

# The sub-Antarctic

## Genetic information at different spatial scales



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# Co-workers and acknowledgements



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# Genetic information at spatial scales



- **Sub-Antarctic scale**

- Broad scale molecular phylogenies
- Dispersal, time of speciation

- **Island scale**

- Phylogeographic studies for specific taxa on specific islands
- Refugia, differentiation across islands

- **Local (site) scale**

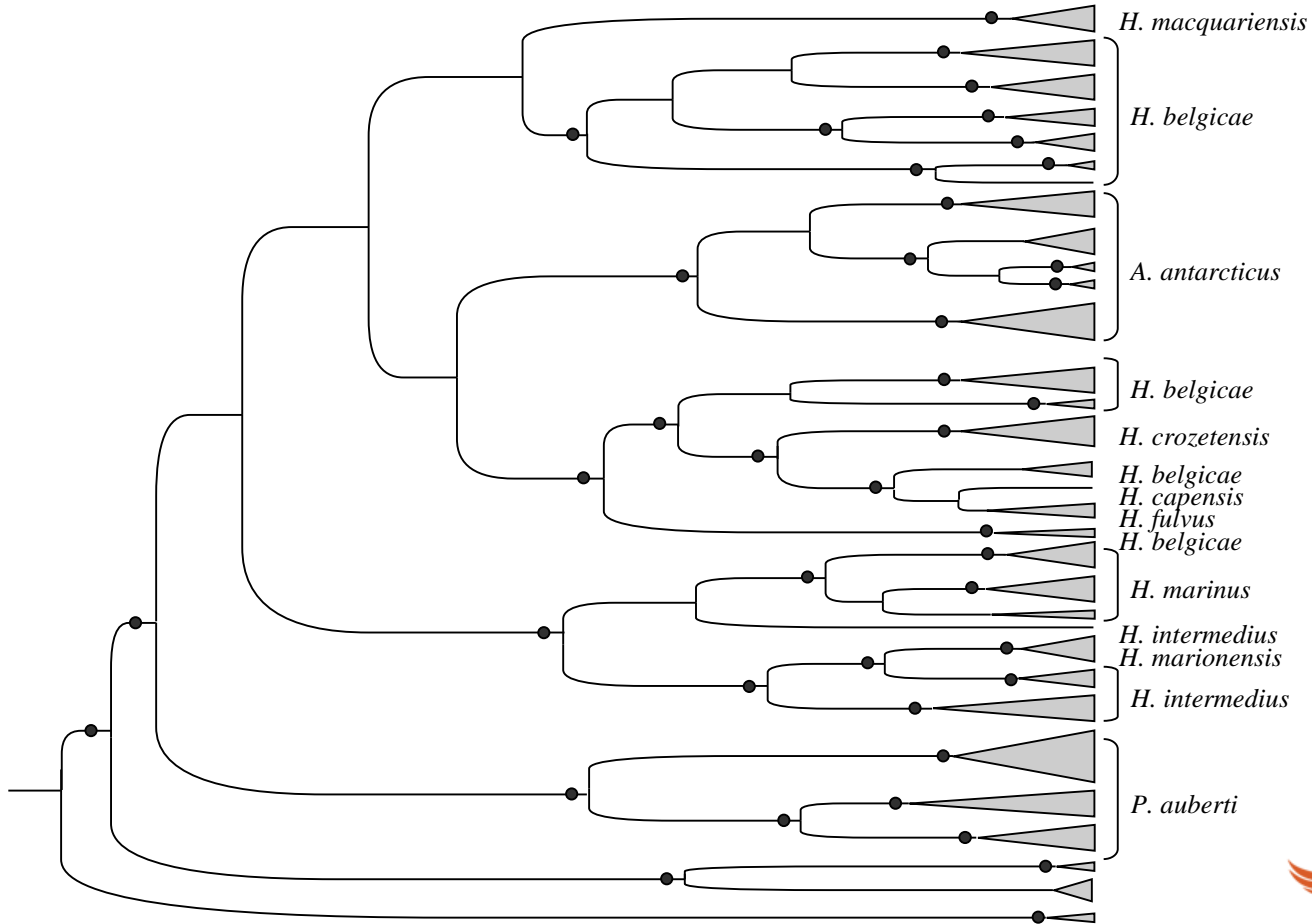
- Inbreeding, genetic health of populations
- Dispersal estimates

# Biogeography



- Traditional models to explain the (fragmented) distribution of species:
  - **Equilibrium model** (MacArthur & Wilson 1963, 1967, Gressitt 1967)
    - Rapid turn-over of species through colonizations and extinctions
    - Dispersals lead to high gene flow
  - **Vicariance model** (Rosen 1978, Nelson & Platnick 1981, Wallwork 1973)
    - Validation of plate tectonics in 1960 / 1970s
    - Great stability of taxa (no dispersal / colonization)
      - Species persist for millions of years
    - High diversification (endemism) on islands
- Robust molecular phylogenies that provide rough but reasonable estimates of lineage divergence times shed light on these questions (Emerson 2002, Heaney 2007)

