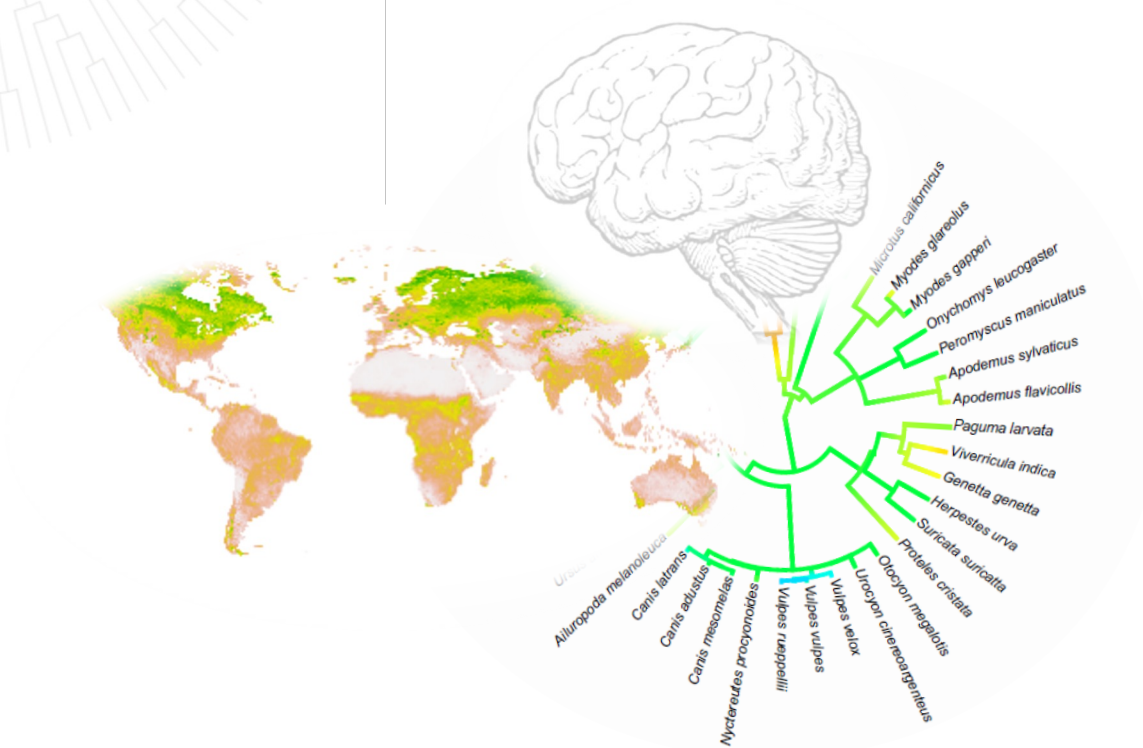


Seasonality and Brain Size

-

Cognitive Buffering is Unique to Anthropoid Primates



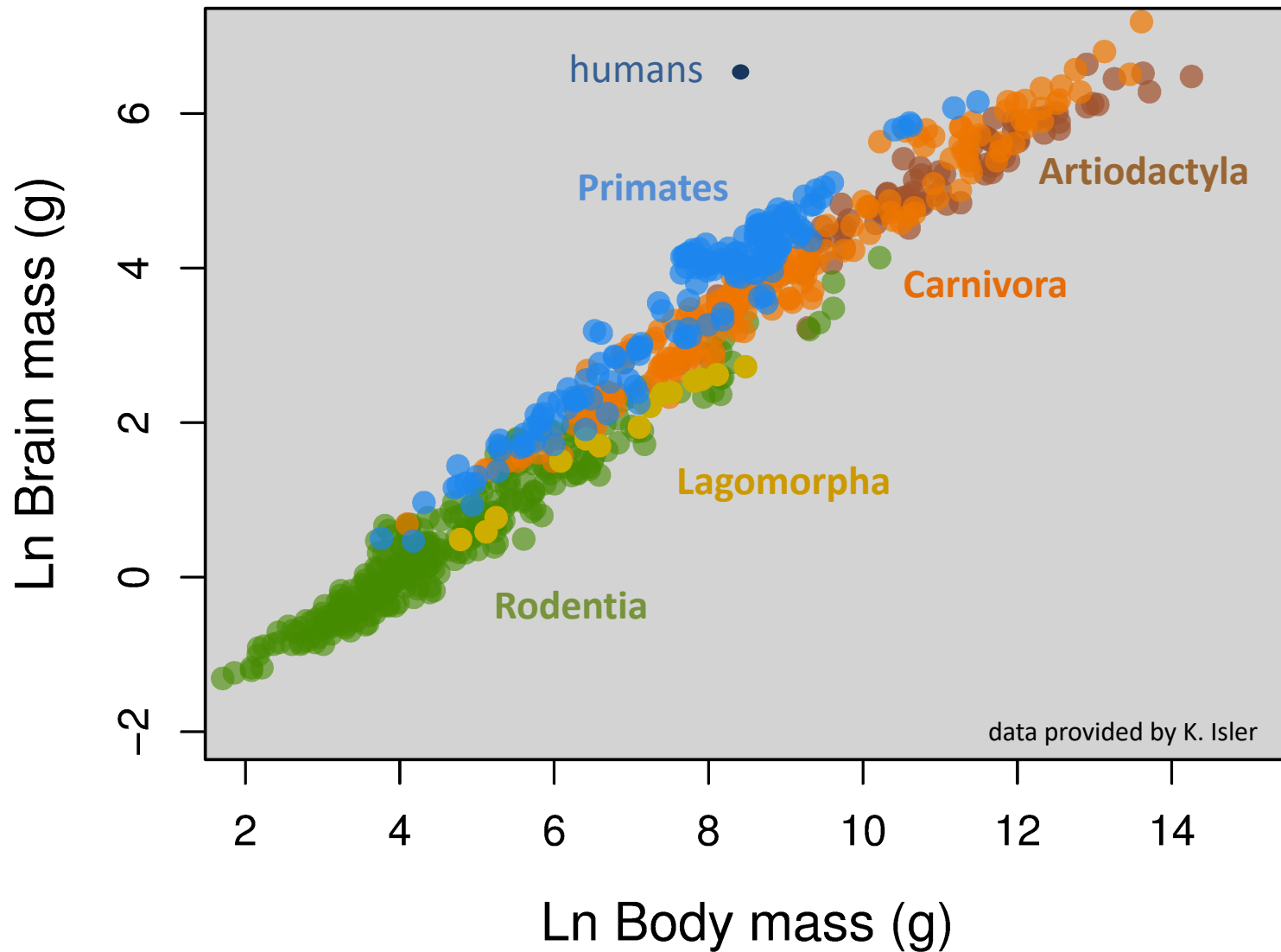
Sereina M. Graber, Carel van Schaik and Karin Isler
Department of Anthropology, University of Zurich

Variation in Seasonality

