Do anisotropic processes influence fine-scale spatial genetic structure of a keystone sub-Antarctic plant species?

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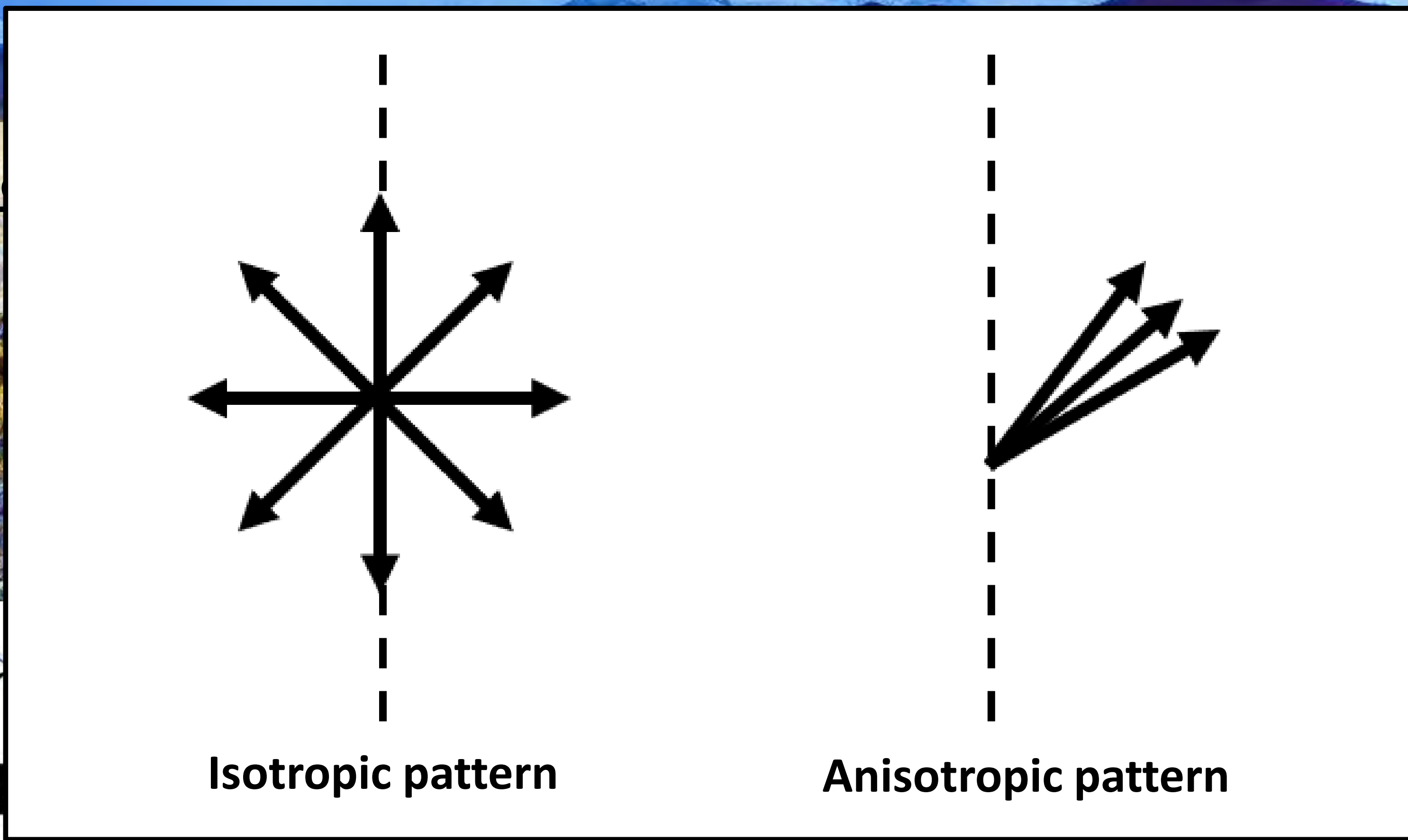
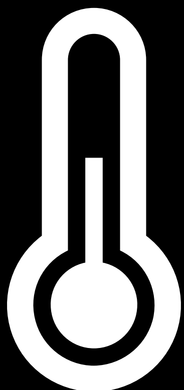
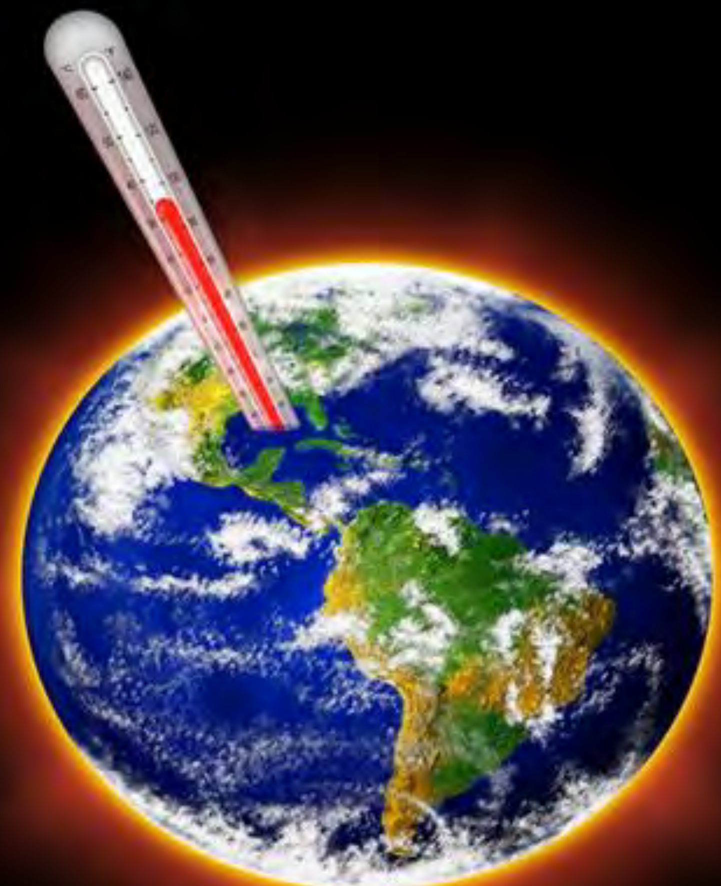
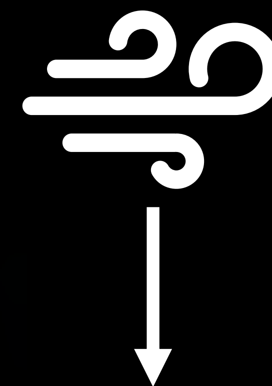