# Ameronothroid phylogeny



108 taxa  
 763 bp  
 H3: 269 bp  
 COI: 494 bp

● 0.9 BI  
 80% Pars





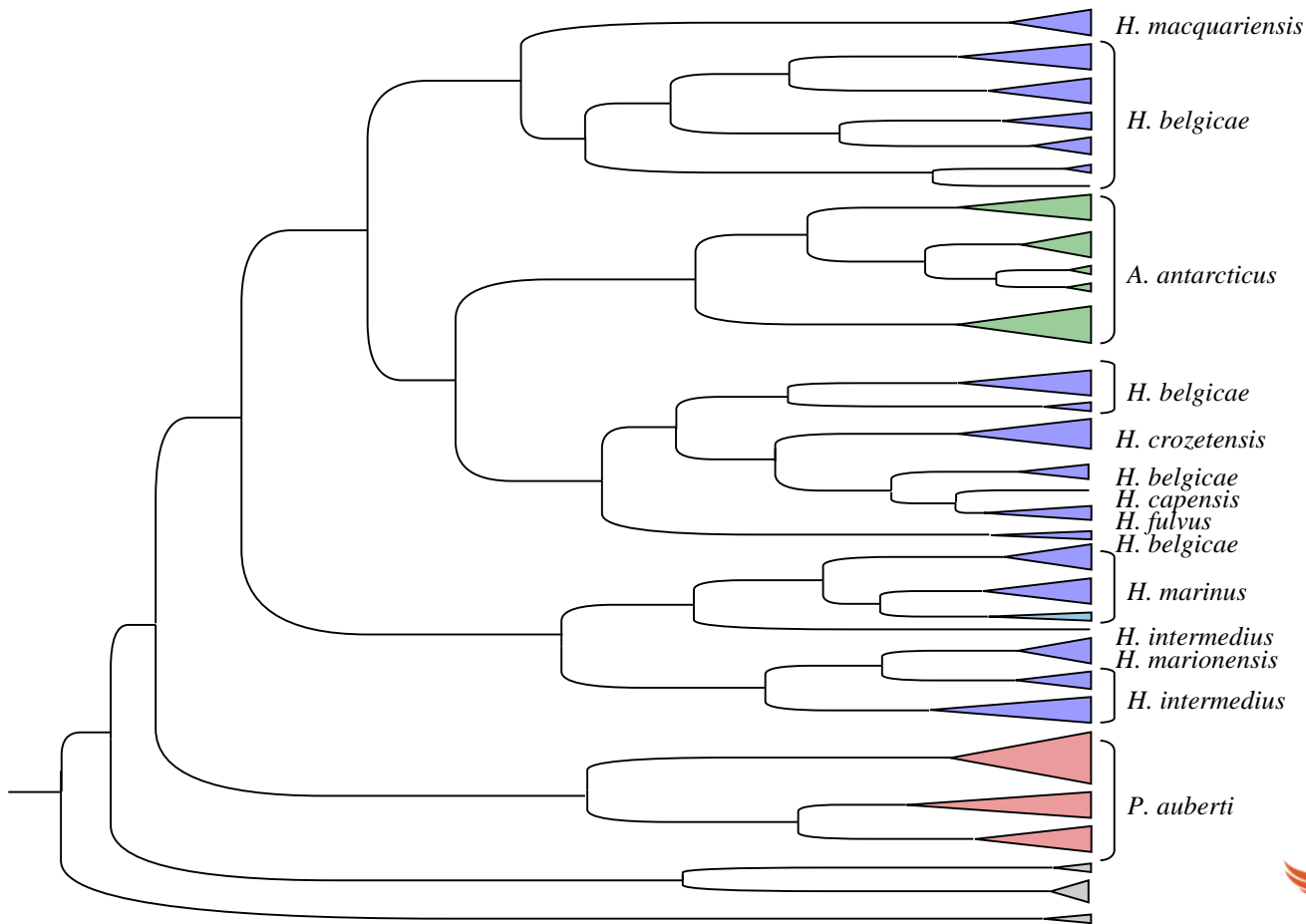


# Ameronothroid phylogeny

*Halozetes*

