How wild is the Bengal cat genome?

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A Bengal cat with glitter fur trait. Credit: Anthony Hutcherson

If you're wondering who holds the title of domestic cat royalty, look no further than the stunning Bengal breed. They take the prize for the most popular breed in The International Cat Association (TICA) registry due to their unique, exotic appearance and affectionate charm of a beloved house companion.

Despite their top marks among cat lovers, the Bengal breed has been around for less than a century, which is the blink of an eye compared to most domestic cats that have been around for thousands of years.

Bengal cats are a hybrid breed created in the 1960s by crossing domestic cats (Felis catus) with Asian leopard cats (Prionailurus bengalensis), a small spotted wild cat species from Asia. These two species had a last common ancestor about 6 million years ago; genetic differences between the two species are greater than between humans and chimpanzees.

Bengals were officially recognized as a new breed by TICA in 1986 and are the only domestic cats that can have rosettes like the markings on leopards, jaguars, and ocelots. But all Bengal coats are not created equal; the initial hybridization of domestic and wild cats followed by the selective breeding of Bengals with one another for desired traits introduced an array of new coat colors and patterns.

Most people attribute the unique color and coat traits of Bengals to specific DNA from its wild and distantly related felid ancestor. A new study published in *Current Biology* delves into the fascinating genetics behind these captivating creatures, provides some genetic surprises and reveals some genetic secrets that underlie their unique appearance.

A community effort to demystify Bengal ancestry

Greg Barsh, MD, Ph.D., Faculty Investigator at HudsonAlpha Institute for Biotechnology and Professor of Genetics at Stanford University, is an expert in the genetics of feline coat coloration and patterning. He and his team, led by Chris Kaelin, Ph.D., and Kelly McGowan, MD, Ph.D., sought to dive into Bengal cat ancestry and pinpoint the genetics of popular color traits.

"Cats are wonderful companions," Barsh explained, "but our interests go

beyond their beautiful and exotic appearance. Like the amazing variation among different dog breeds, artificial selection can be a very powerful engine to create morphologic diversity. What's different about Bengal cats from dogs is the raw genetic material–dogs trace their heritage to wolves from tens of thousands of years ago."

"In contrast, Bengal cats trace their heritage to completely different species from millions of years ago. Understanding how these distantly related genomes interact is a general question that applies to any situation when different species exchange genes, from crops to aquaculture to humans and Neandertals."

The Bengal breed was started about 60 years ago by a small number of cat enthusiasts and has grown tremendously. Today, there are hundreds of thousands of registered cats produced by more than 2,000 breeders. Over the last 60 years, many breeders have worked to develop traits that are similar to wild cats, like ocelots, tigers, or leopards.

To dive into the genetics of Bengal cats, the team needed access to DNA from a lot of Bengal cats. They turned to the breeding community, visiting cat shows and breed club meetings, talking about genetics and evolution, and asking breeders to participate in the research.

Chris Kaelin, the lead author of the study, said, "Cat fanciers and breeders are very interested in the research, in part because they want to know more about the science behind artificial selection, and in part, because they want to know if our results can help them produce cats with rosettes, stripes, or other exotic markings."

Kaelin also commented, "This is a great example of citizen science–our work has been enabled by the willingness of breeders to participate, and we share our results with the community."

Enrolling a cat in the Bengal research study requires nothing more than a cheek swab for a DNA sample, photographs of both sides of the cat, and any records about pedigree or registration. The team has been working on the project for several years and has collected nearly 3,000 DNA samples.

One of the findings to emerge from the work is that Asian leopard DNA contributes, on average, only a few percent to Bengal breed DNA and, surprisingly, there isn't one or even a few Asian leopard genes that cause the unique Bengal appearance.

"One of the original motivations for bringing together DNA from the two species was to select for Asian leopard DNA that would recapitulate the appearance of an exotic wild cat in a companion animal," said Kaelin. "It turns out that some of the most striking examples of selection in the breed are for traits that were already present, but very rare, in domestic cats."

Domestic cat DNA is responsible for 'glittery' Bengal coats

As the team describes in their paper, the "glitter" coat in Bengal cats exemplifies that phenomenon. Glitter doesn't involve any actual glitter particles but rather a unique structure of individual hairs that makes the fur shiny and soft. It is a very popular trait in the Bengal breed that the team discovered was caused by a mutation in a gene called Fgfr2. "Fgfr2 is a gene found in all mammals that is important for embryonic development and organogenesis," said McGowan.

"Our results show that while a complete loss of Fgfr2 is lethal, a moderate reduction causes a desirable trait to manifest mainly in the hair."

The results from this study offer valuable information for cat lovers as well as scientists interested more generally in hybridization and selection. "Human DNA of European or Asian ancestry contains a small fraction of Neandertal DNA that was caused by hybridization between the two species after humans migrated out of Africa," said Barsh.

"In some ways, Bengal cats are similar, except the distance between the two hybridizing species is much greater and the time since hybridization is much less." From that perspective, learning more about Bengal cats could tell us more about ourselves.

More information: Christopher B. Kaelin et al, Ancestry dynamics and trait selection in a designer cat breed, *Current Biology* (2024). DOI: 10.1016/j.cub.2024.02.075

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