

# How Zebras Got Their Stripes



Why do zebras have stripes? It's probably a combination of things.

Zebras' main predators are lions. Black and white stripes actually make zebras stand out against their grassland home, rather than camouflage them.

But when many zebras are running simultaneously, the cacophony of stripes may confuse predators as to how many zebras there are and which way they're moving, making it more difficult to target an individual.

However, lions are ultimately successful at catching zebras, so this optical confusion deters but doesn't prevent predation.

It's also thought that the alternating black and white areas may be a thermoregulation strategy. The black stripes are 20 degrees Fahrenheit warmer in the sun, which may help the zebra absorb the sun's heat on cool mornings, while white stripes reflect heat in the hot afternoons.

But perhaps the most beneficial quality of the stripes is to deter biting flies. Researchers have found that the stripes confuse the flies' depth perception, making it difficult for them to land and bite.

In tests, scientists dressed horses in striped coats and put them with captive zebras and solid-colored horses in fly-infested areas.

They found that flies preferred the solid-colored animals four to one, and either hovered over, or bounced off, the striped animals.

Scientists accept it's probably some combination of all these beneficial traits that led the zebra to develop stripes.

Beautiful Hartmann's mountain zebra (*Equus zebra hartmannae*) are native to southeastern Africa with only about 1,300 individuals remaining in the wild.

Credit: Ltshears, via Wikimedia Commons

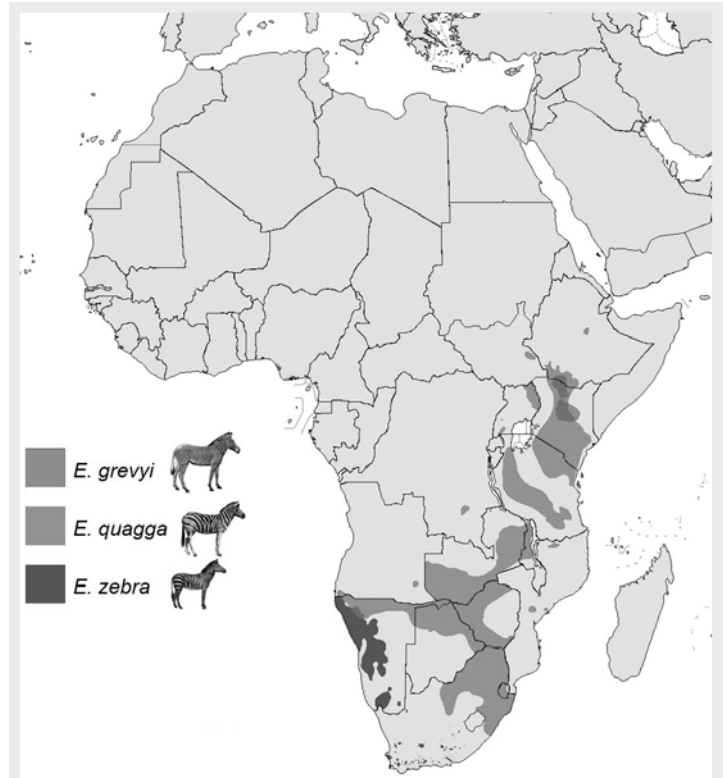


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# Background: How Zebras Got Their Stripes

**Synopsis:** With their dazzling black and white stripes, zebras are some of Earth's most striking animals. Since their colors cause them to stand out in their green-brown grassland habitat, the function of their stripes has perplexed scientists since the days of Charles Darwin. Do the stripes enable thermoregulation? Do they confuse predators? Or are they insect repellent that prevents biting flies from transmitting deadly diseases? Or is it all of the above?

