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

FINAL TECHNICAL REPORT PREPARED BY: SESHADRI K. S.

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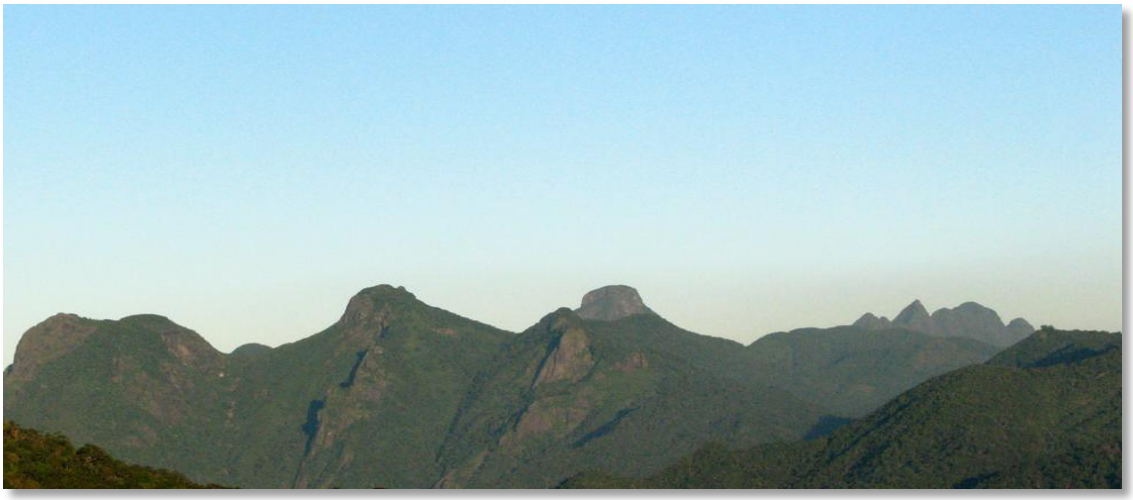

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Contents

List of Figures

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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 stake holders 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.

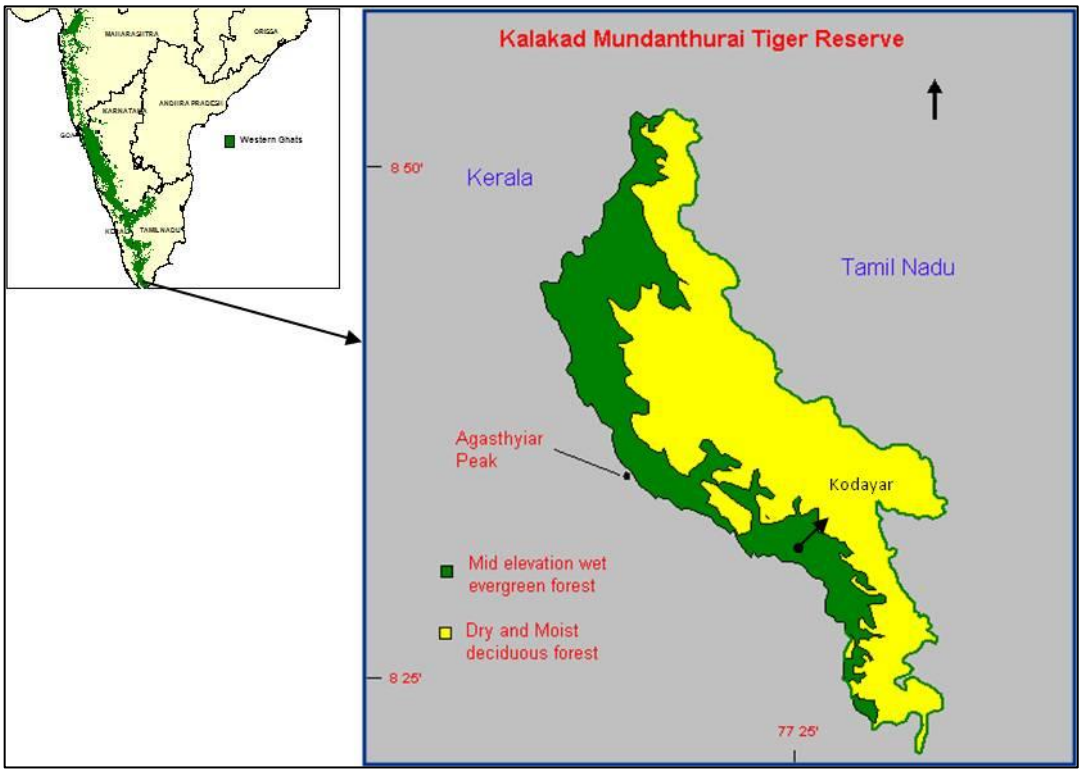

Figure 1. Map showing the study area

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 $\log_{10}$=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.

