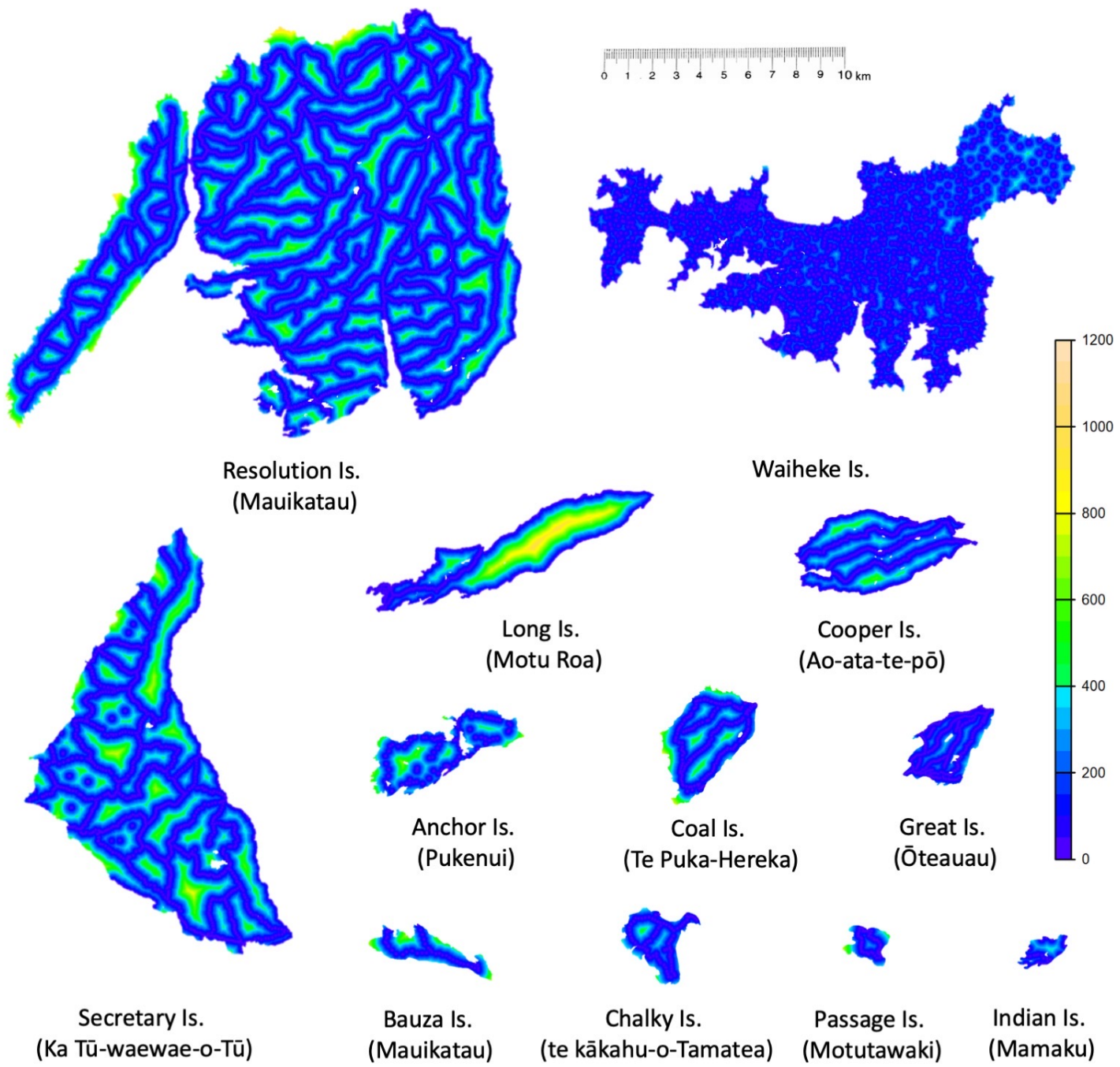


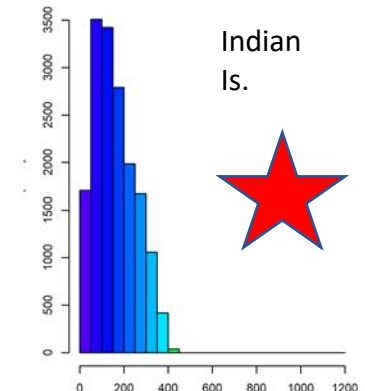
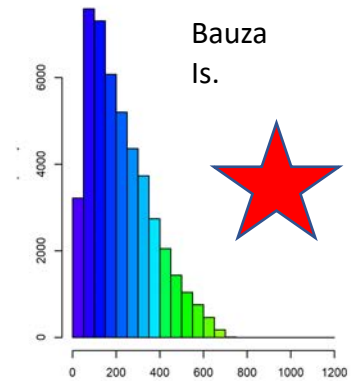
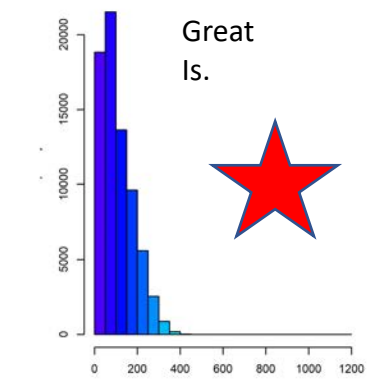
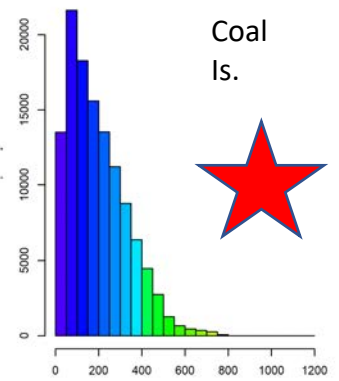
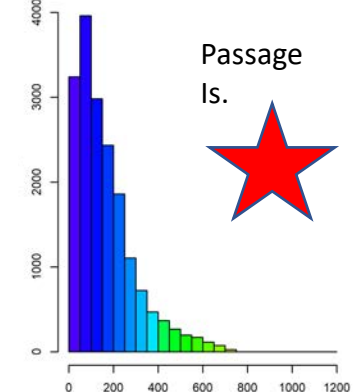
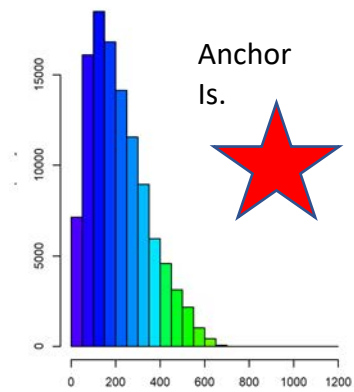
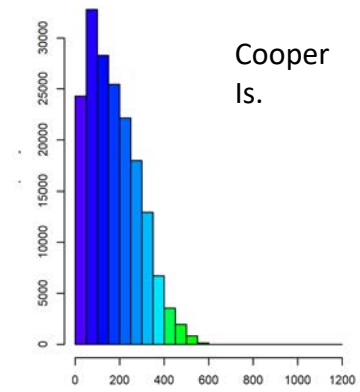
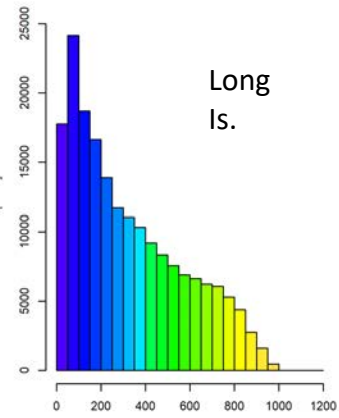
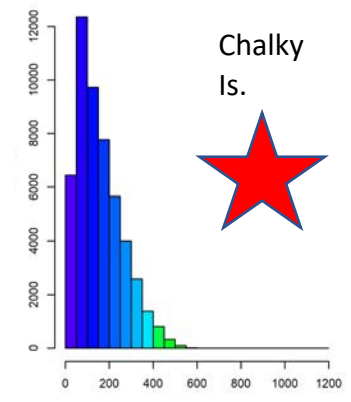
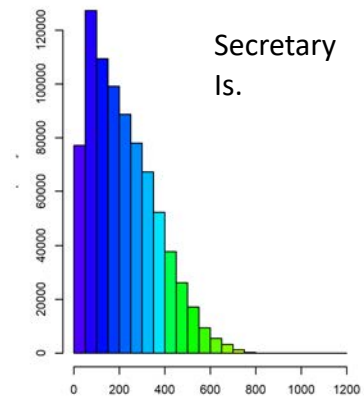
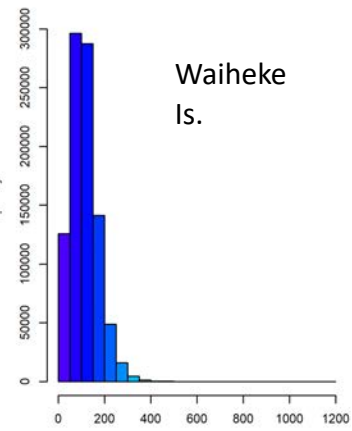
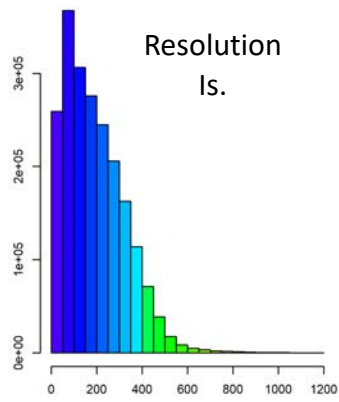
Genomics, Stoats, & Predator Free New Zealand