- Seasonality = recurrent fluctuations in climatic conditions and environmental productivity over the year
- Human hunter-gatherers:
great variety of different habitats with varying degrees of environmental seasonality



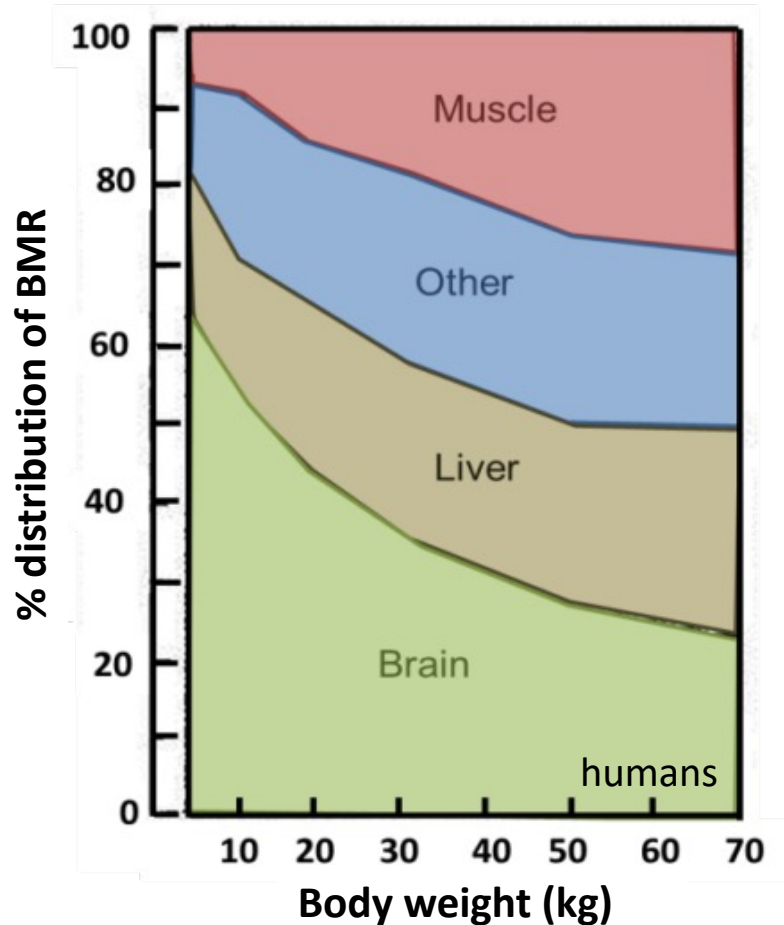
Variation in Relative Brain Size – Mammals



Costs and Benefits of Enlarged Brains

Costs...

