Effect of fragmentation and consequent climate change on amphibian assemblage, KMTR, South Western Ghats, India

Start of field work: October 1st 2010  
End of Field work: October 30th 2011

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Summary

The project objectives as proposed have been successfully achieved. An intensive study has been carried out to compare amphibian assemblages in selection logged and unlogged forest. This provided the first ever assessment of impacts of selection logging on amphibians in the study site of Kalakad Mundanthurai Tiger Reserve (KMTR). These studies also lead to description of a new species of amphibian.

For long term monitoring, an automated protocol has been developed and tested and is being finalized before being suggested for widespread application in the Western Ghats to monitor amphibians in harsh environments. Additionally, a small study on diet content analysis of two species of stream frogs has been carried out. A pocket guide to the amphibians of the study site has been brought out and will be distributed among students and interested persons. Interaction meeting will be arranged with stakeholders and an exciting footage on amphibians will be screened before delivering lectures on amphibian conservation. The study has so far, led to three scientific publications (at various stages of preparation and review); two popular book chapters; One popular article in Magazine and two planned articles in local print media.

A deviation was made with respect to the proposed Objective 3. ‘Determine if there is a potential of degraded forests in supporting amphibians under climate change scenario given their sensitivity to temperature and humidity levels.’ This objective has been reduced to only establishing and gathering base line information about anuran occurrence and density using automated data loggers. The long term program will generate data for climate change models in future. This was suggested by the review committee as well.

Forest canopy of the unlogged evergreen forest
Background

Amphibians are in danger of extinction world over. Habitat loss is considered to be one of the important causal factors. India is home to an astonishing diversity of amphibians. Over 170 species have been described and new species are being described in the Western Ghats. Much of this diversity is endemic and unique to the Western Ghats biodiversity hotspot. However, the studies on amphibians have remained largely taxonomic and have left wide gaps in the knowledge of natural history and ecology of these creatures. There are no field-based continuous amphibian monitoring programs in India which is important given the high diversity and endemism of the taxa and the threats the taxa is likely to face from land degradation and global climate change. This study attempts to narrow these gaps by relating micro climatic variables with amphibian assemblages across various micro habitats by setting up the first autonomous long term monitoring program for amphibians in Western Ghats.

Evergreen forest in the backdrop of Agasthya peak, Agasthyamalai Biosphere Reserve
Summary of Objectives, Activities and Outputs

Objective 1: Determine amphibian distribution on a vertical gradient of forest in degraded forests and undisturbed sites

- **Activity 1: Anuran Sampling**
  Sampling for anurans was done between the months November 2010–January 2011 and again in June–August 2011. The sampling protocol has been provided in the appendix, map showing sample units are depicted in the Figure 1.

- **Activity 2: Data Analysis**
  Species richness estimator and Shannon H, Simpson D and Simpson 1-D were used for comparing diversity, dominance and heterogeneity respectively. Significance testing was done using one way ANOVA using log transformed data.

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**Figure 1. Map showing the study area**
Outputs from objective 1:

- A total of 12 species of anurans were recorded across unlogged and selective logged forest. Three species were unique to unlogged forest and all twelve species were endemic to the Western Ghats of India. The observed species richness between selective logged and unlogged forest was different (9 vs. 12 respectively).

- The diversity index value was only marginally higher in unlogged forest compared to selective logged forest (Shannon $H_{\text{log_{10}}} = 2.0$ & 1.7 respectively).

- A total 257 individuals were encountered during this study in an area of 0.4 ha with an average 6.4 individuals /100 m$^2$. Mean anuran density was higher in unlogged forest (8.15/100 m$^2$) compared to selective logged forest (4.7/100 m$^2$) and the variation was significantly different between the two sites ($F=6.443$, df=37, $p<0.005$). The anuran densities were highest in streams. Streams in unlogged had significantly higher no. of amphibians than in logged forests. Riparian zones had lower densities than streams and forest quadrats had the least in both unlogged and selective logged sites (Figure 2).

Figure 2. Field data collection in process using Visual Encounter Surveys
• During the course of the study, as many as five new species were encountered. One has been described as *Raorchestes kakachi* sp. nov. (species novelty in the taxonomic journal *Zootaxa* published by *Magnolia press*, Auckland. The total checklist of species recorded in the wet evergreen forest of KMTR has been revised to 20 from about 10 from earlier studies (Appendix 2).

• The team members were part of a major rediscovery of a Lost amphibian, *Raorchestes chalazodes*—Chalazodes Bubble nest frog. This frog was not reported for the past 136 years. The team leader collaborated for the search with Dr. S.D.Biju, a reputed authority on Indian amphibians from Delhi University and Dr. R. Ganesan, a botanist at ATREE. An updated list of species in the wet evergreen forest study area has been provided in appendix 2.

![Density comparison across microhabitat and disturbance](image)

**Figure 3. Density differences across micro habitat and disturbance**

**Forthcoming activities planned**

• This sampling was carried out during post monsoon season. Another sampling will be carried out during the next monsoons to verify some of the species and density patterns observed.

• The study has been written up as a manuscript for consideration to be published in a journal. We plan to submit it to the Journal of Tropical Conservation Science.

