Agenda Notes for the 27th meeting of the
RESEARCH, MONITORING AND ADVISORY COMMITTEE OF SACON

AGENDA NO: 1/27
Confirmation of the minutes of the 26th meeting of the Research, Monitoring and Advisory Committee of SACON held on 2nd September 2013 at Coimbatore

Minutes of the 26th meeting of the Research, Monitoring and Advisory Committee are given in the Annexure – 1. Since no comments were received, the minutes may kindly be confirmed.

Agenda No: 2/27
Action Taken Report on the minutes of the earlier meetings

SN	***Agenda on which Action is taken by SACON***	***Observation of the RMAC***
	Agenda : 26/2 : Action Taken Report on the earlier meetings of the RMAC	
1	**<u>Under Sl. No: 1</u>** **1. Strengthening community ……Nagaland** The Chairman stressed the importance of this work for the species and need to involve the local community in the process for its success. The Chairman, urged that SACON and BNHS should come together to work with the local community of Nagaland.	A proposal for the second phase of the study has been submitted for funding to M/s NEPED. Approval is awaited. The components suggested by the RMAC will be included in the second phase of the study.
2	**<u>Under Sl. No: 2</u>** ***1. Ecology of the Endangered Indian Rock Python in Keoladeo National Park, Bharatpur, Rajasthan*** The RMAC wanted to know from the PI, the status / distribution of the species all over the country and if any changes were noticed during the study across the bioclimatic regions, ecological requirement of these species and asked the PI to develop an Action Plan.	Due to sudden demise of Dr S Bhupathy, Principal Scientist/ PI of the Project, we could not pursue the work further. However, a suitable faculty will be entrusted to look into the issues suggested by the RMAC.

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	The RMAC asked the PI to coordinate with the 53 Zoo authorities in the country and prepare a training programme. The RMAC also advised the PI that it would be useful to study the genetic profile of the species. The RMAC asked the PI to develop a proposal in that line in collaboration with the Madras Crocodile Bank and TRAFFIC India.	
3	**<u>Under Sl. No: 5</u>** **10. Review of state of environment in Keoladeo National Park, Bharatpur, Rajasthan and its catchment area: A Historical analysis** The PI of the project intimated that the report, publications and other documents related to the KNP are placed at the SACON library. The materials are also submitted to the KNP authorities. The RMAC suggested the PI summarize the findings of the report and action to be taken based on the findings of the study in abstract, and submit the same to the concerned authorities. The RMAC further advised SACON to organize small functions for release of such study reports and distribute media handouts summarizing the findings of the study, which would be helpful in spreading the message in a big way.	Dr B A K Prusty (Scientist / PI of the Project) has resigned from SACON. However, the suggestion of the RMAC organizing a function for releasing the research study reports is noted for compliance in future.
4	**<u>Under Sl No: 7</u>** Projects submitted to various funding	

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	agencies with the approval of the Internal Research Committee of SACON	
	1. Ecological species sorting in relation to habitat structure in the small cat guild of Eaglenest Wildlife Sanctuary, Arunachal Pradesh The RMAC suggested the PI to explore including study of parasites as a separate component of the study. The RMAC noted the PI of the proposed project has given a presentation to the funding agency, and have been asked to revise the budget.	The Dept. of Science and Technology has sanctioned the project with a budget outlay of Rs 50.00/- lakhs. The study has been initiated now.
	6. Assessment of the helminth parasites in the colonial waterbirds across India The RMAC noted that the project proposal is yet to be submitted and advised the PI to submit it at the earliest	The proposal title has been modified as "Identification of helminthes in the heronry birds using morphological and molecular tools" and submitted for funding as per the advice of RMAC.
5	**<u>Under Sl No: 8</u>** **Concluding Remarks** The members pointed that many of the nature education activities are being published only in 'The Hindu' daily, and it has to go to other dailies, including regional newspapers in order to make the public aware of the findings of research, and nature education activities of SACON. The RMAC said that it is important for SACON to have a Public Relation Officer at SACON to highlight the research findings of the centre. It opined that the Extension Division of the Centre should take care of this	Noted for compliance

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	aspect. Further, the RMAC advised SACON to interact with the forest departments and allied departments at close intervals and to present its findings to the concerned forest departments in consultative meetings. This would help us obtaining the views and priorities of forest departments. The RMAC advised SACON to get details regarding training programmes to the foresters so that SACON could make offer to those trainees to come to SACON for interaction meetings. The RMAC also asked SACON to write to the Director General of the IGNFA requesting him to include SACON as one of its tour points for the trainee officers	
	Agenda No: 3/26 : Consideration of the progress on the ongoing research projects/ EIA studies	
6	1. Conservation of the Edible-Nest Swiftlet in The Andaman and Nicobar Islands. The RMAC noted the progress of the project. It advised the PI to publish a one-page write up on the findings in national media.	After the Animal Committee's recommendations for delisting of the Edible-nest Swiftlet from Schedule-I of the Wildlife Protection Act, 1972 it was decided not to write much about the program in the media till delisting of the species is done. However, the Chief Wildlife Warden was requested to announce the Animal Committee decision through media in Andaman and Nicobar Islands, and the news was published in Daily Telegram (Port Blair). After delisting of the Edible-nest Swiftlet from schedule-I of the Wildlife Protection Act, 1972 a popular article was published about the Edible-nest Swiftlet conservation program and its achievements in "SAVEUS" Magazine.
7	2. Reassessment of the Impact of Nest	

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	Collection on the Edible-Nest Swiftlet in the Andaman Islands The RMAC noted that the final draft report on the study is being finalized. To avoid confusion on the population status of the species and the role of human pressure on it with the findings of the ongoing project (Andaman Swiftlet project), the RMAC suggested circulating the draft report among the RMAC members for their comments before submission to the funding agency. The PI was also advised to restrict his report with just population survey as per the mandate of the project rather than going into the other details such as nest collection pressure, decline of the population etc. The RMAC further opined that this study should have been inbuilt in the earlier project as one of its objectives. The RMAC noted that the research publications cited under the study are not related to the study concerned and PI should ensure publication of the research papers related to the project.	As per RMAC's suggestion draft of the final report was circulated to the RMAC members. The final project report improved according to the comments received was submitted to the funding agency.
8	3. Status, Ecology and Conservation of Narcondam Hornbill *Aeceros narcondami* On Narcondam Island, India The RMAC asked the PI of the study to highlight the uniqueness of the habitat of this species, and study the vegetation complexities of the study area and food availability to the birds. The PI intimated the RMAC that the police force posted in the island is	As per RMAC's suggestion the proposal was submitted to the "Mohammad Bin Zayed Conservation Funds". Unfortunately the funding agency did not fund the proposed project this time. The proposal is be modified and submitted to any other suitable funding agency.

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	also taking care of the species and its nest from the Burmese poachers. The RMAC suggested SACON giving a "Best Conservationist" award to the police unit/s of the Narcondam Island in recognition of their contribution to the conservation of the species. The Chairman (RMAC) said that he would take up the matter at the next State Wildlife Board Meeting.	
9	4. Owl assemblage and occupancy in Andaman Archipelago, India The RMAC noted that the study is initiated only recently with the recruitment of research personnel to the project. The RMAC said that as a whole this is an important project and again reiterated to look into the genetic aspect of the study. Further, the RMAC asked the PI to get in touch with Dr Pamela Rasmussen for the purpose.	Collection of feather samples of owls is in pipeline. So far, feather samples of Barn Owl were collected from northern Andaman. In subsequent years, feather samples of all owl species will be collected. Discussions in this regard were initiated with Dr Pamela Rasmussen.
10	6. Patterns of Distribution of Selected Faunal Groups in the Agasthiamalai Hills, Western Ghats, Kerala, India The RMAC opined that the controlling factors determining the density of the faunal groups according to the altitude, and how those factors influence the distribution should be studied. The RMAC pointed out lack of good statistical analysis in the study. The RMAC advised the PI to consult a good statistician in SACON or outside while dealing with other parameters such as distribution and its correlations. The RMAC asked the PI to give a presentation on the study at the next RMAC meeting.	1. As advised by the RMAC, the scope of the explanatory factors for altitudinal distribution of faunal groups has since been expanded to include eco-climatic parameters and surrogates of primary productivity like NDVI. 2. Data analysis is under way to test different theoretical premises for observed elevational patterns of species diversity in both reptiles and birds (like area effect, sampling effort, productivity hypothesis, etc) 3. We have begun to discuss the data analysis and observed patterns with other senior ecologists who had already conducted similar studies in Western Himalayas and north Western Ghats. 4. As advised by RMAC, a

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		presentation on project progress would be made at the meeting.
11	8. Determining the taxonomic and Conservation Status of the Forest Owlet (Heteroglaux blewitii) The RMAC noted that the study has been just now initiated with the recruitment of research personnel to the project. The RMAC asked the PI of the project to clearly demarcate the role of each collaborator in the study. It also advised entering into a MoU with the heads of the organizations, with which the co-investigators of the project are affiliated, separately mentioning clearly the Terms of Reference, the objectives, the respective roles of each investigator and financial implications.	MoU/agreement certificates have been obtained from all collaborators. All finances for projects handled by the Principal Investigator of the project concerned are administered at SACON.
12	9. Social Organization, Behaviour and Phylogeography of *Macaca fascicularis umbrosa* in The Nicobar Islands, India The RMAC noted the progress made in the study during the review period. As a general comment, the RMAC suggested that while giving the budget of each project to the RMAC, it is necessary to give the expenditure incurred by the PI on the project until the day of reporting the progress to the RMAC.	The suggestions of the RMAC were noted for compliance. Accordingly, this component was included in the format
13	10. A survey of slender loris in parts of Kerala and Tamil nadu, India The RMAC noted that the Tamil Nadu Forest Department is yet to give its	Accordingly data was collected and the project was completed.

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	permission for the study in areas falling under the Tamil Nadu Forest Department. The RMAC noted that the PI would use the secondary data to map the study areas of the Tamil Nadu part. However, the RMAC advised the PI to discuss with the Additional PCCF (Coimbatore) and apprise him of the importance of the study for getting the permission from the Department. The PI may also contact Chennai to speed up the process.	Meanwhile we have contacted APCCF-Coimbatore, and submitted all the required documents. We were informed that the department is awaiting feedback from the different CFs on the matter.
14	11. Evaluating the Status of NTFP Trees and Development of A Model For Sustainable Harvest of *Garcinia gummi-gutta* in Aghanashini -Lion Tailed Macaque Conservation Reserve, Western Ghats, India The RMAC noted that the local community is involved in the task of managing the tree species and its sustainable harvesting in their respective locations. It advised SACON to prepare a management plan.	We have been providing the required information for the management of the park. However, department has not yet initiated to develop separate management plan for the ALTMCR
15	12. Ecological Investigation of Woody Vegetation and Nest Tree Use By Birds in The Riverine Forests of Athikkadavu Valley, Western Ghats As a general observation, the RMAC pointed out that some of the write-ups are exactly reproduction of the earlier progress report submitted to the previous RMAC meetings. The members advised that it should be avoided and asked the PIs to take care of the language also while preparing the report.	Advice of the RMAC noted for compliance.

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16	14. Monitoring Pesticide Residues in Select Components of An Agro-Ecosystem Adopting Organic and Chemical Farming in Padayetti Village, Palakkad District, Kerala The RMAC advised the PI to send a copy of the report to the Centre for Science and Environment and also to upload the same in the website of SACON. The Chairman (RMAC) asked the PI to publish articles on the study and requested to provide the RMAC members a copy of the articles as they are published.	The final report is being compiled and will be submitted by October 2014. As advised by the RMAC, the final technical report would be sent to the Centre for Science and Environment and uploaded in the SACON's website. A paper, accepted for publication by Bulletin of Environmental contamination and Toxicology on the impact of chemicals on deformity in frogs, will be submitted to the members of the RMAC at the meeting.
17	15. Monitoring and Surveillance of Environmental Contaminants in Birds in India The RMAC asked the PI to communicate the results of the study as an abstract to the Departments of Forests and Agriculture of all states.	It is being done on case to case basis. The project is extended up till August 2014. As advised by the RMAC, the final report will be sent to the Departments of Forests and Agriculture of all States in addition to the funding agency.
18	17. Assessment of The Impact of Agrochemicals On Avifauna in The Catchment of Keoladeo National Park, Rajasthan The RMAC advised the PI to examine the movement of pollutants in the wetlands; how it moves and speed with which it moves, and the factors determining the movement, and said that these information would be highly useful for understanding the dynamics of the wetlands. The RMAC asked the PI to think of modeling pollutants movement within the wetlands. The RMAC suggested SACON to put up a proposal on invasive fish, African	AS intimated earlier, Dr BAK Prusty, Scientist/ PI of the project has resigned from SACON and has desired to shift the project from SACON to GUIDE, Gujarat where he has joined recently. A proposal for the same has been sent to the DST, Govt. of India for further action.

