MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HIKINA WHAKATUTUKI

Landcare Research
Manaaki Whenua

The Trojan Female Technique

Developing a new approach to pest control

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agresearch
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Te Ahuwhenua, Te Kai me te Whai Ora. Tuatahi

Landcare Research
Manaaki Whenua

Department of Environment and Primary Industries

State Government Victoria

Advisory Group

Ministry for Primary Industries
Manatū Ahu Matua

TBfree New Zealand

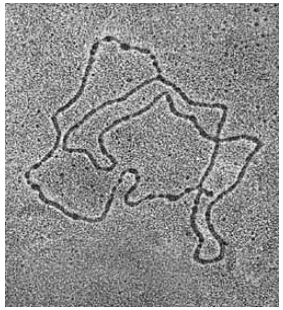
beef+lamb new zealand

Environmental Protection Authority
Te Mana Rauhī Taiao

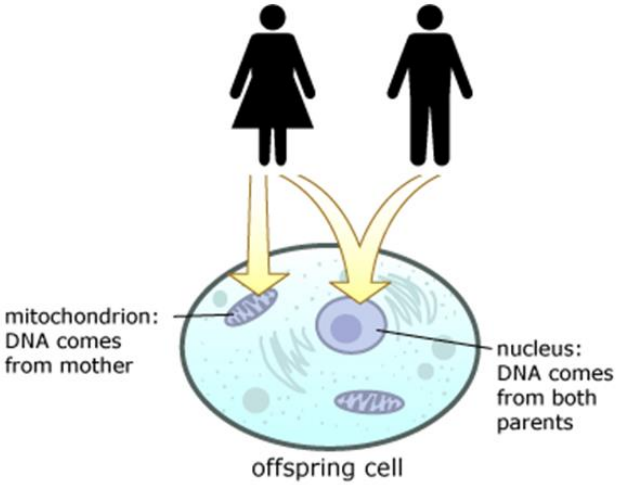
Department of Conservation
Te Papa Atawhai

What is the TFT?