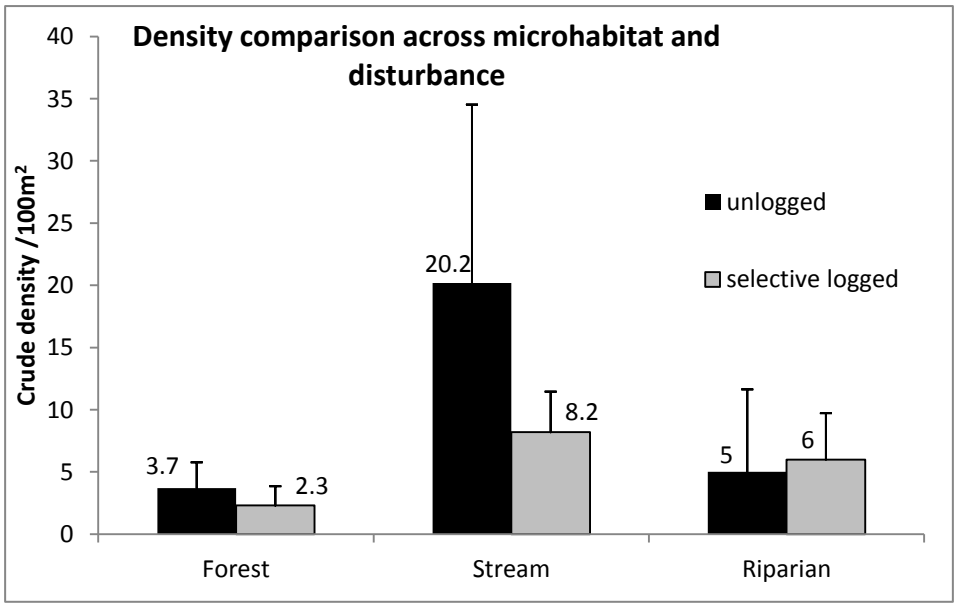

Figure 3. Density differences across micro habitat and disturbance

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 contests 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 (~8^0C) and the peak was during March–April (~23^0C). Temperature and humidity were positively correlated. Relative Humidity reached 100% during the cold months of December–January.

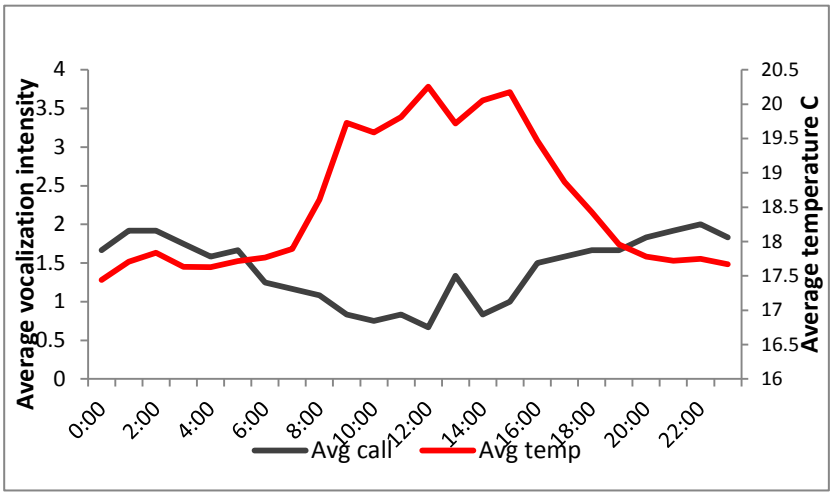

Figure 4. Relationship of temperature and anuran vocalization

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

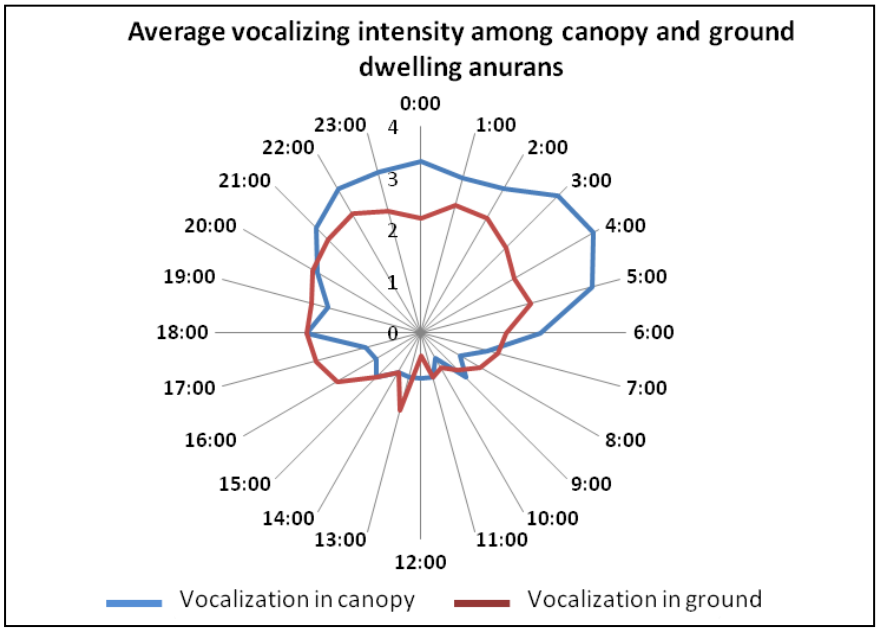

Figure 6. Average vocalizing intensity over time

Outreach activities:

As part of the outreach activities apart from involving local communities in the study, we carried out a cultural program in from 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 eco system 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 form 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 tentativelyto **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 form 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 m^2 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 110^0 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