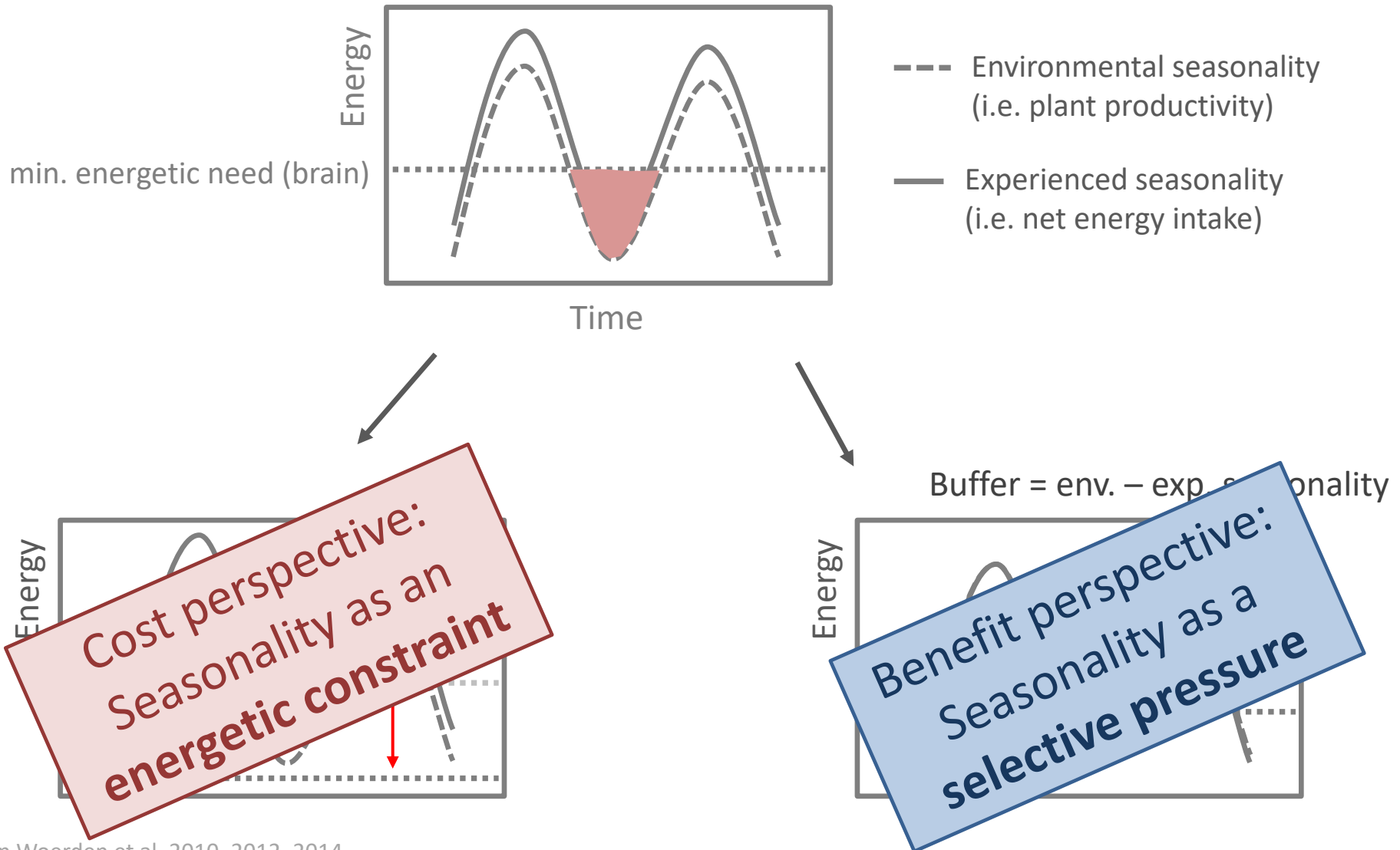
...and benefits of large brains



enhanced cognitive abilities

Seasonality and Brain Size

Energetic constraint vs. Selective pressure

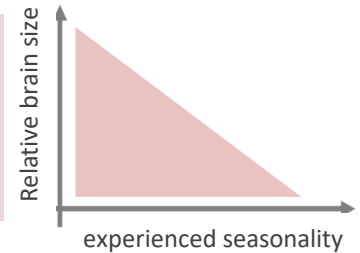


Seasonality and Brain Size

Expensive Brain vs. Cognitive Buffer Hypothesis

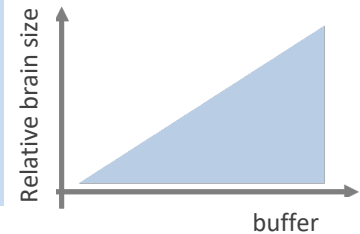
Expensive brain

Rel. brain size vs. **experienced** seasonality



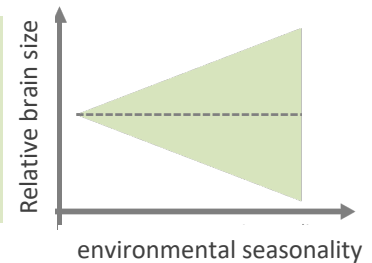
Cognitive buffer

Rel. brain size vs. **buffer** (= env. seasonality – exp. seasonality)