• A popular article on the adventures and mis-adventures and wildlife sightings during amphibian sampling at night has been written and submitted to be published in Sanctuary Asia. It is a leading wildlife, conservation and environment magazine for Asian Wildlife.
An additional pilot study was undertaken for diet composition analysis of stream dwelling frogs. As it was a new method, two common species were chosen (*Nyctibatrachus vasanthi* and *Micrixalus fuscus*) in unlogged sites. The individuals were caught and stomach was flushed with distilled water. Thirty individuals were caught and contents observed. The stomach contents had a diversity of arthropods. A total of 70 morpho species have been identified and the taxonomic details are being worked upon. The smallest creature was an ‘amphipod’—a fresh water arthropod and the largest was a ‘Centepede’. The arthropods will be identified and the manuscript submitted for publication.

**Objective 2:** Determine if micro climatic changes in these forests explain the observed patterns with strong emphasis on canopy amphibians

- **Activity 1:** Measurement of habitat characteristics
  Soil and water temperature, substrate depth, water depth, atmospheric temperature, relative humidity and canopy cover were measured. (For methods see Appendix)

- **Activity 2:** Long term monitoring of environmental variables
  For long term monitoring of trends in environmental variables, two Kestrel® Weather trackers were deployed one each in the canopy and on the ground. The unit automatically takes record of 10 environmental variables at specified intervals i.e. once every 30 mins.

**Outputs from objective 2:**
- Among the habitat parameters measured, only substrate thickness and substrate temperature had significant positive relationship with species density and the two parameters were responsible for 40% of the variation while canopy cover and relative humidity did not have any significant influence (Multiple Linear Regression: $R^2=0.55$; adjusted $R^2=0.49$; $F=9.88$, $p<0.005$).

- We have observed the vocalization of frogs to peak during low temperatures (Fig. 4). Overall, during the 6 months of data collection on weather, the lowest temperatures were reached during December–January (~$8^\circ$C) and the peak was during March–April (~$23^\circ$C). Temperature and humidity were positively correlated. Relative Humidity reached 100% during the cold months of December–January.
Figure 4. Relationship of temperature and anuran vocalization

Forthcoming activities planned

- A detailed analysis of the environmental data logged by the recorder will be tested for specific patterns.

Objective 3: Protocol for Long Term Monitoring of anuran occurrence over a spatial and temporal scale.

- **Activity 1**: Development of protocol
  There are currently no established protocols for long term monitoring of amphibians in the Western Ghats. Acoustic monitoring techniques have been in use in the Western countries and such methods are known to be efficient. They also allow the opportunity to integrate interested persons, school children and nature enthusiasts for monitoring. We deployed an automated sound recorder in six spatially separated trees (500 m apart) and recorded amphibian calls for 24 h. to discern patterns. The sound recorder was placed for 24 h. in the canopy and another 24 h. on the ground (Fig. 5)

- **Activity 2**: Testing protocol
  A total of 12 trees were chosen and monitored for calling patterns during two rainy seasons. Recordings of 1 min. duration were made for every 30 min. on each location and this was synchronized with the weather data logger from the previous objective.

- **Activity 3**: Validation and verification
  Five most common species of amphibians were chosen for the monitoring program and their presence was monitored by surveying the trees and forest floor at night. This activity also involved spending time in obtaining good quality recordings of each calling species in order to assign the call to its origin. Those species calling was recorded to be present or absent over time. The sound
recordings were also cross verified by randomly listening to few recordings in each sample point for any variations in call or addition of calling species.

- **Activity 4: Data analysis**
  Data analysis was done using software for automated call detection. The proprietary software ‘Song Scope’ was used for this. First, using the good quality recordings obtained in activity 3, the software is trained to detect patterns of vocalizations by assigning the species to its known set of calls. The software, then generates a recognizer with statistical confidence. This step was repeated for each of the selected species. The recordings made at each location are then loaded into the software and the recognizer’s are run. The system, depending on the user defined selection criteria identifies regions of the recordings most statistically suitable with the recognizer. The observer than manually verifies each of the detected portions for the match with intended species and the table is exported for analysis (Fig. 8, Appendix).

![Figure 5. Process involved in Rigging canopy, Tree climbing and setting up Song Meter Outputs from objective 3](image)
Outreach activities:
As part of the outreach activities apart from involving local communities in the study, we carried out a cultural program in front of street play in association with Nature Talkies, a cultural drama team consisting of local children and Mr. Elango, a local folk and theater artist. The drama was conducted on 26th of January 2012. The theme of the drama was how biodiversity was important to wet paddy agriculture and the ecosystem services of frogs, owls and other birds.

The street play was conducted in two villages, Vaagaikulam and Naanal kulam on the evening of 26th, which is a national holiday. The play had a surprisingly high attendance by villagers and over hundred spectators were present in each village. Many had come to watch their own children perform. The children were trained by Mr. Elango through the day. A school bag and a T-shirt were given to the children who participated in the play as a small token of appreciation.