- Zebras come from the *Equus* genus, the same as horses and donkeys.
  - *Equus* originated in North America about 4 million years ago (Pliocene) and migrated to Eurasia and Africa between 3.4 to 2.1 million years ago (Pliocene to early Pleistocene). By that time horses had split away as a subgenus, and by 2 million years ago asses and zebra had split apart.
  - There are three living species of zebra in Africa: the most populous are the plains zebra, with small populations of the mountain zebra and the Grévy's zebra remaining in the wild.
- Most zebras live in male-dominated social groups, but Grévy's zebras prefer to live alone or in loose groups.
  - They live in grasslands, savannahs, woodlands and mountainous areas.
  - They graze on dry grass that is too tough for other grassland species, like antelopes and wildebeest, to digest.
  - Lions are their main predator, but leopards, cheetahs and hyenas also attack them. They bite and kick to protect themselves.
  - Zebras sound like horses and donkeys, snorting and braying and sometimes barking like dogs.
  - Unlike their cousins horses and donkeys, they have never been domesticated.
- Zebras have black skin under their black and white stripes, so technically we can say they are black with white stripes. But how did they get their stripes?
  - In folklore, a San legend from the Kalahari Desert of Namibia says that a selfish baboon, refusing to share his water hole with zebra, fought the zebra, resulting in losing the fur on his backside and the zebra being burned in a poolside fire, causing the stripes.



The modern range of zebra species.

1. *Equus grevyi* (red) is called Grévy's zebra with about 1,500 individuals still living and no subspecies (IUCN endangered).
2. *Equus quagga* (green) is known as the plains zebra with about 750,000 individuals in five subspecies (IUCN near threatened). One subspecies has recently become extinct.
3. *Equus zebra* (blue) is the mountain zebra with just 9,000 individuals remaining in two subspecies (IUCN vulnerable).

Credit: Mariomassone, via Wikimedia Commons

## References: How Zebras Got Their Stripes

Zebra Facts | LiveScience

Motion Camouflage Induced by Zebra Stripes | Zoology

How the Zebra Got Its Stripes: A Problem | The Royal Society

Benefits of Zebra Stripes: Behaviour of Tabanid Flies | PlosOne

We Now Know Why Zebra's Stripes Are So Effective | ScienceAlert



Contributors: Juli Hennings, Harry Lynch

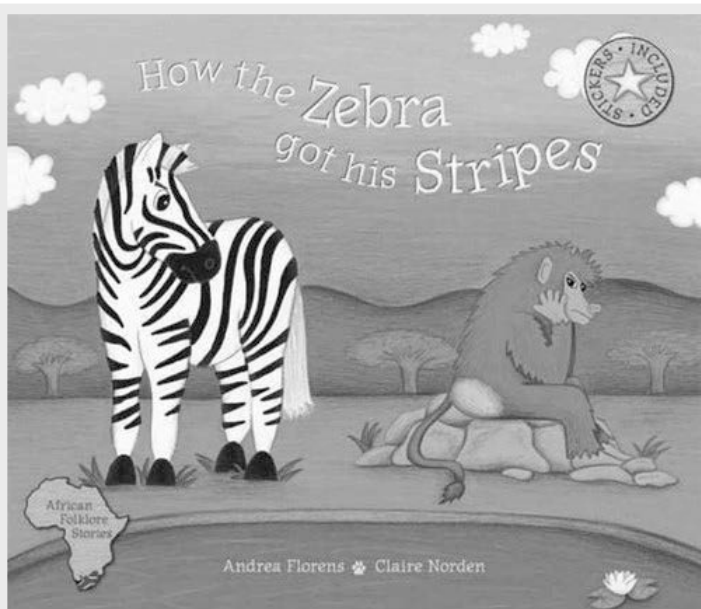
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Aerial view from a helicopter of a group of Burchell's zebras (*Equus quagga burchellii*), Okavango Delta, Botswana.

Credit: Diego Delso, via Wikimedia Commons



The fable is a popular children's book.