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	Cat Fish, on the wetlands of the Keoladeo National Park to the Forest department, which may fund the study.	
19	21. Impact Assessment of Prospecting Exploration Activities, Through 3D Seismic Data Acquisition By Oil India Ltd, On Mangrove Fauna At Kakinada, Andhra Pradesh The RMAC noted the study and said it is expecting to see research papers from this study.	The project report has now been submitted and a publication on the impact of seismic surveys is under preparation.
20	23. Assessment of The Morphological Diversity and the Ecological Patterns in The Near Threatened Colonial Water Birds Across Indian Sub-Continent Using A Novel Approach The RMAC noted that unless a research paper from the study is published in a high impact peer reviewed journal the technique, if proved appropriate for bird studies, will not get recognition. The technique / methodology being explored should be applicable for other species of birds as well as individual birds.	As per the recommendations of the last RMAC, Standardization of video methods has been carried out. Further, the Principal investigator visited the Zoological Survey of India, Kolkata and used the specimens of birds for standardization of the method. It was found that the video graphic methods gave results that are coming within millimeter accuracy to the physical measurements of the specimens and models. Statistical tests also substantiate the acceptability of the method. The findings were summarized as a manuscript that has been communicated for critical comments to subject experts. Positive and encouraging comments have been received that would be incorporated in the final manuscript to be communicated to Professional journals.
21	24. Ecological and Ethno-Cultural Examination of The Rise and Fall in Rice Diversity in Southern India, With Special Reference To The Western Ghats	

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	The RMAC noted the valuable information collated by the study on traditional seeds and traditional knowledge evolved according to specific environmental features, and suggested the National Biodiversity Authority, would be interested in the study. As a general observation, the RMAC said that the extension division also should take more extension work.	Noted for compliance.
22	**27. Monitoring Nature Through Birds** The RMAC felt that the objectives of the project are too ambitious and opined that Rs.6.00 lakhs per year for conducting the study throughout the country is grossly insufficient. The PI informed the RMAC that the funding agency has suggested a change in the title of project: *Exploring* Nature through Birds instead of *Monitoring* Nature through Birds.	As part of the project a Brain storming workshop is conducted on 18th and 19th of June 2013 for all the master resource persons and partners of the project and a road map for the future implementation of the project was made. A module of education materials including three books and four postures is prepared. A National Orientation Programme for the resource persons/mentors of the programme was arranged at SACON on 13th and 14th August 2014. 45 Participants attended the program. Plan for up-scaling and expanding the reach of the project with the plan of action for the next one year was discussed and finalized in the meeting Primary field level activities have been started.
	Agenda No: 4/26: Completed Projects	
23	1. A Survey For The Fishing Cat (*Prionailurus viverrinus*) in Coastal Kerala, India The RMAC noted that the final report	We will write a proposal for a larger project in the year 2015-2016. In the meanwhile we are continuing analysis of previous samples to extend the work to a global scale which was part

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	is submitted to the funding agency. The RMAC noted with concern that during the survey the species was not found in the study area and felt something wrong with the survey or the species, while several other researchers are claiming the presence of the species. The RMAC asked SACON to develop a larger project proposal on fishing cats.	of the original proposal funded by Panthera, New York. The global analysis could not be done at that time due to logistic reasons. Additionally Dr Mukherjee is co-supervising a Masters dissertation from NCBS on fishing cats in West Bengal. Once we piece all the bits of information together we will be in a position to ask more meaningful questions for the bigger project.
24	Study On Impact of Construction of High Rise Towers On Migration of Fauna Including Avifauna - Bengal NRI Township Project (Urbana), Anandapur The RMAC noted the submission of the final report to the funding agency and asked SACON to upload the report on the website of SACON.	The final technical report is uploaded in the SACON's website
	Agenda No: 6/26 **Consideration of White Paper and Vision of SACON**	
25	The RMAC members perused the modified White Paper and Vision of SACON. The Member Secretary briefed the members of the RMAC with regard to the document and intimated that all suggestions by the RMAC made at its previous meeting were included in the document. The RMAC noted that draft document was circulated to the faculties and also sent to Drs Jay Samant and Erach K Bharucha for their final comments. Deliberating upon the document, the members suggested including a tabular form in the document indicating the manpower requirement, infrastructure requirement for every five years, which would communicate the salient	Incorporating the suggestions of the RMAC and faculties, the White Paper was placed at the 66th meeting of the Governing Council held on 30th July 2014 at New Delhi. The GC approved the White Paper with some minor corrections. The final White Paper would be circulated to the members of the Society, Governing Council and RMAC shortly.

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	features of the document at a glance and would also help in monitoring purposes. With these additional suggestions, the RMAC advised the Director, SACON to incorporate the suggestions by the RMAC and finalize it at the earliest for submission to the forthcoming meeting of the Governing Council. The Chairman also requested the members to send if there are any more comments within a week, which would enable SACON to finalize it.	
	For information of the RMAC	
26	***D. Publications*** Noting the faculty strength of SACON, the RMAC asked SACON to publish its research papers in high quality journals and also to publish books. The RMAC hoped that it would find more research papers published in quality journals in the next RMAC meeting. The RMAC said since SACON has undertaken several studies in the Andaman & Nicobar Islands, it would be advisable for it to compile all such research / conservation works as a compendium for wider distribution. In this regard, SACON may organize a workshop at Andamans in collaboration with other organizations (e.g. GIZ India) to highlight the works of SACON in the islands.	During the reporting period, SACON has published the following books 1. Lakes of Coimbatore City 2. Common Birds of Coimbatore 3. How to Study Birds 4. Fun with Birds published 5. Learn about Birds published 6. Ecosystem Services and Functions of Birds (ICIO-2013; 19-23 Nov 2013) It is intimated, SACON has planned to release a series of publications starting with the tentative title 'Two Decades in the Andaman & Nicobar Islands – A Journey through the Islands'. This would help us to compile all research / conservation works of SACON in Andaman and Nicobar Islands, and produce as a compendium for wider distribution. As suggested by the RMAC, SACON would organize a workshop at Andamans in collaboration with other agencies to highlight the research works of SACON in the islands.

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		It is also submitted that SACON will be celebrating its silver jubilee celebrations during 2015. The SACON Society at its 23rd AGM recommended to the MoEF & CC, Government of India to consider granting Rs 30/- lakhs for the purpose to SACON. The AGM suggested SACON the following activities in the celebrations a. Workshops / seminars in select locations in the country inviting various stakeholders, experts and managers b. Organize inter-ministerial discussion on biodiversity conservation c. Publications of compendium or edited volumes on SACON's works and achievement during the last 25 years, covering its works on the islands and other biogeographical provinces of the country d. A meeting of bird watchers and individual researchers in the field of ornithology and conservation for the purpose of effective networking and collation of the scattered works done at various parts of the country e. The AGM also suggested that SACON may hire a consultant for preparing the compendium / edited volumes on various themes based on SACON's works in various parts of the country. This occasion would help us to compile all research / conservation works of SACON since inception, not only in Andamans, but also other biogeographic regions, as a compendium for wider distribution.

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	Other issues with the permission of the Chairman, RMAC:	
27	***Provision for Core Funds (R&D) to SACON by the MoEF*** in view of the lack of funds at SACON the RMAC unanimously requested the MoEF to release in full the financial allocation recommended to SACON (Rs. 6.30 crores, for the FY 2013-2014) by the SACON Society (at its 22nd AGM held on 28th March 2013 at Chennai), so that SACON could manage its various essential requirements including it R&D activities. The RMAC also advised SACON to get the proposed rules vetted / approved by the MoEF, at the earliest so that the Research Revolving Fund could be made operational.	The MoEF & CC sanctioned Rs. 4.20 crores to SACON for the FY 2013-14, and for the FY 2014-15, the MoEF & CC has sanctioned Rs. 4.50/- crores. As advised by the RMAC, the final draft rules governing the management of corpus funds and EIA consultancy Rules were placed and the GC approved the same for implementation at SACON.
28	**Grant of retrospective promotion to the senior faculty members** At the meeting, the senior faculty members brought to the notice of the RMAC a long pending issue related to them: the denial of promotion to them from the due date, which has caused huge financial loss to each of them. The RMAC noted that the issue was raised at various levels in the MoEF by SACON and it is under consideration of the MoEF. The RMAC took note of this genuine demand of the senior faculties of the centre and their dejected feelings with deep concern and recommended the MoEF to consider the matter favorably.	The issue was discussed at the 66th meeting of the GC and at the 23rd AGM of the SACON Society. The Society and GC asked the Director, SACON to place the issue before the Recruitment, Assessment and Promotion Committee (RAPC) for a decision within six months. The RAPC is constituted by the Chairman, SACON (GC), and the committee is chaired by Dr R Sukumar, Professor, Centre for Ecological Sciences, Bangalore.

Agenda No: 3/27

Consideration of the progress on the ongoing research projects/ EIA studies

ORNITHOLOGY, AVIAN PHYSIOLOGY & GENETICS, AND CONSERVATION ECOLOGY

1. Owl Assemblage and occupancy in Andaman archipelago, India

Principle Investigator	:	S Babu
Co-Investigators/Consultants	:	H N Kumara
Research Fellows	:	S Suresh Marimuthu & N Rajeshkumar
Project period		Three years
Date of Commencement	:	19th June 2013
Expected Date of Completion	:	18th June 2016
Budget	:	Rs 41, 17,000/-
Expenditure till date	:	Rs 12,29,357/-
Funding source	:	SERB-DST, Govt of India
Status	:	On-going
Collaborative Agencies	:	NA

Summary

In 118 points, reconnaissance survey was conducted to elucidate distribution pattern of owls in north Andaman using three survey protocols. Five owl species reported earlier were recorded. Encounter rate of four species of owls was higher in agriculture, forest and agriculture-forest mixed habitats. Altogether, 50 spatial grids were covered for occupancy. Yet, spatial data is not sufficient to run any models, thus the models will be run once we complete required number of grids. Fifteen islands of varied sizes and isolation were surveyed for testing assembly rules. Oriental Scops Owl, Andaman Scops Owl, Andaman Hawk Owl and Hume's Hawk Owl were recorded to be common to uncommon however, Andaman Barn Owl was observed as uncommon/rare in North Andaman

Objectives

1. How do offshore islands' size, degree of isolation and habitat diversity (alone or combination of all) determine the assemblage of owls in the Andaman archipelago?
2. What are the habitat covariates influence the distribution and occupancy of owls in the North Andaman?

Methodology

Objective one: Reconnaissance survey was carried out in 118 points covering entire North Andaman. Degree of isolation and size of the offshore islands in North Andaman was determined. Number of owl census points within each selected island was determined by stratified random sampling method considering island size as stratum variable. Point count method was adapted to sample owls in those selected islands. Three standard sampling protocols *viz*., initial quiet listening, broadcasting of conspecific calls and spotlight searches were followed in each point count station to assure the occurrence of owls. In each of owl census point, habitat diversity of

offshore islands was assessed at structural class level using Point Centered Quarter method.

Objective two: Site occupancy framework was followed to identify the habitat covariate that influences owl occupancy. Four km^2 spatial grids were considered as individual sampling unit; however, alternative grids were sampled. In all selected grids, owl sampling was conducted using protocols that are mentioned in objective one. In addition, sampling covariates such as climate, moon status and breeding season and habitat covariates were also quantified in all owl census points. At present, habitat covariates were quantified at three levels: site, habitat and landscape to elucidate factor that might influence occupancy of owls in the North Andaman.

Results

Reconnaissance survey was carried out in 118 points covering entire North Andaman to examine distribution, abundance and habitat use pattern of owls. Five owl species reported earlier were recorded during the study. Encounter rate of four species of owls was higher in agriculture, forest and agriculture-forest mixed habitats. Oriental Scops Owl (*Otus sunia*) and Hume's Hawk Owl (*Ninox obscura*) was recorded in all surveyed habitats however, Andaman Hawk Owl (*Ninox affinis*) was recorded only in forest mixed agriculture habitats and it was not recorded from the human habitation and plantations during the survey. Number of owl species per point was higher in forest-agriculture mixed habitats and forested habitat. During the preliminary survey, habitat characteristics around the owl census point were also assessed at two levels *viz.,* tree and understory. The presence of Hume's Hawk Owl was significantly influenced by higher the tree height (Mann-Whitney U test=588.00; p=0.042). Higher the understory height (U test=96.50; p=0.00) and understory cover (U test=148.500; p=0.002) influenced the occurrence of Andaman Hawk Owl. Occurrence of Andaman Scops Owl (*Otus balli*) was influenced by higher the understory height (U test=313.500; p=0.001) and cover (U test=385.50; p=0.009) but lesser the grass height (Mann-Whitney U test=431.50; p=0.037) and grass cover (U test=419.50; p=0.031). Oriental Scops Owl was influenced by the higher the tree GBH (U test=593.00; p=0.040) and tree canopy cover (U test=600.50; p=0.049). Altogether, 50 spatial grids were covered. Yet, spatial data is not sufficient to run any models, thus the models will be run once we complete required number of grids. Fifteen islands of varied sizes and isolation were assessed for the occurrence of owl species. Among the surveyed islands, four species of owls were recorded from the Interview Island, whereas in other islands maximum of two species of owls were recorded. Oriental Scops Owl was recorded in all surveyed islands.

Discussion and recommendations

Oriental Scops Owl, Andaman Scops Owl, Andaman Hawk Owl and Hume's Hawk Owl were recorded to be common to uncommon however, Andaman Barn Owl (*Tyto deroepstorffi*) was observed as uncommon/rare in North Andaman. Barn owl was recorded opportunistically twice near human habitation. Higher species richness in forest-agriculture mixed habitats and forested habitat can be attributed to availability of diverse niches.

Publications (emanated from the research study) Nil

2. Identification of RNA transcripts present in chicken sperm and their relation to fertility.

Principal Investigator	:	Ram Pratap Singh
Co-Investigator/ Consultant	:	Nil
Research Fellow	:	Shafeeque CM
Project period	:	3 year
Date of commencement	:	30th July 2012
Expected date of completion	:	29th July 2015
Budget	:	Rs 21/- lakhs.
Funding source	:	DST, Government of India.
Status	:	Ongoing
Collaborating agency	:	Central Avian Research Institute, Bareilly, India

Summary

Currently RNA transcripts are being used as male fertility biomarker for many mammalian species, but research work on birds is at halt because classical RNA isolation methods are not effective for chicken spermatozoa. Hence, attempts have been made to optimize RNA isolation protocol from chicken sperm by using different methods, and to to identify RNA populations in sperm by microarray. Semen samples were centrifuged at low speed for removing debris like uric acid. Further, 1 ml diluted semen was gently placed over 40% PureSperm, and centrifuged to remove somatic cells and immature diploid spermatocytes. RNA was isolated from sperm by using RNAzol or TRIzol reagent or RNeasy Micro kit with certain modification, and RNA quantity and quality was evaluated. RNA isolated by using RNAzol or RNeasy Micro Kit yielded good quantity and quality of RNA for downstream applications compared to TRIzol. 40% PureSperm was found effective in removing somatic cells. RT-PCR results showed that sperm RNA samples were negative for *CD4* and *PTPRC*. All the sperm RNA samples were positive for *PRM* and *PLCZ1*, markers of sperm RNA. In the present study, a total of 37490 specific probes were detected in chicken sperm and testis. Of these 37490 specific probes, 19629 were common in both sperm and testis, whereas 10277 probes were unique to sperm.

Objectives

1. Optimization of the RNA isolation methodology for chicken sperm.
2. Molecular analysis of the population of RNA in chicken spermatozoa.
3. Expression analysis of fertility related genes in low and high fertility chickens.

Methodology

Objective 1: Optimization of the RNA isolation methodology for chicken sperm.

RNA isolation from sperm: Semen from five males were collected and used for RNA isolation. Before RNA isolation, semen samples were subjected to 40% PureSperm100 density gradient centrifugation to remove somatic cell contamination followed by sperm concentration measurement. The adjusted sperm concentration (100-3000 X 10^6 sperm/ml) in semen samples were further used for RNA isolation by RNAzol or Trizol or RNeasy Micro kit. The quantity and quality of RNA was measured using NanoDrop and bioanalyzer.