*Alaskozetes*

*Podacarus*



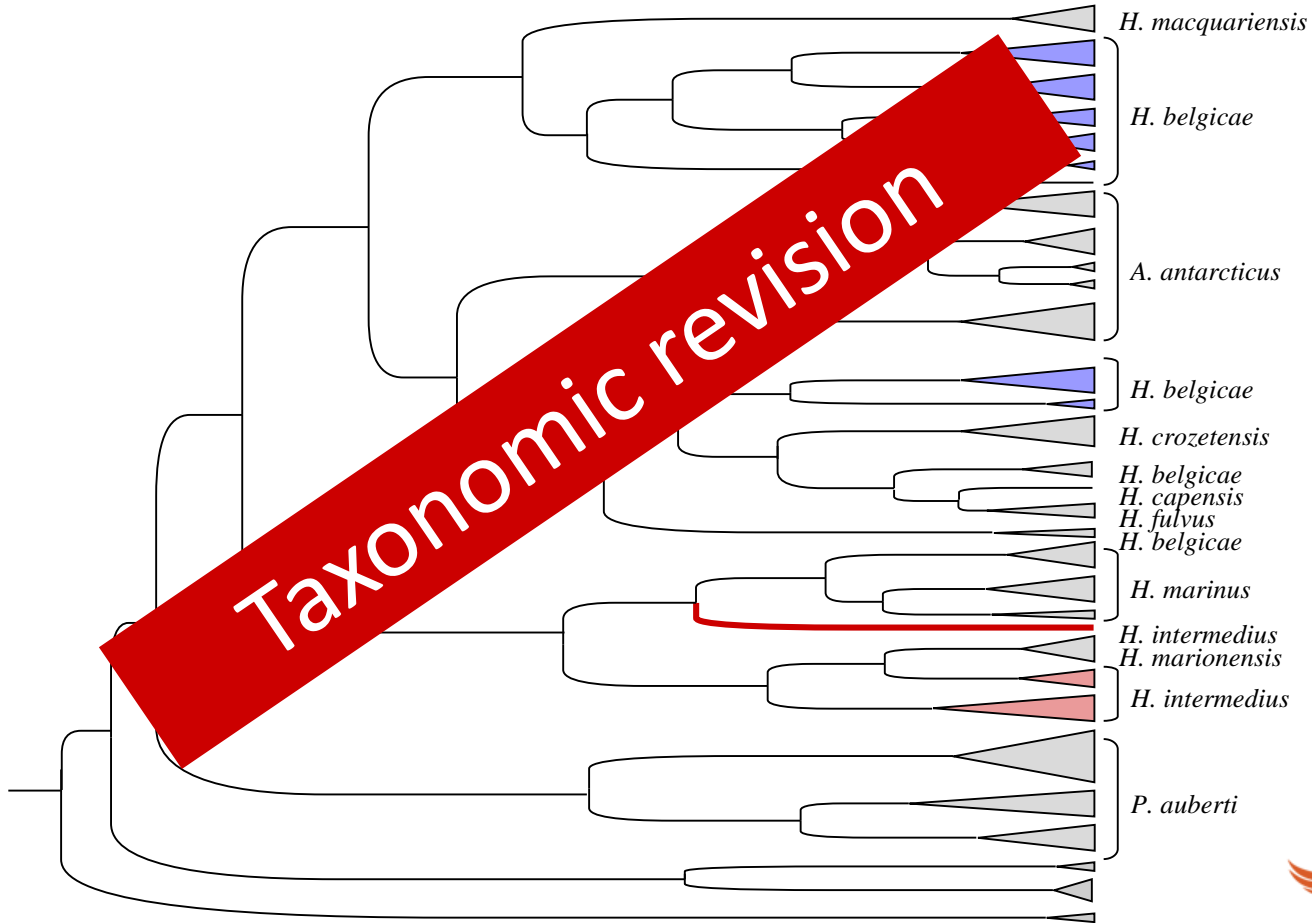
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# Ameronothroid phylogeny