Credit: Andrea Florens and Claire Norden

- Rudyard Kipling lightheartedly mused that the zebra got its stripes by standing in dappled shade, “with the slippery-slidy shadows of the trees” falling on its body.
- Over a century and a half, scientists have come up with more than a dozen hypotheses about the evolution of zebra stripes.
  - In the 1870's, Charles Darwin openly puzzled about them, originally suggesting they served as a fingerprint-like identifier that helped with social cohesion as males and females identify mates. Every zebra's stripe pattern is unique.
  - He also proposed the stripes may act as camouflage in the hot, hazy African air. But zebras prefer open grasslands to stripy woodlands that might better camouflage them, and they don't try to hide from lions, they run, so their conspicuous stripes don't help as traditional camouflage. Lions catch and consume many zebras.
- Three of the proposed hypotheses still stand:
  - Stripes evolved to help zebras evade predators through confusion-based motion camouflage that creates optical illusions. Recent work questions this hypothesis.
    - Stripes have been shown to influence the perception of size, speed and trajectory of an object, producing visual illusions like the spinning spokes of a wheel or the barber pole effect.
    - In chasing striped prey, lions visual systems are likely to be flooded with these illusions, and with a number of striped animals moving in different directions, it would be even more bewildering.
    - Researchers want to know—when lions attack striped prey do they react differently than when they attack solid-colored prey? This is very difficult to test for many reasons, including the possibility that optical illusions for human eyes may be different for lion eyes.
    - Since lions are ultimately successful at hunting zebras, this effect may only provide temporary protection.

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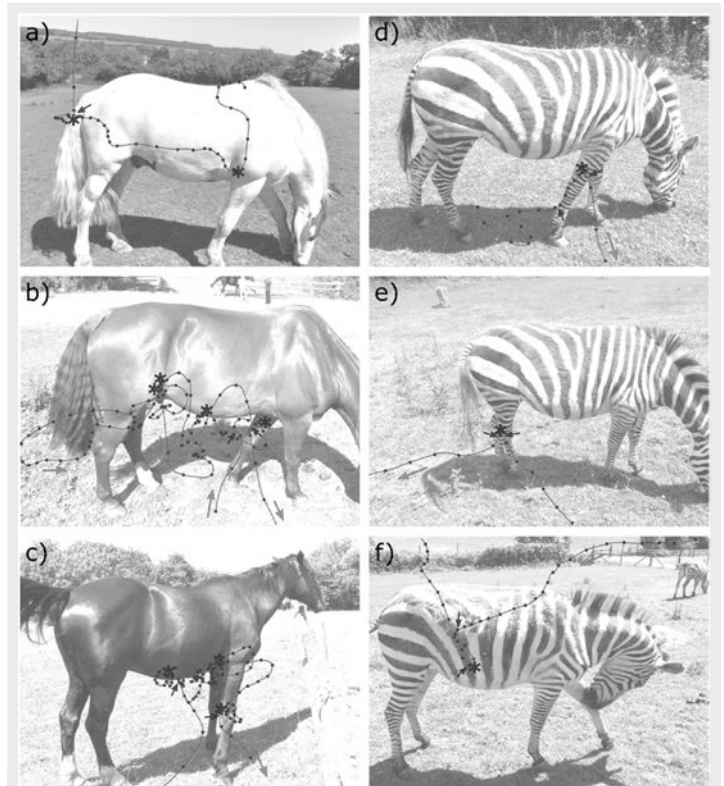


