

Natal dispersal in hihi

Kate Richardson

PhD (Conservation Biology)

Massey University

Zoological Society of London

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Talk overview

- Natal dispersal – definitions and literature review
- Natal dispersal data - hihi
 - Tiritiri Matangi Island 1997-2007
 - Zealandia 2005-2007
 - Maungatautari 2009-2013
- Can we use natal dispersal data to make inferences about post-release dispersal?



Dispersal

- **Natal dispersal**

- Movement from natal site to first breeding territory
- Key part of species life history & primary mechanism of gene flow

- **Post-release dispersal**

- Immediate movements of individuals after translocation and/or attempts to return to source site



Literature review

- Post-release dispersal literature mostly descriptive, little known about similarities and differences with natal dispersal
- Natal dispersal literature more extensive



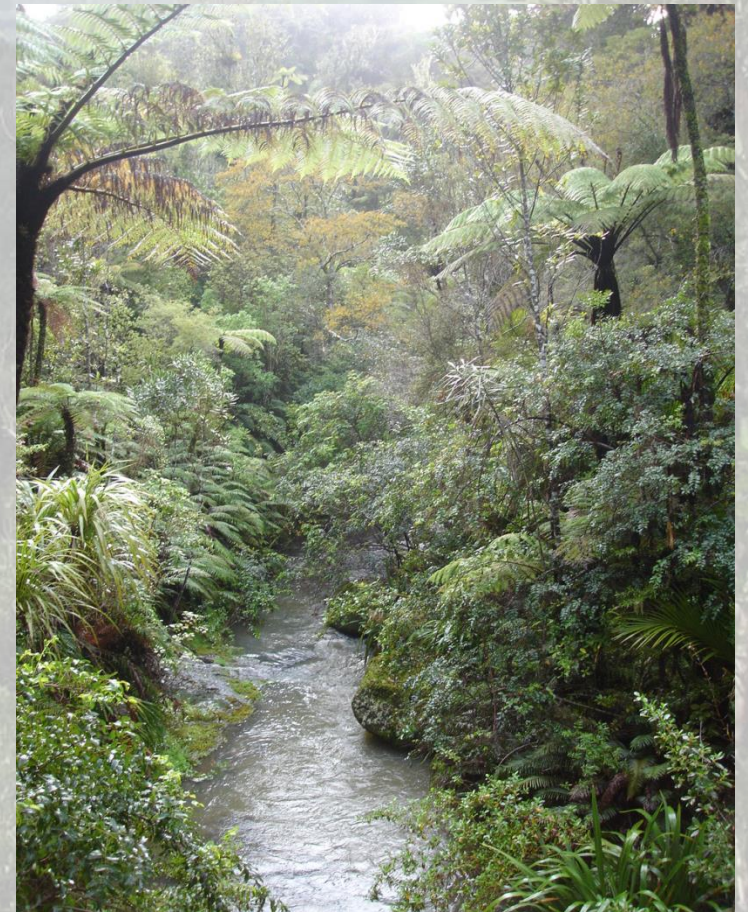
Natal dispersal

- Topical issue in ecological literature
- Interaction of factors at many levels:
 - Individual
 - Social
 - Environmental
- Operates at many scales:
 - Individual
 - Population
 - Landscape



Natal dispersal

- Extrinsic factors
- Habitat selection
- Inbreeding/kin avoidance
- Population density and sex ratio
- Predators and parasites



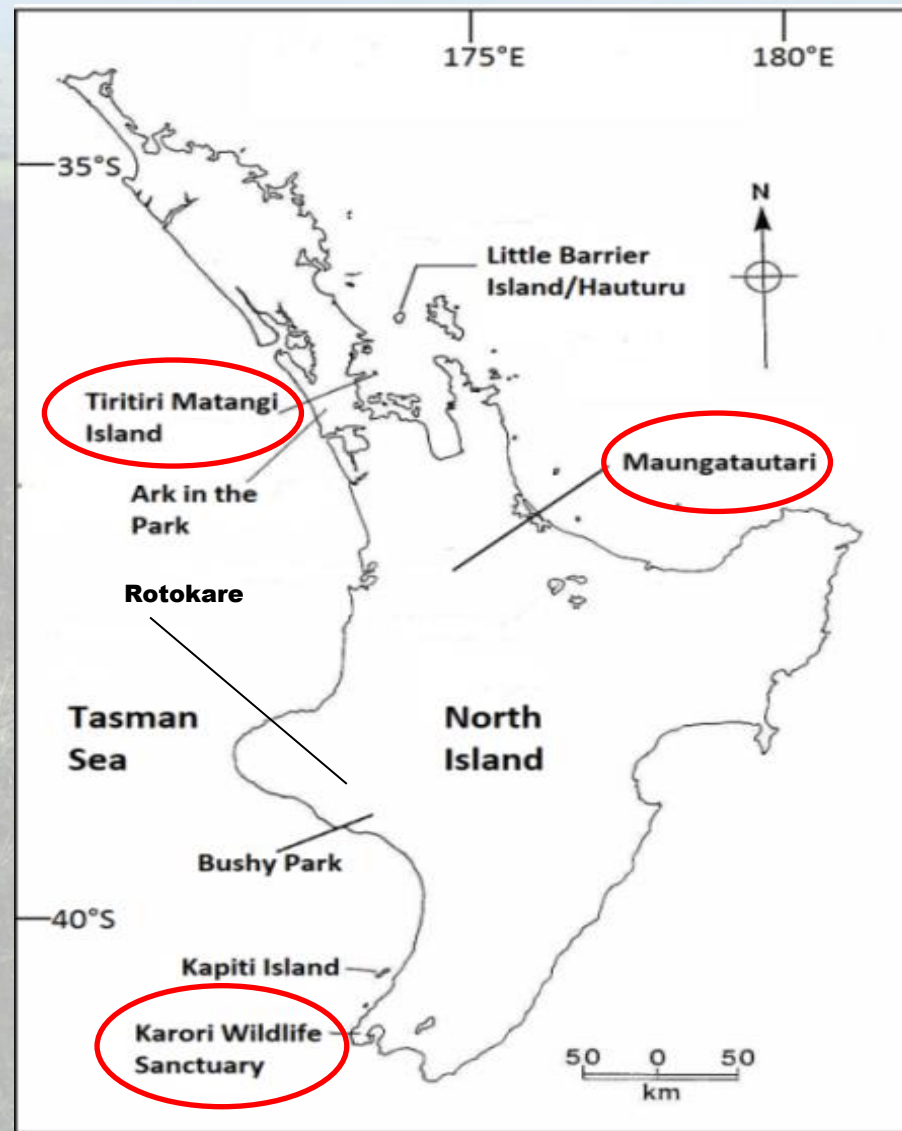
Natal dispersal

- Intrinsic factors

- Parental effects – heritable, pre/post-natal
- Morphology
- Behavioural types/ personality/temperament
- Condition – early nutrition

