Collaborate to Innovate

A Workshop on Ticks & Tick-Borne Diseases

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Summary

Ticks are external blood-sucking parasites that feed on a variety of hosts including livestock, wildlife and humans. The most common tick in the UK is the sheep tick *(Ixodes [I.] ricinus)* which is indiscriminate, feeding on a wide range of hosts, from birds to small and large mammals, including humans, whereas many other species of ticks feed more selectively on specific animal species. The sheep tick can carry pathogens responsible for several diseases including louping ill (LI), tickborne fever (TBF), babesiosis (red water), Lyme disease, tick pyaemia and tickborne encephalitis (TBE). These diseases can cause significant economic losses to farmers but may also impact on human health. Heavy tick infestations themselves may cause ill-health such as irritation, anaemia and production losses even if no diseases are transmitted.

A growing concern facing livestock producers in the UK is the increased risk from ticks and associated tick-borne diseases (TBDs). Factors influencing the increase in ticks and TBDs include:

- Climate change resulting in a wider geographic spread or earlier activity of ticks
- Increased wildlife movement and geographic spread with more ticks' hosts and reservoirs
- Shifts in land use and agricultural practices, such as rewilding and reforestation

All these factors can have an impact on ticks and TBDs expansion, which is concerning and particularly relevant for upland areas of the UK, of which Scotland has many.

With the support of the Scottish Environment, Food and Agriculture Research Institutions (SEFARI) Innovative Knowledge Exchange (IKE) Fund and led by the Moredun Research Institute (MRI), with partners Scotland's Rural College (SRUC), Biomathematics & Statistics Scotland (BioSS) and the University of Glasgow, a one-day workshop was organised and held at MRI on the 6th of September 2024. The focus of the workshop was to discuss the challenges posed by ticks and TBDs expansion, promote exchange of information, build a coordinated network to improve industry guidelines and explore practical solutions. The morning of the workshop was designed to be a fact-finding exercise with presentations and sharing of experiences, with the afternoon focusing on addressing specific questions within focus groups. The workshop was by invitation only (80 stakeholders) to make it as relevant and as broad as possible but also focused. Effective management of ticks and TBDs requires a collaborative approach involving all stakeholders, to ensure that the differing priorities of the farming community, veterinary and pharmaceutical industries, land management and game sector, public health bodies, policy makers and conservationists are addressed and that all affected are involved in the decision making.

Figure 1:
A sheep in its environment, which is the same for ticks

Lucy Gilbert, an ecologist from the University of Glasgow, opened the day by setting the scene and presenting some of the most recent advances in research on ticks and TBDs. Lucy's presentation was followed by testimonials from stakeholders with direct experience of outbreaks of TBDs in livestock (one farmer lost 30% of their flock in a week) and the consequences of Lyme Disease in patients. These testimonials were very powerful and left a profound impression on the audience.

The work then moved to five breakout groups which were led by sector experts, to discuss the major problems in the different areas and to try to identify solutions. Expertise in these groups was intentionally mixed to gain different perspectives. For example, farmers were placed in the communication group, and vets and land/grouse moor managers in the public health group. Each group produced a list of sector-specific recommendations. The group efforts were summarised into key themes, with the recurring one being the creation of a trusted One Health body to coordinate and disseminate information and lobby for intervention at many levels.

Issues reported by stakeholders included:

- The diagnostic tests available do not give timely answers
- There is a lack of accessible surveillance data to understand the distribution and spread of ticks
- Ticks and TBDs increase requires additional research and funding
- Available information and best practice are too fragmented, difficult to find and not appropriately disseminated

Policy measures, such as the strict control on bracken interventions and incentives to rewilding and reforestation all favour wildlife movement and, consequently, tick spread.

Introduction

The Scottish livestock industry faces a significant challenge due to the rise of ticks and TBDs, driven by factors such as climate change, changes in land use, and increased movement of animals and wildlife. Warming temperatures and milder winters are expanding the geographic range and activity period of ticks, allowing them to survive and reproduce in previously unsuitable areas and times of year. This increases exposure risks for livestock and people. Livestock management changes such as reduction in sheep dipping to address environmental concerns, flock size reduction or removal of flocks from pastures, all favour increase in tick numbers by reducing their removal from the animals and the environment. Human activity, especially wildlife disturbance due to increased access to the countryside, changes in land use and reduced deer culling are followed by changes in the distribution of mammals and birds which are tick hosts and TBDs carriers. Finally, biodiversity and environmental policies resulting in changes to land use can also have unwanted detrimental effects by favouring the expansion of tick-rich habitats. At the same time, numbers of laboratory confirmed human cases of Lyme disease in Scotland have been steadily increasing since 2006 and are at an all-time high.

