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IMPACT OF HABITAT ALTERATIONS ON THE REPTILE DIVERSITY IN THE HIGHER ATLITUDES OF NILGIRI BIOSPHERE RESERVE, WESTERN GHATS, INDIA

S. Bhupathy
A.M.A. Nixon

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SALIM ALI CENTRE FOR ORNITHOLOGY AND NATURAL HISTORY

Anaikatti (PO), Coimbatore- 641 108

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S. Bhupathy, Principal Investigator

A.M.A. Nixon, Junior Research Fellow

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SUMMARY

Biological diversity is being eroded at a greater pace due to various anthropogenic activities. Habitat degradation and fragmentation are the major and fundamental causes of species loss. However, comprehensive studies on the impact of habitat alterations on species communities are scanty in India. Lack of information and continued habitat loss due to development projects, intensified agriculture and plantation activities could lead to species extinction before discovery and understanding their role in the ecosystem. Also, conservation plans without proper understanding of species biology would be futile, especially in the case of reptiles, as they have restricted ranges and specific microhabitat requirements. It has been estimated that in India, over four million hectares of forests have been lost during the last 25 years. An effective approach towards gauging or monitoring habitat change would be studying the response of various taxa in terms of changes in diversity among natural and man-modified habitats. In this background, the present investigation was initiated to (1) determine the distribution and abundance of reptiles in various natural and man-made (modified) habitats occurring in the higher altitudes of Nilgiri Biosphere Reserve (2) collect baseline data on the habitat requirements of various reptile species inhabiting higher altitude, and (3) to quantify the impact of habitat alterations on reptiles in terms of their distribution and abundance.

A large proportion of Grasslands of the Nilgiris have been cleared for raising monoculture plantations such as Wattle, Eucalyptus, Pine and Tea. Even after so much changes, the Nilgiri Biosphere Reserve holds a few patches of natural Montane Shola and Grasslands in the Upper Nilgiri plateau. Currently, these habitats are protected under Mukuruthi National Park, which offers an opportunity for comparative study. Hence, the present study was initiated in and around Mukuruthi National Park, Nilgiri Biosphere Reserve, Western Ghats. The Upper Nilgiris experiences colder climatic conditions with mild temperature regime. Annual rainfall of the area exceeds 2000 mm.

Area (Quadrat) and Time constrained (Visual Encounter Survey) sampling techniques were used for data quantification. Monthly field surveys were conducted from October 2000 to September 2002. Sampling was largely restricted to day hours between 0800 and 1600 hrs due to colder climatic conditions, activity of the species and logistic support in the field. Data on macro and microhabitats, perch site of the species, availability of boulders, crevices and trees were recorded. Data on morphometry (snout-vent length, tail length, weight), sex and breeding status were recorded, whenever a species was handled. Breeding season of a species was assessed based on females with eggs and breeding colour in males.

Pooled data at species level using Time Constrained Visual Encounter Surveys (TCVES) and Quadrat sampling showed a similar trend in result. The present study indicates that TCVES is suitable for inventories and quadrat sampling for studies involving comparison. Small (10*10 m) quadrats are suitable for sampling compared to larger ones such as 25* 25 m for various reasons, especially with respect to resource required.

Eleven species of reptiles were recorded in Upper Nilgiris, of which, nine (81.8%) were endemic to India. This includes the Horse-shoe pit viper, *Trimeresurus strigatus*, a venomous snake, but not lethal to humans. Seven species (63.6%) are endemic to the Western Ghats and one species (9.1%) each to the Eastern and Western Ghats and Peninsular India. It is interesting to find two non-endemic species, *Xenochrophis piscator* and *Ptyas mucosus* in such a specialised bio-climatic zone (ie. near temperate zone). These species have largely been recorded in the lower altitudes or plains. They would have found their way into this high altitude area through anthropogenic activities. Study on how these species establish and survive in colder climatic conditions is needed, which may throw further light on the adaptability of species. This type of study would also give pertinent information on the impact of global warming and movement of species to higher altitude or vice-versa.

In all, 864 reptiles belonging to eight species were observed in 25. 05 ha of quadrat and 650 hours of visual encounter surveys. *Salea horsfieldii* contributed the maximum (42.8 %) followed by *Cnemaspis indica* (36.9 %) and *Scincella bilineatum* (8.8 %). All (5) species of snakes contributed only 11.6 % of the total observations. Among snakes, *Ahaetulla perroteti* (42%) and *Plectrurus perroteti* (36%) were common compared to other species. *Xylophis perroteti* was the rarest species as its comparative abundance was the lowest (0.4 %) among all species observed in Upper Nilgiris.