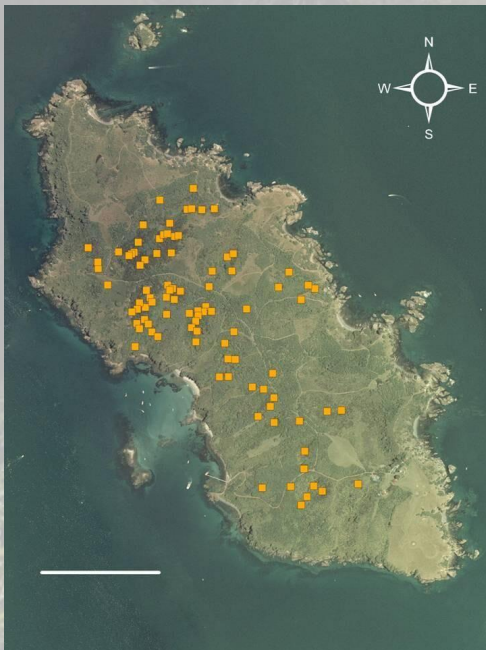


Hihi reintroduction history

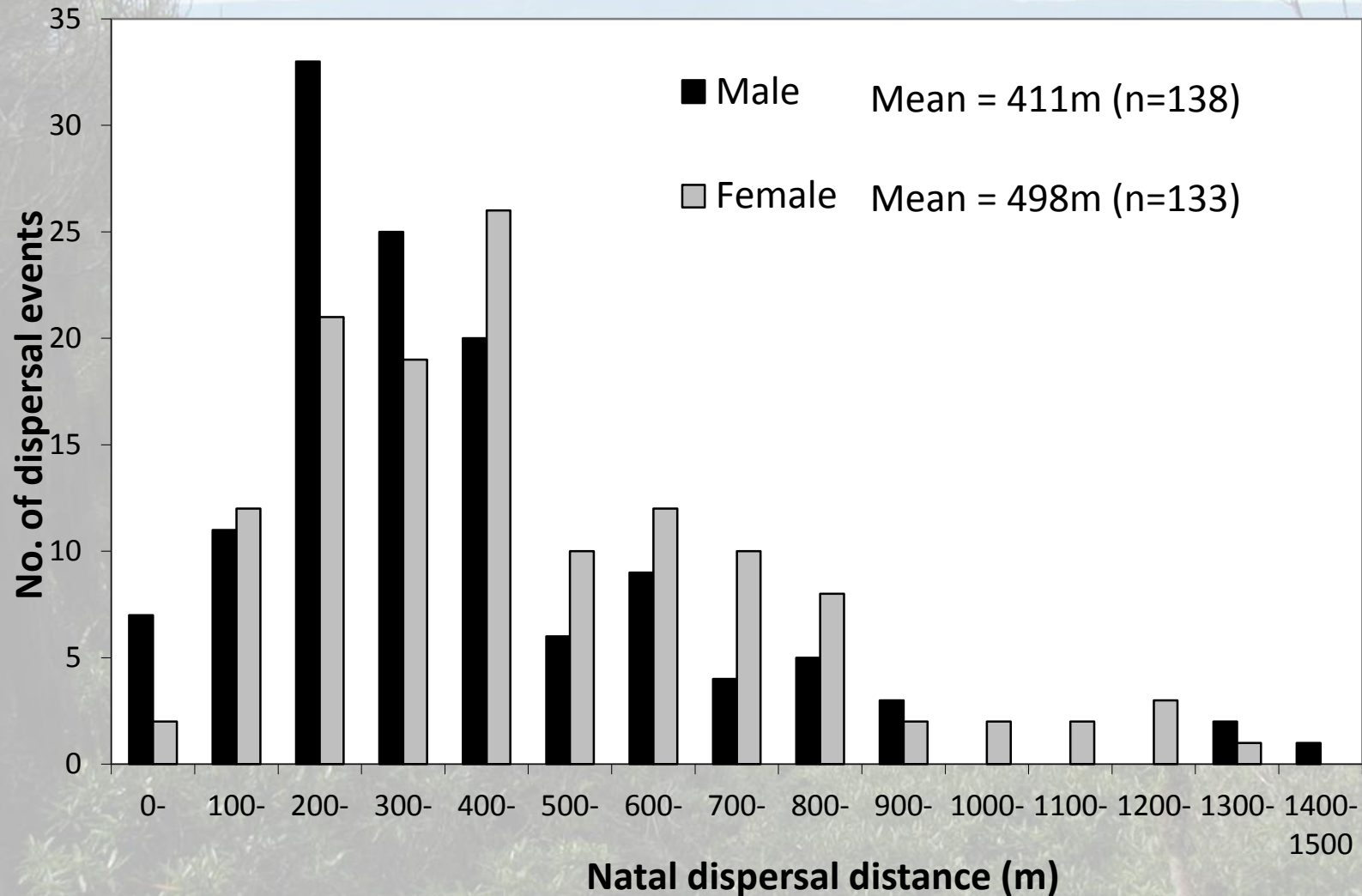


Tiritiri Matangi Island

- Released in 1995
- Breeding population increased from 16 to 170 in first ten years
- Natal dispersal data analysed from 1997/98 to 2007/08
- Distance btwn nest box hatched in -> nest box first bred in
- 220 ha island, greatest distance btwn boxes ~2 km



Tiritiri Matangi Island

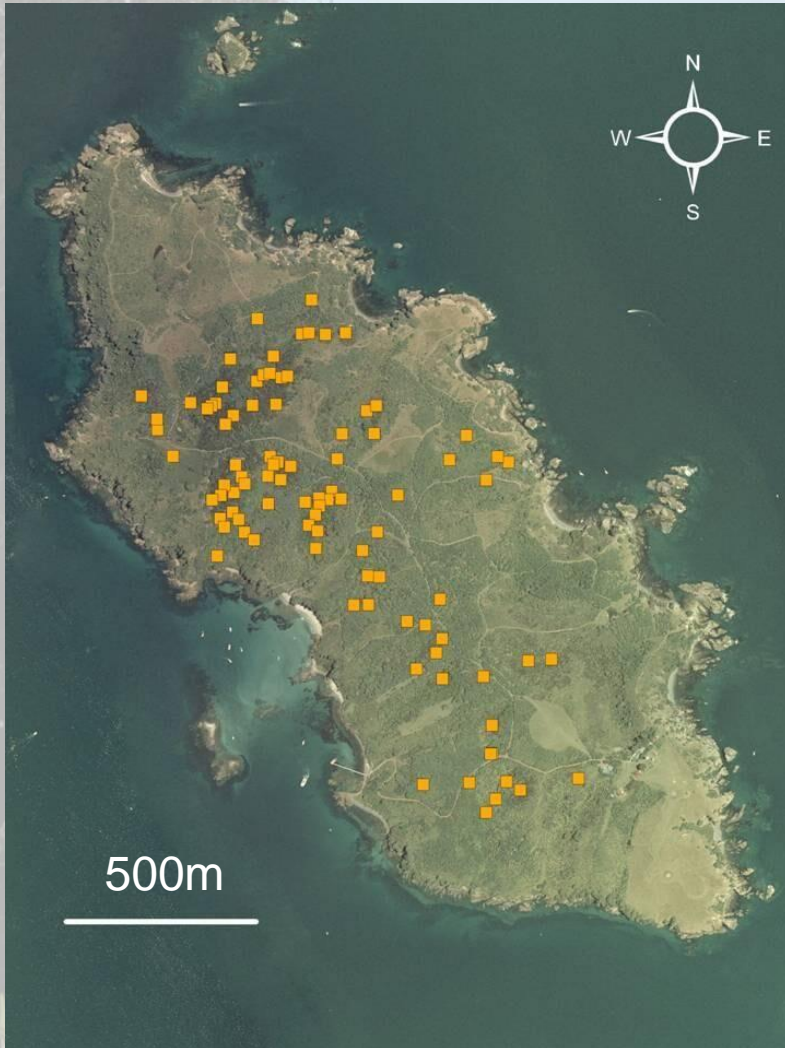


Richardson *et al.* 2010. Sex-specific shifts in natal dispersal dynamics in a reintroduced hihi population. *Behaviour*. 147: 1517-1532.