Main factors influencing increase in tick numbers

- **Climate change:** wet summers and mild winters
- **Livestock management changes:** reduction in sheep dipping and reduction in grazing flocks
- **Increased deer populations and wildlife displacement:** reservoir for ticks
- **Land-use changes:** environmental diversity increasing tick habitats

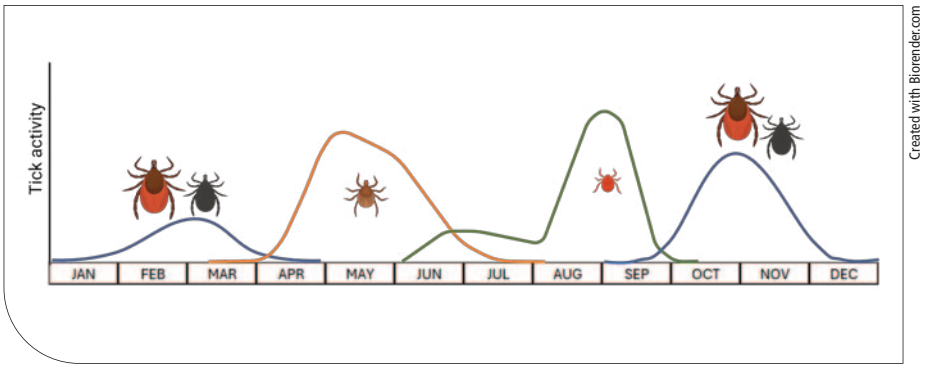
In Scotland and the UK, ticks are vectors for several harmful livestock pathogens, including:

- Louping Ill, a viral disease principally affecting sheep, grouse and occasionally cattle, leading to neurological issues and death
- Tickborne fever, a bacterial infection resulting in immunosuppression, fever, abortion, transient ram infertility and severe secondary infections
- Red water, caused by a protozoan parasite, leading to fever, anaemia, dark stained urine and weight loss in cattle, potentially causing death if untreated

These diseases can reduce productivity, increase mortality rates, and necessitate costly veterinary interventions.

In humans, the principal TBD of concern in Scotland is Lyme disease. Lyme disease, caused by a bacterium can present with fever, a rash and flu-like symptom but can have serious consequences if untreated. Numbers of laboratory confirmed cases of Lyme disease in Scotland have been increasing since the early 2000s. In addition, Tick Borne Encephalitis (TBE), recently introduced in the UK, can lead to neurological disease and death. The spread of ticks therefore increases the risk of zoonotic diseases (diseases transmissible to humans), which could lead to stricter regulations and additional public health campaigns that indirectly impact the livestock sector.

Figure 2:
Tick stages activity and seasonality



Farmers, veterinarians and land managers have observed increased TBDs, leading to economic losses in the livestock industry. The economic impact of TBDs is related to increased veterinary costs for diagnosis, treatment, and prevention measures (such as acaricides and vaccines where available) raising costs for farmers. Loss of productivity such as reduced weight gain, milk yield, and reproductive performance in affected animals also decreases profitability. Additionally, some TBDs may trigger trade restrictions, reducing export opportunities for livestock.

The largest land use change in Europe is woodland expansion, through planting and natural regeneration. Unintended consequences of this could include changes in environmental hazards, such as exposure to parasites and pathogens. A recent study carried out in Scotland shows that woodland expansion could lead to higher tick densities and Lyme disease hazard. It also shows that an environmental solution could be to control deer populations (https://besjournals.onlinelibrary.wiley.com/doi/full/10.1002/2688-8319.12403).

Current control methods in sheep rely heavily on the use of acaricides, which presently are over-used. Both Diazonin (organophosphate) dips and pour-ons (pyrethroids), have been reported as becoming less effective and it has been shown that they can cause environmental harm through uptake by non-target species such as dung beetles and aquatic.

In response to this pressing issue, a SEFARI funded workshop was organised to identify best practice and produce industry guidelines for tick and TBDs control. The workshop aimed to promote a collaborative approach involving stakeholders from diverse sectors all affected by these issues, with the aim of building a coordinated stakeholder network to tackle tick and TBDs challenges.

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The workshop

Titled "Collaborate to Innovate: A Ticks and TBDs Workshop", the workshop was held at Moredun on the 6th of September 2024 and included stakeholders representing different industries as shown in Table 1. Participants received a pre-workshop brief *(Appendix 1)* to highlight the program and the challenges to be discussed.