Species accumulation pattern in various habitats showed that number of missing species is negligible. Hence, number of species observed in the present study may be considered as closer to the number of species occurring there. The observed fewer (only eight) species in Upper Nilgiris could be due to the colder conditions prevailing in the area. These species are adapted to the colder climatic conditions. Environmental parameters such as temperature may play an important role in the distribution of reptiles.

Overall reptile diversity (Shannon-Wiener Index, H') of the area was 1.34, and the highest diversity (H'= 1.24) was observed in Grasslands and lowest in Shola (H'= 0.24). Number of species that contribute to the reptile community was high in

Grassland (Hill's Diversity, N_1= 3.5), whereas it was low in Shola (N_1 = 1.3). This indicates that only one species dominated the reptile community in Shola, whereas it was four species in Grassland. *Salea horsfieldii* mostly used the edge of Shola and Grassland and avoided interior shaded parts of Shola. Similarly, this species considerably avoided open Grasslands as well. The present findings indicate the importance of habitat edge (ecotone) and undisturbed contiguous Grassland and Shola for the conservation of this species.

Breeding of reptiles in Upper Nilgiris is during dry season (October- May) as evident from the number of females with eggs and nests observed. Vertical distribution of reptiles showed that only three species used above ground microhabitats. They were *Salea horsfieldii* (58.9 ± 59.28 cm), *Ahaetulla perroteti* (3.75± 17.92 cm) and *Cnemaspis indica* (3.01±12.49 cm). Remaining five species were found on or under ground. Among the reptiles of Upper Nilgiris, *Salea horsfieldii* is versatile with respect to the utilization of various tree or shrub layers. Niche breadth at habitat and micro habitat aspects revealed that all reptile species were highly specific with respect to the utilization of spatial resources. This is indicated by the low niche breadth values. Among them, *Cnemaspis indica* and *Salea horsfieldii* were comparatively adaptable with respect to habitat, and *Salea horsfieldii* with microhabitat. The shieldtail snake, *Plectrurus perroteti* was highly sensitive to both macro and microhabitats.

On the whole, the species richness (number of species) was apparently similar both in natural and altered habitats when the results are combined. The species richness may be maintained by the loss of native species and invasion of new species from adjacent areas or habitats. Hence, there is a possibility of change in species community, when habitats are altered. Notable difference was also observed in species diversity and density in altered and unaltered habitats. Species diversity was high (H'= 1.28) in natural habitats, and low (H'= 1.01) in altered habitats. Number of contributing species (Hill's Divesrity Index) to the community of reptiles decreased, ie. 3.5 species in the case of natural and 2.7 species in altered habitats. Notable difference was observed in reptile density, ie. 14.7/ha in unaltered, and 6.9/ha in altered habitats. Density of species was different in natural and man-modified (altered) habitats.

The reduction in density of species in altered habitats is largely due to the change in temperature regime and microhabitats. This is supported by the fact that the diurnal temperature was higher in Grasslands compared to other habitats. Availability of boulders and reptile density was significantly related ($r = 0.349$, $P < 0.05$) indicating the importance of boulders as microhabitat for the reptiles of Upper Nilgiris. On the whole, number of trees and reptiles

showed negative correlation ($r = -0.269$, $P > 0.05$). This is reflected by the highest density of reptiles in Grasslands where the tree density is low, compared to other habitats.

Suggestions for the reptile conservation in Upper Nilgiris include habitat protection and fire control. Occurrence of many species of reptiles, especially the endemic *Salea horsfieldii* along the edge of Shola and Grasslands indicates the importance of habitat edges (ecotone) for the conservation of reptiles in Upper Nilgiris. Removal of exotic plantations adjacent to the Mukuruthi National Park is being done by the Tamil Nadu Forest Department. This would bring back the native biota in general and reptiles in particular. All reptile species were largely found under boulders or stones. Probably warmer conditions under boulders may be suitable for them. Hence, during habitat manipulations, stones and boulders should be left as such in the field. As higher number (both species and number) of reptiles were found in Grasslands, fire, if any would affect the populations of reptiles seriously. Fire protection force is already in place in Mukuruthi National Park. Continued support for this and creating fire lines should be ensured on a regular basis.

This study clearly demonstrates the impact of habitat alterations on reptiles in terms of the difference in species richness, diversity and density. Factors such as temperature, availability of boulders (loose stones) and tree density play an important role in determining the distribution and abundance of reptiles in Upper Nilgiris, Nilgiri Biosphere Reserve, Western Ghats. Thus it brings out the need for more such natural habitats and the restoration of altered habitats.