Environmental seasonality

Rel. brain size vs. **environmental** seasonality



Seasonality and Brain Size

Expensive Brain vs. Cognitive Buffer Hypothesis in Primates

Catarrhines



Platyrrhines



Strepsirrhines



Expensive brain

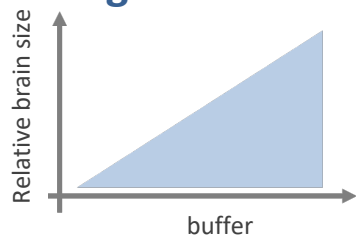


✓

✓

✓

Cognitive buffer



✓

✓

✗

Seasonality and Brain Size – Carnivora & Rodentia

Data collection & analyses

Environmental seasonality

coefficient of variation (CV) in **N**ormalized **D**ifference **V**egetation **I**ndex (NDVI)

GIMMS database 1981-2004, Tucker et al. 2005

Experienced seasonality

- seasonal diet composition: monthly frequency of occurrence in scats/stomach contents
- CV in food category with highest nutritional value

Buffer = environmental – experienced seasonality

Brain and body size

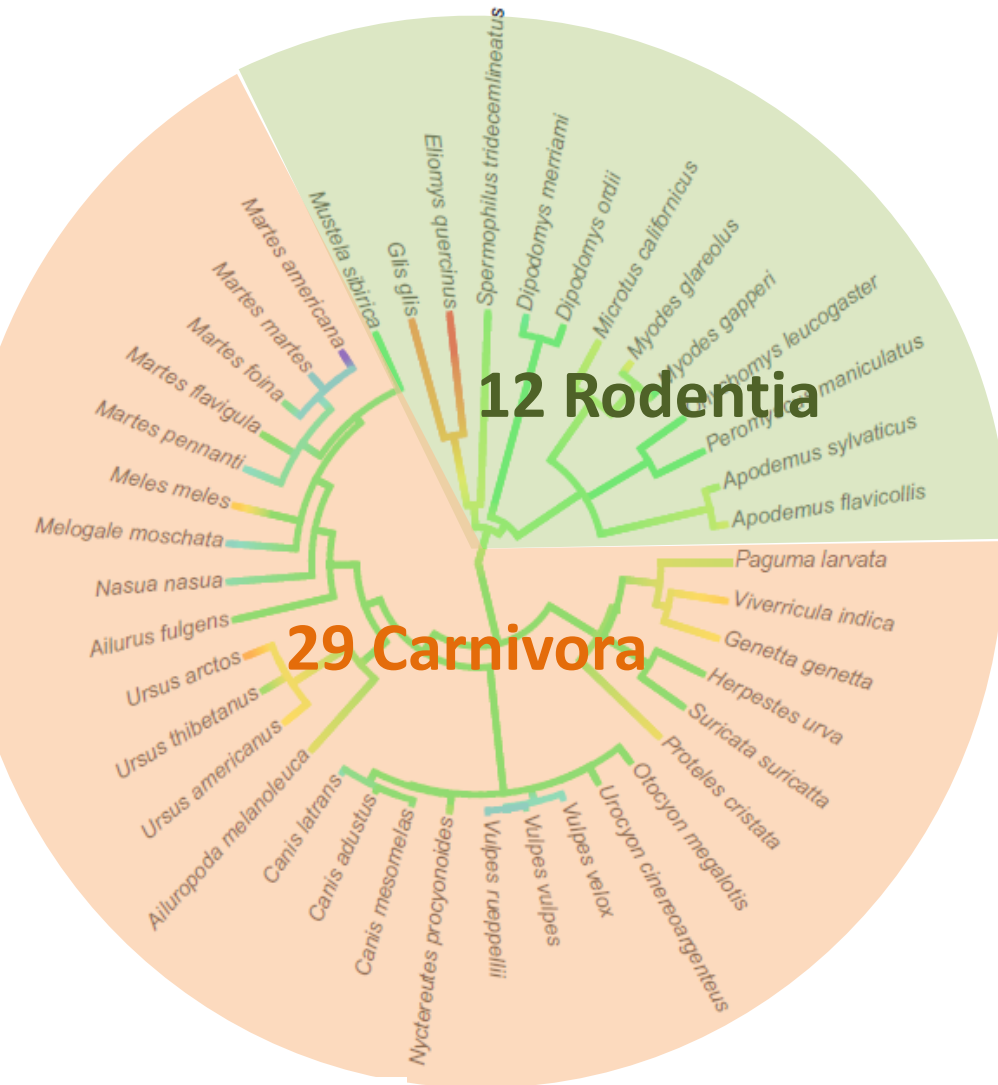
- endocranial volume measurements based on glass beads
- body mass from established database by K. Isler