*H. belgicae*

*H. intermedius*

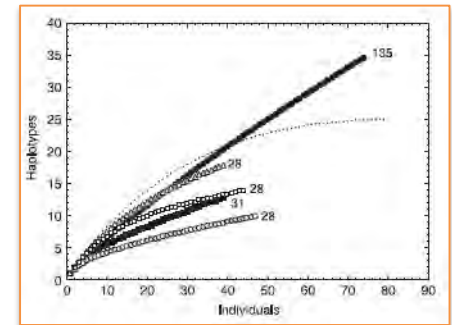


# Genetic patterns at the island scale

- Congruent findings across several taxa for Marion Island

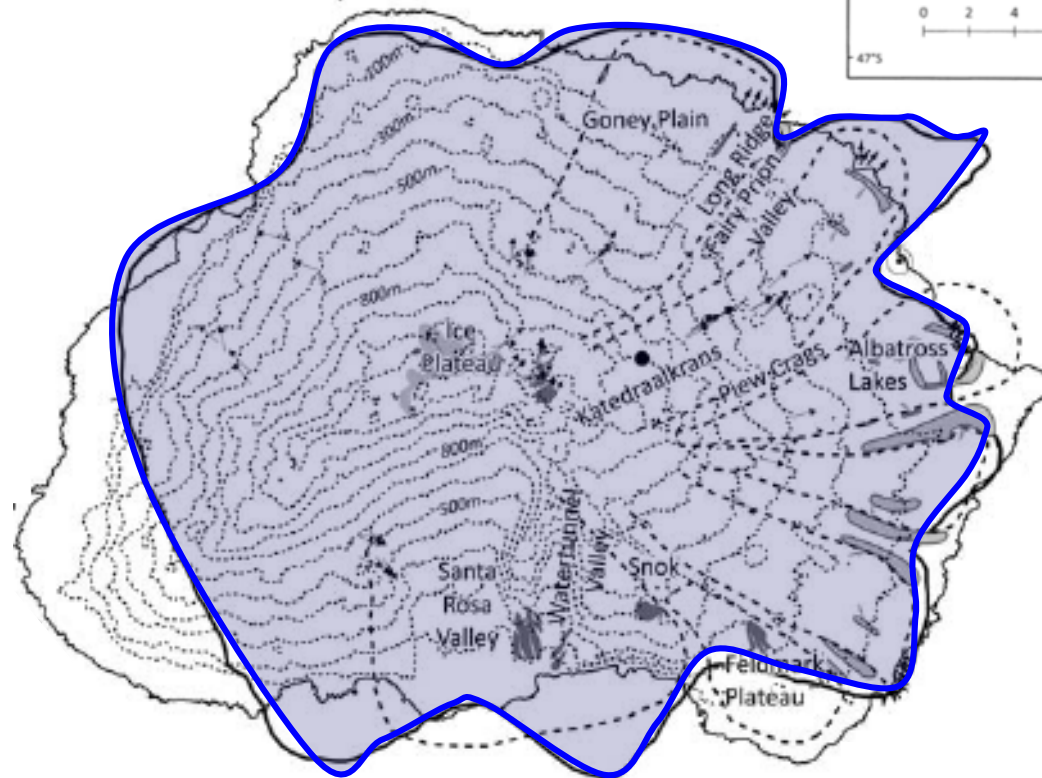
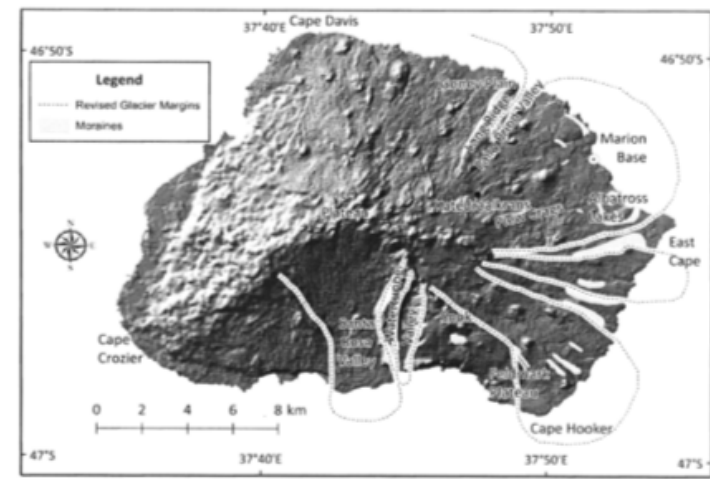
- Very complex

- High genetic diversity
- Driven by the **heterogeneous landscape**
  - Volcanism (McDougall et al 2001, Boelhouers et al 2008)
  - Geological lineaments (Mortimer et al 2011)
- Driven by **variable climatic conditions**
  - Glacial refugia (McDougall et al 2001, Boelhouers et al 2008, Hall et al 2011)
  - Across the islands (Nyakatya & McGeoch 2008)