On February 2nd, the District Collectorate inaugurated the “Pocket guide to Frogs and Toads of KMTR” ahead of the “Run for Us” cycle rally organized by us in association with ATREE. He said that the field guide will go a long way in fostering support for conservation. The leaflet is made in both English and Tamil, the local language for maximum reach.
Figure 7 Outreach Activities. (Counter clock wise). Frogs and Toads of KMTR being released by Mathivanan M with Collector; Nature Talkies team; Mr. Elango during street play; Audience and Mathivanan M, speaking on frogs.
Achievements and Impacts (max 250 words)

The successful implementation of this study can be evaluated from the many quantitative outcomes of the project.

- Parts of the studies in this project are presented in two international conferences (SCCS—Bangalore, September 2011 and ICCB New Zealand, December 2011).

- The study resulted in three manuscripts for publication consideration in peer reviewed international journals. One species of bush frog has newly been described to science and has already been submitted to a peer reviewed journal in taxonomy—Zootaxa. Another manuscript on the impacts of selection logging on anuran assemblages has been prepared and will be submitted to tentatively to Oryx, an open access journal, in December 2011. The other manuscript is in preparation and will describe a modified protocol for ‘stomach flush’ on the diet contents of two stream dwelling species.

- Long term amphibian monitoring program has been established using autonomous data collection protocol. This will have wide application in climate change impact modeling on amphibians. The protocol once published, can be replicated along the amphibian rich Western Ghats in future studies.

Overall, the study was aimed at knowledge generation for establishing baselines and the above mentioned outcomes precisely contribute to the existing knowledge of amphibians in the Western Ghats.

We have developed a photographic pocket field guide to the frogs and toads of the KMTR and this will prove to be an important tool for dissipating information and the gathered knowledge among local stakeholders, especially children and farmers. Field modules, Conservation education activities and street play delivered at schools and villages will further a cause for amphibian conservation.

- First ever database of amphibian vocalizations in KMTR has been done. This information is essential for success of the long term monitoring program.

- A protocol developed and is being tested for successful replication in the Western Ghats. This involves, Song meter, Software, Data Logger and very low man power. This method gives ability to monitor amphibians easily in the canopy, where working at night hours is difficult. The protocol will be written up and published in a peer reviewed international journal.
• So far, up to five species of amphibians have been conclusively known to occupy the forest canopy (Raorchestes sp., R. crustai, R. kakachi, R.bobingeri and Rhachophorous calcadensis). Among these, R. bobingeri is almost exclusively known only from the forest canopy and has never been encountered on the ground (it has however been seen vertically stratified from bushes of up to 10 m to forest canopy of about 34 m, Fig. 6).

• Seasonal fluctuation has been observed in vocalizing amphibians. The peak vocalizing (and thus breeding) season begins with first rainy season during May–August. All the species except post/ pre monsoon season vocalizing frogs like Micrixalus fuscus vocalize during this season. The second breeding/ vocalizing peak occurs during the second spell of monsoon during November–January. However, species like R. bobingeri, R. chalazodes, R. kakachi, R. crustai do not vocalize intensively. However, more seasonal data is required for any firm conclusions.

• Automated pattern detection from recordings is a difficult task and requires significant trial and error before finalizing the procedure. In this direction, the team leader is training in the use of pattern detection software and generating recognizers. Good quality recognizers have successfully been generated for Chalazodes bubble frog and tested to detect vocalizations. Other study species are currently being tested.

• The protocol developed and tested has been written as a popular article for the book “Forest Canopies of South Asia– A glimpse”, ATREE publications. We have also been invited to submit another article on the same theme to a book “Treetops at Risk”, Springer publications. This book will be released during the 6th International Canopy Conference in Mexico, October 2012.

• The protocol and the preliminary results of the study are being presented by the team leader in the 25th International Congress on Conservation Biology, New Zealand, 2011.
Training members in tree climbing and amphibian identification: Overall, nine persons including team members have been trained in tree climbing using single rope technique. One undergraduate intern has been trained in arthropod identification, stomach flush techniques and scientific publication writing. All the nine volunteers are trained in amphibian identification as well.

Figure 8. Personnel trained in canopy access (Fig g: Photo: R.Ganesan)
Problems encountered and potential solutions

Which project activities and outcomes have been problematic and in what way, and how has this been overcome?
The major problematic activity was obtaining research permits from the forest department. The problem was overcome by repeated interaction with the department, presentation of proposed work, and follow up of application status over eight months period.

Please detail any problems that the project has encountered or deviations from original project plans. Describe how these problems were addressed and what solutions were found to deal with these issues (for example with project management or administration).
The only deviation in the project was the removal of climate change prediction modeling as it would be unreliable with one year data. This was also strongly recommended by the CLP review committee. The objective was limited only to establishing monitoring protocol, gathering species information and baseline building for future model predictions.

