Chapter 19

A REPORT ON THE SURVEY OF RAINFOREST FRAGMENTS IN THE WESTERN GHATS FOR AMPHIBIAN DIVERSITY

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Introduction

A survey of the rainforest fragments in Kerala was conducted as part of the project titled "Impact of forest fragmentation on the biological diversity of rainforest small mammals and herpetofauna of the Western Ghats mountains, southern India". This project was a USFWS, WII and SACON collaborative project that spanned from 1996 to 2001. The first phase of the project dealt with the identifying the factors that govern diversity in a contiguous rainforest. The rainforest covering ca. 100 sq. Km in Kalakad-Mundanthurai Tiger Reserve (KMTR) was identified as a study site and information was gathered. In the second phase of the project the focus was on quantifying the impacts of rainforest fragmentation on the diversity of herpetofauna and small mammals. The fragmented landscape of Anamalais was chosen as the study site for this phase. In the third phase the project aimed to validate some of the findings that were obtained from the intensive study in the contiguous rainforest study site of KMTR and in the fragments of the Anamalai hills. This involved identifying rainforest fragments in the state of Kerala and sampling them. A report on the number of species documented in the rainforest fragments of Kerala and the two other study sites of KMTR and Anamalais is presented here.

There are about 220 amphibian species documented in the country while the Western Ghats alone has more than 120 species (Daniels, 1992). The amphibian diversity of the Western Ghats are well known for their uniqueness, with more than 80% of them being endemic to the region. Most of the endemic species have their distribution in the rainforests of these mountains. The intensive study on the amphibian diversity documented patterns in loss of diversity due to rainforest fragmentation. However, these findings would gain wider applicability if data were collected again in a different area and then tested for conformity to the patterns observed through the intensive study. The results presented here are from this survey and comparable data from the intensive studies carried out in KMTR and the Anamalai Hills. The conclusions have been made by collating information gathered during the entire study period and do not restrict to the findings from the survey of fragments in Kerala.

Study Area and Methods

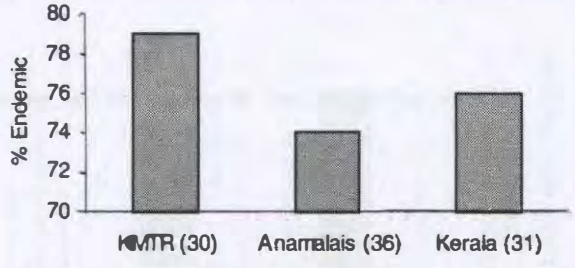
The survey was conducted between February and May 2001 in Nemmara, Munnar and Thenmalai forest divisions of Kerala. These forest divisions have remnant rainforest fragments in a landscape, which has been modified from rainforest to plantation crops such as rubber, coffee, cardamom and tea. The choice of the rainforest fragment for sampling was limited due to the nature of the matrix and logistic constraints. During the intensive study in the Anamalais 14 fragments belonging to three size classes namely, very large (> 501 ha), large (151-500 ha), medium (11-150 ha) and small (< 10 ha) were sampled. In the three forest divisions of Kerala 11 fragments in large and medium size classes were sampled.

The survey employed quadrat search to enumerate forest floor amphibians (refer to Vasudevan et al. 2001 for details). The inventory of species in rainforest fragments also included the opportunistic sightings. Caecilians have been excluded in the comparison since they were not targeted in the sampling and all the records from the intensive study either came from road kills or opportunistic sightings.

Results and Discussion

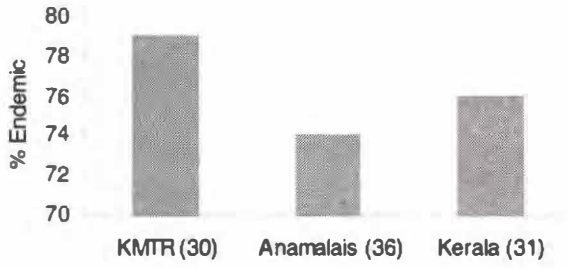
The survey documented 31 species of amphibians of which 24 are endemic to the Western Ghats. Among these species, six have not been identified (Appendix). At least one "new species" of *Bufo* has been recorded. In the percentage of endemic species the amphibian community in the rainforest fragments of Kerala was comparable to that of Anamalais (76%, N = 36) and the contiguous rainforest in Kalakad-Mundanthruai Tiger Reserve (79%, N =30; Figure 1). Although individual fragments have low species richness and proportion of endemic species (mean = 8.6 & 0.55), the fragments together have species richness and proportion of endemics (mean = 21 & 0.75) comparable to the contiguous rainforest. In terms of area the contiguous rainforests of KMTR has more than three times the extent of rainforest than the Anamalais, despite this the fragments provide refuge for a sizeable number of endemic amphibians.