- **Based on the mitochondria – the "batteries" of the cells;**

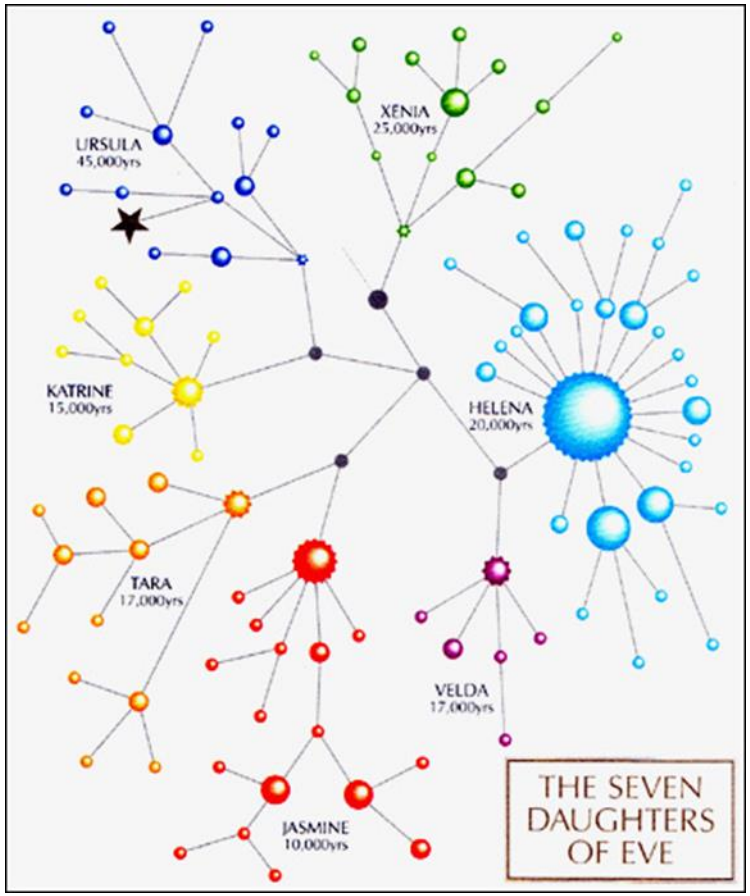


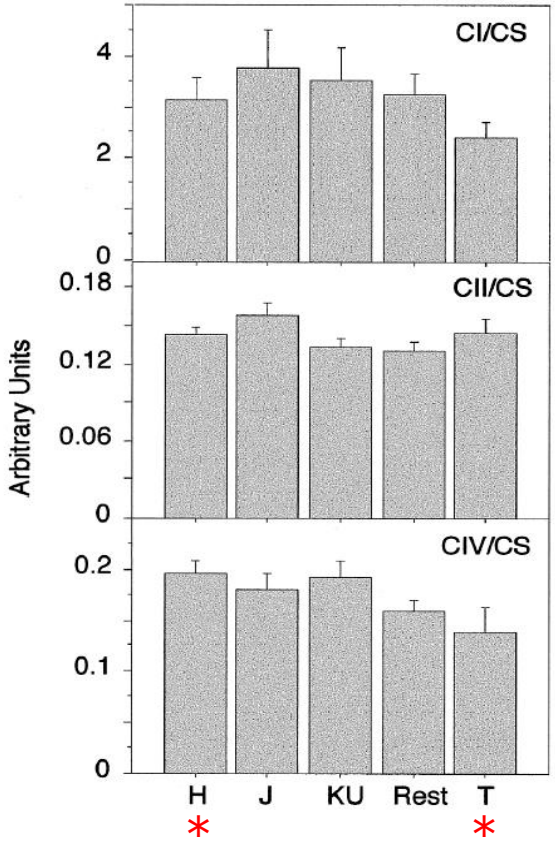
- **Naturally occurring variation in the mtDNA causes variation in the energy output of these batteries; this variation is maternally inherited;**



What does this variation do?

- **Substantial decreases in energy output cause mitochondrial diseases such as MERRF syndrome;**
- **Minor decreases have no general fitness effects:**





What does this variation do?

- **But, minor decreases in energy output can impact male fertility:**



- **Identified as a cause of male fertility issues in people, and a threat to small populations of endangered species (because not selected against);**
- **Here we're attempting to use to purposively control populations of pest species.**

What makes the TFT different?

PROCEEDINGS OF THE ROYAL SOCIETY B

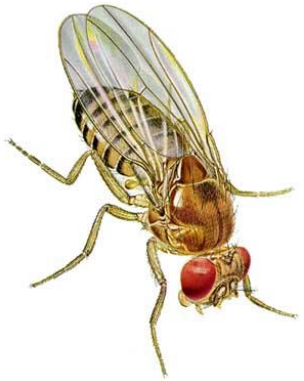
rspb.royalsocietypublishing.org

The Trojan female technique: a novel, effective and humane approach for pest population control

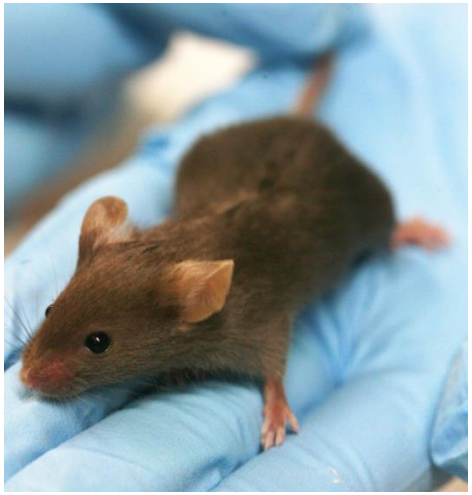
Neil J. Gemmell[1], Aidin Jalilzadeh[2], Raphael K. Didham[3], Tanya Soboleva[4] and Daniel M. Tompkins[5]

- **Predicted the potential for population scale control over a wide range of pest life histories**
- **Because the impacts are to male fertility, and mitochondria are maternally inherited, under most circumstances the responsible mtDNA variation is not selected against and thus persists over multiple generations**

MBIE Smart Ideas Phase I



- October 2013 – September 2015
- RA 1.1 Invertebrate proof-of-concept
  - Demonstrate in the lab that the TFT can regulate populations
- RA 1.2 Vertebrate proof-of-utility
  - Demonstrate that suitable mtDNA variation can be identified in the lab



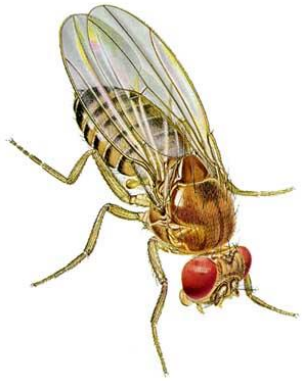
- RA 1.3 Social acceptability
  - Determine how socially acceptable the TFT is as a form of pest control
- RA 1.4 Pathways to market
  - Construct credible pathways for TFT application to address real-world pest issues