Please state important lessons which have been learnt through the course of the project so far.
Need for adaptability. Often, the things we proposed or planned to do in a project may not be feasible due to many difficulties like delay in permits, harsh weather conditions, project personnel needing to attend to personal commitments etc. We learnt to overcome these by having a rapport with forest department staff and updating them on progress of field work. Sampling protocol and duration was aimed to maximize replication and lastly, support was elicited from interns and local assistants in field on realizing the need for the same.
Appendix

Methodology

Anuran Sampling
Anurans were sampled based on a random stratified systematic sampling approach. A total of 40 quadrats of 10X10 m² each were laid and marked permanently with ribbon tags. Hand held GPS Etrex Hc Garmin was used to geo-reference the location. Selective logged and unlogged forest had 20 such quadrats each and the total sample effort was 0.4 ha. Further, quadrats were distributed evenly within each microhabitat with 10 in forest (beyond 10 m from stream edge), five on the stream and five in the riparian zone (10 m from stream edge) in both logged and unlogged forest respectively.

Sampling was carried out between 1800hrs-2100hrs during December 2010 to January 2011. Each quadrat was searched for 20 min duration using an “All out search method” where observers searched the forest floor. Subsequently, they were photographed and released in the same spot within 30 min duration of capture. No specimens were collected during the study. Those individuals with uncertain identity were assigned to the closest congener and indicated as confirmation pending (cf.).

Monitoring environmental variables
Soil and water temperature was obtained using a standard 110° mercury thermometer. Substrate thickness (leaf litter depth for terrestrial and water depth for aquatic respectively) was measured using a 30 cm stainless steel scale. The percentile of canopy openness was estimated using photographs from below the canopy were taken using an 18 mm lens mounted on a Nikon D90 DLSR kept one foot above the ground. The images were then converted to grayscale, brightness reduced to -100 and contrast increased to +100 before obtaining the percentile canopy cover using the ‘Histogram’ option in Adobe Photoshop Ver 7.0.
Long term monitoring
Flow chart depicting process of data collection and interpretation from Song meter recordings

Song meter placed in Canopy and Ground on 12 trees each 500 m apart.

Programmed to record at 1 min./ 15 min. for 24 h.

Weather tracking using Kestrel pocket data logger synchronized with song meter.

Recognizer built by annotating known calls

Pattern Detection option in ‘Song Scope’ used to detect vocalizations and exported to database
Vocalizing intensity was obtained averaging presence of a call in four 1 min. recordings for 1 h. in pooled data.

Figure 9. Flow chart showing methods in automated data collection
**Species list**

List of anurans encountered in selection logged and unlogged areas during October 2010 to November 2011 (Note: * indicates new addition to list or ambiguity cleared)

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
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<tbody>
<tr>
<td><strong>Bufonidae</strong></td>
<td></td>
</tr>
<tr>
<td><em>Duttaphrynus beddomii</em></td>
<td>Beddome’s toad</td>
</tr>
<tr>
<td><em>Duttaphrynus melanostictus</em></td>
<td>Common toad</td>
</tr>
<tr>
<td><strong>Micrixalidae</strong></td>
<td></td>
</tr>
<tr>
<td><em>Micrixalus fuscus</em></td>
<td>Dusky torrent frog</td>
</tr>
<tr>
<td><em>Micrixalus cf. phylophilus</em></td>
<td>Pink thigh frog</td>
</tr>
<tr>
<td><strong>Microhylidae</strong></td>
<td></td>
</tr>
<tr>
<td><em>Ramanella montana</em></td>
<td>Jerdons ramanella</td>
</tr>
<tr>
<td><strong>Nyctibatrachidae</strong></td>
<td></td>
</tr>
<tr>
<td><em>Nyctibatrachus aliciae</em></td>
<td>Alicea’s night frog</td>
</tr>
<tr>
<td><em>N. vasanthi</em></td>
<td>Vasanthi’s night frog</td>
</tr>
<tr>
<td><em>N. beddomi</em></td>
<td>Beddomes night frog</td>
</tr>
<tr>
<td><em>N. pillai</em></td>
<td>Pillai night frog</td>
</tr>
<tr>
<td><strong>Ranidae</strong></td>
<td></td>
</tr>
<tr>
<td><em>Hylarana temporalis</em></td>
<td>Bronzed frog</td>
</tr>
<tr>
<td><strong>Ranixalidae</strong></td>
<td></td>
</tr>
<tr>
<td><em>Indirana beddomii</em></td>
<td>Beddomes Indian frog</td>
</tr>
<tr>
<td><em>Indirana diplosticta</em></td>
<td>Malabar Indian frog</td>
</tr>
<tr>
<td><strong>Rhacophoridae</strong></td>
<td></td>
</tr>
<tr>
<td><em>Raorchestes agasthyaensis</em></td>
<td>Agasthya’s bush frog</td>
</tr>
<tr>
<td><em>Raorchestes bobingeri</em></td>
<td>Bobinger’s bush frog</td>
</tr>
<tr>
<td><em>Raorchestes cf.graminirupes</em></td>
<td>Ponmudi bush frog</td>
</tr>
<tr>
<td><em>Pseudophilautus cf.kani</em></td>
<td>Kani bush frog</td>
</tr>
<tr>
<td><em>Raorchestes chalazodes</em></td>
<td>Chalazodes bubble nest frog</td>
</tr>
<tr>
<td><em>Raorchestes kakachi sp. nov.</em></td>
<td>Kakachi Shrub frog (paper under review)</td>
</tr>
<tr>
<td><em>Raorchestes crustai</em></td>
<td>Bark and moss bush frog</td>
</tr>
<tr>
<td><em>Rhacophorus calcadensis</em></td>
<td>Calacad gliding frog</td>
</tr>
</tbody>
</table>
Figure 10. Plate showing some common anurans (a: Raorchestes graminirupes; b: Rhacophorous calcadensis; c: Duttaphrynus beddomii; d: Indirana bedomii; e: Indirana diplosticta; f: Raorchestes agasthyaensis; g: Raorchestes bobingeri; h: Raorchestes chalazodes; i: Raorchestes manohari)
Figure-11 Image of the newly described species Raorchestes kakachi sp.nov (Seshadri, Gururaja and Aravind, 2012). a=male and b=female.
List of publications from this project


