

Ticks and tick-borne diseases protecting yourself



A review of current information for bush regenerators, bush workers and people who love the bush.



“ The key reason for doing all of this tick protection stuff is that I am a passionate bush regenerator and want to be able to keep doing it safely and want all my colleagues on board too.

Imagine what would happen if we all stopped bush regenerating because of a few tick bites!

I have been really humbled by my volunteers who said, after learning about my Lyme disease diagnosis, that they would keep doing it if I was.

So keeping us all safe from ticks became my focus and obligation.”

Lynn Rees

Ticks and tick-borne diseases—protecting yourself

A review of current information and options for bush regenerators, bush workers and people who love the bush

Edited by Virginia Bear and Lynn Rees

This review was prompted by a number of bush regenerators and ABBR members who have tested positive to Lyme disease and its co-infections in recent years. See ABBR News editions 112 and 113.

It will be updated when new information is available. We welcome suggestions. Please check the AABR website for updates.

Edition 1 October 2013
ISBN 978-0-9923765-0-5

A warning

There are still many contradictions and gaps in the science and practice concerning ticks and tick borne diseases. We have attempted to bring together the most up-to-date and practical information for workers in bushland. This guide is a work in progress and does not offer advice on health care. It remains the responsibility of employers and individuals to assess and manage risk based on each local situation, and their own needs. Always follow product directions.

Published by the Australian Association of Bush Regenerators Inc

AABR C/O Total Environment Centre
Suite 2, 89 Jones Street Ultimo NSW 2007
0407 002 921
www.aabr.org.au
enquiries@aabr.org.au

Layout: Virginia Bear, Little Gecko Media www.littlegeckomedia.com vb@littlegeckomedia.com

Cover photos: Bush Regenerators—Ian Stych EnviTE Environment, Tick—Virginia Bear

Dedication

This review is dedicated to Natalie Young. Nat has worked endlessly and unselfishly in getting the Lyme disease message out to the community, despite her own disability from the disease.

Disclaimer The use of the information and data contained within this review is at your sole risk. While every effort has been made to provide accurate information, it is the end user's responsibility to check the original source of information which is stated in the text. Any opinions expressed are not necessarily those of AABR.

Contents

1 Tick removal and prevention

- 1 **Removing ticks**
- 1 Adult ticks
- 1 Larval and nymph ticks
- 1 Killing ticks prior to removal
- 1 Aerostart®
- 1 **How can you protect yourself from tick-borne diseases ?**
- 2 Aerosol insecticide containing pyrethrin
- 2 Lyclair®
- 2 Tick removal devices
- 2 Tick twister®
- 2 Zapa Tick®
- 2 Tick key®
- 3 Chemical removal of larvae and nymphs
- 3 Benzyl benzoate (BB)
- 3 Bicarb soda
- 3 Lyclair®
- 3 Head lice solution
- 3 **Killing ticks on clothing**
- 4 **Preventing tick bites**
- 4 Permethrin treated clothing
- 4 Factory treated permethrin clothing
- 4 Permethrin clothes wash
- 5 Insect shield permethrin treated clothing effectiveness and toxicity
- 5 Is Insect Shield tested and proven?
- 5 Insect Shield advantages:
- 5 How well does Insect Shield work?
- 5 EPA toxicity categories for consumer labelling
- 6 Personal repellents
- 6 Natural or organic products
- 6 Main conclusions in relation to ticks
- 7 Clothing types
- 7 Inspections
- 7 Ultra sonic devices to repel ticks
- 7 Don't take ticks home from work
- 7 **Bushland management tips to minimise tick bites**

8 Ticks and tick-borne diseases

- 8 **Which ticks carry diseases?**
- 8 **Where are ticks found?**
- 8 **How do ticks find a host?**
- 8 **Tick-borne disease hot spots in Australia**
- 9 **The tick life cycle**
- 9 **Can larval ticks transmit infections?**
- 9 Observed seasonal occurrence of life cycle of *Ixodes holocyclus*. Pittwater study area
- 10 **Identifying *Ixodes holocyclus* paralysis tick**
- 11 **Tick anatomy**
- 11 **How quickly can ticks transmit infections?**
- 12 **Lyme disease**
- 12 Lyme disease in Australia
- 12 What is Lyme disease?
- 12 Lyme disease—the great imitator
- 12 Co-infections
- 13 National review of Australian Lyme disease
- 13 Early borrelia research in Australia
- 13 Research that defined Australia's position of denial of Lyme Disease
- 14 Report into the experience of Lyme disease sufferers in Australia
- 14 **Watch that rash!**
- 15 **Red meat allergy from tick bites**
- 15 Tick bites and mammalian meat allergy
- 15 Typical features
- 15 The association between tick bites and mammalian meat allergy

17 Zoonotic infections in Australia

- 18 **Lyme disease**

19 Research into tick-borne diseases

- 19 **Ticks wanted!**
- 20 **How you can help**

Tick removal and prevention

Review by Lynn Rees and Virginia Bear

Ticks are widely known for their ability to cause paralysis in pets, and small children. The fact that they can also transmit diseases is less well known and the details are still not fully understood by researchers. People working in the bush often regard tick bites as an inconvenience with no long-term effects—and that is usually true—but some have been unlucky enough to end up seriously ill with tick borne diseases. It's worth the effort to minimise the risk of tick bites, and to be prepared to deal with them effectively if they occur.

There is considerable debate about the best ways to remove or deter ticks so take this review for what it is: current best practice based on research and personal experience. This review attempts to highlight the different options, so the reader can choose which options suit their personal situation. As more research becomes available we will attempt to keep it up to date.

How can you protect yourself from tick-borne diseases ?

The common sense answer, considering the opinions of a range of experts, is:

1. minimise the risk of tick bites
2. if you are bitten, remove the tick as quickly and safely as possible
3. if you notice possible symptoms of tick-borne diseases, seek medical advice quickly



Removing ticks

Ticks should be removed as soon as possible. However, it is essential to minimise the chance of the tick injecting toxins or pathogens during the removal process.

Once a tick is attached, disturb it as little as possible. Don't scratch it or try to pull it off with your fingers, or kill it with anything that is an irritant, such as methylated spirits, essential oils, kerosene, liquid soap, or a flame/hot match.

There is debate in the medical community about whether ticks should be killed prior to removal, to prevent the tick from injecting its saliva.

If you are likely to encounter ticks, get prepared and ensure you have the necessary products and equipment handy so you can deal with them straight away. Don't wait for your next tick bite as an incentive to go out shopping—it may be in the middle of the night when you discover the tick!

Adult ticks

Gently manually remove, using fine pointed tweezers or other suitable tick removal devices, to grasp the tick as close to the skin as possible, without squeezing its body. Gently pull the tick straight out with a steady pressure, or chemically remove using Lyclear®, or freeze the tick with Aerostart® (see below).

Once the tick is removed, apply antiseptic to the bite site.

Larval and nymph ticks

Because of their small size and tendency to occur in large numbers, it is difficult to safely manually remove larval ticks, and often nymphs as well, without squeezing or irritating them. A chemical solution may be more effective. Tick removal devices can also be helpful (see page 2).

Tick life stages

The paralysis tick, *Ixodes holocyclus*, is responsible for most bites to people in Australia.¹

The paralysis tick has four life stages: egg, larvae, nymph and adult. The larvae, nymph and adult female attach themselves to an animal to obtain a blood meal. Larvae are the most numerous, and people are frequently bitten by multiple larvae (occasionally hundreds) at once. Nymphs are less common, but still often responsible for multiple bites. Adults are the least common.



Engorged adult (8 legs)
13.2 mm long, 10.2 mm wide



Unengorged adult (8 legs)
3.8 mm long, 2.6 mm wide



Unengorged nymph (8 legs)
1.2 mm long, 0.85 mm wide



Unengorged larvae (6 legs)
0.5 mm long, 0.4 mm wide

source: en.wikipedia.org/wiki/Ixodes_holocyclus

Killing ticks prior to removal

Aerostart®

Applying a product marketed as Aerostart® to the tick is recommended by the University of Sydney Department of Medical Entomology, and the Australian Society of Clinical Immunology and Allergy.

Aerostart® contains 24% ether. It freeze-dries the tick, killing it instantly. The tick will then fall out or may be gently scraped off.

It is used by applying a small squirt directly onto the tick, taking care to minimise contact with the surrounding skin.



It is classed as a skin irritant, so if you are using it regularly you probably should be considering ways to reduce tick exposure.

Aerostart® is highly flammable and must be kept away from naked flames or lit cigarettes.

Aerosol insecticide containing pyrethrin

The University of Sydney also recommends spraying the tick with an aerosol insecticide containing pyrethrin or a pyrethroid.

Lyclear®

Also recommended by the University of Sydney is Lyclear®, a scabies cream containing 5% permethrin. The application should be repeated after one minute. The tick should be left in place until it drops off. If the tick is still in place after 24 hours, gently remove it with fine-tipped tweezers.¹

Tick removal devices

Various tick removal devices can be purchased from pharmacies, pet shops, camping shops, or on line. Below are three examples.

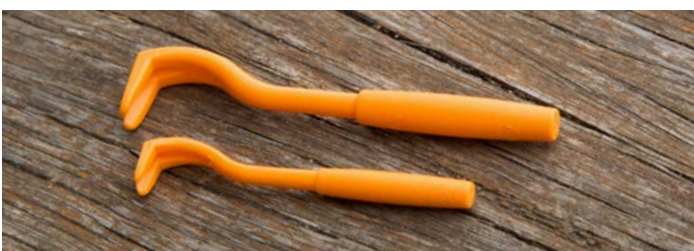
Tick twister®

Many bush regenerators find the "Tick Twister®" easy to use (despite the name, it doesn't actually twist the tick).

The manufacturers claim that it removes ticks:

- "without leaving the mouth-parts of the tick implanted in the skin
- without compressing the abdomen of the tick, minimizing the transfer of infectious agents (Lyme disease, Babesiosis, etc.)
- without ether or other products
- in a few seconds, without pain."

www.ticktwister.com/



Zapa Tick®

This is promoted as a revolutionary eco-friendly electric system for destroying ticks and extracting them from people and animals.

"The Zapa Tick® electric tick pincer works by imprisoning the tick in its small globe. Once the tick has been captured it gets an electric pulse that irreversibly destroys its neurological system, hygienically, safely and in an eco-friendly way. This revolutionary pincer is fitted with a self-contained electric device and works without a battery (piezoelectric system) which kills the tick instantly. The intensity given off by the electric system is nil and completely safe.

The person handling the device doesn't feel it since it is operated inside the globe."