Figure 1. Percentage of endemic amphibian species recorded in different study areas during the project. The total number of species recorded is given in parenthesis.



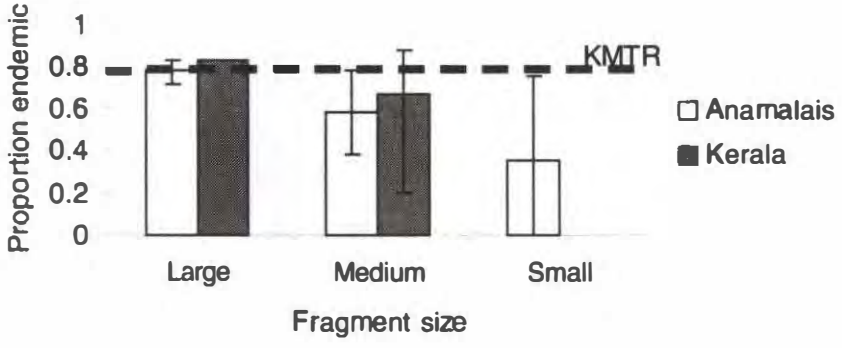
Among the three divisions in Kerala, Munnar had the highest percentage of endemic species (88%, N = 18) followed by Thenmalai (64%, N = 9) and Nemmara (60%, N = 15; Figure 2). The variation in the percentage of endemic species among the three divisions could have been due to altitude, since Nemmara and Themalai were in lower elevation while Munnar was in a higher elevation. There is a tendency for endemicity in amphibians to be highest between 800 and 1400 m msl (Daniels, 1992).

Figure 2. Percentage of endemic amphibian species recorded in rainforest fragments in three divisions in Kerala between February and May 2001. The total number of species recorded is given in parenthesis.



A comparison of the data from fragments of different size classes indicates that there is a decline in the proportion of endemic species with decreasing fragments area in the fragments that were sampled in Kerala, as in the case of fragments in the Anamalai Hills (Figure 3). The large fragments had proportion of endemic species comparable to that of the contiguous rainforests of KMTR (Figure 3).

Figure 3. Proportion of endemic amphibian species in contiguous rainforest of KMTR, fragments of the Anamalais and Kerala. The histograms indicate the mean or single values for the proportion, and the error bars the maximum and minimum values wherever available.



The fragments in Munnar contributed the highest proportion of endemic species in the large size. Though there was a tendency for the proportion of endemic species in small fragments to decrease significantly from the values obtained for the large and contiguous rainforest samples, the range of values obtained indicates that size of the fragment alone did not contribute to the decline in diversity of amphibians. Some medium sized and small fragments that were less disturbed and were relatively intact had greater proportion of endemic amphibian species. The fragments in Munnar were

geographically closest to the Anamalais than the fragments in other divisions. The elevation range of the forest fragments in the large size category was also comparable for the Anamalais and Munnar. This is reflected in the similarity in the amphibian species between these two areas.

Conclusions

1. In the southern Western Ghats, when four segments of 2°N latitude were compared for the extent of amphibian species overlap, it was observed that there was an overlap of less than 60% of the species between any of these segments (re-analyzed from Daniels, 1992). Our intensive study has documented a similar pattern of turnover of diversity of amphibians. Many of the rainforest fragments such as those in Munnar hold several endemic species of amphibians and have important conservation value. More so, because these endemic species may be specific to a drainage and would not be shared with those of other rainforest areas in the Western Ghats.

2. Size of the fragments alone does not contribute to the reduction in the endemic amphibians, the quality of the fragment plays an important role in regulating the diversity of amphibians in the fragmented landscape.

3. The general pattern of loss of endemic species with increasing intensity of fragmentation of the rainforest habitat may hold true for the southern Western Ghats.

4. In view of extent of rainforest fragmentation of the Western Ghats, it should be considered a priority to inventory the amphibian taxa and document the so far undescribed species surviving in the remnant rainforest fragments.

5. The turn over of diversity of amphibians across drainages and hill ranges documented through this study point at the inadequacy in the PAs in different drainages along the Western Ghats, if the amphibian diversity has to be conserved.

References

Daniels, R. J. R. 1992. Geographical distribution patterns of amphibians in the Western Ghats, India. J.Biogeog. 19: 521-529.