**Seshadri, K.S. (Manuscript, 2012)** Impacts of selective logging on anuran assemblages in an evergreen forest stand of southern Western Ghats, India. To be submitted to ORYX.

Acknowledgements:
We acknowledge the support of CLP, SOS and Idea Wild both financially and for their help in assisting us in many ways for the successful completion of field work of this project. Permissions to the study were provided by the Tamil Nadu Forest Department vide permit number WLS/33019/201 to Seshadri.K.S.

Tamil Nadu Electricity board provided accommodation in the reserve. Facilities of the Agasthyamalai Community Based Conservation Centre were extended by ATREE. Dr Subramanya S of GKV welcomed this idea and gave an excellent recommendation letter which helped receive this grant. We are particularly grateful to him. Drs. Ganesh T., Soubadra Devy M., and Ganesan R. provided valuable inputs for the completion of the project. Drs. Aravind N.A and Gururaja K.V helped in amphibian identification apart from discussing several concepts. Preeti, Kiran, Kishan, and Kumble volunteered for the work. Chian, John, Murthy, Esaki and Murugan provided field assistance. Mrs. Rani and her colleagues from Anantha and Co helped with auditing the expenditure. We are thankful to all of them.
Annexures

News in Popular Media

In Kalakad forests, a project to bring out amphibian ecology
P. Sudhakar

A rare frog (Duttaphrynus beddomei) which was discovered by the researchers at Kalakkad Mundanthurai Tiger Reserve in Tirunelveli District after the gap of 136 years. Photo: Special Arrangement

Perhaps for the first time in the country, researchers of the Ashoka Trust for Research in Ecology and Environment have initiated a project to monitor the presence of frogs and toads in the evergreen forests of the Western Ghats to preserve these endangered species serving as indicators of climate change.

The Ashoka Trust is based at the Agasthyamalai community conservation centre at Manimuthar.

The researchers plan to exploit the behaviour of frogs and toads by placing automated sound recorders and climate data loggers in the forests to record the calling of males at
night to attract females for breeding. They will analyse the data in relation to climate and the frog species found in an area and discern the patterns after a few years of monitoring.

Among amphibians, frogs and toads are exceptions: they are without tails while being adults. They are collectively called anurans. India is a home to 277 species of anurans, and close to 150 species have been listed as ‘threatened.’

If the predictions of the Intergovernmental Panel on Climate Change are to come true, many more anurans may be pushed to the brink of extinction. Sensitive to temperature and moisture in the atmosphere, amphibians also serve as indicators of climate change. This will be the first effort at monitoring the amphibians for long-term population dynamics.

“This study will throw light on the present status of anurans, and we will be able to understand the role of climate in the anuran population,” says K.S. Seshadri, who is heading the study team in the Kalakad Mundanthurai Tiger Reserve.

The key components of the study are a pilot survey of anurans and documentation of calls of each species; setting up of equipment for seasonal and long-term monitoring in the mid-elevation evergreen forest of the Kalakad Mundanthurai Tiger Reserve; an intensive study of the habitat of anurans; training of volunteers from urban and rural communities in the use of gadgets for long-term monitoring; and an analysis of the data gathered to predict the impact of climate change on anurans.

“These efforts at modern technology, we will be able to gather baseline data on the amphibian population. Long-term monitoring of the anuran population will help us better understand the drastic changes, which may indicate a decline in amphibian population,” says T. Ganesh, Senior Fellow at the Ashoka Trust and an adviser of the project.

Automated sound recorders, ‘Song Meter,’ made by Wildlife Acoustics Inc., U.S., and Kestrel Pocket Weather Tracker, are used to record climate change. These gadgets allow for pre-set programming to record data for specified lengths of time.

Forest canopies experience a harsh environment as they are the first to interact with the atmosphere. There are many anurans living in this harsh environment. For a holistic understanding, sound recorders with climate data loggers will be placed on the forest floor as well as on the forest canopy at an altitude of 900-1,200 metres.

The success of the pilot project conducted by the Ashoka Trust helped its researchers bag the prestigious Future Conservationist Project, which is funded by the Canada-based Conservation Leadership Programme’s Rs. 5.75 lakh-worth ‘Save Our Species Campaign.’

