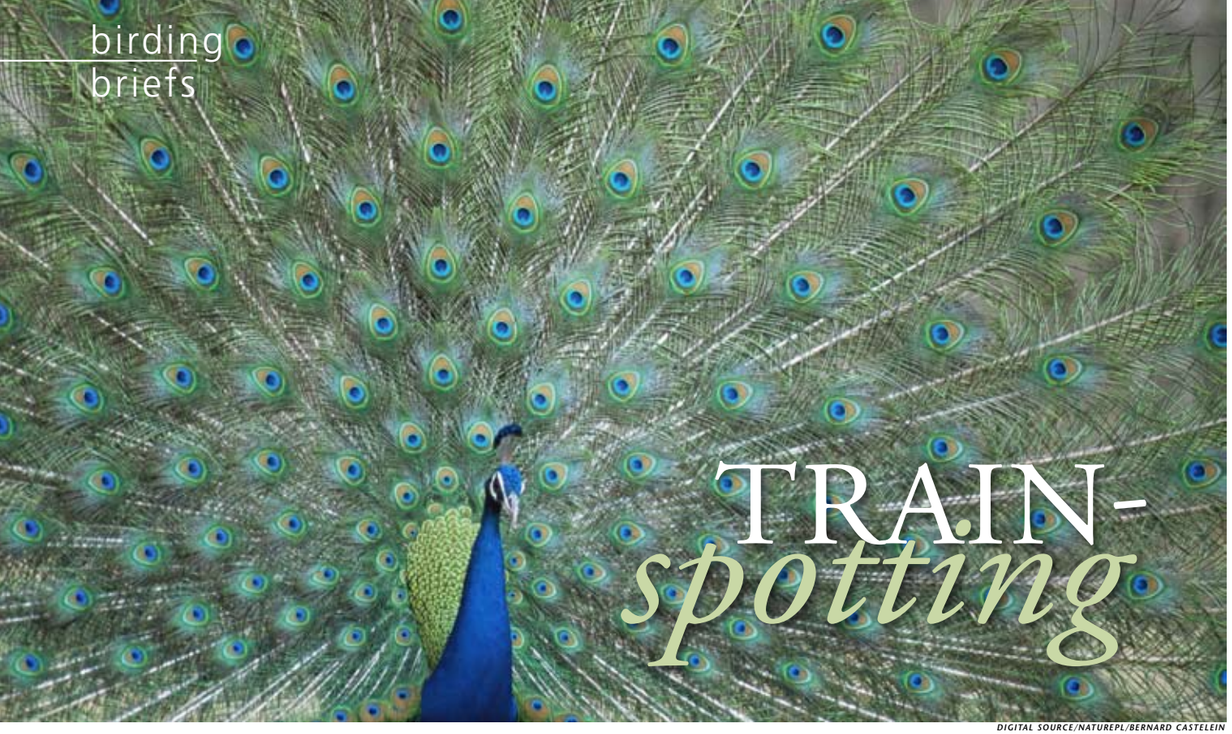

TRAIN-*spotting*

DIGITAL SOURCE/NATUREPL/BERNARD CASTELEIN

The elaborate tail of the male peacock is so gaudy, colourful and long that it is often used as a prime example of how male birds attract and dazzle females with elaborate plumages.

The process of females choosing males with the largest or most colourful display characters is termed sexual selection and many examples exist: cichlid fish with brilliant fin patterns, shorebirds with bright ruffs, giraffes with long necks, whydahs with long, symmetrical tails, and flowers with colourful and regular patterns. Symmetry is a trait often preferred by females (or pollinators such as bees) because it may be a reliable indicator of the vigour or fitness of the individual displaying it.

The Common Peacock *Pavo cristatus* is considered the prime example because of its extremely elaborate tail, an appendage so long it may actually hinder the bird's movements through the dense Asian jungles where it occurs. Furthermore, the male doesn't merely parade with his tail expanded hoping to impress a female, but actively 'shivers' it 20 or more times as a female approaches, and turns it to catch the light.

However, recent research on a feral peacock population in Japan questioned the use of the tail as a female attractant. Whereas researchers in the UK had found that the number of eye-spots and male mating success, the length of the train and male survival, and the size (weight) of the tail and the number of eggs fertilised by the male were all related, this did not tally with the results of the Japanese researchers.