The health promotion charity, Sarcoidosis Lyme Australia is selling these as a fund raiser. www.sarcoidosisaustralia.com/zappatick



Tick key®

The manufacturers explain that it "...uses natural forward leverage to remove the entire tick, head and all, quickly and safely without touching or squishing even the toughest engorged ticks."

Sarcoidosis Lyme Australia sells these as a fund raiser.

www.sarcoidosisaustralia.com/coming-soon---tick-key



Chemical removal of larvae and nymphs

If you have ever been covered in larval ticks you are likely to never forget it. The itch and discomfort can last for weeks.

These ticks may transmit disease organisms harmful to humans (see page 8). The faster you can safely kill them the better for your health, but because they are tiny and often numerous, removing them individually can be difficult and time consuming.

Nymphs are larger, so easier to see and safely remove than larvae, but they can still occur in large numbers.

Below are a number of options.

Benzyl benzoate (BB)

Benzyl benzoate (BB), is commonly used for scabies. Apply as per the label. All nymphs will be paralysed and drop off. It is more effective than bicarb soda, but should not be used on babies or small children.

Bicarb soda

Bicarb soda creates an alkaline environment unfavourable to ticks, encouraging the larvae and nymphs to drop off. Bicarb soda is good if you have a high incidence of infestations, e.g. if you are getting bitten on a regular basis.

Bicarb soda baths are generally effective for babies and small children and for removing larvae or nymphs. It may be a useful alternative for adults who have concerns about other treatments (e.g. allergic reactions) or need to remove infestations frequently. Add two cups of bicarb soda in a deep bath. Make sure your whole body is immersed, stay soaking for as long as possible. Spot any remaining ticks with Lyclear® to effectively kill them.

Bicarb soda, according to the material safety data sheet “May cause skin irritation. Repeated or prolonged exposure may cause drying and cracking of the skin.” It should be thoroughly rinsed off after use.

Lyclear®

Lyclear® (a topical cream containing 5% permethrin) is more effective than bicarb soda but there is a higher chance that you can develop an allergic reaction to the active ingredient, hence it is best used infrequently or for serious infestations only.

Are essential oils OK to kill ticks?

No they are not! According to Dr McManus², essential oils are irritants. Any substance that has a different pH to that of the tick, as well as blocking the ticks ability to breathe or feed (oils are thick and the hypostome (mouth) can't work), would irritate the tick.

Head lice solution

For infestations of the head, a head lice solution containing pyrethrin or pyrethroid may be the best solution. Follow the instructions on the label.

Note: pyrethrin is the natural insecticide derived from a daisy, other, similar compounds such as pyrethrum, permethrin and pyrethroid are synthetically produced.

Is there any problem if tick mouth parts are left in?

There can be. Leaving mouth parts in the skin is potentially dangerous as the saliva in the mouth can possibly continue to deliver pathogens. Dr McManus suggests antibiotics ASAP, if mouth parts are left in.

For the most up to date advice on prophylactic treatment for a tick bite contact either www.karlmcmannusfoundation.org.au or www.lymedisease.org.au

Killing ticks on clothing

Scientifically tested methods:

- place in a clothes dryer on the hottest setting for at least 10 minutes—this is usually the easiest and most effective method
- immerse clothing in water over 60 degrees for at least 50 minutes (e.g. a hot wash) note—this has been tested on British tick species only, see note below)
- treat clothes with a commercial insect control product.

Other methods that may be useful—based on anecdotal evidence:

- iron tick infested clothes
- place clothing in a plastic bag and freeze overnight
- soak clothes overnight in a 10 litre bucket with about 20 ml of eucalyptus oil, then wash and dry as usual.

A cool wash does not kill ticks

A recent British study tested the survival of *Ixodes ricinus* ticks in wash cycles and found “100 per cent of ticks survived both 30 and 40°C machine washes, even when the long cycle length was used. There was no difference in the survival of males or females. However, washing at 60°C resulted in 100 per cent mortality of both sexes, regardless of the use of washing powder or cycle length; even in the 49 minutes wash all ticks died at 60°C”³

Similar findings have been reported in North America for the ticks *Amblyomma americanum* and *Ixodes scapularis*.⁴ These results show that to eliminate the risk of bites from ticks acquired on clothing, clothes should be laundered in a hot wash of at least 60°C.

Preventing tick bites

Permethrin treated clothing

Permethrin treated clothing offers a high level of protection and convenience. It reduces or eliminates the need for other protection methods such as spraying clothes with insecticide, checking clothes for ticks, or using a clothes dryer after work to de-tick your clothes.

Permethrin is an insecticide. Insects are killed when they come in contact with permethrin treated materials.

For the greatest protection, any exposed skin still needs to be treated with an insect repellent.

Factory treated permethrin clothing

This clothing has been trialed by bush regenerators and it is proving very successful and cost effective.

Safari Life® makes a range of permethrin treated clothes, socks and accessories. Ticks are killed on contact and the permethrin lasts up to 70 washes. They sell coveralls, work shirts and trousers as well as bush walking styles. The chemical safety of permethrin on a sweating body appears to be safer than for products containing DEET.

Contact www.safarilifeworld.com for sales and testing information.

East Coast distributor Kim Cheney
02 6655 2942 0421 476 541
kdcheney@westnet.com.au



Lynn Rees wearing the tick repellent coveralls from Safari Life
A Safari Life tick repellent shirt

Permethrin treated clothing toxicity test summary

This information was supplied by Cheryl Loots, Director of Safari Life, manufacturers of permethrin treated clothing.

The bio-monitoring study used three methods of measuring permethrin transfer from the clothing to the skin and absorption by the skin.

The first is called the gauze wipe method. The users wear the clothing during an 8 hour period of strenuous activity and then the skin is wiped by gauze and the amount of permethrin in the gauze is measured to calculate how much permethrin has transferred from the clothing to the skin.

The second method is called passive dosimetry. The users wear the clothing over a full body garment (like long underwear) during an 8 hour period of strenuous activity. Afterward the under garments are tested for permethrin content to measure transfer from garment to underwear.

The third method, urinary bio-analysis, is the true gold standard for this type of toxicity testing. First the user's urine is tested for the presence of permethrin before wearing the clothes (everybody has some in their system just from the food they eat) to establish a baseline. Then the users wear the clothing for several days and a urinary test is performed daily to measure the amount of permethrin that is presumably absorbed by the skin and metabolized.

The results of the study overall were very good and the three measurement methods correlated well, which is important because you don't want one method giving one answer and another method giving you a different answer. The levels of permethrin exposure were on the order of 100 times lower than the EPA's (USA) allowable limits of exposure. Based on this result it's likely that if you could wear 100 outfits all at once that you would still be highly likely to have no observable effects, either due to long term (chronic) or short term (acute) exposure to permethrin.

Permethrin clothes wash

Some bush regenerators have had very good success treating their clothes with a permethrin clothes wash called Debugger. This product kills ticks on contact. The manufacturer states that this product is effective for at least six months. "Any material can be treated with Debugger. Hats can be soaked in it along with clothes to give full protection."

www.equip.com.au/Products/Product.aspx?pid=59



Pyrethrin, permethrin, pyrethroid?

Pyrethrin is a natural insecticide derived from a daisy and has been used for centuries as an insecticide and lice remedy, other, similar compounds such as pyrethrum, permethrin and pyrethroid are synthetically produced.

Insect shield permethrin treated clothing effectiveness and toxicity

This following information has been reproduced from a brochure *Insect repellent you'll love to wear™ Technology Education Guide*. Produced by Insect Shield (insectshield.com) Available at www.safarilifeworld.com/AboutInsect.html/ Safari Life clothing described on page 4 uses Insect Shield.

Testing was carried out on the brown dog tick and *Rhipicephalus sanguineus* and deer tick *Ixodes scapularis*.

Insect Shield advantages:

- requires no re-application
- has no potential for over-use
- cannot be swallowed
- is not harmful to eyes
- can be used by women who are pregnant or nursing
- can be used by infants and children of any age

Is Insect Shield tested and proven?

The U.S. EPA issues a consumer labeling rating for each product it registers, and Insect Shield has been rated category IV—which is the most favorable rating.

Product Name	Toxicity Category
Bleach	I
Liquid Disinfectant Bowl Cleaner	I
Disinfectant Antibacterial Kitchen Cleaner	II
Mildew Remover	II
Insect Repellent, 23% DEET	II
Insect Repellent, 15% DEET	II
Insect-Repellent Clothing and Gear Spray, 0.5% permethrin I	II
Disinfectant Daily Shower Cleaner	III
Military-Style Insect-Repellent Clothing Treatment, 0.5% permethrin	III
Insect Repellent for Kids, 7% DEET	III
Tick Repellent Spray, 0.5% permethrin	III
Insect Shield® Repellent Apparel	IV

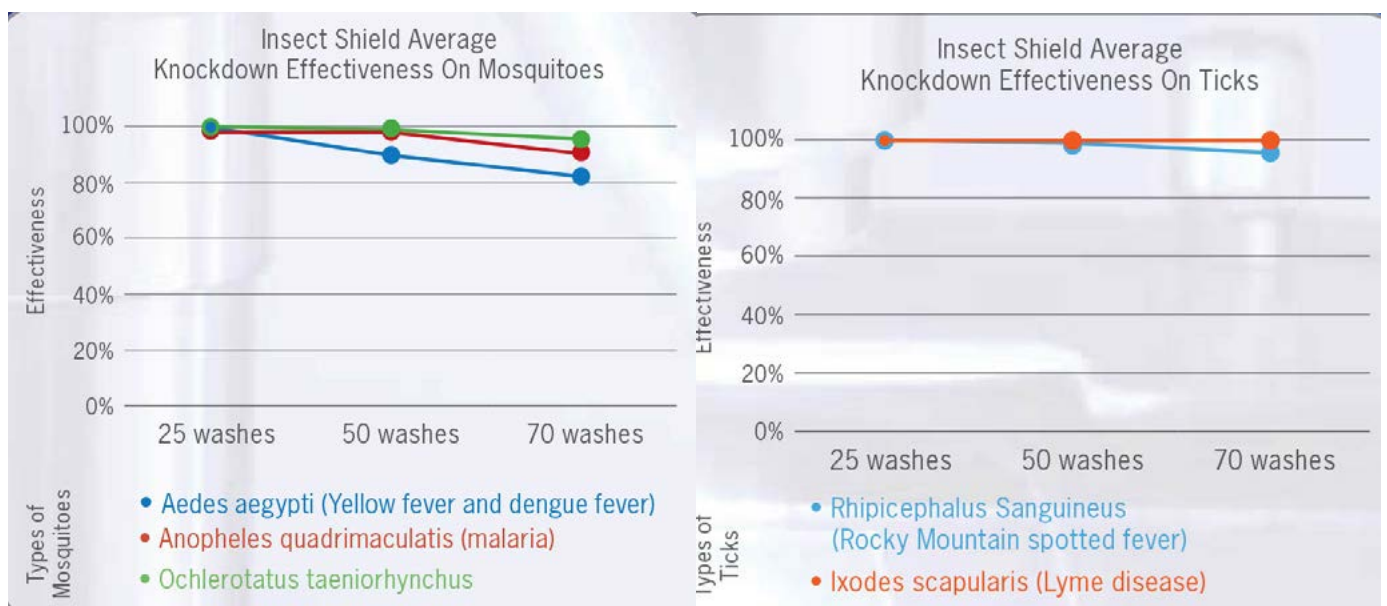
EPA toxicity categories for consumer labelling

- Category I DANGER
- Category II WARNING
- Category III CAUTION
- Category IV NONE REQUIRED

The overall category is determined by the most severe route of exposure (i.e., oral, dermal, ocular, inhalation)

Note: Similar sounding products with different EPA registration numbers may not be comparable in toxicity to those shown above.