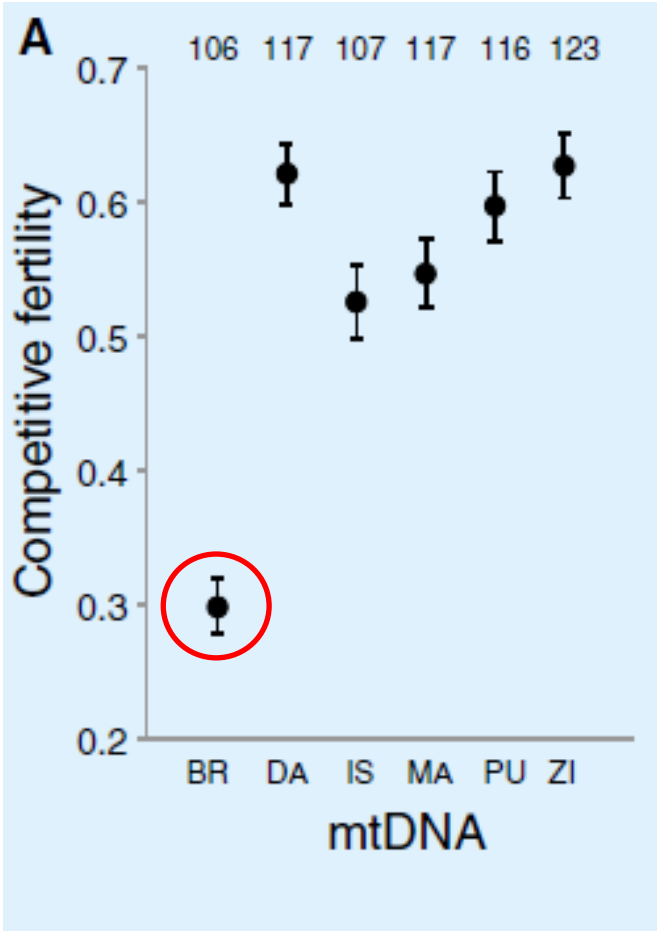
RA 1.1 Invertebrate proof-of-concept

Goal: Demonstrate in the lab that the TFT can regulate populations

<u>Prior to Phase 1</u>

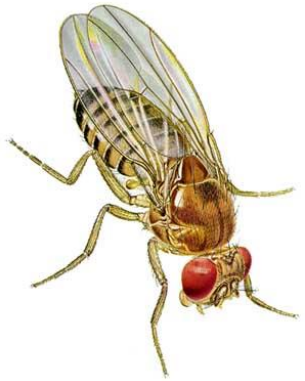
Demonstration that certain mtDNA haplotypes have reduced male fertility