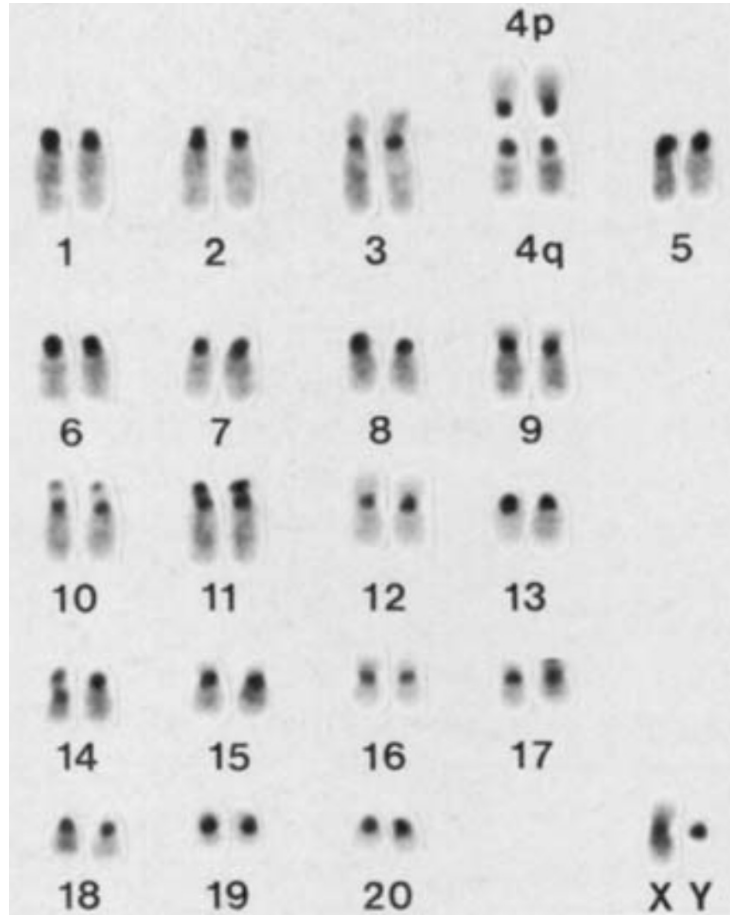
Dr Andrew Veale, Wildlife Ecologist: Manaaki Whenua Landcare Research

Stoats and Islands





The stoat genome



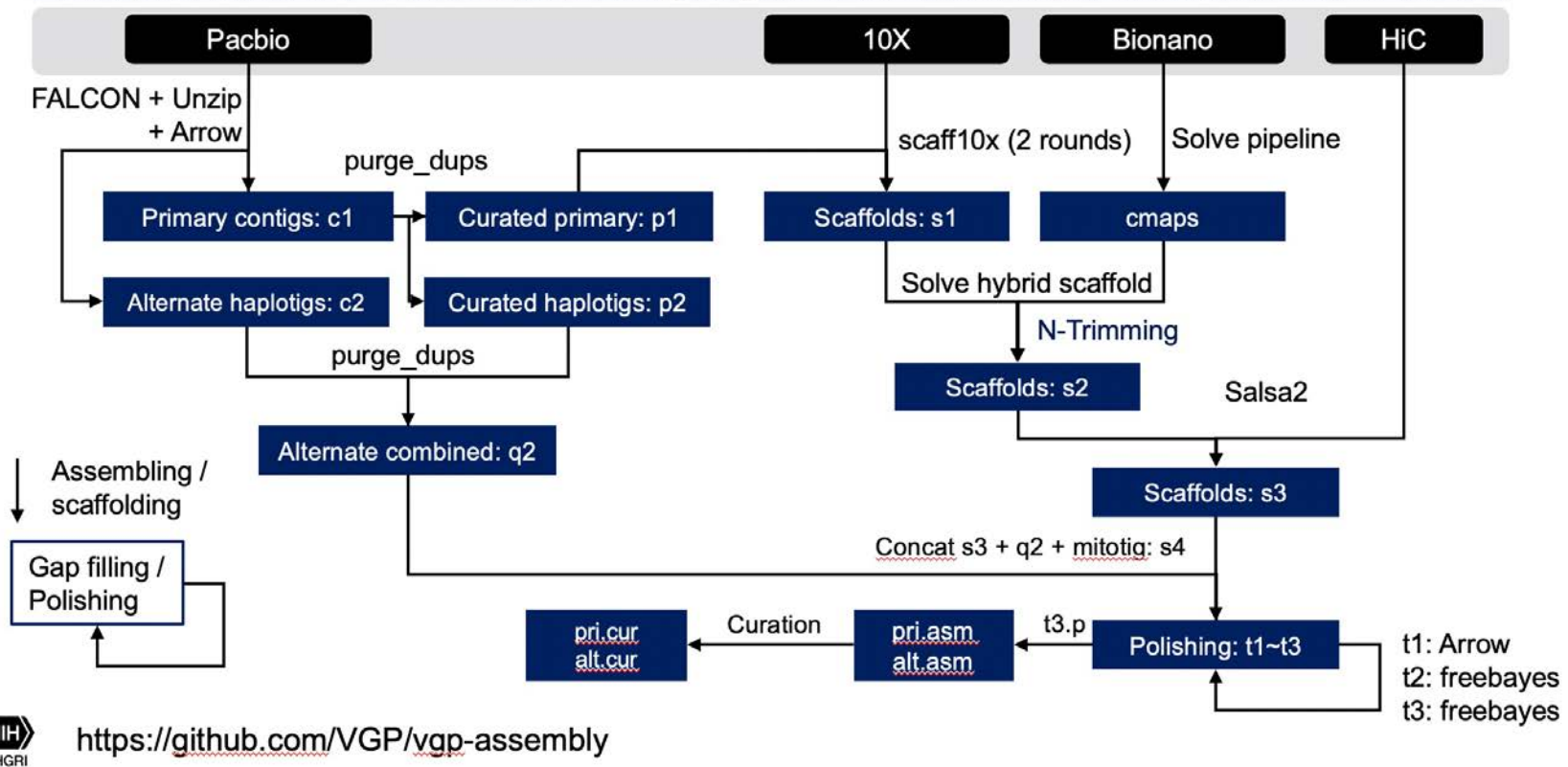


Vertebrate Genome Project

- Combines 4 sequencing technologies (Pacbio, 10x, bionano, Hi-C)
- Gapless telomere to telomere chromosome level assemblies.

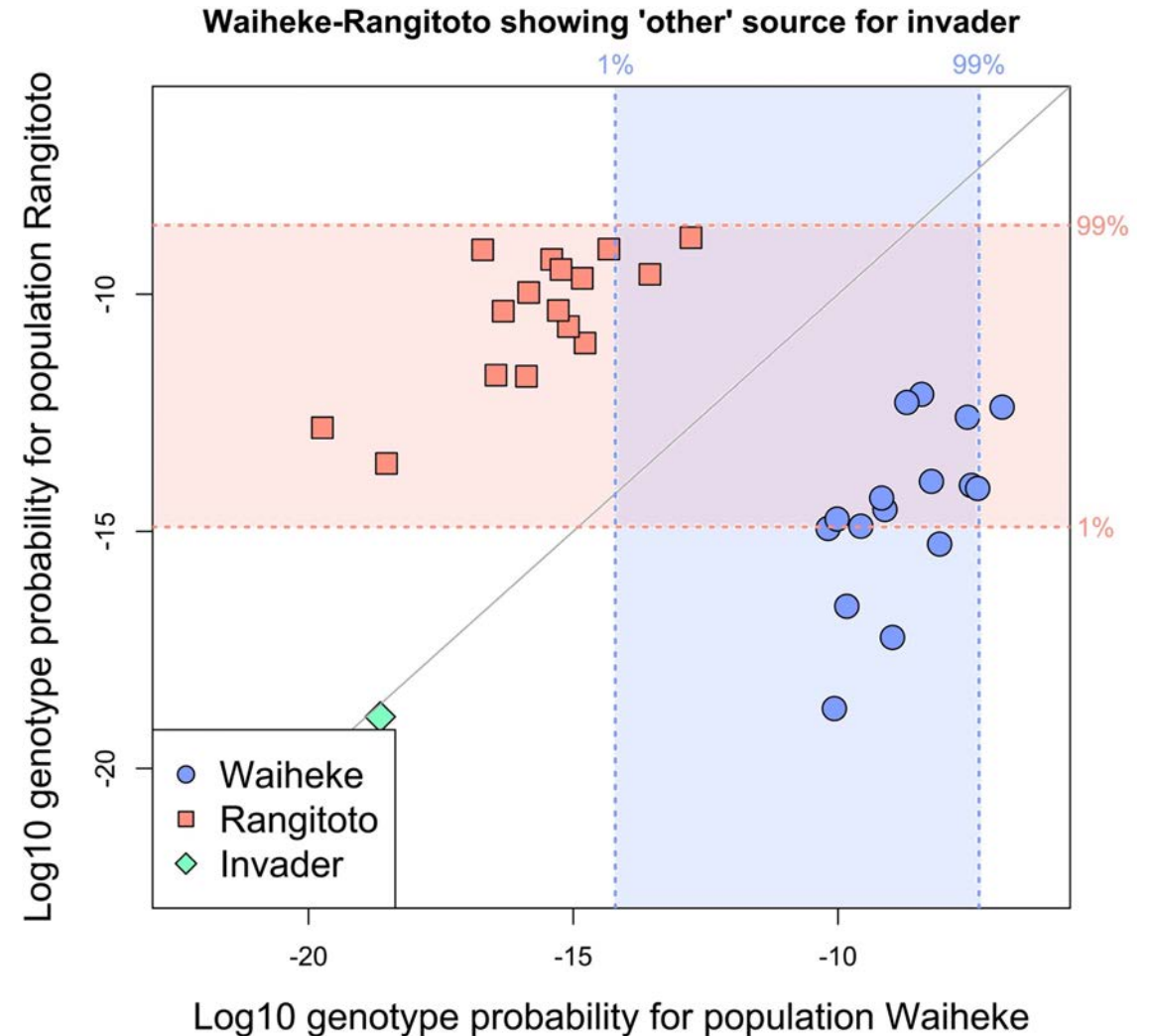


VGP standard 1.6 pipeline



Quantum leap in genetic resolution

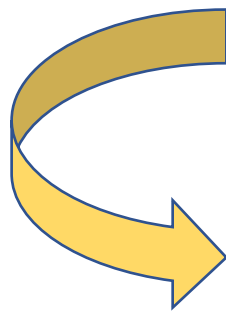
- 30,133 SNPs (Waiheke Island)
- 55,880 SNPs (Taranaki)
- 17 microsatellites
(What I used for my PhD)