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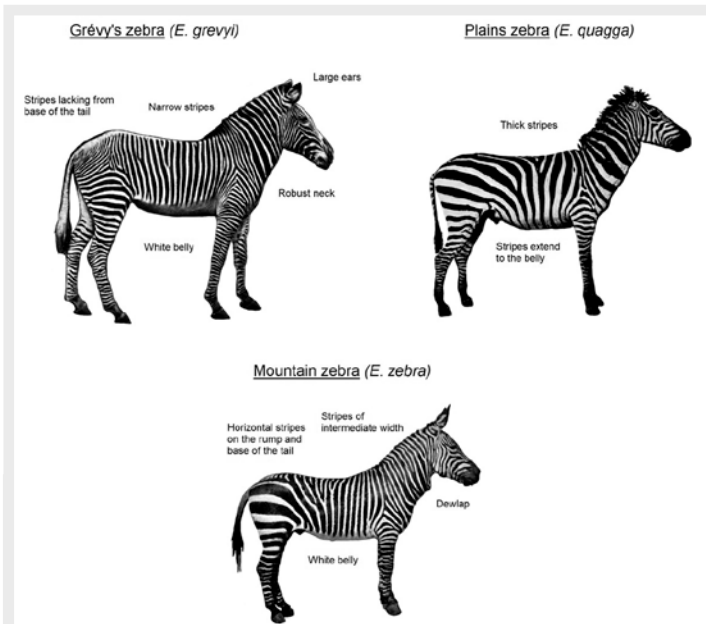
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- Stripes enable thermoregulation to warm and cool zebras.
  - Spacing and density of zebra stripes have been correlated with the average temperature or sun intensity of a group's habitat.
  - Black stripes absorb heat in the morning sun to warm zebras while white stripes serve to cool zebras during the blazing heat of the afternoon sun.
  - Black stripes on zebras have been shown to be 22 to 27°F (12–15°C) warmer than white stripes and may facilitate evaporation of sweat from the zebra's body, enhancing cooling in the African heat.



Examples of horsefly flight trajectories around domestic horses (a–c) and captive plains zebra (d–f). Red line indicates the flight path and dark red dots show position at 0.1 second intervals. Red arrows indicate direction of flight. Blue stars show points of contact or landings on the equid. Blue arrows show the end position of the approach and start position of the leave phases of flight. These markers are associated with maneuvers that show changes in both direction and speed, and where this could not be reliably identified (e.g. approach in a), the data were omitted from analysis (February 20, 2019).

Credit: Caro T, Argueta Y, Briolat ES, Bruggink J, Kasprosky M, Lake J, et al., via Wikimedia Commons



The placement and intensity of zebra stripes vary across species and location. These 1897 to 1912 drawings show comparative illustration of living zebra species.

Credit: Lydekker, RichardGriffini, AchilleHayes, Matthew Horace, public domain, via Wikimedia Commons

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- Zebra Facts | LiveScience
- Motion Camouflage Induced by Zebra Stripes | Zoology
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- Stripes confuse and repel dangerous biting flies (tsetse flies and horseflies) that carry fatal diseases.
  - Striping is more pronounced in zebra herds in fly-infested environments.
  - Since 1981, scientists have performed experiments with biting flies and stripes, confirming that they prefer to land on large dark surfaces.
  - While they may hover, fewer flies land on striped surfaces, especially when the stripes have strong contrast. When they try to land, the flies do not decelerate sufficiently, causing them to bounce off. It appears they may struggle to gauge their distance to a striped surface.
  - Researchers have shown that the relatively close spacing of zebra stripes falls in a range that is optimal for confusing the flies, making the zebra appear to be less of a target, or multiple thin targets.
- In 2019, scientists dressed some horses in zebra coats and compared the behavior of biting horseflies on the costumed horses, some tame zebras, and some solid-colored white and black horses. The flies bit the solid-colored horses but appeared to be confused about where to land on the zebras as well as costumed horses, touching the stripes but not landing on the animals. They landed on solid-colored animals four times as often as they did on striped animals. They did bite the costumed horses on their exposed necks.
- Another piece of evidence supporting the biting fly theory is that one species—*Equus quagga quagga*—migrated away from tsetse fly-infested habitats in the Cape Province of South Africa and lost its stripes before becoming extinct in around 1870.
- Researchers accept that a combination of processes may have produced the distinctive stripes since biting flies also live in the warmest environments.

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