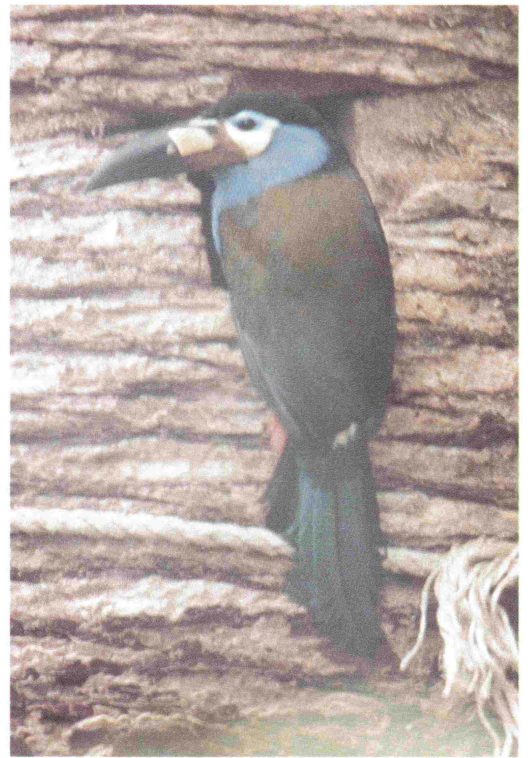
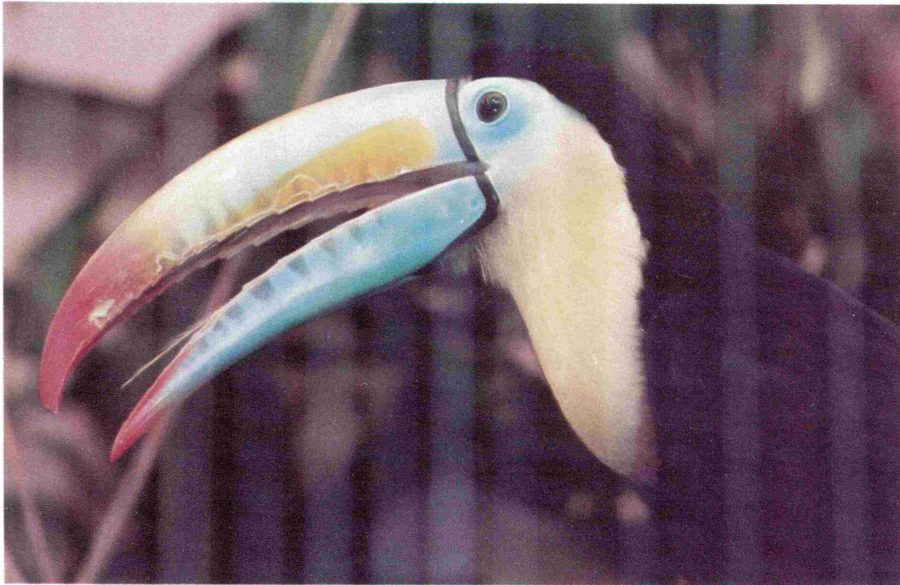




Close-up of a female saffron's schnoz. The small notch near the end of the bill is an individual quirk.



A plate-billed mountain toucan profiles her peculiar beak. The yellow patch on her back is the mark of the female.



A keel-bill toucan shows off his overgrown beak.



A young saffron toucanet flaps off with her favorite food. The lack of tail and over-grown feet are marks of the juvenile.



A pet emerald toucanet debates whether or not to eat his bit of apple.



A crimson-rumped toucanet peeps out of her palm log nest hole.

The Long Bill of the Toucan

by
Roger Paul Williams
and
Elaine Radford
New Orleans, Louisiana

Ever since the first human saw a toucan, people have wondered why a bird would have such an awkward-looking bill. Adding to the confusion is the fact that, once having grown the beak, the ingenious toucan puts it to use in a variety of ways, many of which are probably unrelated to its original function. We'd like to leap into the resulting fray with a suggestion of our own: we think the toucan evolved its bill as a cooling system.

The toucan's bill is a light, porous structure rich in blood vessels, internally similar to the smaller beaks of other softbills. Like all birds, the toucan has no sweat glands and hence must pant when overheated, using the evaporation of moisture within its open mouth as a cooling mechanism. But the toucan has a real problem regulating its body temperature; not only does it dwell in the hot, humid rain forests of Central and South America, where evaporation is a slow and difficult process, but its plumage consists of fine, almost fur-like feathers which can act like an insulating blanket. Perhaps the toucan's answer to the dilemma was the development of a long beak with broad internal surface area, allowing the blood circulating therein to cool more efficiently as the bird gaped.

