Skull shape can predict how extinct vultures fed on carrion

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Learning more about the form and function of living species can help predict the feeding habits of extinct species, like the Haast's eagle. Credit: PLoS Biol. 2005/CC BY 2.5

Variations in the skull shape of vultures have been found to coincide with the preferred method each species uses to feed on a carcass.

Learning more about the form and function of living species is helping

scientists to understand more about the behavior of extinct birds such as the giant Haast's eagle.

Vultures are unique as they are the only vertebrates that require a supply of carrion to survive.

These birds have therefore adapted to a highly specialized diet, which is reflected in their bodies and behavior.

Although vultures are often lumped into the singular category of scavengers, a new study looked to see if skull shape differed depending on how a vulture feeds on a carcass.

Researchers compared the skulls of 22 living vulture species, and found that skull shape can accurately predict the preferred feeding strategy adopted by a particular species. The results have been published in the *Journal of Zoology*.

Dr. Andrew Knapp, a Museum scientist who co-authored the study, says, "Different parts of an animal's body can tell us important things about how they live."

"The skull is really important because there's so much concentrated there. It houses the brain, the mouth-feeding apparatus, teeth and sensory organs. There's a lot of information contained in this region that can tell us a lot about an animal."

"We can take living species and work out what it is about their lifestyles that might be shaping the evolution of their skulls, and then we can apply that to extinct species."

How do different vulture species feed?

There are 23 living species of vultures which are separated into two different families. Afro-Eurasian vultures are in a family called Accipitridae, which also includes birds like the golden eagle and common buzzard. The second group are the North American vultures in the family Cathartidae, which includes the California condor.

Despite the two groups evolving completely independently, different vulture species across these families have been observed to prefer particular parts of a carcass. These can be divided into three categories: rippers, gulpers and scrappers.

Rippers generally go for the really tough material like skin and tendons. Gulpers go for the soft innards, such as intestines and other internal organs, while scrappers will go for the bits that are left over.

The specialization on different parts of a carcass has allowed multiple species of vultures to coexist and evolve alongside each other rather than competing for the same type of food. As a result, their form has adjusted to suit these different behaviors.

Bird skulls have long been an example of adaptive evolution, with different bird beaks being famously well-adapted for various diets. The classic example is Darwin's finches, whose beaks have all evolved different shapes and sizes depending on where they live and what food is available.

However, a bird's diet has yet to sufficiently explain the majority of shape variation in beaks.

"Diet is something that we always think of as something that shapes bird beak evolution," explains Andrew.

"But when you look across all birds, diet actually isn't a very good

explainer of shape at all. The reason for that is because there are many different ways to approach the same diet."

"If you're a carnivorous bird, for example, you might be swallowing prey whole or just tearing chunks off. When you look broadly across different species, there are many ways to approach the same problem."

How are vulture skulls different depending on feeding strategy?

The researchers discovered that the different skull shapes of vultures fell neatly into three clusters that coincided with the three different feeding strategies.

Those classed as "rippers" tended to have a wider skull and a more robust beak for tearing the tougher tissue away from the carcass. "Scrappers" had the slenderest beak, reflecting the precision necessary for picking up small scraps of leftover material around the carcass.

But out of the three groups, the "gulpers" had the narrowest skull with the relatively longest beaks, ideal for inserting into and maneuvering inside a carcass to consume the soft internal tissue.

Researchers also looked at the skulls of eight non-vulture raptors, which were similar in size and range. The skulls of these birds tended to be much more similar in shape to each other and a lot less diverse than those of the vultures.

They then ran an analysis to see if they could predict which dietary category a species might be in based solely on the shape of the skull, excluding factors such as how closely related species were to each other. These results were then compared to the observed feeding behaviors of

the birds and showed that the analysis had a 100% success rate at predicting the dietary categories of these different vultures or whether the skull belonged to a non-vulture raptor.

The analysis was also used to determine the feeding method of extinct birds, such as the ancient vulture called Breagyps clarki discovered in the La Brea tar pits in California. The skull shape of this species was found to fit comfortably within the "gulper" category, suggesting that the extinct bird would have likely fed on the soft innards of animals like mammoths and ground sloths.

The researchers also looked at the Haast's eagle, an extinct giant eagle from New Zealand that died out around 600 years ago. Although the species had previously been thought to resemble a vulture, the model predicted it to be a predatory bird rather than a scavenger, which aligns with the theory that they preyed on flightless moa.

"To estimate how extinct species would have behaved, I think you really have to have a good understanding of living animals," says Andrew.

"Vultures are normally lumped together into one category—scavengers. But we get much better results by splitting them into these groups, which could be used to help predict the behavior of extinct animals."

"It's difficult to ascribe anything behavioral-wise to extinct animals, but I think with a good understanding and showing that this works with living things, then we can be confident that it will work when applied to species of the past."

More information: Carrion converging: Skull shape predicts feeding ecology in vultures. *Journal of Zoology*. doi.org/10.1111/jzo.13127. zslpublications.onlinelibrary. … ll/10.1111/jzo.13127