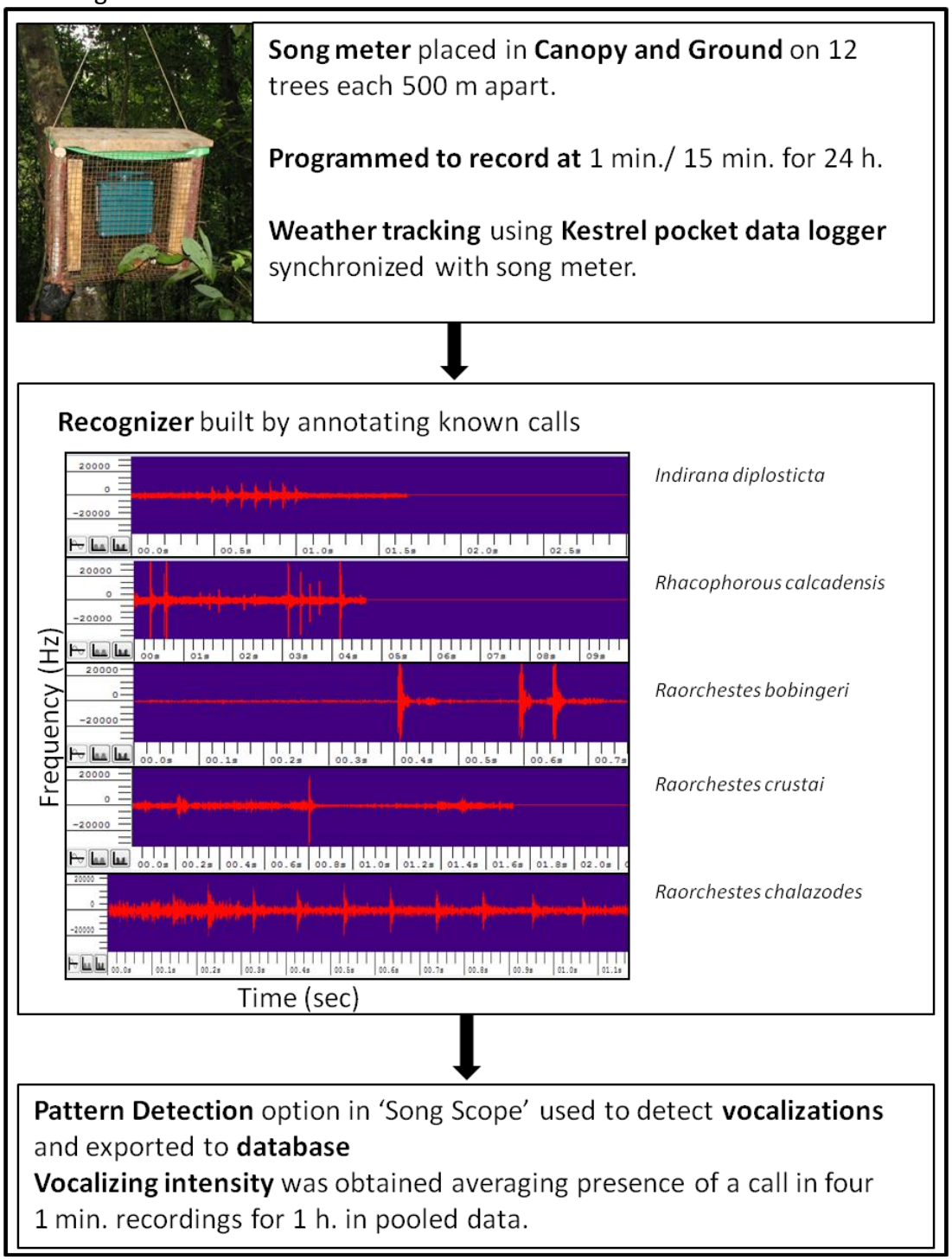

Figure 9. Flow chart showing methods in automated data collection

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)

Species	Common name
Bufonidae	
Duttaphrynus beddomii	Beddome's toad
Duttaphrynus melanostictus	Common toad
Micrixalidae	
Micrixalus fuscus	Dusky torrent frog
*Micrixalus cf. phyllophilus**	Pink thigh frog
Microhylidae	
Ramanella montana	Jerdons ramanella
Nyctibatrachidae	
Nyctibatrachus aliciae	Alicea's night frog
N. vasanthi	Vasanthi's night frog
N. beddomi	Beddomes night frog
*N. pillai**	Pillai night frog
Ranidae	
Hylarana temporalis	Bronzed frog
Ranixalidae	
Indirana beddomii	Beddomes Indian frog
Indirana diplosticta	Malabar Indian frog
Rhacophoridae	
*Raorchestes agasthyaensis**	Agasthya's bush frog
*Raorchestes bobingeri**	Bobinger's bush frog
*Raorchestes cf.graminirupes**	Ponmudi bush frog
*Pseudophilautus cf.kani**	Kani bush frog
*Raorchestes chalazodes**	Chalazodes bubble nest frog
*Raorchestes kakachi sp. nov.**	Kakachi Shrub frog (paper under review)
*Raorchestes crustai**	Bark and moss bush frog
Rhacophorus calcadensis	Calacad gliding frog

