[curious music plays]

[Shane Campbell-Staton, Evolutionary Biologist, Princeton University]

SHANE CAMPBELL-STATON: I first heard about this story going down a YouTube rabbit hole. It was like three o'clock in the morning. It's none of your business why I was up at three o'clock in the morning. I came across this video about the tuskless elephants of Gorongosa. It got me so curious. They were talking about this increase in the number of tuskless female elephants in the park and how it may be related to the war, which brought up so many questions for me.

[birds chirping, elephant trumpeting]

NARRATOR: Coincidentally, one of Shane's colleagues was planning research in Mozambique's Gorongosa National Park that summer. He invited Shane to join his team.

[helicopter blades spinning]

SHANE: I watched that video in November, and I think by June I was, like, in a helicopter in Gorongosa looking for elephants, which was crazy.

[exciting music plays]

SHANE: The central question was twofold. One, is this rise in the number of tuskless elephants due to natural selection? And then the second major question was exactly what the genetic basis of this trait is.

[elephants trumpeting]

[The Genetics of Tusklessness]

NARRATOR: African elephants use their tusks to strip tree bark for food, dig for water, and protect themselves.

Tuskless elephants are rare in most populations across Africa. But surveys conducted in the early 2000s revealed that nearly half of Gorongosa's female elephants were tuskless.

To figure out why, Shane collaborated with Dominique Gonçalves, who leads the Elephant Ecology Project in Gorongosa.

SHANE: I don't think anything happens with elephants in Gorongosa without Dominique.

[Dominique Gonçalves, MS, Elephant Ecologist, PhD student, Gorongosa National Park, University of Kent]

DOMINIQUE GONÇALVES: Gorongosa National Park is this preserved area located in the center of Mozambique. It's home for many, many different species. Once it hosted one of the densest populations of wildlife in this part of the world.

[birds chirping, hippo snorting]

But, you know, Gorongosa had a tragic past where war conflict destroyed about 90% of the large mammals.

[intense music plays]

NARRATOR: From 1977 to 1992, the Mozambican civil war devastated communities and wildlife in and around Gorongosa. Elephants were killed for their ivory, which was sold for weapons and supplies.

Using data collected by Dominique and others, Shane and his colleagues calculated that during the 15-year war, tuskless females were five times more likely to survive than tusked females.

This difference in survival led to an increase in the proportion of tuskless females in the park's population.

SHANE: In an environment where elephants are being killed for their tusks, not having those tusks would be a selective advantage. Those individuals are more likely to survive and reproduce. That would be evolution by natural selection.

[curious music plays]

NARRATOR: Next, Shane wanted to identify the gene or genes that affect tusklessness. And that would require collecting elephants' DNA.

[helicopter starting up]

NARRATOR: To collect samples, the researchers needed to locate the elephants and tranquilize them without harming them.

[helicopter flying]

SHANE: We tranquilized this female and, you know, as we were collecting data, Dominique, she identified the individual, and this female was like 65 years old. Nine out of 10 of the individuals in her species died during a 15-year period. She survived that event. And there she is, right? In all her thousands of pounds of glory.

DOMINIQUE: I wouldn't say that I'm used to it anymore because every time it's kind of like, a feeling. You see different things, you see different, you know, shapes and sizes.

SHANE: To be able to interact with an animal that has … has experienced so much. That to me is really special.

DOMINIQUE: It's a great opportunity to be closer to such a magnificent animal.

SHANE: So we ended up sampling 13 individuals total, all females. Half of those individuals were tusked and half of the females were completely tuskless.

Once we had the samples in hand, we extracted the DNA out of the blood, and then we took that DNA back to the lab and we put it on a sequencer.

[curious music plays]

NARRATOR: A DNA sequencer essentially "reads" the sequence of nucleotides: the A's, C's, T's, and G's that make up DNA.

Shane's team sequenced all the DNA — the genome — of each elephant to find the differences in nucleotides between tusked and tuskless elephants. Those differences could point them to regions of the genome containing genes related to tusklessness.

SHANE: It's essentially trying to find a needle in millions of haystacks. But we had a few bits of information that would help us to narrow down what the potential genetic basis of the trait was.

[test tube spinning]

NARRATOR: The first piece of information was that all the elephants came from the same local population.

SHANE: Because we're looking within the same population, most of the genome should be relatively similar except at those regions of the genome that are specifically involved in the trait differences that we're interested in.

The second piece of information that we knew is that females seem to be the only individuals in the population that were tuskless. Males always have tusks, as far as we know.

NARRATOR: In Gorongosa, researchers had observed that tuskless females have more female than male offspring and about half the female offspring of a tuskless mother were tuskless themselves and none of the tuskless offspring were male. What could explain this inheritance pattern? Shane's hypothesis was that the genetic mutations involved in tusklessness in females would be located on the X chromosome and be fatal to males before birth, resulting in fewer males born than females.

[lab machine spinning]

SHANE: And the third piece of information that we have is that we actually know a lot about the genes that are involved in tooth development, and tusks are essentially really large, modified teeth.

Within humans there are about 300 genes that are generally involved in tooth development. Still a lot of genes, but it also kind of narrows the scope if you're considering an entire genome.

NARRATOR: Shane and the team analyzed the elephants' DNA using these three pieces of information to help pinpoint genetic regions that could be involved in tusklessness.

SHANE: So we did find a region of the X chromosome that met all of our expectations. And this region contains a gene called *AMELX*.

NARRATOR: In humans, mutations in *AMELX* can cause tiny or malformed teeth, and deletions of a neighboring gene usually inherited *with AMELX* are lethal for males.

Based on the differences between tusked and tuskless elephants from the same population, its position on the X chromosome, and its function in humans, *AMELX* is a strong candidate for being a gene involved in tusklessness, and helps us understand how the Gorongosa elephant population evolved by natural selection.

[elephants trumpeting]

NARRATOR: The story of elephants in Gorongosa shows how our actions can leave a genetic footprint on the species we share the planet with.

[elephants trumpeting, birds chirping]

But that footprint doesn't have to be permanent.

SHANE: Half of the surviving females, you know, from the war were tuskless. But once they had children, those animals that were born after the war, only 33% of them were tuskless. And that will sort of tick on until you get back to the sort of very rare frequency that it occurs in most populations that live in undisturbed places.

[hopeful music plays]

[car drives down road]

DOMINIQUE: The elephants in Gorongosa, I mean they're stable and growing well, they're protected. However, there's always threats. We cannot say that this is a, you know, a complete paradise. We are trying to make it like that. I do hope that we keep providing this protection and habitat and coexistence so these elephants have a chance to show their tusks again.

[elephant trumpeting]