How well does Insect Shield work?



Personal repellents

Products containing DEET or Picaridin are considered best for protecting the skin and clothing from ticks. There is debate about what percentage of DEET should be used ranging from 20% to 40%.

Bush regenerators have found spraying clothing with Bushmans® 40% DEET to be effective. To reduce the risk of DEET absorption, if applying to bare skin, we use either OFF or Aerogard Tropical Strength® which contains 20% DEET, and we avoid spraying wide areas of bare skin. OFF Tropical Strength® is effective against ticks and contains Picaridin. Available evidence suggests that Picaridin is a less toxic substance to humans than DEET.

It is not recommended to use products containing DEET on children or babies.

Read the directions—they usually advise regular application as repellents evaporate quickly so must be applied frequently.

Natural or organic products

Natural repellents have been used for thousands of years. Make sure you choose one that has been registered by the Australian Pesticides and Veterinary Medicines Authority (APVMA).

Several readers have recommended Ya mate® and Mosi-guard® as effective tick repellents.

Ya Mate

Ya mate is an Australian owned and manufactured product registered with the APVMA for the control of biting insects. It contains: organic citronella and other six essential oils and two plant extracts.

From YaMate www.loveoilco.com/showpage.asp?pageno=8 "Ya mate organic personal insect repellent will always protect you from mosquitoes and other biting insects including sandflies, midges, stable flies, leeches, ticks, ants, fleas, mites and nits! It is safe to use on children and babies."



Mosi-guard

Mosi-guard is produced in Australia by Aussieguard Natural Products Pty Ltd. It is AVPMA approved, and approved for children.

From www.mosiguard.com.au "Mosi-guard is the number one selling natural insect repellent. It is nature's most effective way of protecting yourself from biting insects such as mosquitoes, sandflies, ticks and midges. Mosi-guard also protects against leeches. The active ingredient of Mosi-guard is Citriodiol®, a naturally occurring extract of lemon and eucalyptus oil."

Expert review of insect repellents

A 2010 paper by Goodyer et al *Expert Review of the Evidence Base for Arthropod Bite Avoidance*, looks at the efficacy of various active ingredients in insect repellents, and makes some interesting findings.

The authors looked at the effectiveness of commonly used active ingredients in repellent formulations and methods of bite avoidance. The review concentrated mostly on mosquitoes but also considered ticks. Repellents were applied topically to skin or clothing (the treating of an area was also considered, but not included here).

The main purpose of the review was to provide available evidence to make recommendations for the selection of appropriate repellents and other methods of bite avoidance. Deet (N,N-diethyl-3-methylbenzamide) was used as the gold standard to compare the various ingredients, both chemical and natural.

The repellents for topical use included: deet, icaridin (formerly picaridin), IR3535 (EBAAP), lemon eucalyptus extract (*Corymbia citriodora*), citronella, neem, and essential oils. The repellents used in barrier methods included: permethrin, bath oils and chemical based oils, soybean oil, garlic and vitamin B.

Main conclusions in relation to ticks

The concentration of the active ingredient in a product greatly influences longevity of the product. Some products have suboptimal concentrations of active ingredients.

For topical application, icaridin and lemon eucalyptus extract are reasonable alternatives to deet.

In relation to barrier methods such as fabric treated with insecticide, clothing impregnated with permethrin came out as the most effective.

Protection from ticks using icaridin at 20% concentration was reported to be short, therefore regular application is needed.

Products containing lemon eucalyptus extract were shown to reduce attachment and feeding times of ticks by 77%.

The efficacy of citronella based products was reported only for mosquitoes and complete protection time was less than two hours.

Neem studies were considered questionable, some showed high to medium efficacy when compared to deet, however neem is a skin irritant and proven reproductive toxicant and should be used with caution.

The effects of essential oils for ticks was not reported on in the study, however due to their volatility they are considered to have poor longevity and irritate the skin. The most effective of the oils in relation to mosquitoes are; thyme oil, geraniol, peppermint oil, cedar oil, patchouli and clove. The repellent effect of these oils is highly variable depending on formulation and concentration.

Bath oils and chemical base oils offer some degree of protection against biting insects, not as a repellent but as a skin barrier. Soybean oil was only considered for mosquitoes and black flies.

The review reported that garlic and vitamin B ingestion "must never be suggested as a natural method of bite prevention."

The review is available here: onlinelibrary.wiley.com/doi/10.1111/j.1708-8305.2010.00402.x/full

Clothing types

Also see permethrin treated clothing on page 4 and 5

Light coloured clothing with a smooth fabric weave can help, because ticks are easiest to see on a light background and they find it hard to hold on to smooth fabrics.

Suggestions for reducing tick entry points:

- tuck long pants into thick long socks
- wear long sleeves
- put your collar up high around the neck
- tuck in your shirt
- wear coveralls
- wear a wide-brimmed hat
- wrap masking tape around wrists and the top of socks
- sewing up shirt fronts also reduces entry points.

Protection can be improved by the use of insect repellent treated clothing or spray on repellents—don't forget to spray your hat and around the tops of your gloves.

Chemical toxicity

People who perspire heavily may need to think about how to reduce their potential of chemical absorption if using regular insecticidal sprays or washes. All the above mentioned chemicals come with their own risks. Material Safety Data Sheets are available from the manufacturers.

Inspections

Regular inspections of the clothes and hairline are helpful. The less chemical or other protection you are using, the more important this is, and the more frequently you should check.

Larval ticks are only just visible to the naked eye. A magnifying glass is useful. If you use reading glasses you will need to have them with you in the bush.

Ultra sonic devices to repel ticks

There are several electronic devices that emit ultrasonic pulses which are supposed to repel ticks and other insects. We have received a few reports indicating that they are effective. They can be purchased from camping and pet stores or on-line.

Pictured is Mitey Tick Off For You (there is also a Mitey Tick Off For Pets), costing \$75. The manufacturer, Mitey Shield advises:

- Mitey Tick Off for You uses no chemicals or odours and is environmentally friendly.
- proven under Australian conditions.
- easy to use – clip device to lapel, pocket or simply wear around your neck.
- deactivate Mitey Tick Off for You when not in use.
- protection up to 3 metres around your body and inaudible to you and your pets.
- in areas of severe tick infestation, Mitey Tick Off for You may not be able to provide 100% protection—therefore self examination is always still advisable.

Find it at miteyshield.com.au/shop



Don't take ticks home from work

Good workplace hygiene can assist in reducing the incidence of tick bites and help you avoid taking ticks home to potentially infect your family and pets.

If you wear permethrin-treated clothing at all times, you can probably ignore these suggestions because you won't be likely to have any ticks on your clothes.

Suggestions for the end of the work day:

- when you return to base remove and treat all clothes in the laundry then go straight to the shower
- place clothes in clothes dryer on the hot setting for at least 10 minutes
- If you don't have a work base, or if your work base does not have a shower, washing machine and clothes dryer, follow these principles at home
- have a shower and wash your hair, run a head lice comb through well conditioned hair—this will help remove any ticks that have not yet found a bite site
- if you have embedded ticks do not scrub them
- leave work clothes at work to ensure you don't take any hitchhikers home.

Bushland management tips to minimise tick bites

These suggestions are based on bush regenerators experiences and observations. We are interested to hear about any other strategies that could be added to the list.

In areas where ticks may be present consider:

- covering up in permethrin treated clothing at all times when working in the bush
- planning your work to minimise time in high risk areas or at least know when to take maximum protective measures
- planning work schedules around tick season—keep records of tick bites and the season when bitten (see ABBR Newsletter 112 for information on this)
- do you really need to go there?
- can the area be burnt first then hand weeded after?—recently burned areas and more open areas generally have fewer ticks
- can the area be sprayed with herbicide and then, once dried out be finished off by hand?—a dry microclimate is less attractive to ticks
- avoiding crawling under dense weeds—work from the outside in
- if needing to go to the toilet in the bush do not squat over any vegetation, squat on bare ground only.

Footnotes and references

¹medent.usyd.edu.au/fact/ticks.htm#remove

²Mualla McMannas pers com

³Jennett, A and Wall, R 2012, 'Low temperatures won't wash for tick elimination', letter in *Veterinary Record* December 2012, Volume 171, Issue 22 Publisher & location.

⁴Carroll, FJ 2003, 'A Cautionary Note: Survival of Nymphs of Two Species of Ticks (Acari: Ixodidae) Among Clothes Laundered in an Automatic Washer' *Journal of Medical Entomology* 40(5):732-736.

⁵Goodyer, LI, Croft, AM, Frances, SP, Hill, N, Moore, SJ, Onyango, SP and Debboun, M 2010, 'Expert Review of the Evidence Base for Arthropod Bite Avoidance' *Journal of Travel Medicine* 17: 182-192.

Ticks and tick-borne diseases

Review by Lynn Rees and Virginia Bear

The study of tick-borne diseases (TBD) is still an emerging science in Australia, but ticks are known to spread diseases such as tick typhus and Lyme disease.

Don't panic if you get a tick bite, because most tick bites, although annoying, won't make you sick. However because recognition, testing and treatment for various TBD is poor, we need to be vigilant in reducing the number of tick bites, and in treating bites effectively as soon as possible.

A detailed overview of tick borne disease is covered on page 17 *Zoonotic infections in Australia*, By Dr Mualla McManus.

Which ticks carry diseases?

There are between 75¹ and 90² species of tick in Australia. The paralysis tick, *Ixodes holocyclus*, appears to be responsible for most bites to humans on the east coast of Australia.¹

However scientific knowledge of the disease carrying potential of different species is limited, so any tick bite may be considered a potential source of tick-borne diseases (TBD).