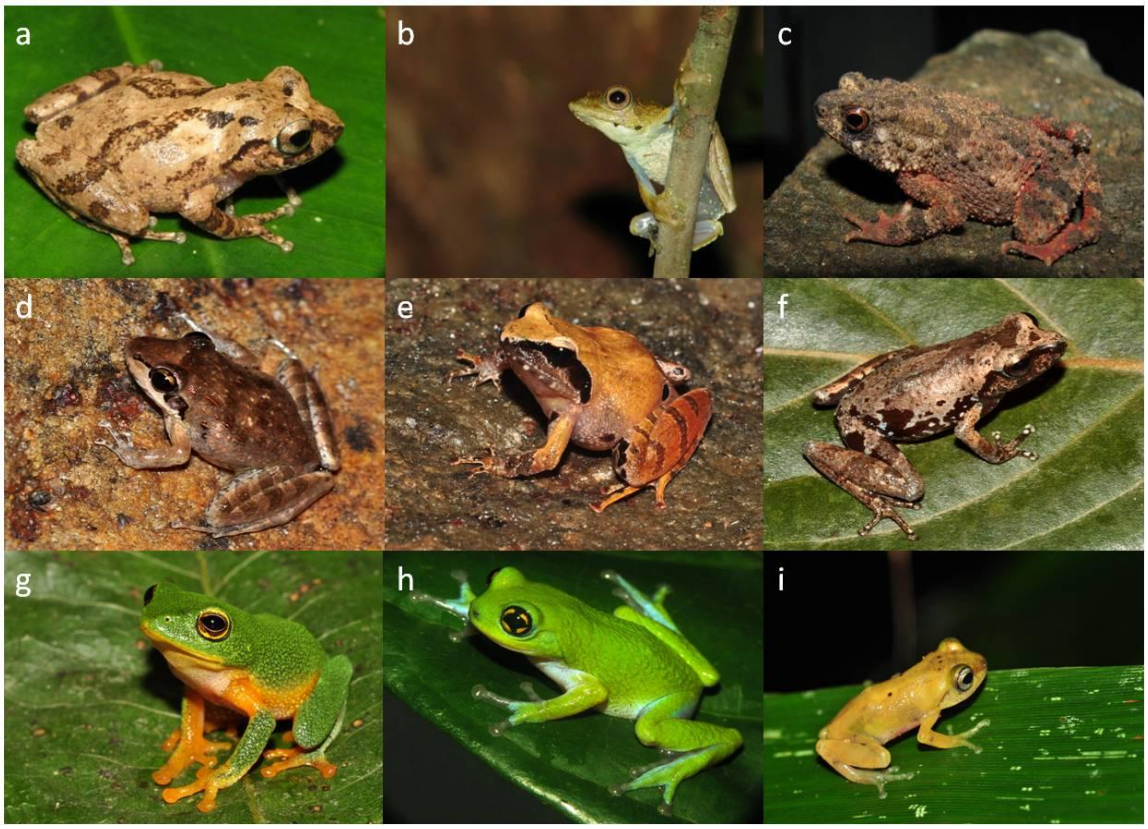

Figure 10. Plate showing some common anurans (a: Raorchestes graminirupes; b: Rhacophorous calcadensis; c: Duttaphrynus beddomii; d: Indirana bedomii; e: Indirana diplosticta; f: Raorchestes agasthyaensis; g: Raorchestes bobingeri; h: Raorchestes chalazodes; i: Raorchestes manohari)

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., Aravind., N.A & Gururaja.K.V. (2012). A new species of *Raorchestes* (Amphibia: Anura: Rhacophoridae) from mid- elevation evergreen forests of the south Western Ghats, India. *Zootaxa*: 3410: 19–34.

Seshadri.K.S (2012) Kodayar by Night, *Sanctuary Asia* (A bimonthly magazine on Aisan wildlife), February, 2012.

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.

Seshadri, K.S., Allwin.J., Mathivanan, M., Ganesh,T. (2012). Pocket guide to the Frogs and Toads of Kalakad Mundanthurai Tiger Reserve, ATREE publications.

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 WL5/33019/201 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 GKVK 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 discover by the reasearchers 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*.

"With the backing of 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 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

Source: http://www.thehindu.com/sci-tech/energy-and-environment/article1556345.ece

As accessed on: 30-11-11

களக்காடு முண்டந்துறை புலிகள் காப்பகத்தில் அரிய வகை தேரை இனம் கண்டுபிடிப்பு

திருநெல்வேலி, மார்ச் 10—

களக்காடு முண்டந்துறை புலிகள் காப்பகத்தில் அரிய தேரை இனம் கண்டுபிடிக்கப் பட்டுள்ளதாக ஆராய்ச்சி யாளர்கள் தெரிவித்தனர்.

மணிமுத்தாறு அசோகா சுற்றுச்சூழலியல் ஆராய்ச்சி நிறுவன அகத்தியமலை சமு தாயம் சார்ந்த இயற்கை வளப் பாதுகாப்ப மைய ஆராய்ச்சி யாளர்கள் குழு மேற்குத்தொ டர்ச்சி மலையில் பசுமை மாறாக்காடுகளில் தவளைகள் குறித்த ஆராய்ச்சியை கடந்த ஒரு ஆண்டாக மேற்கொண்டு வருகிறது.