Tiritiri Matangi Island

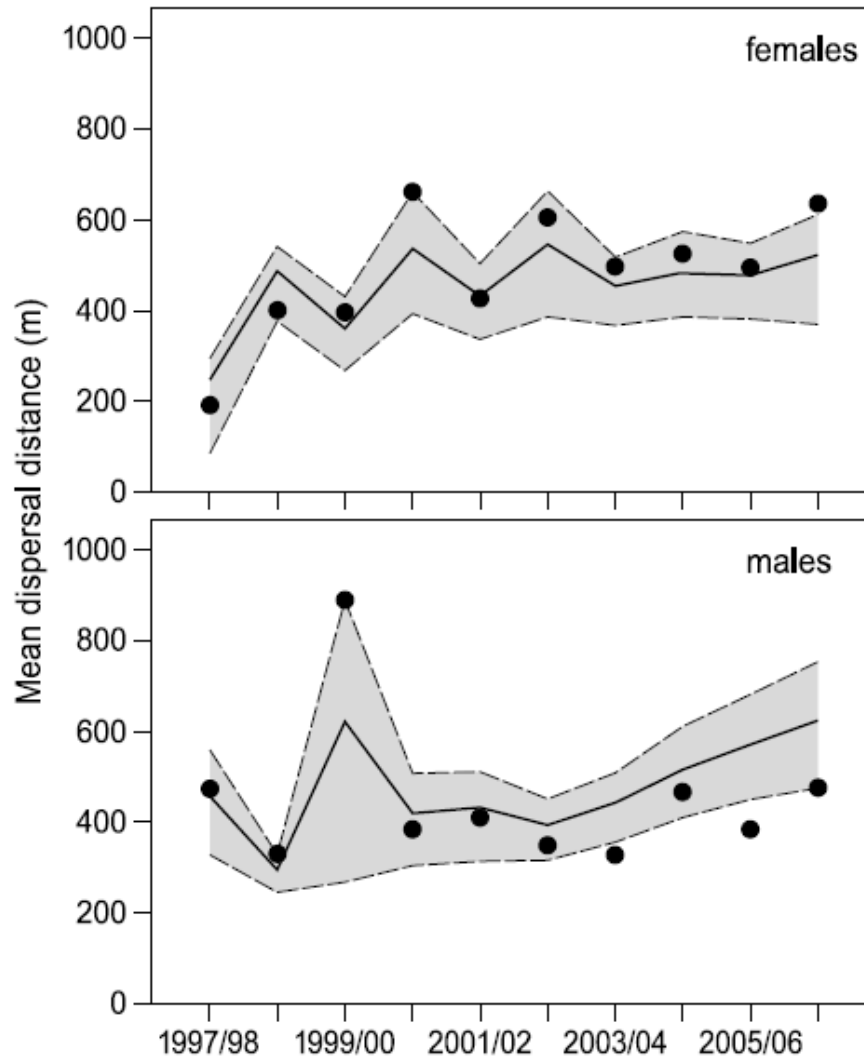
Permutation test

- Compared observed with expected dispersal distances
- 1000 randomised data sets for each sex
- Randomly assigned observed natal nest box locations among birds in each cohort



Richardson *et al.* 2010. Sex-specific shifts in natal dispersal dynamics in a reintroduced hihi population. *Behaviour*. 147: 1517-1532.

Tiritiri Matangi Island



Permutation test - Results

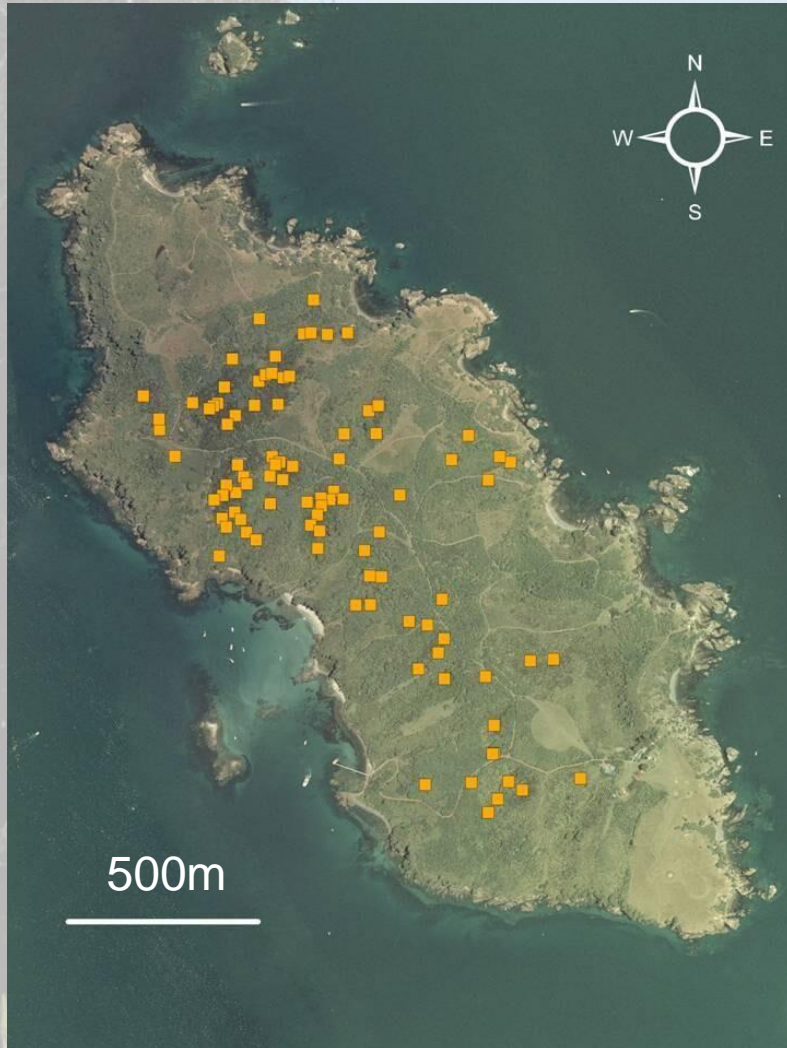
- Expected dispersal distance (mean)
- - - Expected dispersal distance (2.5 and 97.5 percentiles)
- Actual dispersal distance (mean)

Females – dispersal **higher** than expected by chance

Male – dispersal **lower** than expected by chance

Tiritiri Matangi Island

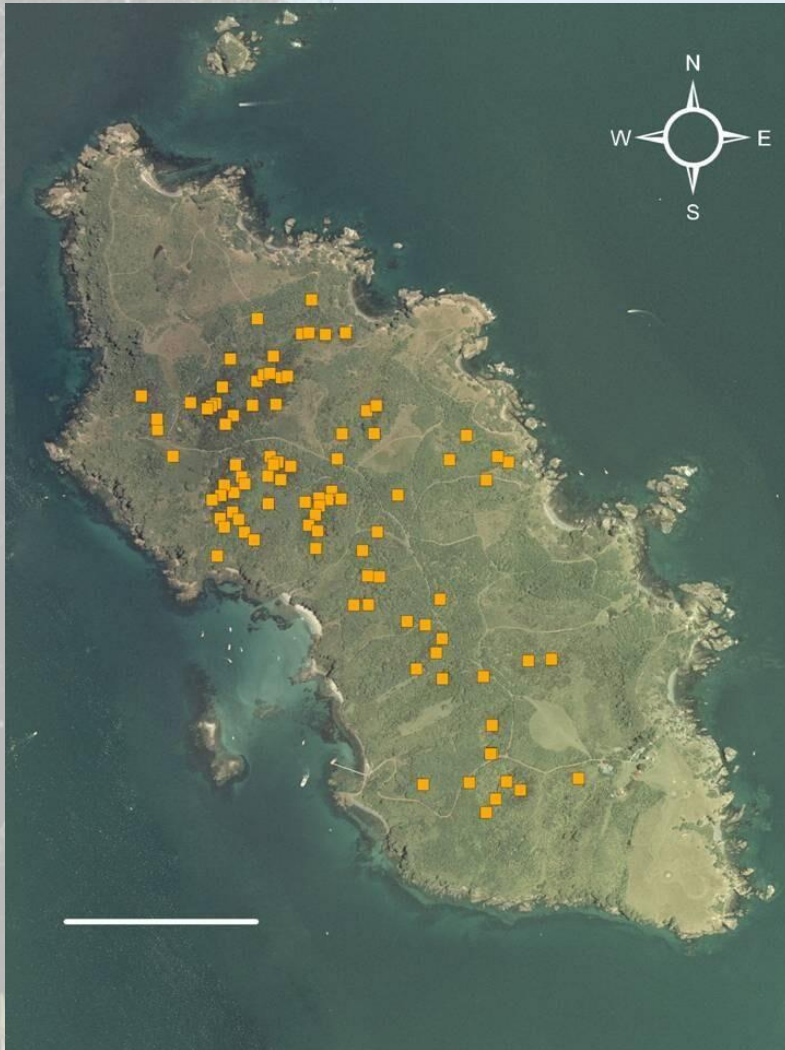
General linear mixed model – natal dispersal distance



- Fixed effects:
 - Sex
 - Density
 - # population
 - # adult ♂
 - # adult ♀
 - # juveniles
 - Sex ratio
- Random effects:
 - Year
 - Maternal & nest box
- Controlled for distance from geographic centre

Richardson *et al.* 2010. Sex-specific shifts in natal dispersal dynamics in a reintroduced hihi population. *Behaviour*. 147: 1517-1532.

