

Studies reveal impact of land use on species diversity in rock outcrops

by Arathi Menon on 14 August 2023

- *Land use changes are threatening open natural ecosystems like rock outcrops in the northern Western Ghats that support unique species diversity.*
- *Hydroperiod is found to be crucial for the survival of rock pool-dependent arthropod communities but is upended by change in rainfall pattern.*
- *Studies provide evidence to make conservation efforts both land use and species specific.*

The Western Ghats brings to one's mind images of rolling grasslands, thick verdant greenery, loquacious cicadas, charismatic cats and jumbos, and the like. While this is close to reality, for a wholesome picture of the Western Ghats, one must include rare lateritic plateaus, on its northern side, harbouring unique but unsung life forms. Belonging to the general habitat category of rock outcrops, they are home to a large number of endemic flora and fauna, many of them assessed by the International Union for Conservation of Nature (<https://www.iucn.org/>) (IUCN) as threatened.

A status review of rocky plateaus (https://www.researchgate.net/publication/275425799_Status_review_of_Rocky_plateaus_in_the_northern_Western_Ghats_and_Konkan_region_of_Maharashtra) reveals that the region is composed of Deccan Trap lava flows (<https://www.sciencedirect.com/topics/earth-and-planetary-sciences/deccan-trap>) part of Maharashtra. According to the 2013 review, the present topography of the region is the surface) with scarce soil cover. Often marked on topographic maps as rocky scrub, stony waste on the Wastelands Atlas of India. This description completely overlooks the high biodiversity v



The lateritic plateau or rock outcrops in the Ratnagiri region of the northern Western Ghats. This geographical region lacks forest cover or enough vegetation, putting it in the category of barren rocky or stony waste areas on the Wastelands Atlas of India. Photo by Jithin Vijayan.

There have been attempts to understand the value of conservation of rock outcrops through studies of the landscape, land use changes and species' response to these changes. In a 2023 study (<https://www.sciencedirect.com/science/article/pii/S2351989423002172>), scientists studied the impact of land use changes on various species in the rock outcrops of the Ratnagiri region of Maharashtra by comparing the rock-availability and fauna in outcrops, orchards and abandoned paddy. During the survey of 7179 surface rocks, they encountered 5738 individuals from 38 animal taxa.

Read more: Wastelands or grasslands? India's history with defining open ecosystems (<https://india.mongabay.com/2022/12/explainer-wastelands-or-grasslands-indias-history-with-defining-open-ecosystems/>)

Change in agriculture, rainfall pattern determine species diversity and survival

Lead author Jithin Vijayan said that the region witnessed many land use changes in the last century; agriculture changed from paddy and millet to agroforestry with orchards of largely mangoes and some cashew, kokum etc. When Ratnagiri alphonso mangoes garnered global attention, more farmers switched to growing mango orchards. The unpredictable rains too contributed to the decline in popularity of paddy farming.

A natural rock outcrop will have many rock pools and loose rocks scattered across the plateau, explained Vijayan. In the 1920s, when paddy farming was becoming popular, the plateau was altered to facilitate it. Then later, around the 1950s, when mango orchards were gaining attention, the plateau underwent another type of land use change, Vijayan told Mongabay-India. "When people changed the land to create mango orchards, what they essentially did was to remove all the loose rocks because animals like snakes would be attracted to the place otherwise. They blasted the plateau, made large pits and filled them with soil to plant mango saplings," he said. This altered the open habitat into a forested habitat, driving open habitat specialist species out of their natural dwellings.



The team of researchers led by Jithin Vijayan (in the photo) looked under the rocks for various species the landscape harbours. Photo by Manali Rane.

To understand the natural biodiversity of this region, the team of scientists led by Vijayan analysed 38 taxonomic groups, ranging from mites to snakes, that live under the rocks. They focused on the prevalence of three species — the endemic caecilian (*Gegeneophis seshachari*) and gecko (*Hemidactylus albofasciatus*) and saw-scaled viper (*Echis carinatus*) which is widespread in Ratnagiri region — for the main analysis.

Conservation should be both landscape and species specific

In a similar but unrelated study, which is yet to be published, a team of scientists studied crustaceans and insects that inhabit rock pools in rock outcrops in the Satara district in Maharashtra to understand the determining factors behind the structure and assembly of crustacean and insect communities in this habitat.

They studied functionally diverse arthropod communities in 32 freshwater rock pools on three plateaus, sampling them throughout their hydroperiod of two to seven months.



One of the rock pools in the Satara district of Maharashtra. A study revealed that the hydroperiod determined the diversity and structure of the crustacean and insect communities in the region. Photo by Mihir Kulkarni.

Mihir Kulkarni, a researcher at the Centre for Cellular and Molecular Biology, who led the study, said that the hydroperiod, when an area

of land is inundated with water, was found to be a major determinant of the diversity and structure of the communities.

Rock pools are used by both crustaceans and insects during various stages in their lives and rains play an essential part in facilitating their use. Crustaceans are passive dispersers which means they cannot move from one place to another on their own. Being permanent residents of these rock pools, they have developed special adaptation traits to survive in these habitats. Insects, on the other hand, are active dispersers that use these rock pools during certain life stages. When the rock pools are destroyed, these communities of crustaceans and insects are lost.

Kulkarni lists a few key takeaways from the study that can steer the conservation efforts in the right direction. "The hydroperiod, when the pools are holding water, attracts these arthropods to the rock pools. However, not all species have the same response to the same environment which is evident from the fact that you see different species during different hydroperiods," explained Kulkarni. The change in rainfall patterns, as we are witnessing today, can have a lasting impact on these communities. According to the researchers, the results highlight the importance of habitat-level factors and the role of evolutionary processes in shaping diversity in this vulnerable landscape characterised by its seasonality. These factors make it crucial for the conservation efforts to be focused on the entire landscape and not individual pools or species.



White-striped viper gecko is one of the species studied by Vijayan and his team in the Ratnagiri region of Maharashtra. Photo by Jithin Vijayan.

Vijayan who studied three different landscapes of abandoned paddy, mango orchards and outcrops found the community composition (number and diversity of particular animals) in the three landscapes to be entirely different. "For instance, in outcrops, you find many animals like crickets and grasshoppers under the rocks but they are absent from orchards and paddy and are replaced by other animals, like ants," he said.

The studied snake species of saw-scaled vipers were found in abundance in outcrops even though historical records indicate that the population has declined owing largely to anti-venom collection. But these snakes as well as the geckos were missing in other landscapes since they are ectotherms and are adapted to a certain habitat. However, it is the caecilian which has made the most of this opportunity to not just survive the land use change but thrive in the abandoned paddy fields. "The most important takeaway from this study is that one cannot say that land use changes are negatively impacting all animals equally, which makes conservation ideas for specific animal groups crucial," Vijayan said. Read more: Path of destruction: Road to Anjaneri hilltop could threaten fragile rocky outcrop ecosystem (<https://india.mongabay.com/2020/12/path-of-destruction-road-to-anjaneri-hilltop-could-threaten-fragile-rocky-outcrop-ecosystem/>)

Banner image: A saw-scaled viper under a rock in the rock outcrops in the Ratnagiri region of Maharashtra. Photo by Jithin Vijayan.

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