Objective 2: Molecular analysis of the population of RNA in chicken spermatozoa.
Semen and testis from five males were collected and used for RNA isolation. The concentration and purity of the RNA extracted were evaluated using the Nanodrop Spectrophotometer. The RNA samples were labeled using Agilent Quick Amp Kit. 500ng of total RNA was reverse transcribed using oligodT primer tagged to T7 promoter sequence. cDNA thus obtained was converted to double stranded cDNA in the same reaction. Further the cDNA was converted to cRNA by in-vitro transcription reaction by T7 RNA polymerase enzyme in presence of Cy3 dye. 1650ng of labeled cRNA were fragmented and hybridized on the array using the Gene Expression Hybridization kit in Sure hybridization Chambers (Agilent) at 65° C for 16 hours. The hybridized, washed microarray slides were then scanned on a G2600D scanner. Images were quantified using Feature Extraction Software. Significant genes up and down regulated showing one fold (log base2) and above within the samples with respect to control sample were identified. Differential expression patterns were identified among the samples. Differentially regulated genes were clustered using hierarchical clustering based on Pearson coefficient correlation algorithm to identify significant gene expression patterns. Genes were classified based on Gene ontology functional classification.

Results
Somatic cell removal from semen: Two density gradient mediums, Percoll and PureSperm were used to enrich normal sperm for RNA isolation. This density gradient centrifugation separated samples into two distinct layers; mature sperm settled at the bottom of tube, whereas somatic cells and immature spermatocytes were observed in the upper layer. The two layers were more prominent in Percoll as compare to PureSperm. Sperm enrichment with a one-layer 40% PureSperm density gradient medium was found to be optimal in removing somatic cells, bacteria, immature round spermatids, and diploid spermatocytes from semen samples as compared to two-layer 45% / 90% Percoll density gradient medium. Sperm loss of the initial sperm count during density gradient centrifugation was about 50% in both Percoll and PureSperm (Table 1).The light microscopy assessments before and after purification confirmed the absence of other cells in the purified samples (Fig. 1). The purification efficiency was observed higher in 40% PureSperm compared to 45% / 90% Percoll, which was further substantiated by PCR results.

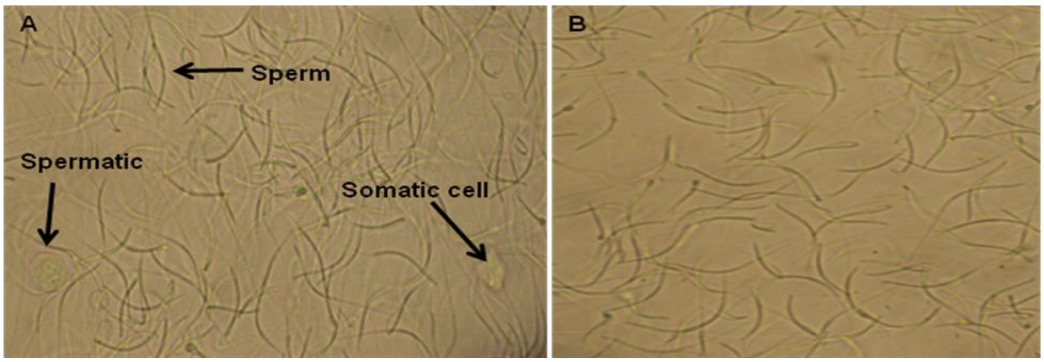

Figure 1: Photograph showing sperm purification after one-layer density gradient centrifugation with 40% PureSperm. (A) Before purification (x400); (B) After purification (x400).

Table 1: Sperm loss during density gradient centrifugation (DGC) with Percoll and PureSperm.

DGC medium	Sperm concentration before DGC (10^6)	Sperm concentration after DGC (10^6)	% sperm loss
Percoll (n=11)	2462±599	1448±413	50.15±6.0
PureSperm (n=13)	2710±452	1244±252	50.26±2.16

RNA isolation and quality assessment: RNA from chicken sperm was isolated successfully by using all three methods (TRIzol, RNAzol and RNeasy Micro Kit with spin columns). The best results were obtained by using RNAzol or RNeasy Mini Kit. RNA isolated by TRIzol or RNeasy Mini Kit was always found contaminated with genomic DNA, thus DNAse treatment is mandatory. RNA isolated by RNAzol was devoid of any genomic DNA contamination, thus DNAse treatment was not required. The overall RNA concentration was observed higher (293 ng/µL) when isolated by using RNeasy Mini Kit as compared to RNAzol and TRIzol (Table 2). The absorbance ratios at A260/ A280 for RNA samples isolated by RNAzol and RNeasy kit were between 1.24 –2.05 (Table 2). The absorbance ratios represented that isolated RNA samples were free from proteins and organic compounds. The Bioanalyzer profile of testes RNA showed two distinct peaks of 18S and 28S rRNA respectively (Fig. 2), at the same place as indicated in reference with a RNA integrity number (RIN) of 7.9. In contrast, sperm RNA bioanalyzer profile exhibited only a single peak at 40-50 s intervals, indicating the principle difference between testes and sperm RNA (Fig. 2). The absence of 18S and 28S rRNA peaks in sperm RNA indicated that the RNA was originated from sperm and was uncontaminated with somatic cell RNA.

Table 2: RNA yield and other parameters of sperm RNA samples

RNA isolation method	Sperm used for RNA isolation	Absorbance at 260/280	RNA concentration (ng/µL)	DNA contamination

	($x10^6$)			
RNAzol (n=23)	300	1.62-2.05 Mean=1.76	30-337 Mean=146	No
TRIzol (n=12)	300	1.24-1.69 Mean=1.53	34-392 Mean=106	Yes
RNeasy Micro Kit (n=4)	100	1.83-1.89 Mean=1.85	136-556 Mean=293	Yes

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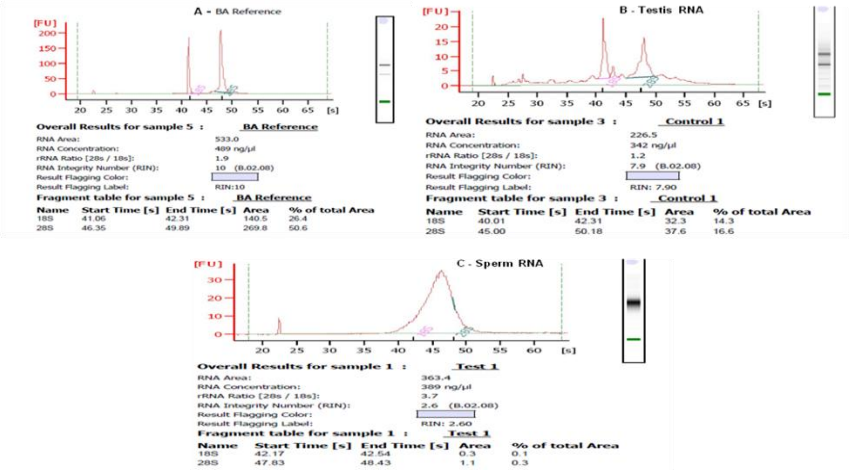


Figure 2: Representative image showing microarray electropherogram of chicken RNA sample isolated by RNAzol. (A) *18s* and *28s* rRNA reference; (B) Total testis RNA; (C) Total sperm RNA isolated by RNAzol.

PCR amplification of PRM and PLCZ1: All the RNA samples were used for PCR with CD4, PTPRC, PRM and PLCZ1 gene specific primers. CD4 and PTPRC genes were used to check somatic cell RNA contamination in isolated sperm RNA samples. All the sperm RNA samples were found negative for CD4 and PTPRC genes, indicating that sperm RNA samples were free from any somatic cell RNA, whereas testes RNA samples were positive for CD4 and PTPRC genes (Fig. 3 a & b). The genomic DNA contamination in RNA samples was checked by an intron spanning primer of CD4 gene, which exhibited no amplification in sperm samples. These results showed that all the sperm RNA preparations were free from genomic DNA. Further, PRM and PLCZ1 genes are known as positive marker for both sperm and testis. All sperm and testes RNA samples were found positive for PRM and PLCZ1 transcripts, indicated that chicken sperm do have PRM and PLCZ1 mRNA (Fig. 3 c & d).

Figure 3: (picture Removed)Agarose gel image showing PCR results in sperm RNA samples. (a) Amplification with *CD4*; (b) Amplification with *PTPRC;* (c) Amplification with *PRM*; and (d) Amplification with *PLCZ1.* M-100bp marker; NTC-non template control; PC- testis RNA sample; S1-S4-four representative sperm RNA samples isolated by RNAzol.

Molecular analysis of the population of RNA in chicken spermatozoa: in the present study, a total of 37490 specific probes were detected in chicken sperm and testis. Of these 37490 specific probes, 19629 were common in both sperm and testis, whereas 10277 probes were unique to sperm (Fig. 4). Clustering of differentially regulated genes using hierarchical clustering based on Pearson coefficient correlation algorithm to identify significant gene expression patterns revealed six different functions governed by up and down regulated genes in sperm (Fig. 5). The maximum numbers of up and down regulated genes were related to transcription, whereas least numbers of genes were associated with fertilization (Fig. 5). Further, the mapping of differentially regulated genes on genome revealed the presence of maximum genes on chromosome 1 (up regulated-679, downregulated-831; Fig. 6), and least on chromosome Z (up regulated-3, downregulated-5; Fig. 6).

Figure 4: (picture removed)Venn diagram showing number of probes specifically detected in sperm and testis and commonly detected in testis as well as sperm with raw signal intensity greater than 50.

Figure 5: (picture removed) Pie chart showing number of up and down regulated genes in sperm based on different functions. Functional classification is done after filtering the genes for Fold >=2 & <=-2.

Figure 6: (picture removed) Integrated view of sperm transcripts on genome. Outer ring represents the various chromosomes of Chicken genome. Inner ring represent the distribution of differentially regulated genes based on the fold values. One unit=10 kb of nucleotide base pair.

Discussion and recommendations

Chicken sperm contain very less RNA as compared to other mammalian sperm. Our results showed that TRIzol is not suitable for RNA isolation from chicken sperm even after modifications. A new RNA isolation method from chicken sperm has been standardized. A large number of transcripts are being shared between sperm and testis indicating sperm RNAs are remnant RNAs of spermatogenesis process. During the sperm maturation in epididymis, sperm are enriched with specific foreign RNAs which may have important roles during fertilization and early embryonic development. The maximum number of up and down regulated transcription factors indicated their role in controlling gene expression during early embryonic developmental stages which are very crucial.

Publications (emanated from the project)

1. Shafeeque CM, Singh RP, Sharma SK, Mohan J, Sastry KVH, Kolluri G, Saxena VK, Tyagi JS, Kataria JM, Azeez PA. (2014). Development of a new method for sperm RNA purification in the chicken. Animal Reproduction Science, DOI: 10.1016/j.anireprosci.2014.06.032.
2. Shafeeque CM, Sharma SK, Sastry KVH, Mohan J, Singh RP. (2014). Sperm RNA: a new class of fertility biomarkers for birds. Advances in Animal and Veterinary Sciences, 2 (3): 155 – 158.
3. Shafeeque CM, Sharma SK, Sastry KVH, Mohan J, Tyagi JS, Singh RP. (2013). Protamine transcripts in chicken sperm: Bio-marker for fertility prediction. In: Proceedings of XXX Conference & National Symposium of Indian Poultry Science Association 22-23 November, 2013, CARI, Izatnagar-243 122 (UP) INDIA.

3. Patterns of Distribution of Selected Faunal Groups in the Agasthiamalai Hills, Western Ghats, Kerala, India

Principal Investigator	:	S. Bhupathy (01-10-2013 to 28-04-2014) & Rajah Jayapal (19-06-2014 till date)
Co-Investigators/Consultants:		Lalitha Vijayan
Research Fellows	:	V.J. Jins & Madhumita Panigrahi
Project Period	:	3 years + 7 months
Date of Commencement	:	30 May, 2011
Expected Date of Completion:		31 December, 2014
Budget	:	Rs. 24,90,000/-
Expenditure till date	:	Rs. 19,66,962/-
Funding Source	:	Dept. of Biotechnology, Govt. of India
Status	:	Ongoing with no-cost extension
Collaborative Agencies	:	Nil

Summary
This project completed its three-year tenure on 29, May 2013 as originally sanctioned by DBT (vide order BT/PR13769/BCE/08/803/2010). Following the unfortunate demise of the PI (Dr. S. Bhupathy) in April 2014, a request was made to the funding agency for approval of Dr. Rajah Jayapal as the new PI and request was also made for no-cost extension of the project given the pending collection of some crucial data from the field. Consequently, DBT has approved the change of PI and no-cost extension till 31 December, 2014 (vide sanction order of even number dated 19/06/2014). During the reporting period, data on reptile and bird diversity in different elevational categories were collected along with vegetation data. We also modelled distribution ranges of two endemic species of reptiles Kangaroo Lizard *Otocryptis beddomii* and Captain's Wood Snake *Xylophis captaini* in the Western Ghats using species-habitat matrix.

Objectives
This project aims to study the spatial patterns of distribution of selected fauna (birds and reptiles) and factors governing the same along the altitudinal gradient (about 50 to 1868 m above sea level) in the Agasthiamalai Hills, Western Ghats. Within this analytical framework, it is also planned to map the distribution range of select species of rare and endemic taxa using predictive tools like Ecological Niche Modelling (ENM). The study intends to explore these spatial patterns of species diversity to develop a protocol to identify, prioritize, and delineate biodiversity-rich sites for further protection in the newly declared Agasthiamalai Biosphere Reserve.

1. To determine the species richness and turnover patterns of reptiles and birds with altitude in Agasthiamalai Range, Western Ghats, Kerala
2. To understand both abiotic and biotic factors influencing such patterns
3. To know the status of reptile and bird species found in the Agasthiamalai Range, Kerala
4. To apply distribution (Ecological Niche) models to find out the probable distribution limits of selected endemic species found in Agasthiamalai Hills

Methodology
An intensive study area (8°33'N- 77°6'E & 8°43'N 77°15'E) representing most altitudinal categories (50 m to 1868 m) was selected and has been stratified at 100 m altitude and gridded (1 sq km) using GIS and Remote Sensing protocols. The sampling effort was largely depending on area availability in each category. In the end, 15 altitudinal categories were delineated and sampling for both reptiles and birds was undertaken in each altitudinal category.

Reptiles were sampled using time-constrained visual encounter survey (Heyer et al. 1994. *Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians*. Smithsonian Institution, Washington DC). Birds were sampled using open-width circular plot (Bibby et al. 1992. *Bird Census Techniques*. Academic Press, London). Species turnover among different altitudinal categories was estimated using Sorenson's dissimilarity index (S_I).