Tiritiri Matangi Island

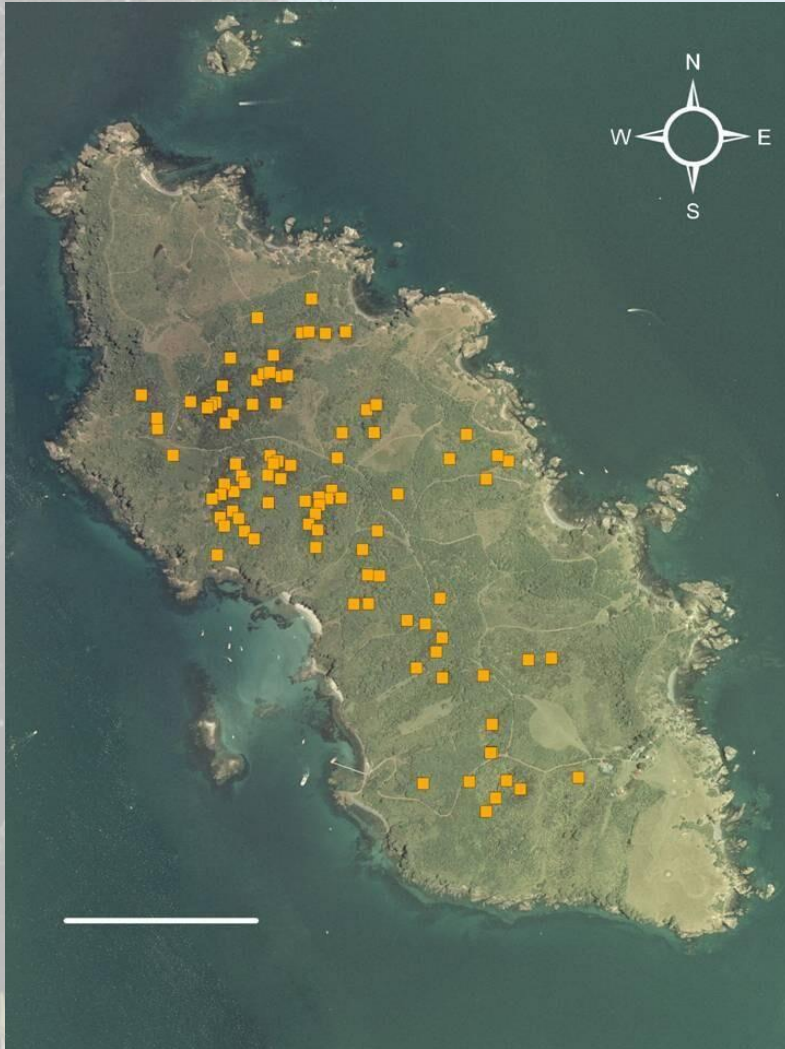


GLMM – Results

- ***Number of juveniles***
 - As juvenile cohort increases
 - Juvenile male dispersal decreases
 - Juvenile female dispersal increases
 - Effect stronger in males than females
- ***Sex ratio***
 - ♀ dispersal decreases under male-biased sex ratios
 - No effect on ♂ dispersal
- Random effects
 - Year – no support
 - ***Maternal*** – strong support for effect

Richardson *et al.* 2010. Sex-specific shifts in natal dispersal dynamics in a reintroduced hihi population. *Behaviour*. 147: 1517-1532.

Tiritiri Matangi Island



Why? Population density

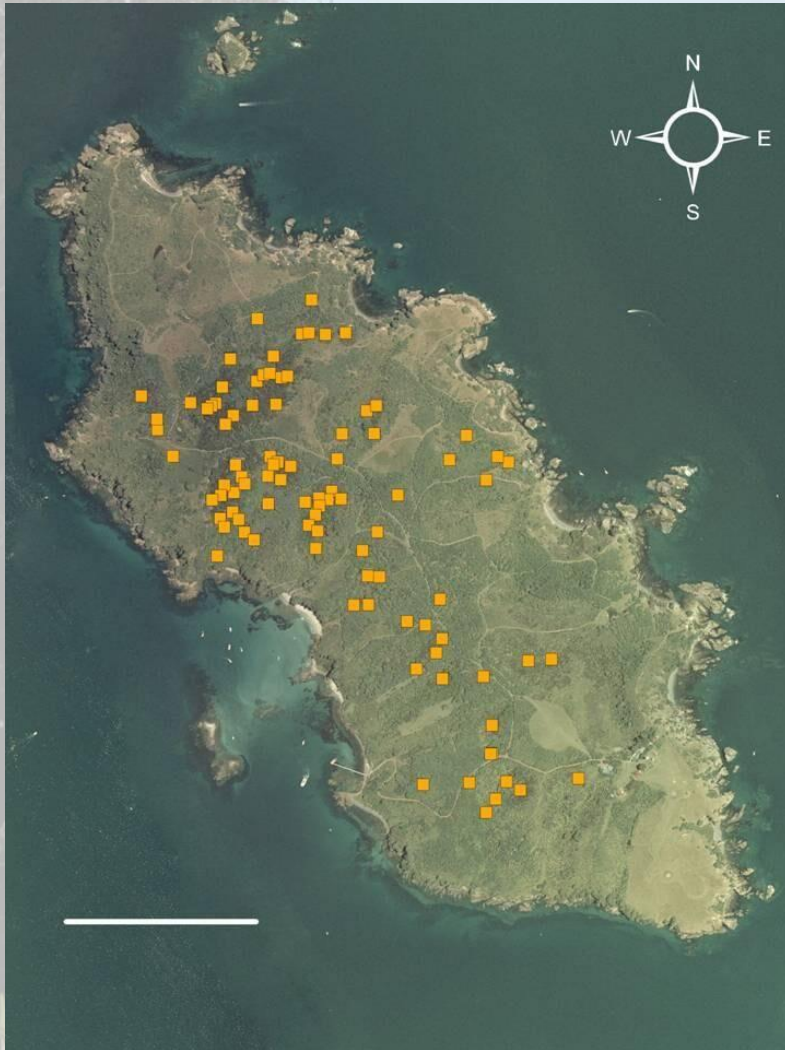
- Positive density-dependent dispersal in females – disperse further to find vacant territories.
- Negative density-dependent dispersal in males?
- Closer males may be more likely to acquire territories at high densities?
- High proportion of unpaired males in hihi populations – proportions likely change with density. Males that may in some years have dispersed the furthest may remain unpaired at higher densities.
- **Sex ratio**
- More males -> females may not need to move as far to find an unpaired male with territory.

Richardson *et al.* 2010. Sex-specific shifts in natal dispersal dynamics in a reintroduced hihi population. *Behaviour*. 147: 1517-1532.

