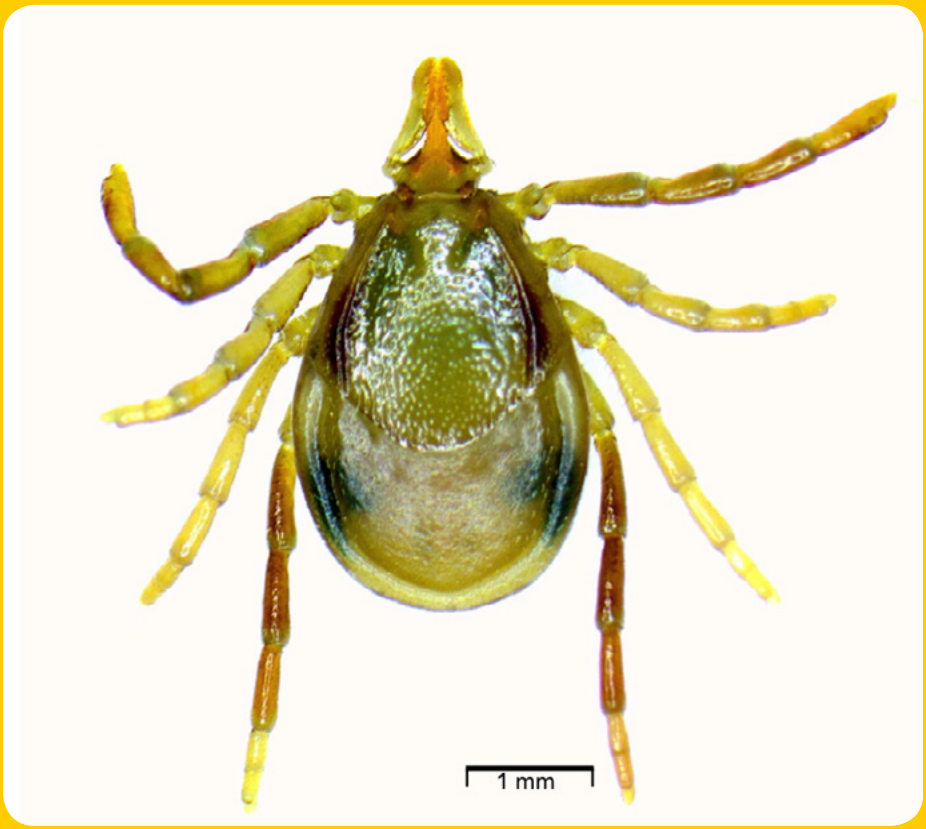
PAWSEY supercomputing centre

PARTNER INSTITUTION
Murdoch UNIVERSITY



Paralysis tick, *Ixodes holocyclus*, commonly found on the eastern seaboard of Australia (dorsal view). Imaged by PhD student Telleasha Greay.

PROJECT LEADER
DR CHARLOTTE OSKAM

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SYSTEM
MAGNUS AND GALAXY

TIME ALLOCATED
150,000 HOURS

AREA OF SCIENCE
BACTERIOLOGY

APPLICATIONS USED

USEARCH, QIIME, BLAST V2.3

REVEALING THE HIDDEN BACTERIAL WORLD IN TICKS

Ticks are one of the most important vectors of disease affecting humans and animals. A quarter of world-wide pandemics over the last decade have been attributed to vector-borne disease, and controlling these emerging infectious diseases is one of the most important objectives of global economies. Despite this, little is known about the pathogens transmitted by ticks to people and animals in Australia. The Vector and Waterborne Pathogen Research Group (VWBPRG) at Murdoch University led by Professors Peter Irwin and Una Ryan, with Dr Charlotte Oskam and Dr Andrea Paparini and their postgraduate students, are utilising the processing power of the Pawsey Supercomputing Centre's systems to analyse tick bacterial community profiles and identify tick-borne bacterial species that may be associated with illness.

2016

UNCOVERING THE MICROBIOME OF AUSTRALIAN TICKS

THE CHALLENGE

Understanding the source of emerging infectious diseases in humans and animals is important for public health. Ticks are known to transmit a greater variety of pathogenic microorganisms than any other arthropod group.

