WHICH ARE THE INDIVIDUALS WITH THE MOST RESILIENT METABOLISM TO CLIMATIC CONSTRAINTS?

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CLIMATIC AND PHYSIOLOGICAL BACKGROUND

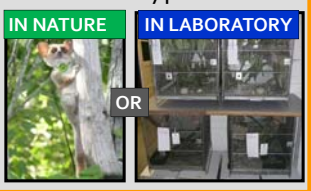
Unfavorable temperatures impose two constraints to endotherms: they increase the allocation of energy and time to thermoregulation, and they reduce food availability by inhibiting primary (vegetation) and secondary (invertebrate) productions. Phenotypically flexible genotypes should cope better with fine-grained climate-induced environmental temperature heterogeneity. We investigate the efficiency of an flexible energy saving mechanism at buffering the organism from fluctuating energetic constraints.

Torpor (controlled resting hypometabolism and hypothermia) is a physiological mechanisms that supposedly allows heterothermic endotherms to adaptively match their energy expenditure with energetic constraints. Facultative daily torpor is the most flexible expression of torpor, and would be more widespread in environments with poorly predictable episodes of harsh climatic conditions.

What are the individual characteristics that constrain the ability to rapidly launch torpor use in response to thermal or food shortage challenges ?

Canale & Henry (2010) *Clim. Res.*

MODEL Grey Mouse Lemur - small (60-120 g), nocturnal, heterothermic primate, that evolved under the 'hypervariable climate' of Madagascar



Experimental paradigm : manipulations of food availability during the dry season

ACCLIMATION TO FOOD SHORTAGE

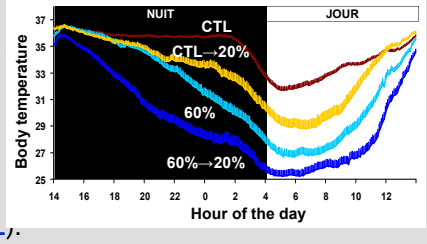
LAB

24 ind. were acclimated at 2 levels of food availability

CTL = ~ *ad libitum* (N = 12)

60% of CTL food av.(N = 12)

Then , half of each group was exposed to a sudden food shortage (**20% of CTL**).



Animals acclimated to a reduced food availability (60%) more rapidly increased torpor use than CTRL individuals: **acclimation to food shortage increases torpor (and locomotor) flexibility.**

Canale *et al.* (2011) J. Exp. Biol.

FOOD SHORTAGE TIMES SEASONAL TORPOR USE

NATURE

At the start of the dry season, we food supplemented 11 free-ranging ind. whereas 10 others were exposed to the natural, seasonal food shortage. Food supplemented individuals postponed torpor use by 1 (♂) to 2 (♀) months.

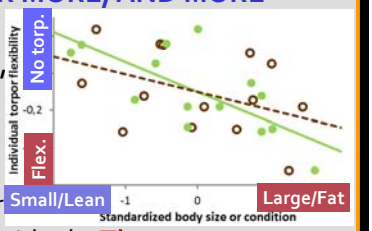
The seasonal launching of torpor use is flexible, and adjusted to food availability.

Vuarin *et al.* (in prep.), Vuarin & Henry (2014) J. Comp. Physiol. B

FAT INDIVIDUALS USE TORPOR MORE, AND MORE FLEXIBLY

NATURE

Using a **reaction norm** approach, we estimated **propensity** and **flexibility** of low skin t° (**torpor**) in response to air t° (N=14).



Fat/large individuals used deeper torpor depth than lean/small individuals. **The more individuals have secured access to energy, the more prone they are to flexibly use torpor.**

Vuarin et al. (2013) Funct. Ecol.

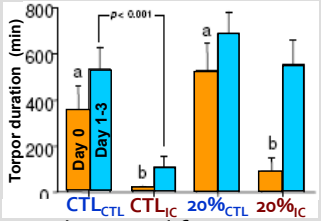
FEVER IS PRIORITARY OVER TORPOR

LAB

2 groups (N = 12 each) for 24 days:

CTL food availability and **20% of CTL**

Then , half of each group was exposed to an **immune challenge** (**IC** by LPS injection) vs. controls (saline injection). On day 0, IC food shortaged individuals skipped torpor, and entered fever. But by day 1, they returned to deep torpor, whereas CTL_{IC} prolonged euthermia. **Immune challenged individuals were forced to reduce torpor use.**



Canale & Henry (2011) Funct. Ecol.

WHICH ARE THE TEMPERATE SONGBIRDS THAT SURVIVE TO CLIMATIC ANOMALIES ?

NATURE

We will use **25 years** of standardized **capture-recapture data** of 20 common species to identify the spatial scale (**local – regional – national**) at which **climate forcing** operates on local demography, and test if **hot anomalies** favor the local survival of **smaller individuals** (Bergmann's rule).

Téplitsky & Millien (2014) Evol. Appl. M. Ghislain, FRB – NPDC PhD; Labex BCDiv PhD

BEYOND EXPERIMENTAL BIOLOGY AND DEMOGRAPHIC PATTERNS…

Healthy, fat, large individuals with good food availability on their territories have the most flexible use of torpor, and therefore should be the most resilient to climate-driven energetic constraints.

But how do we include this individual heterogeneity and metabolic flexibility in predictive models of the impacts of climatic changes on eco-climatic niche dynamics ?

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