

# Scientists study effects of La Nina on frogs in tropical Costa Rica

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UNM Ph.D. candidate Mason Ryan and tropical biology students finish up sampling a leaf litter plot. Leaf litter was removed from each plot by placing it on sheets and piling it up outside of the plot. Amphibians were hand-captured while removing the litter for counts and identification. After the plot was completed, the leaf litter was dispersed back into the plot.

Extreme climate events such as an El Niño or La Niña weather patterns can wreak havoc on global economies, health systems, and plant and animal communities. In tropical Costa Rica, where rainfall is usually abundant, researchers from the University of New Mexico and the University of Costa Rica (UCR) set out to study the effects of a record-

breaking La Niña event on frogs in their natural habitat.

Led by Ph.D. candidate Mason Ryan, the group surveyed frogs over a five-year period that included the 2010-2012 La Niña event. The research, titled "Too wet for frogs: changes in a tropical [leaf litter](#) community coincide with La Niña," was published today in *Ecosphere*, a journal of the Ecological Society of America.

The role of extreme rainfall associated with a La Niña event is not well-known for amphibians in tropical areas, but one wouldn't expect abundant rainfall to harm populations of moisture-loving organisms like amphibians. Leaf litter frogs live in a humid and moist environment comprised of dead leaves and other forest debris that falls to the ground. The onset of the 2010-12 La Niña provided a natural experiment with which to address the effects of excess rainfall on this community. Ryan and colleagues documented extreme changes in leaf-litter frog populations that coincided with the La Nina event.

"Because many amphibian populations are declining globally, it is important to understand the role that cyclic climatic events such as La Niña play in amphibian population fluctuations if conservation efforts in the tropics are to be successful," said Ryan. "This is especially important because climatic events such as La Niña are expected to increase in frequency and intensity in the coming years."

The greatest source of rainfall variability in the tropics occurs with El Niño or La Niña weather-related events. The community-wide disturbance in 2010-11 was associated with 4,980 millimeters (nearly 200 inches) of rainfall, a record for the region. Weaker La Niña conditions persisted in the community through 2011-12.



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Ryan, with the help of more than 60 UNM and UCR tropical biology undergraduate students, under the guidance of UNM Department of Biology Professor Joseph Cook and renowned tropical biologist Norman Scott, set out to document population dynamics in frogs. They studied changes in [species diversity](#) and abundance during this five-year period using specialized techniques for sampling leaf-litter animals. Undergraduate biology students were immersed directly in the research project and learned just how dirty field biology can be.

Using four different species of leaf litter frogs, they replicated and sampled 10 plots per year, using a plot survey technique of total leaf litter removal within each plot. They measured and sampled annual species diversity and community composition once a year during March, during the dry season, at the Organization of Tropical Studies Las

Cruces Biological Station in southern Costa Rica.

Their findings were surprising in that strictly terrestrial frog species (i.e., they do not breed in water) can be influenced by extreme rainfall events much like their aquatic-breeding counterparts. The researchers discovered that species diversity and the community structure changed negatively in dramatic fashion from the two pre-La Niña years compared to the onset of the La Niña event in 2010.

The altered community structure due to extreme rainfall lasted for over 20 months. During that time, all four leaf litter frog species declined in number and several measures revealed marked changes in the community structure in terms of both plot diversity and occupancy.



UNM tropical biology undergraduate students prepare a leaf litter plot to be sampled under the direction of Norman Scott. After the students finished the preparation, they measured and placed string to mark the plot boundaries.

The researchers observed changes at LCBS that suggested too much water can elicit a strong ecological effect even in climates considered to be moisture-rich. The changes included increased mortality of eggs and altered resource availability in the leaf litter. The changes in resource availability negatively affected the frogs through a series of complex interactions involving the dynamics of predators and prey.

"Each year, the La Niña resulted in the loss of species and restructuring of the leaf litter frog community," Ryan said. "Both species identities and abundances shifted during the wet La Niña years as species reordering occurred and species were lost from the community. Plots became more similar, creating a more homogenous frog community compared to pre- La Niña. This was surprising because we did not expect that too much rainfall would have a negative impact on frogs."

However, just as surprisingly, the researchers found that when the La Niña conditions abated and rainfall neared its average, the frog community rebounded to pre-La Nina levels within a year.

"This is very encouraging news suggesting the tropical leaf litter frogs are capable of rapid recovery from extreme climatic disturbances," Mason said. "Of course, this depends on whether outside factors such as habitat modification or disease are not simultaneously afflicting frog populations. If these additional stressors are not a major factor during an extreme event, species diversity and abundance may rapidly recover to pre-climatic disturbance levels."

Provided by University of New Mexico

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