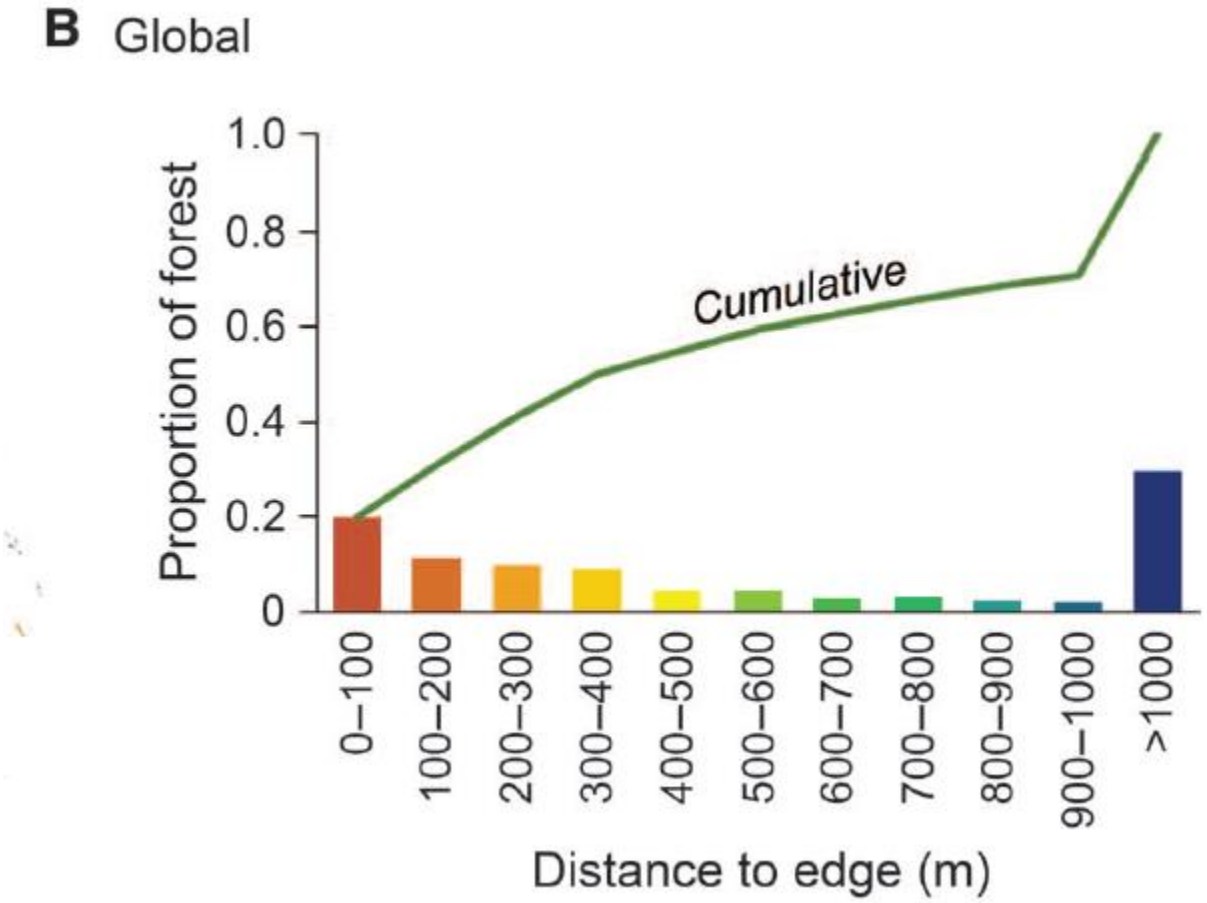
Sex and sociality in a disconnected world

BIOL3110

Habitat fragmentation

70% of Forests within 1km of forest edge

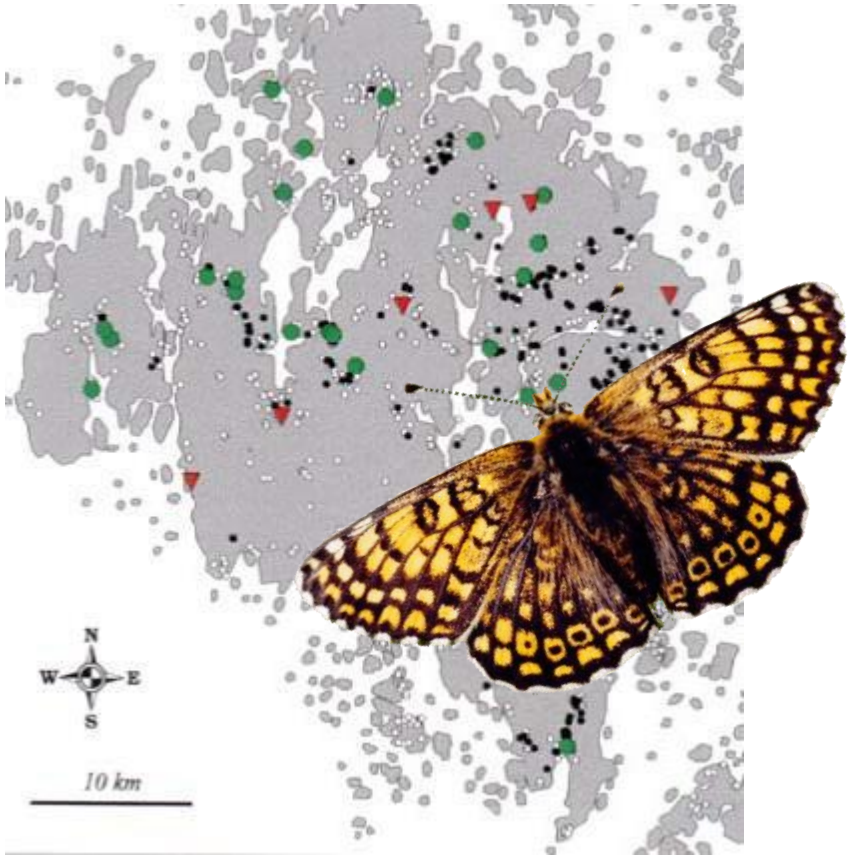


Haddad et al. 2015 Science

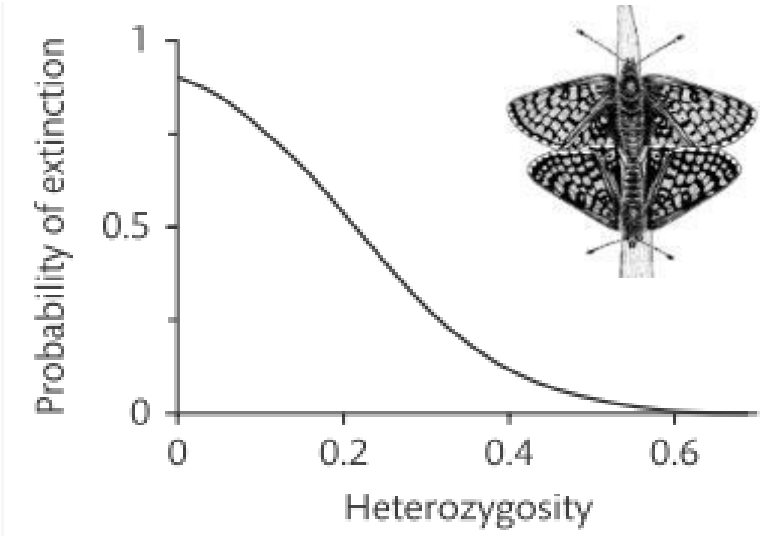
Loss of genetic variation

Glanville fritillary butterfly

Saccheri *et al*. 1998 *Nature*

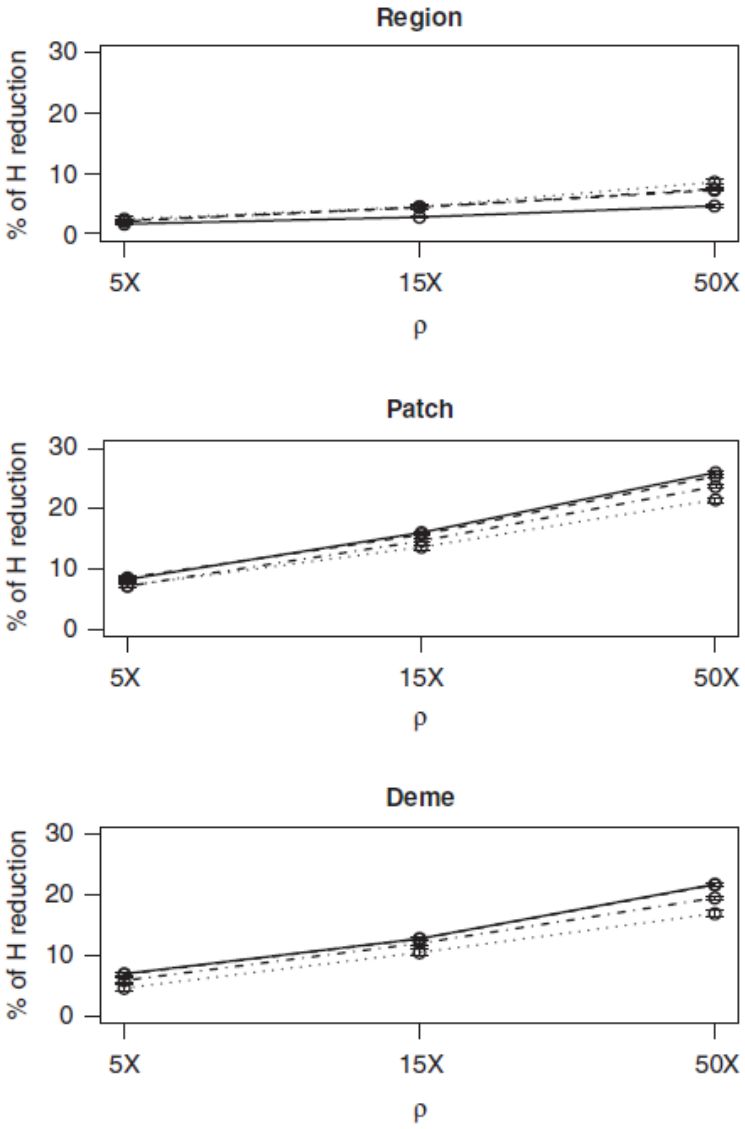


Simple genetic diversity was the best predictor of local extinction



Frankham *et al.* (2017)

