ELEPHANTS · GENETICS & EVOLUTION

Tuskless Elephants

Genetics, inheritance and evolution — and how ivory poaching reshaped an elephant population in a single generation.

SERIES **SAFARI NOTES** FORMAT **FIELD & GUIDING NOTES** PUBLISHED BY **THE SAFARI SHOW**

> Tusklessness has always turned up now and then in African elephants. What changed is how often. In places hit hard by ivory poaching, it became far more common among females, and it gives us a rare, well-documented example of humans driving evolution in a wild animal.

01 What are tusks?

Tusks are **modified upper incisors**. They are made mostly of **dentine** and keep growing for much of an elephant's life. Elephants use them as everyday tools:

FEEDING

Stripping & prising

Stripping bark, levering roots and getting at food other animals can't reach.

WATER & MINERALS

Digging

Digging in dry riverbeds for water and gouging out mineral-rich soil.

DEFENCE

Protection

Defence against predators and in fights between bulls.

SOCIAL

Communication

Displays and contact in social interactions within and between herds.

02 What does "tuskless" mean?

A tuskless elephant develops **without visible tusks**. The trait occurs naturally at low levels in African elephant populations, but its frequency has risen dramatically in some populations that went through intense ivory poaching.

03 The genetic basis

A major study of elephants in **Gorongosa National Park, Mozambique** (published in 2021) used genome scans to identify the **AMELX** (amelogenin, X-linked) gene as a leading candidate for female tusklessness. AMELX sits on the **X chromosome** and is involved in tooth development.

The same study also linked a second gene, **MEP1a** (on chromosome 1), to the trait. Both genes have known roles in tooth development — including the formation of enamel, dentine, cementum and the tissues that anchor a tooth. So this is not a simple single-gene on/off switch, and the study did not find the exact causal mutations; but the AMELX region on the X chromosome could account for the unusual inheritance pattern seen in females.

In humans, damage to the region of the X chromosome around AMELX causes an X-linked dominant syndrome that is lethal to males and in which women can lack or have small **upper lateral incisors — the teeth that correspond to elephant tusks**. The researchers suggest that AMELX sits close to other genes that males can't survive without, which may explain why tuskless males are so rare.

04 Why are tuskless males so rare?

The variant linked to tusklessness appears to be **lethal to males**. Females have two X chromosomes (XX), so a female carrying one affected X survives — she is simply tuskless. Males have one X and one Y (XY). A male that inherits the affected X has no second copy to fall back on, and is thought not to survive.

The evidence for this is in the calves. In Gorongosa, **65.7% of the young calves (up to 5 years old) of tuskless mothers were female** — almost exactly the two-thirds you would expect if half their sons never survived. Tusked mothers' calves showed no significant bias. The researchers stress that the exact genetic and developmental mechanism is still unknown.

SIMPLIFIED CROSS: TUSKLESS MOTHER × TUSKED FATHER

Mother (tuskless) carries one affected X	Father (tusked) X	Father (tusked) Y
X^t	X^t X — Daughter Tuskless	X^t Y — Son Usually not viable
X	X X — Daughter Tusked	X Y — Son Tusked

X^t = X chromosome carrying the tusklessness-linked variant

Expected outcome: half the daughters tuskless, half tusked; surviving sons tusked. The result is fewer sons overall.

OFFSPRING	INHERITS	EXPECTED OUTCOME
Daughter	Affected X + normal X	Tuskless
Daughter	Normal X + normal X	Tusked
Son	Affected X + Y	Usually not viable
Son	Normal X + Y	Tusked

05 How ivory poaching changed the population

During the **Mozambican Civil War (1977–1992)**, armies on both sides targeted Gorongosa's elephants for ivory, and the park's large-herbivore populations fell by more than 90%. Tusks made an elephant a target; **tuskless females were far less likely to be killed**. The survivors went on to breed, and passed the trait on.