The brown dog tick *Rhipicephalus sanguineus* and the bush tick *Haemaphysalis longicornis* were brought into Australia in the 1890's and they have been shown to harbour *Borrelia*: the bacteria which causes Lyme disease.³

Where are ticks found?

The paralysis tick *I. holocyclus* occurs along the east coast of Australia, commonly up to 30-50 km inland, but can be found further inland. Ticks need moist, humid conditions to thrive—they don't like very high or very low temperatures, and can't tolerate prolonged exposure to hot, dry winds.

The paralysis tick is found in many vegetation types but in greatest numbers in moister areas such as wet sclerophyll forest and temperate rainforest.

Ticks are usually found in vegetation below one metre in height, where they are likely to encounter their preferred host: small ground dwelling mammals. Larvae are more commonly found in the leafy, moist ground layers where the eggs are laid. Adults and nymphs may also climb taller shrubs and trees.

As Dr Mualla McManus from Karl McManus Foundation³ explains "Trees, (e.g. she oaks in Northern Beaches of Sydney) are apparently a source of ticks as well as along the east coast. People also tend to find ticks in the head, behind the ears, neck, arm pits etc, rather than behind the knees. Australian *Ixodes* ticks may behave differently to American *Ixodes* ticks in this regard,"

How do ticks find a host?

Ticks are described as being geotropic, meaning that they instinctively climb to the highest point or in opposition to gravity. They use one set of legs to grab onto a host as it brushes past. This behaviour is called questing. Ticks do not jump on to their host.

When searching for a host, a tick responds to exhaled carbon dioxide, movement, body heat and scent. Some people seem more prone to tick bites than others.

Tick-borne disease hot spots in Australia

Wherever there are ticks there is the potential for tick-borne diseases. It's best to be careful and use the precautionary principle at all times.

The Karl McManus Foundation, and the Lyme Disease Association of Australia advise that hot spots for TBD are the NSW South Coast, Sydney and the Central Coast, the Coffs Harbour area, the Gold Coast, all the way up the QLD coast to Cape York, and parts of rural Victoria and rural and coastal Queensland. Lyme disease is also being diagnosed in southwest Western Australia.⁴

Ixodes ticks are not native to WA, but the bush tick and brown dog tick occur there.³

Mualla McManus suggests that TBD hot spots result from a combination of high disease incidence and a high level of awareness. Where there is a high level of awareness, TBD is more likely to be correctly diagnosed.

According to Dr McManus, "Ticks are becoming more prolific and their range is expanding and the rising temperature together with high rainfall makes the perfect environment for tick eggs to develop and thrive. These subtle effects of climate change appear to be making the bacteria in the tick's guts more virulent. This means people who get infected get sicker with more serious symptoms." Anecdotally some veterinarians are finding this also applies to dogs when bitten by ticks.⁵

In Europe and America 28% of *Ixodes* ticks carry more than one bacteria, virus or protozoan that can cause disease in humans.



Adult male *Ixodes holocyclus*. Photo: Virginia Bear

The tick life cycle

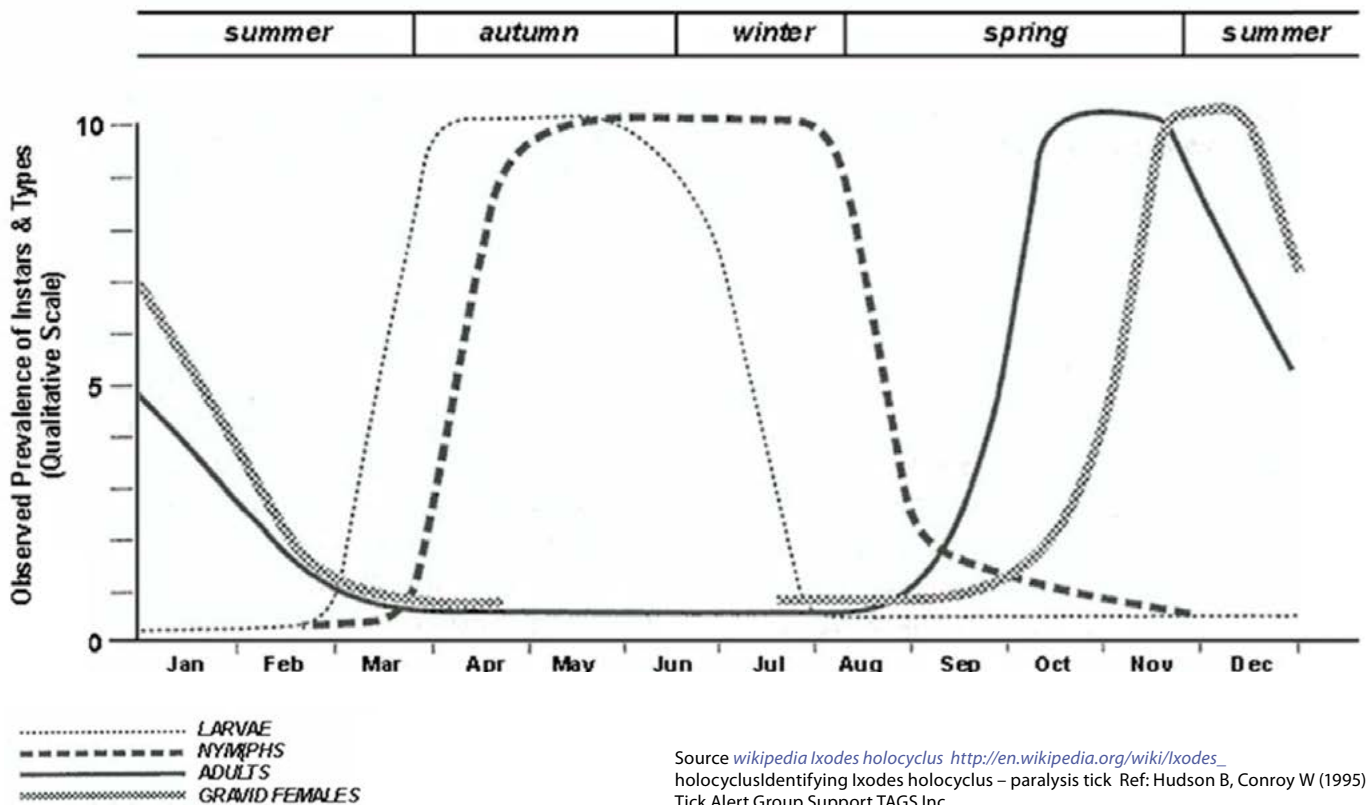
The paralysis tick has four life stages: egg, larvae, nymph and adult. Larvae, nymphs and adult females need a blood meal; therefore it is classified as a three host tick. Male adults do not require a blood meal from a host but search out females to feed from and mate with. The complete life cycle can take up to 365 days with a minimum of 135 days and maximum of 437 days.

A female tick can lay from 2000 to 6000 eggs in leaf and branch litter, under bark or in dense foliage near branch tips. Only a small fraction of the eggs survive and hatch to larvae after 40–110 days incubation.

There is some evidence that suggests the larvae and nymph ticks are the most infectious, because people often get more than one bite (sometimes hundreds) from nymphs or larvae at a time. This has potentially serious health implications for humans.

Research conducted in Sydney in the 1990s found that larvae and nymphs are most active during the cooler months of the year, while adults become more prolific during the warmer months. Anecdotal evidence from bush regenerators in NSW finds this pattern up and down the east coast (see graph below).

Observed seasonal occurrence of life cycle of *Ixodes holocyclus*. Pittwater study area



Can larval ticks transmit infections?

There are several tick-borne pathogens that have been shown to be transmitted transovarially (from parent to offspring) e.g. babesiosis, ehrlichia/anaplasma and rickettsiosis.

According to Lyme expert and author Karen Vanderhoof-Forschner "People can be told erroneously that larvae do not transmit Lyme disease because the bacteria do not cross from the adult to the egg. Yet in Europe, up to 21% of unfed larval *Ixodes ricinus* are infected with the pathogen. In Russia, the *Ixodes persulcatus* tick transmits 100% of its infection to its eggs, and 100% of the emerging larvae are infected. In New Jersey, 16% of the clusters of unengorged larvae harbour *Borrelia burgdorferi*."

To date there is no research in Australia to support transovarial transmission, but the precautionary principle should apply.

Nymph and larval tick bites are a particular cause for concern because:

- their greater abundance means we are likely to be bitten by more individuals—increasing the chance of TBD transmission
- it may take longer to detect them, giving them more opportunity to pass on an infection
- it is common for people to scratch the bite area before realising they have a tick, and this can irritate the tick, increasing the chance of infection
- people may not realise they are ticks—their distinguishing features are almost impossible to see with the naked eye—tick information and folklore has usually focussed on adult ticks, and many people are unaware and surprised by how tiny the larval stage is.

Larval ticks often make their presence felt—it can hurt when they bite. However a big infestation of larvae or nymph bites is often not noticed until that characteristic itch starts at night. Adults ticks often attach unnoticed.



It is common to be bitten by multiple larval ticks (244 in this case), resulting in many small rashes. Photo: Lynn Rees

Identifying *Ixodes holocyclus* paralysis tick

The paralysis tick can be distinguished from other ticks by the darker front and back leg pairs and an oval shaped groove encircling the anus. *Holocyclus* is Latin for complete circle, and refers to this groove.

