TOXINS IN TICKS

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The word 'host' is generally used to denote someone who provides hospitality. For over 225 million years, ticks have used animals as hosts. Feeding only on blood, ticks have two major host-seeking strategies — the ambush strategy where they climb up vegetation and, with their front legs held out, wait for passing animals; and the hunter strategy, where they emerge from their habitat and run towards and chase animals. Many ticks lack eyes and instead have a variety of sensory organs, including hair-like structures on the body, leg, and mouthparts that can smell and feel – enabling them to locate their hosts and also to communicate with other ticks.

Tick in ambush mode

Highly responsive to signs that indicate a warm-blooded animal is close-by, ticks can sense body temperatures associated with warm-blooded animals and chemicals such as ammonia, humidity, various aromas and vibrations. Carbon dioxide emitted by animals is an important stimulus that guides ticks to their hosts. They are attracted by feet hitting the ground and, extraordinarily, by the carbon monoxide emitted by a car stopped in the bush!

There are over 869 species of ticks (the largest subclass in the class Arachnida, to which spiders also belong) feeding on the blood of every class of vertebrates (except fish) in almost every region of the world – except New Zealand which has only cattle ticks). Grouped into 2 families, Ixodidae or 'hard ticks' represent over 80% of ticks. They feed on multiple species of animals and are the most important in terms of diseases. They have a life span from several months to 3 years, increase their weight by over 100 times while feeding and are susceptible to starvation and desiccation. The bite of hard ticks is usually painless, allowing them to go unnoticed as they penetrate the skin, anchor themselves with cement-containing saliva and secrete anaesthetic and chemicals to dilate blood vessels, prevent blood clotting and suppress the hosts immune system. Females need to feed for 2–15 days for a complete blood meal – during which they alternate between blood sucking, regurgitation and defaecation.

Argasidae, or 'soft ticks', so-called because of their flexible soft body, live in dry, sheltered areas, feeding briefly and often on their favourite host species. They live up to 10 years, are more resistant to starvation and increase their body weight by up to 12 times while feeding. Soft ticks do not produce cement and their saliva contains anticoagulant substances. They feed frequently in short bouts - up to 10 times within

Mouth part burrowed into skin. (Image provided by Pr. A. Aeschlimann, Institut de Zoologie, Neucha^tel, France).

a few hours. The spend just a brief time on their host and after each meal return to cracks and crevices and just below the soil surface in their habitat.

Ticks rapidly concentrate the blood meal by secreting water and electrolytes in the faeces and saliva. Generally, adult males feed only briefly. Mating occurs on the host, after which females detach and drop off to digest their blood meal — and to lay between 400 and120,000 eggs. Each tick species has preferred environmental conditions that determine its geographic distribution - and hence the risk areas for tickborne diseases. However climate changes, urbanization and deforestation can increase their distribution and geographical location.

Image provided by www.kmf.org.au Karl McManus Foundation

Ticks are second only to mosquitoes as vectors of infectious diseases in the world, but the first in importance in North America. The role of the brown dog tick in the transmission of the disease was established in the 1930s and, in the aftermath of World War II, a number of tickborne diseases (TBD) were described in animals and humans. Ticks are the carriers and reservoirs of many pathogens and since the beginning of the 1980s, more than 15 new tickborne bacterial diseases have been described in the world. In the 1980s, Lyme borreliosis due to Borrelia burgdorferi was identified and Lyme disease is now considered the most important vector-borne disease in Europe and the United States. Ticks also carry the micro-organisms that cause such diseases as African tick bite fever, anaplasmosis, babesiosis, cowdriosis, encephalitis, human granulocytic ehrlichiosis, Lyme disease, Q fever, relapsing fever, spotted fever rickettsioses (Mediterranean and Rocky Mountain spotted fever), Thai tick typhus, theileriosis, trypanosomiasis, tularemia and tick-borne lymphadenopathy. Fortunately few of these diseases occur in Australia. The distribution of TBD is identical to that of the ticks that host them. The distribution of ticks is determined by biosecurity, animals movements, migratory birds and climate changes.

Ticks have 3 basic life stages: the larva, nymph and adult. Adults and nymphs have 4 pairs of walking legs, and larvae have 3. Although each stage of hard tick feeds only once, this can be done on a range of animal species, including man — making them good carriers of diseases, spreading them from one animal (or person) to the next. And once bacteria infect a tick, they not only stay in the tick as it grows from larva to nymph to adult, but they can also multiply in all organs and fluids, including the female ticks ovaries, ensuring that they pass from one generation to the next! Some bacteria are transmitted sexually (passing from tick-to-tick during mating) and others during cofeeding (when several ticks feed close togther on a host). And, that's not all... ticks can carry more than one type of disease-causing micro-organism at the same time, delivering a 'cocktail' of infections when they feed on you or your animals!