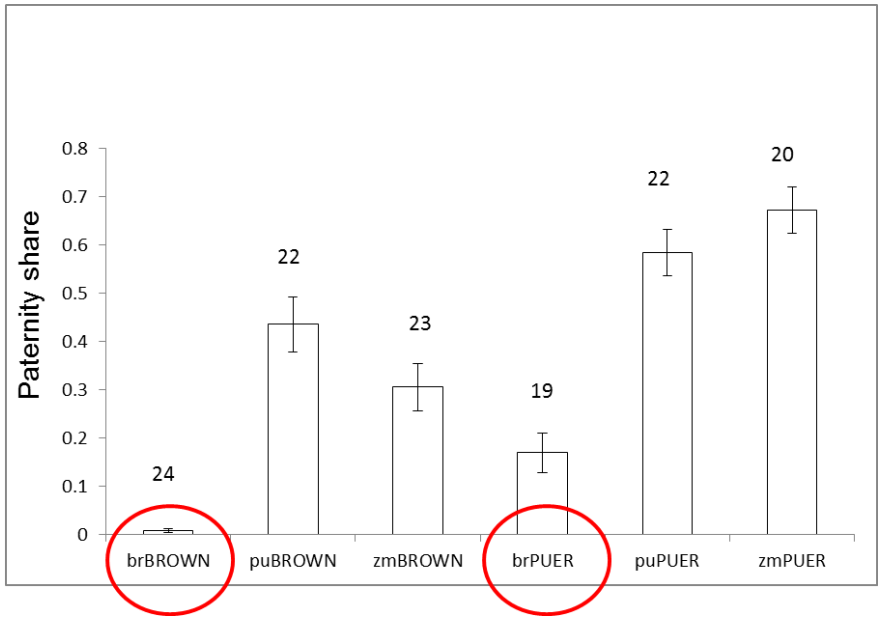
RA 1.1 Invertebrate proof-of-concept

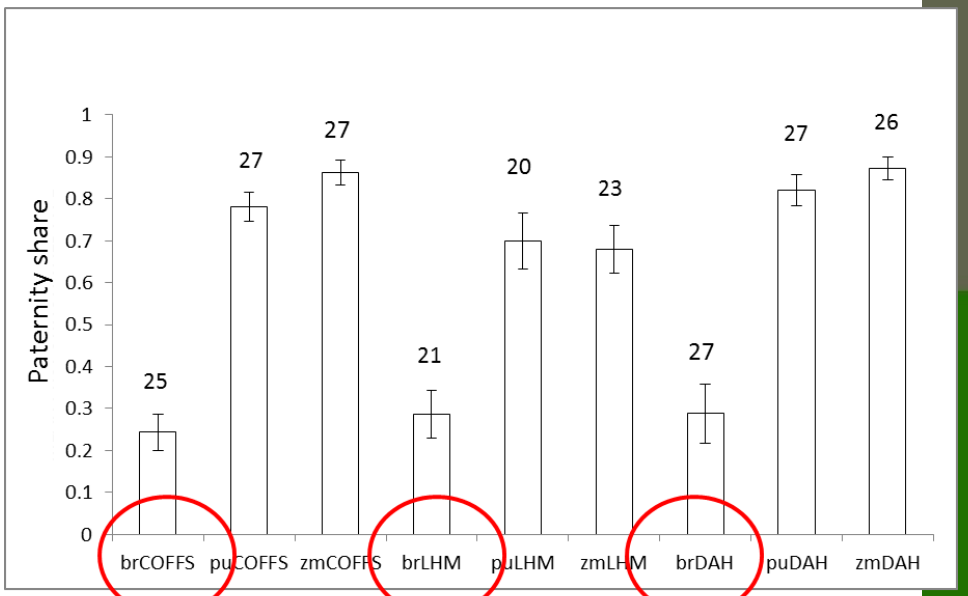
Goal: Demonstrate in the lab that the TFT can regulate populations



Progress 1

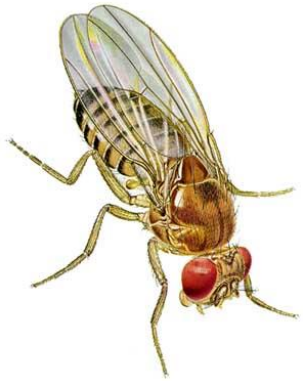
Confirmation that the effect consistently reduces breeding success across genotypes