# Glaciation

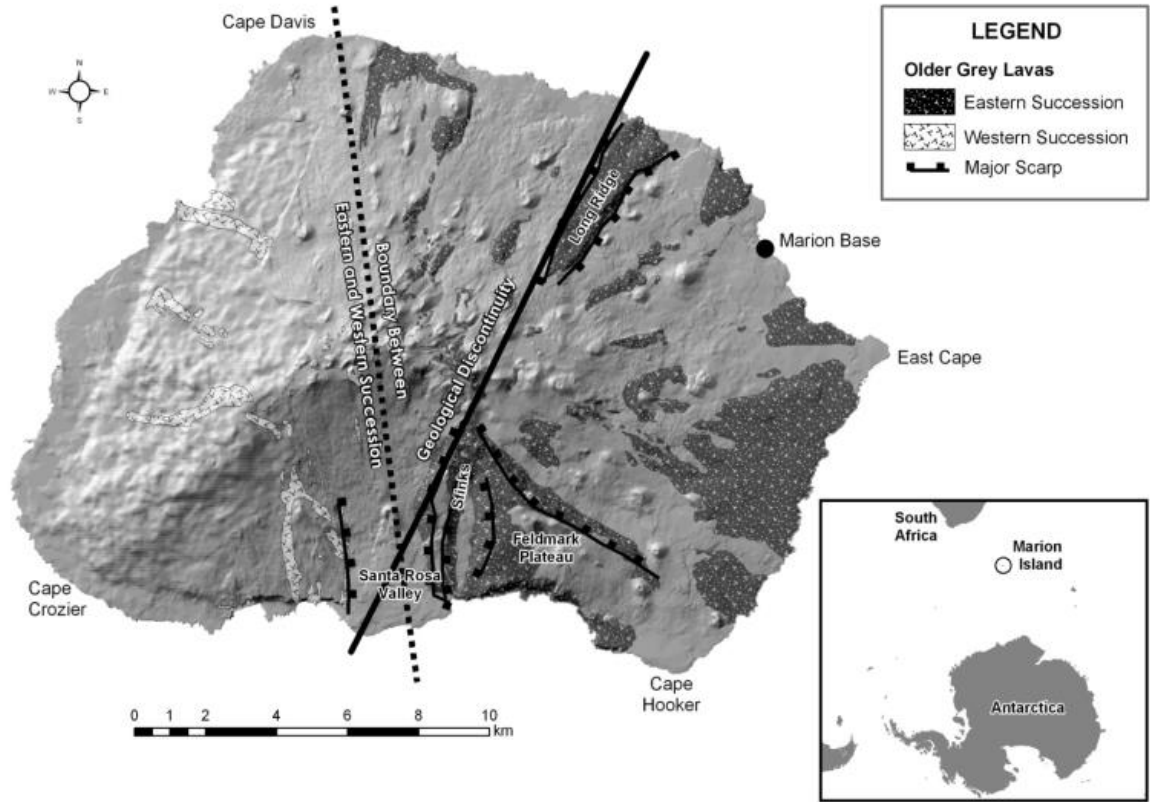


Boelhouwers et al (2008) The Prince Edward Islands pp 65-96

Hall et al. Ant. Sci. (2011) 23, 155-163