ஆண் தவளைகள், தேரை கள் இரவில் பெண் தவளை கள், தேரைகளை இனப்பெ ருக்கத்திற்கு கவர்ந்திழுக்க இனத்திற்கே உரிய ஒலி எழுப் புகின்றன. தானியங்கி ஒலிப் பதிவு கருவி, தட்பவெப்பமா னிகளை பயன்படுத்தி தவளை களின் வகைகளை பதிவு செய் யும் பணி நடக்கிறது. சில ஆண்டுகள் ஆய்வு மேற் கொண்ட பின் திரட்டப்பட்ட தகவல்களை பகுதிகளாக பிரித்து கண்டறிந்த தவளைக ளின் வகைகளை தட்ப வெப்ப நிலைகளுடன் ஒப்பிட்டு

களக்காடு முண்டந்துறை புலிகள் காப்பகத்தில் கண்டுப்பிடிக்கப்பட்ட அரிய வகை தேரை.

அறிக்கை தயாரிக்க திட்டமி டப்பட்டுள்ளது.

தவளைகள், தேரைகள் கணக்கெடுப்பு, இனங்களின் எண்ணிக்கை, பருவக்காலத் திற்கு ஏற்ப மாறும் தவளை இனங்களை களக்காடு முண் டந்துறை புலிகள் காப்பக காடு களில் உரிய கருவிகள் மூலம் கண்காணிப்பது உள்ளிட்ட பணிகளில் ஆராய்ச்சிக்குழுவி னர் ஈடுபட்டுள்ளனர்.

ஆராய்ச்சிக்குழு தலைவர் சேஷாத்ரி கூறும்போது, ''தவ ளைகள், தேரைகள் 'ஆனு ரன்ஸ்' குழுவின் கீழ் வருகின் றன. இந்தியா 277 ஆனுரன்க ளின் தாயகம். இதில் 150 அழி யும் நிலையில் உள்ளன. எதிர் காலத்தில் மேலும் பல ஆனு ரன்கள் அழிய வாய்ப்புள்ளது ஆய்வில் தெரியவந்துள்ளது. வெப்பம், வளிமண்டல ஈரப்ப தத்தை உணர்வில் தவளைகள் முதன்மையானவை. பருவ நிலை மாற்றங்களை முன் கூட்டியே தெரியப்படுத்தும் காரணிகளாக அவை உள்ளன. பசுமை மாறாக்காடுகளில் கடும் சூழ்நிலையில் தவளை கள் வாழ்கின்றன. இதுதொ டர்பாக ஆய்வு மேற்கொண்ட எங்கள் குழுவிற்கு 'எதிர்கால இயற்கை பாதுகாப்பாளர்கள்' என்ற விருது கிடைத் துள்ளது'' என்றார். அவர் மேலும் கூறும்போது, ''வடகி ழக்குப்பருவ மழைக்காலத்தில் மேற்கொள்ளப்பட்ட ஆய் வில் களக்காடு முண்டந்துறை புலிகள் காப்பகத்தில் 10 ஆண் டுகளுக்கு முன் கண்டறியப் பட்ட 'டட்டாபிரைனஸ் பெடோமி' என்ற அரிய தேரை இனம் இருப்பது தெரி யவந்துள்ளது'' என்றார். ஆராய்ச்சிக்குழுவை சேர்ந்த மதிவாணன் கூறும்போது, ''த வளைகள், தேரைகள் குறித்து அறிந்து கொண்டால் அவை களை பாதுகாக்கலாம். நெல் வயல்கள், நகரங்களில் உள்ள தவளைகள், தேரைகளை மக் கள் எளிதில் தொடர்புபடுத்தி பார்க்கலாம்'' என்றார்.

மர உச்சியில் வசிக்கும் தவளைகள்

மர உச்சிகளில் வசிக்கும் தவளைகள் குறித்து மிகக்கு றைவாக ஆய்வுகள் மேற் கொள்ளப்பட்டுள்ளன. அவை கள் குறித்த தகவல்கள் முழு மையற்றவை. தற்போதைய ஆய்வின் மூலம் முழு தகவல் கள் கிடைக்கும். மர உச்சியில் வசிக்கும் தவளைகளை அறிந்து அவைகளை பாது காக்க அறிவுரைகள் வழங்க முடியும் என்கின்றனர் ஆராய்ச்சியாளர்கள்.

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

Sanctuary | **Field Report**

Kodayar by Night

When he chose to study amphibians he knew what he was letting himself in for… night after night tramping through forests! But nothing, K. S. Seshadri says, prepared him for his frog adventures in Tamil Nadu's Kodayar forest.

The Chalazodes bubble-nest frog *Raorchestes chalazodes* is a nocturnal, arboreal species found in moist evergreen forests. It had been lost to science for 136 years before it was rediscovered in the Kodayar forest in the Kalakad Mundanthurai Tiger Reserve (KMTR).

Sanctuary | **Field Report**

The Northeast monsoon had all but receded and the night was cold and windy, yet strangely humid. Headlamps affixed to our foreheads, my assistants John and Chian and I set out on one motorcycle in search of the amphibians we knew lay hidden under the cloak of darkness.

At well past 10 p.m. we were stopped in our tracks by the sight of a huge bull gaur at a point where the road curved ahead of us near a stream. After what seemed like an endless wait to allow it to finish browsing, I gunned the bike. Apart from an audacious look… nothing! The gaur continued browsing, ignoring us. We still had another five kilometres to reach John's house, and so we decided to risk driving past it. Luckily we survived to tell the tale, though we passed mere inches from the gaur. He could just as easily have tossed us into the valley below. Interestingly, that night as we returned to our field station, the gaur was still there on the same path, this time towards the valley, which is probably why he bolted to safety as we passed him. Moments later we saw a Jerdon's Nightjar strutting like a chicken on the path in search of insects. We also saw three mouse deer crossing the road.