In some species of tick, toxins in the saliva may cause paralysis of the host. Tick paralysis is caused by nerve toxins produced in the salivary glands of hard ticks. In Australia, tick paralysis affects humans, cats, cattle, dogs, horses, llamas, penguins, pigs, poultry and sheep. As well as an ascending paralysis, the nerve toxins can also cause heart and respiratory system compromise, lung distension and enlargement and paralysis of the oesophagus (the tube that carries food from the mouth to the stomach). Diagnosis and treatment require finding ticks or evidence of tick attachment; treatment with an acaricide (tick-killing chemical); administration of tick antiserum and ongoing monitoring and supportive care (frequent re-positioning, turning, assistance to stand, assistance to nurse, bottle feeding and treatment of pressure sores).

A survey by the University of Sydney recorded the numbers of horses affected by tick paralysis in NSW and Queensland from 2005 to 2009. Over 100 horses were diagnosed and they ranged in weight from 95 to 450kg. Although there may have been more cases that were undiagnosed or unreported, this valuable compliation of data provides us with a much greater understanding of the best way to look after and care for affected horses. The survey revealed that clinical signs are more common in in horses weighing <100 kg and in horses <12 months of age. However, small-breed horses were not found to be at greater risk of death than large-breed horses.

Horses weighing >100 kg had greater risk of death – primarily due to more complications associated with

Jonathan Bean - unsplash

A tick in in a horse's mane

recumbency. Most ticks were found on the head, neck, axilla (shoulder and armpit area), inguinal region (around the groin and lower belly) and chest. The survey highlighted the difficulty in locating ticks and the need to thoroughly treat affected horses with a suitable acaricide (tick-killer!). The study also showed that delayed diagnosis and treatment reduced, and high doses of anti-tick serum increased the chances of recovery.

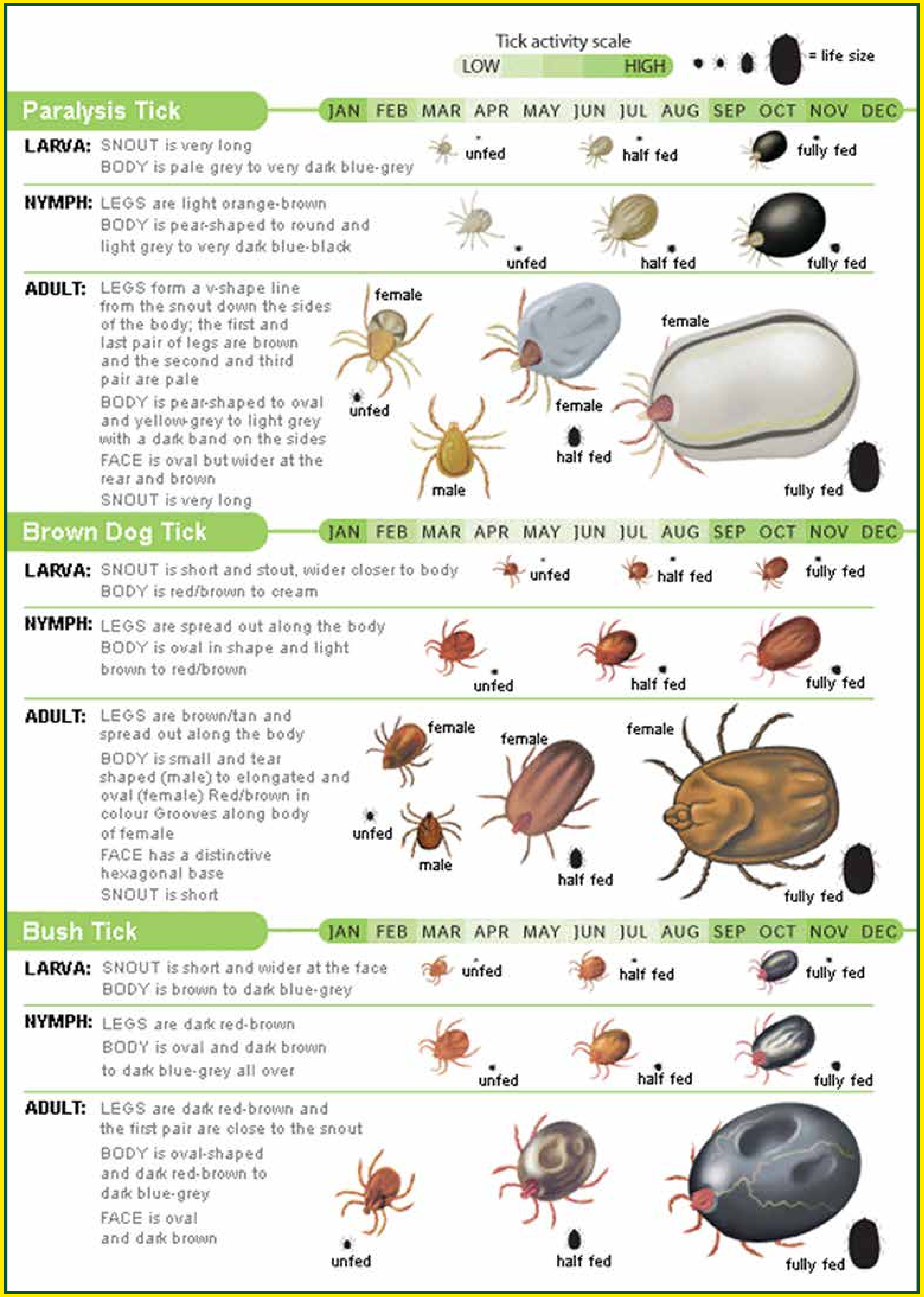
Ticks may travel to new areas by walking, but rarely cover more than 50 metres. Most often, they are dispersed by attaching to hosts that travel long distances, including migratory birds and mammals, agricultural equipment, humans, shipped cattle and travelling horses. The introduction of ticks to new areas by horses has occurred several times: in 1914 cavalry horses from Queensland bound for Egypt were diverted via Melbourne - bringing cattle ticks with them; in 2000, live cattle ticks were discovered on horses that returned to Tasmania via Victoria after competing in an endurance ride in Queensland. These examples highlight the importance of inspections and spray treatments for ticks – with particular attention to ears, mane and tail — and not forgetting rugs, tack, trailers and trucks. If an embedded tick is discovered, a thorough search should be undertaken for further ticks.

