# R&D Applied Biology

**GRAZE THE MOOR PROJECT**

**MOLLAND MOOR, EXMOOR NATIONAL PARK**

Sheep Tick *Ixodes Ricinus* and Tick-Borne Disease Survey
and
Outline Action Plan 2018 to 2019

## 1 Preamble

1.1 The contractor has worked on tick activity on Exmoor on an intermittent basis since the early 1990s.

1.2 One of the issues the Graze the Moor Project has highlighted on Molland Moor is the presence of Tick-Borne Diseases (TBD) in farm animals (cattle and sheep) from Luckworthy Farm, which graze this area of the moor.

1.3 After discussions with the Project Manager, Simon Thorp, and in agreement with the landowner, the farmer, Exmoor National Park Authority and other interested bodies, it was decided to carry out a survey of the tick population on Molland Moor, and assess the diseases that they are carrying.

## 2 Objectives

2.1 To collect evidence of tick activity in the habitat and also on hosts,

2.2 To test stock and culled deer for the presence of TBDs, and

2.3 To produce a summary report with suggestions for action to limit/control sheep tick activity and TBDs

## 3 The Contractor

3.1 R&D Applied Biology was appointed to carry out the work. Professor Roy Brown directed the programme, determined the protocols, arranged the testing and the data analysis. Simon Daligan, a highly experienced field scientist, carried out or supervised all the field work.

## 4 Background

4.1 In earlier work, the contractor identified the importance of different vegetation types/management inputs in determining levels of tick activity.

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4.2 In the context of open ground (as opposed to woodland) on Exmoor the sequence from the highest to the lowest levels of activity is:

| | |
|---|---|
| 1 | dense Bracken |
| 2 | tussocky Purple moor-grass |
| 3 | Bilberry beds |
| 4 | coarse acid grassland |
| 5 | wet flush areas |
| 6 | mature heather *Calluna vulgaris* |
| 7 | Purple moor-grass mat |
| 8 | recently burnt dwarf shrub, and |
| 9 | semi improved grassland. |

4.3 Levels of host activity are also key, so where there are extensive beds of dense bracken, bilberry and tussocky Purple moor-grass with activity by deer, sheep and certain small mammal species, the tick populations are magnified further. Molland fits this description. There is already evidence of TBD in cattle and there are some management practices in place which encourage some of the 'best' habitats for ticks.

# 5 Field Methodology

## 5.1 Questing Ticks

5.1.1 Four areas within or on the edge of Molland Moor had been sampled in 2010, and it was decided to repeat the sampling on these and eight other areas, which represented the range of habitat (identified in earlier surveys) and intensity of host activity reasonably well (Figure 1).

5.1.2 Time and resources have been limited so most of the12 sites were sampled on only one occasion between 4$^{th}$ and 9th October 2018, when weather conditions were suitable for starving ticks trying to find hosts for a blood feed (questing).

5.1.3 On each site ten, 30 x 1m$^2$ wool blanket drags were carried out, giving a total of 120. However, on two sites, the weather suddenly became unfavourable, and 10 additional drags were carried out at a different time to give comparable data.

5.1.4 On each drag the blanket was turned over after 15m and again at 30m. Any ticks that had been attracted were picked off and placed into a sealed container for each drag. A count was recorded using the life stages of larva, nymph, adult female or adult male, at time of collection.

5.1.5 In the laboratory, the same life stages from all ten drags were put into one tube and the numbers checked and confirmed to give the raw data for each site, summarised in Appendix 1. Each tube was then used to create 'tick squashes' to be tested for TBDs.

## 6 Engorging Ticks and host bloods

6.1 **Deer**.

6.1.1 Because of the logistics involved, it was not possible to organise a dedicated programme. However, as a TBD survey is currently taking place for Public Health England (PHE), to which the contractor is attached, it was possible to use the information being collected from deer, which were being culled on the normal annual cycle.

6.1.2 Within the time framework of this study, 4 deer (see Table 1 below) were shot and the engorging ticks and fresh blood samples were collected under the protocols of the PHE study. Both the bloods and the attached ticks were analysed for any TBDs present.

6.2 **Farm stock.**

6.2.1 It was intended that Sophia Elworthy (Torch Farm Vets) and Simon Daligan would collect engorged ticks and blood samples from 10 first-year cattle and 10 first-year ewes, in early February 2019. These would be sent for analysis, using the same assays applied to deer ticks and bloods.