Table 1:
List of stakeholder categories and organisations represented at the workshop

Stakeholder Category	Organisations Represented
Farming industry	Moredun Regional Advisors, National Sheep Association (NSA), National Farmers Union Scotland (NFUS), Dartmoor Commoners Association, Sheep Farmers, Scottish Agricultural College (SAC) Consultants and Farm Advisory, Cumbrian Farmers Network, livestock farmers
Veterinary and pharmaceutical industries	Practising veterinarians (both livestock and avian), Scottish Rural College (SRUC) veterinary advisors, pharmaceutical companies
Disease surveillance and public health	Animal and Plant Health Agency, SRUC, Public Health Scotland, UK Health Security Agency (Zoonoses), Scottish Lyme Disease and Tick-borne infections Reference Laboratory (SLDTRL)
Game and wildlife	Game and Wildlife Conservation Trust (GWCT), Scottish Gamekeepers Association (SGA), Estate gamekeepers, managers and owners, Bracken Control Group, NatureScot, deer industry, The Heather Trust
Policy and government	Scotland's Chief Scientist, Scotland's Chief Veterinarian, Scottish Government (SG) policy veterinarians, SG Animal Health and Welfare division
Academic	Moredun Research Institute (MRI), University of Glasgow, Forest Research, University of Liverpool, Centre of Ecology and Hydrology (CEH), SRUC, BiOSS

The workshop programme *(Figure 3)* was structured around knowledge exchange and interactive discussions, with a combination of lectures, audience testimonials and participation, and brainstorming sessions. The day was facilitated by Simon Cousins, an experienced Journalist, Radio Producer and Presenter, Television Director and Series Producer of "Landward". Simon has had a long career in bringing together groups with different needs to solve complex issues in farming and land management, therefore was ideal for this role in the workshop delivery.

Figure 3:
Workshop programme

Figure 4:
Left, Professor Lucy Gilbert. Right, informal stakeholder discussion

Several participants shared their experience of ticks and TBDs *(Figure 4, right, and Figure 5)*, including farmers and land managers who had suffered significant livestock or game losses, veterinarians concerned about lack of training in this specific area, stakeholders worried about acaricide effectiveness and public health professionals supporting Lyme disease patients. These testimonials highlighted the lack of information available to the public and the farming industry in particular. The need for joined up research including robust tick monitoring and data sharing, alongside the importance of public reporting platforms to improve disease surveillance were recurring topics.

Figure 5:
Moredun lecture theatre during the workshop

Table 2:
Breakout session and group leaders

Landscape, Moor & Wildlife Management Ross MacLeod, Game and Wildlife Conservation Trust
TBDs Diagnosis & Surveillance Helen Carty, Veterinary Centre Manager, Scotland's Rural College
Ectoparaciticides, Traditional & Innovative Tick Control Methods Matthew Colston, Ruminant Technical Consultant, Elanco
Development of Effective Communication Strategies & Practices Bridget Taylor, Board Member - The Moredun Foundation
Public Health & Human/Animal Interface Dominic Mellor, Public Health Scotland

The final recommendation of each break out session and a summary of the discussion is reported on the following pages; the original contributions from each group can be provided on request.

1. Landscape and moor management

Recommendations:

- Implement/increase surveillance and testing of ticks/livestock and wildlife and collaborate with public health bodies
- Create a communication network encompassing farming and wildlife industries, add government policy colleagues to the network to overcome disconnections
- Implement environmental management including bracken control, muirburn, control of deer, design and management of woodland

Ticks are a growing issue across the UK, spreading into previously unaffected areas and becoming active year-round, reflecting changes in landscape, ecosystems and wildlife distribution. In addition to their direct impact on livestock disease, their role as zoonotic disease carriers underscores the need for additional public responsibility in managing the risks associated with their expansion.

Changes in land management practices have worsened the problem and, environmental strategies, such as those championed by the local and national Governments, often overlook the unintended consequences for animal health. Unchecked vegetation growth provides extensive tick habitats, with both moorlands and lowland heathlands increasingly affected. Livestock grazing near forest edges are particularly vulnerable to tick encroaching, posing challenges for livestock farmers. There are serious concerns regarding TBDs moving from uplands to lowland grazing (e.g. sheep wintered on dairy farms). Developing granular, evidence-based early warning systems, such as temperature-based forecasting models, similar to the ones already developed by Sustainable Control of Parasites in Sheep (SCOPS) could help predict local tick behaviour.