Data on environmental parameters such as canopy, shrub and herb cover, stem density, litter cover and temperature and relative humidity and other microhabitat variables are being collected using standard methods.

Results

When the species richness of reptiles and birds was plotted against the altitudinal categories and contrasted with the simulated response, it was found that both taxa did not show unimodal pattern as predicted by the mid-domain theory. Typically, the species richness of both the taxa showed a steadily declining trend with increasing altitude, though the rate of decline varied between altitudes. For example, the decline was slow and gradual till 800 m elevation, but took a steep fall between 800-1200 m. The slight spike in reptile diversity at around 1000-1100m altitude is suspected to be a sampling artefact which is expected to be corrected with further sampling. Further up (above 1200m), the species richness became extremely low for both the taxa.

The highest reptile species turnover among consecutive elevational zones was noted between 1100-1200m and 1200-1300m zones (S_I=0.75). In addition, the species turnover of reptiles was observed to be nearly complete between 600-700m and 800-900m zones. Expectedly, most of the higher altitudinal zones (>1200m) had higher turnover (S_I > 0.8) with lower altitudes. Unlike reptiles, the species turnover in birds was rather gradual and contiguous barring the composition of communities between 300m and 1500m which were almost completely non-identical.

The Ecological Niche Modeling (MAXENT) predicted that potential sites (p>0.7) for *Otocryptis beddomii* were found south of Periyar Tiger Reserve and highly suitable sites (p>0.8) were predicted only further south of the Shenkottah gap. About 730 sq km of Western Ghats, including 620 sq km in Agasthiamalai Biosphere Reserve, was found to be moderately suitable at (p >0.6) for this species (Figure 2). Similarly, *Xylophis captaini* was found in 33 locations. The model showed that the predicted distribution of *X. captaini* as south of Thodupuzha (09˚58'N, 76˚38') of the Kerala State.

Discussion and recommendations

Since the final phase of field work is currently under way with more replicates to be sampled for reptiles and birds across higher altitudinal ranges, the results presented here are only indicative and not conclusive. However, some general patterns seemed to have evolved with respect to spatial distribution of species richness in both reptiles and birds in Agasthiamalai Hills in southern Western Ghats. Curiously, both the taxa did not show any mid-domain effect along the elevational gradient. This is in sharp contrast to predicted species richness patterns and also observed elsewhere too. This contradiction needs to be further investigated in view of several competing hypotheses presented in various ecological literatures. These include ecotonal effect, competition, productivity, structural complexity of habitats, ecological sorting, area effect, and sometimes mere sampling effect. We plan to test each of these hypotheses with full dataset at the end of the current season.

The differences between reptiles and birds in terms of species turnover along altitudinal gradient were quite marked unlike their near-convergence in species

richness-elevation pattern. We suspect this to be largely a function of relatively higher degree of endemism and niche-conservatism shown by reptilian taxa compared to birds. In this regard, we intend to carry out analyses in future on how range size dynamics could influence the species turnover in space in Western Ghats.

Regarding the species-distribution models, it was evident that the precipitation seasonality has highest predictive gain when used in isolation and it appeared to be the most important variable for the predicted model. The findings show that MAXENT model is suitable for predicting distribution range of species, which will be useful for further targeted surveys. Other models using presence and absence data and habitat variables will be developed for predicting distribution range of little known species particularly rare and endemic taxa of high conservation significance.

Publications (emanated from the research study):

Communicated to journals

1. Jins V.J, S. Bhupathy & Madhumita Panigrahi (2014). "New record of Beddome's coral snake *Calliophis beddomei* Smith, 1943 from the Southern Western Ghats, India" –Submitted to *Herpetology Notes*
2. Bhupathy, S., V.J. Jins, S. Babu & J. Jose (2014). "Distribution of a Caenophidian Snake *Xylophis captaini* (Gower & Winkler) in the Western Ghats, India". – Submitted to *Current Science*

CONSERVATION BIOLOGY

4. Ecological species sorting in relation to habitat structure in the small cat guild of Eaglenest Wildlife Sanctuary, Arunachal Pradesh.

Principal Investigator	:	Shomita Mukherjee
Co-Investigators	:	Karunakaran PV and Ramana Athreya
Research Fellows	:	To be selected. Advertisement sent
Project Period	:	3 years
Commencement	:	December 2013
Date of Completion	:	November 2016
Budget	:	Rs 48,08,000/-
Expenditure till date	:	Rs 10,52,126/-
Funding Source	:	Department of Science and Technology, GoI
Status	:	Ongoing
Collaborative Agencies:		Dr Ramana Athreya's laboratory, IISER (Pune)

Summary

Nine of the 15 species found in India, occur in the North-East, perhaps the richest anywhere in the world. Cat morphology frequently indicates evolutionary origins with long tails suggesting arboreality and short tails, adaptation to open habitats. Yet, literature suggests considerable flexibility in the choice of habitats by most felids. We propose to explore if felid morphology is strictly related to habitat structure, facilitating co-existence particularly in a high diversity region. We will study this in

Eaglenest Sanctuary in the West Kameng district of Arunachal Pradesh, through non-invasive sampling using scats, molecular tools, camera trapping and spatial analysis on the GIS platform.

Objectives

1. Examine the role of morphology in spatial distribution patterns and habitat associations in small and medium cats in EWS.
2. Examine the relationship between body size and diet for felids in EWS.
3. Compare conventional techniques for surveying small carnivores for cost effectiveness and information obtained.

Methodology:

Habitat categorisation (structural):

The vegetation map will be prepared by using Geographical Information System (GIS) derived from information sources such as Survey of India Toposheets, satellite images, GPS points and field inventory. GPS receivers will be used to identify the coordinates of ground truth points during field surveys. Forest vegetation map of the Sanctuary will be prepared through supervised classification of satellite images. Apart from this, data on climatic variables (temperature and rainfall, light levels) will also be collected across altitudes using weather stations with relevant sensors.

Scats will be collected along the motorable road running through Eaglenest Wildlife Sanctuary and along trails inside the forest. GPS coordinates; date and relevant information for each scat location will be noted. Scats will be transferred in alcohol to Dr Ramana Athreya's laboratory for further analysis using molecular tools for assignment to species as well as determine diet.

Heat sensory camera traps will be deployed for opportunistic as well as systematic sampling in order to maximise results to inventory species as well as quantify results of habitat use. Camera traps will be placed along the motorable road as well as on inner trails and selected locations inside forests. For the opportunistic sampling, we will place camera traps in specific locations where the probability of obtaining results is high – such as crossroads of forest trails, along bends of the motorable road and around places where scats have been located. This will be done primarily to maximise results on presence.

Results

- We have just (August 2014) received permits form the Arunachal Forest Department and the Ministry of Environment and Forests, GoI for beginning work in Eaglenest WLS
- Weather stations have been procured and transferred to Eaglenest Wildlife Sanctuary where they will be deployed in the winter months. LISS IV imageries for the sanctuary and 30 heat sensor camera traps have been procured.
- Preliminary surveys were initiated in the month of January and May-June 2014 to select the project staff (field assistants and driver) as well as to identify trails

inside the forest and map them for camera trapping in winter. This mapping is in progress currently.

- Chemicals and kits for molecular analysis of scats have been procured.

Discussion and recommendations: Project is in the preliminary stage.

5. Determining the taxonomic and conservation status of the Forest Owlet (*Heteroglaux blewitti*)

Principal Investigator	:	Shomita Mukherjee
Co-Investigators	:	Robin Vijayan and Prachi Mehta
Research Fellow	:	Pankaj Koparde
Project Period	:	3 years
Commencement	:	April 2013
Date of Completion	:	March 2016
Budget	:	Rs 30,52,000/-
Expenditure till date	:	Rs 14,25,503/-
Funding Source	:	Department of Biotechnology, GoI
Status	:	Ongoing
Collaborative Agencies:		Dr Uma Ramakrishnan's laboratory, NCBS, (Bangalore)

Summary

The Forest Owlet (*Heterogalux blewitti*) is a Critically Endangered, endemic species distributed in less than ten locations in Central India. This species was rediscovered in 1997 after a gap of 113 years when it was believed to be extinct. Its distribution is extremely patchy with no information on connection between various populations. Its primary habitat is under severe threat from anthropogenic pressure which has probably led to the extinction of some earlier pockets of populations. On another issue, a recent article speculated on the possible hybridization of the Forest Owlet with the Spotted Owlet (*Athene brama*) which met with severe criticism. However, there is no scientific evidence for or against this claim. The current proposal aims to study the phylogeography of the Forest Owlet to examine genetic connectivity between various populations, examine its molecular taxonomy and phylogeny with other owls and resolve the issue of possible hybridization with Spotted Owlet. The study is based on molecular analysis of feather, and pellet samples collected non-invasively as well as tissue samples of dead birds found during field sampling. This is the first time that genetic data has been generated for the Forest Owlet which is Critically Endangered and endemic to Central India. From our preliminary analysis using mitochondrial data we show that the Forest Owlet falls within the *Athene* genus. We are attempting to use the Hybrid-Capture technique and Next Generation Sequencing on the Illumina platform to obtain larger breadth of data from mitochondrial as well as nuclear genomes for more robust phylogenetic analysis.

Objectives

1. To identify any genetically unique populations through a phylogeographic study.

2. To compare molecular based phylogeny to current taxonomy. Does molecular data support the existing taxonomic position?
3. To resolve the taxonomic ambiguity surrounding *Heteroglaux blewitti* with respect to possible hybrid individuals in the populations.

Methodology

For the first objective of resolving the phylogeny and taxonomy, we require samples from several species of owls. Sample collection includes approaching rescue centres, NGOs, Zoos, natural history museums and researchers and field visits for obtaining samples of feathers, pellets, egg shells of species of interest. Please refer Table 2 for our sample collection summary. We could also procure samples of several Little Owl (*Athene noctua*), Jungle Owlet (*Glaucidium radiatum*), and other owl species from the collection. We also received samples from bird rescue centers and through individual submissions. In addition, we are in the process of obtaining permission to collect samples from Zoological Survey of India.

Data collection and literature survey

Taxonomic data was obtained from taxonomic monographs, field guides and research articles. Spatial distribution data of species of interest was downloaded from <www.iucn-redlist.org> portal. Point location data of Forest Owlet was collected from previously published articles and recent records from on-going field studies.

Laboratory Work: Standardization of Protocols

- Protocol for extracting DNA from non-invasively collected samples such as feathers, egg shells and pellets were standardized. Qiagen DNAeasy tissue kit was used to extract DNA with a few modifications that we made to optimize the extraction.
- DNA extraction from museum samples was carried out in a separate laboratory free from foreign DNA. Qiagen DNAeasy blood and tissue kit was used to extract DNA.
- Published PCR primers were used for amplifying Cytochrome b-oxidase (Cyt b) and Cytochrome oxidase I (CO I) genes. Apart from these, a nuclear marker, Recombination Activating Gene – 1 (RAG-1) is being standardized for PCR amplification. For museum samples, we designed short range PCR primers using reference sequences downloaded from < http://www.ncbi.nlm.nih.gov/>. PCR products were visualized for amplification success on a 2% agarose gel.
- All the PCR primers used for amplifying a particular region of DNA were standardized for optimal annealing temperature.
- PCR amplified products were cleaned with enzymes to remove unbound DNA. Cleaned products were sequenced using the Sanger method with ABI 3730 Genetic Analyzer (Applied Biosystems, Foster city, USA).

Data analysis

- Point location data was used for building exploratory Habitat Suitability Models (HSM) using MaxEnt v3.3.3k. Nineteen bioclimatic variables (derived from temperature and precipitation data) and altitude were used in niche models. These variables were derived from WorldClim database at 30' resolution (~1km^2). Highly correlated variables were removed from working database using a correlation analysis done in PAST v3.0. Six variables were used to build habitat suitability model for Forest Owlet. The six variables included – altitude, maximum temperature of warmest month (BIO 5), temperature annual range (BIO 7), mean temperature of warmest quarter (BIO 10), precipitation of driest quarter (BIO 17) and precipitation of coldest quarter (BIO 19).
- Generated DNA sequences were viewed and aligned using Chromas Lite v2.1, MEGA v4.0 and Geneious v6.0.
- DNA sequences available on NCBI were downloaded and used for multiple sequence alignment.
- DNA sequence alignment data was subjected to ModelTest v3.7. For identifying the best fit substitution model based on Akaike Information Criteria (AIC) for the given dataset. The best fit model for Cyt B (940 bp) dataset and for Cyt B and CO I concatenated (1565 bp) dataset were found to be TIM+I+G and GTR+I+G respectively.
- Preliminary phylogenetic trees were built using Maximum Likelihood and Bayesian algorithms using PAUP*4.0 and Mr Bayes plugin in Geneious v6.0, respectively. Trees were built using individual Cyt B and CO I sequences as well as concatenated (1565 bp) sequences.