6.2.2 It has not been possible to complete this in time to include the results in this report which has been prepared for the Graze the Moor project meeting on 28th February 2019. Comments are confined to the existing, confirmed presence of TBDs in farm stock over the last 10 years.

6.2.3 The analysis of the blood samples and engorged ticks will take place and analysed as soon as the ticks can be collected and the blood samples taken as part of the second phase.

6.3 **Small Mammals**.

6.3.1 One of the Molland sites was included in an earlier study on Exmoor; small mammals were live trapped and engorged ticks were tested for TBDs.

6.3.2 Tick burdens were substantial but the assays used at that time did not record any TBDs.

6.3.3 It is likely that small mammals are involved in the chain of disease transmission, but the logistics of the current study again did not allow for live small mammal work.

6.3.4 A brief live trapping and sampling programme at three ‘hot spot’ habitats on Molland Moor would be a recommended part of a second phase assessment.

## 7 Laboratory Methods

7.1 A series of assays, involving direct identification of pathogens, sequenced DNA, antibody and titre analysis have been utilised.

7.2 The technical details are available in a separate appendix where confidentiality issues permit.

7.3 There is no detailed discussion here but all protocols conform to recognised scientific standards and good experimental practice requirements.

# 8 Results and Implications

## 8.1 Questing Tick Activity

8.1.1 Taking all the blanket drag results together, a high level of activity was recorded (x = >2 per $30m^2$ over the moor as a whole.[1] (Appendix 1).

8.1.2 There were some very high concentrations in 'hot spot' habitats, especially of the larval stage (Appendix 2) reflecting optimum habitat conditions for questing and echdysis (moulting between life stages) coupled with a plentiful supply of hosts.

## 8.2 TBD in Questing Ticks

8.2.1 Other than site 2 (with 9 questing ticks in total) and site 6 (with just 1 nymph), all other sites returned at least one of each life stage, with at least one TBD causative agent identified (Appendix 2).

8.2.2 Four pathogens, in the form of *Flavivirus* (f), *Ehrlichia* (e), *Babesia* (b)[2] and *Borrelia* (B) have been positively identified. *Staphylococus aureus* was universally present and is not discussed further.

8.2.3 A 'cocktail' of up to 3 pathogens has been recorded in some samples, for example: females on site 8 and nymphs on site 10 and 2 pathogens are common.

8.2.4 It is of great concern that 3 larval samples (in areas 4, 5 and 10) recorded *Borrelia spp* (which is the Lyme Disease causing bacterium) which must have been acquired transovarially (from infected female to egg).

8.2.5 The combination of large numbers of questing ticks[3], and the variety and distribution of potential TBD pathogens[4] is also of great concern. This level of activity poses a high level of risk to human and animal health and welfare.

## 8.3 TBD in Engorging Ticks and Bloods in Deer

8.3.1 Red Deer range widely over Exmoor and the four sampled in relation to Molland could have picked up ticks and associated TBDs anywhere over a large area. However, all four were carrying at least one bacterial TBD pathogen (See the Table 1 below).

8.3.2 These results confirm the importance of deer as tick hosts, transport mechanisms and potential TBD reservoirs.

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[1] A high impact value is generally set at 0.5 per $30m^2$

[2] Babesia has caused problems in the cattle

[3] On area 10, x = 9.7 per $30m^2$

[4] 50% of nymphs were carrying Flavivirus, and 65% of females were carrying *Borrelia*

| Deer Detail | Pathogens in Blood | Pathogens in engorged ticks | |
|---|---|---|---|
| | | Nymphs | Females |
| Hind 1 | b | e,b (3) | |
| Hind 2 | e | e (6) | e (5) |
| Hind 3 | e,b | | b (3) |
| Stag | | b(4)<br>Riovirus? | e, b (3) |

Where b = Babesia (Red Water) and e = Ehrlichia.
(3) = number of individual ticks in sample
**Table 1: TBD in Engorging Ticks and Bloods in Deer**

## 9 TBDs in Engorging Ticks and Bloods in Cattle and Sheep

9.1 As explained above, it has not been possible to collect new information in time for inclusion within this report

9.2 Records within the last 10 years confirm two cases of *Babesia* (Red Water) in cattle and one *Ehrlichia* presence (no clinical signs) in one ewe. On top of this a Golden Retriever was recorded *Borrelia spp* positive, three years ago. This is sufficient to confirm domestic animal impact and is likely to be an understatement of the real levels in the area.

