Desert birds' capacity to keep cool depends on their drinking habits

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Birds inhabiting hot desert habitats occupy some of the most physiologically challenging environments on the planet, where extremely high environmental temperatures pose substantial risks of lethal hyperthermia and dehydration. One key challenge arid-zone birds face is maintaining their water balance and ensuring water losses do not exceed water gains. Some species drink at waterholes on a daily basis, often flying considerable distances to do so. Others, however, are able to maintain their water balance without ever drinking, often switching from seed to insect diets during hot periods and using behaviours that minimize water losses.

Variation among species in terms of water dependence has been well-studied in the context of behaviour and movement ecology, but much less is known about functional links between drinking habits and thermal physiology. We hypothesized that the heat tolerances and evaporative cooling capacities of desert birds have co-evolved with their drinking water dependence. We quantified relationships between air temperature, body temperature, evaporative water loss and resting metabolic rate in 13 songbird species in the arid western parts of South Africa, and used these data to test predictions that a) regularly-drinking species invest larger amounts of water in evaporative cooling than non-drinking species and b) drinking species can maintain body temperature below upper critical limits up to higher air temperatures than non-drinkers.

Set-up in the field.

Our data supported both predictions. At high air temperatures, non-drinking species typically increased rates of evaporative water loss by around 8-fold above baseline levels. Drinking species, on the other hand, showed maximum rates equivalent to approximately 12 X baseline levels. The greater capacity of drinkers to elevate rates of evaporative heat loss was correlated with more impressive heat tolerance. Most non-drinking species handled maximum air temperatures of 50 °C or lower before reaching their thermal limits, but drinking species typically reached 52 °C or higher.

These findings provide new insights into the co-evolution of avian behaviour and physiology in desert environments, and have implications for understanding the vulnerability of arid-zone birds to rising temperatures associated with rapid anthropogenic climate change.