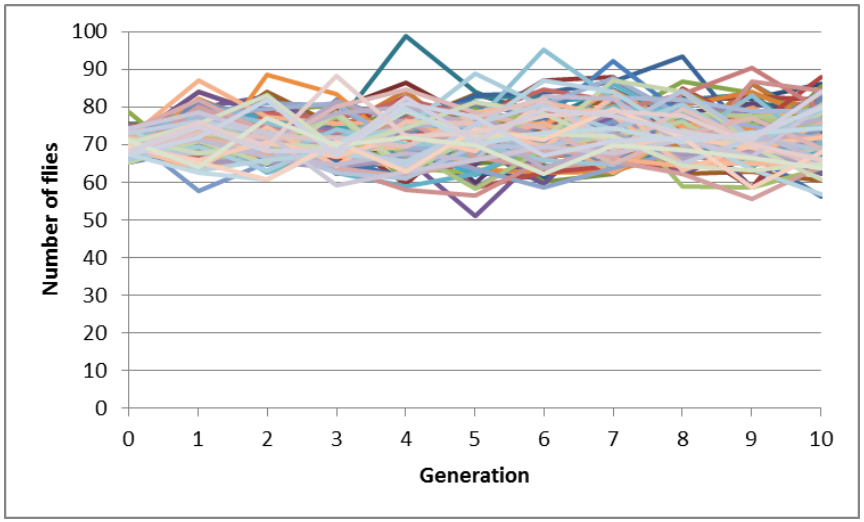
RA 1.1 Invertebrate proof-of-concept

Goal: Demonstrate in the lab that the TFT can regulate populations

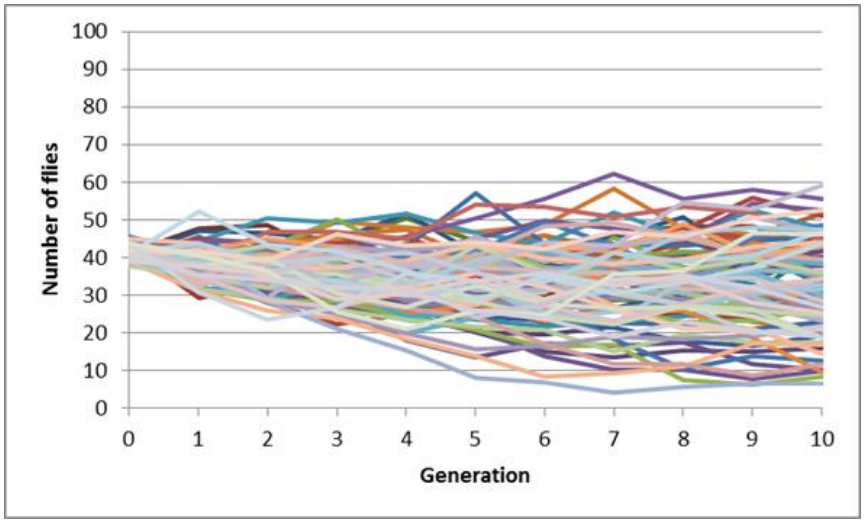


Progress 2

Modelling predicting that these effects will result in population regulation in the lab



Wildtype populations



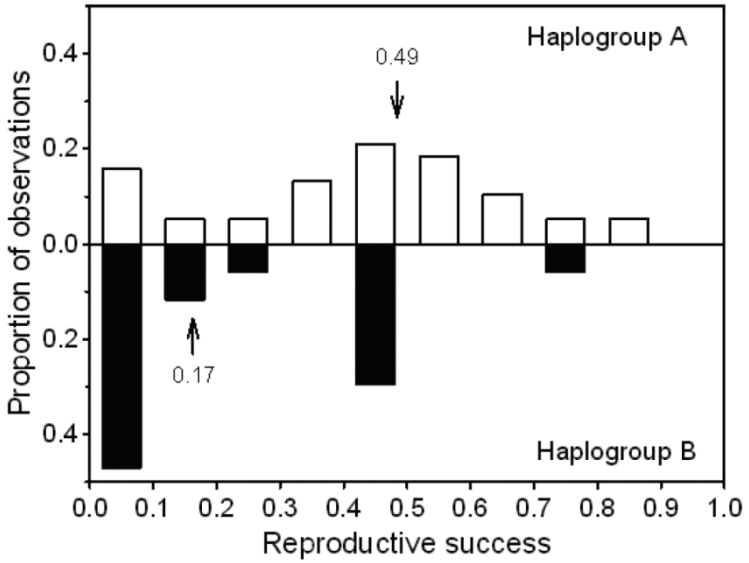
Single TFT release

RA 1.2 Vertebrate proof-of-utility

Goal: Demonstrate that suitable mtDNA variation can be identified in the lab

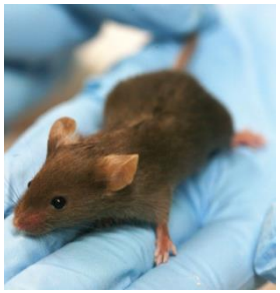
<u>Prior to Phase 1</u>

Demonstration of mtDNA linked reductions in male fertility in a captive colony of European hares (with no other detectable effects)