Results

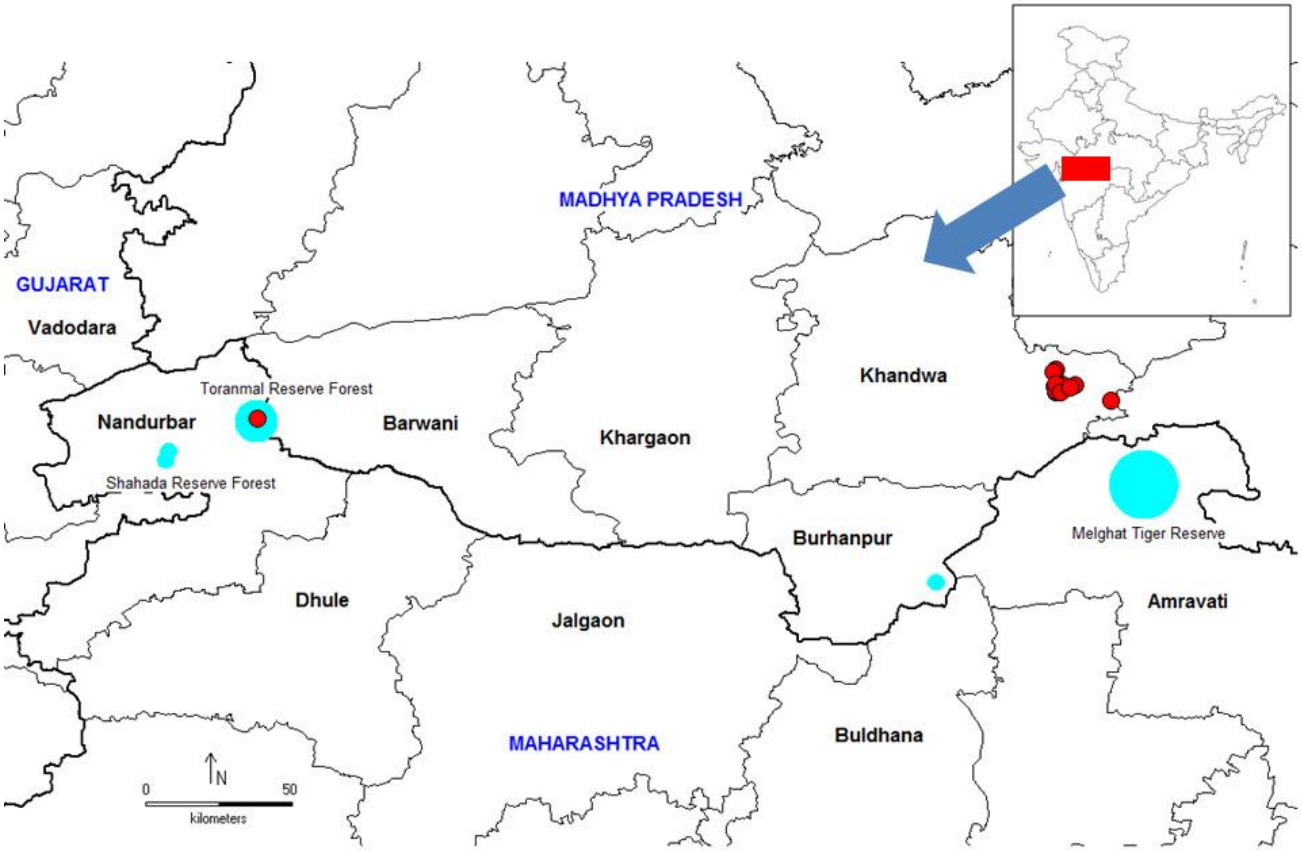
Samples procured to date have been summarized in **Table 2** below and the locations of Forest Owlet samples procured are shown in **Figure 1**.

Table 2. Samples obtained during August 2013 – July 2014.

Species	Material	Number of Samples	Contributor	Place of collection	Remarks
Forest Owlet	Feathers (19), egg shells (3), skeleton/tissue from a dead chick found near nest (1)	23	Dr. Prachi Mehta	Khandwa, MP Pradesh	Collected during bird banding studies
	Feathers (8), pellet (1)	9	Mr. Pankaj Koparde	Khandwa, Madhya Pradesh	Collected from nest-sites
	Pellet	3	Dr. Farah Ishtiaq	Toranmal reserve forest, Maharashtra	Collected in 2001 during ecology studies
	Feathers	1	Bombay	Toranmal	Collected in

			Natural History Society	reserve forest, Maharashtra	2003 during ecology studies
Spotted Owlet	Feathers (6), egg shells (2), pellets (2)	10	Mr. Pankaj Koparde	Madhya Pradesh, Maharashtra, Tamil Nadu, Karnataka	Collected from nest-sites
	Feather	1	Mr. Jugal Tiwari	Gujarat	Collected from dead bird
	Feather	1	Pune Municipality Zoo, Maharashtra	Maharashtra	Collected from rescued bird
	Museum toe-pad samples	42	Bombay Natural History Society	All across India	various studies
Jungle Owlet	Feather(1), pellet (1)	2	Mr. Pankaj Koparde	Khandwa, Madhya Pradesh	Collected from nest-site
	Museum toe-pad samples	36	Bombay Natural History Society	All across India	various studies

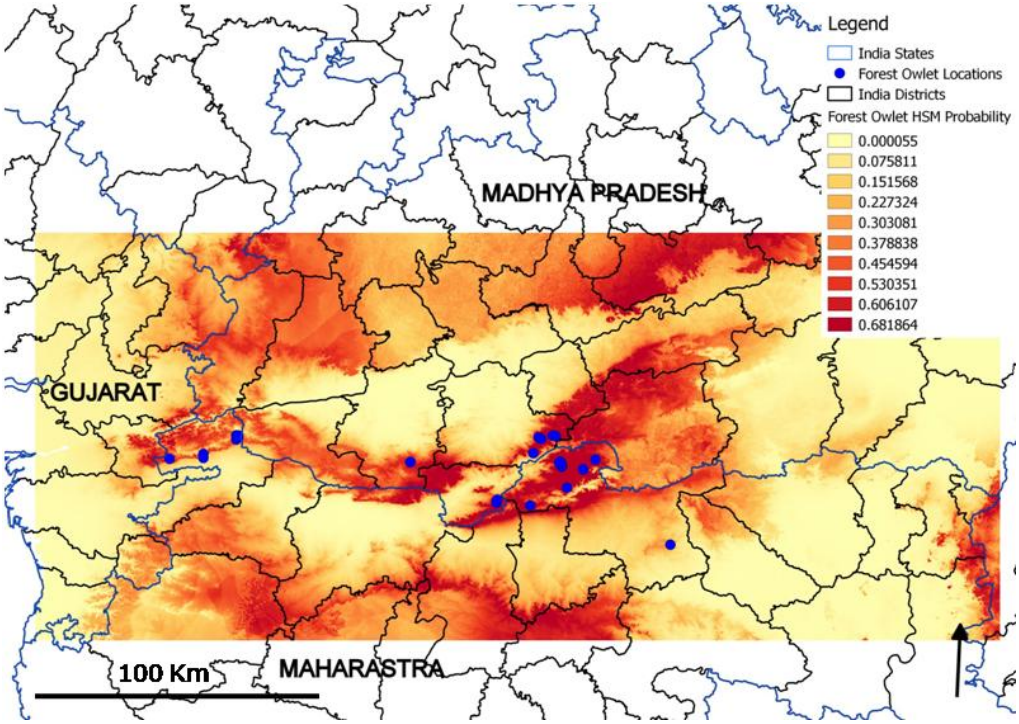
Figure 1. Sampling locations for Forest Owlet. Blue filled circles show known distribution of Forest Owlet as given by Birdlife International and IUCN Red List (http://maps.iucnredlist.org/map.html?id=22689335). The red solid circles with the black outline show locations from where samples were obtained. Dark black line shows state boundary. Thin black lines show district boundaries.



Habitat Suitability Models (HSM) of Forest Owlet:

- The exploratory model showed that apart from known locations of the species, there is potentially suitable habitat scattered across its known range (**Figure 2**).
- There seems to be a habitat corridor between populations in the east and west. However, cross-validation of the model through field surveys is required to test the habitat corridor hypothesis.

Figure 2. MaxEnt (Maximum Entropy) model of distribution of Forest Owlet. Dark red color indicates high probability of suitable habitat. Blue circle indicate Forest Owlet locations.



Molecular phylogeny of Forest and Spotted Owlet:

- To date, we could generate 24 sequences of Forest Owlet for Cyt b and CO I regions of the mitochondrial DNA and the RAG 1 portion from nuclear DNA; 5 of Spotted Owlet from the Cyt b region of mitochondrial DNA and 1 of Jungle Owlet from the Cyt b region of mitochondrial DNA.
- Trees built with considering single genes as well as concatenated genes showed the same results with high bootstrap values. The topology of the tree suggests that Forest Owlet might be a more ancient lineage than the Spotted Owlet and Little Owl.
- The current taxonomy of Forest Owlet places it in a monotypic genus, *Heteroglaux*. There are claims by taxonomists that Forest Owlet and Spotted Owlet are sister species, which have been partitioned in niche. Our phylogenetic analysis shows that Forest Owlet and Spotted Owlet are not sister species. However, our results also show that the Forest Owlet falls within the *Athene* genus (**Figure 3a & b**).

Figure 3a. Bayesian phylogenetic tree based on Cyt B sequences (940 bp). The trees were built using Mr Bayes plugin in Geneious v6.0. **Talba** = Barn Owl *Tyto alba*; **Mathn** = Elf Owl *Micrathene whitneyi*; **AegA** = Northern saw-whet Owl *Aegolius acadicus*; **AegH** = *Aegolius hardyi*; **AegF** = Tengmalm's Owl *Aegolius funerus;* **Sulu** = Northern Hawk-Owl *Surnia ulula*; **Ghrd** = Amazonian Pygmy-Owl *Glaucidium hardyi*; **Gnan** = Austral Pygmy-Owl *Glaucidium nanum*; **Ggno** = Austral Pygmy-Owl *Glaucidium gnoma*; **Gcu** = Asian Barred Owlet *Glaucidium cuculoides*; **Grad** = Jungle Owlet *Glaucidium radiatum*; **Gpas** = Eurasian Pygmy Owl *Glaucidium passrinum*; **Acn** = Burrowing Owl *Athene cunicularia*; **HB** = Forest Owlet *Heteroglaux blewitti*; **Anct** = Little Owl *Athene noctua;* **Abr** = Spotted Owlet *Athene brama.* The nodal value indicates posterior probability values. High value indicates high support for the node. **Grey region** = position of the genus *Athene*. The nodal value indicates posterior probability values. High value indicates high support for

the node. **Grey region** = position of the genus *Athene*. The scale shows nucleotide substitutions per site.

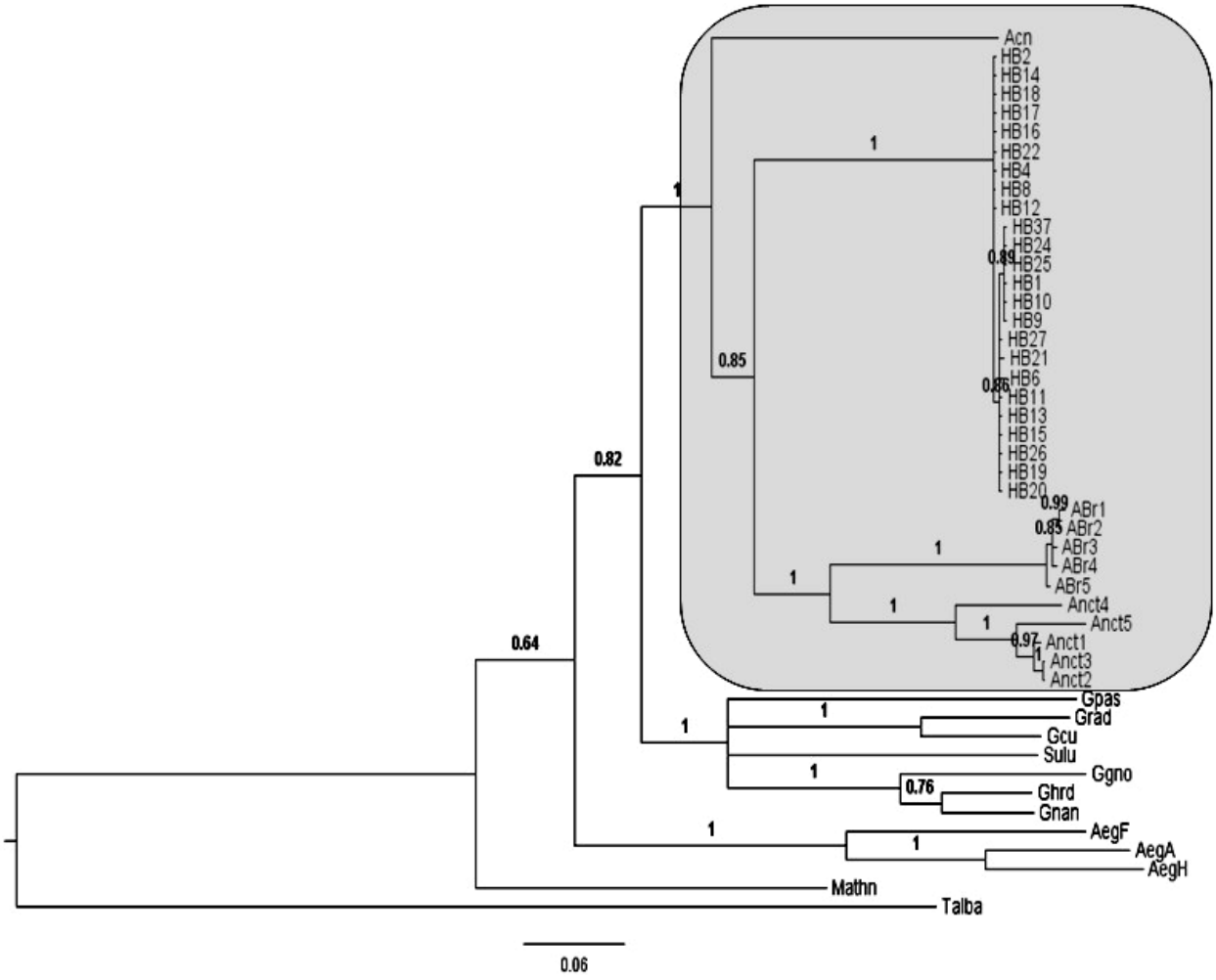
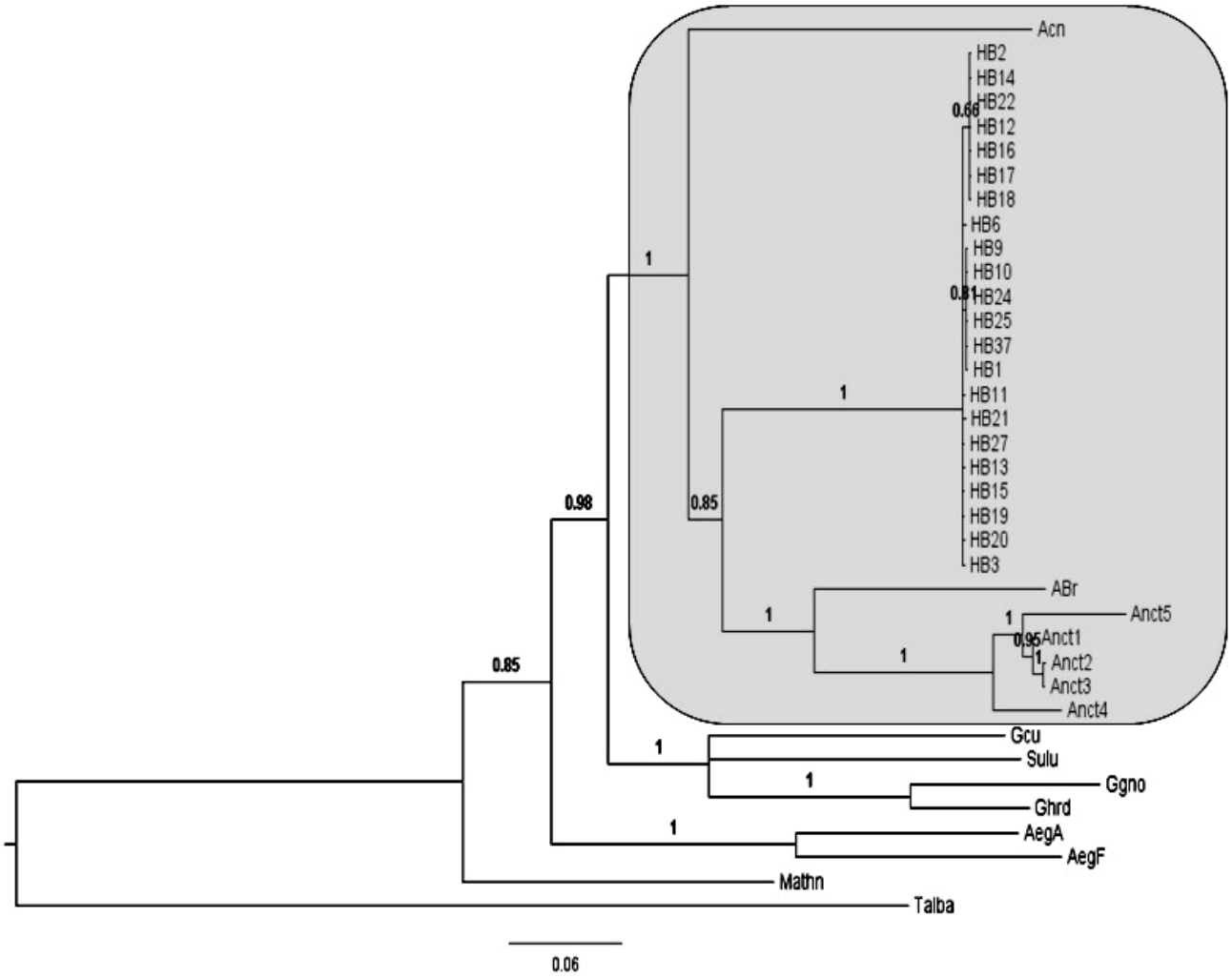