They faced a tough competition from more than 150 teams worldwide. Research scholars J. Allwin and M. Mathivanan of the Ashoka Trust will be involved in understanding the perceptions of the local communities of the amphibians and build the stewardship
towards amphibian conservation. Mr. Seshadri and P. Mrugank will document the amphibians and the ecological aspects. A database of anuran photographs and calls will also be made available.

“Understanding the perception of the people, living both in and outside of the KMTR, of the amphibians will go a long way towards their conservation. People can easily relate to frogs and toads as they are found even on paddy fields and in cities,” says Mr. Mathivanan, who has a long-standing association with local communities in conservation and now manages the Agasthyamalai community conservation centre.

“The project is well under way, and we have finished one field session during the northeast monsoon and got some interesting insights. We also sighted a rare toad, Duttaphrynus beddomei (Beddome's toad), after a decade. It was last sighted in 2001,” Mr. Seshadri says.

**Rare green frog**

A rare green frog, *Raorchestes chalazodes*, was recently rediscovered in the Kalakad Mundanthurai Tiger Reserve by Dr. Ganesan and Mr. Seshadri, and Dr. S.D. Biju of Delhi University. The frog was not seen for 136 years, they claim, and nothing much is known about it.

This project is a significant step towards filling this gap in the knowledge.

“In the long run, we will be able to better understand the relationships and provide inputs for amphibian conservation,” Dr. Ganesh says.

Keywords: Western Ghats, ecological project, Ashoka Trust, monitoring amphibians


As accessed on: 30-11-11
Article in local print media, Dinamalar.
'Frog song' may help understand climate change
Jayashree Nandi, TNN Jan 3, 2012, 07.10AM IST

NEW DELHI: If not kissing the frog, at least appreciating their 'croak' may lead to some headway in to climate research. For the first time frog song is being monitored using automated sound recorders by Indian scientists to track the impact of climate change on amphibians in the forests of southern Western Ghats. The methodology for tracking their call has recently been standardized by researchers.

Principal investigators of the study were struck with the idea when three of them were 100 feet above the ground on a rainy day, sitting on a tree shelter for canopy research at Kalakad Mundanthurai Tiger Reserve. They heard frog song and decided to investigate how it could relate to climate.

Since frogs and toads respond to changes in atmospheric moisture and temperature, the team decided on analysing the sound recordings of frog song and corelate it with readings from climate data loggers.

"Amphibians have long been considered to be the barometers of the climate any subtle variations in the atmospheric conditions like moisture availability and temperature is likely to have profound impacts on them' said Seshadri.KS, who is heading the project and is part of the team that won the Conservation Leadership Programme-Save Our Species with senior fellow at Ashoka Trust for Research and Ecology, Ganesh T.

The team is using programmable automated sound recording systems called 'Song Meter' and coupling it with an automated weather data logger device. These units are set in remote forest areas and programmed to switch on or off at specified intervals. During the South West and North East monsoons, of the past two years, they have been able to listen to the forest at day and night.

"Amphibians are facing unprecedented declines world over. This has largely been attributed to loss of habitat, fungal infections and global climate change. We are lacking the big picture in India. So long term monitoring may help," he said.

Seshadri explained that the frog song can be the unique element that will help scientists in the future. "For example, some frogs vocalize in a wide window of time while some, are active for a very short window of time, may be for a few weeks. If the climate change predictions are true, amphibians should be negatively be affected. By monitoring the vocalizing activity, we can come up with an activity calendar for each of the indicator species. Using this information, we can discern the changes in observed patterns and interpret it in the context of climatic variations. This is the goal of the project," he added.

In the process of documenting various frog species in KMTR, the team consisting of Seshadri, R Ganesan and S D Biju of Delhi University recently spotted the bubble nest
frog, which was last spotted 136 years ago. They also spotted Beddome's toad that was seen almost a decade ago.

While the monitoring process is long-term, the methodology has been standardized and the initial results of their study were shared at the International Congress for Conservation Biology in New Zealand held in December. The results would also be published soon next year.

The Times of India. As accessed on 1st September 2012: http://articles.timesofindia.indiatimes.com/2012-01-03/flora-fauna/30583705_1_frog-species-climate-change-s-d-biju
What frogs tell us about the planet

CLIMATE CHANGE IMPACT

A team of scientists at Kalakad Mundanthurai Tiger Reserve reason that analysing sound recordings of frog croaking combined with readings from climate data loggers could improve our understanding of the effect of climate change on amphibian populations, writes Atula Gupta

Sitting 100 feet above the ground, in the dense canopies of the Kalakad Mundanthurai Tiger Reserve, three researchers were keen to finish their work before the approaching rain clouds drenched them from head to toe. But the trio were distracted, because with the impending storm, the forest had come alive with songs of frogs that happily conversed with the hovering clouds. It was right at that moment that a striking idea was born in the minds of the scientists: What if frog calls changed with changing climate? What if frogs could foretell the future of the planet?

Intrigued by the cacophony of sound that the rains triggered, KS Seshadri with T Ganesh, and S Devy initiated a monitoring programme to document the presence, or absence, of amphibians in the Kakachi-Kodayar region of Kalakad Mundanthurai Tiger Reserve (KMTR), paying special attention to canopy frogs.

