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How does biting midge abundance on thoroughbred holdings influence the risk of African horse sickness virus transmission?

We apply new methods for assessing the risk of AHSV transmission in the UK and show that insecticide-treated screening can substantially reduce horse: biting midge contact

Vector parameters determining risk and mitigation of African horse sickness spread at a local scale



- Project number: 766
 - PI: Dr Simon Carpenter (The Pirbright Institute)
 - Key Researchers:
 - Dr Lara Harrup (The Pirbright Institute)
 - Dr Gianni Lo Ianoco (University of Cambridge)
 - Co-I:
 - Prof. James Wood (University of Cambridge)
 - Dr Richard Newton (Animal Health Trust)
 - Dr Simon Gubbins (The Pirbright Institute)
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Why was the study performed?



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- To assess how the number of *Culicoides* biting midges attracted to and feeding on horses in the UK varies and how this affects the risk of transmission of African horse sickness virus (AHSV)
 - To assess whether the use of insecticide screening can reduce horse: biting midge contact and mitigate against AHSV transmission
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Relevance to the thoroughbred



- AHSV causes a lethal disease of horses with a high case fatality rate
- The potential for AHSV to emerge in the UK is uncertain
- *Culicoides* (biting midges) transmit AHSV when they feed on horses and their control may reduce exposure of horses to the virus
- This has relevance to both thoroughbreds in the UK and those being transported globally



Project Aims



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- (1) To improve risk estimates of AHSV transmission in the UK by surveying biting midge populations on thoroughbred holdings using methods that accurately reflect biting midge feeding rates
 - (2) To assess the impact of techniques to reduce biting midge populations that are logistically straightforward to employ and do not require specialist training
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Project Objectives



1. To produce methods of measuring feeding rates of biting midges on horses and to compare these with current surveillance tools
2. To carry out a targeted assessment of the maximum feeding rates of biting midges at selected sites
3. To survey the influence of alternative hosts (cattle) in increasing or decreasing biting midge feeding rates on horses
4. To assess mitigation techniques for reducing biting midge feeding rates on horses to interrupt AHSV transmission
5. To integrate these objectives into mathematical models developed as part of HBLB project reference PRJ/754

Methods: Biting midge surveys



- Development of traps to collect biting midges that mimic horse odour
- Assessment of traps vs direct collection of biting midges from a horse
- Surveys of biting midge feeding rates across 10 holdings in Newmarket, Lambourn and Epsom
- Within site surveys of biting midges (paddock vs yard vs stable)
- Assessment of results vs site surveys and horse owner questionnaires

Culicoides Biting Midge Traps



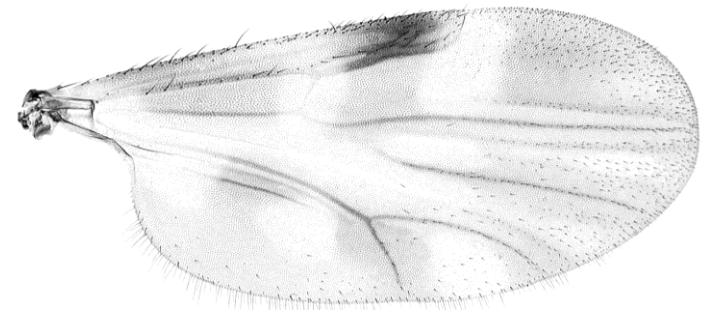
Host-odour baited

UV Light baited

Methods: Impact of cattle on biting midge abundance



- Assessed using yards at Dorking (Surrey) and Saltash (Cornwall)
- Lines of horse-odour traps run from horse to cattle fields
- In biting midges containing blood, identity of blood meal origin was confirmed using DNA analysis
- All species of biting midges identified using wing patterns or DNA
- Biting midge abundance assessed in presence or absence of cattle



Methods: Insecticide treated screens as mitigation



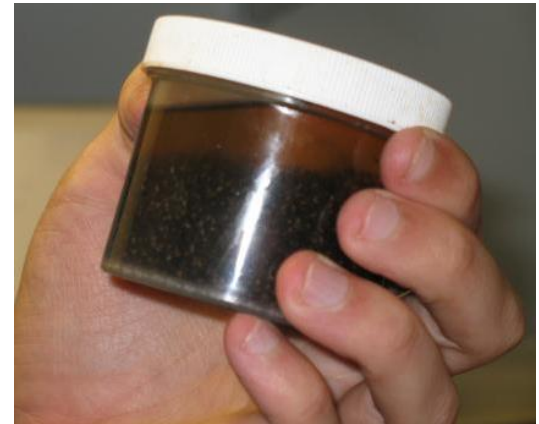
- Laboratory-based studies used to rank effect of 10 insecticides and repellents licensed for amateur use
- Trials conducted for 14 days environmental exposure; mortality of biting midges and feeding rate following exposure assessed
- Most effective product trialled under semi-field (1) and field (2) conditions
- Impact of technique inferred vs untreated screening and no screening



Main Results: Biting midge surveys



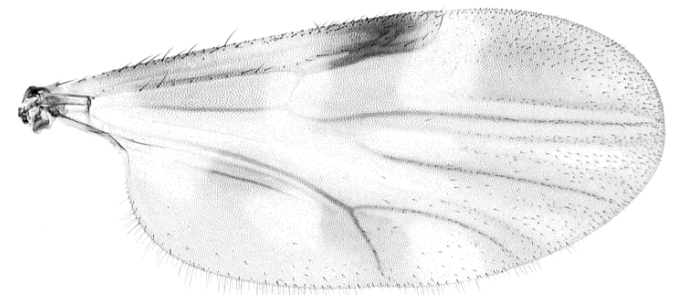
- Host-odour baited trap catches accurately reflect catches from a horse
- Biting midges are ubiquitous across UK thoroughbred holdings
- Biting midge feeding rate variation between sites is mostly related to horse husbandry (e.g. dung management) and location (Lambourn > Newmarket and Epsom)
- Biting rate variation within sites is mostly dependent upon degree of exposure (Paddock > Yard > Stable)



Main Results: Impact of cattle on biting midge abundance



- Presence of cattle significantly increased the predicted feeding rate of biting midges
- Species feeding on cattle were also collected in fields containing horses
- 'Spill-over' effect probably limited to contiguous or overlapping grazing areas
- Likely that the impact of cattle on AHSV transmission probability is limited



Main Results: Insecticide treated screens as mitigation



- Tri-Tec 14® (cypermethrin/pyrethrin) inflicted 100% mortality rate at 1, 7 and 14 days post-treatment
- Treated mesh successfully excluded or killed all biting midges in a semi-field trial using an ultraviolet light bait
- Treated mesh excluded a high proportion of biting midges during a field trial at stables (only one individual was recovered within the stable)
- These results are likely to be transferable to protective transport



Impact on the Thoroughbred



- Accurate information on biting midge feeding rates will be integrated into risk models for AHSV improving our ability to predict vulnerability to incursion by location and season
- The impact of cattle on biting midge populations will also be integrated into models, although this appears to be very limited except at a local scale
- Information regarding the efficacy of screening to prevent biting midge: thoroughbred contact will be integrated into response plans for AHSV at a UK and an global OIE level

Possible Next Steps



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- Systematic testing of commercially available repellent compounds on thoroughbreds as anti-feedants
 - Implications of potential development of insecticide resistance on control efforts
 - Design of spatial repellents that can be deployed safely within housing
 - What proportion of UK biting midge species can transmit AHSV?
 - What is the potential impact of donkeys as a reservoir species for AHSV?
 - How do biting midge populations overlap with donkey populations?
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