.

Produced by

The Moredun Foundation

Pentlands Science Park, Bush Loan, Penicuik, EH26 0PZ, Scotland

Phone: +44 (0)131 445 5111

Fax: +44 (0)131 445 6235

E-mail: info@moredun.org.uk

Website: www.moredun.org.uk



© Moredun 2018

All rights reserved. No part of this publication may be reproduced or transmitted in any form or in any means, electronic, mechanical, photocopying, recording or otherwise without the prior permission of the publisher.