The study’s first aim is to document anurans, their calls and habitat, in the canopy or on the ground, and will be the first time that such an extensive effort is being made in India to monitor amphibians for long-term population dynamics based on calls.

Since frogs and toads respond to changes in atmospheric moisture and temperature, and specific frogs sing at specific times of the year, the team reasoned that an analysis of sound recordings, combined with readings from climate data loggers, could help improve understanding of the effect of climate change on amphibian populations.

Over the past two years, the researchers have successfully gathered lots of sounds during the south west and north-east monsoons using a programmable automated sound recording device called song meter. These calls are then being matched with individual frogs to identify them.

At the third stage, the sounds are being coupled with automated weather data logger device to know eventually how over the years, weather conditions are changing and affecting the presence or absence of frogs.

Weather forecasters

Amphibian skin is extremely thin, which makes frogs acutely sensitive to even minor changes in temperature, humidity, and air or water quality.

“Amphibians have long been considered to be the barometers of the climate and any
subtle variations in the atmospheric conditions like moisture availability and temperature is likely to have profound impacts on them,” said Seshadri. According to him, some frogs vocalise in a wide window of time while some are active for a very short duration, may be for a few weeks. If the climate change predictions are true, by monitoring the vocalising activity, an activity calendar for each of the indicator species can be made. The information can be discerned in the context of climatic variations.

Worldwide, various researchers have noted that frog species are dying at a very high rate and global warming may be the reason for the widespread extinctions. In 2006, American scientists suggested that many of the county’s frog species were vanishing due to deadly infectious fungal diseases spurred by changing water and air temperatures. “Disease is the bullet killing frogs, but climate change is pulling the trigger,” said Pounds, lead study author. “Global warming is wreaking havoc on amphibians and will cause staggering losses of biodiversity if we don’t do something fast.”

India is home to 277 amphibians of which about 150 occupy the IUCN Red List for threatened species. Many of these species have been recently described to science and are already in danger of extinction. The long-term monitoring of frog activity therefore will be invaluable in knowing the greater impact of climate change and also saving the species.

**Role frogs play**

But why invest so much time and money on saving frogs and not tigers that naturally seem to have a more poignant presence in the forests and are also known as the umbrella species whose conservation will help save all other species?

In nature’s drama, even the seemingly insignificant frogs have an important role to play. Amphibians, although small, have a great impact in sustaining the biodiversity and ensuring that forest cover remains, monsoon showers occur in time and river do not run dry. If frogs and toads are gone, it will lead to rise in insect population, their main preys. These insects will feed on leaves destroying forests and leading to zero ground water precipitation. Clouds will not form and thus without rains, rivers will dry.

That the disappearance of frogs will then ultimately affect forests, rivers and humans is a given.

The human-led changes brought on to the planet have changed the dynamics of the earth so much that the possibility of mass extinction of all living beings is no more a fantastic thought.

That the summers are becoming hotter and winters unbearably cold, are phenomenon that everyone observes but no one cares enough to interpret the changing pattern with human enforced changes like pollution, deforestation and excessive harnessing of natural resources.
India also trails far behind when it comes to actual on-site data of its flora and fauna. Will the croak alarm finally wake us from our ignorant slumber? The answer lies in the future.

The Deccan Herald, as accessed on 1st September 2012:
http://www.deccanherald.com/content/226881/what-frogs-tell-us-planet.html
Popular Articles

Kodayar by Night

When he was a kid, Sathish says he knew what he was setting himself to be... night after night tramping through forests! But nothing. K. S. Seshadri says, prepared him for his frog-adventures in Sathish Seshadri’s Kodayar forest.

The forest seemed to be well stocked, with way too many frogs everywhere, jumping erratically and seemingly straight into the air. Seshadri says he was reading a book about frogs, and he would hang out there to watch them jump. He soon realized that the frogs were jumping towards a certain point, and he decided to see where it led. He found a clearing, and he noticed that the frogs were jumping towards a stream. He followed the frogs and found a small pond, which he thought was the destination of the frogs’ jumps.

The pond was surrounded by trees, and there were frogs all over it. Seshadri says he was amazed by the number of frogs he saw, and he decided to see if he could catch any of them. He got a net and started trying to catch the frogs, but they were too quick for him. He gave up and decided to wait until the frogs came out of the pond during the night. He got a flashlight and waited for hours, but the frogs didn’t come out. He gave up again and decided to try the next day.

The next day, he went back to the pond and started catching the frogs. He was able to catch a few, and he was amazed by the way the frogs were jumping. He started to wonder if there was a pattern to their jumping, and he decided to see if he could figure it out. He got a notebook and started writing down the directions the frogs were jumping in. He was able to figure out the pattern, and he was amazed by the way the frogs were jumping in a straight line.