# Geology

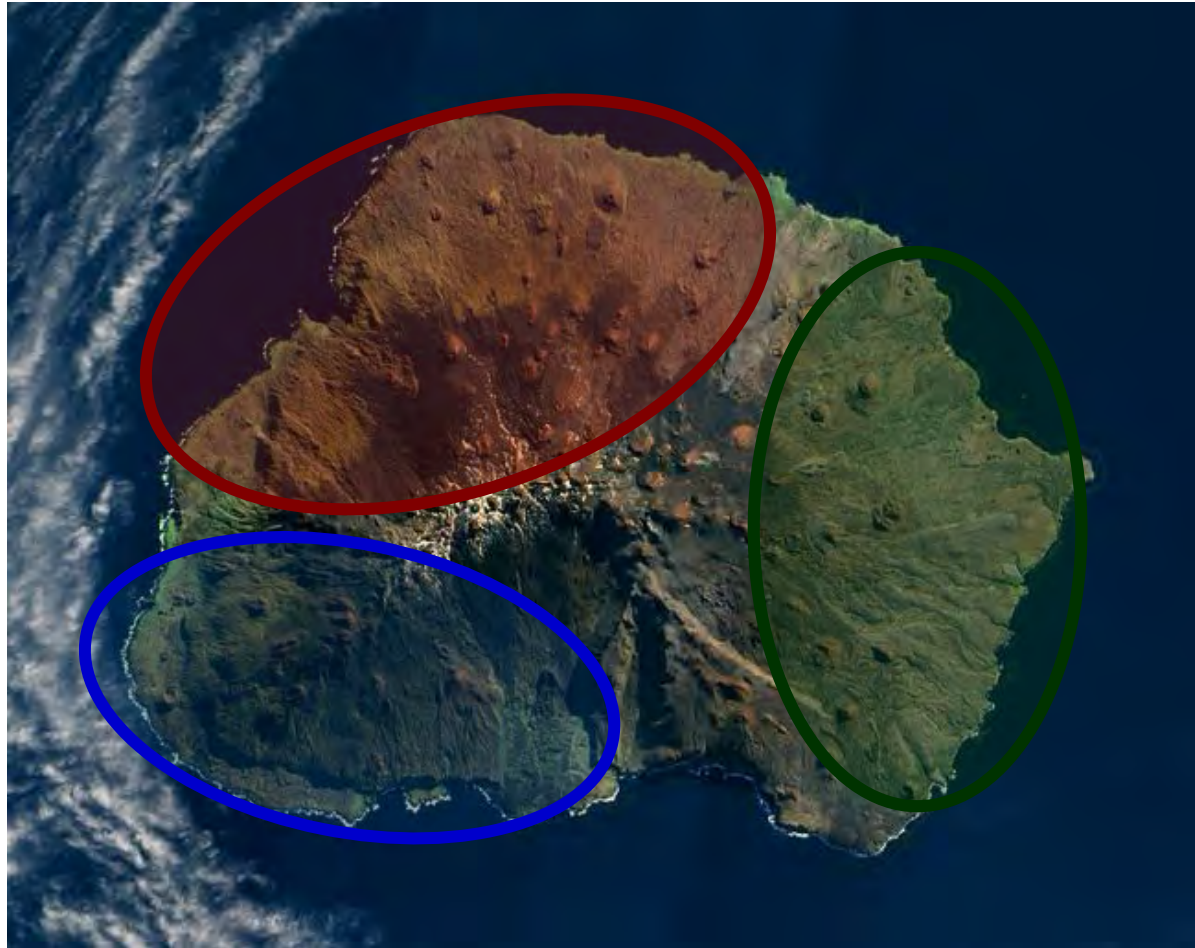
Lineament orientated along N26.5°E



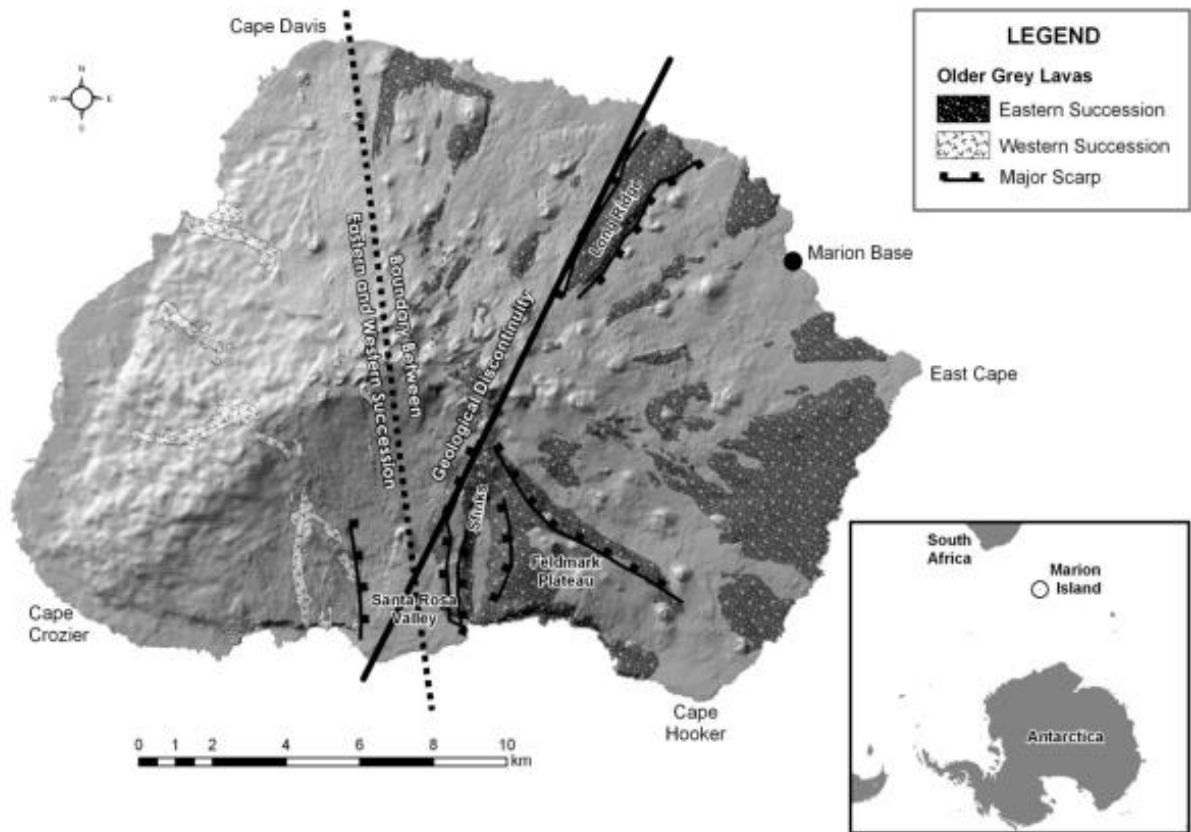


# *Pringleophaga marioni*

