

The Bird That Hasn't Flown for Over 60 Million Years

As a species, these birds lost their ability to fly many years ago, but their genes actually changed and allowed them to adapt to newly created environmental niches, turning them into the specialized, entertaining and beloved creatures they are today.

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STORY AT-A-GLANCE

- A team of researchers gained new insights into penguins' evolution via a complete genome analysis, which included the DNA of all living and recently extinct penguin lineages
- Penguins once flew like other birds but evolved into the adept swimmers they are today over the course of millions of years
- The research team found specific genes involved in penguins' ability to thermoregulate and dive, as well as those responsible for oxygenation, vision, diet, immunity, body size and even taste
- Penguins have the slowest evolutionary rate among birds, which could challenge their future survival
- Half of the world's 18 penguin species are considered either endangered or vulnerable

Penguins are among the most iconic bird species on the planet. They're also among the most highly specialized and adapted to live in some of the most extreme environments on Earth. A team of 40 researchers gained new insights into the tuxedo-clad birds via a complete genome analysis, which included the complete DNA of all living and recently extinct penguin lineages using the fossil record.¹

"Penguins lost the ability to fly more than 60 million years ago, subsequently evolving a hyper-specialized marine body plan," the researchers wrote in the journal *Nature Communications*.²

They identified specific genes responsible for helping penguins adapt to cold temperatures and aquatic environments, but also revealed that the birds have the slowest rate of evolution known among birds, which could challenge their future survival.³

Evolving From Flying to Swimming

Penguins once flew like other birds but evolved into the adept swimmers they are today over the course of millions of years. National Geographic reported:⁴

"Early penguins were surprisingly quick to adapt to newly created environmental niches throughout the Southern Hemisphere in the wake of the Cretaceous-Paleogene mass extinction around 66 million years ago. After dinosaurs disappeared, there was more room for other animals to spread, and penguins filled in different climates and biomes around the southern half of the world."

In short, it's thought that cycles of cold and warm periods drove penguin populations to decline and expand.⁵ During this time, their genes changed, turning them into the specialized creatures they are today.

By making forearm bones shorter, denser and more rigid, certain genes were involved in the creation of penguins' flippers, while the bones' increased density supported deeper dives.⁶ Today, penguins are so well-adapted to the surf that they can swim 15 miles an hour and spend most of their lives in the water.⁷

Certain genes also changed penguins' vision to see better in the deep, blue ocean, including by lessening their perception of the colors red and green.⁸ The research team found specific genes involved in penguins' ability to thermoregulate, or maintain an optimal body temperature, and dive, as well as those responsible for oxygenation, vision, diet, immunity, body size and even taste.⁹

Penguins evolved to have a less sophisticated sense of taste than most other birds; they're unable to detect anything tasting bitter, sweet or umami, unlike other birds, which are missing only the ability to taste something sweet.¹⁰

"Penguins are evolution's most entertaining product," study co-author Daniel Ksepka told National Geographic. "They've adapted an entirely different body plan and lifestyle than their ancestors."¹¹

But penguins, being long-lived, large-bodied and capable of producing few offspring, have the slowest evolutionary rate among birds, the study found. "We hypothesize that the rate in penguins represents the culmination of a gradual slowdown associated with increasingly aquatic ecology," the researchers explained.¹²

In fact, the genomic data and fossil record suggest that while penguins have low evolutionary rates, many of the features that make them well-suited for aquatic life were acquired rapidly very early in their diversification — and rates of change only began to slow down from there. According to Penguins International:¹³

"The transition from flying birds to wing-propelled divers was a gradual process which started around 65 million years ago for penguins, and would have involved an intermediate stage whereby its ancestors could use their wings for both flying in the air and diving/swimming underwater (much as Razorbills, for example, do today).

These ancestors were probably seabirds similar to modern diving petrels ... By 55 million years ago, penguins were completely flightless but thoroughly adapted to life in water."

Many Penguin Species Are Endangered

Half of the world's 18 penguin species are considered either endangered or vulnerable according to the International Union for Conservation of Nature's (IUCN) red list.¹⁴ Unfortunately, as more is being uncovered about these fascinating animals, many populations have been on a steady decline. Numbers of African penguins, for instance, have been reduced by approximately 90% since the beginning of the 20th century.

"In 1910, there were probably approximately 1.4 million adult birds in one population alone at Dassen Island [a South African island], which had been reduced to about 145,000 birds by the mid-1950s," the Center for Biological Diversity noted.¹⁵

Threats to penguins include environmental disruptions, habitat loss, pollution, disease and reduced food availability as a result of commercial overfishing.¹⁶ While ancient penguins survived by adapting to live in extreme environments, it's unknown how modern-day penguins will fare.

Avian paleontologist Vanesa De Pietri told National Geographic that penguins' specialized nature may ultimately be their downfall. "Modern penguins seem to be less well equipped to survive these rapid environmental changes than ancient penguins because of this decrease in evolutionary rate," she said. "Have they specialized themselves into a corner? Yeah, probably."¹⁷

Sources and References

^{1, 3, 6, 8} [Smithsonian Magazine July 20, 2022](#)

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^{4, 11, 17} [National Geographic July 19, 2022](#)

^{5, 9} [Scimex July 20, 2022](#)

^{7, 16} [BirdLife International. Penguins](#)

¹⁰ [NCBI Feb. 16, 2015](#)

¹³ [Penguins International January 7, 2020](#)

¹⁵ [The Center for Biological Diversity, African Penguin](#)