Despite the dangers of night forest walks, the adrenaline rush was incomparable. Two glowing eyes in the darkness could mean anything – from the liquid glance of a glow to the glowing eyes of an alien.
A new species of Raorchestes (Amphibia: Anura: Rhacophoridae) from mid-elevation evergreen forests of the southern Western Ghats, India

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† & NKELEVARA ANANTHARAM ARAVIND*†
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*†Centre for Infrastructure, Technology Transportation and Urban Planning (CITPUT), Indian Institute of Science, Bangalore 560012, India. E-mail: ashokit@gmail.com and sma.maligari.org
*Corresponding author. E-mail: ashokit.ail@gmail.com

Abstract

A new species of the shrub frog genus Raorchestes: Biju, Sencha, Debosh, Dutta and Rosemyn is described as Raorchestes kothur sp. nov. from Agastyamalai hill range in the southern Western Ghats, India. This small sized Raorchestes (males: 24–25.8 mm, n = 5 and females; 24–25 x 1 mm, n = 5) is distinguished from all other known congeners by the following suite of characters: Snout oval in dorsal view; tympanum indistinct; head wider than long; markings in feet; color on dorsum varying from ivory to brown, blotches of dark brown on flanks, brown motting on throat reducing towards vent; inner and outer surface of thigh, inner surface of shank and inner surface of arms with a distinct dark brown horizontal band which extends upto first three toes on upper surface. A detailed description, advertisement call features, ecology, natural history notes and comparison with closely related species are provided for the new species.

Key words: Shrub frogs, Agastyamalai, Taxonomy, Acoustics, Western Ghats

Introduction

The Western Ghats of India harbors a high diversity of amphibians, particularly shrub frogs of the genus Raorchestes (Biju et al. 2010). Molecular phylogenetic work by Biju et al. (2010) on the genus Philautus revealed in its segregation into Philautus, Gregil, Paroedaphnopus Laurenz and Raorchestes. The genus Raorchestes comprises of relatively small frogs (15–45), active at night, venusia teeth absent, transparent/moist vocal sac while calling and direct development without free swimming tadpoles (Biju et al. 2010; Li et al. 2011). Here, we report a new species of Raorchestes from Kakkachi Tea Estate in the mid-elevation evergreen forests of Kalakkad Mundanthurai Tiger Reserve (KMR) from the Agasyamalai hill range, southern Western Ghats, India, making the total species in Raorchestes in Western Ghats to 40.

Material and method:

Study area. The study was carried out in the Kakkachi tea estate and the adjacent forests of Kalakkad Mundanthurai Tiger Reserve (KMR). The reserve covers an area of 895 km² and is located between 8°16’56”N to 8°23’33”N latitude and 77°16’06”E to 77°22’30”E longitude with the altitude ranging from 40 m to 1,000 m asl. It experiences two monsoons, the southwest (June–September) and the northeast (October–January) receiving a mean annual rainfall of about 3,000 mm (Ganesh et al. 1998). Kalakkad Mundanthurai Tiger Reserve comprises of a matrix of habitats ranging from dry evergreen forest in the foothills to the wet evergreen forests in higher elevations and has a high diversity and endemism of flora and fauna (Velmurugan 2001). The species described here was col...
Outreach material

See attachments for PDF
Audited Financial Statement

1. Name of the project

2. Name of Project co-ordinator

3. Project start date

4. Project end date

5. Award Amount sanctioned (in USD)

6. Total Amount Received (in USD)

7. Total Amount spent up to (in USD)

Statement of Expenditure for the period from 01-10-10 to 30-03-2012

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<th>Itemized expenses</th>
<th>Total CLP used</th>
<th>INR</th>
<th>Total CLP used</th>
<th>USD</th>
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<tr>
<td>Administration</td>
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<td>Communications (telephone/internet/postage)</td>
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<td>Insurance/Medical supplies</td>
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<td>Visas and permits</td>
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<tr>
<td>Reconnaissance</td>
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<tr>
<td>Field supplies and rations, vehicle repairs</td>
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<td><strong>Equipment</strong></td>
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<td>Scientific equipment and supplies (Please detail: Solar scope-2, kestral weather station-2, Lactop-1, kestral data downloder)</td>
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<td>Camping equipment (Please detail: main items: hammock, rain gear)</td>
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<td>Rural/legends truck (including fuel) (Please detail: vehicle rent and fuel expenses at concessional rates)</td>
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<td>Other (Please detail: Maglite torch, Head lamps, rechargeable batteries, chargers, electronic calipers, measurement tapes, hard disks for storing data, SD card for song meter)</td>
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<td><strong>Phase II - Implementation Expenses</strong></td>
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<td>Administration</td>
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<td>Accommodation for team members and local guides</td>
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<td>Report production and results dissemination - Refer Note 1 below</td>
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Note

This includes the following:
- For dissemination of report to all stakeholders and for dispatch to CLP
- Postage for sending reports overseas and inland.
- For interactions with local stakeholders like forest officials and volunteers for apprising of the study outcomes

Total: 6,510.00

For Gyananta & Co
Chartered Accountants
FRN: 005165-S

Bangalore 2012

Seshadri K.S
Project Investigator

Ran.N R
Partner
M.No.214316
This work was executed by Seshadri.K.S, Allwin Jesudasa, Mathivannan M and Mrugank Prabhu. All and any opinions expressed in this report are that of the author and not of the organization associated with at the time of report production. This report has not been formally copyedited.