Selective forces acting on the island rule

A colloquium by Wicher Vos S1718037
Supervised by Irene Tieleman
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)
On islands small animal become larger (Gigantism)

On island large animals become smaller (dwarfism)
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)
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?
• 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)
What is considered small

and what is considered large?
• 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
Character displacement: example

G. fortis

G. fuliginosa

Santa María, San Cristóbal

Daphne

Los Hermanos

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Species richness on islands

Selective forces acting on the island rule
Most elephant populations showed dwarfism (Van de Geer et al. 2016)

Dwarfism was less dramatic when large competitors occurred in sympatry (Raia & Meiri 2006)
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?
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
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).
**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
Skyross wall lizards (Runemark 2015)

- insectivorous
- Mainlands populations prefer soft insects
- Islands have less soft insect
Skyross wall lizards II (Runemark 2015)

Selective forces acting on the island rule
Neonate tiger snakes (Aubret 2015)

$R^2 = 0.98$, $p < 0.0002$

$R^2 = 0.77$, $p < 0.023$
Dwarfed tiger snakes had access to:
- year round abundantly available
- predator avoiding
- small prey species (Lizards <10 gram)
(Keogh et al. 2005)

Giant tiger snakes had access to:
- Seasonally abundant
- easily accessible
- large prey species
(mammals and chicks 300-350 grams)
(Keogh et al. 2005)
Mainland mustelids show character displacement

No size change occurred in insular populations

Insular prey species composition was identical to the mainland

(Meiri 2007 B)
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)
Resource density affects population size

- Resources
  - Carrying capacity
  - Population density
    - Intraspecific competition
  - Body size
Skyross wall lizards (again)

- Body size is correlated with population density,
- Population density is correlated to resource density

(pafilis 2009)

| 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 |

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Aquatic vs terrestrial prey

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Selective pressures enacting the island rule:
- Competition release
- Predator release

Selective pressures which can counteract the island rule:
- Prey size
- Resources abundance
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)
Complexity of insular differences.

Body size

Predation

Population density

Resources

Competition

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Biass fór the island rule

The island rule specifically

And insular body size change in general

May be overrepresented in scientific literature
Shifts in body size are predictable

This predictability is based on a lot of factors

Making it a complicated phenomenon to study thoroughly
Thank you for attending my colloquium

And thanks to Irene Tieleman for supervising me during my colloquium
Any questions?

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