The Wikipedia page on *Ixodes holocyclus* has detailed information on this tick's biology, including close up pictures of tick body parts (such as mouthparts) and diagrams of the tick's life cycle and feeding behaviour. en.wikipedia.org/wiki/Ixodes_holocyclus



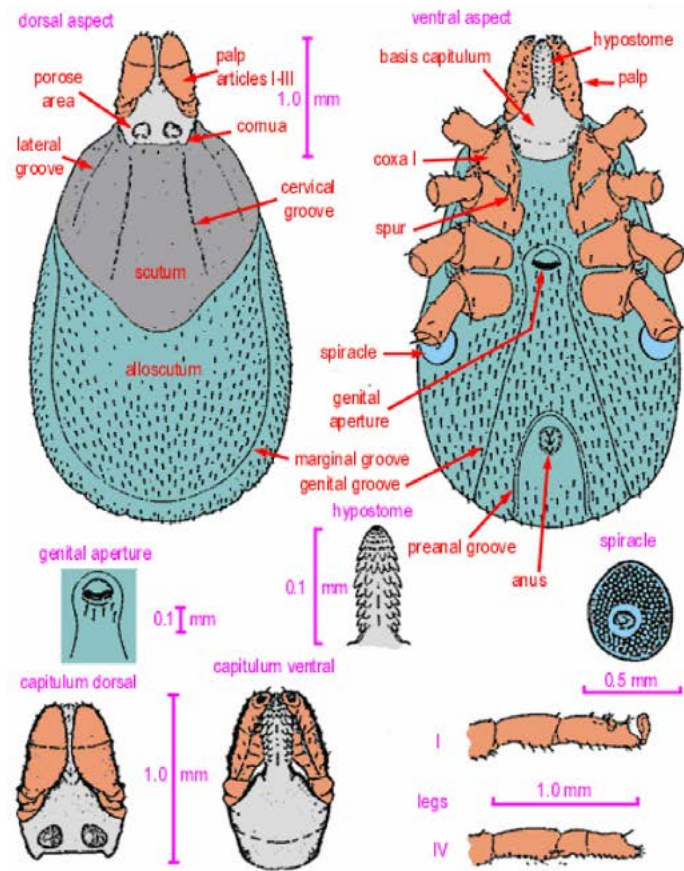
Ixodes holocyclus adult and nymph, both female, and two views of an engorged adult female. Photo: Virginia Bear

Common Names for *Ixodes holocyclus*

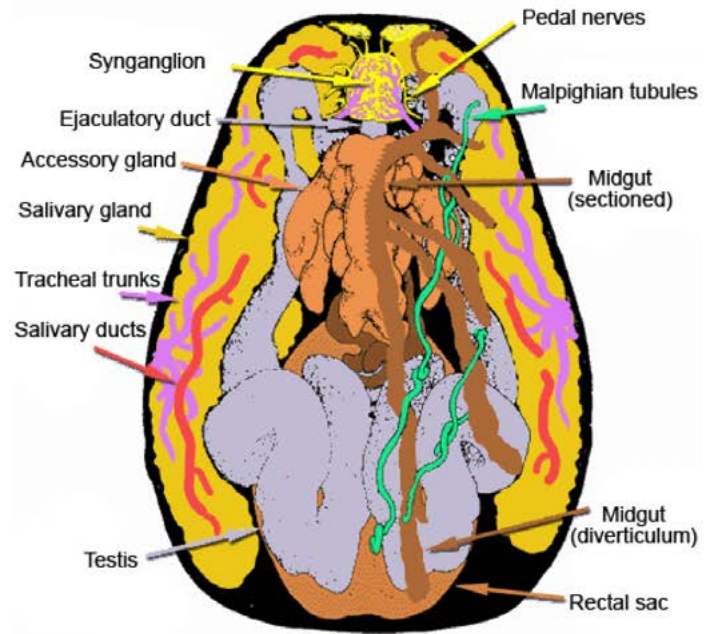
The adult paralysis tick has many common names: wattle tick, hardback tick, blue bottle tick, and shell back tick. Larvae and nymphs are variously described as the grass tick, shower tick, and scrub itch tick, which are often mistakenly thought to be different species of ticks, or mites.

Tick anatomy

The diagram below shows how the salivary glands run straight down each side of the tick. This is why correct tick removal is imperative: if the body is squeezed the salivary and gut contents can be squeezed into the host, transmitting any pathogens that the tick carries.



A study on tick salivary glands from the journal *Parasitology* says, "When feeding, the tick is able to return about 70% of the fluid and iron content of the blood-meal into the host by salivation into the feeding site. This saliva also contains many bioactive protein and lipid components that aid acquisition of the blood-meal. The salivary glands are the site of pathogen development and the saliva the route of transmission."⁶



(Note the large salivary glands running the length of the body. This is why it's dangerous to squeeze an attached tick—it could inject more saliva and pass on an infection.)

Source [wikipedia Ixodes holocyclus](http://en.wikipedia.org/wiki/Ixodes_holocycclus) http://en.wikipedia.org/wiki/Ixodes_holocycclus identifying Ixodes holocyclus – paralysis tick. Ref: Sonenshine, DE: Biology of Ticks, 2 volumes: Oxford University Press, New York, Oxford, 1991 |Author=Sonenshine, DE: Biology of Ticks, 2 volumes: Oxford University Press, New York.

How quickly can ticks transmit infections?

There is contradictory evidence about this, but it is likely quick removal or killing of the tick will reduce the chance of infection. So check yourself regularly!

Karen Vanderhoof-Forschner says: "One of the least studied and most intriguing features of ticks is that some are systemically infected with pathogens found both in the mid gut (stomach) and salivary glands, while others are infected locally, with the agent present only in the mid gut. The distinction is very important. With Lyme disease, for example, a systemically infected tick may be able to transmit a pathogen in only a few hours whereas a tick with a localised infection may take 24-48 hours to move the bacteria into its salivary glands so that transmission can occur."⁷

Mualla McManus adds "Transmission of TBD while feeding can be very fast, different species of ticks can transmit infection at different rates. The bacterial load of each tick can vary depending on the previous reservoir animal they have been feeding on."

Lyme disease

Lyme disease in Australia

Controversy continues regarding whether or not Lyme disease can be contracted in Australia from ticks. However there is increasing evidence that an illness resembling Lyme disease can be acquired. This illness produces similar symptoms to Lyme disease, tests positive for Lyme disease in USA and German specialist tick-borne disease labs, and responds to Lyme disease treatment.

There are also several bodies of research and clinical studies that have isolated *Borrelia* bacteria in Australia, and some are thought to cause Lyme disease.

Despite this, most Australian state and the federal government health agencies maintain that Lyme disease bacteria do not occur here. Australian doctors are often unfamiliar with signs and symptoms of tick-borne diseases and in particular Lyme disease.

NSW Health maintains that, "Although locally-acquired Lyme borreliosis cannot be ruled out, there is little evidence that it occurs in Australia. There is a continuing risk of overseas-acquired Lyme disease being imported into NSW."⁸

Authorities are now starting to refer to a Lyme-like illness, and are becoming more receptive to an Australian species of *Borrelia* which can cause symptoms similar to Lyme disease.⁹

The University of Sydney, Department of Entomology refers to a "LD-like illness" being present in NSW.¹⁰

There are currently two Australian universities researching tick borne diseases. These are Sydney University and Murdoch University in WA. They are using different approaches, and you can help by sending in ticks (see pages 19 and 20).

Even if you don't believe Lyme disease can be acquired from Australian ticks (and given recent government advice, you may be justified in thinking this), it is still important to apply the precautionary principle to all tick bites.

What is Lyme disease?

Dr Joseph Burrascano is one of the key Lyme disease doctors in America and offers this description of Lyme disease.

"Traditionally, Lyme is defined as an infectious illness caused by the spirochete, *Borrelia burgdorferi* (Bb). While this is certainly technically correct, clinically the illness often is much more than that, especially in the disseminated and chronic forms.

Instead, I think of Lyme as the illness that results from the bite of an infected tick. This includes infection not only with *B. burgdorferi*, but the many co-infections that may also result. Furthermore, in the chronic form of Lyme, other factors can take on an ever more significant role—immune dysfunction, opportunistic infections, co-infections, biological toxins, metabolic and hormonal imbalances, reconditioning, etc."¹¹

Ticks are not the only problem, in *Lyme Disease in Australia—Fundamentals of an Emerging Epidemic* Dr Nicola McFadzean states that "case reports in Australia demonstrate illness after bites with mosquitoes and bird mites."¹²

If you think you may have symptoms or signs of Lyme disease and co-infections, get tested by an appropriate doctor early. Early detection and treatment leads to significantly better outcomes (see key Lyme disease references on page 16 for symptom lists and other tick borne infections).

The Lyme Disease Association of Australia has a Doctors Kit and symptom chart that can be downloaded and taken to your doctor. Contact: www.lymedisease.org.au.

It is not a new disease either. The bacterial spirochete, *Borrelia burgdorferi* was first identified by Dr Willy Burgdorfer in 1981, however many references to tick bites resulting in rashes and symptoms now characterised as Lyme disease have been recorded in journals and medical writings for at least 400 years in Europe and the Americas.

Is it Lyme or Lymes disease?

Lyme disease is named after the towns Lyme and Old Lyme in Connecticut, USA, where the disease was first identified in 1975. The first cases were children previously thought to have juvenile rheumatoid arthritis. Whole families in neighbouring towns were found to have been infected by ticks carrying Lyme disease.

Lyme disease—the great imitator

Lyme disease symptoms are generally widespread and have remitting or relapsing episodes and can overlap or be misdiagnosed for many other conditions including fibromyalgia, multiple sclerosis, lupus, motor neurone disease, rheumatoid arthritis, neuropathy, chronic fatigue, myalgic encephalomyelitis, depression, anxiety, obsessive compulsive disorder, early dementia, autism and attention deficit hyperactivity disorder.

People with Lyme disease however often have the symptoms of these conditions but they can be atypical. Many symptoms may appear unrelated but can be linked.

There are over 160 symptoms related to Lyme disease. Some of the more common symptoms are: intermittent fever, joint and muscle pain, migrating pain, fatigue, low stamina, symptom flares, fluctuating symptoms, headache, tremor, memory loss, poor cognition and dizziness. See the recommended websites for comprehensive lists.

Co-infections

In a survey conducted by the Lyme Disease Association of Australia in 2012,¹¹ approximately 56% of respondents said that they had acquired one or more co-infections as well as Lyme disease. Co-infection testing from private labs costs considerably more so this figure could be greater.

In Australia, tick typhus and spotted fever caused by rickettsia bacteria are the most commonly known tick borne diseases, however, as Lyme disease is not yet recognised here, this could change. Some of the other co-infections reported in Australians are as follows:

- Borreliosis (Lyme Disease)
- Babesiosis (first death recently recorded in NSW 2012)¹³
- Bartonellosis
- Ehrlichiosis
- Anaplasmosis
- Mycoplasmosis
- Brucellosis (*Brucella sp.*)
- Q Fever (*Coxiella burnetii*).

National review of Australian Lyme disease

The Australian Government is monitoring Lyme disease, in consultation with the states and territories, through the Communicable Diseases Network Australia.

The Australian Government Chief Medical Officer, Professor Chris Baggeley, has established a Clinical Advisory Committee on Lyme Disease (CACLD) to provide him with advice on evidence for Lyme disease in Australia, diagnostic testing, treatment and research requirements. The Committee will also provide advice on the most appropriate ways to disseminate information to health professionals and the general public.