Tiritiri Matangi Island

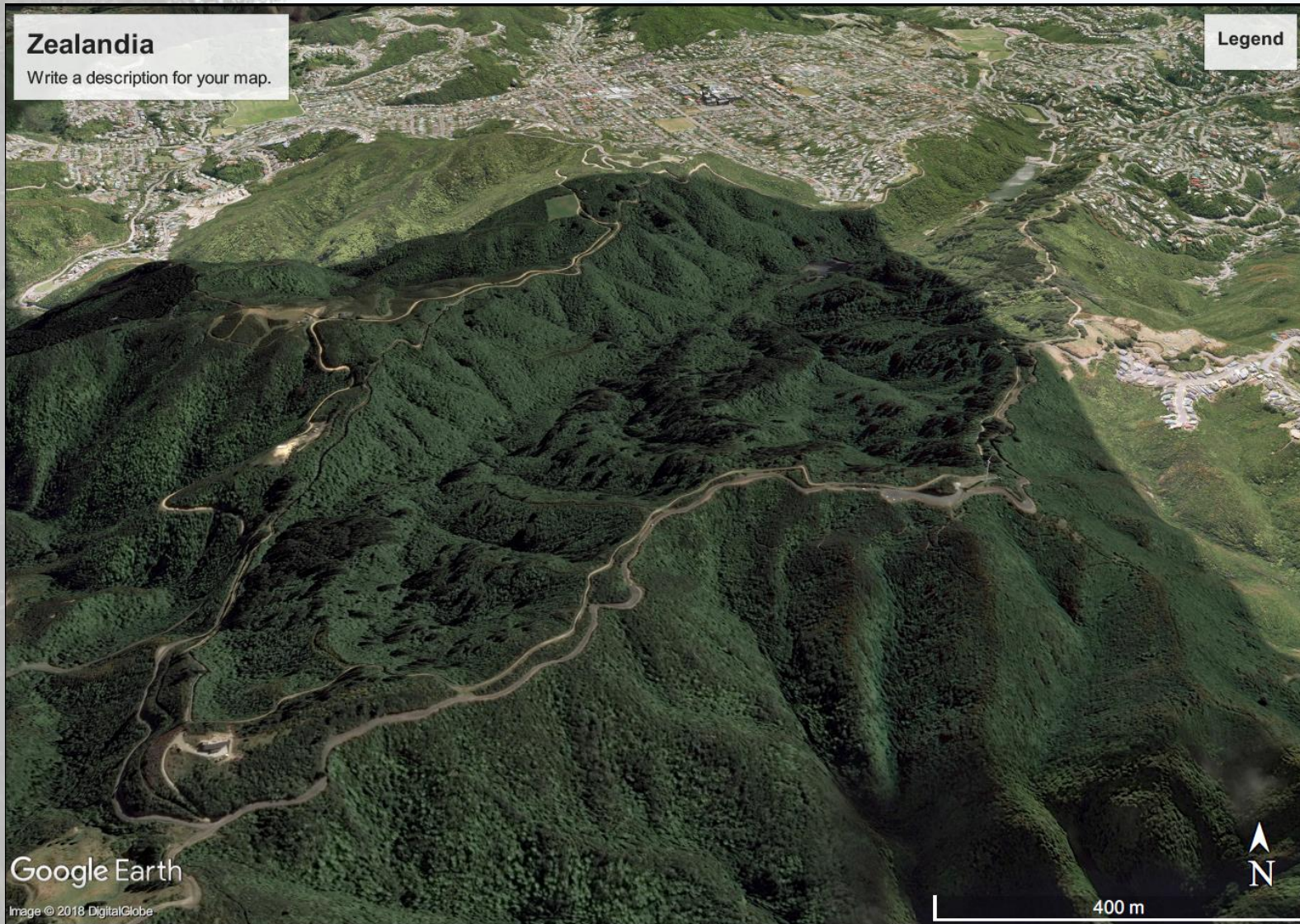
Summary

- Range of natal dispersal distances for both sexes
- Overall female dispersal higher than males
- Strongly affected by density & sex ratio but sex-specific
- Maternal effect may be explained by genetic component (as in other species)



Richardson *et al.* 2010. Sex-specific shifts in natal dispersal dynamics in a reintroduced hihi population. *Behaviour*. 147: 1517-1532.

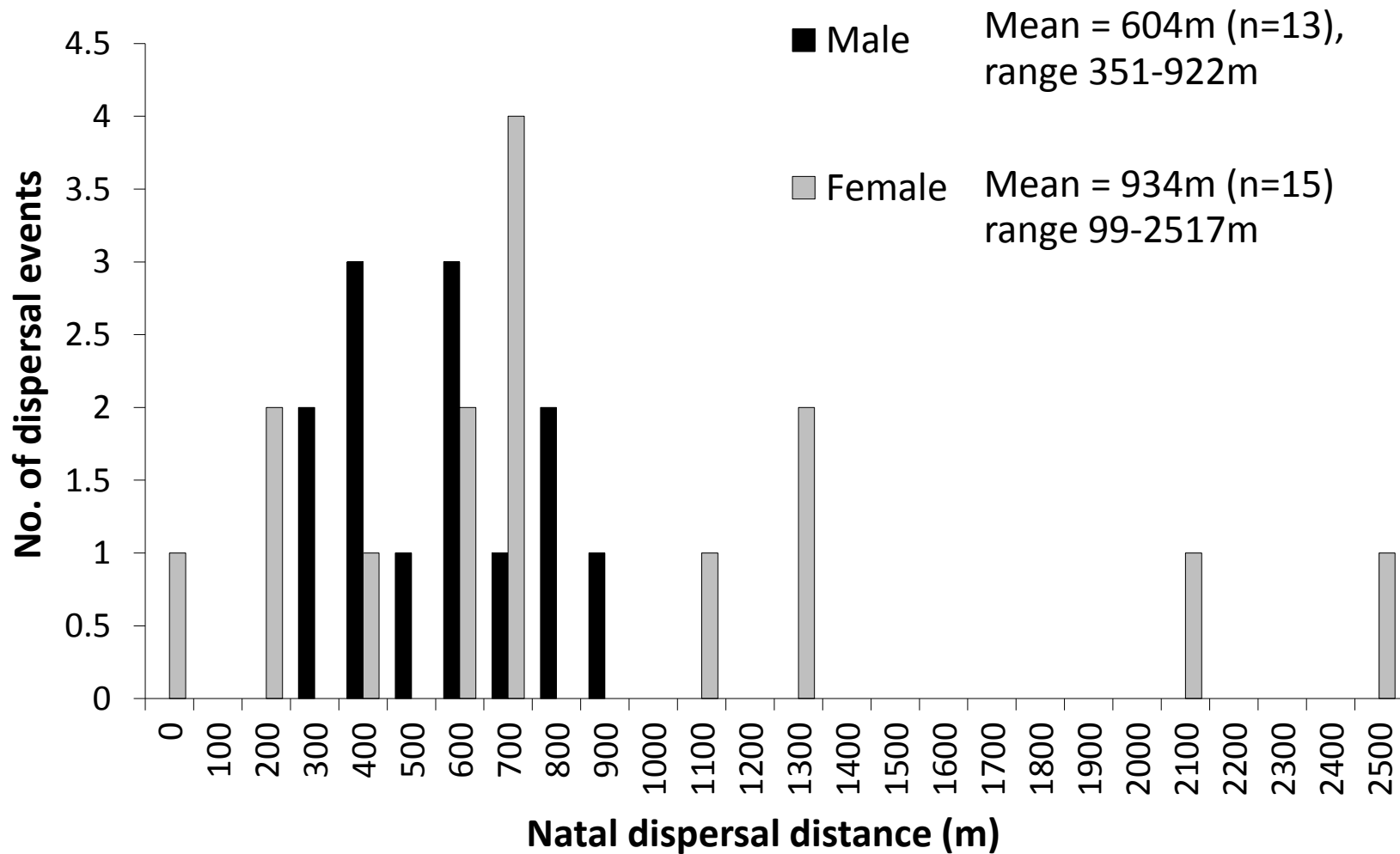
Zealandia 2005-2007



225 ha

Max distance
<4 km

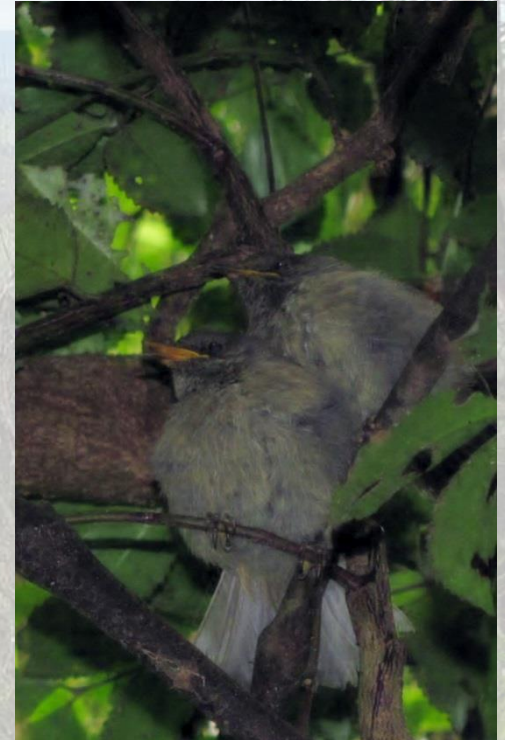
Zealandia 2005-2007



Unpublished data, Zealandia/Karori Wildlife Sanctuary.

