Limited access oil roads in Ecuador’s Yasuni Biosphere Reserve negatively impact the poorly known high canopy frog community

Ecuador’s Yasuni Biosphere Reserve is the most biodiverse rainforest on earth, containing more species of frogs and toads than the total number in the US and Canada combined. Despite Yasuni’s world record species diversity the region has become the epicenter of Ecuador’s oil boom. Oil development in Yasuni has been touted as low-impact through the use of ecologically sensitive techniques. However, a new study in PLOS ONE finds that oil roads in Yasuni with limited access and little to no development have a significant negative effect on the unique frog community inhabiting high canopy bromeliads.

The study, led by researchers at Texas State University, is the first extensive investigation of high canopy-dwelling amphibians and the factors that influence these communities. Large tank bromeliads reside in the upper canopy of Yasuni at heights up to 50 m above ground. These bromeliads are capable of holding in excess of 4 L of water with community numbers reaching more than 150 individuals in a single tree, literally creating a 3-dimensional wetland in the sky. “These arboreal wetlands provide critical microhabitat for a large diversity of invertebrate and vertebrate species at the interface between the rainforest and the harsh equatorial climate,” says lead investigator Shawn McCracken. “It is remarkable the number of species we have observed living within these large epiphytes and utilizing them as a resource, especially the new species of bromeliad-dwelling specialist frogs.”

The initial study plan was to compare the anuran communities living within a large epiphytic tank bromeliad, Aechmea zebrina, when tested across three levels of forest disturbance status in the Yasuni region – undisturbed forest, low-impact disturbed forest, and high-impact disturbed forest. “During the time between our initial surveys in high-impact disturbed forest and our return to sample bromeliads the Via Auca was being widened and paved,” explains researcher Michael Forstner. “We can only speculate that this disturbance and the increased human pressure enabled by road improvements, eliminated the few A. zebrina communities persisting near the roadway.” The scientists observed that as forest disturbance increased the bromeliad abundance decreased, an initial indication that A. zebrina bromeliads appear to be intolerant of deforestation and, to a lesser extent, forest fragmentation.

The researchers hypothesized “that A. zebrina sampled along an oil access road edge with few forest clearings and a minimal footprint through primary forest (i.e. low-intensity disturbance) would reveal little to no impact on the anuran community.” However, they found that nearly twice as many bromeliads were occupied by one or more anurans in undisturbed forest compared to low-intensity disturbed forest. The abundance of anurans found in undisturbed forest was also nearly twice that found in the low-intensity disturbed forest bromeliads.

Aechmea zebrina bromeliads above a low-impact limited access oil road in the Yasuni Biosphere Reserve. Photo by Bejat McCracken.
“Our findings of significantly reduced frog abundance and occupancy along the Maxus oil road were somewhat unexpected to us, as this is a road of minimal width and there is primary forest right up to the edge of the right-of-way with small forest clearings limited to a very few sites within our study area,” said McCracken.

A number of habitat parameters were measured including tree height, bromeliad height, bromeliad water pH, and number of bromeliads in sample tree. Yet, forest disturbance was the only significant factor influencing anuran occupancy and abundance in bromeliads. “Our results show that forest disturbance associated with oil access roads and infrastructure has a negative effect on anurans utilizing the microhabitat of *A. zebrina* bromeliads in the upper canopy of eastern Ecuador’s lowland rainforest,” write the researchers.

“Our study took an intensive look at the impacts that roads are having on the canopy biota in one part of Yasuní. With a lack of correlated habitat factors we must continue our work to identify how roads previously designed to be environmentally sensitive pathways through rainforest habitat still have such a profoundly negative effect on these canopy communities,” adds McCracken.

The researchers re-emphasize the global conservation significance of Yasuní and support the recommendations of the study by Bass et al. in 2010 to permit no new terrestrial access routes into Yasuní or its buffer zone and establish a moratorium on future exploration and extraction operations.

Citation: Shawn F. McCracken and Michael R. J. Forstner. (2013) Oil Road Effects on the Anuran Community of a High Canopy Tank Bromeliad (*Aechmea zebrina*) in the Upper Amazon Basin, Ecuador. PLOS ONE.

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