Impacts at a range of scales

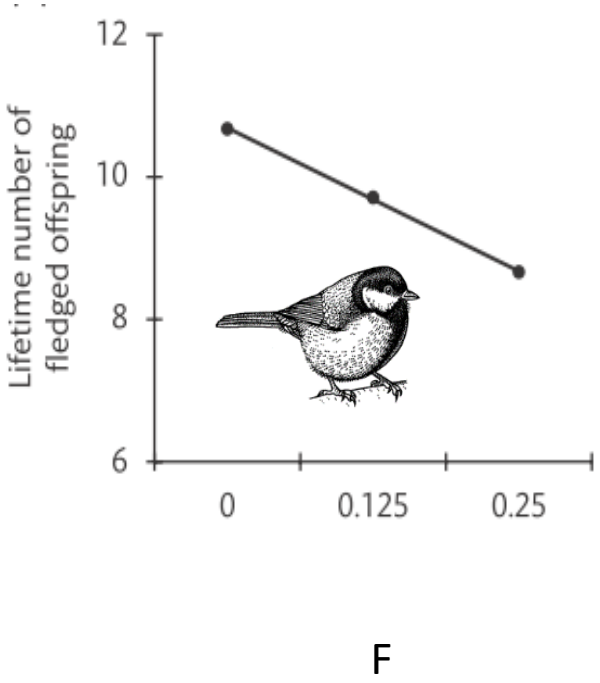


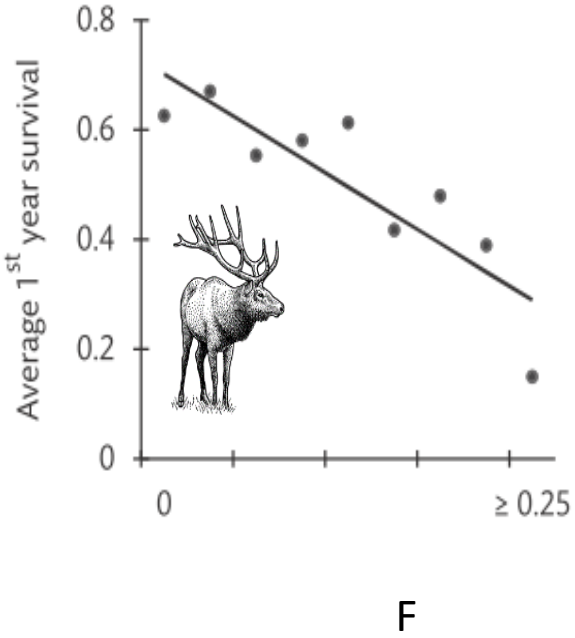
Level of fragmentation

Mona et al. 2014 Heredity

Simulation study

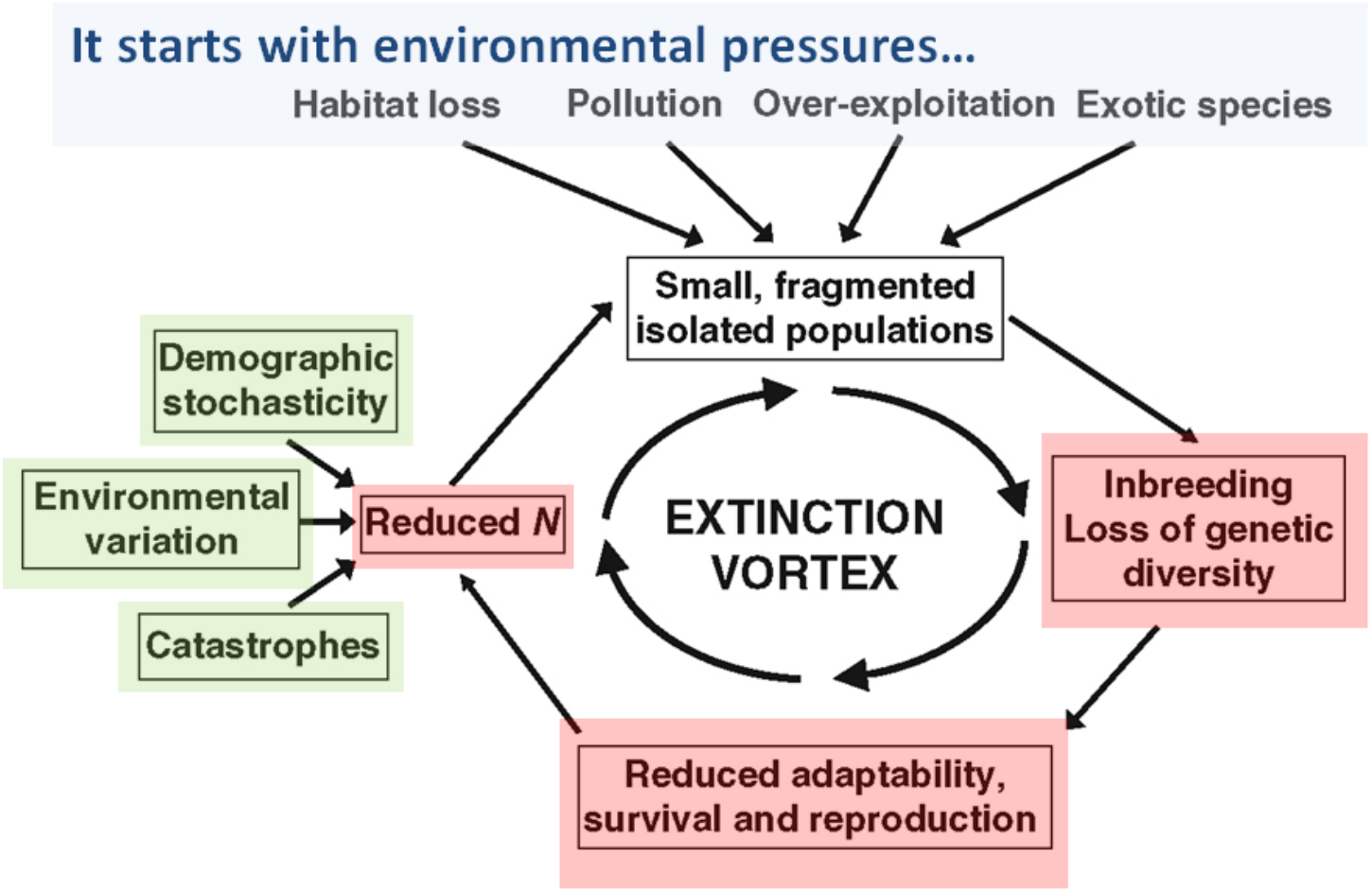
Inbreeding depression seen in virtually all species that usually outbreed



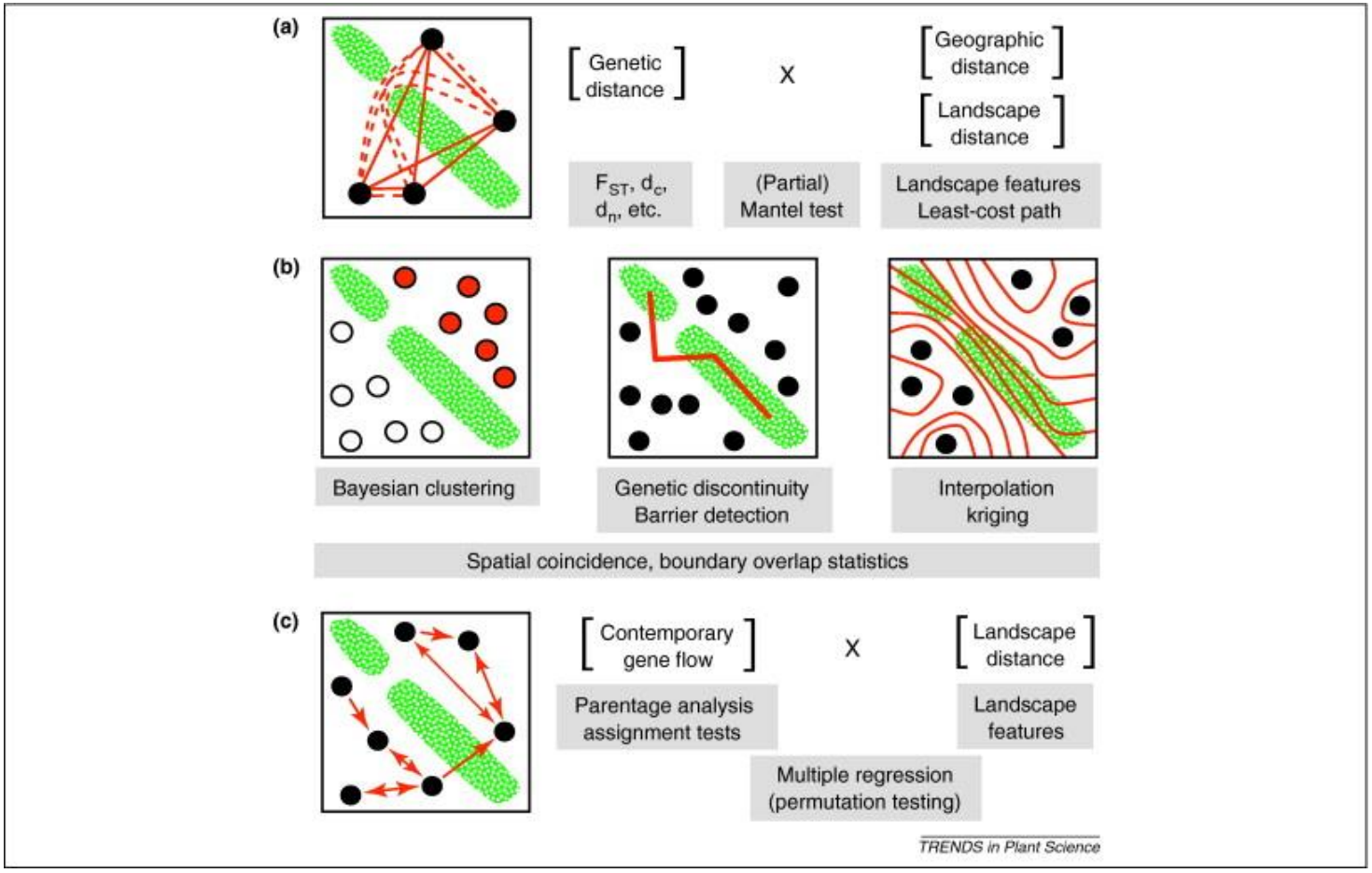


Frankham *et al.* (2017)