Outside of Australia, ticks are recognised transmitters of the bacteria that causes Lyme disease. There is currently intense media interest in a possible link between tick bites and illness in Australians. Although the bacteria responsible for Lyme disease have not been found in Australian ticks, the growing presence of Lyme disease-like illness in Australians is of increasing concern, highlighting the need for research into the possible causes of these illnesses.

The VWBPRG is using advanced DNA sequencing platforms and a recently developed molecular toolkit to detect microorganisms harboured within Australian ticks.

"Assigning taxonomy to millions of DNA sequences is a crucial step but is often labour-intensive and time consuming," Dr Oskam says.

The VWBPRG's own computer systems lacked the technological power to process the increased genetic information available thanks to these advances, and they required higher powered computers to identify and characterise the zoonotic microorganisms carried by these ticks.

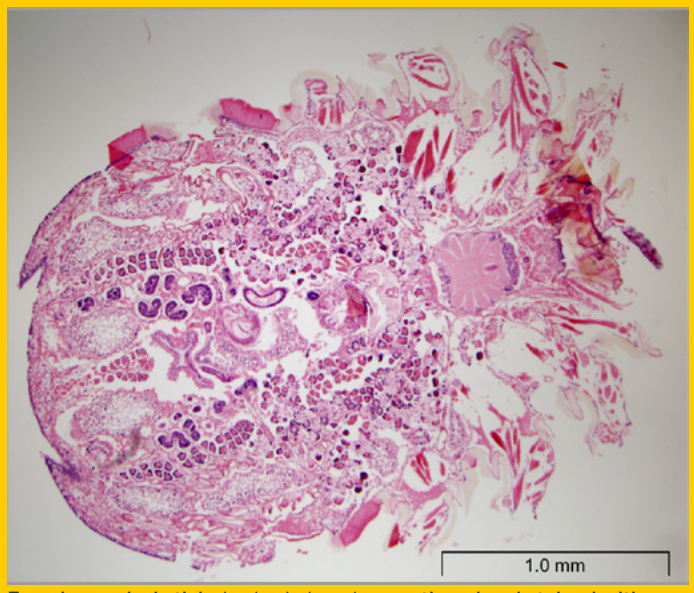
THE SOLUTION

Dr Oskam utilised Pawsey's petascale 'Magnus' supercomputer to analyse over 450 tick bacterial communities carried by four native tick species.

"Standard desktop computers take in the order of days to weeks to analyse our large datasets, however, using the Pawsey supercomputer, Magnus, our datasets are usually analysed within hours," Dr Oskam says.

The use of Next Generation Sequencing technology and the Pawsey Centre's supercomputers has enabled Dr Oskam's team to detect and identify novel bacteria that have previously gone undetected using traditional methods.

"With increasing genetic information, as a result of advanced DNA sequencing platforms, the scale of the data analysis required by this research necessitated access to high performance computing afforded by the Pawsey Supercomputing Centre."



Female paralysis tick, *Ixodes holocyclus*, sectioned and stained with H&E. Imaged by PhD student Alex Gofton.

OUTCOME

Dr Oskam and her team have identified five novel tick-borne bacterial species, which has prompted them to begin developing new molecular tools to investigate these species further.

"While we are yet to determine their zoonotic and pathogenic potential, what we do know is that these new 'bugs' have previously gone undetected with traditional methods."

Dr Oskam's research will contribute to the National Science and Research priority "Health," by expanding knowledge of microorganisms that may negatively impact on the health and welfare of humans and animals in Australia.

"This research is providing the science to help improve the accuracy of current disease diagnoses for microorganisms responsible for locally acquired tick-borne infections in Australia," Dr Oskam says.

The next step for Professors Irwin and Ryan's team is to understand the lifecycle of the five novel bacterial species they have identified, as well as identifying their wildlife reservoir hosts, to improve upon diagnostic tests and methods of control for tick-borne diseases.

The Australian Research Council currently funds this research with industry partners Bayer HealthCare, Bayer Australia and Queensland Health.