Controlling tick populations through landscape management is challenging due to the limited tools available and some restrictive legislations, such as the reduced use of Asulox for bracken control. Alternative methods like cutting or brashing bracken are impractical in uplands, while the decline of cattle herds and sheep flocks has further favoured tick survival through the expansion of unimproved pastures. Although alternative approaches, such as using ponies or muirburn (patchwork burning), have potential, they face scalability problems and often lack evidence. However, controlled muirburn has been effective in reducing tick numbers by limiting vegetation in some instances, as shown in studies by the GWCT. Collaborative models like the Dartmoor Commons demonstrate the value of mapping tick prevalence and integrating data-driven disease management with farming practices. Some veterinary practices have mapped out where TBDs are in a defined area to advise people based on where they have received positive results.

Ticks pose significant risks to livestock, particularly through the spread of diseases like LI, tickborne fever, and babesiosis, with devastating economic and mental health consequences for farmers. LI might also affect ground-nesting birds and is responsible for up to 75% mortality of red grouse chicks. Exploring the feasibility of breeding disease-resilient livestock and developing vaccines, such as the MRI louping ill vaccine, is essential and industry-backed genetic selection breeding and vaccine programs can strengthen long-term resilience. Strategies like "hefting," where sheep gain immunity by grazing in their native terrain, offer some protection against diseases like LI. Exposure strategies—such as ensuring lambs encounter ticks while protected by maternal immunity or calves to Babesia during their non-susceptible period (< 6 months) could build immunity to tick-borne pathogens like LI and Babesia. Unfortunately, there is very limited colostral protection and post-exposure immunity for tickborne fever.

Tick management on grouse moors, like those in the Cairngorms, demonstrates that effective control methods are possible, but raises environmental concerns. Cattle lack licensed tick-control products, relying on short-lived spot-on treatments. The over-reliance on chemicals for tick control highlights the urgent need for sustainable alternatives. Collaborative networks among farmers, veterinarians, and stakeholders can foster adaptive health plans, dubbed SCOTS – Sustainable Control of Ticks - could guide preventive measures. Potentially, acaricide-treated sheep could be put in specific areas to graze and mop up ticks reducing the level of challenge.

Accessible guidance, integrated data-sharing systems, and innovative strategies are essential for sustainable TBDs management and prevention. Wildlife control, especially deer, also demonstrated localized success but requires broader policy support. Excluding wildlife from grazing areas to reduce risk could be an option but is not always practical or cost effective, therefore habitat management, virtual fencing, and wildlife control should be explored but present practical and ethical challenges. Wildlife management could be used to try to reduce the impact of wildlife in breeding ticks. It's worth noting that ticks can feed on any mammal host and we cannot remove all mammals. Nevertheless, reducing wildlife numbers might be only partially effective, since deer and other wild mammals are difficult to control. Habitat management, including reducing vegetation, can lower tick populations but may expose ground-nesting birds to predation.

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The interconnected challenges of reduced upland livestock, afforestation, rewilding, and increased deer populations collectively support tick survival and growth. Addressing these requires collaborative thinking, robust data collection, and adaptive policymaking. Sustainable management of tick populations hinges on balancing environmental conservation goals with effective animal health strategies, reducing tick exposure and fostering immunity, ensuring long-term protection for farmers, livestock, and ecosystems.

2. TBDs diagnosis and surveillance

Recommendations:

- Cheap, effective serological tests for Babesia and tickborne fever (TBF)
- Joined up One Health active surveillance projects required with better data sharing between Scotland and England
- Better guidance on the management of tick-borne diseases for vets/farmers, easily available and understandable

Diagnosis and interpretation of tests reveals several challenges in addressing TBDs, in addition to more affordable tests needed for surveillance purposes. Furthermore, there is a lack of awareness of TBDs, apart from Lyme disease, in the general population among both clinicians and the public, underscoring the need for education. Several tests are available for TBDs affecting livestock, whereas the ones for patients, apart from Lyme, are currently limited.

Louping Ill Virus (LIV) testing in the UK relies on haemagglutination techniques conducted exclusively at the Moredun. These tests aid risk prediction and seroprevalence studies for grouse and sheep. However, grouse data is not reported to APHA and is withheld from the Scottish Government due to confidentiality issues, highlighting data-sharing gaps. Testing for tick-borne encephalitis (TBE) and LIV in humans is carried out in England, with efforts to establish similar capabilities in Scotland. However, challenges such as cross-reactivity with other flaviviruses and vaccine response detection remain.