INTRODUCTION

Climate change







- Dispersal
- Gene flow

(Parmesan, 2006; Nathan et al., 2011; Born et al., 2012; Ma et al., 2017; Zhang et al., 2018; Chau et al., 2019; Momberg et al., 2020; Habibullah et al., 2022)

INTRODUCTION

Climate change

Image: https://www.scientificamerican.com/article/gone-with-the-wind-

Spatial Genetic Structure (SGS)

- Dispersal
- Gene flow

(Friedman & Barrett, 2009; Nathan et al., 2011; Chau et al., 2019)

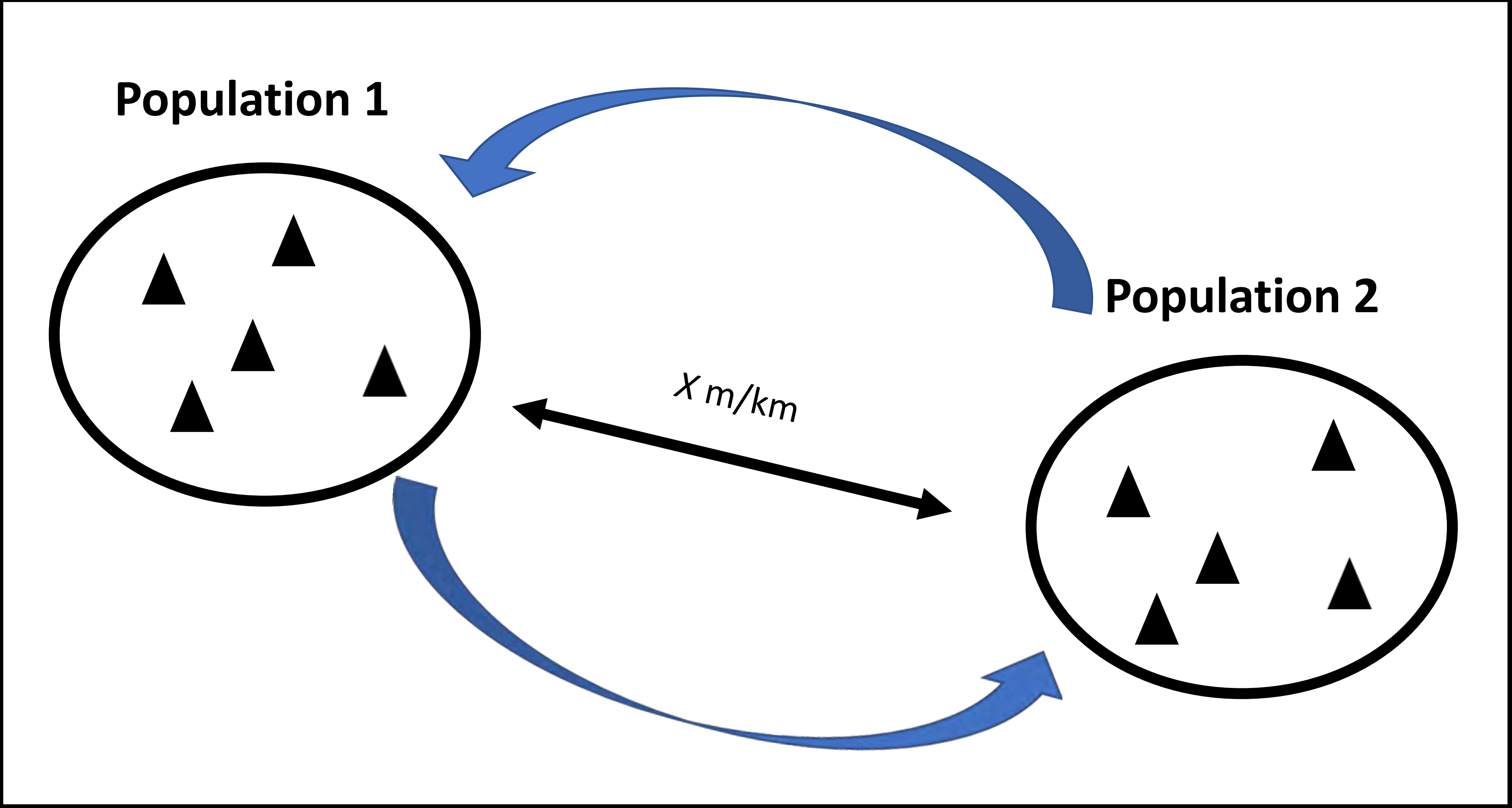
Spatial Genetic Structure (SGS)