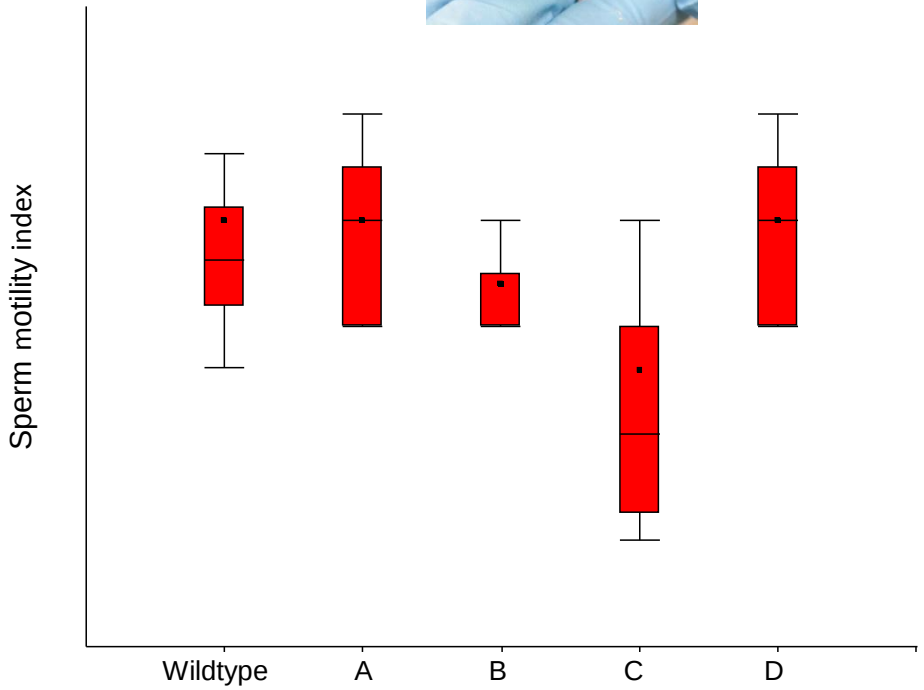
RA 1.2 Vertebrate proof-of-utility

Goal: Demonstrate that suitable mtDNA variation can be identified in the lab



Progress 1

Differences in male fertility indices among mouse mtDNA lineages demonstrated



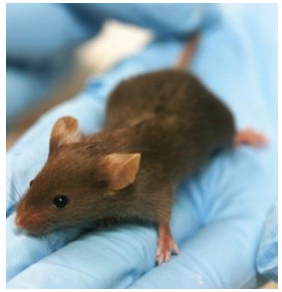
RA 1.2 Vertebrate proof-of-utility

Goal: Demonstrate that suitable mtDNA variation can be isolated in the lab

<u>Progress 2</u>

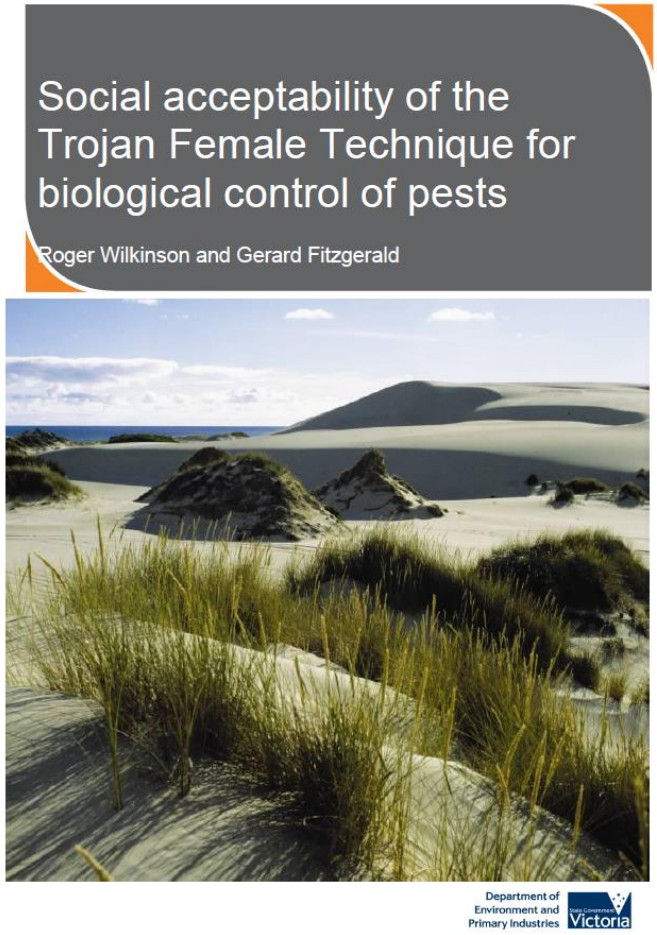
Establishment of mtDNA variant mouse lineages at the University of Otago

- **Import of heterozygous PolG mice**
- **Generation of PolG homozygous individuals**
- **Creation of mtDNA variant lines**
- **Backcross to remove the PolG component**
- **Fertility/breeding assessment and mtDNA sequencing**



RA 1.3 Social acceptability

Goal: Determine how socially acceptable the TFT is as a form of pest control



Used focus groups to identify:

- **Drivers of the social acceptability of pest management approaches**
- **The acceptability of the Trojan Female Technique specifically**

Focus groups:

- **Urban men (Christchurch)**
- **Urban women (Wellington)**
- **Rural public including farmers (Geraldine)**
- **Maori (Northland)**
- **Animal welfare (Christchurch)**
- **Environmentalists (Christchurch)**
- **Scientists (Lincoln)**
- **Pest managers (Palmerston North)**

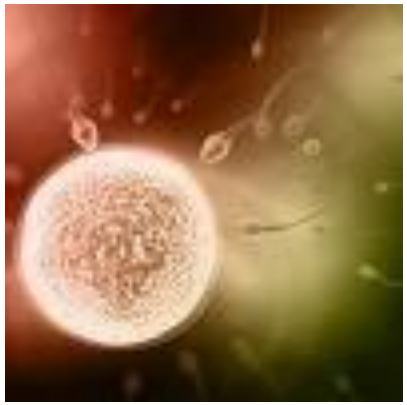
RA 1.3 Social acceptability

- There is cautious support for the TFT
  - Existing methods not working or inhumane. TFT sounds promising on both counts
- Several side risks need to be addressed
  - Main ones are ecosystem effects, effect on genetically similar non-target species, uncontrollability once released
- Public is happy for research to continue
  - Suggestion that the stated goal of field use by 2020 is too optimistic
- Less trust if perceived to be a 'money spinner'
- Need ongoing communication and transparency
- Call for a robust decision process for any field use

"... fundamentally I think it's a sound idea so long as the risks are identified and managed ... just about all of the concerns that were raised immediately when you broached the idea were around the periphery and the management of side risks, rather than the core activity of what was going on. That signals to me that the core activity is socially acceptable so long as risks around it are managed." (Rural public group)

Favourable media coverage

- Radio New Zealand morning report
- Radio New Zealand 'our changing world'
- ABC News
- Otago Daily Times
- New Zealand Herald
- The Southland Times
- And multiple on-line news websites



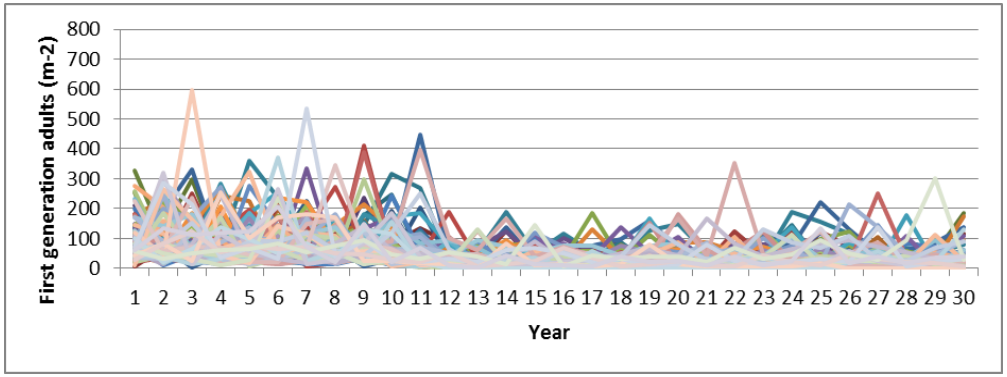
- Publically supported by both Federated Farmers and Forest & Bird in the same RNZ segment and news articles!
- $20k contribution by a member of the public – used as honours and summer bursaries for an undergraduate student.

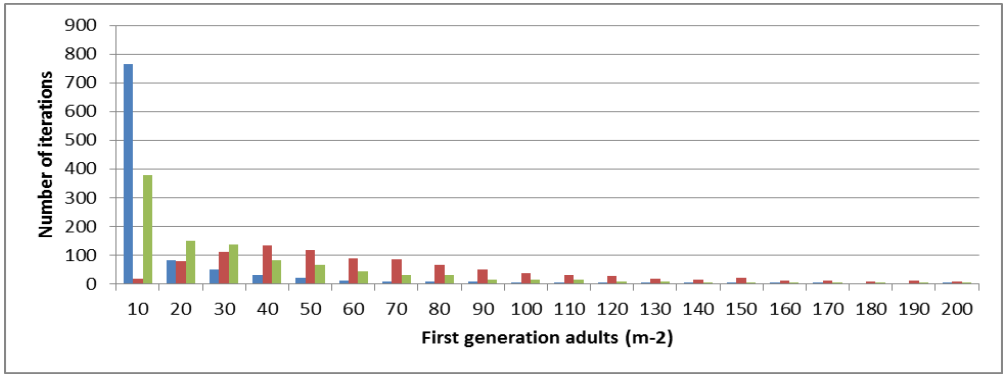
RA 1.4 Pathways to Market

Goal: Construct credible pathways for TFT application to address real-world pest issues