Maintaining dispersal and gene flow (demographic and genetic connectivity)

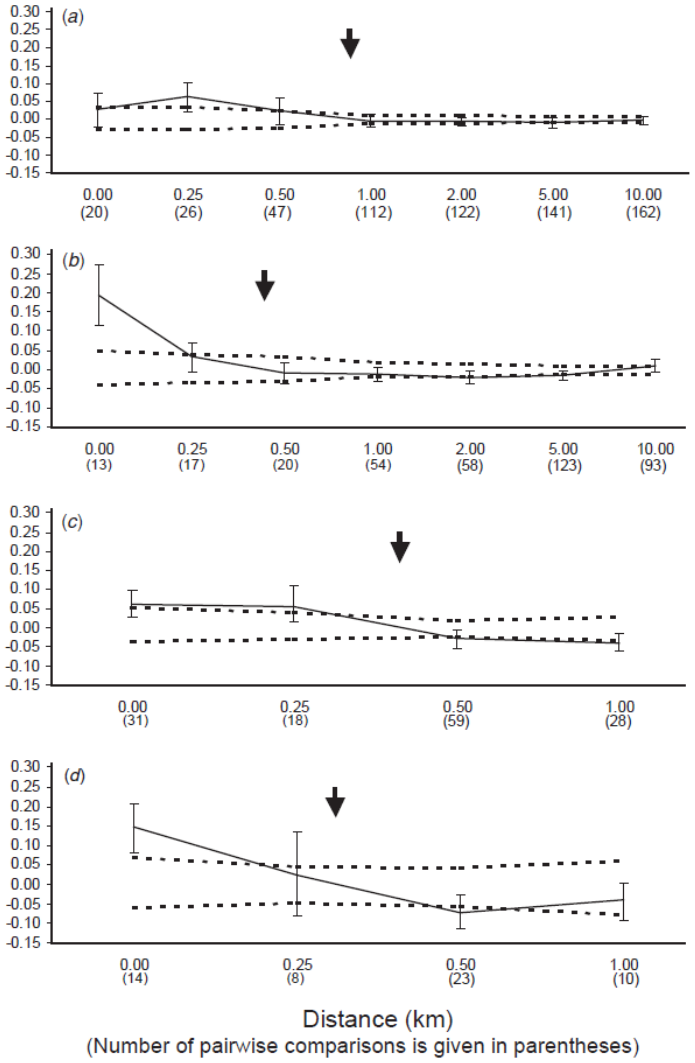


Landscape genetics to evaluate the influence of environmental variables on gene flow/dispersal