There's little doubt that the bill is, at least sometimes, put to this purpose. During the record-breaking heat wave of New Orleans' summer of 1984, our pet emerald toucanet indulged in showers and baths up to five times a day. So closely does this bird link a wet bill with coolness that he has learned to ask for the shower mister by gaping as widely as he can, as if yawning. Once under the spray, he concentrates on

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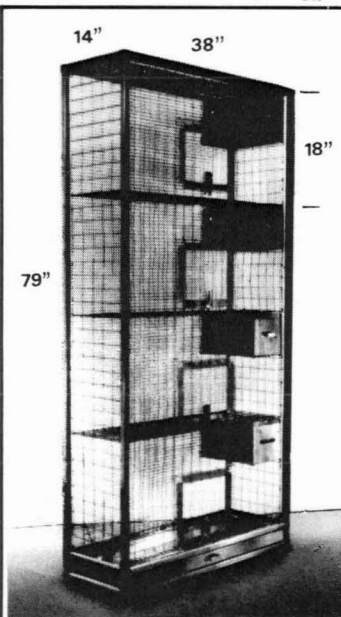
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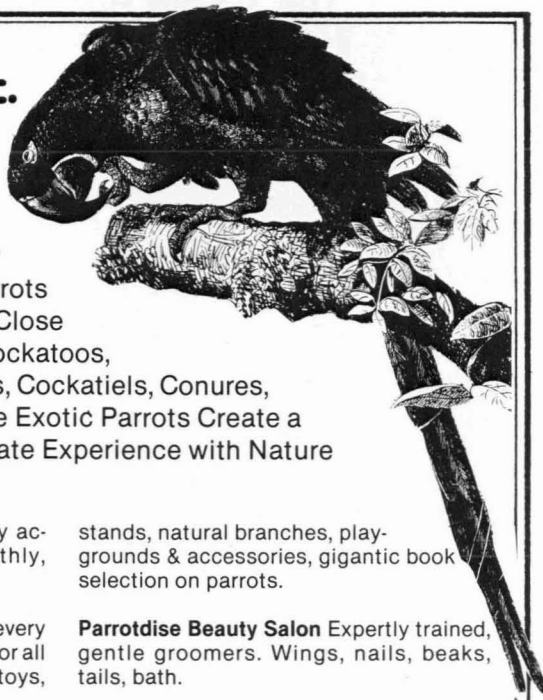
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catching the droplets within his mandibles by yawning and stretching vigorously.

But is there any evidence that this is the original reason for the bill's evolution? We believe so. In addition to the environmental factors already described, there is a rough correlation between habitat and bill size. The larger toucans of the genus *Ramphastos* live in the hotter jungle regions, while the smaller, shorter-billed toucanets generally inhabit the cooler mountain slopes. This trend reflects the need for greater heat loss (and hence larger bills) in the hotter, more humid sea-level rainforests. None of the alternate hypotheses addresses this observation.

Of course, competing theories abound. The most obvious was also the first discredited; like most birds, the toucan has a poor sense of smell.

Another dimly regarded possibility is that old standby, "protective coloration," which has been applied at one time or another to every unexplained bit of plumage in the class *Aves*. The first ornithologist to perform an in-depth field study on toucans dismissed this theory out of hand. In *The Life History of the Toucan*, Josselyn Van Tyne writes, ". . . the actions of a toucan usually defeat any [such] purpose. . . . At the first sign of danger, the toucan almost invariably begins to bob about on its perch and croak loudly, advertising its presence to all within half a mile or more." Protective coloration is useless to an animal that can't sit still.

A more seriously considered idea is that the bill evolved for purposes of identification. In the field, some species can scarcely be distinguished from one another unless the bill is visible; the keel-billed and the chestnut-mandibled (Swainson's) are such a pair. Yet the species identification thesis seems somehow inadequate. While it can hardly be argued that the toucans don't use this handy tool for recognition, we don't feel this theory tells us why the bill came about in the first place. After all, the fact that humans might use the shape of a nose to help recognize one another doesn't mean that Roman noses evolved for that purpose.

At any rate, Van Tyne's studies suggest that the bill developed before the markings. In the genus *Ramphastos*, for instance, we find that the most primitive species, the red-breasted toucan, has a dull green bill, while colorful patterns run riot on the beaks of more advanced species such as the keel-billed. Species recognition, in that case, is almost certainly a secondary function

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of the overgrown bill.

Similar objections arise to the hypothesis that the bill is a convenient feeding device. Why not a slender, more easily negotiated beak like that of an ibis if ease in eating is the goal? In truth, when watching the acrobatics necessary for toucans to feed with their unwieldy bills, we're amazed that anyone could consider this appendage a dinner-time advantage. It's quite common to observe a toucan or toucanet knocking itself clear off its perch while fighting a morsel into position for swallowing.

Although the theory that the long bill evolved for use in battle is a colorful one, we must be careful not to confuse observations of avicultural specimens with what really takes place in the wild. While breeding pairs of captive toucans have been known to injure and even kill their aviary companions, such events are rarely reported in nature where there is more room for a potential victim to flee the clumsy toucan. And as wild adult toucans are almost never attacked by predators, ornithologists haven't had much opportunity to see these fearsome-looking weapons employed in actual fighting. Toucans seem to rely on bluff, perhaps feinting but not actually striking. Given the fragility of this structure, it's probably just as well that it isn't usually pressed into service as a bludgeon.

Therefore, although toucans do use their bills at some time or another for one or more of these purposes, none of these older ideas fully explains how the big beak got there in the first place. Unlike most of these competing forces, the cooling function theory follows the classic form of an evolutionary driving force. It was there, in some measure, at the beginning since all birds gape to cool off; any small increase in bill size would be rewarded with a definite small increase in heat tolerance; and the magnitude of the advantage to the otherwise well-insulated toucan makes it believable that it would be worth the inconvenience to evolve the bill.

Finally, the geometry of the bill (broad rather than slender) is exactly what one would expect to maximize the interior surface area and hence evaporation potential. Given the congruence of these facts, it's easy to see how the bill might have gradually evolved to the comical dimensions we observe today, allowing the toucan to later modify its acquisition to allow for the activities suggested by the alternate theories. You see, the toucan simply went to extremes to keep its cool. ●

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