Non-random spatial distribution of genotypes

- Genetic dissimilarity = Genetic structure
- Movement = low SGS
- Isolation = high SGS

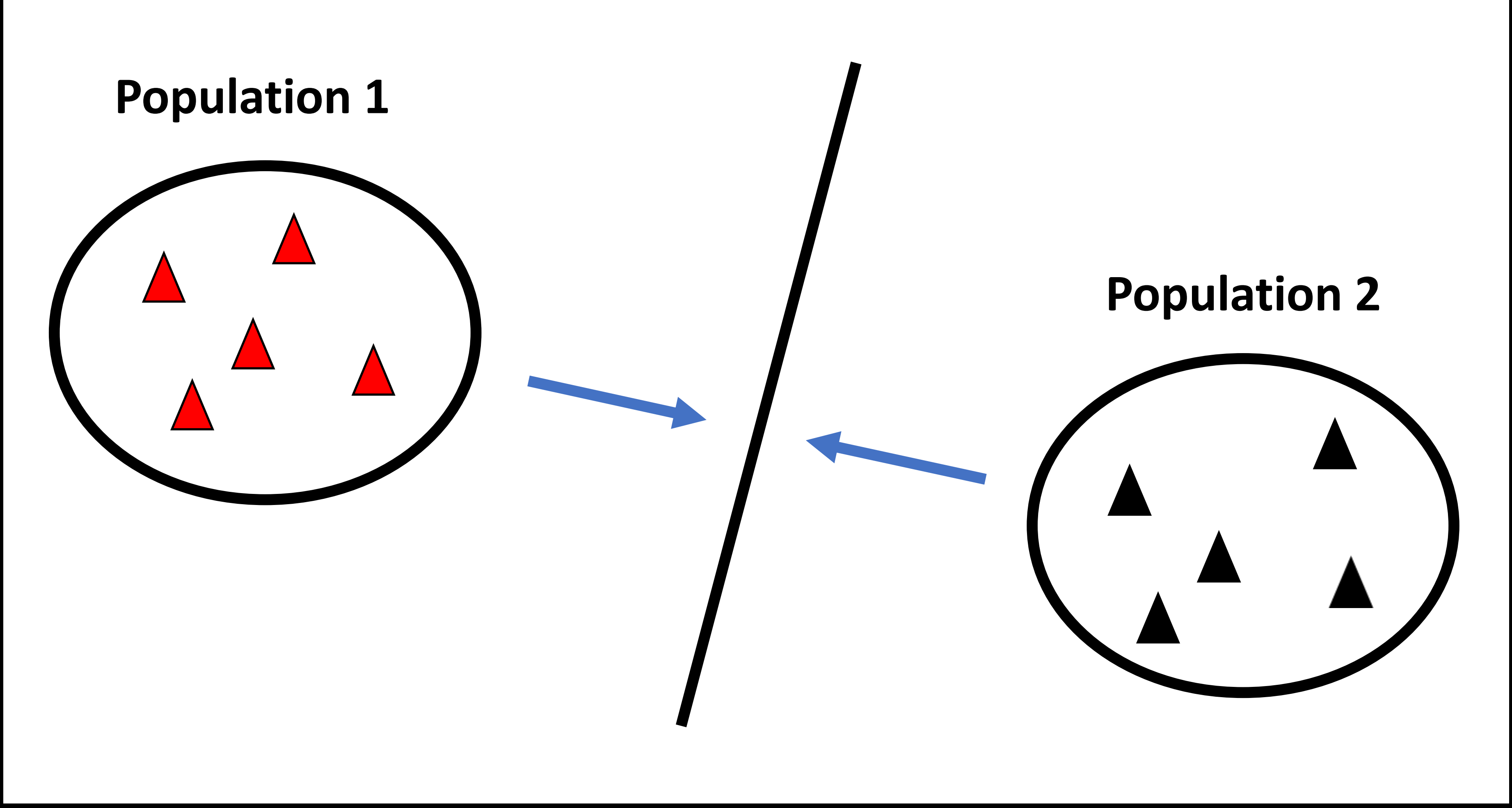
INTRODUCTION

Spatial Genetic Structure (SGS)