Holderegger et al. 2014, Trends in Plant Science

Better at detecting genetic differences that have accumulated recently



Male

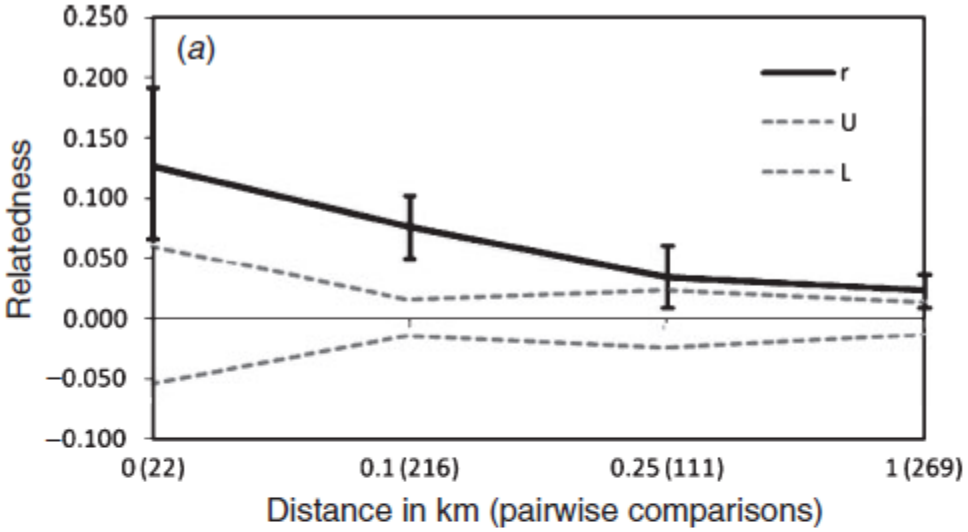
Female

Male

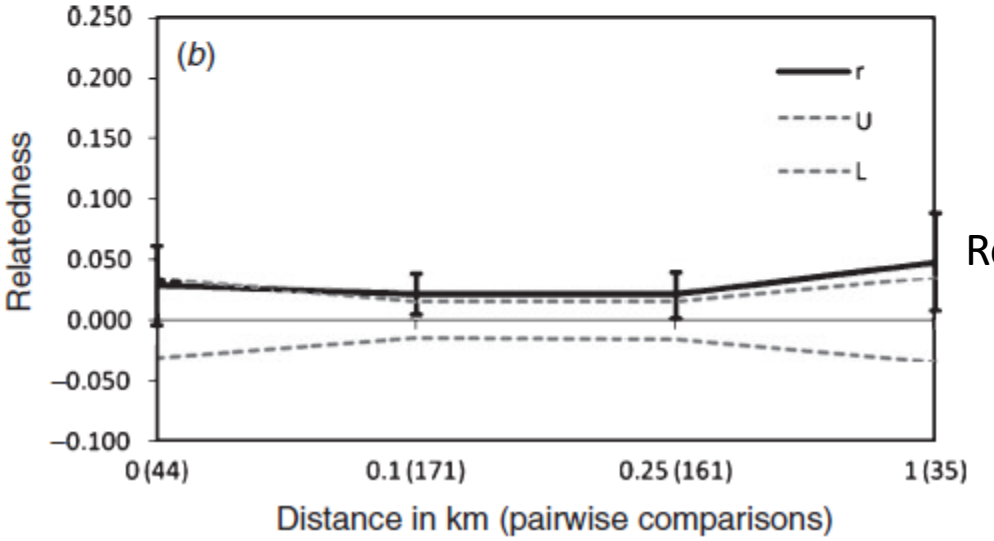
Female

- Behavioural inferences
- Altered dispersal from recent human impacts

Stow et al. 2006 WRes



Logged



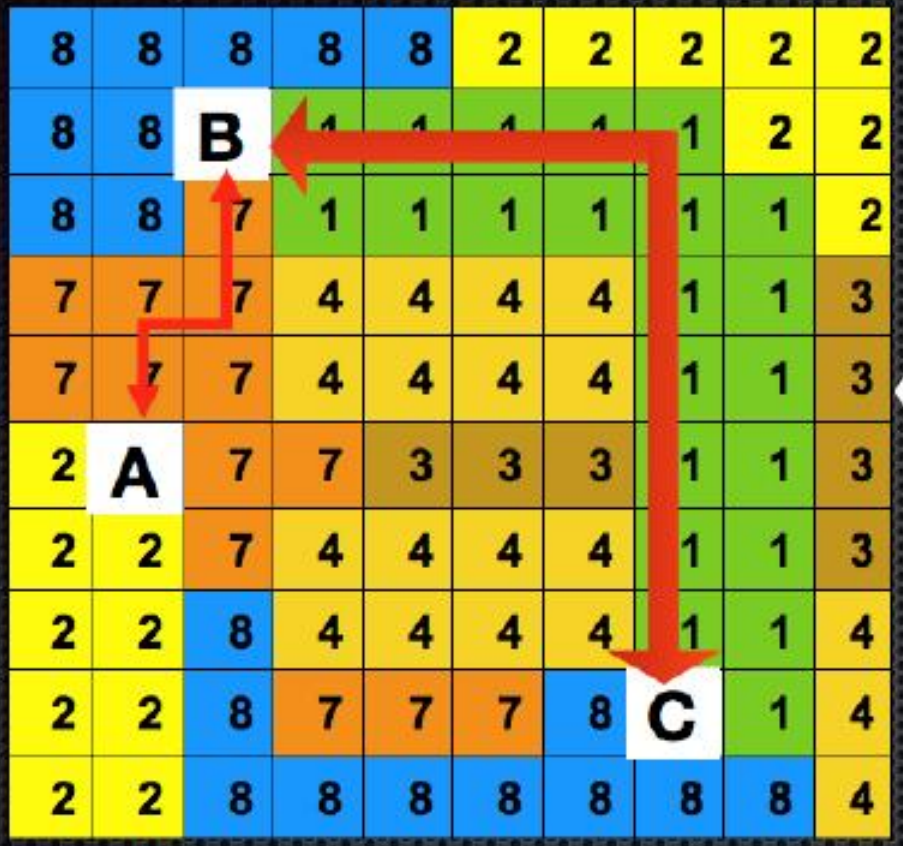
Reserve

Photo credit Zayada

Stronger decline of relatedness with distance in logged areas

Duckett & Stow. 2011 J Zool

Better at identifying variables influencing dispersal



Predicted gene flow

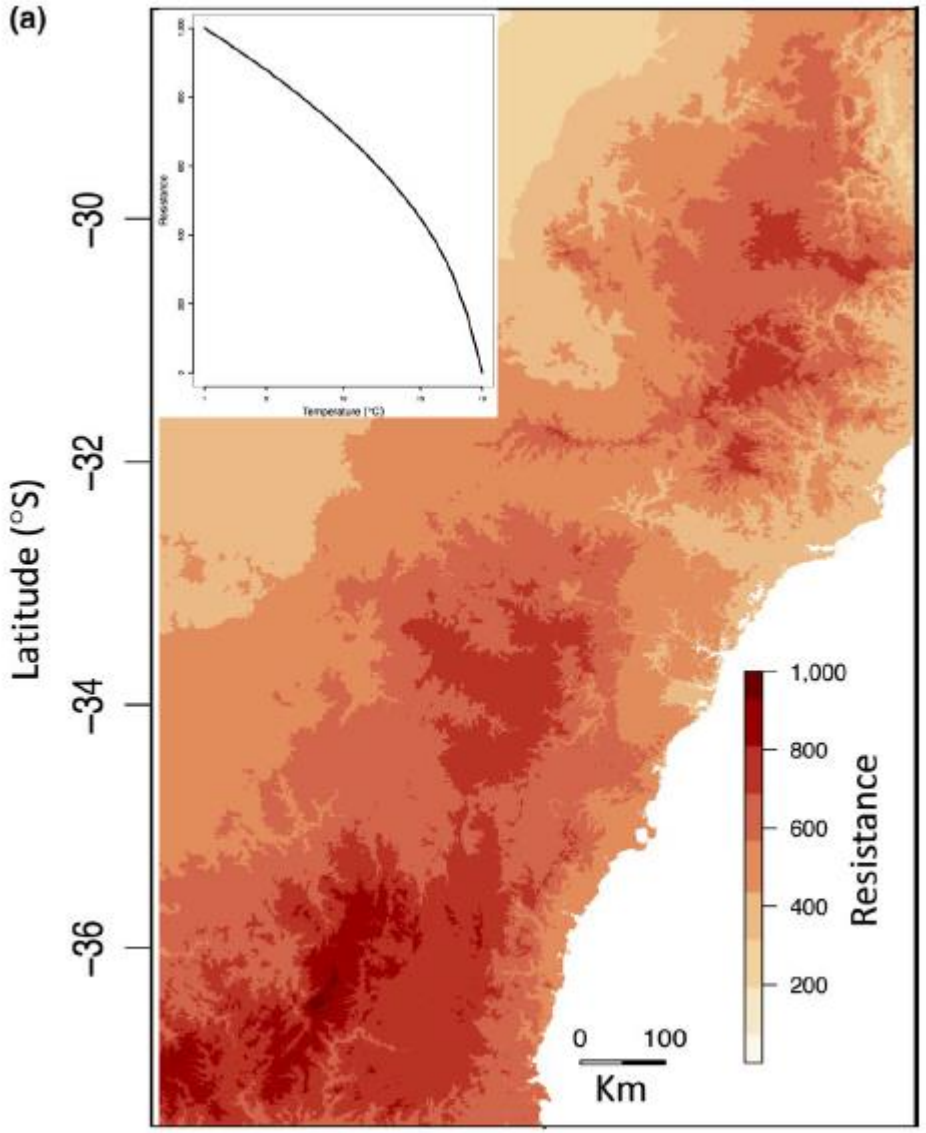
Isolation by resistance

(1) Input: landscape data and sample coordinates

(2) Output: pairwise resistance matrix

Pairwise resistance

	A	B	C
A	0		
B	6.5	0	
C	5.5	3.5	0



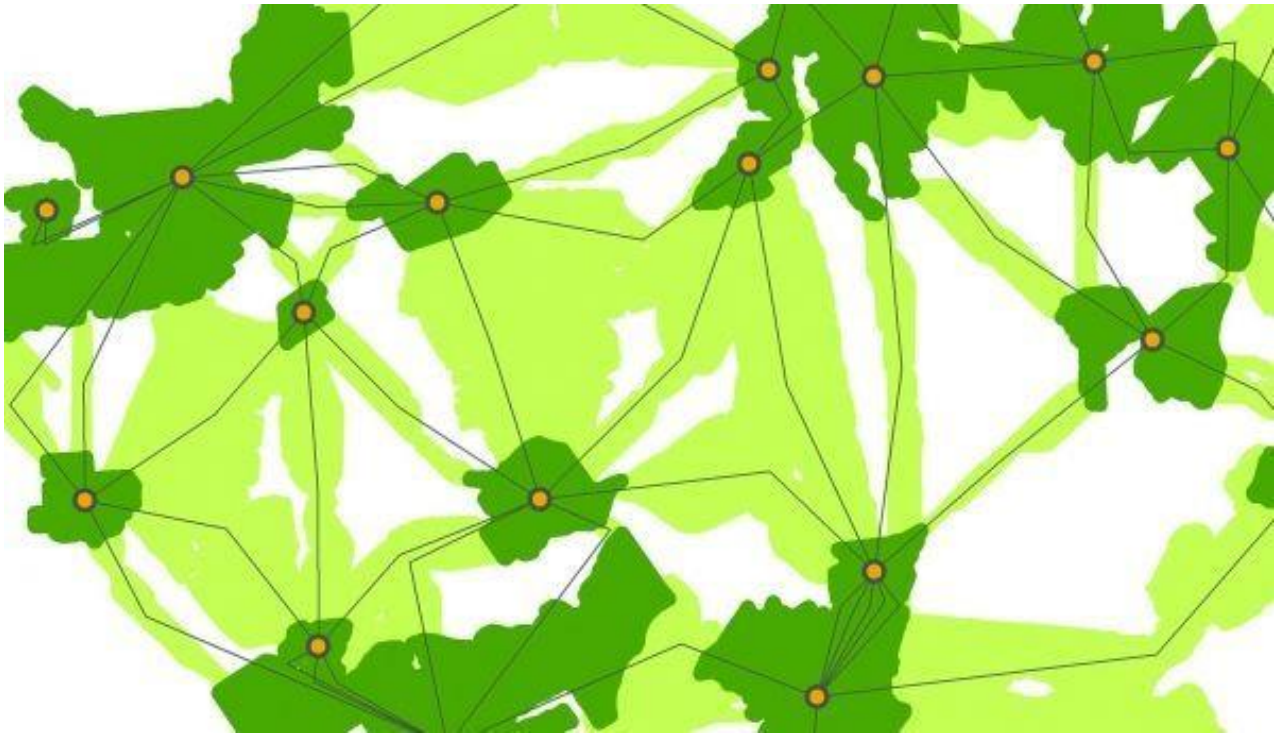
Yadav et al. 2019 Mol Ecol

Temperature influences the Wingless Grasshopper (Phaulocridium)
Darker colour – more resistance

Credit: Museum Victoria

11k SNPs ddRAD

Most emphasis on matrix between habitat patches

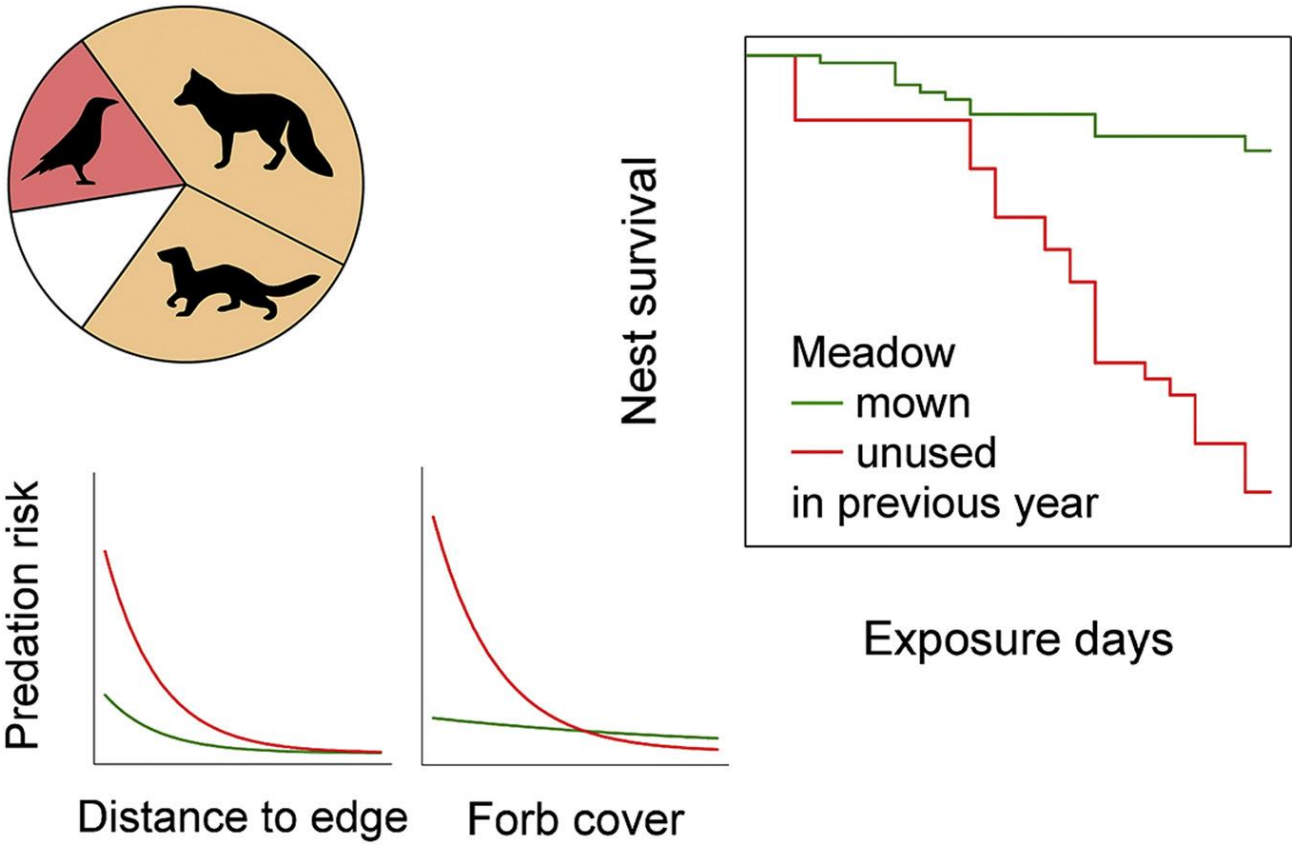


And the influence of environmental variables on connectivity

Within-patch processes: changes to interspecific interactions

- Antipredator behaviour
- Avoidance of parasitism
- Increased competition

Predation risk



Arbeiter & Frank 2018 Acta Oecologica

Within patch – changes to intraspecific interactions

- **Home range size**
- **Aggression**
- **Group size**
- **Kin interactions e.g. infanticide in bank voles**
- **Mate availability**
- **Inbreeding avoidance**

