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Recolonization of anurans in the Knuckles mountain forest range in Sri Lanka: Which environmental factors are primarily involved?

Senarathge R. Weerawardhena[2]* and Anthony P. Russell[1]

[1]Department of Biological Sciences, University of Calgary, 2500,
University Drive NW, Calgary, T2N 1N4, Alberta, Canada.
[2]Department of Zoology, University of Kelaniya, 11600, Sri Lanka.
*ranjithweerawardhena@yahoo.ca

Abstract

Many ecological studies have examined the recovery of animal communities during forest regeneration, but their restricted spatial and temporal scales, often with no replication, render them of limited value for understanding the generalities of the process. Recovery patterns may be different from habitat to habitat, and may differ according to the group of organisms involved. The majority of studies that have been undertaken have focused on the recovery of birds, insects (butterflies in particular), and small mammals. Few have focused on recovery patterns of herpetofaunal elements. Furthermore, the recovery patterns of higher trophic levels following habitat alteration in highland tropical forest areas are poorly understood, and poorly documented (Raman *et al.*, 1998).

The main objective of our research was to test hypotheses regarding the effect of various environmental factors associated with secondary succession following the abandonment of tea plantations and their influence on rates of recolonization of anurans. We hypothesised that abandoned tea plantations at different successional stages equidistant from virgin sub-montane forest are recolonized by anurans according to the environmental factors of those abandoned tea plantations.

The experimental plots were surveyed from April, 2008 to April 2009 to gain information about variation of presence and abundance of anurans in relation to seasonal environmental conditions. We selected sampling stages in the Knuckles Mountain Forest Range on the basis of structural features of the vegetation that differed from one other, since we were unable to reliably ascertain the real time that had elapsed since abandonment. We broadly categorized vegetation in the study area into three successional stages: early, middle, and late, each of these stages was represented by ten sampling sites and we sampled from one, 10 m x 10 m sized quadrat per site per season. The comparators to these successional stages were the undisturbed sub-montane virgin forest as the reference stage and tea plantations as the control stage - the maximum disturbed stage.

We measured twelve environmental variables for each quadrat to enable description of the physico-chemical condition of each: air and soil temperature; percentageof relative humidity; percentage of soil moisture; soil pH; percentage of litter cover; litter depth; percentage of canopy and sub-canopy cover; density of woody trees; girth at breast height of dominant trees; height of vegetation; and density of tea plants.

As we expected, we found that abundance, species richness, and diversity of anurans in abandoned tea plantations located equidistant from the virgin sub-montane forest were greater in experimental plots representing late successional stages than early ones. The abundance of anuran species differed among the successional stages, with the lowest abundance recorded for currently-in-production and the highest

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abundance for virgin sub-montane forest. The species composition of anurans was less complex in the early successional stages than it was in the later successional stages.

Comparison of physico-chemical variables among all stages revealed differences among them, and the pattern of variation of vegetational characteristics among stages also showed differences. Multiple regression analysis of the twelve environmental factors as predictor variables, using the species richness of anurans as the response variable, revealed that density of tea plants; density of woody plants; percentage of litter cover; and percentage of crown cover had variation inflation factor values of more than ten. These higher values indicate that a strong degree of multicolinearity occurred between these four predictor variables and that the recolonization of anurans in the Knuckles Mountain Forest Range in Sri Lanka depends to a large degree upon them.

Keywords: Recolonization, amphibians, Knuckles, Sri Lanka