Forest edge reveals habitat loss in Madagascar

September 5 2012, by Greg Hand

A cleared area defining the forest edge.

(Phys.org)—The dry forests of Madagascar can use all the help they can get. New research suggests a promising tool for understanding and conserving these threatened environments.

In a paper published in the journal *PLoS-ONE* on Sept. 4, Brooke E. Crowley of the University of Cincinnati and colleagues Keriann C. McGoogan and Shawn M. Lehman from the University of Toronto use carbon and nitrogen chemical signatures in leaves to gauge the effects of environmental disturbance at forest boundaries.

"Edge effects represent an inevitable and important consequence of habitat loss and fragmentation," Crowley said. "Such effects can have a substantial impact on species, communities and ecosystems."

The dry, deciduous forests of western Madagascar display an abundance of edge effects as half of the original tree cover has been cut back in recent decades to create farms and pastures.

"The remaining forest is highly fragmented and prone to extreme edge effects," Crowley said. Previous studies have documented changes in plant and animal abundance, size and diversity at the boundaries of forest parcels around the world. However, Crowley said, there is little information on the biological processes resulting from edge creation, particularly in the rare tropical dry forests of Madagascar.

Edge effects can be measured using biotic or living indicators like tree height or species diversity. They can also be measured with abiotic or non-living indicators like light levels and temperature. Crowley and colleagues suggest that the stable isotope data can generate an integrated chemical signature that summarizes the local biotic and abiotic indicators. In particular, Crowley looked at ratios between carbon-13 and carbon-12 and between nitrogen-15 and nitrogen-14 as preserved in plant leaves from the forest edge into the interior of the forest.

"Stable isotope values in leaves may be better quantifiers of edge effects than other variables," Crowley said.

The Madagascar study suggests that different isotopic ratios may be required to understand different types of forest environments. For example, earlier studies suggest that carbon ratios vary strongly with distance from the forest edge, but these studies were conducted in moist tropical rainforests. In Madagascar's dry forests, carbon varied strongly with height above the ground, but not with distance from the edge.

Nitrogen, however, showed a strong relationship with distance from the forest edge.

The strong connection between nitrogen isotope ratios and distance from the forest edge will require further research to understand the mechanism at work, Crowley said. It is unlikely that a difference in plant distribution between edge and interior can fully explain the variation in nitrogen ratios. Human factors like farming, food gathering and herding may tell part of the story. Perhaps the distribution of decomposing leaf litter, or the depth of interior plan roots, or soil conditions are at work, but none of these factors is obviously driving the values recorded at the test site.

Meanwhile, the fragile forest endures ongoing assaults. The co-authors studied an area within one of Madagascar's national parks, but the effects of human activity were widespread.

"Despite its protected status, there is ample evidence of human disturbance within the forest," Crowley said. "We encountered cows as well as numerous meter-deep pits from locals digging up yams. Humans are clearly affecting the forest here, but the long-term ramifications of their actions are unknown."

The research described in this paper was supported by the Natural Sciences and Engineering Research Council of Canada.

Provided by University of Cincinnati