Maungatautari 2009-2013

- Hihi released in 2009, 2010, 2011
- ~3400 ha, max distance 8 km
- Can look at natal dispersal on much larger scale
- Dispersal constrained by farmland



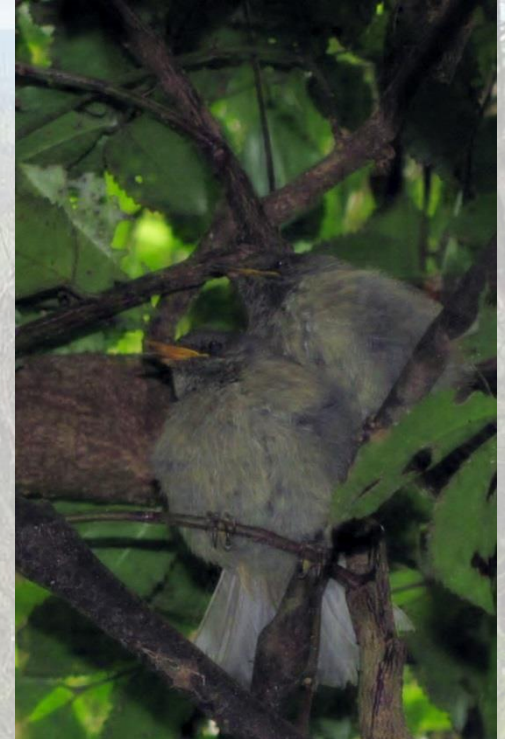
Maungatautari 2009-2013

PhD site

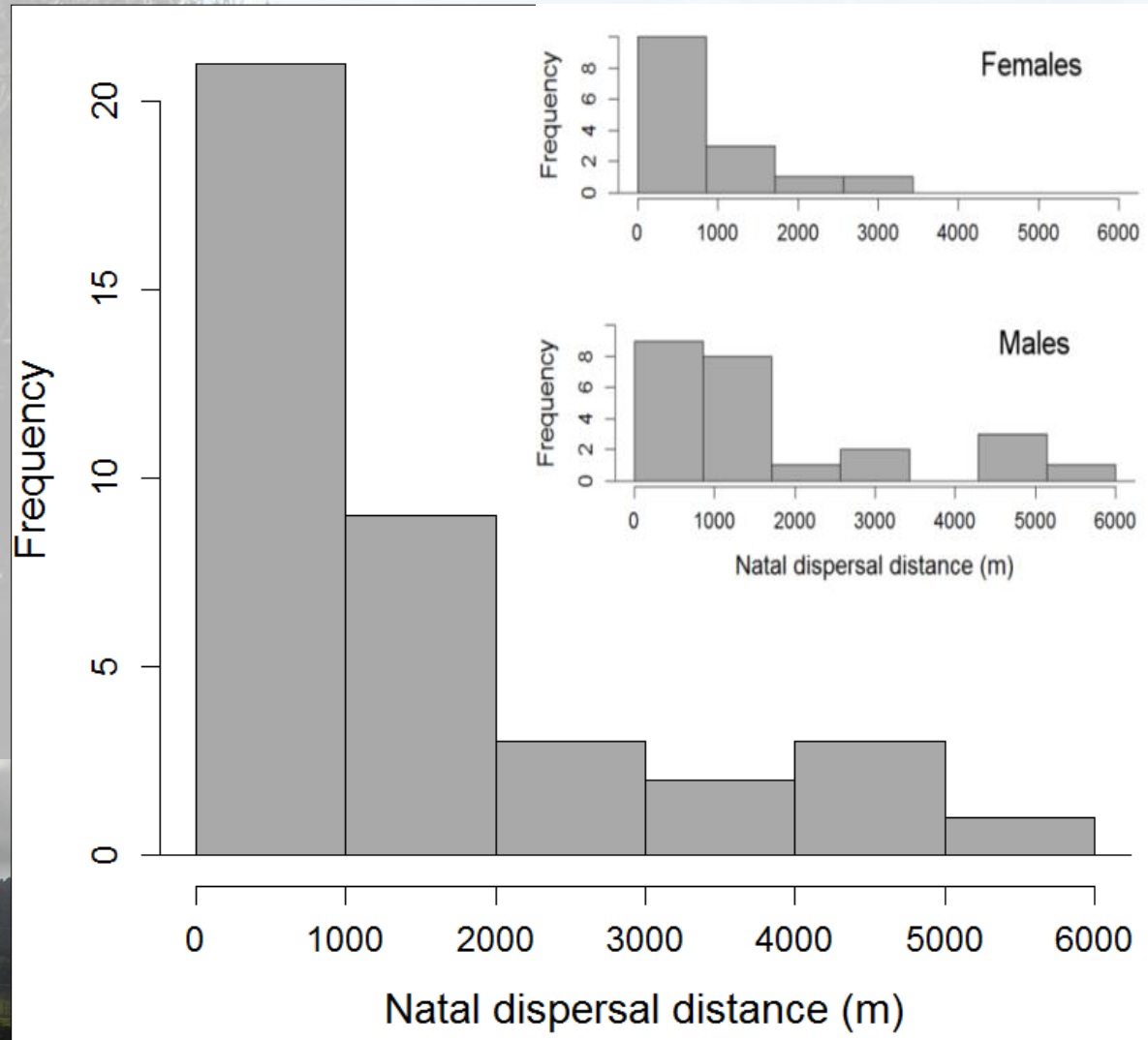
- Territory mapping 2009/10 to 2012/13
- Intensive banding & genotyping

Questions relating to natal dispersal

- Distances
- Male vs female
- Social and environmental factors
- Effects of temperament



Maungatautari 2009-2013



Males

Mean=1749m (n=24)

