Inner ear may hold key to ancient primate behavior

June 13 2012

This is a three-dimensional reconstruction of the cranium and semicircular canals from the fossil anthropoid primate *Aegyptopithecus zeuxis*. The specimen is courtesy of the Egyptian Geological Museum and Division of Fossil Primates, Duke Lemur Center. Credit: Tim Ryan, Penn State

CT scans of fossilized primate skulls or skull fragments from both the Old and New Worlds may shed light on how these extinct animals moved, especially for those species without any known remains, according to an international team of researchers.

The researchers looked at the bony labyrinth in fossil remains and compared them to CT scans previously obtained from living primate species. The bony labyrinth of the inner ear is made up of the cochlea -- the major organ of hearing -- the vestibule and the three semicircular canals which sense head motion and provide input to synchronize

movement with visual stimuli.

"Almost in every case where there is a fossilized skull, the semicircular canals are present and well preserved," said Timothy Ryan, assistant professor of anthropology, geosciences and information sciences and technology, Penn State. "They are embedded in a very dense part of the skull and so are protected."

Normally, researchers assess the locomotor behaviors of extinct animals, including primates, by examining limb bones. However, frequently the only fossilized remains found are from the head. By comparing the semicircular canals of extinct species to those of existing species, the researchers could determine if the extinct animals moved with agility -- leaping like monkeys or lemurs or swinging from limb to limb like gibbons -- or travelled more slowly like baboons or gorillas.

They could make this determination because the size of the three semicircular canals is closely related to their sensitivity.

Previous research showed that there is a direct relationship between the size of the semicircular canals and the degree of agility an animal exhibits. There is also a direct connection between the size of these canals and the size of the animal.

Correcting for animal size, the researchers compared scans from 16 fossil species spanning New World monkeys, Old World monkeys and apes, to living primates whose locomotor behaviors are known. Included in the study are some of the oldest fossil anthropoids -- the group that includes monkeys, apes and humans -- from the Fayum Depression in Egypt.

"The fossil anthropoids analyzed here clearly fall into the range of variation of modern primates, making agility reconstructions based on

extant taxa relatively robust," the researchers reported in today's (June 13) issue of *Proceedings of the Royal Society B: Biological Sciences*.

The researchers believe that the relatively high degree of correspondence with known behaviors suggests that this method produces accurate reconstructions of locomotor agility.

The researchers found that the earliest anthropoids moved in the medium to medium slow range, slower than predicted. They found that other early anthropoids that predated the split between monkeys and apes also fell in the medium slow category, including the well-known species *Aegyptophithecus* from about 29 million years ago and other animals from Egypt and Saudi Arabia.

But once the split between Old World monkeys and apes occurs, both monkeys and apes fall in the medium to medium fast range like macaques. This includes *Proconsul heseloni* found in Kenya and considered one of the first apes.

The scans from New World monkeys, dating from 12 to 20 million years ago, showed the animals were relatively agile similar to cebus monkeys or tamarins.

"Most of the fossil New World monkeys we examined are known only from cranial material with no associated post-cranial fossils," said Ryan, who is also co-director of the Center for Quantitative Imaging. "We had no idea about their locomotion."

The researchers now have predictions of what these New World monkeys were doing and they know that they were faster than their Old World ancestors.

"The research suggests that the last common ancestor of Old World

monkeys and apes would have been an animal of medium agility, much like living macaques," said Ryan. "But what is really surprising is that the early ape, *Proconsul*, appears more agile than expected. "

This result suggests that the living large-bodied apes, such as gorillas and orangutans, may have evolved their slower locomotor patterns from these more agile ape ancestors.

Provided by Pennsylvania State University