Progress 1

Modelling feasibility studies demonstrating potential effectiveness for controlling some invertebrate pests (e.g. pasture weevils) but not others (e.g. varroa mite)



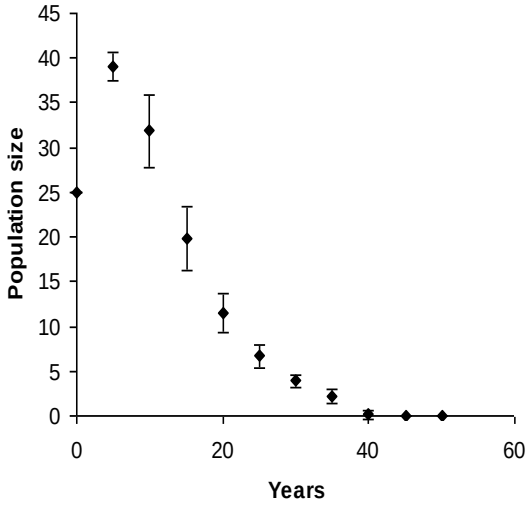


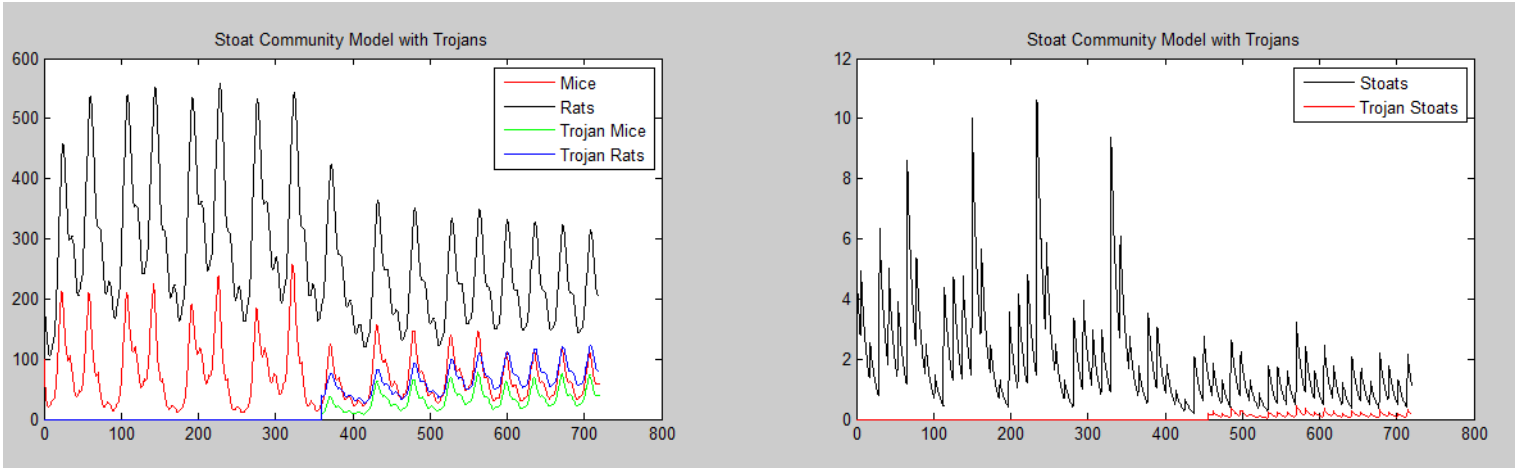
RA 1.4 Pathways to Market

Goal: Construct credible pathways for TFT application to address real-world pest issues

Progress 2

Modelling feasibility studies demonstrating range of potential effectiveness for also controlling vertebrate pests





MBIE Smart Ideas Phase II

- October 2015 – September 2017;
- Moving from 'proof-of-concept' to 'proof-of-application';
- Logical shift in focus from fundamental to applied science;
- Application of the TFT technology platform to economically important pests
  - Focus on application for pasture weevil control
- Underpinning activity
  - Communication and Education
  - Increase understanding of the mtDNA variation involved

Contact

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TFT Project Webpage