Range 0-5170m

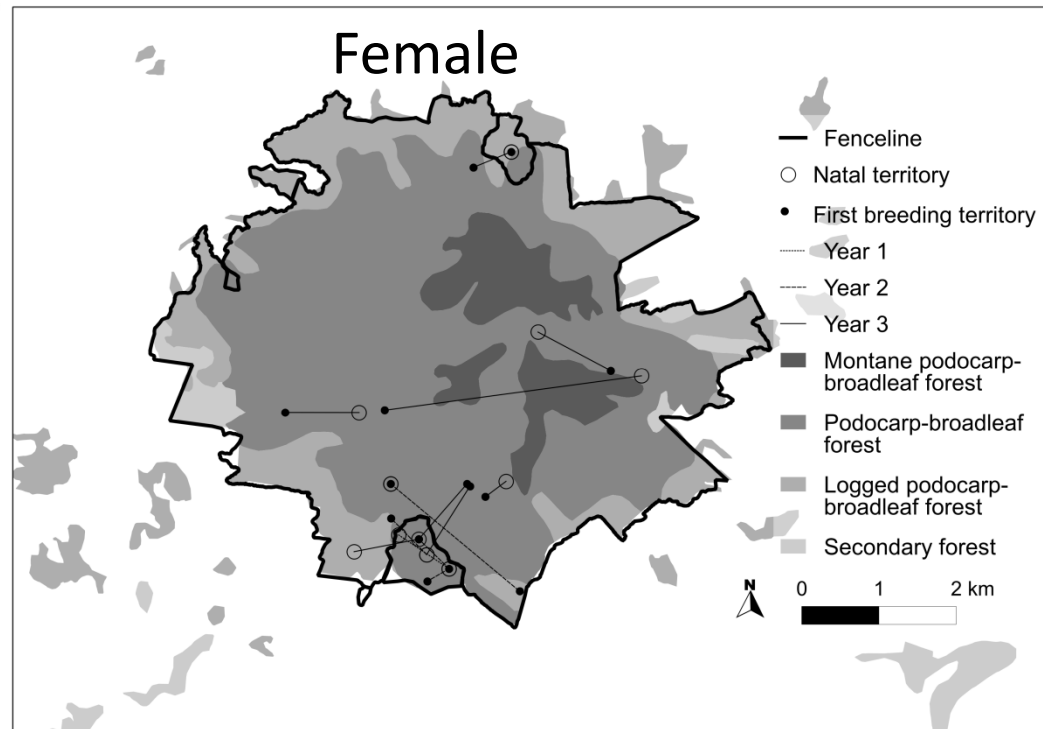
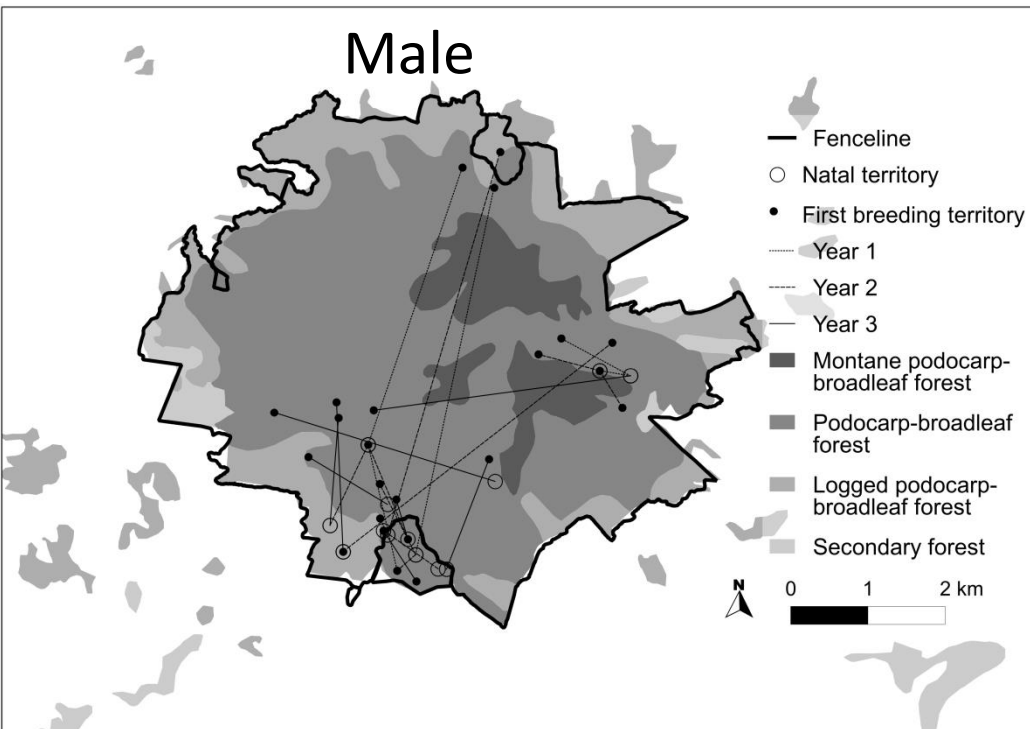
Females

Mean=876m (n=15)

Range 0-3425m

Richardson et al. 2017. Behaviour during handling predicts male natal dispersal distances in an establishing reintroduced hihi (*Notiomystis cincta*) population. *Animal Conservation* 20 (2): 135-143.

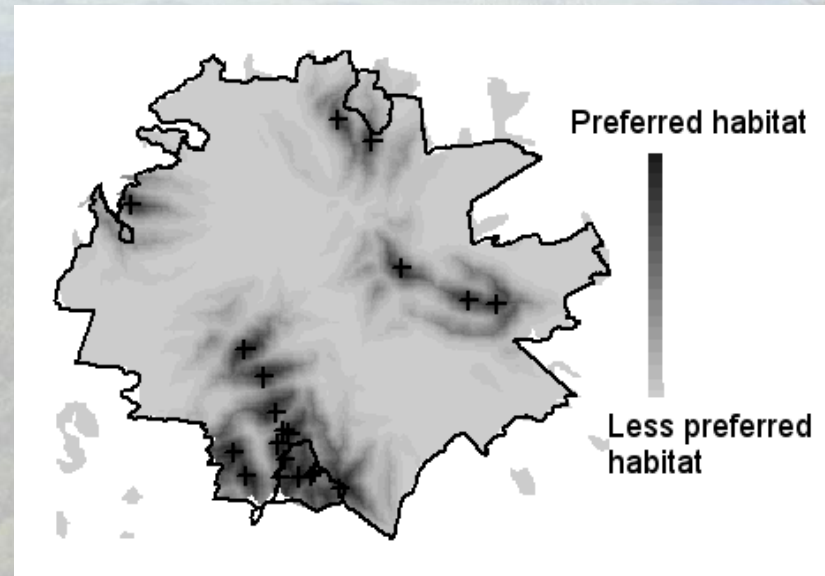
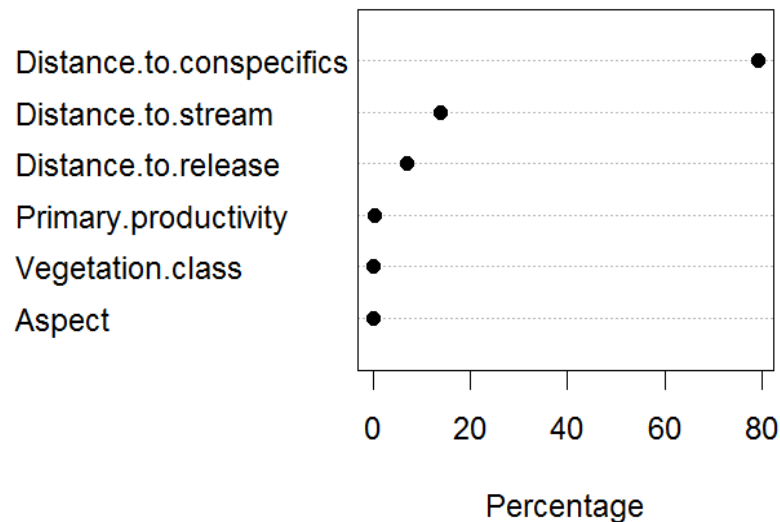
Maungatautari 2009-2013



Richardson et al. 2017. Behaviour during handling predicts male natal dispersal distances in an establishing reintroduced hiihi (*Notiomystis cincta*) population. *Animal Conservation* 20 (2): 135-143.

