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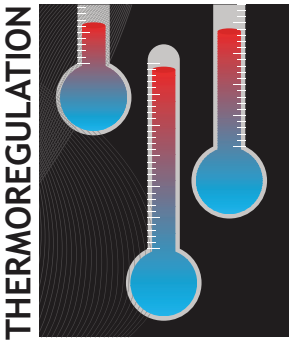
OUTSIDE JEB

Beating the heat through the beak



Darwin's finches are recognized for the remarkable diversity of the form and function of their beaks. The finches became well known when they were used as an example to explain the concept of evolution after it was realized that the finches have different bills because they have adapted to eat different kinds of food. But bills are also important for heat exchange. Birds can alter blood flow to the bill according to the temperature of the bird's surroundings. This means that they can effectively use their bills as a radiator to 'dump heat'. Having been part of the team that originally discovered this function, Glenn Tattersall, from Brock University in Canada, recently gathered colleagues from the USA and Ecuador to find out whether, in addition to enabling their owners to exploit different food sources, the bills of Darwin's finches could also differ in their ability to exchange heat.

The team studied four species of Darwin's finches during summer on the Galapagos Islands. During their visit they measured the thermal properties of the bills of the large, medium and small ground finch (*Geospiza magnirostris*, *G. fortis* and *G. fuliginosa*) as well as the cactus finch (*G. scandens*), with a size ranging between those of the medium and the large ground finches, with a pair of hand-held thermal imaging cameras by photographing the birds foraging in the open during the day. The researchers also photographed recently dead birds placed in the same positions and locations as the live birds, for comparison. In addition, the team knew that the amount of heat from the sun increases the heat load on the bird while the external temperature and wind speed influence the potential for the bird to get rid of heat; in other words, the stiller and warmer the air, the less heat a bird can dissipate. Armed with this knowledge, they measured the air temperature, solar heat and wind speed in the vicinity of the birds to calculate the potential amount of heat that each bird could dump into their surroundings.

As expected, Tattersall and colleagues found that when the conditions were warmer outside, the temperature of the body and legs increased, as did the surface of the bill. More importantly, the team found that the finches could actively control heat loss through the bill, as the bills of the dead birds warmed up considerably faster when placed in the sun than the bills of the live birds. And the team found that the birds' bills are effective heat dissipaters even at high temperatures, in contrast to the legs and body, which gain heat instead of dissipating it.

However, when the researchers calculated the highest temperatures at which each species is able to dump heat through their bills, they found considerable differences. While cactus finches were able to dissipate heat through the bill at air temperatures of more than 40°C, the threshold for the three ground finches was up to 3°C lower. Also, the heat exchange capacity of the bills of the three ground finches was very similar, despite the difference in their body sizes. This could be related to the structure and shape of the bills, which are adapted to different food sources. The beak of the nectar-feeding cactus finch is rather long, to reach the nectaries of flowers, whereas the beaks of the three other finches are relatively short and pointy, to crack open hard nuts and seeds.

Therefore, the shape and structure of Darwin's finches' bills may have been formed not only by their food preferences, but also, in part, by their need to remain cool.

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