Science Photo Library

Impacts of habitat fragmentation

+/- of Resource defence

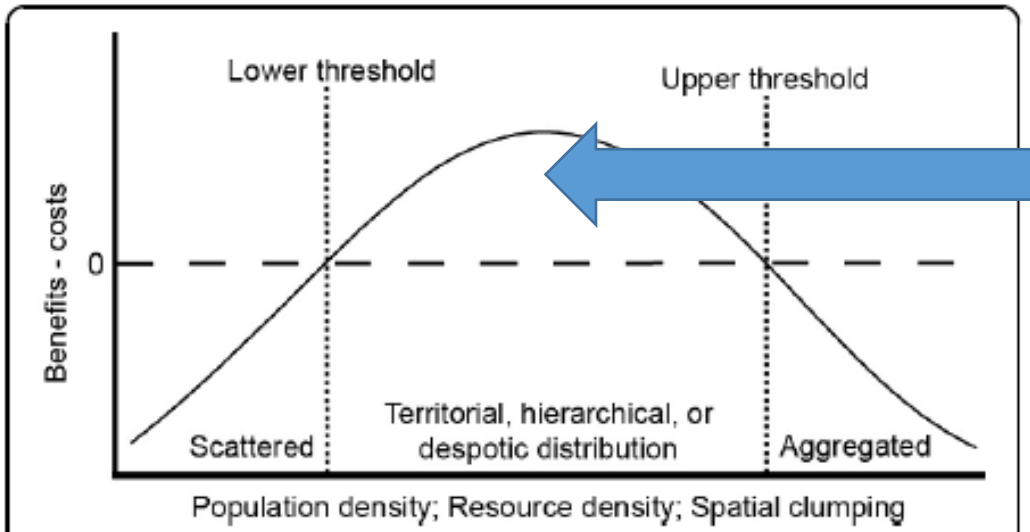
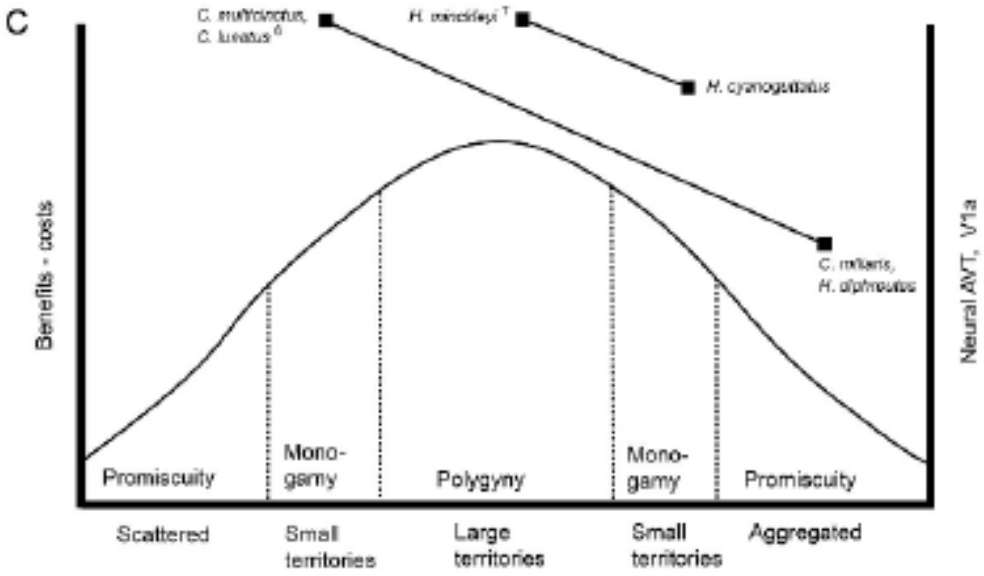


Figure 1 Resource defence theory. Ecological factors such as number and distribution of resources and competitors determine whether an individual guards a resource. Above the lower threshold, individuals aggressively defend space around a resource. Above the upper threshold, they cease to defend a resource. Graph based on [14] with the social structure that emerges under each condition added by the current authors. See text for detailed description.

Aggressive defence

e.g. chuckwalla

Oldfield 2015 Frontiers in Zool



Oldfield 2015 Frontiers in Zool

Blue headed Wrasse Polygyny large territories, Monogamy small territories

AVP implicated in plasticity of social behavior

Females preferentially coexist in fragmented habitat – but avoid in continuous habitat.

Image: Australian Geographic

Walker et al. 2008 Mol Ecol

Fewer males and reduced multiple paternity

Image: The Australian museum

Banks et a. 2005 mol ecol

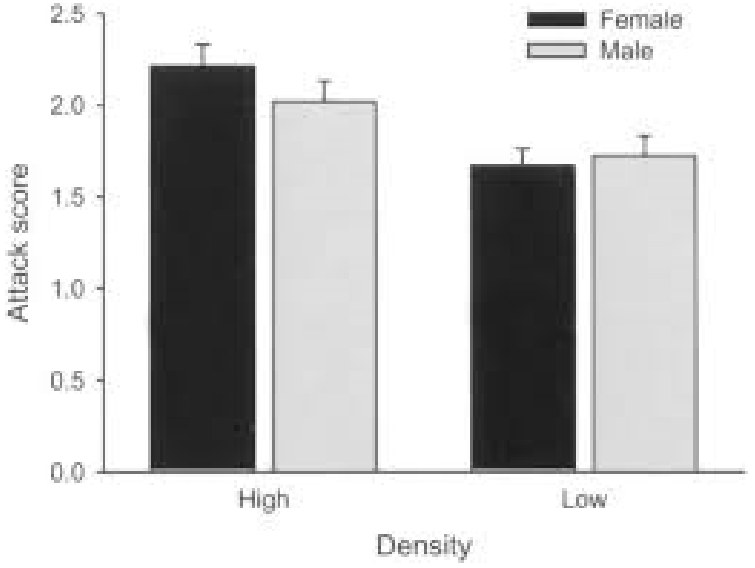
Change from monogamy to polygamy

Image: The Australian Museum

Banks et al. 2007 CJZ

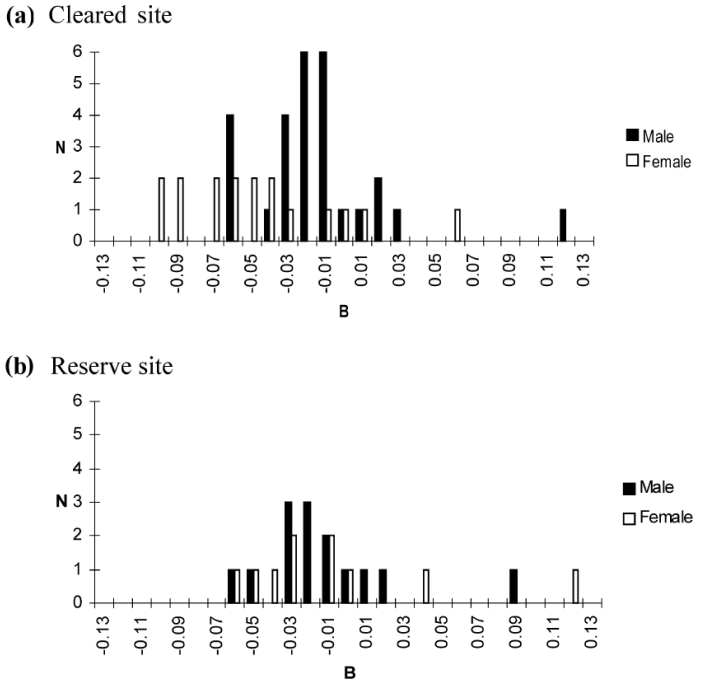
Change in Sex-bias Dispersal and increased aggression/infanticide

Bank Vole



Korpela 2010 Behav

Male biased dispersal only in fragmented habitats



(Stow et al. 2001 Mol Ecol)

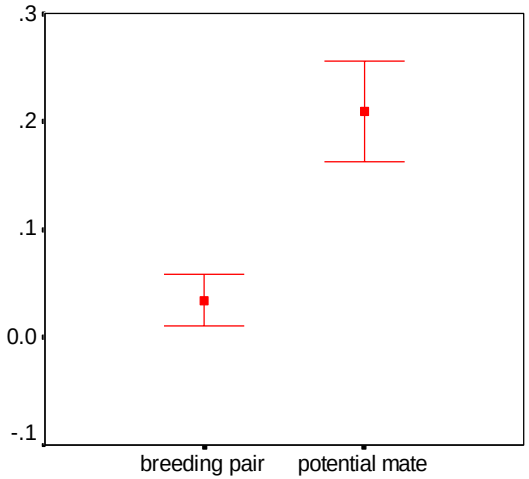
Do some behaviours slow down the negative consequences from isolation?