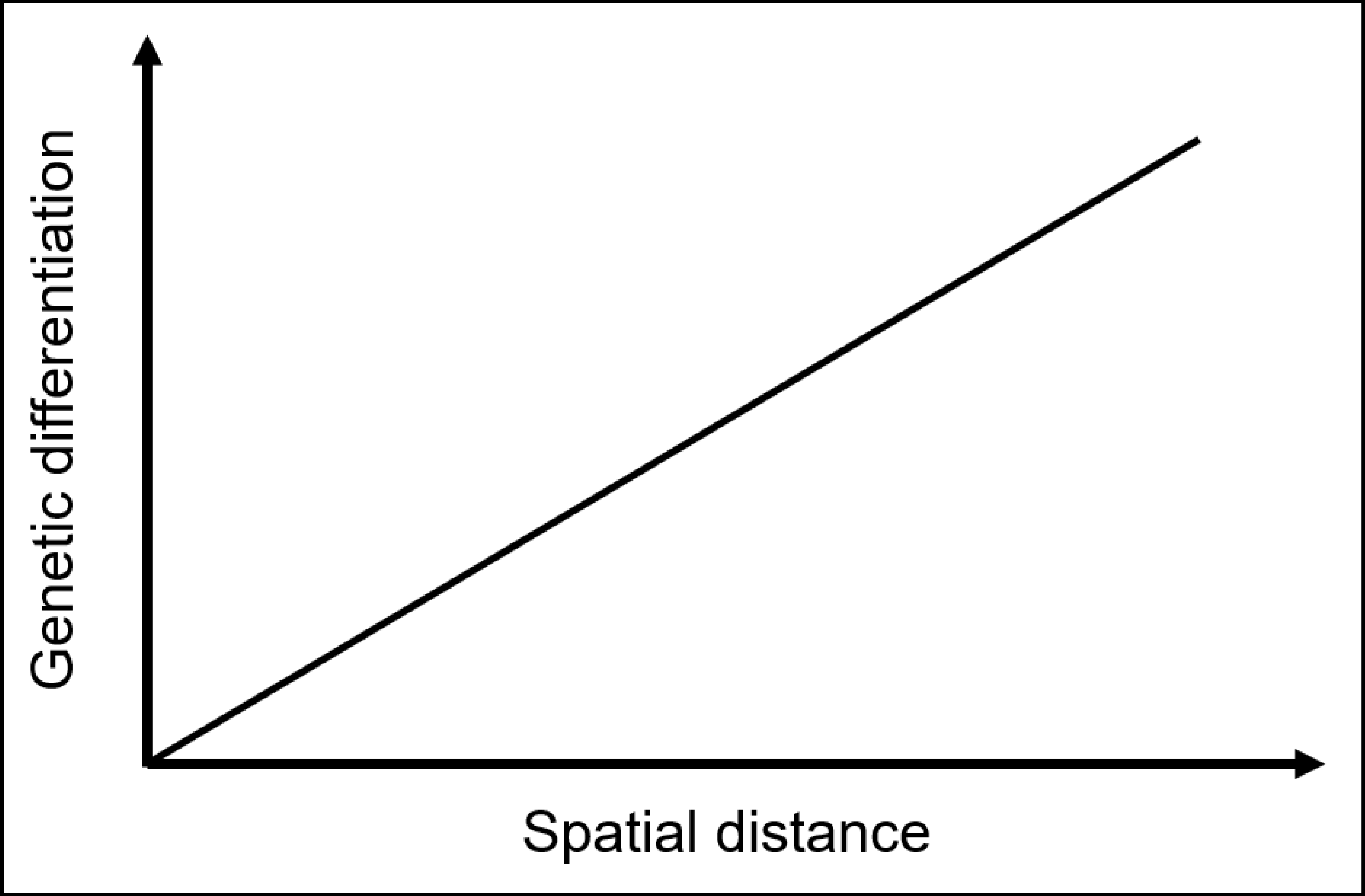
INTRODUCTION

Spatial Genetic Structure (SGS)



(Nathan & Muller-Landau, 2000; Volis et al., 2016).

Isolation by distance (IBD)



(Wright, 1943; Vekemans & Hardy 2004; Born et al., 2012; He et al., 2013; Rhodes et al., 2014; Geremew et al., 2018)

INTRODUCTION

Anisotropic processes

MOLECULAR ECOLOGY

Plant dispersal in the sub-Antarctic inferred from anisotropic genetic structure

CÉLINE BORN, PETER C. Le ROUX, COLIN S

AoB PLANTS

An open-access journal for environmental and evolutionary plant biology

Research Article

Isotropic and anisotropic processes influence fine-scale spatial genetic structure of a keystone tropical plant

Addisie Geremew[1*], Melkamu G. Woldemariam[2], Alemayehu Kefalew[3], Iris Stiers[1] and Ludwig Triest[1]

MOLECU

ORIGINAL ARTICLE

The influence of landscape, climate and history on spatial genetic patterns in keystone plants (*Azorella*) on sub-Antarctic islands

John H. Chau, Céline Born, Melodie A. McGeoch, Dana Bergstrom, Justine Shaw, Aleks Terauds, Mario Mairal, Johannes J. Le Roux, Bettine Jansen van Vuuren

BROAD STUDY AIM

Does wind directionality influence the fine-scale spatial genetic structure of a keystone sub-Antarctic plant species?