On some nights, the forest would be illuminated by moonlight but others were dark, cold and silent. Of course, the silence would not last long – it would be broken by the hoot of a distant Brown Fish Owl, the croak of a frog, or the call of a flying squirrel. Occasionally we would spook a troupe of langurs roosting on a tree, or brush past birds sleeping with their heads tucked underwing looking for all purposes, like golf balls. One Racket-tailed Drongo, alarmed by our appearance took to flight but could not let go of the reed it was tightly clutching on to in its slumber.

Despite the dangers of night forest walks, the adrenalin rush was incomparable. Two glowing eyes in the darkness could mean anything – from the liquid glance of a tiger to the glowing stare of an owl.

Eavesdropping in the wild

The Upper Kodayar range lies in the Kalakad-Mundanthurai Tiger Reserve (KMTR), India's southern-most tiger reserve that extends across roughly 900 sq. km. and harbours amongst the largest contiguous patches of mid-elevation evergreen forest in the region. The study site gets soaked annually by 3,000 mm. of rain. Little wonder the forest is able to support such high amphibian diversity.

Home to the lion-tailed macaque, Nilgiri marten and tiger, the forest has been adversely affected by dams, a large tea plantation and other disturbances, nevertheless the undisturbed portions are still relatively pristine. I was based at ATREE's field station, and was working on my amphibian project under the guidance of Dr. T. Ganesh. We were monitoring amphibian calls, particularly species living in the canopy. Since the last study done a decade ago, over 100 species of frogs have been newly described from the Western Ghats. One of our goals was to re-assess this diversity in KMTR.

Our larger efforts were aimed to monitor amphibians for long-term population dynamics based on calls. Since frogs and toads respond to changes in atmospheric

Pg 56-59_Kodayar Frogs.indd 56-57 1/25/2012 11:55:18 PM

See attachments for PDF

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Article

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A new species of *Raorchestes* (Amphibia: Anura: Rhacophoridae) from mid-elevation evergreen forests of the southern Western Ghats, India

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Abstract

A new species of the shrub frog genus *Raorchestes* Biju, Souche, Dubois, Dutta and Bossuyt is described as *Raorchestes kakachi* **sp. nov.** from Agastyamalai hill region in the southern Western Ghats, India. The small sized *Raorchestes* (male: 24.7–25.8 mm, n = 3 and female: 24.3–34.1 mm, n = 3) is distinguished from all other known congeners by the following suite of characters. Snout oval in dorsal view; tympanum indistinct; head wider than long; moderate webbing in feet; colour on dorsum varying from ivory to brown, blotches of dark brown on flanks, brown mottling on throat reducing towards vent; inner and outer surface of thigh, inner surface of shank and inner surface of tarsus 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* resulted in its segregation into *Philautus* Gistel, *Pseudophilautus* Laurent and *Raorchestes*. The genus *Raorchestes* comprises of relatively small frogs (15–45 mm), active at night, vomerine teeth absent, transparent/translucent 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 Kakachi Tea Estate in the mid-elevation evergreen forests of Kalakad Mundanthurai Tiger Reserve (KMTR) from the Agastyamalai hill range, southern Western Ghats, India, making the total species in *Raorchestes* in Western Ghats to 40.

Material and methods

Study area. The study was carried out in the Kakachi tea estate and the adjacent forests of Kalakad Mundanthurai Tiger Reserve (KMTR). The reserve covers an area of 895 km^2 and is located between 8.416667°N to 8.883333°N latitude and 77.166667°E to 77.583333°E longitude with the altitude ranging from 40 m to 1,800 m amsl. 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.* 1996). Kalakad Mundanthurai Tiger Reserve comprises of a matrix of habitats ranging from thorny scrub forest in the foothills to the wet evergreen forests in higher elevations and has a high diversity and endemism of flora and fauna (Johnsingh 2001). The species described herein was col-

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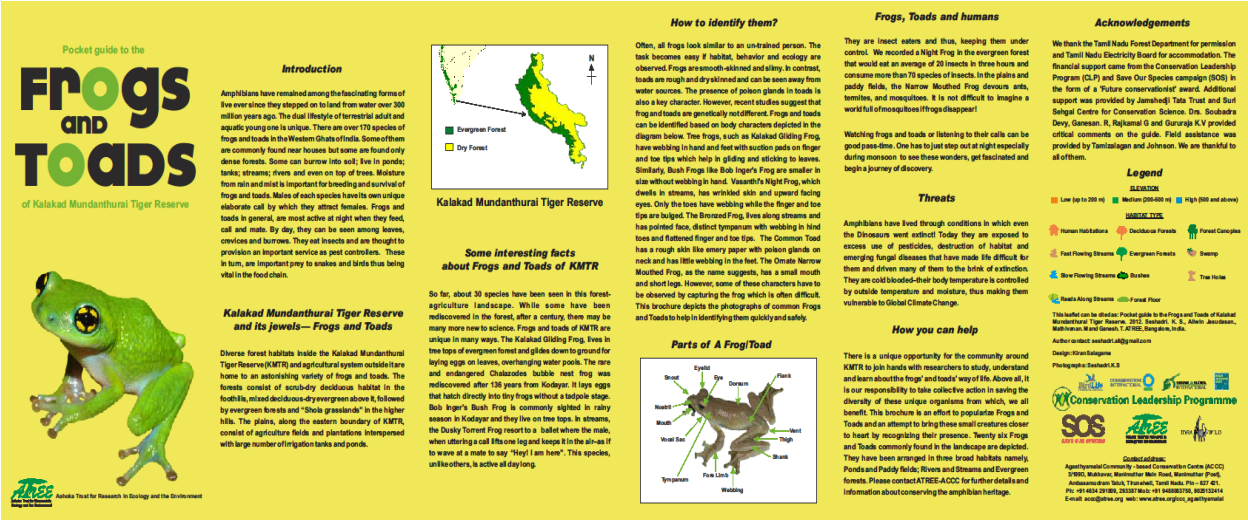
See attachments for PDF