Ticks release more saliva if disturbed — so removing ticks must be done carefully. Traditional methods, none are consistently effective, include kerosene, nail varnish or a hot match to promote detachment of the tick. Similarly, removing or attempting to kill ticks with the fingers (instead of forceps) or using lighted cigarettes, petroleum jelly or suntan oil can increase the risk of regurgitation and transmission of infectious agents. Traumatizing the ticks body increases the risk of release of toxins — and every effort must be made to prevent this happening. Avoid applying methylated spirits, touching or disturbing the tick as it will inject saliva into the skin, which could make the situation worse. The Australian Society of Clinical Immunology and Allergy have suggested a novel approach and that is to use a freezing spray - such as Aerostart: apparently used for cleaning carburetors - which instantly freeze dries and kills the tick. They caution however that the product is not registered for such use and is highly flammable.

The current recommended approaches are to spray with an aerosol insect repellent preferably containing pyrethrin, permethrin or a pyrethroid - the combination of hydrocarbons and pyrethrin prevents the tick from injecting its saliva. The tick should be sprayed again one minute later and, after 24 hours it should drop off naturally or be gently removed with blunt, rounded, fine-tipped forceps pulling upwards at right angles to the skin with a continuous and steady action. A magnifying glass may be helpful. Salvaging the mouthparts helps with identification of the species. Ticks can also be collected by flagging or dragging, where a cloth or blanket is drawn over the vegetation. Dry ice, in a perforated container in the middle of a blanket can also be used as a source of CO2 to attract and capture ticks. Ticks are attracted to the CO2 and become trapped in the cloth as they approach. They can be identified using charts, but immature stages are often difficult to distinguish.

Because many ticks require 3 hosts (often including wildlife) complete tick control is rarely possible. Veterinary acaracides are available (e.g. imidocloprid-permethrin, fipronil), and some human products like DEET (N,N-Diethyl-meta-toluamide) are highly repellent but require frequent application. Others, such as fipronil have no repellent but good killing effect. Permethrin kills fast, but has little repellent activity. The most effective products have a persistent effect. Most ticks attach for a few days and protection against continual infestation is needed. Treatment may be needed every few weeks during summer, when the adult ticks are present in situations especially favourable to the ticks. DEET or picaridin can be applied to tack, bandages, boots and skin before going into tick infested areas. Permethrin (a pyrethroid that kills ticks on contact) can be applied to tack in a pressurized spray formulation - it remains effective for several weeks. Repellants should be applied and re-applied according to the

Rich Dahlgren - unsplash



manufacturer's instructions. Never use chemicals after their use-by date or against the manufacturers instructions. Many chemicals break down to highly toxic. Recently, poisoning of 3 horses with a commercial product that had not been prepared in accordance with the manufacturers instructions, was reported in the Australian Veterinary Journal.

