



What a Cool Bill!

**“...the toucan’s bill is...one of the largest thermal windows in the animal kingdom, rivaling elephants’ ears in its ability to radiate body heat.”
— G. J. Tattersall**

We are all familiar with the oversized bills of toucans, and the toco toucan (*Ramphastos toco*) has the largest one of all, accounting for fully 40% of its body surface area. The purpose of such an oversized schnoz has prompted such debate that even Darwin felt he had to comment. In 1871 he stated, “Toucans may owe the enormous size of their beaks to sexual selection, for the sake of displaying the diversified and vivid stripes of colour with which these organs are ornamented”. Other explanations have included fruit peeling, territory defense and serving as a visual warning.

But now in a paper published in the July 24, 2009 issue of *Science*, researchers have provided the answer. Glenn J. Tattersall of Brock University, St. Catherines, Ontario, Canada and his colleagues show that the big beak acts like a carefully regulated heat radiator used for cooling the bird.

The bill is composed of a bony core surrounded by a network of blood vessels all of which are encased in a horny sheath. Tattersall, *et al.* used heat-sensing cameras to measure the temperature of different parts of the bird’s body as it sat in an environmental chamber while they altered the ambient temperature. Air temperatures ranged from as low as 8-10°C (~48°F) to as high 35-36°C (~96°F). They found that the bird, which doesn’t sweat, is able to control precisely the blood flow to its bill over a wide range of temperatures.

At ambient temperatures approaching 25°C (77°F) the tip of the bill remained cool, only a few degrees higher than the air. However, the proximal portion warmed to as much as ten degrees centigrade (16°F) above the ambient temperature, indicating it was losing heat to the air. At ambient temperatures above 25°C the tip of the bill also began to warm up considerably, rising as much as seven degrees centigrade (13°F) above the air temperature. This occurred because it too began receiving an increased blood flow and dumping excess heat from the body. The temperature changes in the bill’s surface occurred rapidly. But throughout the observed ambient temperature range the back of the bird remained just a few degrees above ambient, indicating relatively little heat loss through the body itself.

These results show that the toucan’s bill is used as the major portal for heat loss. In fact, the researchers estimated that as much as 400% of resting body heat can be lost through the bill as compared to a maximum of 91% through the elephant’s ears. According to Tattersall, “By altering blood flow to the bill’s surface, toucans can conserve body heat when it is cold, or cope with heat stress by increasing blood flow”.



Ecologists have long known that extremities like limbs and ears are used by warm-blooded animals for thermoregulation. Moreover, it is commonly observed that among related species, the more northerly relatives have shorter extremities to conserve heat (think snowshoe hare), whereas the more southerly groups have long extremities to lose heat (think jackrabbit).

Forty years ago evidence accumulated that some dinosaurs were warm-blooded and speculation began about the bony projections sported by many of them. For example, could the bony plates running down the back of *Stegosaurus* or the large bony neck frill of *Triceratops* have been used for thermoregulation as well as defense?



The beak of the toco toucan says it's a good bet.

Saul Scheinbach