They discovered instead that tail length and the number of eye-spots were unrelated, and that the degree of symmetry in the tail was not consistently related to the number of eye-spots. They did find that some males achieved most of the matings, but that the males that were more successful in one year did not have more eye-spots on their tails in that year than previously. In other words, eye-spots and mating success were not related. Also, those males lost to predators had longer tails than those surviving and there was no difference in the number of eye-spots. So, overall, few of the results expected under sexual selection were found. Does this mean that peacocks do not have tails to attract females?

In science it is always dangerous to conclude anything universal from a single study, and typically the best way forward is to undertake a simple experiment. This is a powerful way of manipulating just one factor while keeping all others the same to determine its effect on (in this instance) female preference. This was done by Petrie and others in a UK population: they manipulated the number of eye-spots in the tails of peacocks and found, as expected, that females then preferred those males with more eyespots. So why the differences between populations?

Petrie et al. suggest that it is not the number of eye-spots (measured by both Japanese and UK researchers) that is the direct signal used by females. It is, instead, the density of eye-spots (found by an independent French study) that is important, and this may have confused the issue. That is, the Japanese had not taken this factor into account in their study and may have relied on evidence from too few males. Whatever the reasons, peacocks remain with their tails not only to shiver at peahens, but to tease biologists keen on unravelling their function and significance.

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The eyes have it... A peacock with his train fully expanded.

COOL *tool*

Toucans' massive cooling bills

Toucans are among the most recognisable birds on the planet, thanks to their enormous, multi-coloured bills. The function and evolutionary significance of these remarkable appendages have puzzled biologists for centuries; Charles Darwin speculated they were the result of sexual selection, a process whereby large, colourful ornaments evolve because they are attractive to one or both sexes. Other suggested roles for the toucans' super-sized headgear have included peeling fruit, territorial signalling and nest predation. In 2009, however, a hitherto-unsuspected function was discovered: keeping cool.

Toucans' bills, it turns out, are powerful heat radiators that help the birds avoid overheating in their humid, tropical habitats. A group of Canadian and Brazilian researchers realised that a toucan's bill possesses characteristics of a thermal window (a poorly insulated region of the body with a well-developed blood supply used to dissipate heat). The large ears of elephants are a thermal window: during hot weather, blood flow to the ears is increased and ear-flapping causes internal heat to be rapidly off-loaded via convection.

To test their hypothesis concerning the heat-dissipating role of the toucan's bill, the researchers used a thermal-imaging camera to analyse temperature changes in the bills of captive-bred Toco Toucans *Ramphastos toco* in Rio Clara, Brazil. Adult and juvenile toucans were trained to sit quietly in a temperature-controlled chamber, which allowed the thermal conditions experienced by the birds to be varied. When air temperatures within the chamber exceeded 20 degrees Celsius, the blood flow to the region of the bill nearest the toucans' head increased, causing the temperature of the bill's surface to rise by several degrees. At higher air temperatures, blood flow to the tip of the bill also increased, resulting in similar surface temperature changes. These higher surface temperatures resulted in a steeper thermal gradient between the bill and the surrounding air, causing the birds to lose heat more rapidly.

The efficacy of the toucan's bill as a heat radiator arises from the intricate plumbing of the blood supply to it. The fine network of blood vessels below the bill's surface provides the mechanism whereby heat is transferred from the bird's core. Blood flow to the bill can be regulated in a manner analogous to turning an air-conditioner off in cool weather, to a 'low' setting at intermediate temperatures, and to 'high' in warmer conditions. This adaptability is made possible by a system of valves within the bill's blood-vessel network that shunts blood, and thus heat, to different areas of the bill in response to changing requirements for heat dissipation.

The amount of heat that can dissipate via the toucan's bill is significant and, relative to body size, far exceeds the amount lost through an elephant's ears. This cooling power is particularly useful during activity, such as flight, when the birds generate substantial heat loads. However, heat loss from the bill can become a liability in colder conditions, such as while roosting at night. This may explain the toucans' peculiar sleeping posture, whereby their massive bills are partly tucked under one wing and their tail feathers point forwards.

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Toco Toucan

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