Among Apes, Teeth Are Made for the Toughest Times (w/ Video)

December 16 2009

(PhysOrg.com) -- The teeth of some apes are formed primarily to handle the most stressful times when food is scarce, according to new research performed at the National Institute of Standards and Technology. The findings imply that if humanity is serious about protecting its close evolutionary cousins, the food apes eat during these tough periods—and where they find it—must be included in conservation efforts.

The interdisciplinary team, which brought together anthropologists from George Washington University (GWU) and fracture mechanics experts from NIST, has provided the first evidence that natural selection in three ape species has favored individuals whose teeth can most easily handle the "fallback foods" they choose when their preferred fare is less available. All of these apes—gorillas, orangutans and chimpanzees—favor a diet of fruit whenever possible. But when fruit disappears from their usual foraging grounds, each species responds in a different way—and has developed teeth formed to reflect the differences.

"It makes sense if you think about it," says GWU's Paul Constantino. "When resources are scarce, that's when natural selection is highly active in weeding out the less fit, so animals without the necessary equipment to get through those tough times won't pass on their genes to the next generation."

In this case, the necessary equipment is the right set of molars. The team

examined ape tooth enamel and found that several aspects of molar shape and structure can be explained in terms of adapting to eat fallback foods. For instance, gorillas' second choice is leaves and tree bark, which are much tougher than fruit, while orangutans fall back to nuts and seeds, which are comparatively hard.

For these reasons, the researchers theorized that gorillas would have evolved broader back teeth than a fruit diet would require in order to chew leaves, but orangutans would have thicker enamel to handle the increased stress of crunching seeds.

NIST scientists developed models of how teeth fracture while chewing different foods. By fracturing teeth in the laboratory, they verified fundamental fracture mechanics models incorporating tooth shape and structure. These efforts revealed the effects of food stiffness and how various foods likely would damage ape teeth. "The research at NIST supports our theories and several related ones," Constantino says. "It's likely that fallback foods have influenced jaw and skull shape as well."

Constantino adds that the findings suggest mankind must protect not only forest areas where commonly eaten fruits grow, but also the places where apes' fallback resources appear. While identifying precisely what these resources are is a job for ecologists, he says, the new research shows just how important and influential these foods are in primate ecology.

"Among orangutans, for example, timber companies are harvesting the sources of their fallbacks," Constantino says. "These apes have evolved the right tools to survive on fallback foods, but they need to be able to find these foods in the first place."

More information: P.J. Constantino, P.W. Lucas, J.J.-W. Lee and B.R. Lawn. The influence of fallback foods on great ape tooth enamel.

American Journal of Physical Anthropology, 140 (Dec. 2009), pp. 653-660, doi 10.1002/ajpa.21096