STUDY SITE

Marion Island

STUDY SITE

Marion Island: Climate Change

- Changes in wind flow patterns
- Warming by 1.2°C
- 20% decline in rainfall

(Smith, 2002; le Roux & McGeoch, 2008a; le Roux & McGeoch, 2008b)

STUDY SPECIES

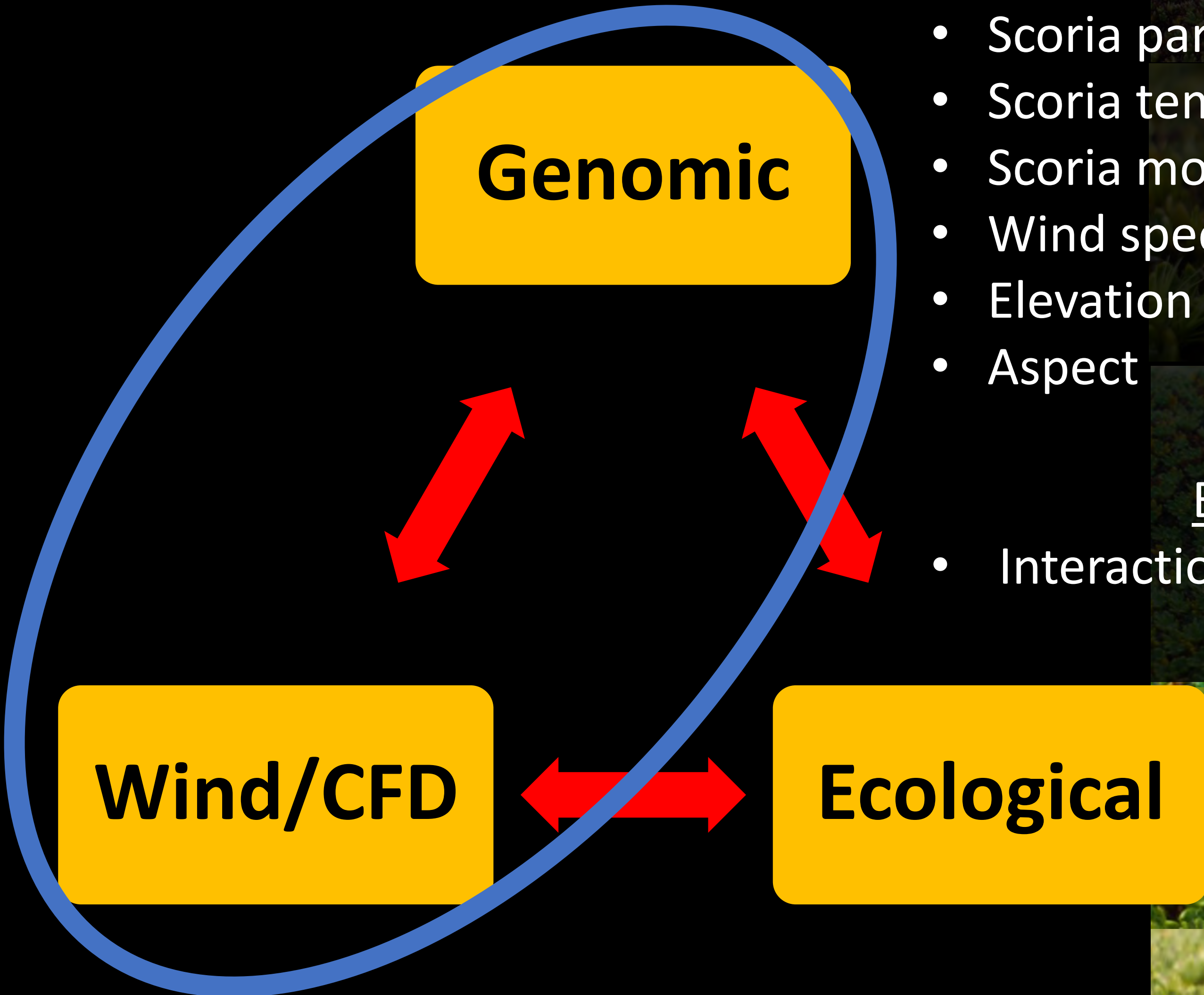
Azorella selago (Apiaceae)