2,542 → 242

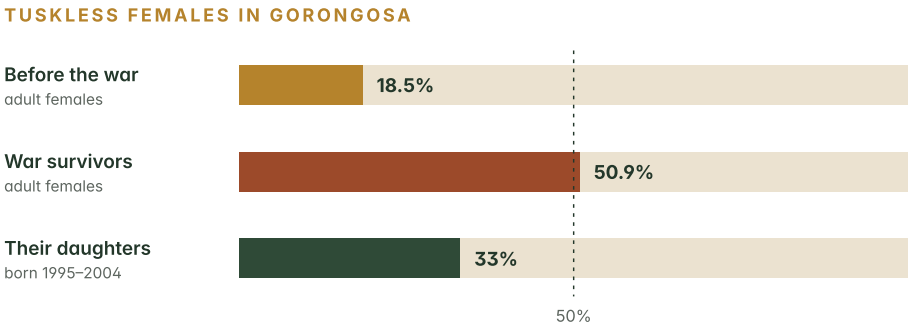
ELEPHANTS, 1972 → 2000

Minimum population of Gorongosa's elephants from aerial counts, before and after the war.

> 5×

SURVIVAL ADVANTAGE

The study's best estimate (5.13) of a tuskless female's relative survival, compared with a tusked one, over the 1972–2000 decline.



Females that survived the war were almost three times as likely to be tuskless as females before it. A third of the first post-war generation of daughters were born tuskless (Campbell-Staton et al. 2021).

WHY IT MATTERS

This is natural selection over a remarkably short time — driven by an extremely strong selection pressure that humans created.

06 Benefits and costs of being tuskless

POTENTIAL ADVANTAGES

- Less likely to be targeted for ivory.
- Better survival during periods of intense poaching.

POTENTIAL COSTS

- Harder to dig for water or minerals.
- Harder to strip bark and handle some foods.
- Loses a tool for defence and social interaction.
- May change the elephant's ecological role, since tusks shape vegetation and soil.

07 An important lesson about evolution

Evolution doesn't always take thousands or millions of years. When selection is extremely strong, inherited traits can shift noticeably within a few generations. The rise of tusklessness shows how human activity can change the genetic make-up of a wild population.

AT THE SIGHTING — HOW TO SAY IT

"See that cow with no tusks? Unless she has broken them, she was most likely born that way. In parts of Africa where ivory poaching was intense, the elephants with tusks were shot and the tuskless females survived to breed. In Gorongosa in Mozambique, about half the females that survived the civil war had no tusks, and a third of their daughters were born without them too. It's evolution happening in front of us, and we caused it."

08 Key terms

AMELX	An X-linked gene involved in tooth and enamel development; identified as a leading candidate gene for female tusklessness in the Gorongosa study.
MEP1a	A gene on chromosome 1 that makes meprin α, an enzyme involved in dentine and tooth development; identified as a second candidate gene in the same research.
X chromosome	One of the sex chromosomes. Females are generally XX, males XY.
X-linked inheritance	Inheritance of a gene that sits on the X chromosome.
Natural selection	The process by which heritable traits that affect survival or reproduction become more or less common over generations.
Selection pressure	Any factor in the environment that makes some inherited traits matter more for survival or reproduction than others.

In summary

- Tusklessness is a **heritable trait**; the leading candidate gene is **AMELX** on the X chromosome.
- The trait behaves as **X-linked dominant**: it shows in females and appears to be **lethal to males**.
- Intense ivory poaching strongly favoured tuskless females, so the trait spread fast.
- In Gorongosa, tuskless females rose from 18.5% before the war to 50.9% of survivors; 33% of their daughters were born tuskless.
- It's a powerful example of **human-driven evolution**.

The inheritance model here is a simplified explanation of the research findings. Tusk development involves multiple genes and biological processes.

SOURCE

- Campbell-Staton, S. C., Arnold, B. J., Gonçalves, D., Granli, P., Poole, J., Long, R. A. & Pringle, R. M. (2021). Ivory poaching and the rapid evolution of tusklessness in African elephants. *Science* 374(6566): 483–487. doi:10.1126/science.abe7389 — https://www.science.org/doi/10.1126/science.abe7389

— SAFARI NOTES · THE SAFARI SHOW —