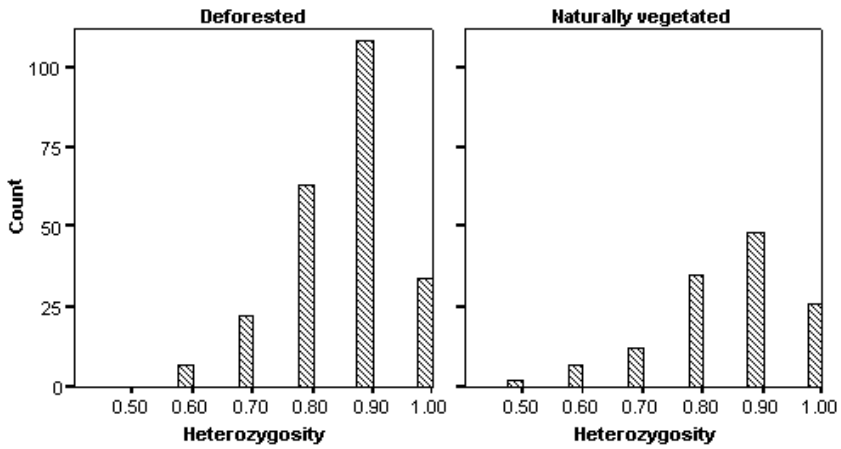
e.g mating system

Do females discriminate against poor quality males ?

Taken from:
https://malikaihle.wordpress.com/research/

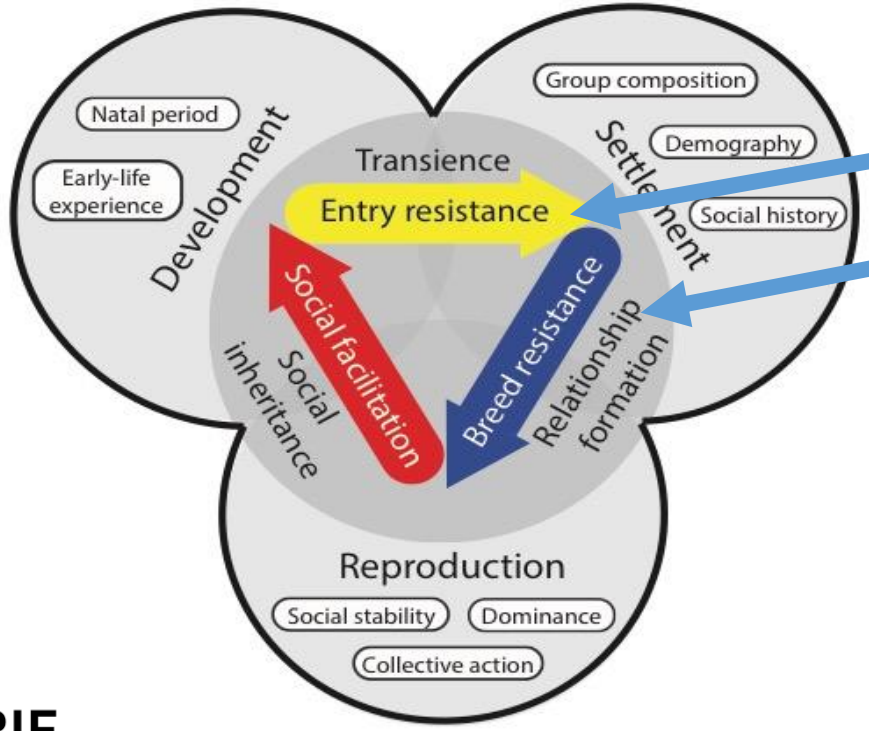
Or active inbreeding avoidance?





Social Resistance

Social resistance affects the transition between key life history stages—development, settlement, reproduction



Dispersal

Effective dispersal (gene flow)

UNIVERSIDADE FEDERAL DE SANTA CATARINA

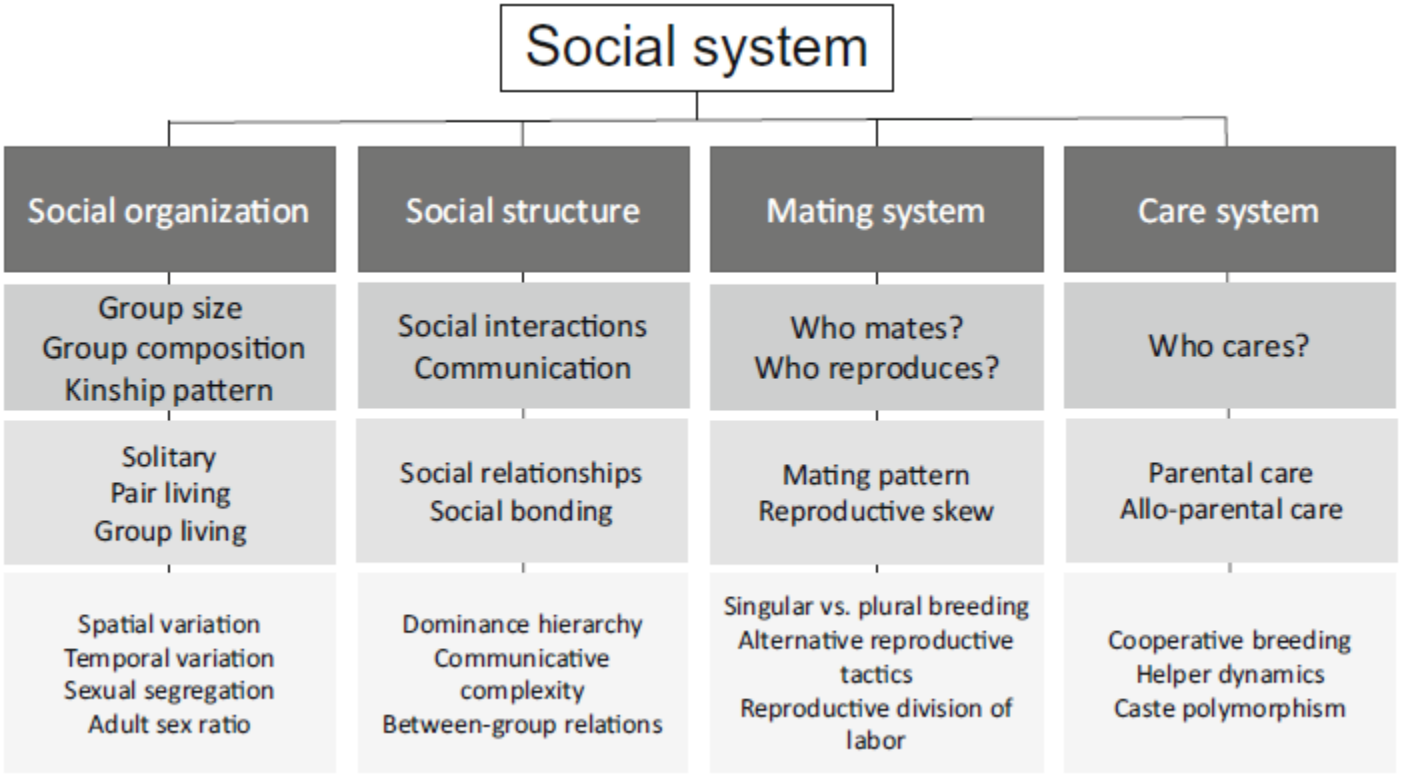
MAX-PLANCK-GESELLSCHAFT

MACQUARIE University
SYDNEY·AUSTRALIA

Armansin et al. accepted TREE

Combining behavioural ecology and landscape genetics

Social System Components (Kappeler 2013, Proc.B)



Social Organisation

Relatedness

E.g. brown jays more likely to migrate to group with related male -

entry resistance for male immigrants

Strong inbreeding avoidance e.g. Cunningham's skink

breeding resistance for immigrants

Social Organisation

Optimal Group Size

E.g. Southern pied babblers will accept unrelated immigrants when group size is below optimum

↑ Group size

↑ High entry resistance

Social Structure

Long-term relationships e.g. pair bonded sleepy lizards reproduce earlier

Breeding resistance

Assortative mixing e.g acoustic pattern toothed whales

Entry & Breeding resistance

Dominance Hierarchies

e.g manakin (Chiroxiphia spp.) – can enter the group but lowest rank in lek

entry resistance

Breeding resistance

Mating System

High reproductive skew

Breeding Resistance

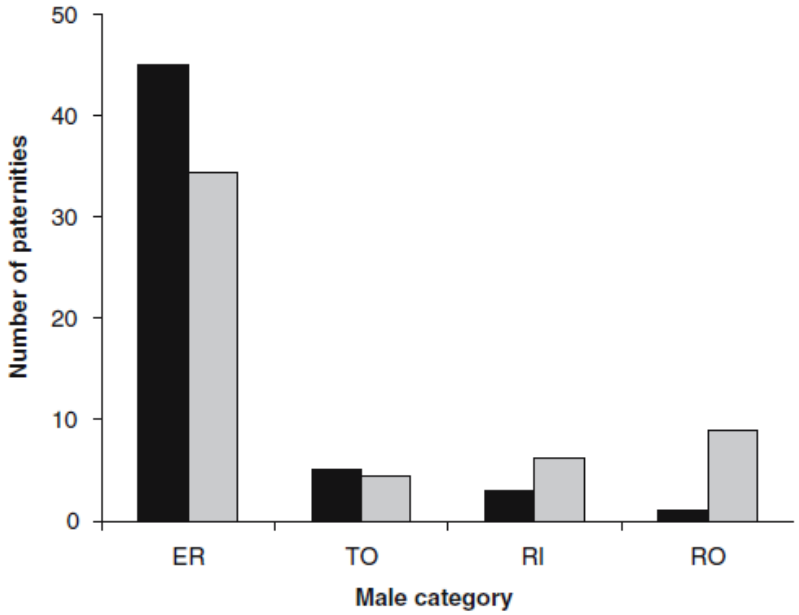


Fig. 1 Distribution of reproductive success among males pursuing different reproductive tactics. Observed (*black*) and expected (*gray*) number of paternities attributed to established residents (*ER*), takeover males (*TO*), recent immigrants (*RI*), and roaming males (*RO*). Expected values are based on the proportion of males in the population across all mating seasons