Vasudevan, K. Ajith Kumar and Ravi Chellam. 2001. Structure and composition of rainforest floor amphibian communities in Kalakad Mundanthurai Tiger Reserve. Current Science 80(3): 406-413.

Appendix

List of amphibian species recorded in different fragments in three forest divisions of Kerala, includes unidentified species. The size of the fragment is mentioned in parenthesis. The survey was carried out between February and May 2001.

Munnar Division:

NAYAMAKAD (*Medium*)

Micrixalus fuscus
Indirana leptodactyla
Nyctibatrachus sp
Nyctibatrachus deccanensis
Polypedates pleurostictus
Polypedates sp
Philautus sp1
Philautus sp2
Philautus leucorhinus

VAGAVURRAI (*Medium*)

Limnonectes nilagirica
Micrixalus sp
Micrixalus silvaticus
Indirana beddomi
Indirana leptodactyla
Philautus sp
Philautus temporalis
Philautus pulcherrimus
Polypedates sp

THENMALAI (*Medium*)

Micrixalus silvaticus
Indirana leptodactyla
Philautus konalarensis
Philautus leucorhinus
Philautus pulcherrimus

KADALAAR RIDGE (*Medium*)

Micrixalus silvaticus
Micrixalus sp
Indirana leptodactyla
Philautus konalarensis
Philautus leucorhinus
Philautus pulcherrimus

KADALAAR RIVER (*Medium*)
Micrixalus fuscus
Indirana leptodactyla
Indirana beddomi
Nyctibatrachus sp
Nyctibatrachus decannensis
Polypedates sp
Philautus sp1
Philautus sp2
Philautus charius
Philautus leucorhinus
Bufo sp
Bufo melanostictus

KFDC KADALAAR (*Large*)

Limnonectes nilagirica
Limnonectes sp
Micrixalus fuscus
Micrixalus sp
Micrixalus silvaticus
Indirana leptodactyla
Indirana beddomi
Indirana phymoderma

Indirana brachytarsus
Rana temporalis
Nyctibatrachus decannensis
Ncytibatrachus sp
Bufo sp
Bufo melanostictus
Polypedates sp
Philautus sp
Philautus pulcherrimus
Philautus charius

Nemmara Division:

KAIKATI AVT (*Medium*)

Bufo melanostictus
Philautus temporalis
Rana aurantiaca
Linonectes brevipalmata
Euphylictis cyanophylictis

KADALAAR RIVER (*Medium*)

Micrixalus fuscus
Indirana leptodactyla
Indirana beddomi
Nyctibatrachus sp
Nyctibatrachus decannensis
Polypedates sp
Philautus sp1
Philautus sp2
Philautus charius
Philautus leucorhinus
Bufo sp
Bufo melanostictus

KFDC KADALAAR (*Large*)

Limnonectes nilagirica
Limnonectes sp
Micrixalus fuscus
Micrixalus sp
Micrixalus silvaticus
Indirana leptodactyla
Indirana beddomi
Indirana phymoderma
Indirana brachytarsus
Rana temporalis
Nyctibatrachus decannensis
Ncytibatrachus sp
Bufo sp
Bufo melanostictus
Polypedates sp
Philautus sp
Philautus pulcherrimus
Philautus charius

Nemmara Division:

KAIKATI AVT (*Medium*)

Bufo melanostictus
Philautus temporalis
Rana aurantiaca
Linonectes brevipalmata
Euphylictis cyanophylictis

KAIKATI OVF (*Medium*)

Bufo melanostictus
Philautus pulcherrimus
Philautus leucorhinus
Rana aurantiaca

Nyctibatrachus sp
Euphylictis cyanophylictis

TAMBOORAN KADU (*Medium)*

Micrixalus gadgili
Micrixalus fuscus
Indirana brachytarsus
Nyctibatrachus sp
Rana temporalis
Indirana beddomi
Bufo melanostictus
Philautus pulcherrimus

Thenmala Division:

PALARUVI (*Medium)*
Limnonectes brevipalmata
Indirana semiplamata
Micrixalus fuscus
Rhacophorus malabaricus
Philautus pucherrimus
Philautus leucorhinus
Philautus temporalis

***PRIYA ESTATE* (Medium)**

Limnonectes brevipalmata
Indirana semiplamata
Micrixalus fuscus
Micrixalus nudis
Rhacophorus malabaricus
Philautus pucherrimus
Philautus leucorhinus
Philautus temporalis
Bufo melanostictus