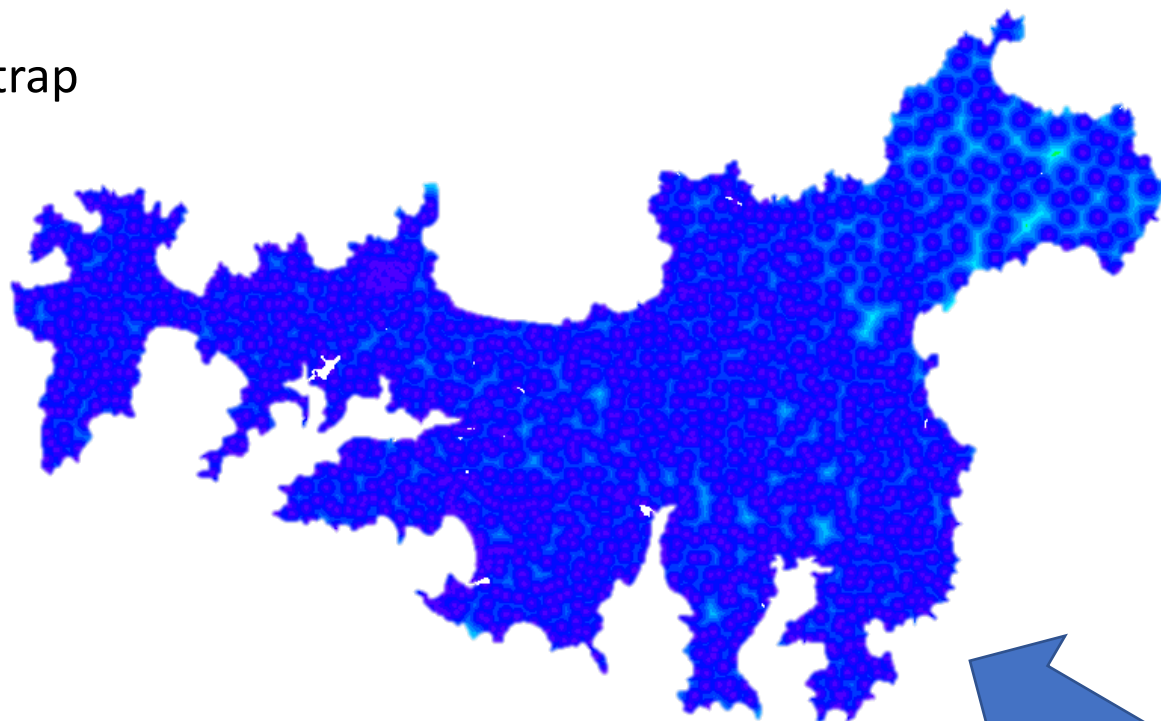
Waiheke stoat genetics



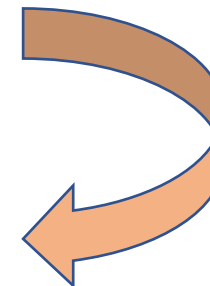
Never encountered a trap



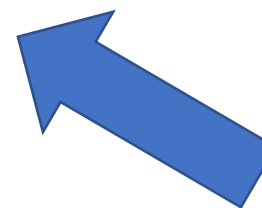
0



Avoided traps



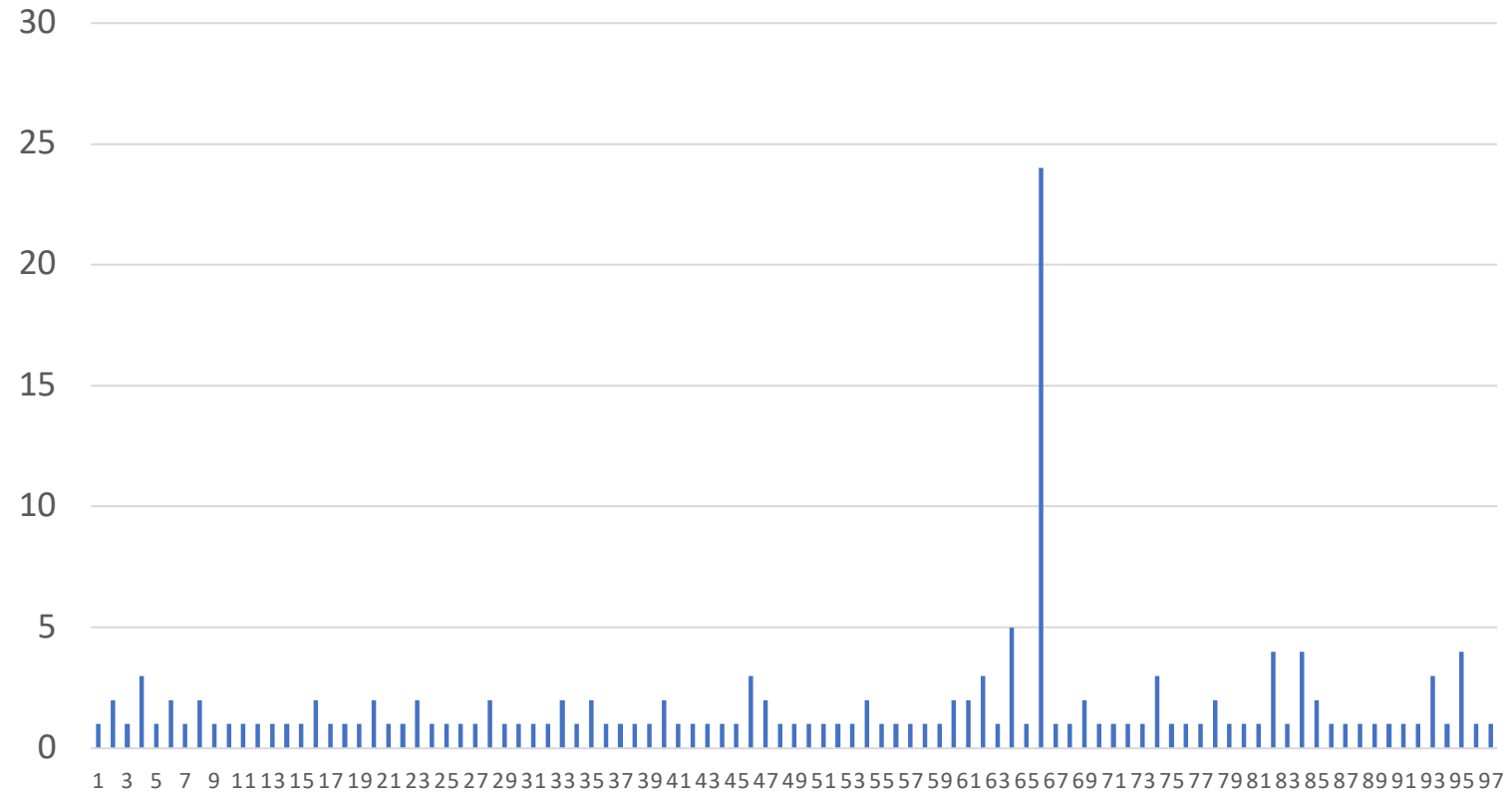
???