STUDY SITE

Junior’s Kop

METHODS

Datasets



Abiotic

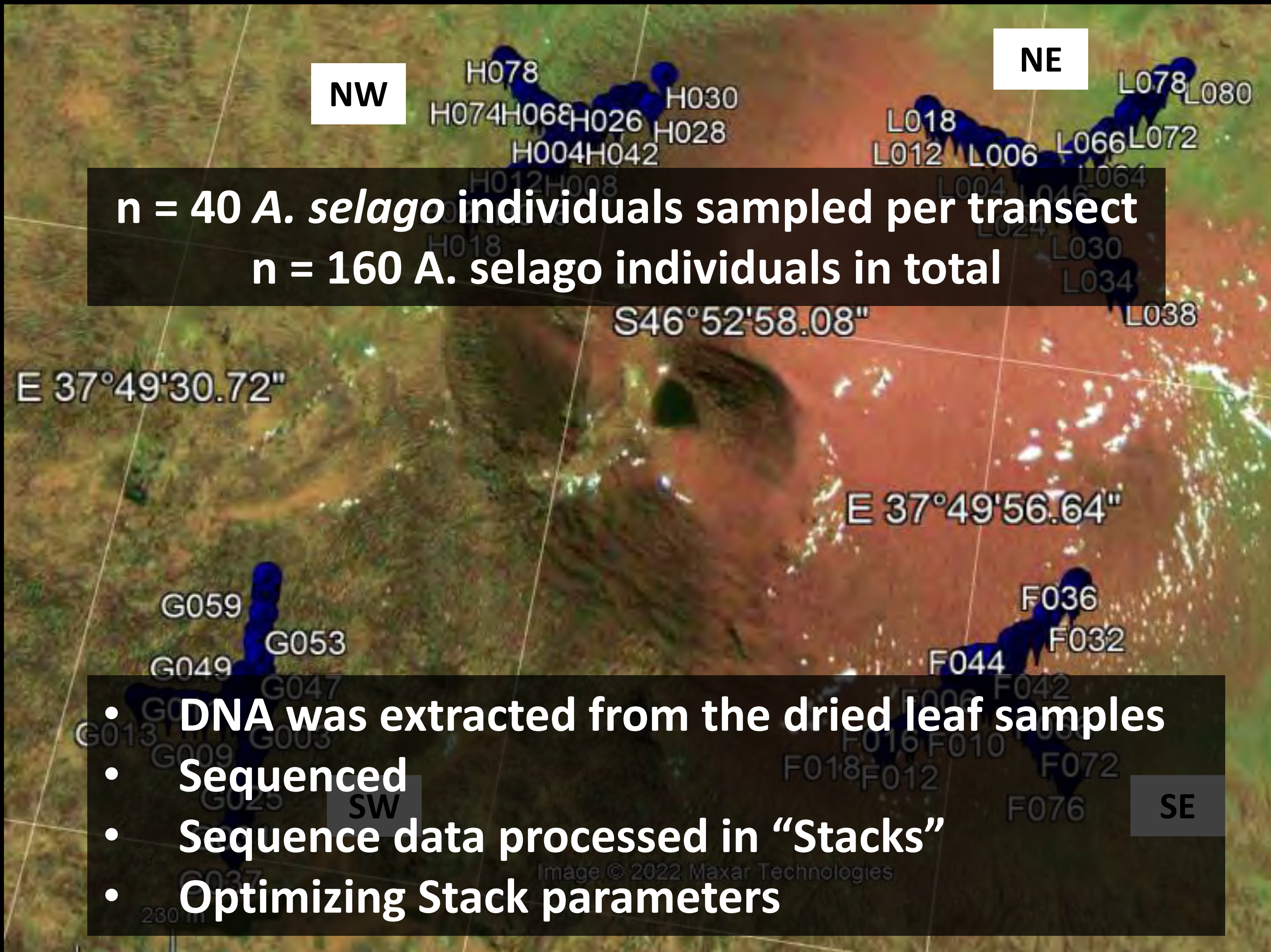
- Scoria moisture content
- Scoria depth
- Scoria particle size
- Scoria temperature
- Scoria movement rates
- Wind speed
- Elevation
- Aspect

Biotic

- Interaction with *A. selago*

METHODS

Genomic data



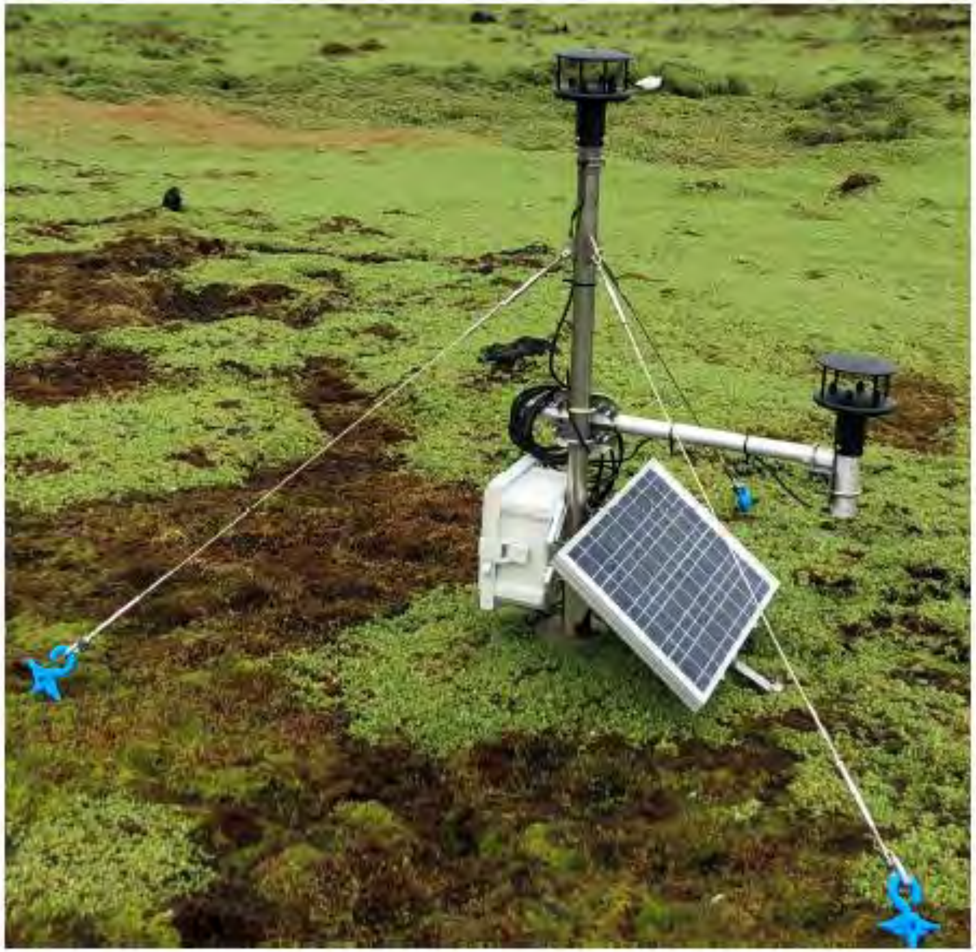
n = 40 *A. selago* individuals sampled per transect
n = 160 A. selago individuals in total

