VICTORIA UNIVERSITY WELLINGTON
TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI

Male-Biased Parasitism in Plants

WHO?

Two researchers from Victoria University of Wellington, Dr Kirsty Yule and Professor Kevin Burns.

WHAT ARE THEY INVESTIGATING?

Dr Yule and Professor Burns have found that in many species the male of the species tends to be more susceptible to parasites than the female. This is true of both animals and plants.

In animals, while the exact reason for this is unknown, but there is a growing consensus that androgens (hormones that play a role in male characteristics and reproduction) have an immuno-suppressant effect.

In dioecious plants (where there are separate male and female plants), males have also been observed with a much higher number of parasites than the females. However, plants don't have appear to have an equivalent hormone to androgens, meaning other processes may be at work.

The researchers hypothesised that one reason for male plants being more heavily parasitized might be that female plants have to expend more energy creating fruit and seeds, which means less resources are available for parasites.

HOW DID THEY TEST THIS HYPOTHESIS?

- *How would you design an experiment to test this hypothesis?*

The researchers looked at the native tree Aristotelia serrata, otherwise known as the makomako or wineberry, and one of its common parasites, the larvae of the puriri moth. They took a sample of twenty trees of each sex and measured both their parasite load (the number of larvae) and the diameter of the trunk. They observed that male trees had a significantly higher number of larvae than female relative to trunk diameter.

- *The researchers also controlled for a number of variables. What do you think those variables were and how did they control for them?*

Establishing the cost of reproduction

In order to test their hypothesis that female plants had less parasites due to expending more energy reproducing, the researchers needed to develop a way of measuring the cost of making seeds in a way that could be compared to parasite load.

- How do you think they did this?
- What kinds of assumptions do you think they would need to make?
- How would they use this method to support their hypothesis?

CAPITAL THINKING. GLOBALLY MINDED.
MAI I TE IHO KI TE PAE

COMPARING SEEDS WITH PARASITES

As the researchers had already identified that parasite load and seed production had a linear relationship to tree diameter, they used tree diameter as the common variable in their calculations.

In order to calculate seed production without the influence of parasitism, the researchers identified a selection of twenty unparasitised female trees and, over the course of three fruiting seasons, photographed five randomly selected panicles (fruit clusters) on each tree. They then multiplied the number of fruit in each panicle by the number of panicles on the tree. This was then multiplied by eight to account for the number of seeds in each fruit and averaged across the three years. The results were used to develop an equation to describe the relationship between seed production and trunk diameter.

Equation 1 - S = Seed production expenditure

$$S_{♀} = m_{♀}(D) + b_{♀}$$

In order to calculate parasite load without the influence of seed production, researchers measured the trunk diameter of an additional 20 parasitised male trees and the results were used to develop an equation to describe the relationship between parasite load and trunk diameter.

Equation 2 - P =Parasite load

$$P_{♂} = m_{♂}(D) + b_{♂}$$

In both equations, m is the slope and b is the intercept.

These two equations were then used to develop a single equation to describe the relationship between parasite load and seed production.

$$P_{♂} = \left(m_{♂} \left(\frac{S_{♀} - b_{♀}}{m_{♀}} \right) + b_{♂} \right)$$

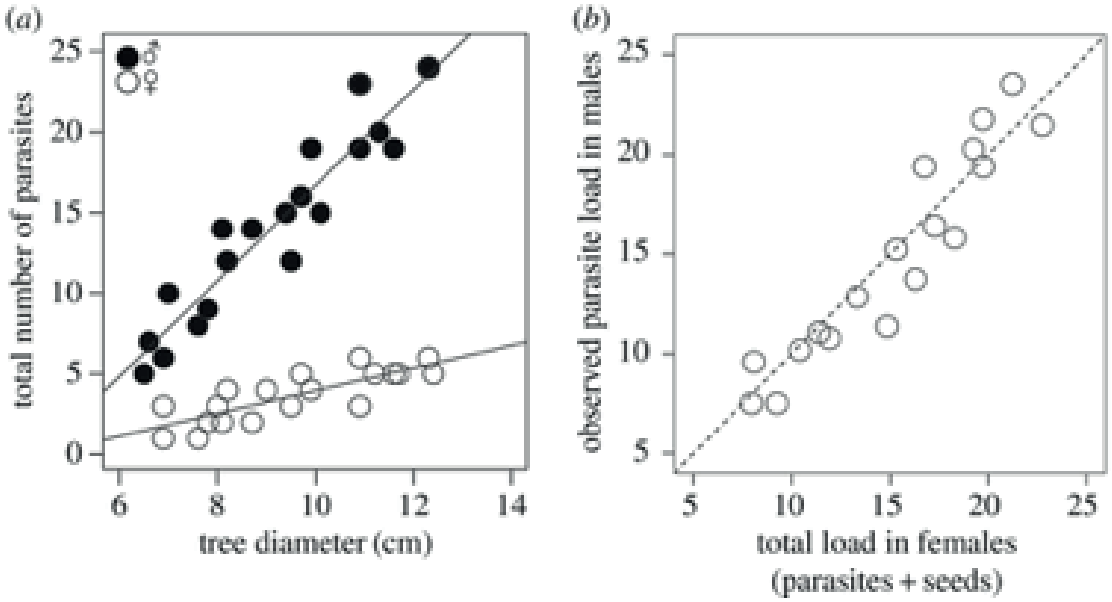
This single equation could be used as a coefficient to quickly and easily convert the energy used in seed production into an equivalent energy loss due to parasitism.

- *Look at the equations, and see how they're described in the method section of the article. Can you see how the researchers used algebra to create a single equation to test their hypothesis?*
- *How did the researchers use this to test their hypothesis?*

TESTING THE HYPOTHESIS

Using this coefficient, the researchers took the original twenty female trees and converted their average seed production into an equivalent parasite load, which was then added to their existing parasite load. They then inserted the diameter of each female tree into Equation 2, which gave them the expected parasite load if the females had been male. The researchers then tested to see whether the observed parasite load of male trees could be predicted using the sum of the female parasite load and seed production, with the trunk diameter again as the common variable.

- *Below are the observed parasite loads of male and female trees compared to the combined parasite load and seed production expenditure in female trees. Does this support their hypothesis?*



Exploring the Research

- While these results seem to support the hypothesis that male-biased parasitism is caused by a difference in the cost of reproduction between male and female trees, there could be a number of other explanations for the trend. What do you think they could be?
- Do any of these explanations also apply to animal species?
- What are some practical applications for this research in conservation or forestry efforts?