There is an increased awareness of the effect of other TBDs apart from LI on livestock, for example TBF and babesiosis, in the farming community. TBF is immunosuppressive, therefore is a 'gateway' to other diseases; additionally, it can cause temporary ram infertility, which could have been responsible for the large number of infertile rams reported in 2023-24 in Dartmoor. Specific modifications to health plans are needed if this disease is detected and management strategies should be implemented swiftly; these discussions would serve as an additional point of contact between the farmer and the vet. However, it is also recognised that recently graduated vets might require additional training in disease recognition and management to support these strategies effectively and retain their trusted advisor role.

Cost-effective diagnostic tools for Babesia and Anaplasma testing (e.g. ELISA) are required for both humans and animals. While PCR testing is accurate, its expense limits widespread use, though pooling samples could reduce costs. Therefore, diagnosis often depends on clinical observations or blood smears which are less sensitive, leading to misleading prevalence estimates. For both diseases, no serological tests exist for livestock, while human diagnostics rely on immunofluorescence (IFAT), which is infrequently used for Babesia and sporadically for Anaplasma. This underutilisation raises concerns about underreporting due to lack of awareness, failure to recognise subclinical infections, and cannot be distinguished from genuinely low infection rates.

Tick surveillance by blanket dragging and pathogen testing, modelled on successful sheep scab protocols, can provide valuable data. Surveillance could also involve deer (or other hosts) blood sampling to predict high-risk areas, as demonstrated by UKHSA UK-wide study that led to the discovery of TBEV in the UK. Integrated "One Health" surveillance is vital for monitoring TBDs. In England and Wales, tick surveillance and pathogen detection are separately managed by the Medical Entomology Unit (UKHSA) for humans and APHA for animals, resulting in fragmented and isolated systems. Scotland lacks an operationally effective unified surveillance framework, making it difficult to monitor emerging infections effectively. Establishing a Scotland-based unit with a One Health approach is crucial to overcoming these limitations and avoiding the inefficiencies observed elsewhere. Surveillance data sharing between the UK nations is hampered by data protection regulations, though a recent BBSRC-funded data-sharing hub offers potential for improvement.

Farmer engagement is critical for early detection and enhanced surveillance. Awareness programs for farmers could significantly boost data collection efforts. Surveillance of Anaplasma in dogs may offer insights into zoonotic risks for humans, though further research is needed to determine if zoonotic risks are associated with strains present in the UK. On estates, sheep used as "tick mops" for grouse moors are treated with acaricides multiple times yearly and monitored for LIV responses. While ethically contentious, this practice provides valuable data for surveillance and control strategies.

Greater awareness and management strategies among farmers and veterinarians are also critical, as is dialogue, for example, it was suggested that Public Health Scotland (PHS) could take the opportunity to have a presence in the Royal Highland Education Trust (RHET) stand at the Royal Highland Show (RHS).

Scotland lacks integrated and standardized tick surveillance systems. Collaboration between human and veterinary surveillance is emerging, but resource gaps persist, particularly in medical entomology expertise. Data from sentinel systems, like those in Canada, could inform Scotland's efforts. Surveillance models could integrate human, animal, and tick data, supported by citizen science. Research on tick burdens, such as blood sampling in deer, has proven predictive of high-risk areas. Funding constraints pose a major obstacle to advancing One Health surveillance initiatives, though lobbying policy advisors and leveraging existing projects could provide opportunities.

3. Acaricides and control methods

Recommendations:

- Reliance on treatments is not sustainable. Other solutions such as habitat management and controlled exposure are needed to build resilience. One Health and environment need to be considered holistically
- How to develop independent, non-biased information on available treatments and make it widely available? More knowledge exchange is required
- Use of novel technology to develop anti-tick vaccines is desirable

Acaricides are pharmacological agents used to manage tick infestations, acting through neurotoxic poisoning of invertebrates in general, not only ticks. Acaricides can threaten non-target species, including wildlife and aquatic organisms. They also pose environmental risks, require careful handling, and have significant withdrawal times for meat and milk. For instance, synthetic pyrethroid (SP) products like Crovect necessitate an 8-day meat withdrawal period, with a recommendation to avoid handling treated animals for a month due to human exposure risks.

Current licensed options for sheep in the UK include organophosphate (OP) dips and SP pour-ons, but there are no licensed treatments for cattle. OP dips provide prolonged protection (up to six weeks) but must be managed carefully to prevent environmental contamination, particularly of water courses, especially if dipping activities are not managed and monitored adequately. Pour-on products (generally synthetic pyrethroids-SPs) kill ticks but might not fully prevent disease transmission, since they achieve a very high concentration at the beginning of treatment, with the concentration reducing over time, therefore lengthening the time the tick takes to die, allowing for biting and pathogen transmission. SPs are lipophilic and bind into lanolin therefore they are not waterproof but resilient to being washed out. The assumption should be that these products do not safeguard from TBDs.

