

### The Keys to Survival for Birds During the Cretaceous-Tertiary Extinction

Sixty-six million years ago, a six-mile-wide asteroid slammed into the earth's crust at a site that is now at the northern tip of the Yucatan Peninsula. The initial impact wiped out many species, and the world-wide coating of ash and climate-altering debris cloud created more destruction. Over 80% of species alive at that time went extinct.



Figure 1. Birds were the only species of dinosaur to survive the K-T Extinction. <https://www.sciencerecorder.com/news/2015/06/05/cretaceous-bird-fossil-offers-clues-on-dinosaur-evolution/>

Notably resilient species, such as the small, burrowing mammals that gave rise to all mammals—including humans—made it through the event due to their ability to live underground and eat almost anything. Another notable class of survivors are birds, though their survival is not nearly as easy to explain as the survival of ancient mammals. Unlike mammals, prehistoric birds were direct relatives of the dinosaurs that were completely wiped out during the extinction. In fact, birds are technically the one class of dinosaurs that made it through the bolide impact. What set birds apart from their dinosaur counterparts? Why were they, alone, able to escape extinction?

The reason for the survival of birds remains a great mystery. There hasn't been a singular, large factor that can be attributed to their success when the rest of the dinosaurs died out. Rather, the general consensus in the scientific community is that birds' ability to persevere rested on multiple small adaptations. The largest of those adaptations is the fact that most birds were not as large as their



Figure 2. Artist's rendition of a Microraptor, one of the Early Cretaceous ancestors of modern birds.  
<http://kids.nationalgeographic.com/content/dam/kids/photos/animals/Dinosaurs%20&%20Extinct/H-P/microraptor.jpg.adapt.945.1.jpg>

dinosaur counterparts. From 230 million years ago all the way to the K-T extinction, 66 million years later, dinosaur body size had been steadily trending upwards. Early Triassic dinosaurs weighed, on average, no more than a medium sized dog. The end of the Cretaceous was home to such famous creatures as the Titanosaur, which was 122 feet long and weighed up to seventy tons. Only one group of dinosaurs stayed small: the maniraptorans. This group of feathered dinosaurs included velociraptors and eventually evolved into birds. When that fateful asteroid impacted Earth 66 million years ago, the only dinosaur survivors were maniraptorans that had evolved to weigh under 1 kilogram. These animals were birds. Large-bodied animals were not as adaptable as the small maniraptorans; they weren't as mobile and required much larger quantities of food.

While body size is likely the biggest factor in unraveling the mystery of birds' survival, there are a number of other factors that allowed birds to adapt to Earth's new post-apocalyptic climate. There were other flying animals around, such as pterosaurs, that would've been able to evade the initial destruction. There were also plenty of other small animals that perished. Small body size and the ability to fly were not a golden ticket to escaping the 5<sup>th</sup> major mass extinction. Two fossilized seabirds were recovered from the London Clay Formation on the Isle of Sheppey, and were found to have exceptionally large brain cavities. These 55-million-year-old birds had brains that were every bit as developed as modern birds in the areas of sight, flight, and high-level functions such as the ability to learn and remember things. All modern bird brains have an area of extremely dense brain tissue, known as the "wulst." This area allows modern birds to pack more brain power into a more compact and light



Figure 3. *Odontopteryx Toliapica*, the fossilized Paleocene birds found on the Isle of Sheppey.  
[http://vignette3.wikia.nocookie.net/prehistrico/images/9/90/Osteodontornis\\_orri.jpg/revision/latest?cb=20150619142824&path-prefix=es](http://vignette3.wikia.nocookie.net/prehistrico/images/9/90/Osteodontornis_orri.jpg/revision/latest?cb=20150619142824&path-prefix=es)

package, which is important for flying. Every gram counts. Unlike previously thought, these prehistoric birds had wulsts that were nearly as developed as modern birds. The increased brain power provided by the wulsts would've suggested that the birds around at the end of the Cretaceous were much smarter than previously thought. This increased adaptability could've been

the difference between life or death during the End-Cretaceous Extinction.

Beyond brain and body size, the egg shape of Mesozoic birds contributed to their survival of the initial bolide impact during the K-T Extinction. Bird's larger counterparts had much more elongated eggs with significantly more porous shells. These porous shells could've been more susceptible to the contaminants thrown into the atmosphere by the bolide impact. Ancient bird eggs were also proportionally larger than the eggs of other dinosaurs, suggesting that bird hatchlings had a shorter, less vulnerable childhood than other dinosaurs. Slow reproductive periods may have had a large part in the extinction of most dinosaurs. In addition to egg shape, incubation habits of ancient birds may have contributed to their survival. Most dinosaurs in the Late Cretaceous simply buried their eggs while they incubate, while ancient birds likely used the contact incubation method that is prevalent today. If 66-million-year-old birds sat on top of their eggs and protected them, they would've had a larger chance of surviving in the strained environment that followed the impact.

The survival of birds during the End-Cretaceous Extinction is one of the most remarkable outcomes of that event. Birds were unique in their survival; all of their closest relatives died out, but for

some reason, they did not. A series of small, lucky adaptations provided the necessary resistance against the asteroid that hit the earth 66 million years ago. The earth is facing a new catastrophe in the present day; the 6<sup>th</sup> mass extinction. This time, it's not an asteroid; it's a mix of human-caused activities, ranging from earth surface disturbance to interspecies mixing to large-scale greenhouse gas emissions. The adaptations that got birds through the 5<sup>th</sup> extinction may prove advantageous during the 6<sup>th</sup>, but as we have seen with North American bats, central American amphibians, and the extinct Great Auk, survival tactics that have worked for hundreds of millions of years may suddenly fail in the presence of humans.

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