Oxidative stress in helpers : the example of Alpine marmot

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CONTEXT

Kin selection is the evolutionary pressure that play a key role in the evolution of cooperative societies [1]. In such societies, the **cost of reproduction** is shared between breeding individuals and individuals who assist them, called **helpers** [2].
A major question: does helping carries measurable **physiological cost** for helpers?

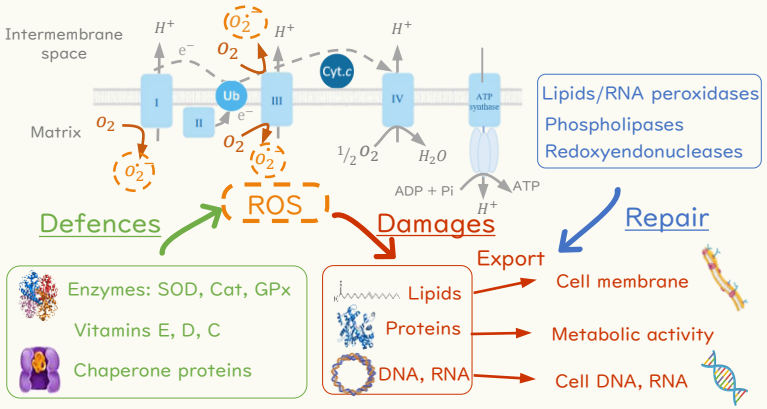
In some studies, helping has been shown to have an impact on helpers' body weight (i.e. in meerkats and in Seychelle warbler [3,4]). However, the consequences of helping and the **modulation of helping effort** have been poorly studied.
Many **physiological indicators** can be used to assess the cost of helping.

OXIDATIVE STRESS AS A COST OF HELPING ?

1) What is oxidative stress ?

Production of Reactive Oxygen Species (o_2^-) by mitochondrial respiratory chain and cellular consequences [5, 6].

Oxidative stress is considered as a mediator of **life-history trade-offs**: reproduction, senescence, immunity and development [6].



2) In cooperative breeders ?

Oxidative status of **dominant individuals** in wild cooperative breeders linked with **reproduction** :

Species	Antioxydant defenses ?	Oxidative damages ?	Effect of helpers ?
♀ Seychelles warbler [4] *(Acrocephalus sechellensis)*	↗	NS	Probably +
Superb starlings [7] *(Lamprotornis superbus)*	NS	NS	+
♀ Sociable weaver [8] *(Philetarius socius)*	NS	↗	Not tested
♀ White-browed sparrow weaver [9] *(Plocepasser mahali)*	↘	↗	+

Cooperatives societies promotes sharing reproduction costs between dominants and helpers.

Only 2 studies [4,7] assessing the cost of helping in terms of oxidative stress.

EMPIRICAL STUDY

1) Which study organism ?

Alpine marmot *(Marmota marmota)* : hibernating ground-dwelling squirrel and cooperative breeding.

Family group =  Dominants, Subordinates, Pups

Helpers : subordinates males(≤ 2 years old), help increase juvenile survival by warming them during hibernation [10]. But helpers have a physiological cost of helping, the **loss of body mass** [11].

2) Which predictions ?

Helping does not have oxidative cost.

Helpers can balance the oxidative cost of helping.

Helping have an important cellular cost.

Helping is too expensive to counter oxidative stress.

3) Models and data to assess that ?

Defenses(helpers) ~ number(helpers)*number(pups) + environment
Damages(helpers) ~ number(helpers)*number(pups) + environment

Environment : territory, climate

Data were collected between April and July from 2009 to 2011 in a population located in the Nature Reserve of La Grande Sassière. Blood samples from 50 helpers among 25 families.
Oxidative status will be estimated from 2 markers :

Marker of antioxidant defenses

- **Enzymatic antioxydant capacity: SOD assay**

Superoxide dismutase converts superoxide into hydrogen peroxide. Activity measured in plasma by spectrophotometry. Inexpensive, relatively reliable, simple but no possibility of sample storage.

Marker of oxidative damages

- **Lipids peroxidation: TBARS assay**

Thiobarbituricacid Reacting Substances. Estimating MDA (malondialdehyde) in plasma, stable product of oxidation to polyunsaturated fatty acids. Inexpensive, possibility of sample storage but can react with other compounds.

LIMITS

Plasma samples allows to have the circulating oxidative status and to leave animals alive. Two markers of antioxidant defenses and oxidative damages and one tissue are not enough to assess to the real oxidative status. Free radicals production and repair mechanisms markers measurement could be added to better understand oxidative stress complexity.
Moreover, studying other physiological costs could allow to complete the assessment of helping cost.

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