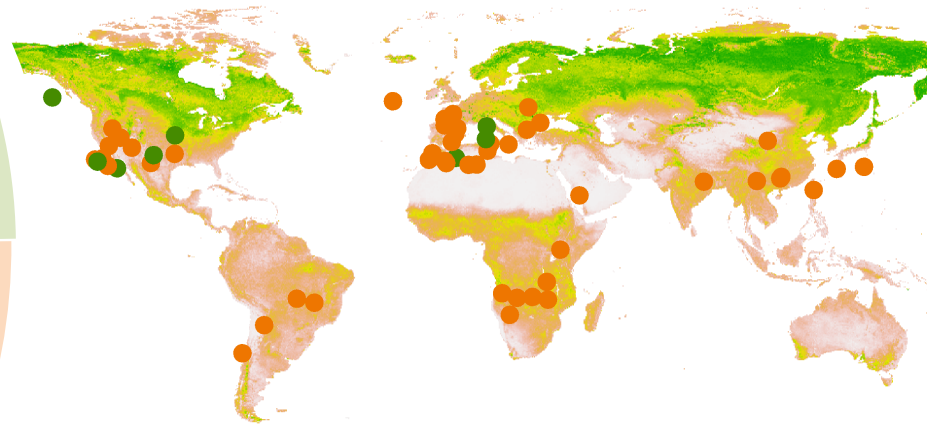
Phylogenetic analyses

- mammalian supertree Fritz et al. 2009
- phylogenetic least-squares and logistic regression (PGLS, PLogReg)
{R} : `caper` Orme et al. 2013 , `phylolm` Ho and Ané 2014
- all analyses controlled for body mass

Data – Carnivora & Rodentia



annual range in plant productivity (NDVI)

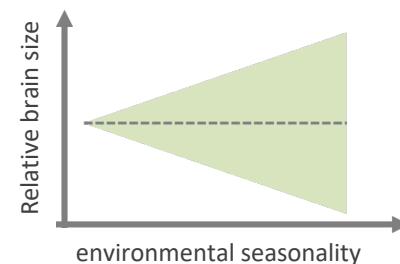
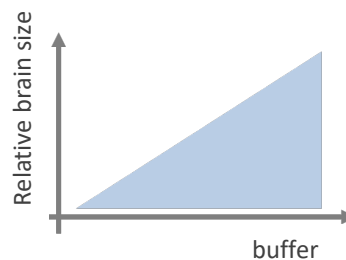
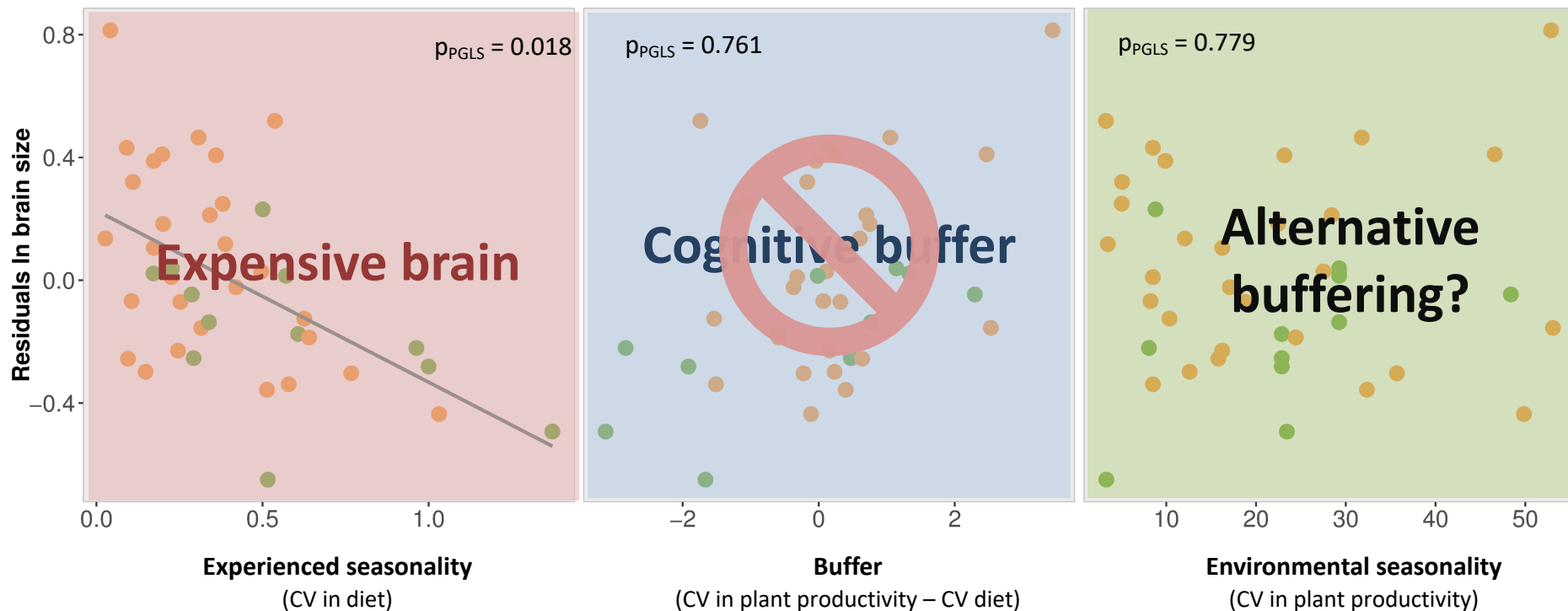