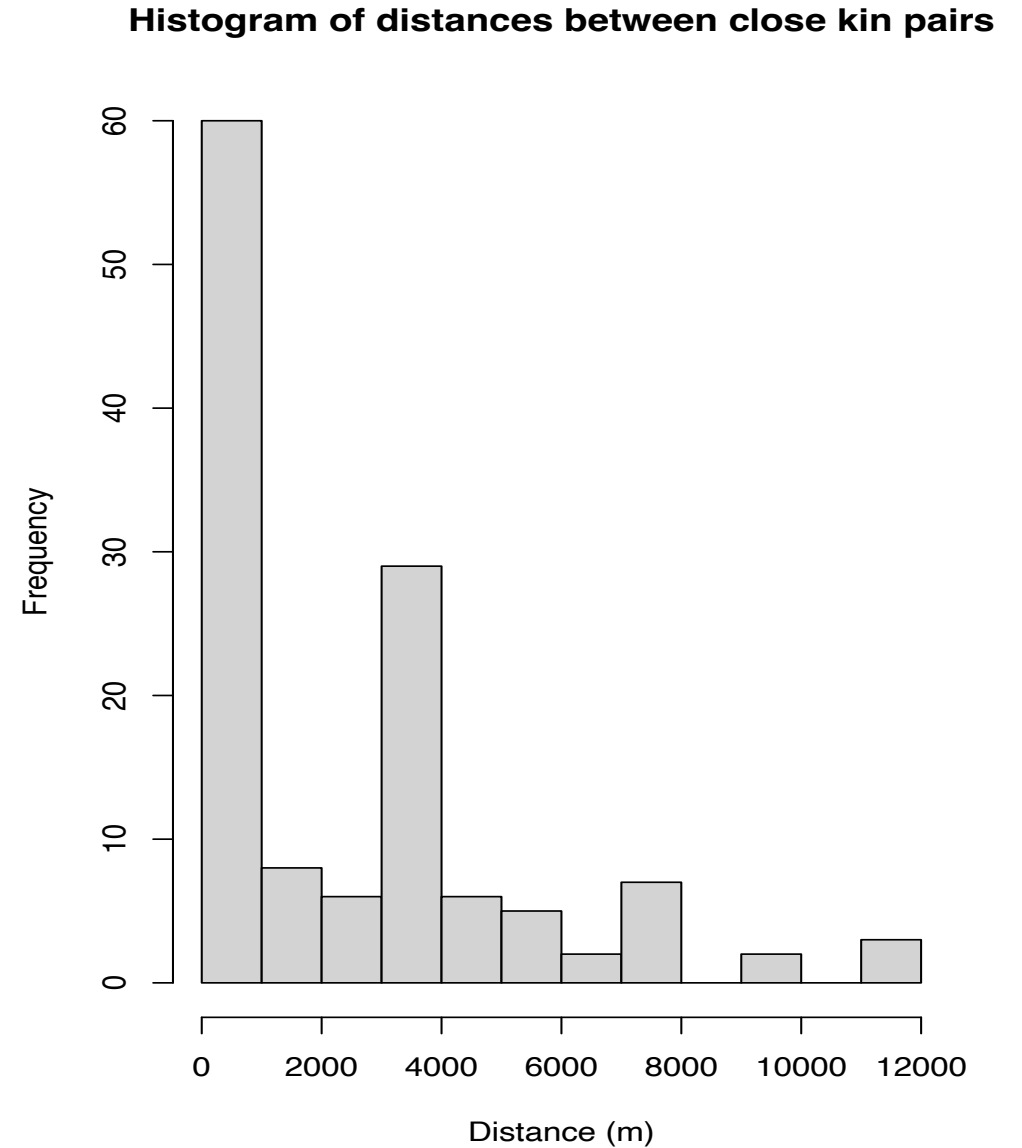
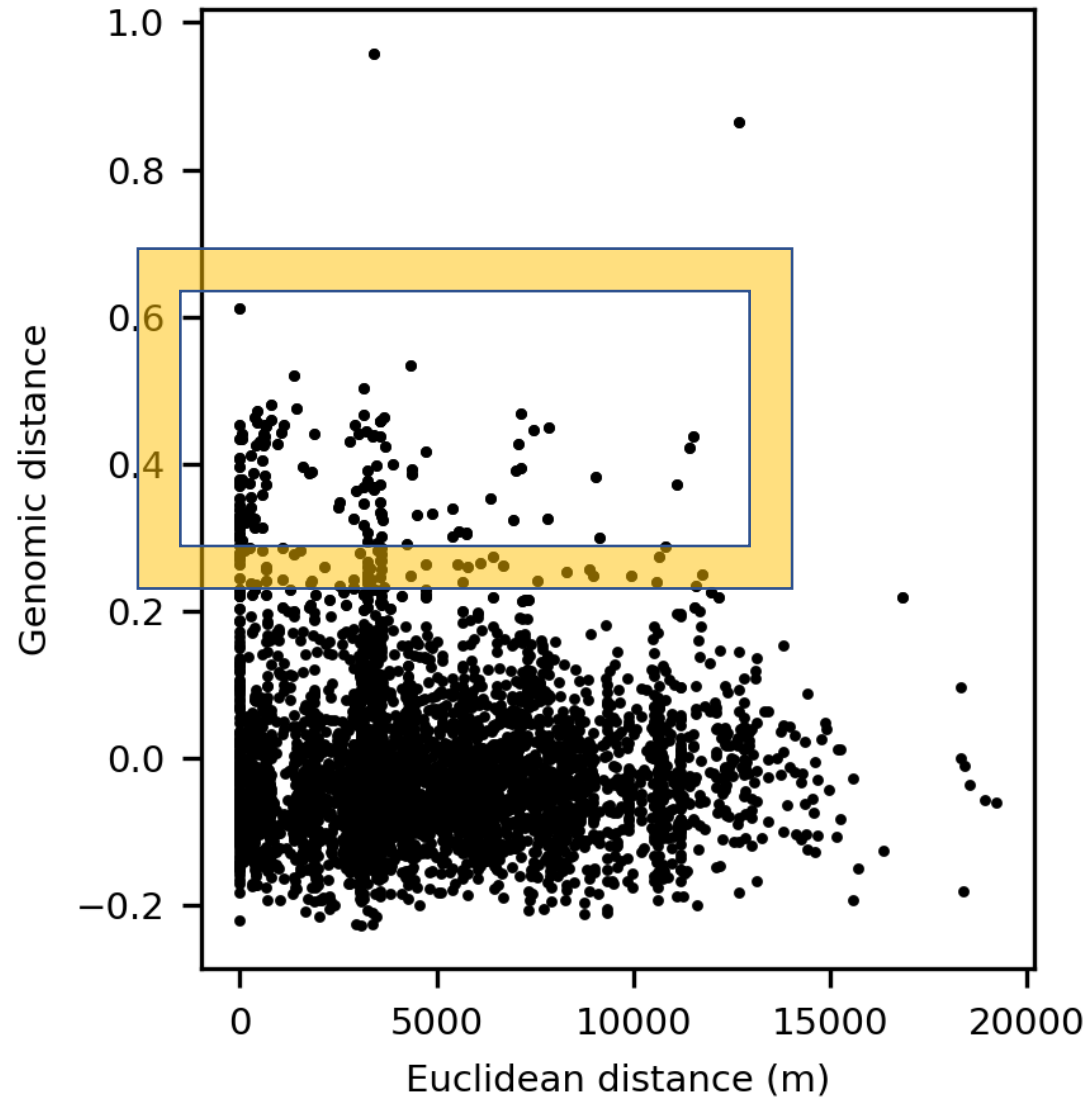
Immigrant

0

of stoats caught per trap (Waiheke Island)

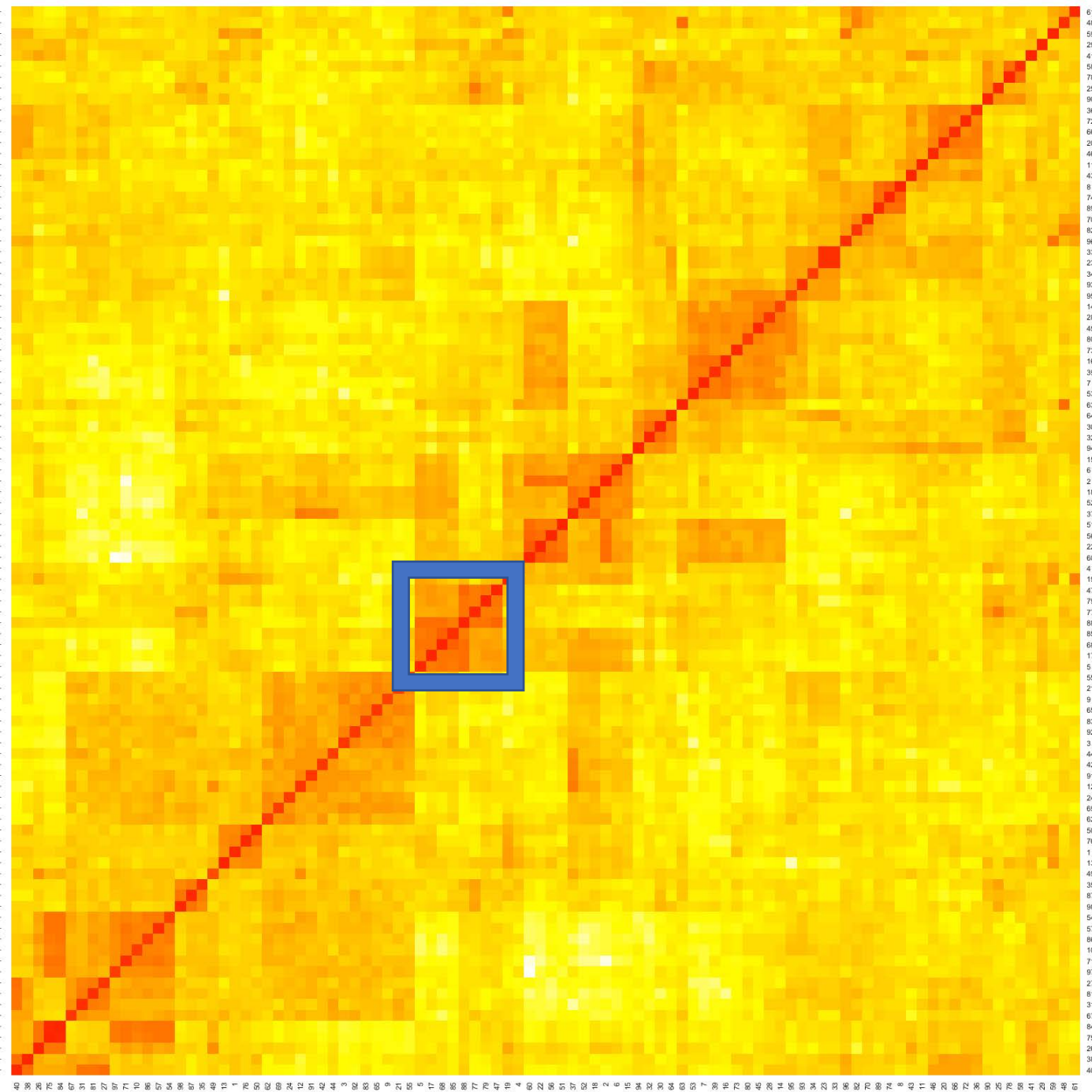


Genetic distance vs geographic distance



Waiheke Stoaat relatedness

- Relatedness of all stoats vs all stoats
- Diagonal “self relatedness”
- Red = highly related
- Orange = moderately related
- Yellow = low relatedness
- Clustered so related individuals are next to each other.
- Square structures of orange are litters.