The purpose of the CACLD is to provide advice to the Chief Medical Officer on:

- whether there is evidence of *Borrelia spp.* causing illness in humans in Australia
- the most appropriate laboratory diagnostic testing algorithms (best world practice) for persons who have suspected borreliosis in Australia
- the most appropriate treatments for borreliosis in Australia
- the most appropriate ways to disseminate information to health professionals and the general public on borreliosis
- the requirements for further research into borreliosis in Australia
- the generation of appropriate new questions relevant to the terms of reference.¹⁴

The cost of treating Lyme disease—employers beware!

There are a number of environmental workers in NSW who are currently covered by workers compensation for their occupationally acquired Lyme-like disease and other tick borne diseases such as Rickettsia.

In the case of co-author Lynn Rees, in her first year of Lyme disease treatment it cost her employer's insurance company just over \$33,000. This amount comprised of testing, doctors visits, sick leave, drugs and supplements.

It took 5 years for Lynn to be correctly diagnosed and treated. If this illness had been picked up early the costs would have been minimal. See Lynn's personal story in AABR News 112. Better still avoid getting bitten in the first place.

For those unlucky people not covered by workers compensation insurance, the cost of treating this disease complex can be crippling.

Early borrelia research in Australia

In 1956 researchers J.H. Pope and J.G. Carley isolated a species of borrelia from native rats, in north-western Queensland.¹⁵ This borrelia species was named *Borrelia queenslandicus*.

In 1959 M.J. Mackerras¹⁶ again found borrelia in the blood of cattle, rodents, kangaroos, and bandicoots. Significantly this study also found a number of co-infections as well.

The review revealed numerous published accounts of borrelia found in animals in Australia dating from as early as 1797, as follows:

- 1797—bandicoot
- 1800—grey kangaroo
- 1822—red kangaroo
- 1897—rats
- 1946—rodents, kangaroos and cattle
- 1952—cattle.

Research that defined Australia's position of denial of Lyme Disease

During the late 1980s and early 1990s, two separate research projects were undertaken in the search for *Borrelia* and other tick borne pathogens in Australia, with contradictory findings.

1. The first research project (Wills and Barry, 1991¹⁷) found three borrelia species and subsequently developed a screening test for them. One of these species resembled the American strain *B. burgdorferi* and the other two resembled the European strains of *B. garinii* and *B. afzelii*. This was the work of microbiologist, Professor Richard Barry, and his PhD student at the time, Michelle Wills, from University of Newcastle.
2. The second research project was undertaken by entomologists, Richard Russell and Stephen Doggett (1994)¹⁸ at the Institute for Clinical Pathology and Medical Research, Westmead, with Sydney University. No *Borrelia burgdorferi* bacterium was found in the Russell and Doggett study.

Russell and Doggett isolated "spirochete-like objects" in fed ticks but dismissed them as artefacts, therefore concluding that there is no *Borrelia burgdorferi* in Australia.

However, before their paper was published in 1994, in a paper by James Alpers (1992),¹⁹ he claims "... that Doggett had made over 70 isolates of spirochete-like organisms from more than 30 separate coastal areas stretching from Southern Queensland to northern Victoria".

Despite all the positive findings and clinical evidence from doctors here and from overseas labs, it appears that both state and federal governments only quote and rely on the negative findings of the Russell and Doggett study.

Government advice maintains that Lyme disease bacteria have been found on every continent in the world, except in Australia and Antarctica.



Borrelia, a spirochaete bacteria. Photo: Scivit / www.shutterstock.com

Report into the experience of Lyme disease sufferers in Australia

In November, 2012 the LDAA released the first research of its kind in Australia into the experience of Lyme disease patients in Australia.²⁰ Some key findings were:

- the time between tick bite to diagnosis takes an average of six and a half years—the outcome means that 80% of Australian Lyme patients will progress to chronic Lyme disease before they are even diagnosed
- more than 80% of patients stated that they had to see 4 or more doctors before they were diagnosed, and of those diagnosed 75% have found it difficult to find a doctor to treat them
- the average distance Lyme patients are travelling (one way) to see a doctor to treat them is 236 km (this doesn't include the 9% of Lyme patients that have travelled overseas for treatment)
- 67% of respondents have had to take time off work or school, and most alarmingly 46% have had to quit their job due to their Lyme disease
- this report provides evidence that Australian Lyme patients are being misdiagnosed, mistreated and misunderstood by the medical community, allied health professionals and the government
- Australian Lyme patients face discrimination every day in obtaining appropriate diagnosis, the availability of testing services, in accessing medical professionals who will treat them and in the economic burdens they are enduring in the pursuit of restoring their health
- there exists a serious gap between the medical community's acknowledgement of Lyme disease and the reality of the Australian situation as presented in this study—it requires immediate attention, because the situation for many Lyme sufferers in Australia is dire.

Earliest known Lyme disease case

Otzi the 5300 year old iceman had Lyme disease.

Otzi's corpse was found by hikers in the Italian Alps in 1991. In 2010, scientists sequenced his genome. They found that he suffered many of the same ailments we suffer from today and they found Lyme disease. This is the earliest documented case of Lyme disease.²¹

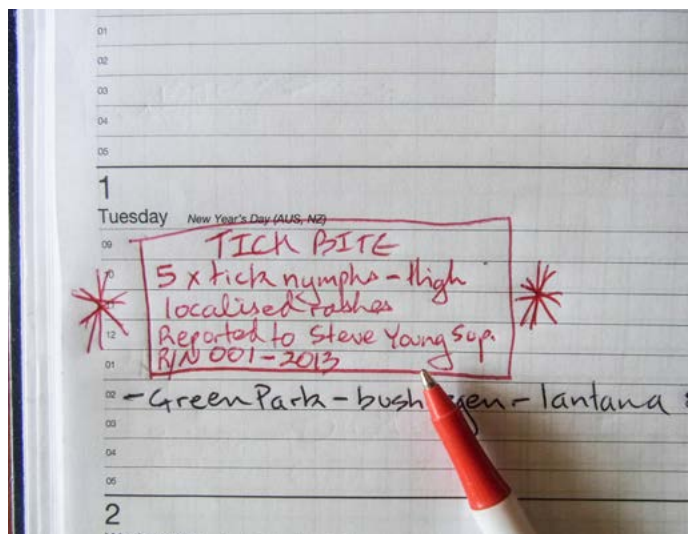
Watch that rash!

It is common to get a rash from a tick bite, and it doesn't necessarily indicate a tick-borne disease. People can get many different rashes ranging from a small local reddish lump, many spots, to large football shaped rashes.

Not everyone who gets Lyme disease notices a rash, chronic flu-like symptoms are more common.

It's a good idea to keep a photographic record (with a ruler), of all rashes and to monitor any spread. If there is anything at all unusual or worrying about a rash from a tick bite, show your doctor. Sometimes rash type can give an indication of which tick borne disease you have especially in the rickettsia group.

Record all tick bites in a diary and, if at work or volunteering, report the bite to your supervisor. Take note of any symptoms from flu-like illness to headaches for the following month or so. See references for some useful websites with symptom lists.



In Top Ten Tips to Prevent Chronic Lyme Disease²² the International Lyme and Associated Diseases Society says 'Show your doctor every rash. The bulls-eye rash is the most famous, but there are many other types of rashes associated with Lyme disease. In fact Lyme disease rashes can be mistaken for spider bites or skin infections. Take photos and make sure a medical professional sees the rash before it fades.'

The following photos show various rashes resulting from tick bites.



Red meat allergy from tick bites

Below are some extracts from a PowerPoint presentation by Clinical A/Professor Sheryl van Nunen, Head of the Department of Allergy, Royal North Shore Hospital & Sydney Medical School-Northern, University of Sydney.



Photo: Meryll / www.shutterstock.com



Tick bites and mammalian meat allergy

The association between prior tick bites and mammalian meat allergy was first described in 2007 by van Nunen et al. The Association Between *Ixodes holocyclus* Tick Bite Reactions and Red Meat Allergy. *Internal Medicine Journal* 2007; 39 (Suppl5): A132.

The molecular basis has been determined by Commins et al. Delayed anaphylaxis, angioedema or urticaria after consumption of red meat in patients with IgE antibodies specific for galactose-alpha-1,3-galactose. *Journal of Allergy and Clinical Immunology* 2009; Vol 123, Issue 2, 426-433.

Typical features

- Mammalian meat allergy is exceedingly rare in adults in the absence of an association with prior tick bites.
- Tick bites precede any reactions to mammalian meats.
- Often, tick bites in the past have given rise to small local reactions (or larger local reactions) usually to adult ticks, occasionally to smaller stages of ticks (nymphs, larvae).
- Mammalian meat allergy symptoms often do not commence until several months after the tick bite.
- The allergic reaction to the meat is typically delayed by several hours after the ingestion of the meat (usually 3-6 hours).
- Cross-reactivity occurs between mammalian meats e.g. venison.

The association between tick bites and mammalian meat allergy

- Management of the meat allergy is limited to the avoidance of all mammalian meats and, in some instances, the avoidance of cow's milk as well.
- Dietary review focussing upon iron intake, ensuring overall nutritional adequacy is advisable.
- Provision of an adrenaline auto-injector and training in its use.
- Prevention of future tick bites is considered prudent.

For a personal story, in *ABBR Newsletter number 113*, Andy Marshall wrote a personal account of his long term red meat allergy.