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Acaricide treatment is now used more frequently than in the past, for example, one farm in NW Scotland needs tick treatment on day of birth otherwise the lambs will succumb to TBDs. The use of SPs and OPs is widespread, but concerns about resistance and environmental harm persist. Currently it is not known how many hill farms use both OPs and SPs every year. Resistance has not yet been observed in the UK's sheep tick *(I. ricinus)*, despite decades of SP use, although resistance in other tick species elsewhere is a cautionary precedent. Sheep treated with acaricides are used as "mops" for ticks on grouse estates, with some being treated after infestation. However, this approach may allow tick-borne pathogens to spread before treatment. In addition, although OP plunge dipping remains an effective means for the control of ticks, anecdotal evidence suggests that the period of protection provided appears to be reducing, with fresh ticks being observed on sheep that were dipped only 2 weeks previously in parts of the UK.

Environmental considerations, such as the impact on dung beetles and other invertebrates, with recovery taking up to 12 weeks, highlight the need for novel and sustainable treatment methods. Environmental concerns are also likely to slow or stop the development and /or authorisation of new products with similar action mode. Avermectins, effective against soft ticks in the Southern hemisphere, are ineffective against hard ticks like *I. ricinus*. The development of a tick vaccine offers promise for sustainable tick control. Such a vaccine could target ticks during feeding, reducing populations with minimal environmental impact. However, creating a vaccine for *I. ricinus* remains a complex challenge due to the intricacies required to raise immunity to ticks and the fact that the tick has to feed in order to be exposed to the antibodies generated by the vaccine.

Human safety concerns with acaricide use emphasize the importance of proper application, personal protective equipment (PPE), and adverse event reporting; education on proper acaricide use for sellers and users is essential. Novel solutions, including fungal biocontrol agents and essential oils, are being explored but lack sufficient efficacy data. Public awareness and collaboration among researchers, farmers, and policymakers are critical to addressing the public health implications of TBDs, which are spreading to lowland grazing areas due to environmental changes.

Global collaboration and knowledge exchange can drive innovative solutions, with inspiration from countries like France or Germany where TBDs receive greater attention. Recognizing the significance of these diseases is essential for sustainable tick and TBDs control.

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4. Communication strategies

Recommendations:

- Utilise existing farm assurance schemes to gather data on tick prevalence that offers an easy way to monitor farmer's impression of tick spread
- Select case study farms willingly to share experiences, challenges, and solutions to make the data collection more relatable and engaging
- Network across sectors (veterinalry, agricultural, environmental and medical) to break down Silos and promote learning. At the same time, acknowledge specific sector requirements for bespoke messaging taking into account expertise of social scientists

Specific strategies are needed to improve communications regarding tick control and management: high quality, consistent advice from trusted sources must be accessible and relevant. Among these, the creation of a cross-sector network could overcome siloed approaches and encourage knowledge sharing; this and other knowledge exchange activities could be harnessed to establish a One Health and co-production platform, ensuring multi-sector collaboration that accounts for regional differences and stakeholder diversity. Effective public communication should be a priority, with a focus on tailoring messages to specific audiences rather than relying on generic national campaigns. Research by Forest Research revealed significant variations in public awareness and risk perceptions, necessitating nuanced and localized communication strategies. For instance, signage explaining un-mowed grass to enhance biodiversity was met with mixed reactions, highlighting the importance of positive, educational, and time-bound messaging. Additionally, educating the public about risks and advantages of chemical treatments used by farmers, like acaricides, including the ones used for companion animals, could improve understanding of farming practices and highlight the tick issue at the same time. While necessary, these messages must be cautiously delivered to avoid fostering negative perceptions.

The critical role of vets as trusted advisors in tick control and farm health is also recognised. There is a need for improved two-way communication channels between vets and farmers/keepers, enabling the exchange of timely, high-quality, and region-specific advice. Retaining and accessing local knowledge, which can be lost as people move on, is another challenge that needs addressed. Easily accessible communication formats, such as SRUC's On the Hoof podcast and WhatsApp groups, have been recognised as very effective by the farming community. The younger generation of farmers, being more engaged with social media, presents an opportunity to leverage platforms like YouTube, and social media influencers like Cammy Wilson, who runs a popular channel called The Sheep Game, could be potential allies in spreading awareness. However, there are gaps in knowledge as well as misinformation that need to be addressed such as the misconception that ticks are strictly seasonal. There is the need to address public responsibility for tick control, combining farming and public health awareness.