Two litters sharing one individual

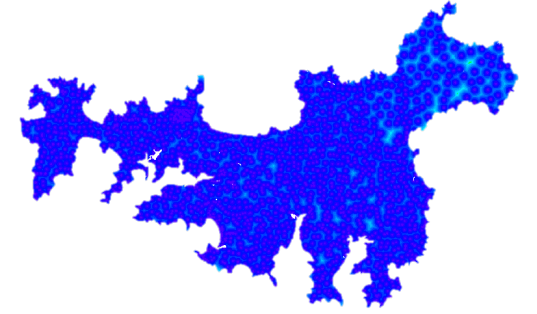


- Here's a zoom in on that cluster of individuals
- There are two groups of evenly related individuals
- This probably represents 2 litters.
- One individual is shared between the two
- Two options:
 - 2 litters from the same mother (different years)
 - 2 litters with a daughter from one year being the mother for the second





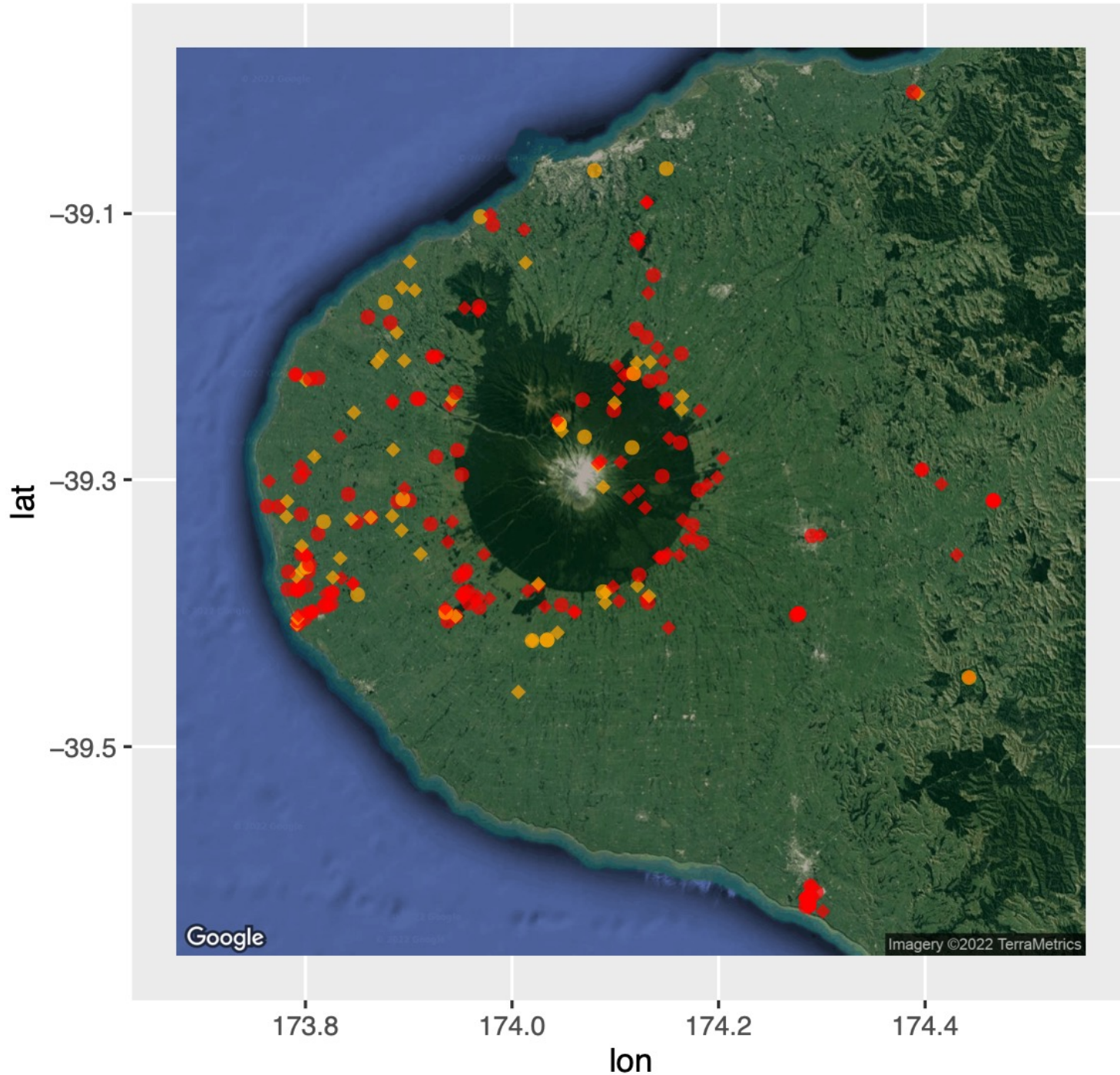
Waiheke summary



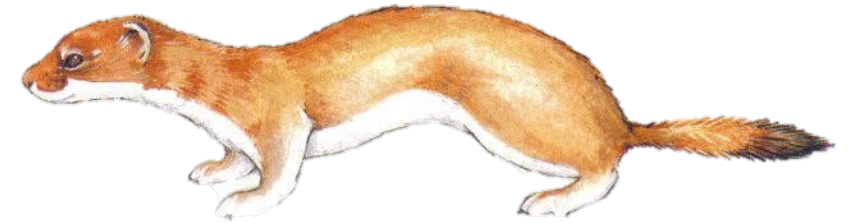
- This project can be used to parameterize our models – very important!
- Both males and females are avoiding trapping for over a year so the population is persisting.
- If trapping ceases the island will reach carrying capacity within 2 years (maybe just 1 year).
- IMHO with dogs, cameras, new lures and toxin it will succeed (largest ever stoat eradication).
- Given the challenges here, mainland operations are in trouble...

Taranaki mustelids





	Stoats	Weasels
Male	96	46
Female	92	19

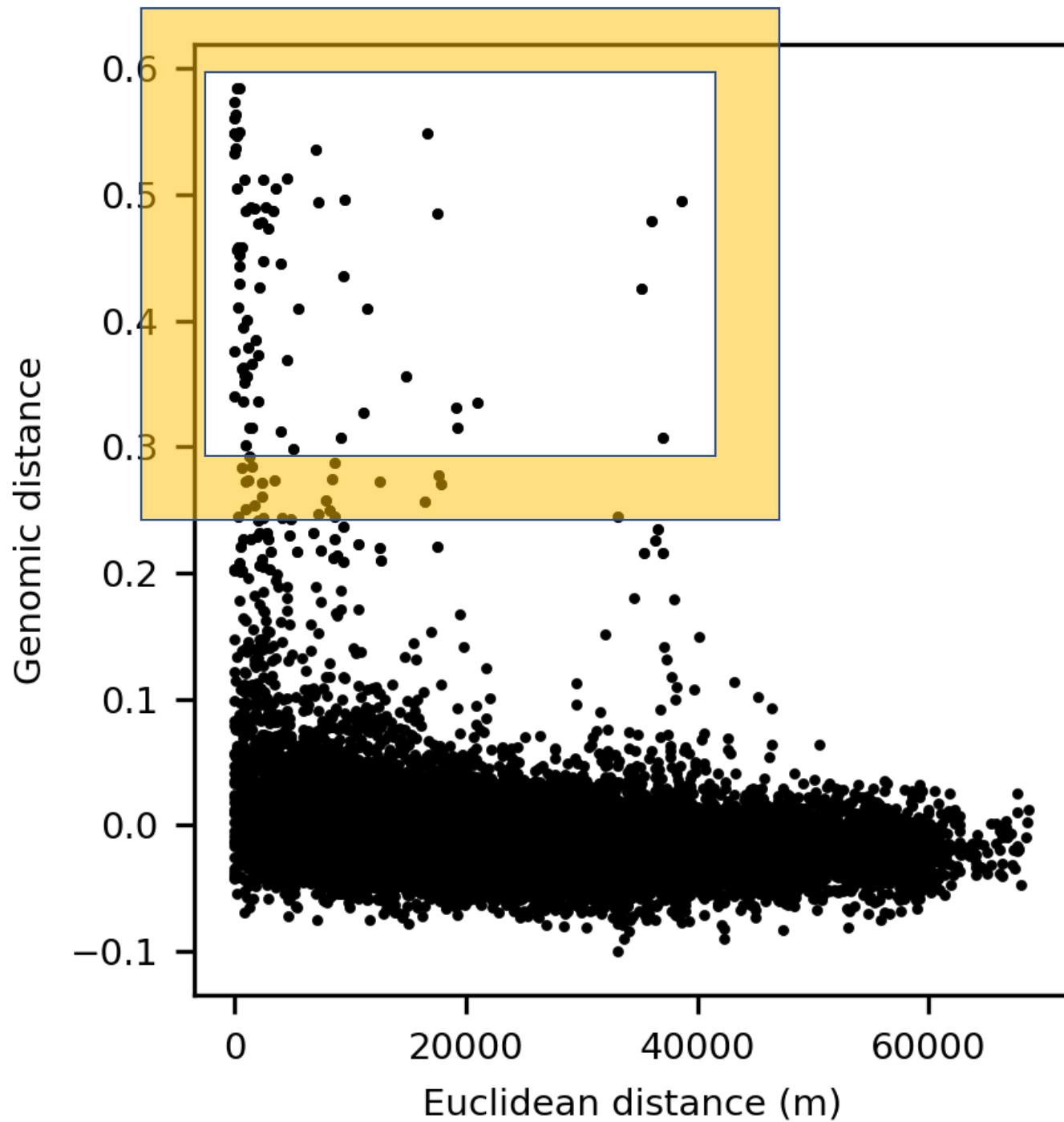
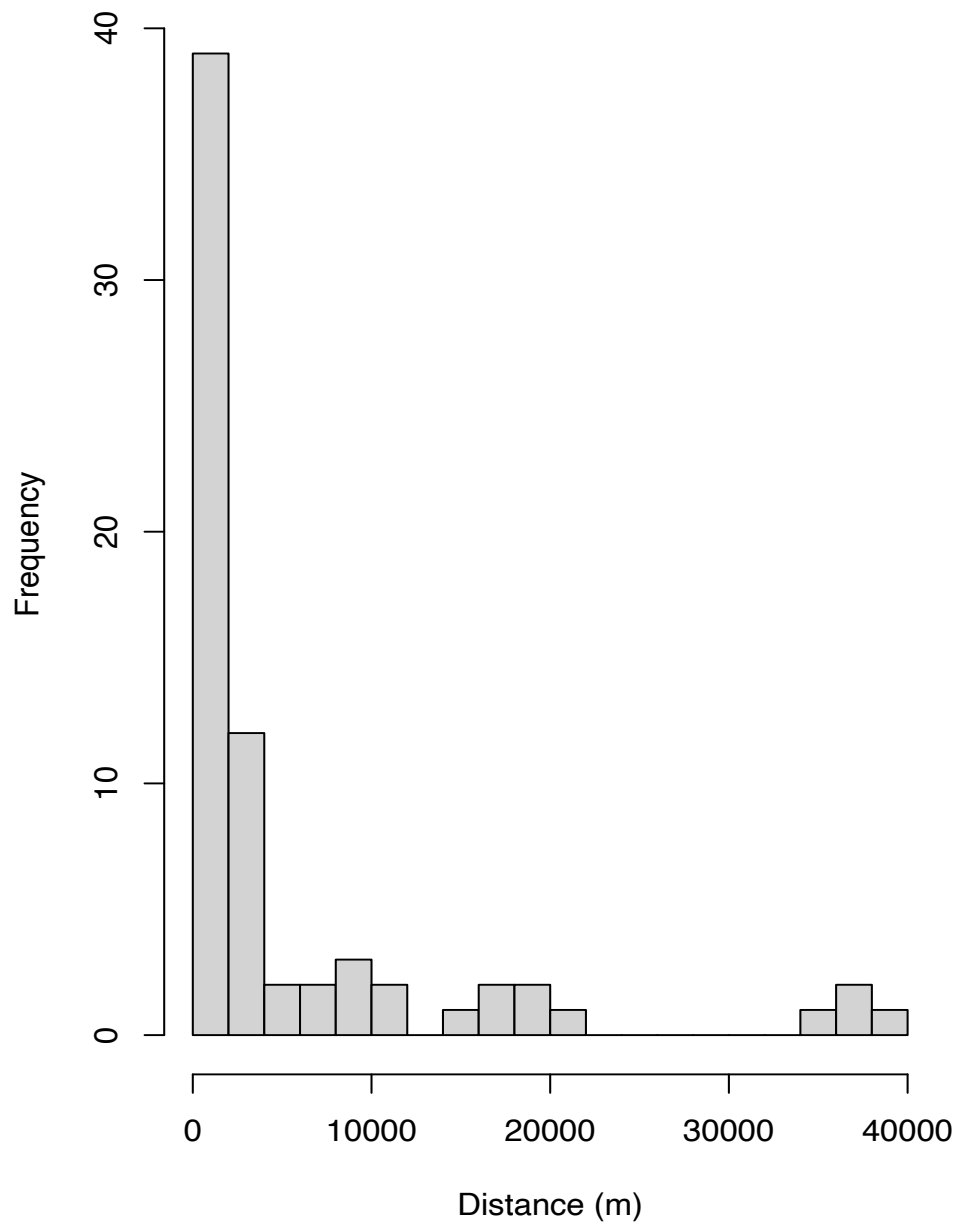