Figure 3b. Bayesian phylogenetic tree based on concatenated Cyt B and Co I sequences (1565 bp). The trees were built using Mr Bayes plugin in Geneious v6.0. **Talba** = Barn Owl *Tyto alba*; **Mathn** = Elf Owl *Micrathene whitneyi*; **AegA** = Northern saw-whet Owl *Aegolius acadicus*; **AegH** = *Aegolius hardyi*; **AegF** = Tengmalm's Owl *Aegolius funerus;* **Sulu** = Northern Hawk-Owl *Surnia ulula*; **Ghrd** = Amazonian Pygmy-Owl *Glaucidium hardyi*; **Gnan** = Austral Pygmy-Owl *Glaucidium nanum*; **Ggno** = Austral Pygmy-Owl *Glaucidium gnoma*; **Gcu** = Asian Barred Owlet *Glaucidium cuculoides*; **Grad** = Jungle Owlet *Glaucidium radiatum*; **Gpas** = Eurasian Pygmy Owl *Glaucidium passerinum*; **Acn** = Burrowing Owl *Athene cunicularia*; **HB** = Forest Owlet *Heteroglaux blewitti*; **Anct** = Little Owl *Athene noctua;* **Abr** = Spotted Owlet *Athene brama.* The nodal value indicates posterior probability values. High value indicates high support for the node. **Grey region** = position of the genus *Athene*. The scale shows nucleotide substitutions per site.



DNA extraction from museum samples:

Eleven museum samples of Spotted Owlet were extracted but the success of amplification was low for the CO I region of mitochondria. Standardization of protocols for museum samples is in progress.

Discussion:

- The HSM suffers from extent and quality of data. Climatic data is an ultimate cause of distribution, but proximal causes such as habitat availability and anthropogenic pressure may interfere with species distributions. Little is known on habitat requirements of Forest Owlet, hence fitting the species distribution only in a climatic space may lead to aberrant results. In addition, the data used for modelling is an old dataset (derived during 2000), hence may not be useful if the habitat is already degraded. The HSM needs refinement in terms of relevance of variables and addition point location data. We are working on obtaining more information on habitat requirements of the species through our collaborations with the team conducting the ecological study.
- This is the first time that genetic data has been generated for the Forest Owlet which is Critically Endangered and endemic to Central India. From our preliminary analysis using mitochondrial data we show that the Forest Owlet falls within the *Athene* genus.
- Forest Owlet samples used for tree building were from a single population. Spotted Owlet which is widespread in the Indian subcontinent and has been divided into six morphological subspecies was under-represented in the tree. With more mitochondrial and nuclear DNA data and taxon sampling the phylogenetic relations can be interpreted with more confidence. We are generating further data including nuclear regions on all species for a better, more robust resolution.
- We are attempting to use the Hybrid-Capture technique and Next Generation Sequencing on the Illumina platform to obtain larger breadth of data from mitochondrial as well as nuclear genomes for more robust phylogenetic analysis.

Publications

We are in process of drafting a manuscript based on molecular phylogeny of Forest Owlet.

6. Social organization, behaviour and phylogeography of *Macaca fascicularis umbrosa* on the Nicobar Islands, India

Principal Investigator	:	Honnavalli N. Kumara
Co-Investigator	:	Prof. Mewa Singh and Shomita Mukherjee
Research Fellow	:	Partha Sarathi Misra, S. Vinoth, and Avadhoot D. Velankar
Project Period	:	3 years
Date of Commencement	:	June 2012
Expected date of Completion	:	May 2015
Budget	:	Rs. 38.54/- lakhs
Expenditure till date	:	Rs. 18.82/- lakhs
Funding source	:	Science and Engineering Research Board (DST)
Status	:	in progress
Collaborative agencies	:	CES, IISc, Bangalore

Summary

Nicobar Islands were among the worst hit areas during the December 2004 tsunami. The long-tailed macaque *Macaca fascicularis umbrosa* inhabits three islands of the Nicobar including Great Nicobar, Little Nicobar and Katchal. The species is known to associate with swamp, riverine and mangrove forests along the coasts of these Islands all of which were severely impacted during the tsunami. The current study will assess the distribution of the species with respect to resource (food, shelter) spread/availability and use. Molecular data will provide information on levels of current genetic variation in the populations as well as the degree of isolation among them. Observations on social organization will be necessary to explain genetic data in the context of social spacing. Together such data will help in identifying the current status of the species as well as provide inputs towards any conservation action, if required.

Objectives

1. To assess the current status of populations of the long tailed macaque on the Nicobar Islands.
2. To study the social organization and time-activity budget of long-tailed macaques on the Nicobar Islands in the post-Tsunami scenario and correlate this to objective.
3. To study the phylogeography of the long-tailed macaques on the Nicobar Islands.

Methodology

Social organisation: All the three Islands will be visited, and location, group size and age-sex will be recorded for all the macaque groups sighted. Phylogeography and evolution: Samples for molecular work will be non-invasively collected faecal samples. Samples will be collected in a vials containing alcohol and transported to a lab for extraction of DNA and further analysis. Behaviour: Scan sampling will be done for data

on activity budgets. The focal group will be followed from 0700 to 1800 hr. While following the focal group a handheld GPS unit will be used to record the geo-coordinates of the group at every 30 min to assess the movement pattern and for plotting home ranges. Any interaction with other groups will be recorded as anecdotal. Focal animal sampling: Individual identification of all the group members will be made, and focal animal sampling will be used to understand the behaviour pattern and individual interactions.

Results

A total of 224.627 km (N=36 trails) was walked in three islands, and sighted 72 groups of monkeys, that gives an encounter rate of 0.32 groups/km. The number of detection of long tailed macaque group was 29, 5 and 38 in Great Nicobar, Little Nicobar and Katchal respectively that gives a relative abundance of 0.26, 0.28 and 0.41 groups/km respectively. The group size and age-sex data could be obtained to six groups in G. Nicobar and four groups in Katchal. The average group size was 41.3. Group had average of 5.2 males/ group (the number varying three to seven), similarly, average of 12.3 females/ group (varying between 4 and 25). The adult male to adult female ratio was 2.3 females per adult male, which varied between 1.3 and 4.2. Study group (20 animals: Adult male-5, Adult female-7, immature-8, infants-0): During the study period, two males were observed to migrate to study group from outer group, and missing of a sub-adult male (1yr) was recorded. However, death and birth of individuals were not recorded in the study group. Seven samples were sequenced. We downloaded sequences of all sub species from NCBI (National Centre for Biotechnology Information) database to compare genetic relationship between the species. The *fascicularis* group is structured and has several sister groups. The Indonesian group is paraphyletic individuals from this group occur in more than one clade. Our present results shows that two haplotypes with just a single mutation was seen in 550bp. Very low variation could be attributed to either sampling the same individual or closely related individuals, since the sampling was from one location or the region of marker chosen (D-loop) is conserved.

Discussions and Recommendations

The relative abundance of monkeys in Great Nicobar and Little Nicobar did not show any significant difference between post and pre tsunami. However, the relative abundance of monkeys in Katchal shows significant increase after tsunami. Pre tsunami encounter rate in Katchal was 0.19 groups/ km, which has significantly increased to 0.41 groups/ km. This increase in encounter rate can be attributed to coconut plantations, which were abandoned after tsunami. The Nicobar macaques seem to be in a separate group (unique) and are closest to the Javan group and they form a sister clade. However, since the samples are from a single location this cannot be conclusive.

Publications

-Nil-

7. Spatio-temporal burrow use patterns by vertebrates in Keoladeo National Park, Bharatpur, Rajasthan, India

Principal Investigator	:	S. Bhupathy (Late)/ Honnavalli N. Kumara (since 30/07/2014)
Co-Investigator	:	Shirish Manchi, S.
Research Fellow	:	Aditi Mukherjee
Project period	:	Three years
Date of Commencement	:	June 2013
Expected date of completion	:	June 2016
Budget	:	Rs. 42.61/- lakhs
Expenditure till date	:	Rs. 18.96/- lakhs
Funding Source	:	Science and Engineering Research Board (DST)
Status	:	in progress

Summary

In arid and semi-arid conditions, due to scanty rainfall and high fluctuations in temperature, it appears that earthen burrows act as important refugia for many species. A study conducted in Keoladeo National Park (KNP), Bharatpur reported the occurrence of several species of vertebrates (both predators and prey) together in underground burrows. However, factors determining faunal assemblage and activity of these species are unknown. Objectives of the proposed study are to, (1) Determine burrow dwelling animal assemblage in KNP, Bharatpur, and (2) Understand (spatio-temporal) factors influencing the assemblage and activity of animals, especially their emergence and retreat into burrow. Direct observations, camera traps, burrow video camera and indirect evidences have been used for assessing burrow occupancy and activities of various species; data loggers for assessing burrow and ambient temperatures and humidity, and burrow structure will be determined using Ground Penetrating Radars. The present study would provide data on factors governing the coexistence of both predators and prey in underground burrows.

Objectives

1. Determine burrow dwelling animal assemblage (in terms of species richness and abundance) in Keoladeo National Park, Bharatpur, and
2. Understand (spatio-temporal) factors influencing their composition and activity of them, especially emergence and retreat into their burrow.

Methodology

The study is being undertaken at Keoladeo National Park (KNP), Bharatpur (27°7.6′ - 27°12.2′N, 77°29.5′ - 77°33.9′ E), Rajasthan. It is one of the Ramsar sites, and it falls under the Semi-arid Biogeographic Zone of India. The total area of KNP is 29 km^2, of which about 20.5 km^2 is terrestrial. Animals inhabiting Indian Crested Porcupine (ICP) *Hystrix indica* burrows are being studied, as this is the most conspicuous system available at KNP. Surveys were carried out on foot traversing the land area to locate Porcupine burrows, and the burrow locations were marked using a Global Positioning

System (Garmin GPS 60® Map Navigator). Number of burrow openings, active and inactive ones, orientation, distance from water source and disturbance level were recorded. Habitat analysis has been done using circular plot (10 m radius for trees, 1m for herbs). Plant species, their number, % ground cover and % cover over the burrows were recorded. Nearest woody plant to the burrow was also noted. Compass orientation (degrees) of burrow openings was determined using Silva® Ranger Compass Type 15. Area of each opening was measured using offset method for calculating area of irregular shapes, .Temperature and Relative Humidity data (at 10 minuteX24 hourX365 days) are being recorded using automatic data loggers (Onset Hobos). High sensitive passive infrared (PIR) motion sensor camera (Boskon Guard Scouting Camera, BG-520 series) were deployed to determine number of porcupines and other animals using a burrow system. Data collection is being done twice in a season for five days each. In addition, track plots are monitored on fortnightly basis to know the animal movement. It is planned to study the below ground burrow structure using Ground Penetrating Radar, and location (position) of the burrow used by various animals using burrow Video Camera.

Results

In all, 41 Porcupine burrow systems were recorded in Keoladeo National Park, Bharatpur during the present study i.e. November 2013 - March 2014. This works out to be about 2 burrows/ sq km. Porcupine burrows were distributed largely in clusters and most of them were present on the periphery of the wetland. 38 plant species were recorded within 10 m radius of Porcupine burrows. The median distance to the nearest perennial woody species was 2.75 m. *Salvadora persica* was present in 43% of the burrow systems followed by *Acacia nilotica* (24%) and *Salvadora oleoides* (12%). Ivelv's Electivity Index showed that ICP preferred six species of woody plants to keep the burrow openings, whereas it avoided two species. *Salvadora persica*, *Acacia nilotica* and *Salvadora oleoides* were preferred relatively higher than *Catunaregam spinosa*, *Eucalyptus spp* and *Ziziphus mauritiana*. ICP avoided *Prosopis juliflora* the most (IV= -0.51) followed by *Prosopis cineraria* (IV= -0.31). In all, 86 openings were found in 37 burrow systems studied, which ranged from 1 to 8 ($\overline{X}$ ± SD =2.32 ± 1.5). Of the 37 burrow systems, the maximum of 13 (35%) burrows had only one opening. 10 (27%) and 9(24%) burrow systems had two and three openings respectively. Mean radius and area of 64 burrow openings measured 17.40 cm (range = 9.19 cm- 33.46 cm) and 952 cm^2 (range 266 cm^2- 3520 cm^2) respectively. Majority (N=38, 56%) of burrow openings had an area of 501-1000 cm^2. Burrow openings had (orientation) mean vector (μ) of 122° ± 111° (mean ± one circular standard deviation) with a mean vector length (r) of 0.15. The Rayleigh Z-test showed that the orientation of burrow openings were randomly distributed, and did not show any trend in orientation (Z = 0.722; p > 0.001) with respect to direction. Twenty burrows were randomly selected to study number of animals dwelling there. A total of 170 trap days across all openings (34 openings X 5 days) showed 13 species of vertebrates; 17 burrows had Porcupines, and Pythons and bats were found in seven and nine burrows respectively (Table 1). A total of 46 Porcupines were observed in 17 burrow systems i.e. 1.96±1.07 (range = 0-8)/ burrow system. This works out to be 3.92 animals km^{-2} in the terrestrial area of KNP. ICP occupied 17 burrow systems with burrow openings ranging from 1-4 per

burrow system. Hyenas and Jackals were also found to be using the burrows for giving birth and an interaction between Jackal and Indian Pythons observed.

