not so chilled?

Burchell's Sandgrouse

ALBERT FRONEMAN

Sandgrouse are *the* classic desert birds. There is no group of birds more archetypally arid-adapted, no taxon that better exemplifies avian evolutionary responses to xeric environments. The calls of sandgrouse arriving at a waterhole to drink are as quintessential a part of the soundtrack of the Kalahari or Namib as the '*tik-tik-tik*' of barking geckos after sunset.

The lessons sandgrouse have to offer about how birds survive and breed in some of the harshest places on earth have made them a source of enduring fascination to ornithologists. Reports in the 1890s that male sandgrouse transport water in their belly feathers to chicks were met with considerable scepticism by the scientific community. It was only 70 years later, in the 1960s, that this remarkable behaviour became accepted as fact, thanks mainly to the observations of Tom Cade and Gordon Maclean.

Sandgrouse spend most of their lives on the ground, in habitats where they are often exposed to searing air temperatures combined with intense solar radiation. Their nests are shallow scrapes in exposed sites and incubating adults must tolerate high heat loads. The remarkable ability of these birds to cope with extreme conditions is perhaps best illustrated by observations from Morocco, where incubating sandgrouse sometimes have to deal with air temperatures above 50 degrees Celsius for four hours each day.

In 2013 a team of researchers from the universities of Pretoria and New Mexico investigated the capacity of Burchell's Sandgrouse *Pterocles burchelli* to cope with extremely high temperatures. Working at a site near Vanzylsrus in the Northern Cape, we measured physiological variables of sandgrouse experiencing temperatures similar to those they encounter on extremely hot days during midsummer.

The sandgrouse were able to cope with substantially higher temperatures than could small passerines like Scaly-feathered Finches and Sociable Weavers, but that was hardly unexpected. More surprising, though, was that the sandgrouse had to work really hard to keep cool. As soon as they began panting (at about 44 degrees), their metabolic rates increased sharply. Offloading heat to the environment thus required the production of significant quantities of additional heat, with the result that the cooling process was much less efficient than it might otherwise have been.

Compared to some groups of birds, evaporative cooling in Burchell's Sandgrouse is strikingly inefficient. Columbids (doves and pigeons) are able to dissipate heat rapidly without panting, by evaporating water directly across their skin. Unlike those of sandgrouse, the metabolic rates of columbids remain low at extremely high temperatures. The same is true for nightjars: even when roosting in full sunlight on scorchingly hot surfaces, their metabolic rates remain near baseline levels, which provides the physiological foundation for extremely efficient cooling.

It is puzzling that sandgrouse seem not to have evolved evaporative cooling of comparable efficiency to that seen in columbids and nightjars. One likely consequence is that sandgrouse are less well equipped to handle increases in maximum temperature extremes, and hence are potentially more vulnerable to direct, heat stress-related impacts of climate change.

ANDREW McKECHNIE