Chi squared equals 0.085 with 1 degrees of freedom.
The two-tailed P value equals 0.7705



Chi squared equals 11.879 with 1 degrees of freedom.
The two-tailed **P value equals 0.0006**

Histogram of distances between close kin pairs

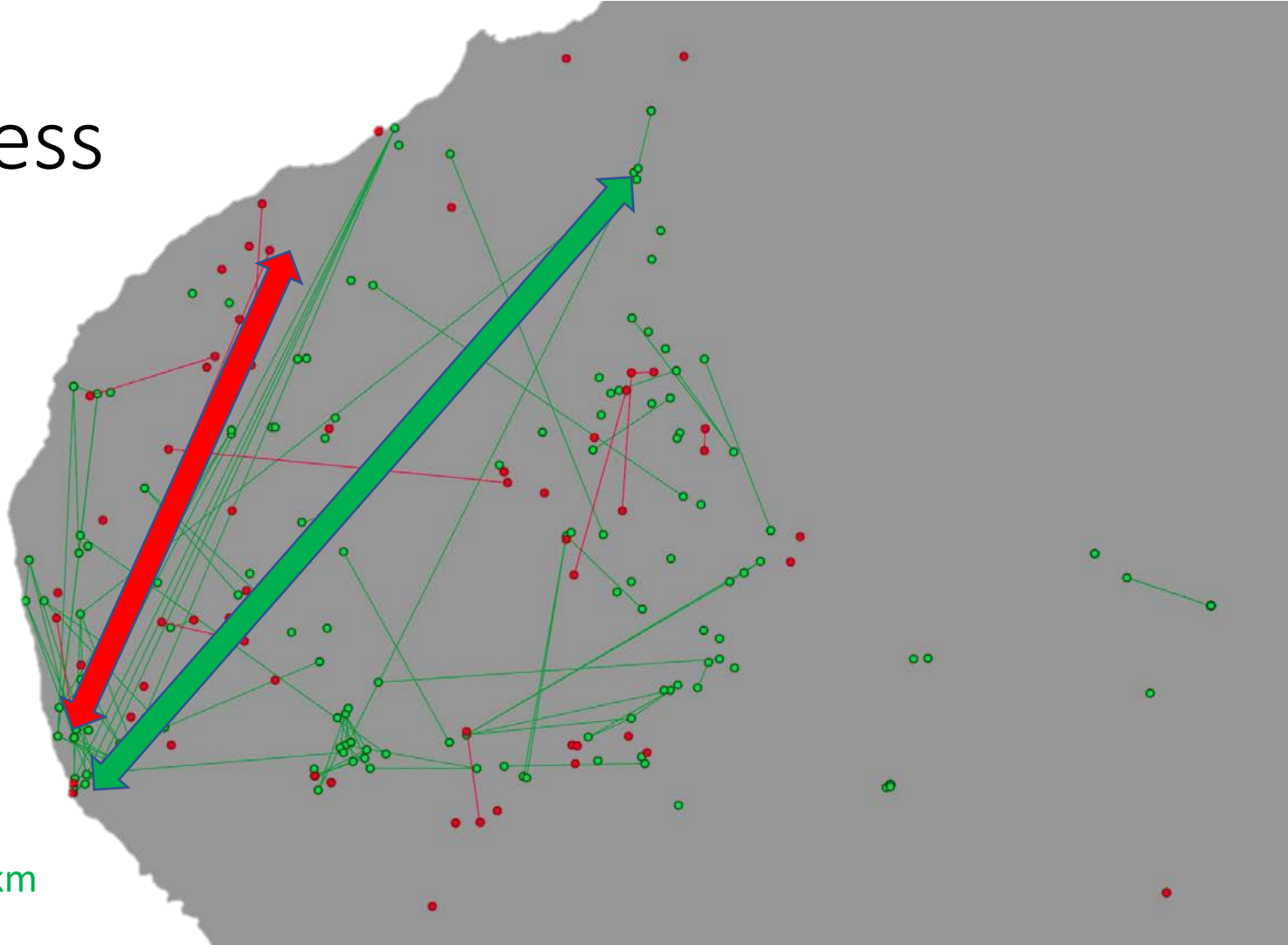


Taranaki Relatedness

Stoats ●
Weasels ●

>25 km

>40 km



Forensics

Sequenced genome

**SNP panel developing
for stoats**

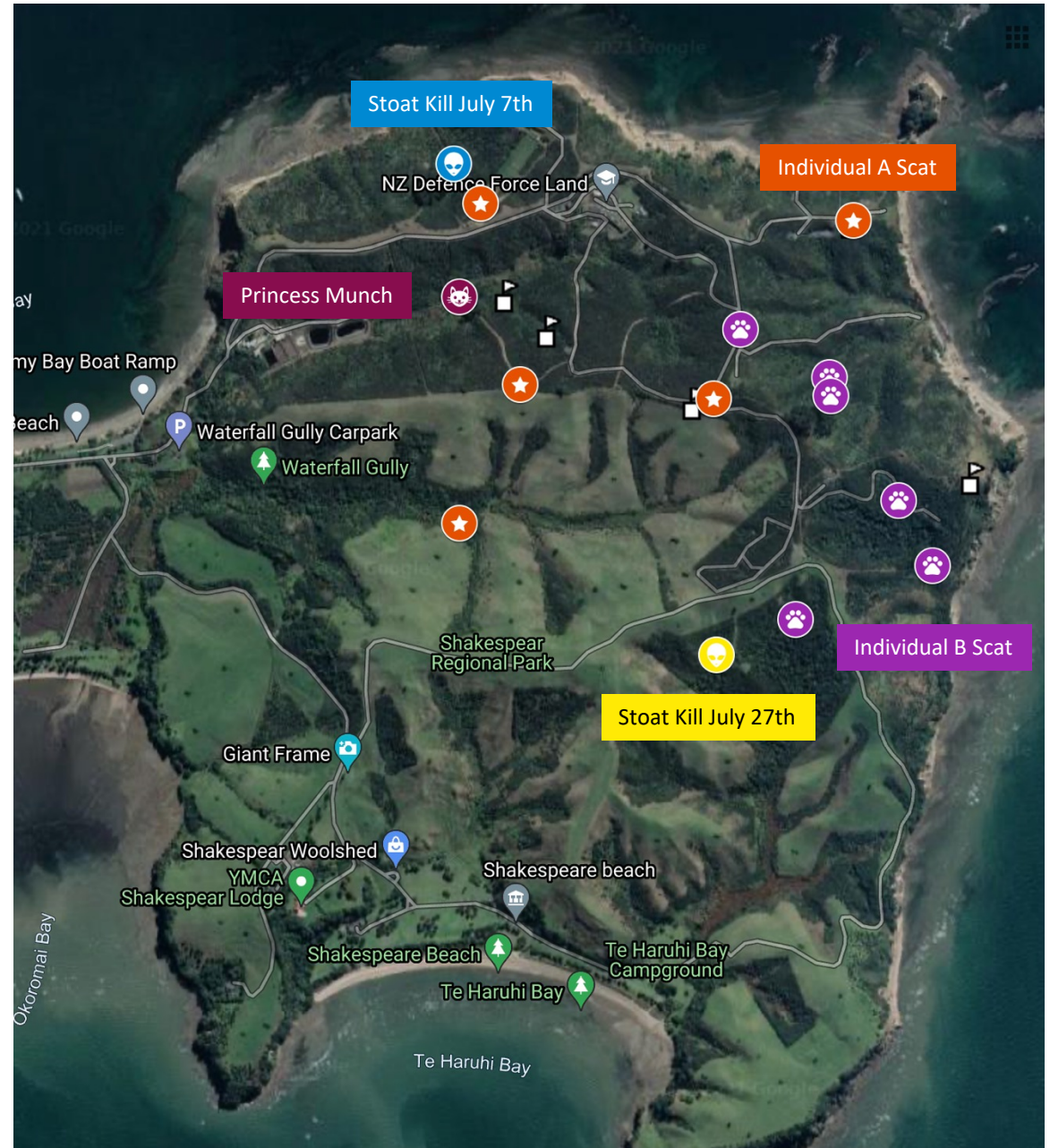
**Already able to use
microsatellites for
forensics (with fresh
samples)**

**With some
development we can
enhance our resolution.**