Outreach material



Pocket guide to the

Frogs and Toads

of Kalakad Mundanthurai Tiger Reserve

Ashoka Trust for Research in Ecology and the Environment

Introduction

Amphibians have remained among the fascinating forms of live ever since they stepped on to land from water over 300 million years ago. The dual lifestyle of terrestrial adult and aquatic young one is unique. There are over 170 species of frogs and toads in the Western Ghats of India. Some of them are commonly found near houses but some are found only dense forests. Some can burrow into soil; live in ponds; tanks; streams; rivers and even on top of trees. Moisture from rain and mist is important for breeding and survival of frogs and toads. Males of each species have its own unique elaborate call by which they attract females. Frogs and toads in general, are most active at night when they feed, call and mate. By day, they can be seen among leaves, crevices and burrows. They eat insects and are thought to provision an important service as pest controllers. These in turn, are important prey to snakes and birds thus being vital in the food chain.

Kalakad Mundanthurai Tiger Reserve and its jewels— Frogs and Toads

Diverse forest habitats inside the Kalakad Mundanthurai Tiger Reserve (KMTR) and agricultural system outside it are home to an astonishing variety of frogs and toads. The forests consist of scrub-dry deciduous habitat in the foothills, mixed deciduous-dry evergreen above it, followed by evergreen forests and "Shola grasslands" in the higher hills. The plains, along the eastern boundary of KMTR, consist of agriculture fields and plantations interspersed with large number of irrigation tanks and ponds.

N

Evergreen Forest

Dry Forest

Kalakad Mundanthurai Tiger Reserve

Some interesting facts about Frogs and Toads of KMTR

So far, about 30 species have been seen in this forest-agriculture landscape. While some have been rediscovered in the forest, after a century, there may be many more new to science. Frogs and toads of KMTR are unique in many ways. The Kalakad Gilding Frog, lives in tree tops of evergreen forest and glides down to ground for laying eggs on leaves, overhanging water pools. The rare and endangered Chalazodes bubble nest frog was rediscovered after 136 years from Kodayar. It lays eggs that hatch directly into tiny frogs without a tadpole stage. Bob Inger's Bush Frog is commonly sighted in rainy season in Kodayar and they live on tree tops. In streams, the Dusky Torrent Frog resort to a ballet where the male, when uttering a call lifts one leg and keeps it in the air-as if to wave at a mate to say "Hey! I am here". This species, unlike others, is active all day long.

How to identify them?

Often, all frogs look similar to an un-trained person. The task becomes easy if habitat, behavior and ecology are observed. Frogs are smooth-skinned and slimy. In contrast, toads are rough and dry skinned and can be seen away from water sources. The presence of poison glands in toads is also a key character. However, recent studies suggest that frog and toads are genetically not different. Frogs and toads can be identified based on body characters depicted in the diagram below. Tree frogs, such as Kalakad Gilding Frog, have webbing in hand and feet with suction pads on finger and toe tips which help in gliding and sticking to leaves. Similarly, Bush Frogs like Bob Inger's Frog are smaller in size without webbing in hand. Vasanthi's Night Frog, which dwells in streams, has wrinkled skin and upward facing eyes. Only the toes have webbing while the finger and toe tips are bulged. The Bronzed Frog, lives along streams and has pointed face, distinct tympanum with webbing in hind toes and flattened finger and toe tips. The Common Toad has a rough skin like emery paper with poison glands on neck and has little webbing in the feet. The Ornate Narrow Mouthed Frog, as the name suggests, has a small mouth and short legs. However, some of these characters have to be observed by capturing the frog which is often difficult. This brochure depicts the photographs of common Frogs and Toads to help in identifying them quickly and safely.

Parts of A Frog/Toad

Eyelid
Snout
Eye
Dorsum
Flank
Nostril
Mouth
Vocal Sac
Vent
Thigh
Shank
Tympanum
Fore Limb
Webbing

Frogs, Toads and humans

They are insect eaters and thus, keeping them under control. We recorded a Night Frog in the evergreen forest that would eat an average of 20 insects in three hours and consume more than 70 species of insects. In the plains and paddy fields, the Narrow Mouthed Frog devours ants, termites, and mosquitoes. It is not difficult to imagine a world full of mosquitoes if frogs disappear!

Watching frogs and toads or listening to their calls can be good pass-time. One has to just step out at night especially during monsoon to see these wonders, get fascinated and begin a journey of discovery.