Tailoring of messages to different farming audiences through case studies and farmers groups is an additional approach to increase communication and exchange information. For example, farmers with persistent tick problems require different communication strategies than those newly affected. By using case studies, both positive and negative, messages can be made more relatable and impactful. For instance, stories about the risks of introducing naïve livestock to tick-heavy areas could resonate with farmers and help to highlight possible preventative measures. Integrating tick-related questions into farm assurance schemes could collect valuable data for mapping tick prevalence and trends. Existing projects in hotspot areas, or from farm assurance schemes, could inform regional campaigns, while dissemination through platforms like WhatsApp groups could became an effective method for reaching farmers. An industry-led organization, similar to SCOPS or COWS, could focus on tick management systematically. Evidence-backed by good quality data should drive policy discussions, emphasising collaborative, region-specific approaches.

There is need for a coordinated effort to address tick management, combining localized communication, enhanced vet-farmer relations, and the systematic use of case studies and data collection. Public and farmer education, supported by innovative communication channels and collaborative networks, are critical steps toward reducing the impact of ticks and tick-borne diseases. This highlights the critical importance of engaging policymakers through collaborative efforts, aligning biodiversity goals with animal and public health priorities. Evidence-based discussions and region-specific approaches can bridge the gap between policy and ground-level management. Collaborative networks among farmers, veterinarians, and industry stakeholders can support adaptive health management plans, and should include organisation like SCOPS, Sheep Veterinary Society (SVS), National Faming Union Scotland (NFUS), National Sheep Association (NSA), Farmer Network, Pharmaceutical companies, Monitor Farms and RSABI, the latter to deal with the consequences of TBDs on farmers.

5. Zoonoses and public health

Recommendations:

- Education is important, the public need to be made aware and ready to live with ticks. Use social media, high profile celebrity cases, roll out education to young people, especially school kids and not forgetting GPs and Vets education
- Funding bodies need to be lobbied to promote research; it is fundamental to find the best person to lobby and to convey the message. Human and animal health surveillance need integration as One Health surveillance to understand the real burden of TBDs
- The public need to be confident about meeting ticks and know what to do, removing the fear. Likelihood to get disease is low. Effective environmental interventions could reduce the risk

Lyme disease is the most prevalent TBD in the UK, particularly in Scotland, where cases have risen significantly in recent years, mainly attributed to climate change. Public Health Scotland (PHS) reports that laboratory-confirmed cases increased from 224 in 2014 to 506 in 2023, though these figures underestimate the total number of cases as most are treated without recourse to a diagnostic test. Diagnosis is complicated by secondary symptoms that can persist post-treatment, leading to patient uncertainty and lack of confidence in their health providers. The Lyme Resource Centre, a patient-led charitable organisation, is making efforts to fill perceived gaps in public and patient awareness of ticks and TBDs. Individuals dissatisfied with NHS care may turn to alternative diagnostic and treatment approaches often offered by private providers, which may be unreliable and unvalidated, contributing to misinformation. A specialist Lyme disease clinic could address gaps in diagnosis and care, although funding and location challenges remain.

While Lyme disease dominates the human TBDs landscape, other infections such as Human Granulocytic Anaplasmosis (HGA) and louping ill are less common but noteworthy. HGA is diagnosed in horses and pets but not routinely screened for in humans by the NHS. Sporadic human cases of louping ill have tended to be occupation-specific. Tick-Borne Encephalitis Virus (TBEV), though not yet detected in Scottish ticks, has implications for public health and tourism should its presence be confirmed. Surveillance is limited due to high costs and technical barriers, but confirmation of presence of TBE could necessitate targeted vaccination for at-risk occupational groups.

Photo: www.pixabay.com

Managing exposure to ticks and TBDs is a public health responsibility due to their health implications; however, public awareness of ticks and TBDs appears to be inadequate, even among some healthcare professionals. PHS and NHS Inform provide educational resources, including a forthcoming module for health professionals. However, effective dissemination of this information remains a challenge. Campaigns like those led by Professor Tom Evans (University of Glasgow) emphasize tick-bite prevention and learning to live with ticks, especially for outdoor and recreational groups. These campaigns underscore the need to shift perceptions of the natural environment as entirely safe, normalize tick presence in the environment and promote co-existence. Education remains a critical intervention, particularly as ticks are increasingly found in domestic gardens, introduced and sustained by pets and/or wildlife. Forming networks and engaging policy makers to align animal health with public health priorities is a necessity.

In conclusion, comprehensive efforts to address TBDs in Scotland must include public and professional education, improved surveillance, and effective interventions. Policy integration, cross-sector collaboration, and innovative research funding mechanisms are vital for reducing risks and enhancing public health outcomes.