# POTENTIAL MANAGEMENT APPROACHES

## 10 Background

10.1 This survey has indicated a very high level of questing tick activity, albeit it contagious in distribution (very high-density areas interspersed with ‘empty’ areas) and related to habitat type, extensive TBD presence and a readily available supply of competent hosts.

10.2 Molland is a high-risk TBD area and sheer numbers of attached engorging ticks may have a detrimental effect on smaller hosts.

10.3 A number of actions can be considered to produce an integrated control programme, which can be tied into normal farming and land management practices..

## 11 Habitat Management.

11.1 This involves categorising the extent of the various habitat types in relation to levels of tick activity and then reviewing the options for reducing the tick population.

11.2 In the case of Molland, consideration should be given to devising and implementing:

11.2.1 A Bracken Control Programme,

11.2.2 Reviewing and adjusting the Dwarf Shrub cover (including Purple moor-grass),

11.2.3 A swaling (burning) programme, and

11.2.4 Reviewing and possibly revising the grazing regime.

## 12 Tick Control

### 12.1 Domestic Host Management

12.1.1 This involves reducing exposure to ticks, protecting against TBDs (for example *Flavivirus*, which causes Louping Ill in sheep), and preventing tick bite with dips and pour-ons.

12.1.2 The option to vaccinate sheep against Louping Ill is no longer available, as the production of the vaccine has ceased. Many of the prophylactic dips, which are 'neuroblocker' based, will be phased out over the next 5 to 10 years.

12.1.3 A new line of botanical-based enteric products (Parakill) will start to become commercially available from June 2019. Parakill products were invented, patented and developed by the contractor between 2004 and 2018.

- These products could provide an important tool in reducing tick activity and preventing the spread of TBDs.
- Parakill can also be used to control ticks on wild hosts to avoid the need for culling or physical exclusion historically.
- A 12-month, monitored trial of Parakill, could be carried out on Molland Moor as part of the Graze the Moor project, should it be extended to March 2020. Parakill would be provided at cost.

## 13 Disease Control.

13.1 The treatments discussed in para 12.1 above will prevent the transmission of disease by blocking biting ticks. *Parakill* has also been found to have a debilitating effect on larger internal parasites (for example: Flukes, Tape and Thread Worms) as well as ticks.

13.2 The actions, time, resources in kind and estimate of costs to compile a strategy for Molland are outlined below. These hinge around three lines of activity involving Purple moor-grass management by co-ordinated burning and grazing; bracken control (primary chemical and then chemical and stock activity follow up) on key hot spots, general grazing and possible burning management (where permitted) and control of ticks on hosts using pour-ons and/or a moor wide *Parakill* programme.

**Habitat Map**
Bracken Control Map Programme from June 2019 to August 2023
Purple moor-grass Management Plan 2019 to 2025

Dwarf Shrub Cutting and Burning Plan 2019 to 2024
Grazing Plan 2019 to 2022

**Host Management**
Small Mammal live trapping, tick count, TBD assessment spring-autumn 2019
*Parakill* Bucket/block use programme 2019 to 2021 for sheep, cattle, (ponies?)
*Parakill* Bucket programme for deer 2019 to 2021
Investigate new vaccines
Review Dip/Pour on status
Deer Culling link
Investigate small mammal impact and if necessary use information to inform habitat management

**Tick Control and TBD management**
All of above and assess the impact of *Parakill* treated hosts on tick activity/population

**General Monitoring**
TBA

## 14 CONCLUSIONS AND NEXT STEPS

14.1 The survey has established that there is a major tick problem in terms of sheer numbers and presence of TBD pathogens, underpinned by aspects of the habitat type, existence of suitable domestic and wild hosts, as well as certain management regimes.

14.2 The next steps involve a review of potential interventions, which are detailed elsewhere, and the development of a feasibility study and implementation of one or more of these actions within the time envelope (from start to completion) of 12 months from 1st April 2019.

**RWB - February 2019**

## Appendices

1 Summary of Molland Tick Questing Tick Populations October 2018
2 Pathogen Detection in Questing Ticks at Molland October 2018
3 Sheep Tick Survey Map & Photos 1
4 Sheep Tick Survey Map & Photos 2
5 Sheep Tick Survey Data 1
6 Sheep Tick Survey Data 2