*Groenewald et al. unpublished*

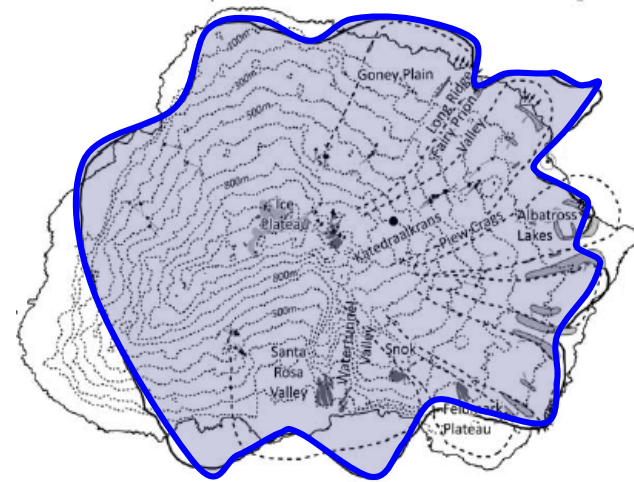
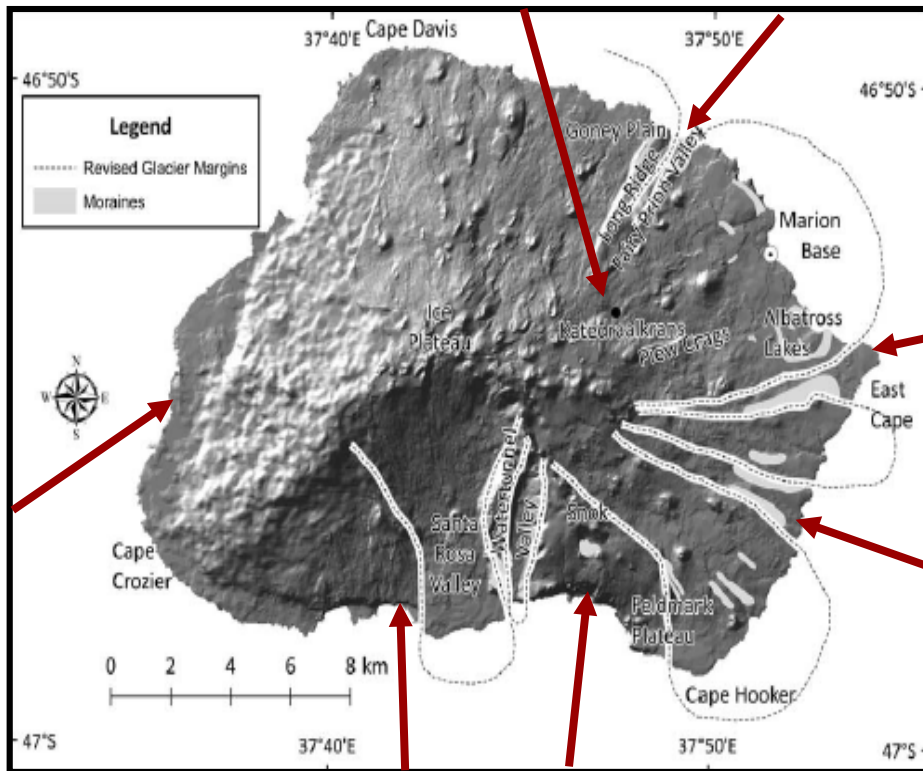
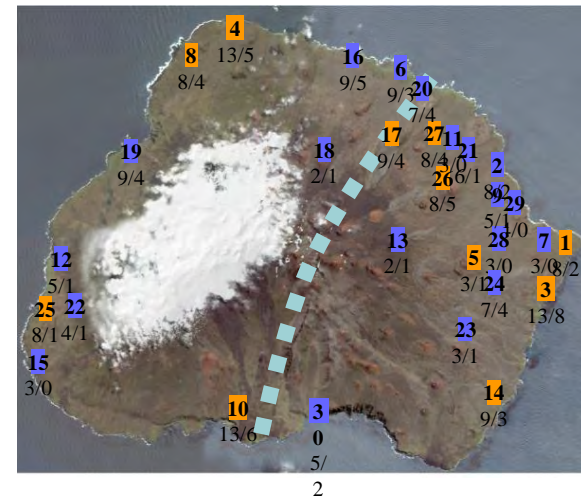