Discussion and Recommendations

The preliminary data on the burrow dwelling animal communities is being collected and it shows the importance of the terrestrial burrows in the semi-arid region of KNP. The camera trapped data so far revealed 13 vertebrate species using these burrows either regularly (e.g. Porcupines, Indian Pythons, Bats) or at some stage in their life cycle (e.g. littering by Golden Jackals and Striped Hyenas).

Publications: -Nil-

LANDSCAPE ECOLOGY

8. Ecological investigation of woody vegetation and nest tree use by birds in the riverine forests of Athikkadavu Valley, Western Ghats

Principal Investigator	:	P. Balasubramanian
Co-investigator	:	Nil
Research Fellow	:	P. Manikandan
Project Period	:	Three years
Date of Commencement	:	April 2012
Date of Completion	:	March 2015
Budget	:	Rs. 10,72,750/-
Expenditure till date	:	Rs. 6,60,716/-
Funding Source	:	MoEF, Govt. of India
Status	:	Ongoing
Collaborative agency	:	Nil

Summary

A study is being carried out in Athikadavu valley, Western Ghats to quantify woody vegetation and nest tree utilization by cavity nesting birds and stick-nesting raptors. 70 woody species were recorded in the 2 ha sampling plots laid in the riverine forests. 157 bird species belonging 51 families were found here. 32 bird species were found to use the tree cavities for nesting purpose. This includes 10 primary cavity nesters, 21 secondary cavity nesters and one weak primary cavity nester. Five raptor nests were located during the reporting period and the three nests in the riverine habitat were placed on *M. indica* (2) and *T. arjuna* (1*)*. Most favored nest tree species for both cavity nesters and stick-nesting raptors include *Mangifera indica* and *Terminalia arjuna,* which are found to be the typical riverine forest species.

Objectives

1. Quantify the woody vegetation and estimate their abundance in the riverine forests of the Athikkadavu Valley, Western Ghats
2. identify the nest trees used by cavity-nesting birds and assess the characteristics of nest trees

3. Find out the nest trees used by stick-nesters, especially raptors and assess the nest tree characteristics
4. Assess the threats to the nest trees and suggest conservation measures

Methodology

The study is being carried out in Athikadavu valley (11°12'48.19" N & 76°45'22.94" E) along the river Bhavani in the south-eastern Nilgiri slopes, Western Ghats. The vegetation type of the river banks is classified as tropical semi-evergreen forest type. Woody vegetation along river banks was quantified, by using belt-transect method. Two belt transects of 1000m X10m were used. All the stems measuring >20 cm GBH (girth at breast height) were enumerated. Snags were also counted. Potential human disturbances include cutting, lopping, and Non-Timber Forest Produces collection. Hence, while sampling the woody vegetation, number of branches, stems cut and trees felled etc were noted. Based on the number of individuals of tree species disturbed, tree species were grouped into i) highly exploited, ii. Moderately exploited and mildly used.

Bird census was carried out along the river bank by using line transect method. Bird observation was made once in a month during morning (07.00 - 09.00) hours. Birds seen or heard 20m on both sides of transect were identified using binoculars. Birds were identified using standard identification manuals and field guides. Nest trees of cavity nesting birds and raptors and were located by making repeated walks along river banks. The plant species on which nests were placed were identified and recorded. Data on nest characteristics and nest-sites were collected. Nest tree parameters such as height of the tree, height of the nest location, placement and orientation of the nest and cavity dimensions were recorded.

Results

Vegetation assessment in the riverine forests:

Vegetation quantification of woody species was done in the riverine forests of Athikadavu valley. A total of 70 woody species belonging to 38 families and 60 genera were recorded. Moraceae constituted the largest family with 8 species followed by Fabaceae (4 species) and Ebenaceae (3 species). At the generic level, *Ficus* has the highest species (7). A total of 1039 trees belonging to 70 species of trees were recorded in 2ha. Highest number of individuals were recorded for *Pongamia pinnata* (n=280) followed by *Diospyros peregrina* (n=151) and *Mangifera indica* (n=80). The dominant tree species were *Pongamia pinnata* (IVI-74.64) *Diospyros peregrina* (41.75) and *Mangifera indica* (41.16). The vegetation of Athikadavu valley can be described as *Pongamia pinnata* - *Diospyros peregrina* - *Mangifera indica* community.

Threats: Twenty tribal (Irulas) settlements are situated in and around Athikadavu valley. They mainly depend on forest and forest products such as honey, amla, queen sago, medicinal plants and other plants. A total of 36 woody species was used by them for various purposes. *Diospyros peregrina, Mangifera indica,* and *Madhuca longifolia* were highly exploited; used for multiple purposes and comparatively higher numbers of individuals were exploited.

Bird community in the riverine forest, Athikadavu Valley

A total of 157 bird species belonging to 51 families and 110 genera were recorded. Out of 51 families, Accipitridae constituted the largest family (9 species) followed by Cuculidae (8 species). Ardeidae, Columbidae, Dicruridae, Picidae, Sturnidae and Turnidae represented by 6 species each. Out of the 157 species, 32 species are cavity nesting birds, which include woodpeckers, hornbills, barbets, parakeets, mynas, owls and tits. Nine raptor species have been recorded. This included Brahminy Kite, Black Kite, Jerdon's Baza, Greater Grey-headed Fish Eagle, Crested Serpent-Eagle, Changeable Hawk Eagle, Black Eagle, Bonelli's Eagle and Shikra.

Cavity nesting birds

A total of 32 cavity nesting birds have been recorded. Major proportion of cavity nesting birds included woodpeckers, owls and mynas (15.63% each) followed by parakeets and barbets represented by 12.50% each and hornbills (9.38%). A total of 146 active cavity nests were located in the riverine forests of Athikadavu. Out of 146 cavity nests, 46 (31.51%) belonged to primary cavity nesters and 100 (68.49%) belonged to secondary cavity nesters. Highest number of cavities was used by Common Myna (23; 15.75%) followed by Brown-headed Barbet (16; 10.96%) and White-cheeked Barbet (14; 9.59%). Highest number of tree species was used by Common Myna (n=15) followed by White-cheeked Barbet (n=12) and Brown-headed Barbet (n=11). In the study area, 39 tree species were utilized by various cavity nesting birds for nesting. Majority of the nests were located on *Mangifera indica and Terminalia arjuna*. In all species such as *Mangifera indica*, *Ceiba pentandra, Terminalia arjuna* and *Terminalia bellirica* were favored by several bird species.

Stick-nesting Raptors

A total of five raptor nests were identified during the reporting period, September 2013 to August 2014 in the riverine forests of Athikadavu valley. A Brahminy kite nest was found on a *Terminalia arjuna* tree. Grey-headed Fish-Eagle used two nest tree species viz. *Mangifera indica,* and *Terminalia bellirica*. Jerdon's Baza's nest was located on *Hardwickia binata* and Changeable Hawk Eagle used two tree species *Albizia lebbeck* and *Hardwickia binata.*

Recommendations

The following suggestions are made to the district forest officer, Coimbatore for his consideration; i) protection of important nest trees, traditionally used by birds including snags, ii) Control expansion of agricultural activities, and iii) control livestock grazing.

9. Status and distribution surveys of selected CR/EN/DD taxa in wild

Principal Investigator	:	P. Balasubramanian
Co-investigator	:	Nil
Research Fellows	:	C. Anbarasu and L. Prakash
Project Period	:	18 months
Date of Commencement	:	August 2013

Expected Date of Completion:		March 2015
Budget	:	Rs. 5,64,400/-
Expenditure till Date	:	Rs. 3,07,515/-
Funding Source	:	Tamil Nadu Forest Department
Status	:	Ongoing
Collaborating Agency	:	Tamil Nadu Forest Department

Summary

A state-wide coordinated programme on status and distribution surveys of IUCN threatened plants in Tamil Nadu was initiated by the Tamil Nadu Forest Department in August 2013. As part of the above programme in 17 Divisional Management Units (DMU) across the state, four units (Sathyamangalam Wildlife Sanctuary (SWS), Point Calimere Wildlife Sanctuary PCW), Mukurthi National Park (MNP) and Gudalur Forest Division (GFD) were allotted to SACON. Field surveys were carried out in all the four DMUs. A total of eighty 0.1 ha plots were laid. Ten threatened species were recorded in Sathyamangalam, six, five were found in Mukurthi and Gudalur respectively. The study is progressing.

Objectives

1. Prepare a master check list of plant species of MNP, PCW, SWS and GFD
2. List out the threatened plant taxa from the target DMUs
3. Assess the population status of the threatened plant taxa (IUCN).

Methodology

Field surveys were carried out in each of the DMUs to prepare list of plants. Vegetation was sampled by nested quadrat technique using 31.62 x 31.62 m sample plot and recording the data on all the trees, lianas and bamboos. All trees with 10 cm and above diameter at breast height were measured and recorded. Diameter of bamboo clumps was measured at the base. Data on all shrubs and saplings was gathered in the 5x5 m quadrats. Two 5x5 m quadrats were laid within each 31.62 x 31.62 quadrat. Data on all herbs were gathered by laying 1x1 m quadrat. Four 1x1m quadrats were laid within the 31.62x31.62 quadrat. Short listing of threatened species of the study areas (DMUs) was done by using IUCN Redlisted species.

Results

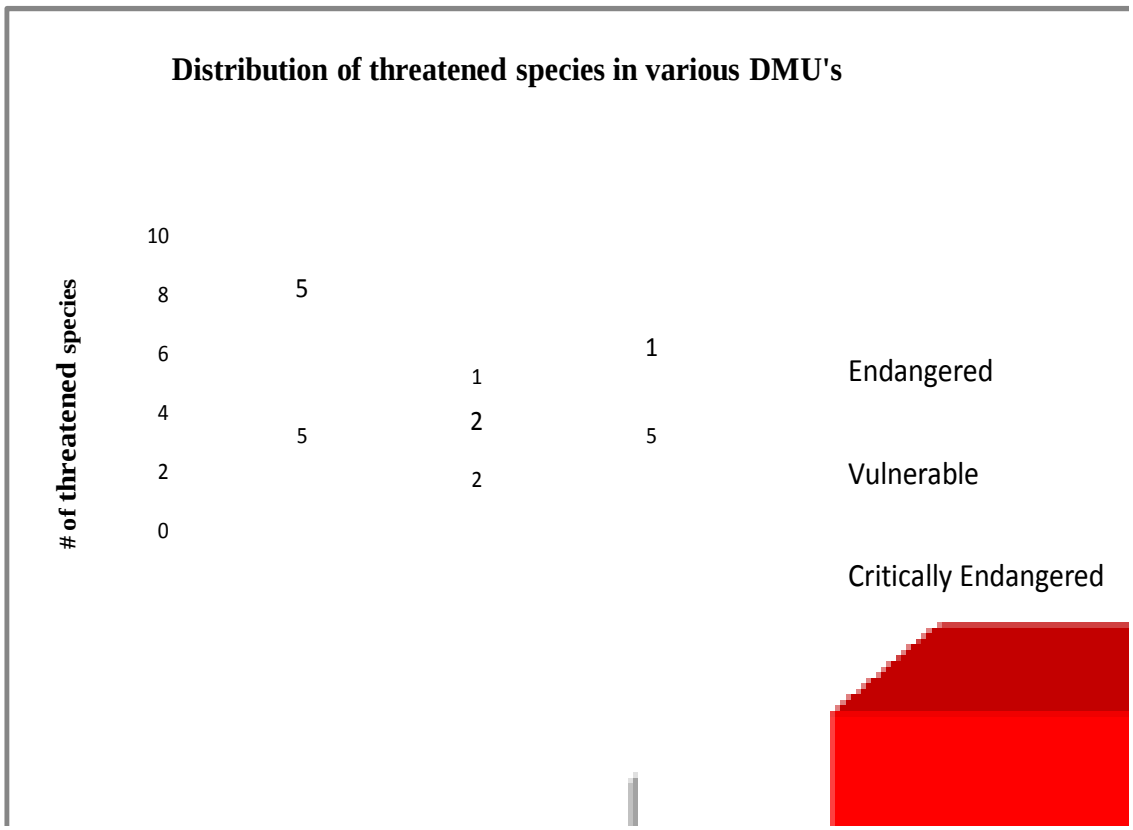
Sathyamangalam Wildlife Sanctuary: A total of 57 quadrats were laid in 14 forest types. In all, 925 species were recorded. A total of 10 threatened species comprising five vulnerable and five endangered species were found. The 10 threatened species include nine trees and an orchid, *Vanda scandens*.

Gudalur Forest Division: A total of 11 quadrats were laid in five different forest types. A total of 280 species was recorded. Five threatened species including four trees and one herb were found. Majority of the threatened species were located from the southern montane wet temperate forest.

Mukurthi National Park : A total of eight quadrats were laid in two different forest types namely (shola) southern montane wet temperate forest and shola-grassland. In

all, 195 species was recorded. Six threatened species including five trees and one herb were found. Majority of the threatened species were located in the southern montane wet temperate forest.

Point Calimere Wildlife Sanctuary: A total of four quadrats were laid. 65 plant species were recorded in the quadrats. No threatened species recorded from here.



Discussion and Recommendations

The surveys indicated the occurrence of exotic weeds across habitats in all the DMUs. *Lantana camara, Eupatorium glandulosum, Parthenium hysterophorus*, *Prosopis juliflora* are commonly occurring in Sathyamangalam Wildlife Sanctuary. *Acacia* spp are abundantly found in Mukurthi National Park.

In Sathyamangalam, exotic weed invasion form a major threat to the native species. *Lantana camara* invasion needs to be controlled. In Mukurthi National Park, the spread of Black Wattle, *Acacia mearnsii* needs to be controlled as it spreads fast into adjoining open areas and pose competition for the native species. In Gudalur Forest Division, habitats of threatened species are encroached by settler population. Forest areas are encroached for agricultural activities. With the involvement of NGOs, forest conservation awareness program needs to be conducted for the settler population.