Threats

Amphibians have lived through conditions in which even the Dinosaurs went extinct! Today they are exposed to excess use of pesticides, destruction of habitat and emerging fungal diseases that have made life difficult for them and driven many of them to the brink of extinction. They are cold blooded–their body temperature is controlled by outside temperature and moisture, thus making them vulnerable to Global Climate Change.

How you can help

There is a unique opportunity for the community around KMTR to join hands with researchers to study, understand and learn about the frogs' and toads' way of life. Above all, it is our responsibility to take collective action in saving the diversity of these unique organisms from which, we all benefit. This brochure is an effort to popularize Frogs and Toads and an attempt to bring these small creatures closer to heart by recognizing their presence. Twenty six Frogs and Toads commonly found in the landscape are depicted. They have been arranged in three broad habitats namely, Ponds and Paddy fields; Rivers and Streams and Evergreen forests. Please contact ATREE-ACCC for further details and information about conserving the amphibian heritage.

Acknowledgements

We thank the Tamil Nadu Forest Department for permission and Tamil Nadu Electricity Board for accommodation. The financial support came from the Conservation Leadership Program (CLP) and Save Our Species campaign (SOS) in the form of a 'Future conservationists' award. Additional support was provided by Jamsheji Tata Trust and Suri Sehgal Centre for Conservation Science. Drs. Soubadra Devy, Ganesan. R, Rajkamal G and Gururaja K.V provided critical comments on the guide. Field assistance was provided by Tamizalagan and Johnson. We are thankful to all of them.

Legend

ELEVATION

Low (up to 200 m) Medium (200-500 m) High (500 and above)

HABITAT TYPE

Human Habitations, Deciduous Forests, Forest Canopies, Fast Flowing Streams, Evergreen Forests, Swamp, Slow Flowing Streams, Bushes, Tree Holes, Roads Along Streams, Forest Floor

This leaflet can be cited as: Pocket guide to the Frogs and Toads of Kalakad Mundanthurai Tiger Reserve. 2012. Seshadri. K. S., Alwin Jesudasan., Muthukrishnan. M and Ganesh. T. ATREE, Bangalore, India.

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See attachments for PDF

Audited Financial Statement

1 Name of the project	0214110 - "Effect of fragmentation and consequent climate change on amphibian assemblage, KMTR, South Western Ghats, India"
2 Name of Project co-ordinator	Seshadri.K.S
3 Project start date	1st October 2010
4 Project end date	30th November 2011
5 Award Amount sanctioned (In USD)	12,500
6 Total Amount Received (In USD)	12,500
7 Total Amount spent upto..... (In USD)	12,766.58

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

Itemized expenses	Total CLP used INR	Total CLP used USD
PHASE I - PROJECT PREPARATION		
Administration		
Communications (telephone/internet/postage)	8,512.50	197.97
Books and printing journal articles/materials	5,341.00	124.21
Insurance/Medical supplies	1,364.07	31.72
Visas and permits	10,064.00	234.05
Team training (Please detail: 2 personnel to be trained in climbing)	0.00	
Reconnaissance		
Field supplies and rations, vehicle repairs	2,010.00	46.74
Equipment		
Scientific/field equipment and supplies (Please detail: Song scope-2,kestral weather staiton-2, Laptop-1, kestrel data downloader	151,741.26	3,065.03
Photographic equipment (Please detail: Nikon D 90, LED light, IR light and accessories)	69,380.28	1,605.34
Camping equipment (Please detail main items: hammock, rain gear)	9,928.00	230.88
Boat/engine/truck (including fuel) (Please detail: vehicle rent and fuel expenses at concessional fares)	34,542.34	803.31
Other (Please detail: Maglite torch, Head lamps, rechargeable batteries, chargers, electronic calipers, measurement tapes, hard discs for storing data, SD card for song meter)	29,498.80	686.02
PHASE II - IMPLEMENTATION EXPENSES		
Administration		
Accommodation for team members and local guides	40,400.00	939.53
Food for team members and local guides (Please detail: Food for six project members during data collection period)	33,760.02	785.12
Other (Please detail: Stipend for 6 personnel for 12 months)	91,550.00	2,129.07
Transportation		
Travel and local transportation (Please detail: Travel charges, local and overnight from place of residence to field site for 4-5 personnel)	50,039.50	1,163.71
Customs and/or port duties (Please detail: Importing equipment)	0.00	
Workshops (Please detail: Organize public halls, address systems and field workshop expenses)	18,000.00	418.60
Outreach/education activities and matenals (brochures, posters, video, t-shirts, etc.) (Please detail: Posters of amphibian, pocket books for identificaiton, education material)	6,427.00	149.47
PHASE III - POST-PROJECT EXPENSES		
Administration		
Report production and results dissemination - Refer Note 1 below	6,760.00	155.81
Other (Please detail: apprisal meeting with forest dept and local villagers)	0.00	
Total	**569,318.77**	**12,766.58**

Note

1 This includes the following :

For dissemation of report to all stake holders and for dispatch to CLP	3500.00	80.00
Postage for sending reports overseas and inland.	860.00	20.00
For interactions with local stake holders like forest officials and volnteers for apprising of the study outcomes	2150.00	50.00
Total	6,510.00	150.00

For G Ananthha & CO
Chartered Accountants
FRN: 005160 S

Rani.N.R
Partner
M.No.214318

21/2012

G. ANANTHA & CO. BANGALORE-4 CHARTERED ACCOUNTANTS

Seshadri.K.S
Project Investigator

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.

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