

### Selective forces acting on the island rule

A colloquium by Wicher Vos S1718037 Supervised by Irene Tieleman



#### university of groningen Typical changes on islands

- Predator naïveté (blumstein & Daniel 2005)
- Loss of flight (McNab 1994)
- Loss of defensive structures (kavanagh 2015)
- Change in feeding organs (Grant & Grant 2006)
- Dwarfism (Van de Geer et al. 2016)
- Gigantism (Wu, Li & Murray 2006)











university of groningen The island rule (Foster 1964)

# On islands small animal become larger (Gigantism)



On island large animals become smaller Wicher Vos s1718037 "Selective forces acting on the island rule"



#### university of groningen **The island rule** (Foster 1964)

• Why is insular divergence on size so universal?

#### • Size affects fitness

- Predation
- Competition
- Metabolism
- Size change is genetically simple
- Size change occurs quickly (Millien 2006)



university of groningen Research question

- Is this so-called island rule correct?
- If so, then which selective forces drive the island rule?

• If not, which selective forces counteract the island rule?



#### university of groningen The island rule is often correct

- Elephants became dwarfed (Van de Geer 2016)
- Frogs became giant (Wu 2006)
- Large birds became small and small birds became large (Clegg & Owens 2002)

#### But

- Small rodents, became smaller still (Durst & Rott 2015)
- Insectivorous lizards always became bigger (Meiri 2007 A)



university of groningen **A good question** 

## What is considered small

# and what is considered large?



#### university of Fundamental size and character displacement

- A fundamental size may exist (Brown, Marquet & Taper 1993)
- Same size species are often competing for the same resources. (Pritchard & Schluter 2001)
- Less efficient competitors will morphologically diverge (Pritchard & Schluter 2001)
- This minimizes overlap in resource use

#### university of **Character displacement: example** groningen



Campbells biology 5<sup>th</sup> edition, page1117

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#### university of groningen Species richness on islands



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#### university of groningen Insular character release

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Most elephant populations showed dwarfism (Van de Geer et al. 2016)

Dwarfism was less dramatic when large competitors occured in sympatry (Raia & Meiri 2006)





#### university of groningen Size affects predations

#### Size is predation dependant:

- Small animals and can hide (Remmel & Tammaru 2009)
- Large animals repel predators (Sinclair et al. 2003)

Selection favours small animals to become smaller and large animals to become larger

So

When predation is relaxed, will prey return to default size?



#### university of groningen Example on islands

#### Small Skyross wall lizards had

- Reduced escape behaviour
- Reduced cryptic coloring
- Increase in size (Runemark et al. 2014)







#### Both **predation** and **competition** cause divergence from fundamental size

These pressures are relaxed on islands

Hence at islands small animals become bigger Big animals become smaller



#### university of groningen Predators don't follow the island rule

- Herbivorous and omnivorous lizards followed the island rule (non-significantly)
- Predatorial lizards followed the opposite of the island rule (significantly) (Meiri 2007 A)
- Mustelids showed no size change (Meiri 2007 B)
- Tigersnakes populations can be giant or dwarfed (Keogh et al. 2005)





#### university of groningen Shifts in available resources

#### **Carnivores are dependant on prey size**

- Large predators can not handle small prey
- Small predators can not catch large prey

#### Prey size is a determinant for predator size



#### university of groningen Skyross wall lizards (Runemark 2015)

- insectivorous
- Mainlands populations prefer soft insects
- Islands have less soft insect







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Resource

Shift



#### university of groningen Neonate tiger snakes (Aubret 2015)





#### university of groningen Adult tiger snakes

Giant tiger snakes had access to:

- Seasonally abundant
- easily accesible
- large prey species

(mammals and chicks 300-350 grams) (Keogh et al. 2005)





Dwarfed tiger snakes had access to:

- year round abundantly available
- predator avoiding
- small prey species (Lizards <10 gram)

(Keogh et al. 2005)



#### university of groningen Mustelids

Mainland mustelids show character displacement

No size change occured in insular populations

**Resource Shift** 

Insular prey species composition was identical to the mainland (Meiri 2007 B)





#### university of groningen Resource density affects size

#### **Rodents show**

- gigantism on islands with high primary production,
- dwarfism on island with low primary production (Durst & Roth 2015)

#### Komodo dragons showed

gigantism on islands with high density of deer (Jessop 2006)

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#### university of groningen Resource density affects population size



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university of groningen Skyross wall lizards (again)

- Body size is correlated with population density,
- Population density is correlated to resource density (pafilis 2009)



Fig. 1 Male lizards from Exo Diavates (left), Lakonissi (middle), and

SVL males (museum and field pooled)	61.36 (185)	64.55 (33)	66.12 (46)	71.95 (64)	85.28 (69)
SVL females (museum and field pooled)	55.65 (101)	57.07 (19)	57.98 (25)	62.27 (25)	70.34 (43)
SVL juveniles (Field)	28.14 (37)	28.77 (7)	28.97 (7)	30.82 (10)	32.52 (18)
Cannibalism	1.20% (1/83)	0% (0/12)	0% (0/11)	4.54% (1/22)	21.42% (3/14)
Densities	185	95	110	350	850
Gull presence	0	5	8	10	50

#### university of groningen Aquatic vs terrestrial prey



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#### university of groningen **Discussion**

#### **Selective pressures enacting the island rule:**

- Competition release
- Predator release

#### Selective pressures which can counteract the island rule:

- Prey size
- Resources abundance



university of groningen Skyross wall lizards (final)



- Reduced predation  $\rightarrow$  increase in body size (Runemark 2014)

- Larger prey items  $\rightarrow$  increase in body size (runemark 2015)

- High population density  $\rightarrow$  increase in body size (pafilis 2009)







university of groningen Biass fór the island rule

The island rule specifically

And insular body size change in general

May be overrepresented in scientific literature



university of groningen Concluding

Shifts in body size are predictable

Concluding

This predictability is based on a lot of factors

Making it a complicated phenomenon to study thoroughly



university of groningen Thank you

#### Thank you for attending my colloquiem

## And thanks to Irene Tieleman for supervising me during my colloquiem



university of groningen Any questions?