Footnotes and references

- ¹Storer, E, Adam, T, Sheridan, A, Warren, L and Wayte, J 2003, 'Ticks in Australia' *Australasian Journal of Dermatology* 44, 83–89
2medent.usyd.edu.au/fact/ticks.htm
- ³Mualla McMannas pers com
- ⁴Mualla McManus 2011, Nikki Coleman 2012 pers. com
- ⁵Gatewood Hoen, A, Margos, G, Bent, SJ, Diuk Wasser, MA.,;Barbour, AG, Kurtenbach, K, Fish, D 2000, 'Phylogeography of *Borrelia burgdorferi* in the eastern United States reflects multiple independent Lyme disease emergence events, *Proceedings of the National Academy of Sciences of the United States of America*, 106(35):15013-15018
- ⁶Bowman, AS and Sauer, JR 2004, 'Tick salivary glands: function, physiology and future', *Parasitology*, 129 Suppl:567-81.
- ⁷Vanderhoof-Forscner, K 2003, *Everything you need to know about Lyme disease and other tick-borne disorders*. Second Edition, John Wiley and Sons USA.
- ⁸www.health.nsw.gov.au/resources/publichealth/infectious/diseases/pdf/lyme_disease_testing_advice.pdf Accessed July 2013
- ⁹Rees, L *The Lyme Disease Debate in Australia - Research and Testing Explored* unpublished paper.
- ¹⁰University of Sydney Medical entomology medent.usyd.edu.au/ Accessed July 2013
- ¹¹ Burrascano, JJJR 2008, *Diagnostic hints and treatment guidelines for Lyme and other tick-borne illnesses*, Sixteenth Edition International Lyme and Associated Diseases Society.
- ¹²McFadzean, N 2012, *Lyme Disease in Australia. Fundamentals of an Emerging Epidemic*. BioMed Publishing Group
- ¹³Senanayake, SN, Paparini, A, Latimer, M, Andriolo, K et al 2012, *First report of human babesiosis in Australia*. MJA 196: 350-352.
- ¹⁴ www.health.gov.au/internet/main/publishing.nsf/Content/ohp-lyme-disease.htm
- ¹⁵ Carley JG, Pope JH 1958 :13th Ann. Rep.Qld. Int.med. Res, p.4
- ¹⁶ Mackerras J 1959, 'The Haematozoa of Australian Mammals'. *Australian Journal of Zoology* vol.7 No.2
- ¹⁷Wills, MC and Barry, RD 1991, 'Detecting the cause of Lyme disease in Australia' letter. *Medical Journal of Australia*, 155: 275
- ¹⁸Doggett, SL, Russell, RC, Munro, R, Dickeson, D, Ellis, J, Avery, D, Hunt, CL, Simmonds, J and Trivett, N 1994, 'Lyme disease - the search for the causative agent in southeastern Australia', *Arbovirus Research in Australia*, 6: 313-315.
- ¹⁹ Alpers J 1992, 'Borrelia isolated from Australian ticks' *Today's Life Science* pp. 40-42
- ²⁰Lyme Disease Association of Australia (2012) *Lyme Disease: Australian patient experience in 2012* www.lymedisease.org.au/wp-content/uploads/2012/11/ldaa-lyme-disease-australian-patient-experience-in-2012-22nov12.pdf
- ²¹ Hall Stephen, S 2011, *Iceman Autopsy* ngm.nationalgeographic.com/2011/11/iceman-autopsy/hall-text. Accessed 2013.
- ²² The International Lyme and Associated Diseases Society *Top ten tips to prevent chronic Lyme disease*. www.ilads.org/lyme_disease/lyme_tips.html. Accessed July 2013.

General references

- Burrascano, JJJR 2008, *Diagnostic hints and treatment guidelines for Lyme and other tick-borne illnesses*, Sixteenth Edition International Lyme and Associated Diseases Society.
- Foundation for Alternative and Integrative Medicine *Lyme Disease Workshop*. www.faim.org/lyme/lymediseaseworkshop.html Accessed July 2013
- McFadzean, N 2012, *Lyme Disease in Australia. Fundamentals of an Emerging Epidemic*. Publisher & location Storer, E, Adam, T, Sheridan, A, Warren, L and Wayte, J 2003 'Ticks in Australia' *Australasian Journal of Dermatology* 44, 83–89
- Rees, L and Bear, V 2012, "Tick-borne diseases: update", *AABR Newsletter*, vol.113, pp.9-10. Australian Association of Bush Regenerators.
- Rees, L and McManus, M 2012, "Ticks—protecting yourself Manual and chemical removal and protection options", *AABR Newsletter*, vol.112, pp.9-14. Australian Association of Bush Regenerators.
- University of Sydney Department of Medical Entomology
- Wikipedia en.wikipedia.org/wiki/Ixodes_holocycclus

Key Lyme disease websites

Australian Lyme disease websites:

- www.lymedisease.org.au/
www.karlmcmannasfoundation.org.au/
www.drmayne.com/

NSW Health websites

- www.health.nsw.gov.au/factsheets/infectious/lyme_disease.html
www.health.nsw.gov.au/resources/publichealth/infectious/diseases/pdf/lyme_disease_testing_advice.pdf
www.health.nsw.gov.au/environment/Publications/tick_alert_brochure.pdf

The International Lyme and Associated Diseases Society

- www.ilads.org

Zoonotic infections in Australia

Dr Mualla McManus, Karl McManus Foundation

Zoonotic infections are caused by pathogens (bacteria, virus, protozoa and parasites) that are transmitted from animals to humans via direct or indirect contact, or by vectors such as ticks.

Zoonotic infections can be confined to a small area or be widespread. How far the zoonotic infection spreads depends on the reservoir animals that carry that specific zoonotic pathogen.

This article does not intend to raise unfounded fear with people who work in the bush. These zoonotic infections are observed in farms, even in suburbia, so people do not need to abandon their vocation or their residence because of them. Instead we must be aware and learn to live with animals.

People working in the bush can be in contact with various native animals, or feral animals such as rabbits, foxes, rats, mice, and

birds. People are also often in contact with farm animals such as sheep, cattle and pigs. There may be direct connections between humans and these animals, indirect contact (faeces, urine), and vectors such as ticks and mites. Hence when working in the bush or enjoying the bush, one should be aware of zoonotic infectious diseases.

This is very pertinent in today's environment with climate change affecting the proliferation of these pathogens and the reservoir animals. Understanding the route of transmission of these zoonotic infections is vital in prevention. The most common route is via urine, faeces and/or by blood sucking vectors like ticks.

Below is a table of some common zoonotic infections known to occur in Australia. All are blood-borne diseases transmitted by blood sucking insects, commonly ticks.

Some zoonotic infection known to occur in Australia (adapted from Goldsmith 2005).		
All transmitted by blood sucking insects, commonly ticks.		
Disease	Causative Agent	Reservoir
<i>Actinomyces pyrorogenes</i> abscess	<i>Actinomyces pyrogenes</i>	Cattle
Babesiosis	<i>Babesia</i> spp.	Birds, mammals, cattle
Barmah Forest virus	<i>Alphavirus</i>	Birds, mammals
Bird mite disease	<i>Ornithonyssus</i> spp.	Birds
Brucellosis	<i>Brucella</i> spp.	Goats, cattle, pigs
Campylobacteriosis	<i>Campylobacter</i> spp.	Small mammals, birds
Cat scratch disease	<i>Bartonella</i> spp.	Cats
Cryptosporidiosis	<i>Cryptosporidiosis</i> spp.	Many mammals
Cryptococcosis	<i>Cryptococcus neoformans</i>	Birds
Dog tapeworm	<i>Dipylidium caninum</i>	Dogs
Ehrlichiosis	<i>Ehrlichia</i> spp	Dogs
Eosinophilic gastroenteritis	<i>Ancylostoma caninum</i>	Dogs
Haycocknemiiasis	<i>Haycocknema perplexum</i>	Wallabies, kangaroos
Hendraviral disease	<i>Paramyxovirus</i>	Flying foxes
Jap. B. encephalitis	<i>Flavivirus</i>	Birds, pigs
Kokobera infection	<i>Flavivirus</i>	Horses, cattle, macropods
Kunjin infection	<i>Flavivirus</i>	Birds, mammals
Leptospirosis	<i>Leptospira interrogans</i>	Cattle, pigs, rodents, dogs
Lyme disease	<i>Borrelia burgdorferi sensu lato</i>	Rodents, deer, dogs, cattle, sheep, horses, bandicoots, wallabies, small marsupials
Lyssavirus	<i>Rhabdovirus</i>	Flying foxes
Murray valley encephalitis	<i>Flavivirus</i>	Birds
Newcastle disease	<i>Paramyxovirus</i>	Fowls
Pasteurellosis	<i>Pasteurella</i> spp.	Dogs and cats
Q fever	<i>Coxiella burnetii</i>	Birds, cattle, sheep, native animals
Relapsing fever	<i>Borrelia recurrentis</i>	Birds
Ross River	<i>Alphavirus</i>	Native animals
Salmonellosis	Non-typhoidal salmonoellae	Mammals
Scrub typhus	<i>Orientia tsutsugamushi</i> (Rickettsia)	Blood sucking insects
Spotted fevers	<i>Rickettsia</i> spp	Blood sucking insects
Toxoplasmosis	<i>Toxoplasma gondii</i>	Cats, mammals
Yersiniosis	<i>Yersinia enterocolitica</i>	Pigs and rodents

Most of the zoonotic infections listed in the table are rare and hard to diagnose. Some are emerging diseases that are becoming more prominent. These include Lyme disease.

Some zoonotic infections are hard to differentially diagnose by the clinician, because symptoms can overlap with other diseases and/or an emerging disease.

It's best to avoid the zoonotic infection in the first place. This can be achieved by being aware, and applying the relevant precautionary measures, as described in this newsletter.

Lyme disease

The natural reservoir animal of these infectious disease bacteria, *Borrelia burgdorferi* sensu lato (in the broad sense) complex, is most of Australia's native animals (blood sucking insects are vectors). The areas that are affected are rapidly expanding due to migratory birds that fly in from Asia and nest in Australian lakes, rivers, and beaches. Also, due to climate change, the virulence of these bacteria is increasing rapidly.

Lyme disease can effect any organ in the body, and commonly involves the nerves, joints, muscles and heart.

Lyme disease is a great imitator and its symptoms are hard to distinguish from common neurodegenerative diseases like motor neurone disease, multiple sclerosis, Parkinson's disease, Alzheimer's disease, fibromyalgia, rheumatoid arthritis, chronic fatigue syndrome, systemic lupus erythematosus, sarcoidosis and psychiatric disorders.

Lyme disease, like syphilis, has three stages

Stage I: days and weeks after a tick bite. Stiff neck, sweat attacks, persistent flu-like symptoms, headache, gut problems, swollen glands. Can involve an erythema migrans (EM) rash which can persist for months and years.

Stage II: weeks or months after a tick bite. Cranial nerves in the neck degenerating, people having problems speaking and swallowing, muscle nerve pain, brain fog, memory problems, muscle wasting, muscle twitches, increased heart rate, blood pressure problems, balance problems, joint pain, and mood changes.

Stage III: months to years after a tick bite. Can include paralysis of muscles of the hands, arms, legs, problems with swallowing and speech; muscle nerve pain; tremors; inflammation of the brain; heart problems; gut problems; hormonal problems such as abnormal thyroid and adrenal function.

If Lyme disease is diagnosed early and preventative antibiotics are taken after a tick bite, it can be prevented. It is a treatable infection, not a death sentence like other neurodegenerative diseases.

Lyme disease is not a single pathogen disease. A tick bite can deliver many other bacteria, viruses, and protozoa. It is complicated because Lyme disease bacteria, like the AIDS virus, creates an immunosuppressed environment and the co-infections, together with opportunistic infections, complicate diagnosis and treatment. Hence prevention is better than a cure.

Lyme bacteria exist in three different forms: a spiral shape with a cell wall, a cell wall free state inside a cell, and a cyst. Hence, three different types of antibiotics are needed to kill all three forms to recover from Lyme disease. Lyme bacteria divide very slowly hence a lengthy antibiotic treatment period is needed to kill all the bacteria. This is in contrast to average bacteria which divide every half hour and require two weeks of antibiotic treatment.