Final Discussion: summary of all the breakout groups main points

At the end of the breakout sessions, each group summarised their discussions (boxed comments at the start of each section) and the group leaders then presented three of the most important recommendations to the whole audience who were given the opportunity to comment on each topic and discuss the implications of these.

Proposed solutions emphasised surveillance, testing, prevention, improved communications and better (holistic) environmental management. The role of wildlife as tick hosts, particularly deer, and the challenges of balancing tick control with conservation goals, particularly in areas with high biodiversity was a key topic of discussion. The importance of understanding the interconnections within ecosystems, land management practices (including bracken control) and human activity was stressed when planning tick control strategies. It was acknowledged that effective control would require a balance between public health priorities, conservation goals, and economic interests.

Gamekeepers and farmers/land managers shared successful practices, such as vegetation modification and buffer zones to disrupt tick habitats. Targeted treatment of livestock with acaricides and acaricidal efficacy was also discussed. Finally, participants emphasised the need for a unified policy approach integrating public health, animal welfare, and environmental sustainability. Collaborative models involving local communities and cross-sector partnerships were deemed essential for achieving lasting solutions.

The workshop concluded with a lively panel discussion. Participants emphasised that TBDs require a coordinated effort across all sectors. They called for continued collaboration, funding for research, and public awareness campaigns to educate stakeholders and communities on preventive measures. They unanimously called for the creation of a single point of reference organisation (similar to SCOPS) to find the latest information, best practices and emerging research data.

Final workshop recommendations

Moving Forward

The workshop demonstrated the power of bringing together diverse stakeholders to tackle a shared challenge. As tick populations continue to rise, initiatives like this will be crucial in protecting public health, livestock and wildlife while maintaining Scotland and the UK's rich ecological balance.

As a legacy from the workshop, a survey will be circulated to all workshop participants to assess information retention, measure impact and obtain feedback on the workshop.

Funding will be required to create and develop a network with lobbying capacity. This will be further discussed with group leaders and workshop participants. The initial point will be to expand information already present on SCOPs and engage with existing networks such as PHS, UKHSA, NFUS, NSA and Scottish Government.

Photo: www.unsplash.com

Appendix 1

Participants brief

Thank you for agreeing to attend this workshop that will address some of the most important topics for control of ticks and associated tick borne diseases.

The workshop, funded by SEFARI, will be initiated with a topic introduction on the problems facing stakeholders, and following an audience experiences session, the participants will be divided into five interdisciplinary working groups according to their areas of expertise and interest, each led by experts in their field. You will be allocated to a specific group as shown on your name badge. We are looking to reach innovative and sustainable strategies in this part of the workshop. After discussion, the group leaders will then present the resulting strategies agreed within each group back to the other workshop participants and after an open Q and A session, the best options will be adopted, to become part of the workshop outputs. Expected workshop outputs will include best practice recommendation and innovative approaches to address ticks and TBDs problems, and will be aimed to the farming, veterinary and pharmaceutical industries, as well as to influence policy and public health.

Interdisciplinary working groups

- Landscape and moor management to reduce environmental tick burden
- Tick-borne diseases (TBDs), diagnosis and surveillance (both veterinary and human)
- Ectoparasiticides, their correct use and traditional and innovative tick control methods
- Development of effective communication strategies between the different sectors
- Zoonoses, public health and human/animal interface (both veterinary and human)

Facilitator and group leads are as follow

Simon Cousins (Facilitator); Mara Rocchi (Moredun); Beth Wells (Moredun); Lucy Gilbert (University of Glasgow); Helen Carty (SRUC); David Ewing (BioSs); Ross MacLeod (Game and Wildlife Conservation Trust); Matt Colston (Elanco); Rachel Mallet (Bimeda); (Bridget Taylor, BVA); Andrew Kelloe (Moredun); Dominic Mellor (Public Health Scotland); Sally Mavin (NHS Scotland).

A participant survey will be carried out after the workshop and analysed to estimate workshop impact, and a report circulated after the event. This will include a compilation of current knowledge on tick biology, ecology and behaviour; a summary of prevailing tick-borne diseases and their geographic distribution to serve as knowledge base; notes from the Q and A and the best practice advice identified by each group during the workshop.

Expert speakers and breakout group leads will be invited to provide a summary of their interventions and to comment on the documents. This will be followed by policy recommendations.

Beth and I are available at the e-mail addresses below should you need further clarification. We are grateful that you have accepted to participate in this project with us for what we think is a pressing and worthwhile issue.

Best wishes

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Group contributions have been summarised and revised to avoid repetitions. The full notes for each group are available on request.