

Surviving fasting in the cold

July 2 2013



King penguin biology is characterized by an exceptionally long breeding cycle during which the chicks exhibit a terrestrial growing phase of longer than one year. During the austral winter, king penguin chicks are infrequently fed by their parents and usually undergo severe food deprivation. Credit: Pierre-Axel Monternier

King penguin chicks survive harsh winters with almost no food by minimising the cost of energy production. A new study, to be presented at the Society for Experimental Biology meeting in Valencia on the 3rd July, shows that the efficiency of the mitochondria, the power house of

the cell, is increased in fasted king penguin chicks.

King penguin chicks are socially and morphologically well adapted to harsh environmental conditions, however, they experience a severe energy challenge during the cold sub-Antarctic winter, when food is not readily available. Research headed by Pierre-Axel Monternier and Prof Damien Roussel at the Ecology of Natural and Man-impacted Hydrosystems laboratory in France looked, for the first time, at how the king penguin chicks' mitochondria in skeletal muscle, the main heat producing tissue in birds, function during fasting in the winter.

Pierre-Axel Monternier said: "We found that the efficiency of mitochondrial functioning increased in fasted winter-acclimatized king penguin chicks. This indicates that less substrate/oxygen was consumed to produce the same amount of energy in the form of ATP, showing that [mitochondria](#) from fasted chicks adjust its functioning to minimize the cost of energy production."



Pierre-Axel Monternier

Fasting in the cold represents a bioenergetics trade-off between sparing energy for body maintenance and dissipating energy for heat production and endothermy maintenance. In this challenging context, chicks develop a whole range of energy sparing mechanisms (social huddling behavior, reduction in muscle activity and basal metabolic rate, short period of hypothermia and high thermal insulation) that lead to reduce the energy allocated to heat production and growth. Credit: Pierre-Axel Monternier

This study shows how [king penguins](#) are able to produce heat to survive the cold without depleting their energy stores, an essential mechanism to survive the cold when food is scarce. Their biological adjustments increase survival of chicks, which, among birds, have an unrivalled fasting endurance (up to 5 months).



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Provided by Society for Experimental Biology

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