- DNA was extracted from the dried leaf samples
- Sequenced
- Sequence data processed in “Stacks”
- Optimizing Stack parameters

METHODS

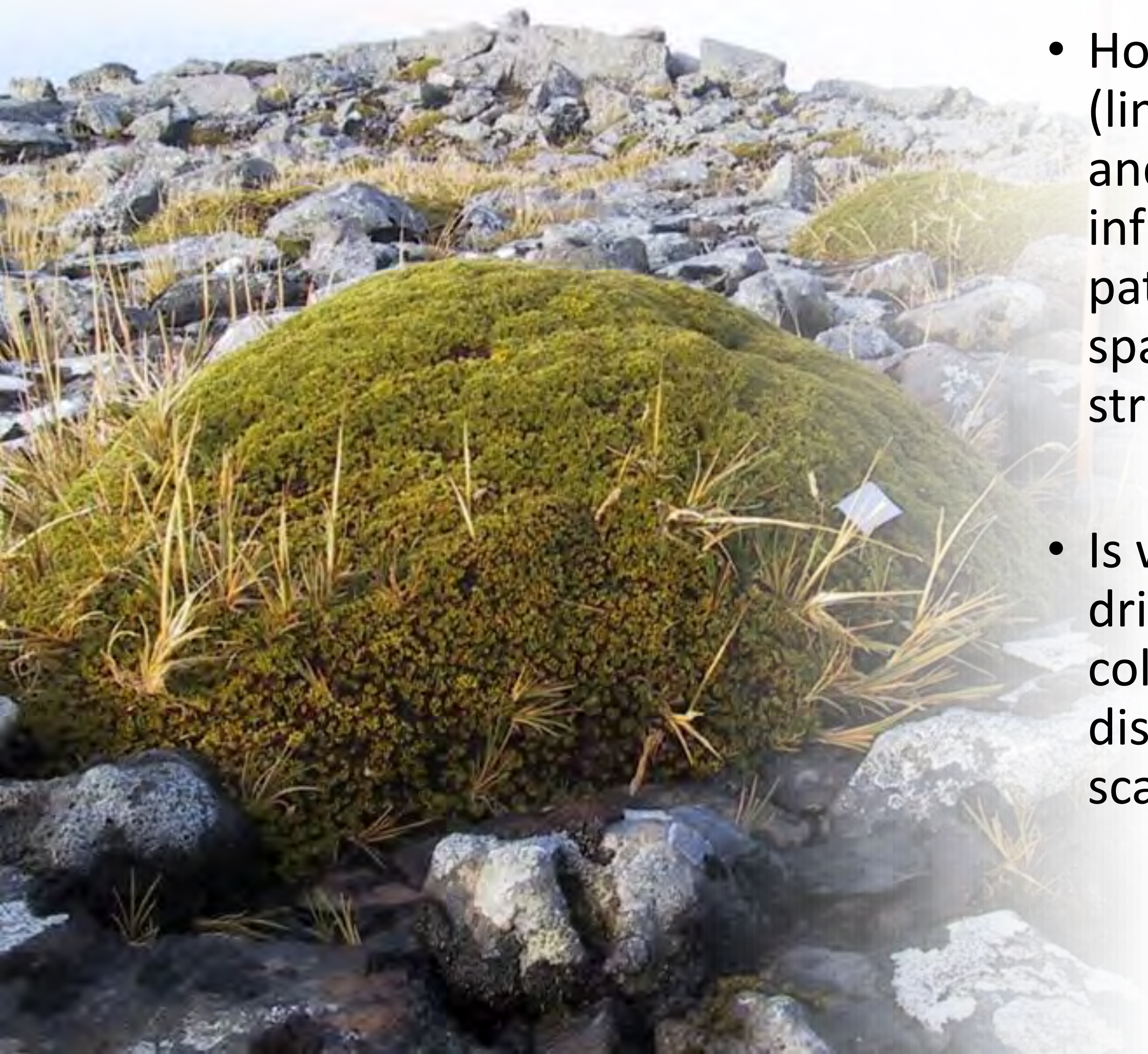
Wind data

(Goddard et al., 2022; Ecological Modelling)



- Sonic anemometers
- Mean wind speed and direction logged at 10-minute intervals
- High-resolution map of wind speed, direction, and turbulence using CFD
- Simulated wind conditions around Junior's Kop were extracted from the CFD dataset

KEY QUESTIONS



- How does dispersal (linked to wind speed and direction) influence colonization patterns and the spatial genetic structure of *A. selago*?
- Is wind flow the main driver of *A. selago* colonization and dispersal at a local scale?