-0.65 Residuals brain 0.81



Seasonality and Brain Size – Carnivora & Rodentia

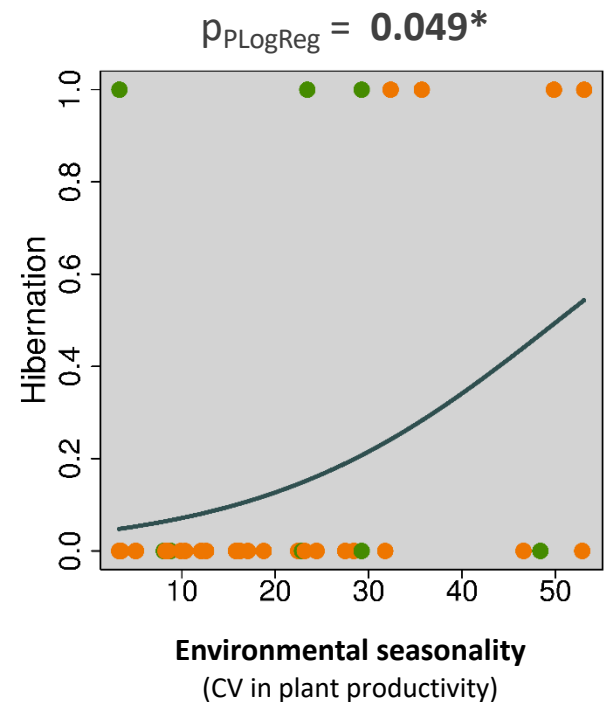
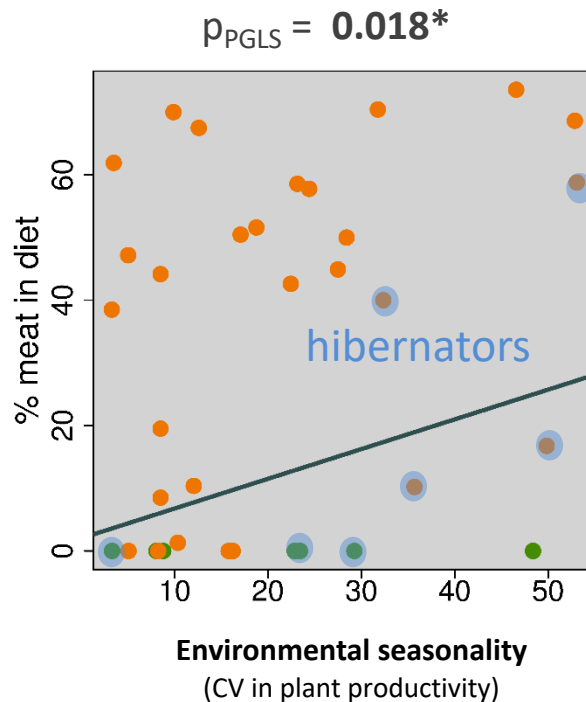
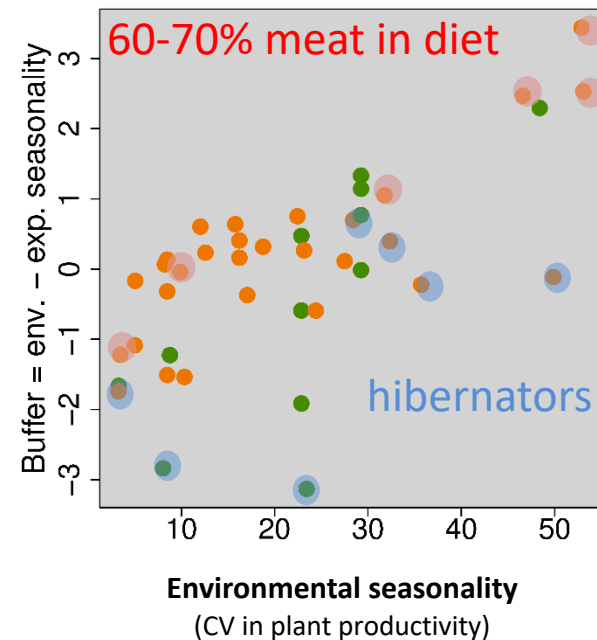
- Carnivora
- Rodentia