Maungatautari 2009-2013

Social and environmental factors – natal dispersal

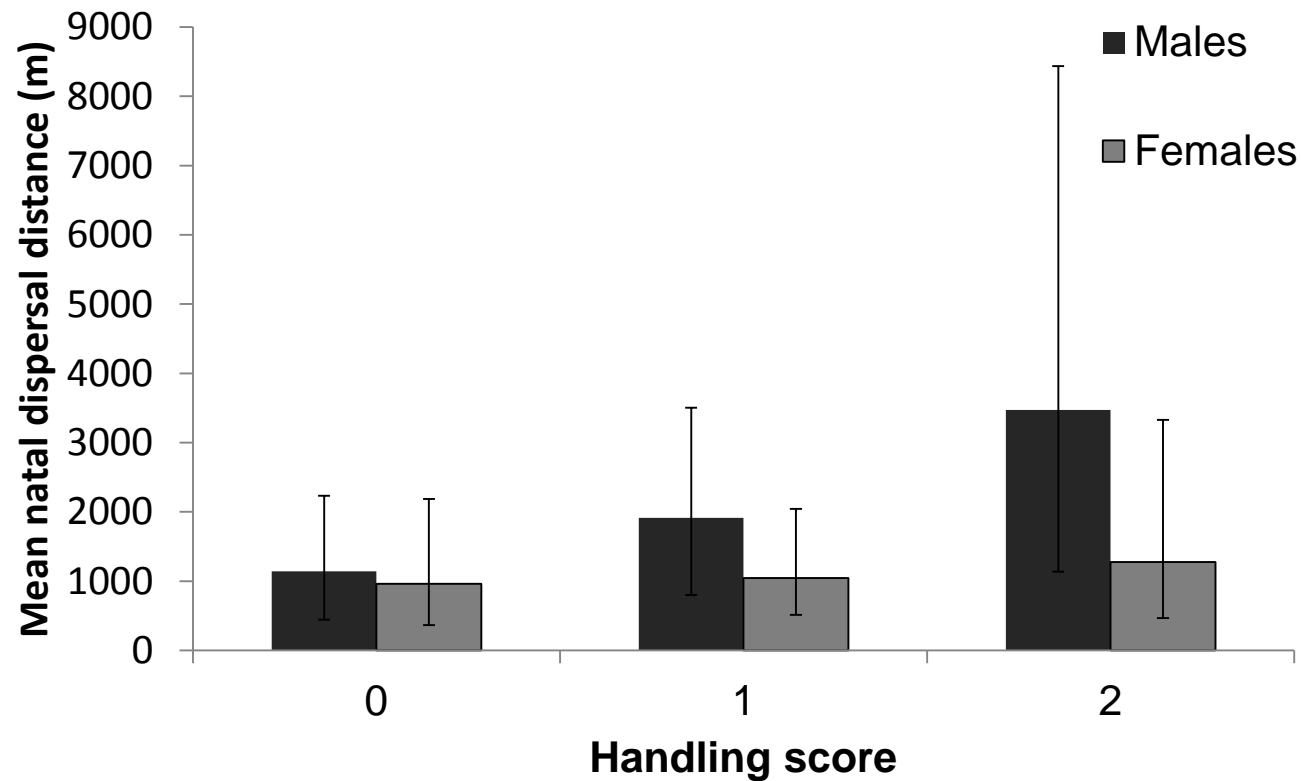


Social effects more important than environmental factors

Richardson and Ewen, 2016, Habitat selection in a reintroduced population: social effects differ between natal and post-release dispersal. *Animal Conservation* 19 (5): 413-421

Maungatautari 2009-2013

Effects of temperament – natal dispersal



Behaviour in the hand predicted natal dispersal distance for males, but not females


-> males that distress call dispersed further

Richardson et al. 2017. Behaviour during handling predicts male natal dispersal distances in an establishing reintroduced hihi (*Notiomystis cincta*) population. *Animal Conservation* 20 (2): 135-143.

Maungatautari 2009-2013

Summary:

- Population - low density, early stages of establishment
 - Natal dispersal patterns more random in first few years?
- Clusters across site – driven by conspecific attraction
- Dispersal between clusters driven by males of a specific temperament



Richardson et al. 2017. Behaviour during handling predicts male natal dispersal distances in an establishing reintroduced hihi (*Notiomystis cincta*) population. *Animal Conservation* 20 (2): 135-143.

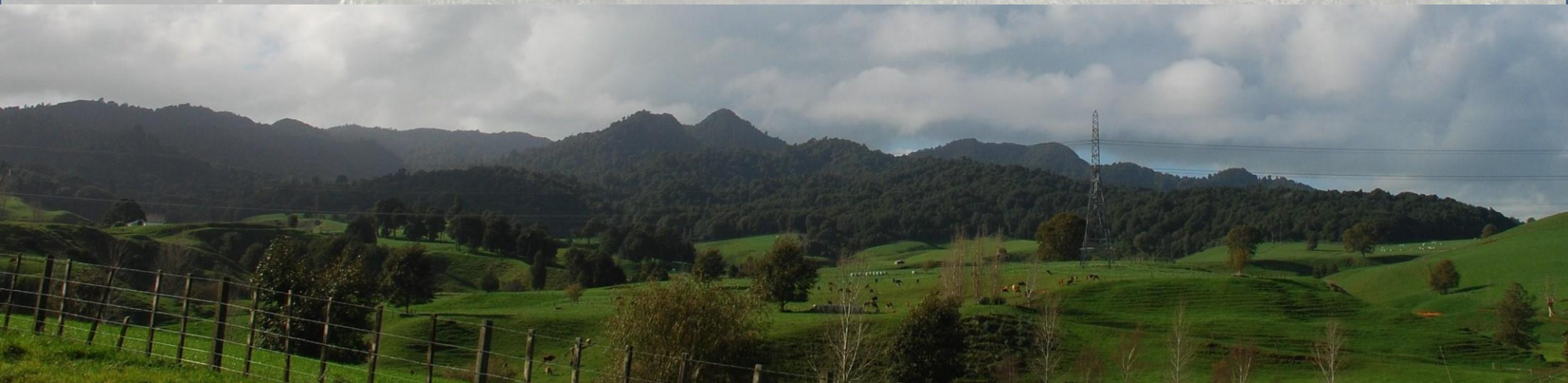
Can natal dispersal behaviour predict post-release dispersal?

Yes

- Distances similar (at Maungatautari)
- Habitat selection similar – close to streams, mid/low altitude forest
- Effects of temperament similar – distress callers disperse further

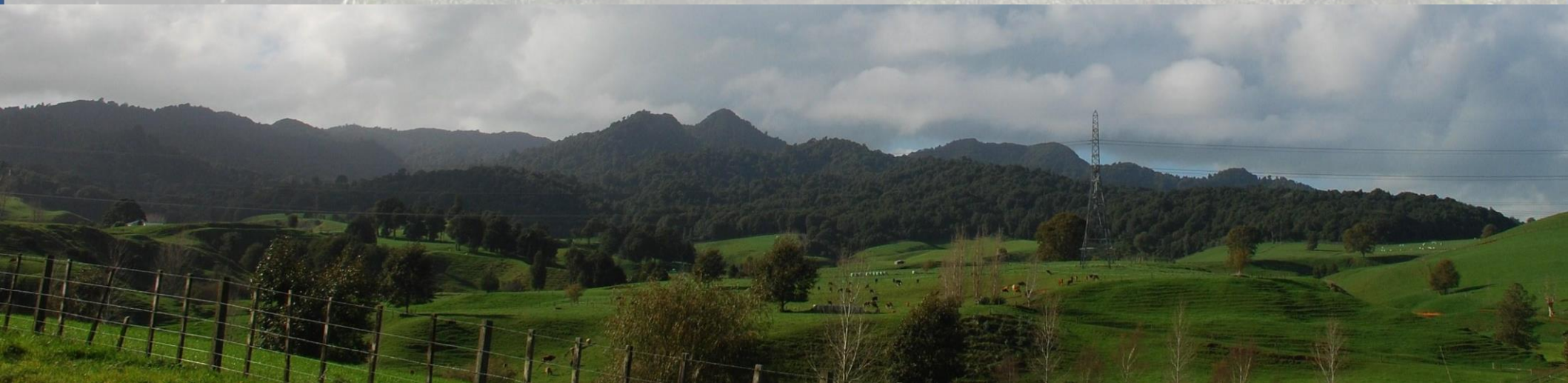
No

- Conspecific attraction only observed in natal dispersal



Acknowledgements

- PhD supervisors: Doug Armstrong, John Ewen, Isabel Castro
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- Maungatautari Ecological Island Trust staff and volunteers
- Raewyn Empson for providing Zealandia data
- DOC contractors and volunteers who collected Tiritiri Matangi Island data
- Photo credits: Lydia Doerr, Isabel Castro, Eric Watson



Questions?