- 17 March 2020 – female stoat recorded in park
- 21st Dec 2020 – 2 stoats seen together in park
- January 2021 – two stoats caught
- May 2021 – three stoats live trapped
- July 2021 – 2 more stoats trapped

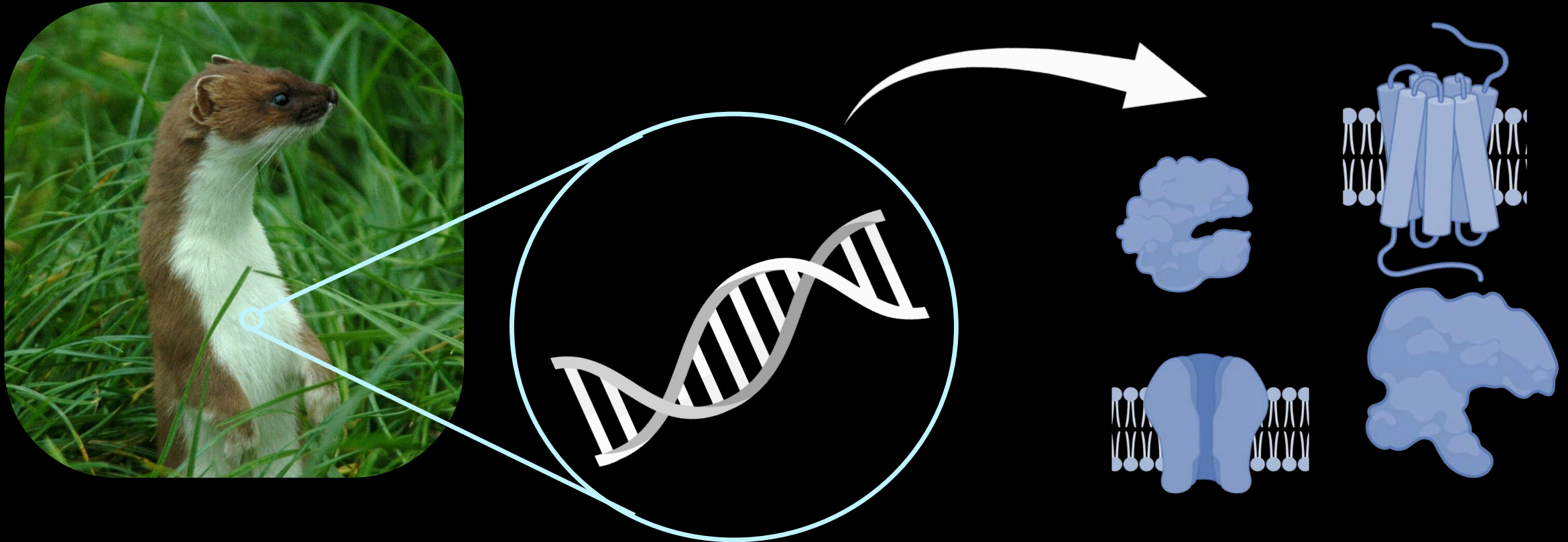
Key to the incursion response: dogs, thermal cameras, forensic genetics using the scat

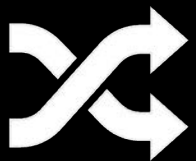




1. Identify potential target proteins

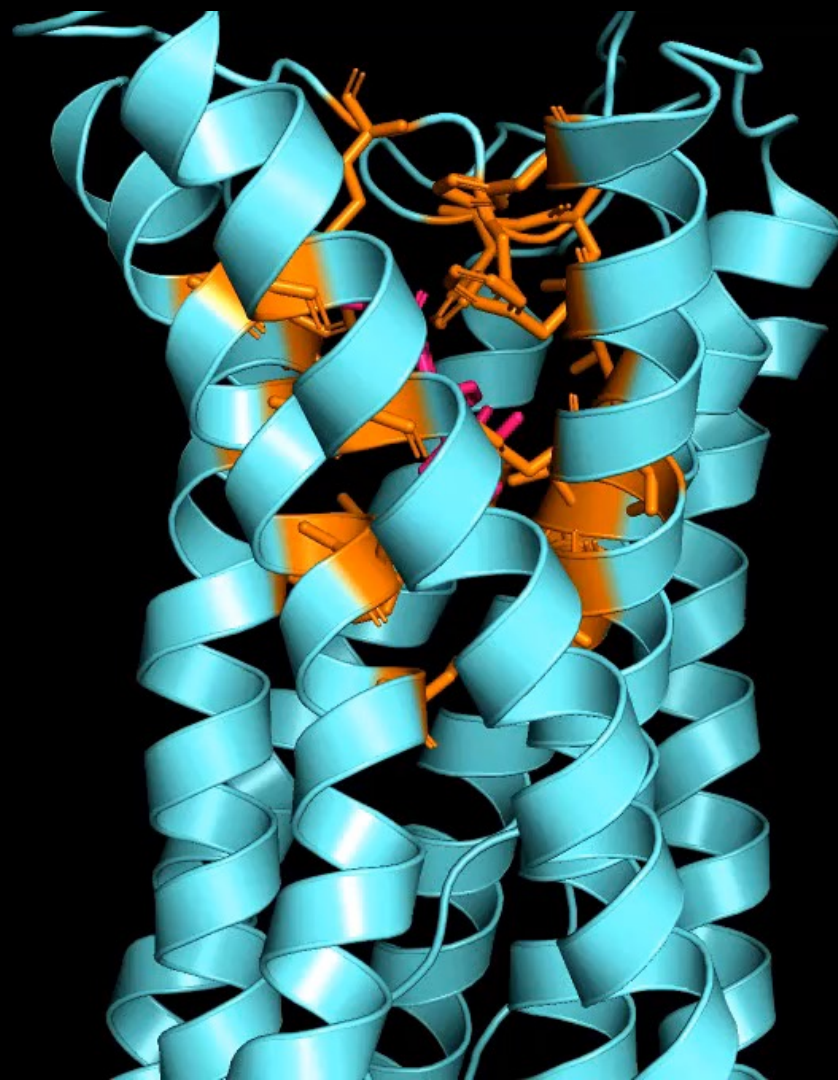
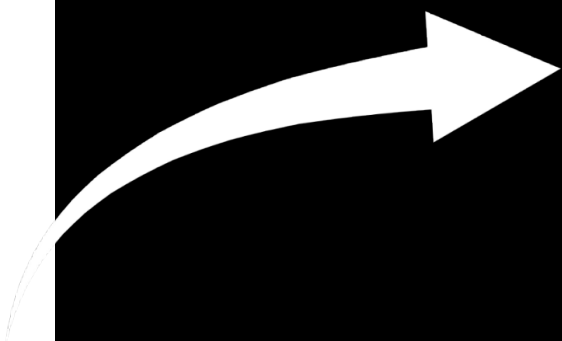
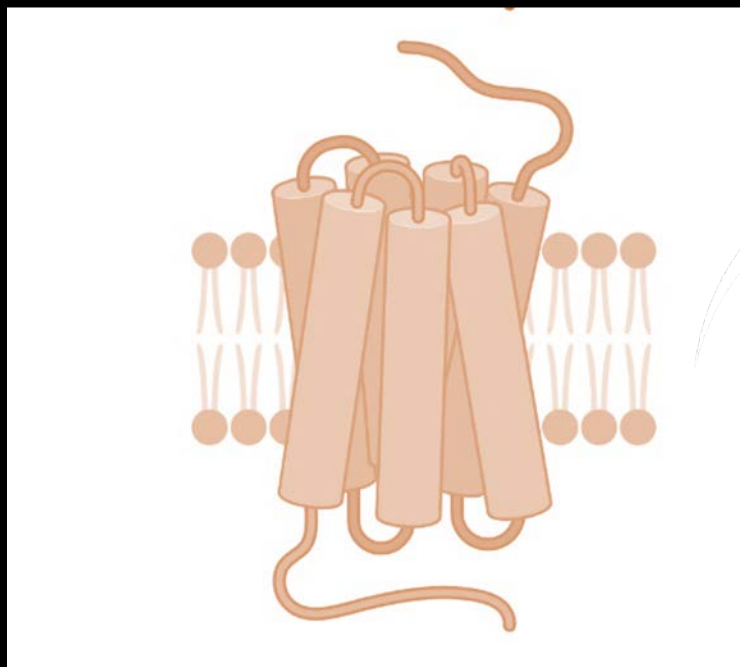
- Genomes provide target libraries (proteomes)