Seasonality – Carnivora & Rodentia

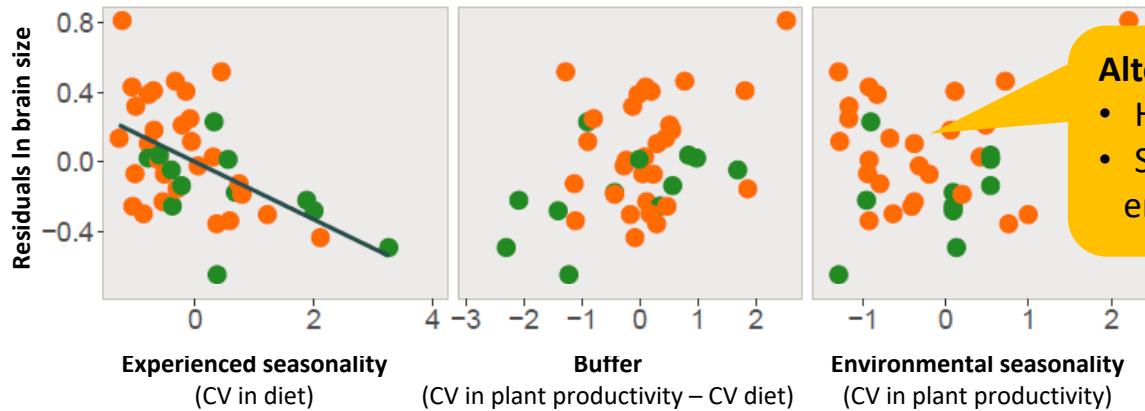
Alternative buffering strategies

- Carnivora
- Rodentia



Seasonality and Brain Size – Mammals

Carnivora & Rodentia



Alternative strategies

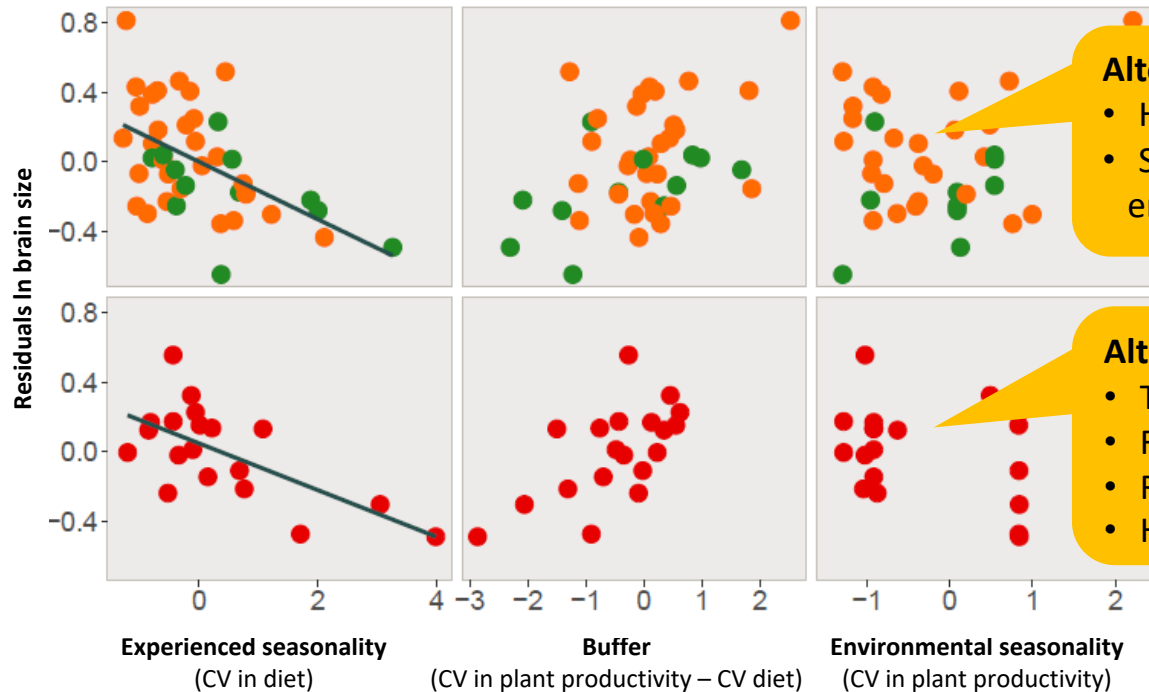
- Hibernation
- Shift in diet -> energy-rich food