Kappeler Schlaffer 2008 Beh Ecol Evol

Disassortative mating

Breeding Resistance

Banded Mongoose - inbreeds

Meerkat – outbreeding

Lukas & clutton-Brock 2014 Royal.Soc. B

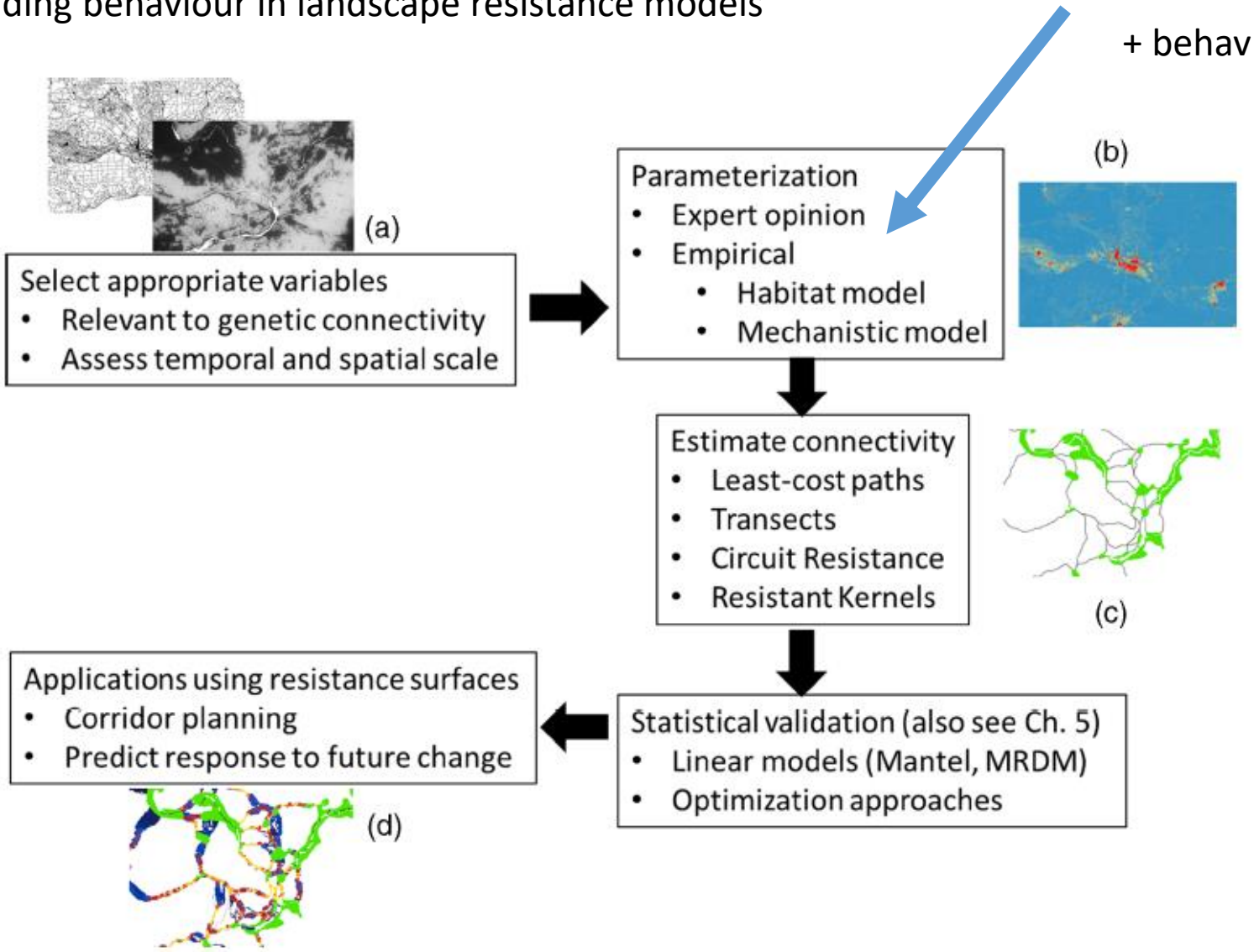
Care System

Longer parental care period ↑ entry resistance

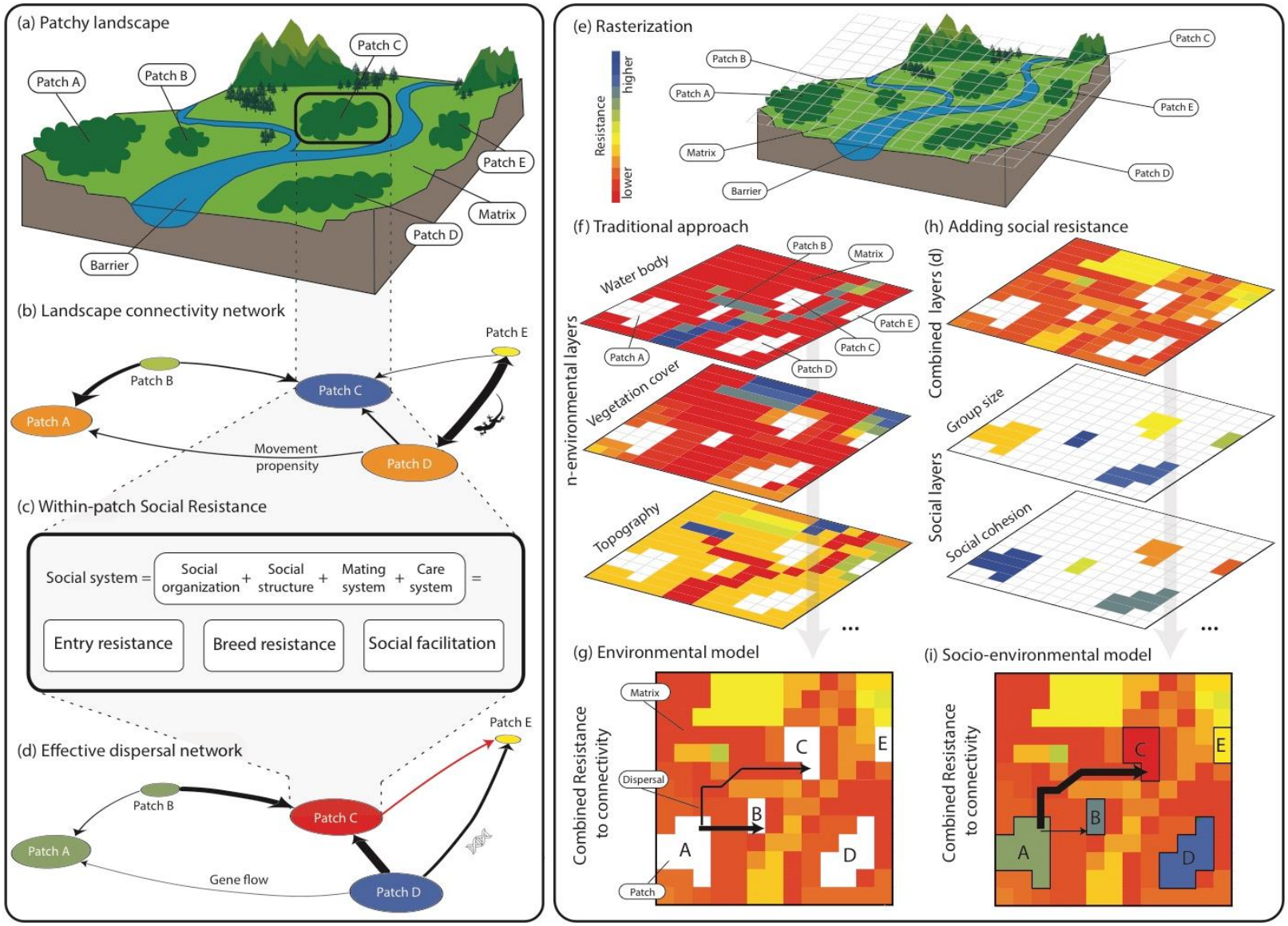
Allocaring ↓ entry resistance

Or pretend to feed young when no one is looking!

Including behaviour in landscape resistance models



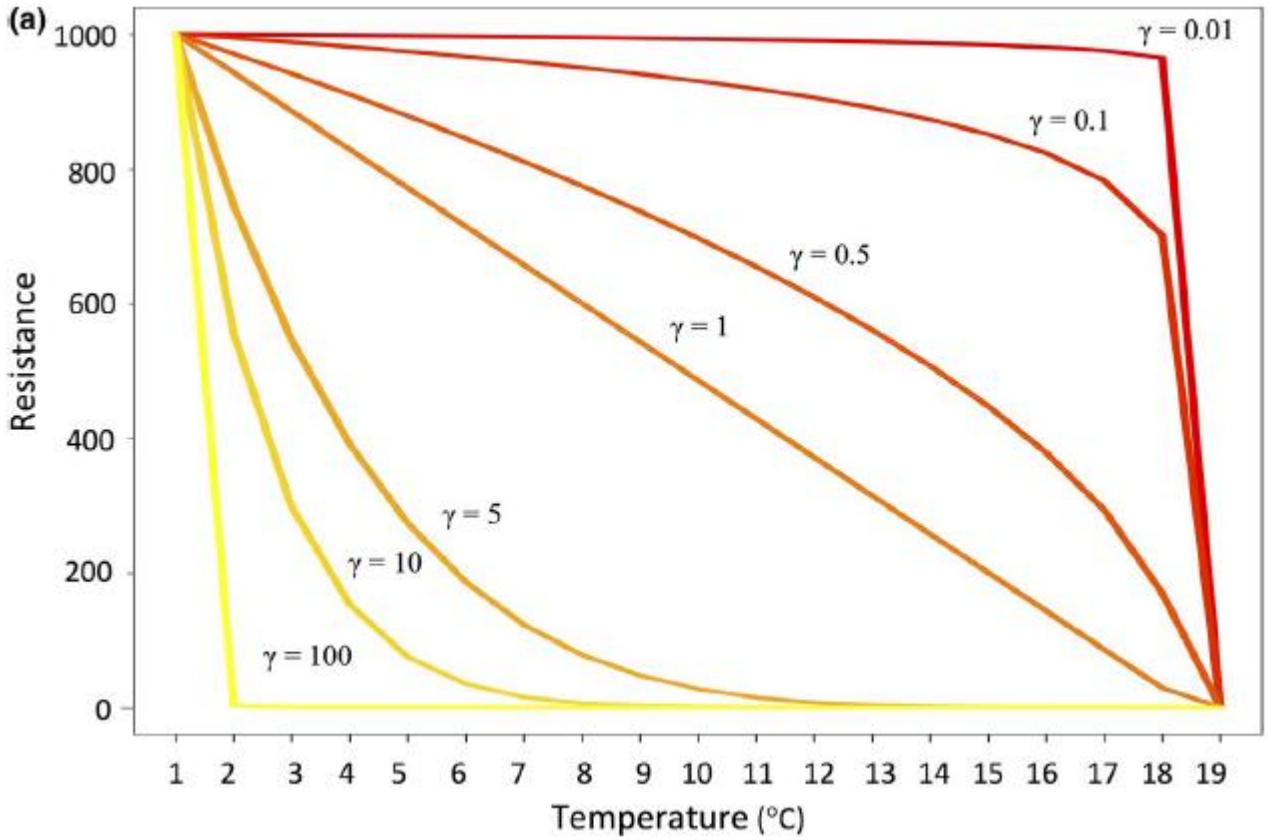
Balkenhol et al. 2015 Lands Gen



Test whether within-patch social environments affect landscape connectivity.