SGS and Anisotropy analyses

Strength of SGS:

- Average kinship coefficient (F_{ij}) ~ pairwise spatial distances (d_{ij}) between individuals per site

Bearing analyses:

- Directional spatial autocorrelations
- Estimate the strongest correlation between a genetic data matrix and a spatial distance matrix for a set of wind directions

(Loiselle et al., 1995; Rosenberg, 2000)

EXPECTATIONS & CONCLUSION

SGS and Anisotropy

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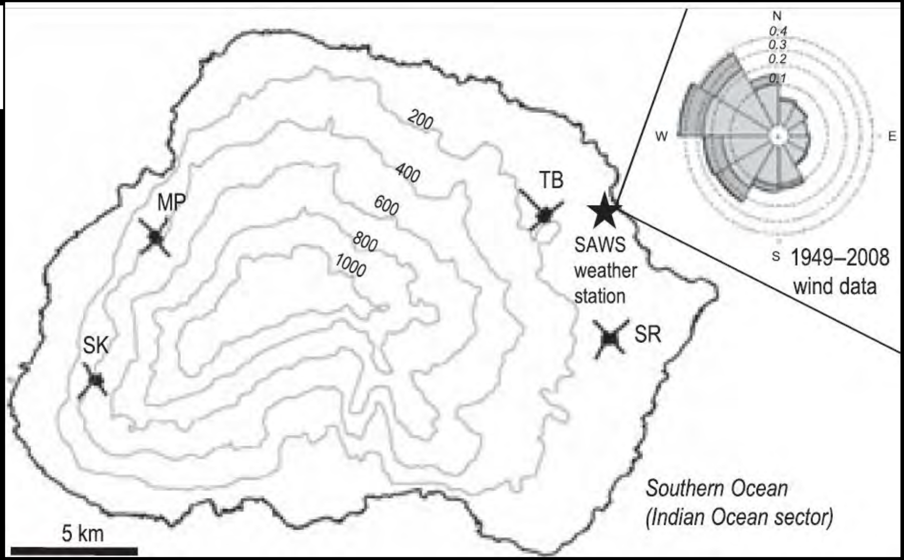
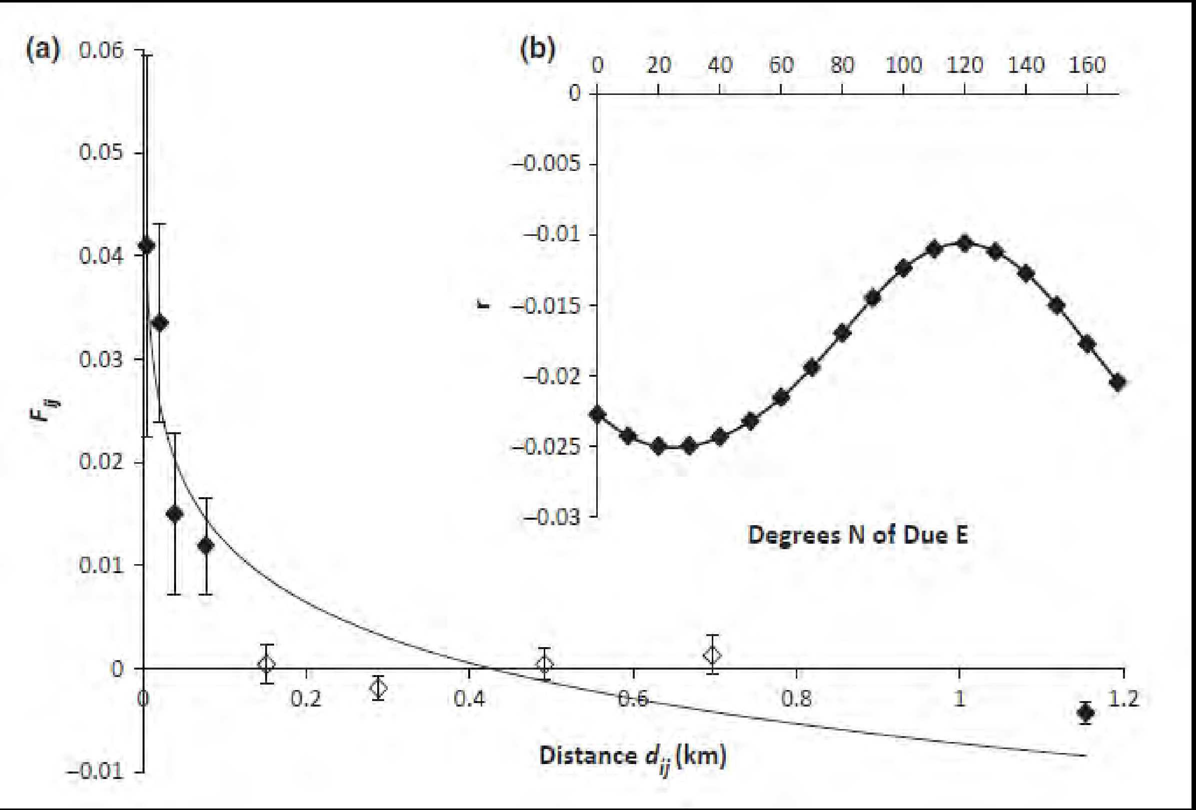


Born et al., 2012 – Molecular Ecology



- SGS variable: suggesting variability in dispersal distance and wind velocities between sites
- Relatedness breaks down at 10m
- Dispersal is strongly directional, but varied between sites depending on the local prevailing winds

EXPECTATIONS & CONCLUSION

SGS and Anisotropy

Antarctic Science 20 (4), 381–390 (2008) © Antarctic Science Ltd 2008 Printed in the UK doi:10.1017/S0954102008001004

Growth form and population genetic structure of *Azorella selago* on sub-Antarctic Marion Island

ELIZABETH MORTIMER[1], MELODIE A. MCGEOCH[2,3], SAVEL R. DANIELS[1,3] and BETTINE JANSEN VAN VUUREN[1,3*]

- Preliminary assessment of genetic diversity at island-scale suggested no significant spatial structure in *A. selago*

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