Also, a large number of plants have pesticidal and repellent action and recent reviews provide excellent and up-to-date information on botanical extracts with insecticidal activity (http://www.sciencedirect.com/science/article/pii/S0304401712000829).

Feeling your horse and using your hands is often the best way to find ticks. They have a preference for dark areas and thinner skin – the very areas where it is hard for horses to groom themselves or rub/scratch to remove the ticks! So when checking horses pay special attention to the ears, head, under the jaw, neck, axilla (armpit), inguinal (groin), perineal (anus), tail, areas and chest. These areas should be targeted when applying repellents and acaricides – and because its not always easy to find ticks on horses, especially the tiny larval stages, regular application of a suitable acaricide is important.

Repellants containing diethyltoluamide (DEET) or picaridin are widely recommended - check the label and follow the manufacturers instructions regarding how and when to apply. Remember to check saddle cloths, leg bandages, boots etc.

Tick control options are currently limited and reducing and controlling tick populations is difficult. Keeping arenas and pony club grass mown,leaf litter levels low and trimming shrubs and bushes help reduce exposure. Scientists continue to pursue biological control methods – including promotion of natural predators (including beetles, spiders, and ants), pathogens and parasites (bacteria, insects, mites and worms that kill ticks); the mass release of sterilised male ticks to prevent breeding, and vaccines to boost immunity to ticks. Emerging TBDs are expected to increase so vigilance, prevention and early intervention are important for horse owners and riders – not just for ourselves, but for our horses, cats and dogs too.

Some resources can be find at the following sites:

http://www.arc.gov.au/media/LP13/WA_summary_final.pdf

http://trove.nla.gov.au/ndp/del/article/3665389

http://researchrepository.murdoch.edu.au/240/

http://www.agric.wa.gov.au/PC_92915.html?s=0

http://www.nt.gov.au/d/Content/File/p/Anim_Dis/845.pdf

http://www.publish.csiro.au/?paper=ZO9600392

http://dermatology.anzcvs.org.au/dermatology_assets/documents/Proc2013/ANZCVS%20Dermatology%20Chapter%20Proceedings%202013.pdf#page=35

http://researchrepository.murdoch.edu.au/3350/1/Rickettsia_gravesii.doc.pdf

http://researchrepository.murdoch.edu.au/3186/1/Trypanosoma_copemani.pdf

http://nzetc.victoria.ac.nz/tm/scholarly/tei-Bio23Tuat01-t1-body-d4.html

Dr Jen Stewart has been an equine veterinarian for more than 40 years and an equine nutritionist for more than 10 years. Jen has been developing premium formulas for studs, trainers and feed companies in Australia and around the world and regularly consults to leading international studs and trainers in various countries. Jen has spent a fair bit of time researching and being involved in nutritional management of developmental orthopaedic diseases, colic, tying-up, laminitis, performance problems, post-surgery and other conditions. And is currently the only practicing equine veterinarian and clinical nutritionist in Australia. Jen's promise is to continue to

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http://journal.nzma.org.nz/journal/124-1339/4785/content.pdf

http://www.daff.qld.gov.au/animal-industries/animal-health-and-diseases/animal-disease-control/cattle-tick/overview/tick-identification-table

http://researchrepository.murdoch.edu.au/3350/1/Rickettsia_gravesii.doc.pdf

http://digital.library.adelaide.edu.au/dspace/handle/2440/12170?mode=full&submit_simple=Show+full+item+record

http://www.agric.wa.gov.au/PC_92915.html?s=0

http://www.tickvectors.com/tick-diseases.html

http://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:243f1a16-26ff-4539-aac0-eec7928767e9

http://www.health.nsw.gov.au/environment/Publications/tick_alert_brochure.pdf

http://medent.usyd.edu.au/fact/ticks.htm

http://www.karlmcmanusfoundation.org.au/lyme-information/ticks-in-australia

http://www.ajol.info/index.php/sajas/article/viewFile/3784/11788

http://www.sciencedirect.com/science/article/pii/S0304401712000829

http://onlinelibrary.wiley.com/doi/10.1111/1742-6723.12093

http://www.ncbi.nlm.nih.gov/pubmed/22305296