Armansin et al. accepted TREE

Best model for behavioural influences…



slope

$r_i = 1 + \alpha\,(T_i - 1/\max - 1)^{\gamma}$

intercept

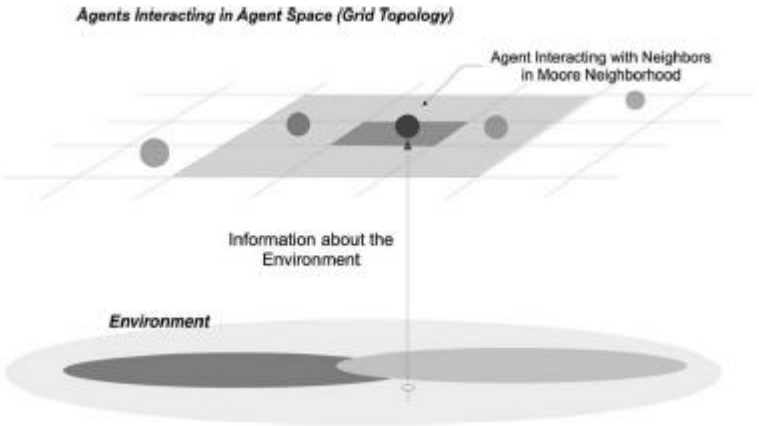
Alpha = 0 – null model – no resistance

AIC to evaluate best model

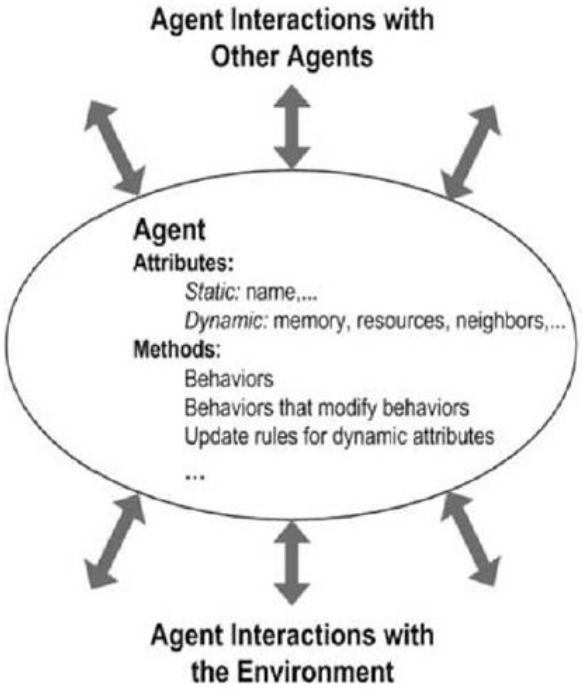
Or… expert opinion

Yadav, Stow, Dudaneic 2019, Mol Ecol

Predicting the consequences agent based models



Macal & North 2010 J Sim



Better understand mismatch between dispersal capacity and genetic structure

SAMOVA

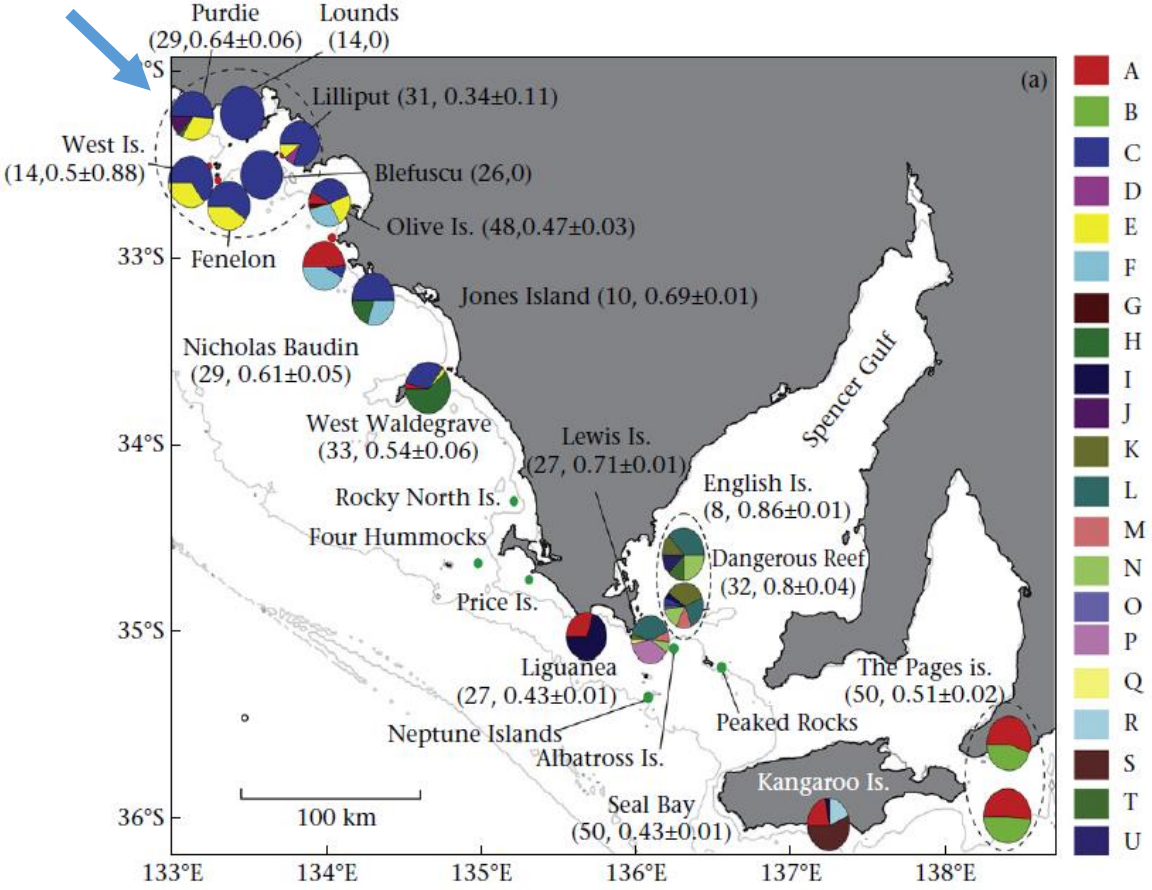
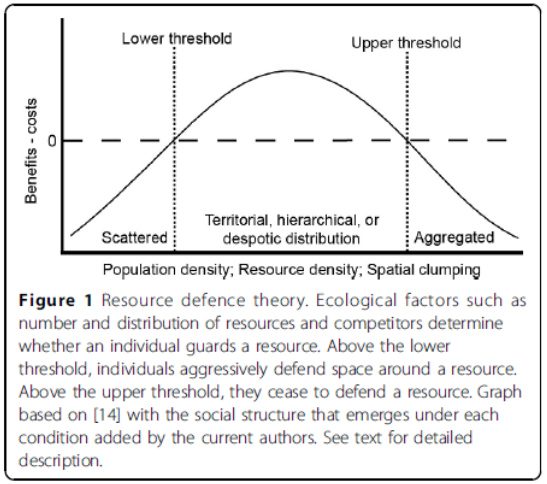


Photo Aust geographic

Lowther et al. 2012 Animal behavior

Social resistance and Habitat fragmentation

How does habitat fragmentation affect the expression of social resistance?



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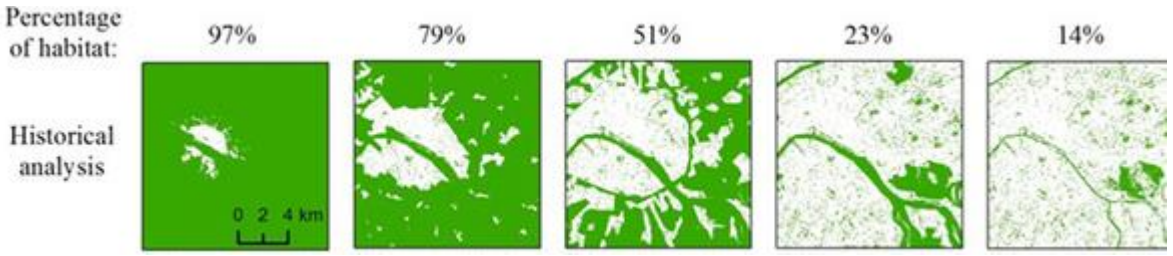

Oldfield 2015 Frontiers in Zool

Can environmental changes render previously optimised dispersal strategies maladaptive by modifying the social landscape?

e.g longer transience or resistance = greater △ effective dispersal & dispersal

Next Lecture – Genetics and Climate Change