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Conservation physiology

A new challenge for thermal biologists

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Global change presents a huge and exciting challenge to the study of thermal physiology. The implication of thermoregulatory strategies and abilities for the survival of individuals and species, are of high importance for predicting species response to global change challenges and ways to mitigate them, and for conservation acts. A good example of such a study is the paper by Cooper and Withers in this issue.[1]

Populations and communities worldwide are changing in distribution and composition as a result of major drivers of global change and their impact on environments, climate, resource availability, and inter- and intraspecifc interactions. These changes are expected to be major stressors for the majority of living organisms and to cause significant species declines. For some of these threats, the ability to regulate energy expenditure and use torpor or hibernation may be of specific significance.[2-4] Hibernation was traditionally studied as an adaptation to energetic challenges in cold climates. However, during recent years, hibernation was described as an adaptation to diverse challenges, both biotic and a-biotic and in diverse habitats, ranging from deserts to tropical.[2] By hibernating for several weeks/months of the year, populations can survive conditions that are outside of their fundamental niche parameters. However, during hibernation animals may also be vulnerable to global changes, mainly in endotherms whose torpor is adapted in a fine-tuned manner to environmental conditions.[5] For example, during hibernation animals do not feed and therefore have to rely on stored body fat as an energy source, whose rate of use depends on ambient temperature.

In spite of a huge interest in global change and biodiversity, very little scientific thought and research has been conducted at the interface of global change and thermal physiology. Understanding the adaptive significance of using torpor and hibernation, and the conditions needed for efficient and successful hibernation, are important for predicting species response to global change challenges facing vertebrate endotherms, ways to mitigate them, and for conservation acts.

In their paper, Cooper and Withers[1] studied The Mountain Pygmy-possum (*Burramys parvus*), an Australian endangered marsupial, performing long hibernation during winter in New South Wales and the Victorian Alps. It is dependent on winter snow and thus is confined to areas above the winter snowline, approximately 1370 meters above sea-level. Only three populations are known, occupying less than 7 sq. kilometers, with total population size estimated in 2005 to less than 1600. It was first described from a Pleistocene fossil in 1896, and was thought to be extinct, until re-discovered in 1966.[6]

Recent field studies suggested that Mountain Pygmy-possum have a preference for boulder fields with close proximity to permanently flowing subnivean streams.[7] In order to understand the preference to running water and its importance for the species conservation, Cooper and Withers[1] hypothesized that during hibernation Mountain Pygmy-possum arouse to drink in order to keep their water balance, and modeled the energetic cost of drinking water vs. the consumption of snow. They found that consuming snow significantly increases energetic requirements, and will result in faster replenishment of energy during the hibernation period (e.g., consuming 5 % of body mass will increase energetic demands by the equivalent of 30 vs. 8.6 days for snow and water consumption respectively). As a result, when consuming snow the Mountain Pygmy-possum will have insufficient energy reserves to sustain hibernation until the arrival of Bogong moths, which migrate to the area during spring and form a major food source for the possums (temporal mismatch), and impact overwintering survival. This finding emphasizes the importance of subnivean access to liquid water during winter for this species, and is important for conservation acts, for example when setting priorities for habitat conservation and management or Mountain Pygmy-possum reintroduction.

Global change presents a huge challenge to science. It also poses a huge and exciting challenge to the study of thermal ecology in general and that of vertebrate endotherms in particular, primarily in the context of climate change, but also other changes in the physical environment as well as in populations and communities. Research at the interface of thermal physiology and ecology is urgently needed, and will most probably produce exciting new insights to the growing scientific field of global change biology.

Disclosure of Potential Conflict of Interest

No potential conflicts of interest are disclosed.

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