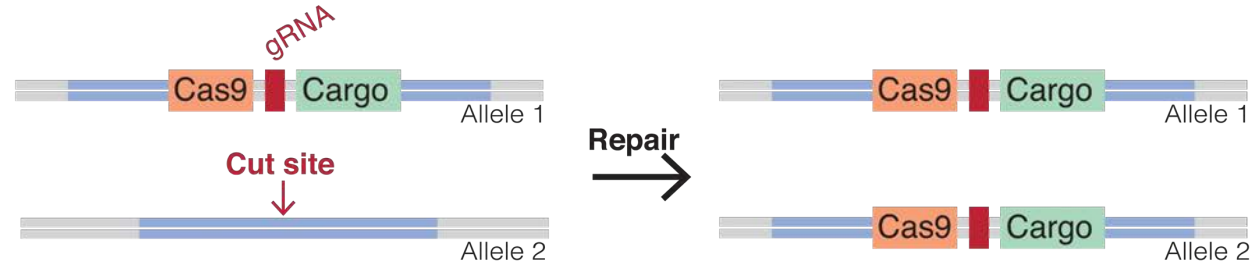


2. Compare targets between species

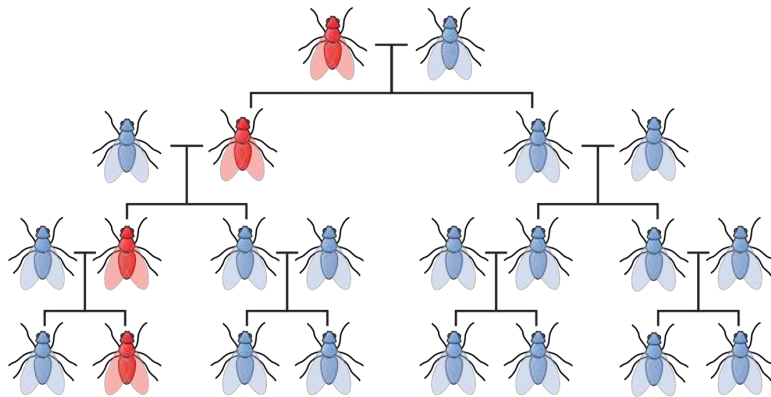
- Whole sequence
- 3D protein homology modelling



Gene drives for PF2050

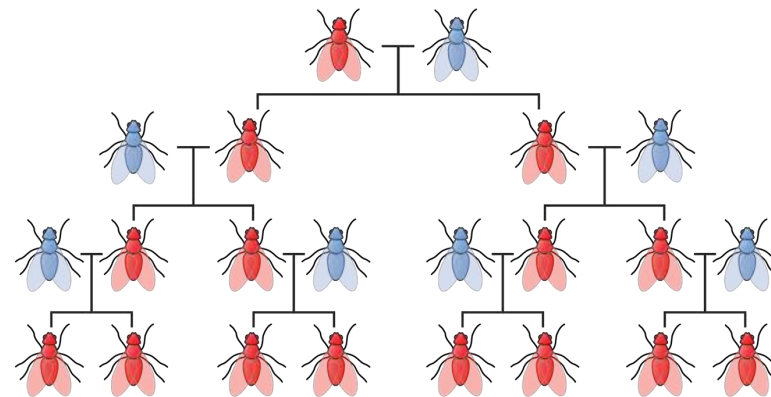


Normal inheritance



Altered gene does not spread

Gene drive inheritance



Altered gene is always inherited

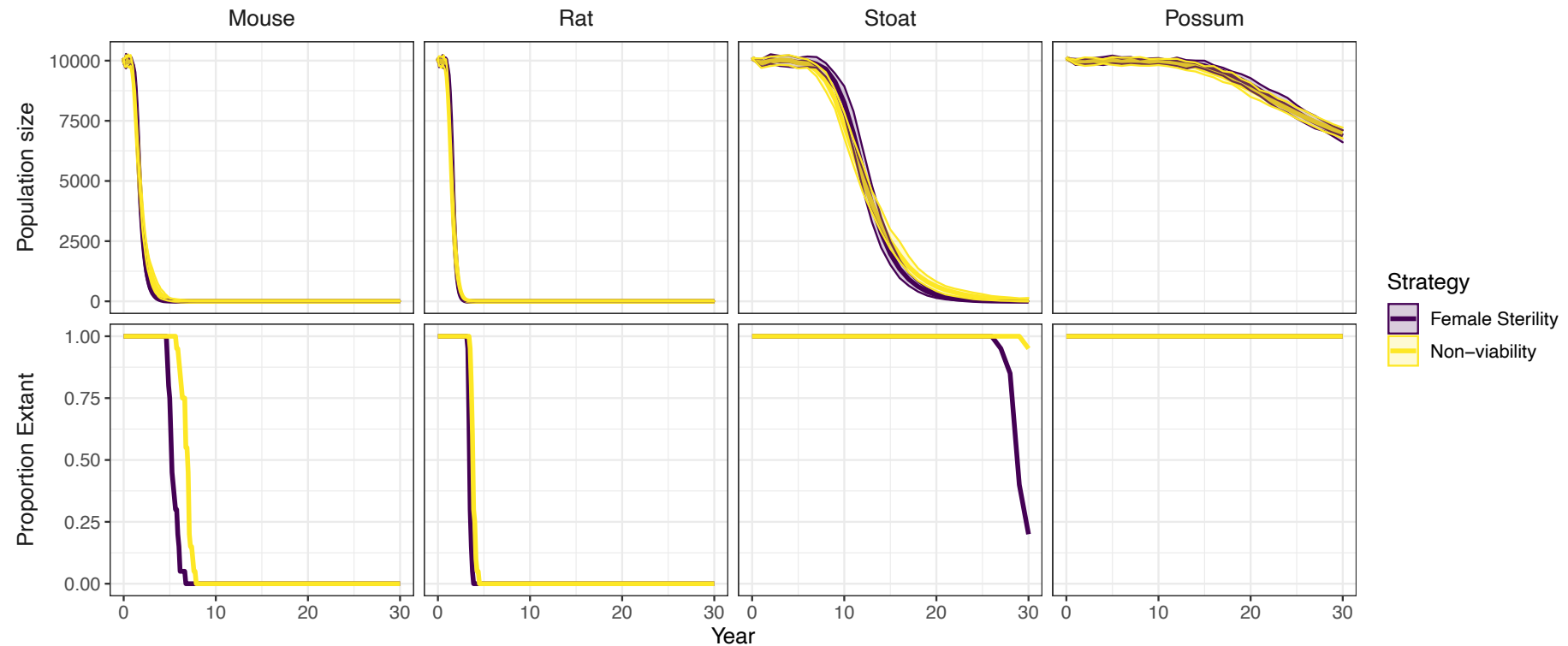
Life history



Manaaki Whenua
Landcare Research

	Litter size	Minimum generation time	Genome?	Average Life expectancy	Maximum Life expectancy
Mouse	7	10 weeks	Excellent	2	4
Ship rat	7	8 weeks	Excellent	1	4
Norway rat	7	8 weeks	Excellent	1	4
Kiore	7	8 weeks	No	1	3
Weasel	7	1 year	In progress	1	8
Stoat	10	2 years	Excellent	2	6
Ferret	6	2 years	Very Good	3	8
Possum	1	2 years	Excellent	5	13

Generation time really matters



Modelling by Thomas Prowse.

Best practice (eradication)



1. Combine toxin and trapping
2. Pulsed toxin in winter.
3. When reinvasion is likely, biyearly pulsed toxin in perpetuity.
4. Suppress/eradicate prey species
5. 250 x 250 m trapping grid
6. Optimised trap location for microhabitat
7. Multiple new lures have good potential (Boffa Miskell, ferret and stoat bedding, sound lures)
8. Detector dogs & genetics of scat.
9. Cameras for monitoring
10. Maintain all traps indefinitely
11. Mop up with toxic rodents

Eradication of mustelids (In my humble opinion)



- Only one PF2050 project in the country is a mustelid eradication (Waiheke Island)
- Possibly Otago Peninsula is, but only for ferrets.
- Capital Kiwi is doing a great job at suppression.
- Research is required for novel tools – and these are likely to not be around trapping (genetics, diseases, toxin distribution).
- Without aerial toxin there is no mustelid eradication currently.



Acknowledgements



People:

- Jo Ritchie, Paul Kviecinkas, Frank Leparo, Mary Frankham et al at. TKOW
- Jordan Lasenby, Tim Sjoberg, Paul Prip, Toby Shanley, Sam Haultain
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- Matt Maitland, Emma Whitton
- Julia Allwood, Talia Bruv-Cubitt
- Tom Etherington, Grant Norbury, Chris Niebuhr, Chris Jones, John Innes, Erica Hendrikse (MWLR)



Taranaki
Regional Council



Te Korowai o Waiheke
TOWARDS PREDATOR FREE WAIHEKE



Taranaki Taku Tūranga
**Towards
Predator-Free
Taranaki**



Manaaki Whenua
Landcare Research

@Dr_Stoat



Andrew Veale

VealeA@landcareresearch.co.nz

Thank you!!!



@Dr_Stoat