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# *Halozetes fulvus*

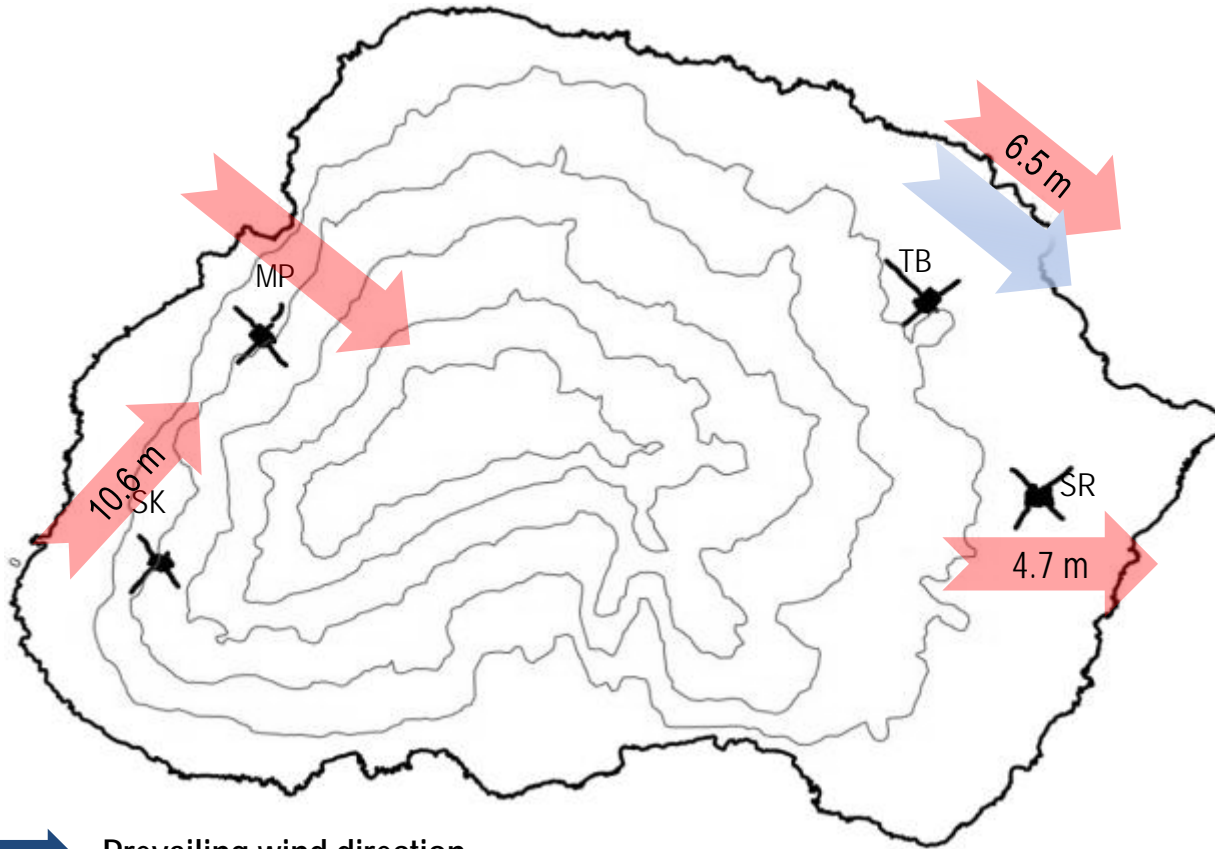
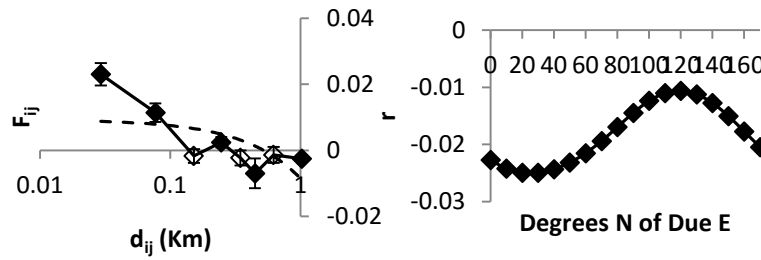




# Fine-scale information

- Genetic data can provide information regarding
  - Migration patterns (gene flow)
  - Inbreeding
  - Genetic health
- Inform us about the biology of the species

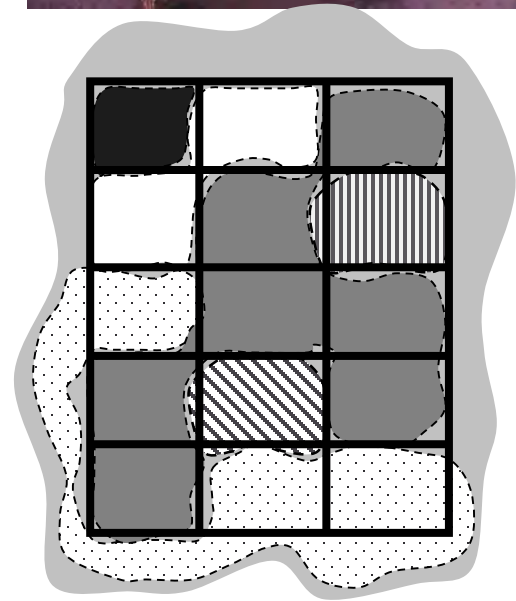
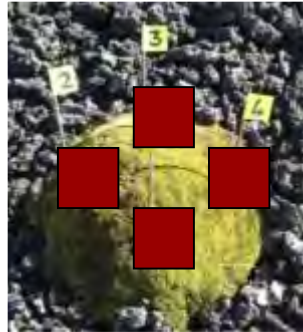
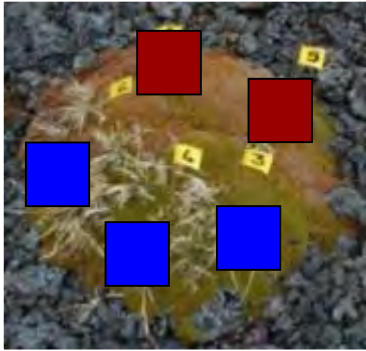




- ➡ Prevailing wind direction
- ➡ Dispersal distance and direction inferred from the spatial genetic structure



# Biology of species



Mortimer et al. *Ant. Sci.* (2008) 4, 381-390  
Cerfonteyn et al. *Am. J. Bot.* (2011) 98, 909-914



# Way forward

- Large, multi-disciplinary studies
- Clearly defined questions
  - Implications of work for management
  - Implementation of key findings and suggestions
- Focus across spatial scales
- Focus across time scales

