MONGABAY

Invisible plant-enemy interactions drive diversity in forest fragments

7 November 2018

- The constant tussle between plants and their "natural enemies", like fungi and insects, play an important role in determining diversity of seedlings in fragmented forests, a new study has found.
- When the natural enemies were knocked off, the diversity of seedlings inside forest fragments reduced drastically, while diversity closer to the edge did not change much. This suggests that the effect of fungi and insects in maintaining plant diversity could be weakening at forest edges.
- The study hints at how cryptic plant-enemy interactions are important considerations when thinking about conservation of plant communities in fragmented forests.

Very few tropical forests around the world enjoy uninterrupted contiguity. Most are divided into uneven, small fragments, cut off from each other, their boundaries marked by roads or farms. But as forests get fragmented, the diversity of plants within them shifts, changing with distance from their ragged edges. What drives these changes? Light, for one. Then there's humidity, soil moisture, or human disturbance. But there's another important, yet cryptic, interaction that influences diversity in fragmented forest patches: plant-enemy interactions. The constant tussle between plants and their "natural enemies" things like fungi and insects play an important role in determining which seeds actually grow into seedlings, and which ones don't, a new study published in Nature Communications has found. "I wanted to see if some of these cryptic interactions are changing due to fragmentation, and if that is what might be affecting diversity [of plants]," lead author Meghna Krishnadas, who recently completed her Ph.D. from the Yale School of Forestry & Environmental Studies, told Mongabay. To see how natural enemies of plants regulate their diversity, especially when seeds transition to seedlings in fragmented forests, Krishnadas set up sampling stations across a 35-square-kilometer (13.5-square-mile) fragmented forest in the Western Ghats in Karnataka, India. In the stations placed within relatively undisturbed forest fragments, right from the edge of the forest patches to about 100 meters (330 feet) inside, she monitored both the seeds that fell into her seed traps and the seedlings that actually grew from those seeds. Then she sprayed insecticide and fungicide on some of the plots, and compared those with control plots that is, plots that were not manipulated in any way.

Seedlings growing in sampling plots placed within forest fragments. Image by Meghna Krishnadas. The study found that the diversity of seeds raining down on the ground was similar at both the interior of the forest fragments, and closer to the edges. However, the diversity of seedlings that grew from those seeds was much higher inside (at 100 meters from the edge), than at sites closer to the edge (up to 60 meters, or 200 feet, from the edge). When Krishnadas sprayed insecticide or fungicide, though, the diversity of seedlings in the interior of the forest fragments dropped drastically. There was no effect on seedling diversity closer to the edge. This suggests that the effect of fungi and insects in maintaining plant diversity was weaker at forest edges. “This is an elegantly designed field experiment that points to a mechanism by which forest fragmentation can lead to reduced plant diversity near edges,” Sandeep Pulla, a plant ecologist at the National Centre for Biological Sciences in the city of Bengaluru (formerly known as Bangalore), who was not involved in the study, told Mongabay.In forests, plants and their natural enemies like fungi and insects play a fine balancing act. The enemies prevent any one species from taking over at the expense of others. If one species starts to become more abundant than others, it draws in more natural enemies that prefer that species. This keeps the plant’s population growth in check, Pulla said. This also gives species that are locally rare a chance to increase in numbers. “This study suggests that this natural ‘diversity-maintaining mechanism’ gets tampered with near edges but remains intact in the interiors,” Pulla said. In fact, disruption of plant-enemy interactions because of fragmentation could mean that rare species that are maintained in a plant community because of the activity of natural enemies could end up struggling to survive.

The role of natural plant enemies like fungi and insects diminishes at forest edges. Image by Meghna Krishnadas. But why do the natural enemies become less effective at maintaining high diversity near forest edges? The answer is unclear. However, Krishnadas speculates that abiotic factors like warmer, drier conditions at the edges could be weakening the enemies’ role in maintaining diversity. Or the edges could be hosting more general enemies rather than specialized ones. “Effective specialization is needed for diversity to happen and to be maintained,” Krishnadas said. “If enemies are generalists, maybe because of the conditions at the edges, then even if they act there, they might not be contributing much to diversity.”Despite the differences in seedling diversity between the edge and interior of the forest fragments, the diversity of adult trees was not very different. “This could be an indication of a forest in transition in some sense,” Krishnadas said. What the study also showed, she added, was that while “edge effects” are usually seen in the light of abiotic factors, biotic ones like fungi and insects could also be driving diversity. “These need to be looked at further,” she said. When it comes to restoring forests, for instance, the role of plants’ natural enemies could be an important consideration. Similarly, when forest fragments lie adjacent to orchards or tea gardens, where pesticides are sprayed in mass quantities, the drift of these pesticides into the forest fragments could also affect plant diversity by changing the community of their natural enemies. “So then we have another mechanism that’s leading to the loss of diversity and it’s probably something we should be looking at," Krishnadas said. A lot of unanswered questions remain, though. Could unaccounted factors, such as soil moisture, for example, be causing the effects Krishnadas observed? "It is possible, but we would need a very different study to tease apart whether it's soil moisture that's directly preventing diversity from being high at the edges or if soil moisture indirectly changes fungal communities, which then drives diversity," Krishnadas said. The experiment period was also short, and limited to one area, to make broader generalizations. "This is generally a very nice study design," said Helene Muller-Landau, a tropical forest ecologist at the Smithsonian Tropical Research Institute, who was not involved in the research. "However, the study extends only a little over one year. Seed production and seedling recruitment are highly variable among years, so there are inherent limits to what we can conclude from any one-year study." Despite these limitations, one thing is clear: plant conservation efforts must look at the world of cryptic interactions that affect their diversity. "In general, I would say that efforts to conserve and manage plant species composition and diversity need to consider not only the direct effects of environmental changes on the plants, but also how those environmental changes affect natural enemies and mutualists of plants, and thereby indirectly affect the plants," Muller-Landau said.

Source:-https://news.mongabay.com/2018/11/invisible-plant-enemy-interactions-drive-diversity-in-forest-fragments/