Seasonality and Brain Size – Mammals

Carnivora & Rodentia



Strepsirrhines



Alternative strategies

- Hibernation
- Shift in diet -> energy-rich food

Alternative strategies

- Torpor/Hibernation
- Fat storage
- Reduced BMR
- High birth seasonality

Seasonality and Brain Size – Mammals

Carnivora & Rodentia



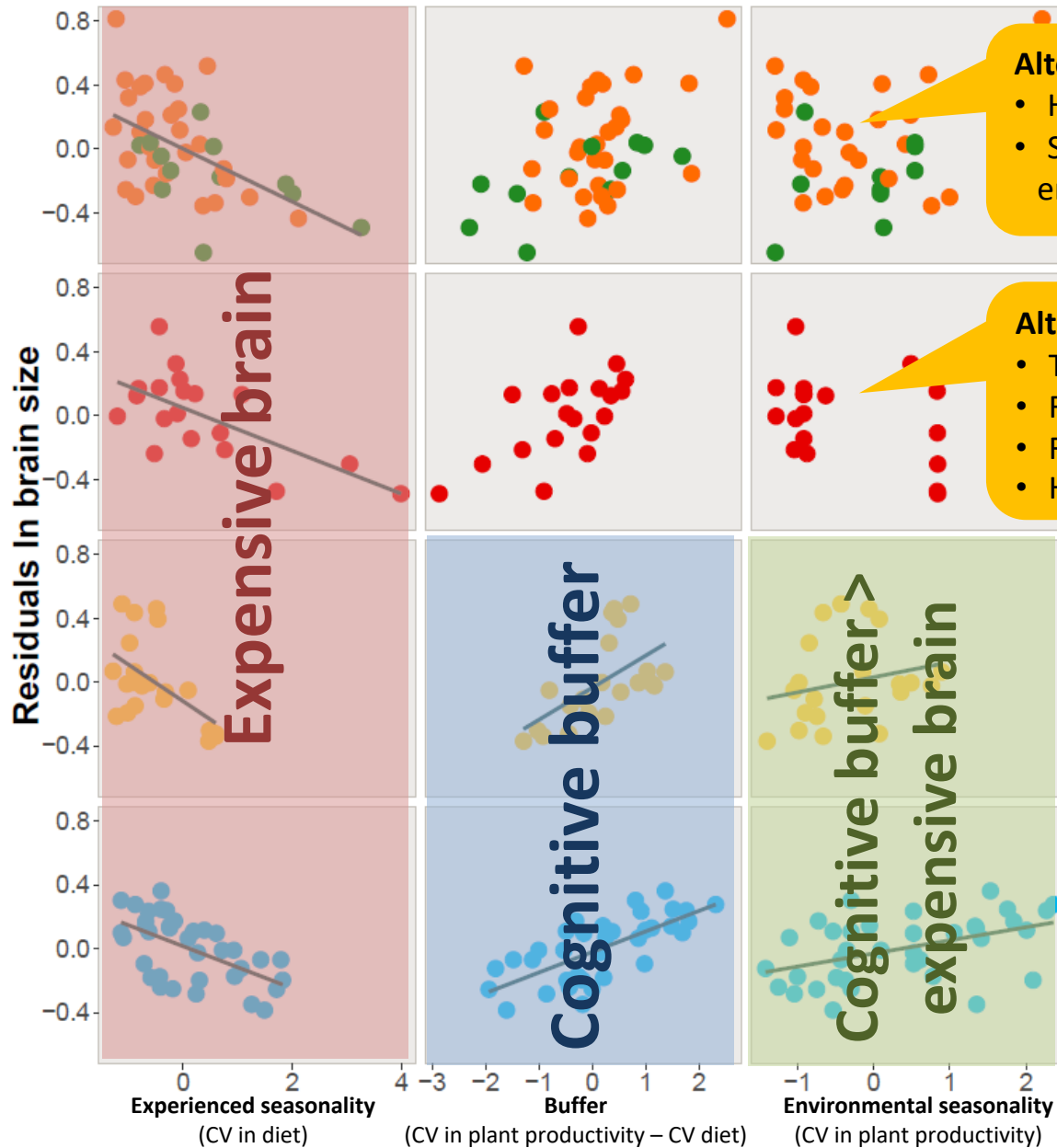
Strepsirrhines



Platyrrhines



Catarrhines



Alternative strategies

- Hibernation
- Shift in diet -> energy-rich food

Alternative strategies

- Torpor/Hibernation
- Fat storage
- Reduced BMR
- High birth seasonality

van Woerden et al. 2014

Thank you...

- Sandra Heldstab
- Janneke van Woerden
- Erik Willems
- Reinhard Furrer



Smithsonian

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