The treatment is also complicated by the release of toxins by the dying bacteria (called a die-off reaction or Herxheimer reaction), which worsens the symptoms. So complementary medication to remove the toxins is essential in therapy.

The most common co-infection in Australia is rickettsia. These are also called spotted fevers. Queensland tick typhus (Australian spotted fever) occurs along the East Coast of Australia and Flinders Island spotted fever found in Tasmania and Flinders Island. The symptoms of rickettsia are similar to Lyme disease: fatigue, sweat attacks, fever, muscle aches, headache, nausea, vomiting, confusion, stiff neck and a unique rash, depending on which species of rickettsia cause the infection.

Another common co-infection is babesia—70 to 80% of Lyme disease sufferers are also infected by this protozoa which is related to malaria. The Lyme disease bacteria and *Babesia sp.* form symbiotic relationships to benefit each other. Babesiosis symptoms include sweat attacks, shortness of breath, fatigue, muscle wasting, and muscle twitches—similar to Lyme disease.

Further information can be obtained from:

www.karlmcmannusfoundation.org.au
www.lymedisease.org.au

Reference

Goldsmith, J.M (2005) Zoonotic Infections: an overview. Chapter 14: 14.1-14.14. Aust. College of Tropical Medicine. Australia.

Originally published in AABR Newsletter 112 March 2012

A request from the Karl McManus Foundation

Please donate so that thousands in Australia can get appropriate testing, diagnosis and treatment.

Karl McManus Foundation for Lyme disease research and awareness needs urgent donations to isolate the Lyme disease bacteria from Australian ticks and once and for all prove to the health department that Lyme disease bacteria is in Australia and was here all along.

When we have isolated the Lyme disease bacteria we will develop tests that are better suited for testing the

Australian strain of Lyme disease bacteria. This way the testing and hence diagnosis can be more accurate. We also intend to educate doctors about Lyme disease clinical symptoms and treatment. We would like to see Lyme disease diagnosed like any other accepted disease in Australia.

www.karlmcmannusfoundation.org.au

Research into tick-borne diseases

Dr Ann Mitrovic, The University of Sydney

Very little is known about the pathogens (bacterial, parasitic, protozoan and viral) that ticks and other vectors carry in Australia. This is an area that is under researched, and as a result we do not have a clear understanding of the potential health risks that may follow an insect bite.

In some cases of tick-borne infection there is an early and obvious physiological response (e.g. tick typhus caused by rickettsia species resulting in a rash and fever) which can lead to a correct diagnosis and appropriate treatment. However, as is the case of some pathogens such as *Borrelia burgdorferi* sensu lato (the spirochete bacteria that causes Lyme disease), the symptoms may not be obvious for weeks or months, and hence may not be linked with an insect bite. This increases the chance of misdiagnosis, particularly in Australia where tick-borne disease is not well understood.

Currently our research is focusing on ticks and investigating the pathogens they may carry. Our investigations will involve culture techniques and DNA techniques to identify species. We also need to identify which species of tick carry the pathogens, identify regions where infected ticks are found, and calculate what percentage of ticks in any given area are infected with specific microbes.

This research may be of interest to many people because of the risk of exposure to tick bite when in the bush.

If you would like to assist us in our research or if you have any questions please contact me at ann.mitrovic@sydney.edu.au or 02 9351 3217.

References

- Alpers, J 1992, 'Borrelia isolated from Australian ticks' *Today's Life Science*. April: 40, -2.
- Carley, JO, Pope, JH, 1962 'A New Species of Borrelia (B. Queenslandica) from *Rattus villosissimus* in Queensland', *Austral. J. Exp. Biol.* 40, 255-262.
- Hudson, BJ, Barry, RD, Shafren, DR, Wills, MC, Caves, S, Lennox, VA, 1994, 'Does Lyme Borreliosis Exist in Australia?', *Journal of Spirochetal and Tick Borne Diseases*, 1 (2), 46-51.
- Hudson, BJ, Stewart, M, Lennox, VA, Fukunaga, M, Yabuli, M, Macorison, H and Kitchener-Smith, J 1998, 'Culture-positive Lyme borreliosis', *MJA* 168, 500-502.
- Mackerras, M, Mackerras, J and Sanders, DF 1953, 'Parasites of the bandicoot, *Isodon obesulus*'. *Proc. Roy. Soc. Qd.* 63: 61-3.
- Mackerras, MJ 1959, 'The Haematozoa of Australian Mammals', *Aust. J. Zool.* 7, 105-135.
- Mayne, P 2011, 'Emerging Incidence of Lyme borreliosis, babesiosis, bartonellosis, granulocytic ehrlichiosis', *International Journal of General Medicine* 4, 845-852.
- Mayne, P 2012 'Investigation of *Borrelia burgdorferi* genotypes in Australia obtained from the erythema migrans tissue', *Clinical, Cosmetic and Investigational Dermatology*. 2012. :5, 69-78.
- Wills, MC and Barry, RD, 1991, 'Detecting the cause of Lyme Disease In Australia' Letter in *Australian Medical Journal* Aug 19;155(4):275.
- Wills, M.C 1995 'Lyme Borreliosis, the Australian perspective' PhD thesis Newcastle University.

Dr Ann Mitrovic is Honorary Associate School of Medical Sciences (Pharmacology)

Originally published in AABR Newsletter 112 March 2012

Ticks wanted!

If you are interested there is an opportunity for you to assist us in the research with tick collection.

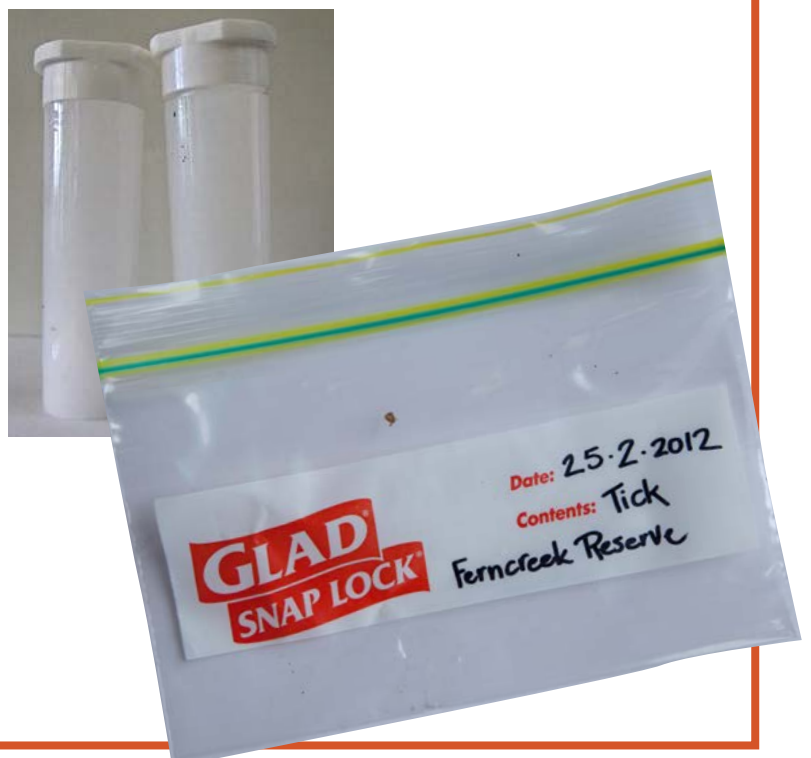
If you happen to return from the bush and find a tick on you or a co-worker, please remove safely and if tick is alive place nymphs and unengorged adults in snap lock sandwich bag with either moist paper towel or moist blades of grass.

If adult tick is engorged please post in plastic vial which can be provided by Ann Mitrovic ann.mitrovic@sydney.edu.au

Dead ticks can be posted without moisture or can be frozen and posted when convenient.

Envelopes can be addressed to:

Ann Mitrovic
School of Medical Sciences (Pharmacology)
THE UNIVERSITY OF SYDNEY
Room 294 Blackburn Building D06
The University of Sydney, NSW, 2006



A new molecular toolkit to investigate tick-borne pathogens in Australia

Dr Peter Irwin, Murdoch University

A \$650,000 grant from the Australian Research Council has been awarded to:

- Murdoch University: Associate Prof. Peter Irwin (Chief Investigator/Project Leader)
- Murdoch University: Professor Una Ryan (Chief Investigator)
- Murdoch University: Associate Prof. Mike Bunce (Chief Investigator)
- University of Sydney: Associate Prof. Peter Banks (Chief Investigator)
- University of Copenhagen: Professor Tom Gilbert (Partner Investigator)
- Bayer Australia: Dr Bob Rees (Partner Investigator)
- Bayer Animal Health: Professor Norbert Mencke (Partner Investigator)

This research uses the latest molecular diagnostic techniques to address unanswered questions about potential tick-transmitted diseases of humans and companion animals in Australia. The study will identify 'hot-spots' for tick-borne pathogens, identify areas of potential risk for humans, and investigate vector-host-pathogen interactions nationwide.

Recreational and employment activities of humans in rural regions, often with companion animals, provide ideal environments for transmission of vector-borne diseases from wildlife. Currently in Australia there is community concern and uncertainty about the occurrence, diversity and distribution of tick-associated pathogens.

The primary objective of this project is to systematically characterise and map potentially zoonotic tick-borne organisms (bacteria, rickettsiae and protozoa) using a new molecular toolkit. This project will create important data about vector-pathogen-host ecologies in Australia and provide new understanding about the potential risk for humans and companion animals of tick-borne disease, nationwide.

Dr Peter Irwin is Associate Professor of Small Animal Medicine

How you can help

Our research is focused on the tick vectors of any potential pathogens, so we would like to receive tick specimens from all over Australia, from any hosts (including humans), and from archived collections.

We can send you collection kits and instructions for how to collect, preserve and ship the specimens to Murdoch University.

If you would like more information about this research please contact Dr Peter Irwin by email: P.Irwin@murdoch.edu.au or by phone: 08 9360 2590.



The Australian Association of Bush Regenerators (AABR) is an association, incorporated in NSW in 1986, with several hundred members from all over Australia.

Our aim is to promote the study and practice of ecological restoration, and foster and encourage effective management of natural areas by qualified people, based on sound ecological principles.

All interested people are welcome to join.

AABR members include bush regeneration professionals, volunteers, natural area managers, landowners, policy makers, contractors, consultants, nursery people, local, state and commonwealth government officers—and lots of people who just love the bush and want to see it conserved. Apply at www.aabr.org.au.