Study examines modifications that occur on proteins in natural environments over time

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Giant Haast's eagle attacking New Zealand moa. Artwork: John Megahan. Copyright: PLoS Biology. Via Wikipedia.

A recently extinct flightless bird is helping molecular paleontologists learn more about not only the species in question, but also about how proteins preserve and degrade in fossils.

Tim Cleland, currently a postdoc in biomedical engineering at Rensselaer Polytechnic Institute, did his Ph.D. work at NC State on how proteins changed in a moa both after they were coded by DNA and during the fossil's degradation after death.

"There hasn't been much work done on the ways that proteins change over time in natural environments," Cleland says. "But if we want to be able to correctly interpret the molecular data we get from fossils, we need to set a baseline for the kinds of proteins that may preserve over time and how the proteins may change after death and during the fossilization process."

Moas were a group of flightless bird species native to New Zealand that became extinct about 1,000 years ago. They were similar in size and appearance to modern-day emus and ostriches. Cleland took samples of cortical bone from a moa that died between 800 and 1,000 years ago, demineralized them and used mass spectrometry to look for evidence that proteins had survived the fossilization process.

When bone is demineralized, collagen is the most commonly found protein. The same held true with the moa. Cleland and his colleagues examined the collagen, comparing it to collagen found in living birds and looking to see if post-translational modifications in the moa collagen were similar to post-translational modifications in collagen from living birds. A post-translational modification, or PTM, is the naturally occurring change to a protein after it has been coded by the DNA – essentially controlling how the protein functions in the organism.

"The changes that we saw in the moa's collagen were in the same places that they occur in living birds," Cleland says. "I think this helps support the fact that the collagen we extracted from the moa fossil belonged to the specimen."

The team also found changes in the protein that are diagenetic, or that occur after death. "The fact that we found these changes will give us greater insight into how proteins break down after death, and give us a baseline for evaluating the age of the proteins we're working with," Cleland says.

"Tracking PTMs gives us the ability not only to better understand the biology of extinct species and where they fit in, evolutionarily speaking, with modern species, but can also give us a handle on what aspects of the burial environment favor preservation," says Mary Schweitzer, paleontologist at NC State and co-author of the paper.

Cleland's next steps are to look for proteins and PTMs in fossils that are older or have been buried in different environments.

More information: "Biologically and diagenetically derived peptide modifications in moa collagens." *Proceedings of the Royal Society B*, DOI: 10.1098/rspb.2015.0015

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