ECOTOXICOLOGY

10. Monitoring and Surveillance of Environmental Contaminants in Birds in India

Principal Investigator	: S. Muralidharan
Research Fellows	: K. Ganesan & K. Nambirajan
Technical Assistant	: V. Kirubhanandhini
Lab Assistant	: T. Manikandan
Project Period	: 3 Years
Date of Commencement	: March 2010
Date of completion	: On extension
Budget	: Rs. 48, 36, 000/-
Expenditure till date	: Rs. 43, 20, 201/-
Funding Source	: MoEF, Govt. of India
Status	: Extended up to August 2014
Collaborating agency	: Nil

Summary

There has been an ongoing concern about the presence of different types of contaminants in the environment and their ill effects on wildlife, particularly birds. Hence, a study is being carried out to document the impact of persistent organic contaminants on birds in India. Present study on organochlorine (OC) and organophosphate (OP) pesticide residues, heavy metals (Cu, Cr, Pb, Cd) and biomarkers in 125 individuals comprising 34 species of birds including 2 vulnerable and 4 near-threatened species in India indicates varying levels of contamination. During the period under report (September 2013 - August 2014), mass mortality of Oriental White-backed Vulture *Gyps bengalensis* (11 Nos.) was reported from Surendranagar district of Gujarat. Data compiled till date show that concentrations of total OCs were the highest in liver tissues of Oriental White-backed Vulture *Gyps bengalensis* from Surendranagar, followed by Himalayan Griffon *Gyps himalayensis* from Assam and lowest in Rose-ringed Parakeet *Psittacula krameri* from outskirts of Ahmedabad. While the differences were significant among various species of birds studied ($P<0.05$), among the tissues they were not. Chlorpyrifos (OP) was detected at high concentrations in Oriental White-backed Vulture *Gyps bengalensis,* Egret *Mesophoyx intermedia* and Oriental White Ibis *Threskiornis melanocephalus* from Gujarat and, Himalayan Griffon *Gyps himalayensis* and Lesser Adjutant *Leptoptilos javanicus* from Assam. This is a matter of concern. Although circumstantial evidences of 11 dead Vultures received from Gujarat are indicative of poisoning, diclofenac residues in liver, kidney, muscle and gut contents did not exceed the threshold value (250 - 1000 ppb) in any of the birds tested. Among the four metals studied (Cu, Pb, Cr and Cd) in 12 species of birds, Bar-headed Goose *Anser indicus* from Assam had high metal load. Cholinesterase activities which could give an early qualitative and semi-quantitative warning of the toxic effects of pesticides in birds were also studied. Continued studies are necessary to monitor populations of birds and to evaluate spatio-temporal variations in contamination levels in the country. This will also help assess effectiveness of Government policies on chemical usage in the country.

Objectives

- Monitor residue levels of persistent chemicals in birds and generate a database.
- Identify chemicals responsible for mass mortality of birds across the country.
- Assess the effectiveness of guidelines on usage of major chemical pesticides in the country.

Methods

Opportunistic sampling strategy and organized field visits were followed to collect samples of dead birds from all over India. Post-mortem examinations were conducted either in the field or at SACON laboratory and suitable tissues preserved at -20^{0}C. QuEChERS multiresidue extraction method was followed for extracting pesticide residues. Final quantitative analysis was carried out in Gas Chromatograph (GC) fitted with electron capture detector (ECD). For metal analysis, Microwave Digestion System was used for digestion of samples and Atomic Absorption Spectrophotometer (AAS) for estimation. Residues of Diclofenac and cholinesterase activities were estimated using HPLC equipped with UV detector and UV/Vis Spectrophotometer respectively.

Results

Between September 2013 and August 2014, 125 individuals comprising 34 species of birds were received dead from states, namely Assam, Gujarat, Kerala, Karnataka and Tamil Nadu. Notable species are Bar-headed Goose, Sarus Crane, Demoiselle Crane, Himalayan Griffon Vulture, Oriental White-backed Vulture, Painted Stork and Great White Pelican. Towards understanding the magnitude of contamination, tissues of select species of birds were analysed for cholinesterase activity, pesticide residues, diclofenac and heavy metals.

Incidence of mass mortality

Mortality of Oriental White-backed Vulture *Gyps bengalensis* was reported near Dhrangadhra city, Surendranagar district of Gujarat on 6th and 7th July 2014. Out of thirteen individuals, 8 were found dead in the field and the rest died during treatment. Post-mortem examination of 11 dead vultures revealed discharge of greenish fluid from mouth, haemorrhage in visceral organs, highly vascular intestinal (greenish in majority cases) wall, vascular kidneys and testicles. However, we did not observe visceral gout. Samples of gut content, kidney, liver, muscle and heart tissues were dissected out, transported to the SACON by air courier and screened for chemical contaminants.

Residues of major metabolites/ isomers of organochlorine pesticides in dead birds collected from Assam and Gujarat

On priority basis, 191 tissue samples belonging to thirteen and thirty species of birds received from Assam and Gujarat respectively were analysed for 19 banned or restricted persistent organochlorine (OC) pesticides. Levels of ∑-OC were found to be the highest (2600.22 ± 564.46 ng/g) in liver tissues of Himalayan Griffon *Gyps himalayensis* from Assam and low (12.99 ± 4.32 ng/g) in Rose-ringed Parakeet

Psittacula krameri from Gujarat. Among the various OCs tested, isomers of HCH (41%) and metabolites of DDT (29%) contributed more to the ∑-OCPs than ∑-Endosulfan (12%), Dieldrin (8%), ∑-Heptachlor (6%), Dicofol (3%) and Alachlor (1%). Among the isomers of HCH, β-HCH accounted for 47% of total HCH, while γ-, α- and λ-HCH accounted for 27%, 22% and 4% respectively. Of all the metabolites of DDT, *p,p'*-DDE contributed the maximum (63%) to the total DDT residue, indicating its higher persistence in bird tissues. The maximum accumulation of OC residues was in liver tissue of birds and the minimum in gut content. Although, the differences were not significant among tissues (ANOVA, $P>0.05$), differences were significant among various species of birds studied. Further, when all the birds were grouped based on their food habits significantly higher load of pesticide residues was recorded in carnivorous birds (ANOVA, $P<0.05$). Total organochlorine pesticide load was in the following order: carnivores> insectivores> piscivores> frugivores> omnivores> granivores. When individual pesticides were considered, significant variation was observed in HCH residues among various species of birds studied ($P<0.05$). Comparatively higher load of ∑-HCH (>2000 ng/g) was recorded in Red-wattled lapwing and Barn Owl from Gujarat. Among all the OCPs detected, α-Endosulfan and p,p'-DDE were the highest in concentrations i.e. 9653.97 (gut content) and 7431.01 ng/g (liver) respectively in Lesser Adjutant *Leptoptilos javanicus* from Assam. Total DDT and HCH levels were high in many individuals. The results clearly indicate that OCPs, namely DDT and HCH, remain widely persistent in birds**.**

Diclofenac residues in Vultures received from Gujarat

Samples of Oriental White-backed Vulture from Gujarat (11 Nos) were analysed for residues of diclofenac. Levels ranged between 62.28 and 266.52 ng/g. It may be noted that the concentration associated with the toxicity of diclofenac ranged from 250 to 1000 ng/g. Although use of diclofenac for treating cattle was banned in India in 2006, it is evident that the drug is still being illegally used.

Organophosphate pesticide residues in dead birds collected from Assam and Gujarat

In addition to organochlorines, residues of Chlorpyrifos, the most common organophosphate, have also been detected in liver (94.43 ng/g) and kidney (83.73 ng/g) of Oriental White-backed Vulture *Gyps bengalensis* collected from an agriculture field near Ahmedabad, confirming the cause of its death. Other species those detected noticeable amounts of Chlorpyrifos include both Intermediate Egret *Mesophoyx intermedia* (gut content: 35.65 ng/g) and Oriental White Ibis *Threskiornis melanocephalus* (liver: 25.80 ng/g) from Gujarat and, Himalayan Griffon *Gyps himalayensis* (liver: 11.92 ng/g) and Lesser Adjutant *Leptoptilos javanicus* (intestine: 11.63 ng/g) from Assam. Levels of Chlorpyrifos were BDL in other samples. Hence it is clear that even chemicals with a very short half-life, such as chlorpyrifos, could pose threat to birds, if the exposure levels are high.

Levels of heavy metals in dead birds collected from Assam, Gujarat, Kerala and Tamil Nadu

During the period under report, 350 tissue samples from 107 birds comprising 12 species collected from states, namely Assam, Gujarat, Kerala and Tamil Nadu were

analysed for Cu, Cr, Pb and Cd. Accumulation of metals differed among the species studied. On an average, Bar-headed Goose *Anser indicus* received from Assam accumulated high concentrations of Cu in liver (7370.44 µg/g) and kidney (7358.99 µg/g). Accumulation of Cu in Rose-ringed Parakeet *Psittacula krameri* (476.55 ± 30.43 ng/g) was thirteen folds lower than the levels recorded in the Indian Pond Heron *Ardeola grayii* (5434.03 ± 1763.92 ng/g) collected from Ahmedabad, Gujarat. Significant variations could be perceived in Cu concentration among different species ($p < 0.05$).

Although concentrations of Pb recorded in most of the species studied were comparably low, significant variation in contamination levels ($p < 0.05$) among species could be perceived. of all the species, Rose-ringed Parakeet *Psittacula krameri* recorded the maximum concentrations (2774.74 µg/g) in liver collected from Kerala which was 45 times higher than those in Indian Pond Heron *Ardeola grayii* (61.59 ng/g) which came from Gujarat. Cadmium contamination was less than 1000 ng/g in the other species of birds. The maximum level was in the kidney of Himalayan Griffon Vulture *Gyps himalayensis* (2759.79 ng/g) collected from Assam while the minimum (84.97 ng/g) in the muscle of House Crow *Corvus splendens* from Mayiladuthurai, Tamil Nadu. While Indian Pond Heron *Ardeola grayii* from Ahmedabad, Gujarat had the highest levels of total chromium (4311.93 ng/g), Black Kite *Milvus migrans* from the same area (353.45 ± 31.43 ng/g) had the lowest. Of all the species, Bar-headed Goose *Anser indicus* suffered the maximum metal load followed by Indian Pond Heron *Ardeola grayii* while among the organs, accumulation was the maximum in liver followed by kidney.

Cholinesterase activity in liver and brain tissues of birds

Forty liver and 78 brain samples from 11 and 23 species of dead birds, respectively collected from Ahmedabad were analysed for cholinesterase activity.

a) Acetyl cholinesterase activity

The highest level of mean liver AChE activity was observed in Oriental Black Ibis *Pseudolus papillosa* 0.93±0.03 µmol/min/g and lowest was in Black Kite *Milvus migrans* 0.24±0.2 µmol/min/g. Brain activity ranged between 2.02 µmoles/min/g in Bar-tailed Godwit *Limosa lapponica* and 8.39 µmoles/min/g in Rosy Starling *Sturnus roseus*. The variation in brain and liver AChE activity among the species was significant ($p < 0.05$).

b) Butyrylcholinesterase activity

Mean liver BChE activity was found to be the highest in Oriental White Ibis *Threskiornis melanocephalus* (2.18 µmol/min/g) and lowest in Black Kite *Milvus migrans* (0.68 µmol/min/g). The brain activity varied between 0.37µmoles/min/g in Blue Rock Pigeon *Columba livia* and 1.63µmoles/min/g in Bar-tailed Godwit *Limosa lapponica*. The variation in brain BChE activity among the species was significant ($p < 0.05$).

Other tissues received are under various stages of analysis.

Laboratory Minor Project

Three MSc (Environmental Sciences, Wildlife Biology and Zoology) and three BTech (Biotechnology) students completed their dissertations on pesticide and heavy metal contamination in different biota and biomarkers with special reference to birds.

Besides, we had 12 MSc and 6 BSc (Environmental Sciences, Chemistry, Life Sciences, Biotechnology and Zoology) students as interns from PSG college of Arts and Science, Avinashilingam Institute of Home Science and Higher Education for Women, Sree Narayana Guru College, Coimbatore; Madurai Kamaraj University, Madurai; Periyar University, Salem and Central University of Tamil Nadu, Thiruvarur on Laboratory Procedures on Ecotoxicological Studies. During the training, both theoretical and practical exposure was given on various analytical tools for quantifying and qualifying inorganic and organic contaminants in biological and non-biological samples.

ENVIRONMENTAL IMPACT ASSESSMENT

11. Preparation of management plan of Fudam Bird Sanctuary, Diu

Principal Investigator	: Arun P R
Co-Investigator/ Consultant	: Rajah Jayapal
Research Fellow	: Rajan, P
Project period	: 6 Months
Date of commencement	: 03/04/14
Expected date of completion	: 01/01/15
Budget	: Rs. 7,00,000/-
Expenditure till date	: Rs. 65,838/-
Funding source	: U T Admin of Daman & Diu
Status	: Ongoing
Collaborating agency	:

Summary

The Fudam Bird Sanctuary having an area of 2.18 Sq.km. is situated in the Diu Island of the U.T. of Daman & Diu and is a rich habitat for the birds. It is interspersed with nurnerous creeks and mud flats. The final notification under Section 26 A (I) of the Wildlife Protection Act, 1972 in respect of this sanctuary was issued on 08/12/2006 by the Administration of Daman & Diu. Though certain habitat management activities have been carried out in the sanctuary from time to time, there is no approved management plan of the sanctuary in place. Hence the forest Department of Daman & Diu approached SACON to develop a management plan to facilitate the long term planning for the habitat management of the sanctuary.

Objectives

Preparation of the Management plan for the Fudam Bird sanctuary

Methodology

Standard field methods for avifauna and wildlife and socioeconomic questionnaire surveys are being used for collecing the primary data, in addition to the secondary sources of information

Results

The study has just been initiated. The initial reconnaissance survey was completed by June 2014 and the initial fiels visit in July-Aug.

12. Impact of Hara Wind power project of CLP Wind Farms (India) Ltd. on Wildlife including Migratory birds and Raptors at Harapanahalli, Davangere, Karnataka

Principal Investigator	: Arun P R
Co-Investigator/ Consultant	: Rajah Jayapal
Research Fellow	: Anoop, V
Project period	: 14 Months
Date of commencement	: 26/11/13
Expected date of completion	: 31/03/15
Budget	: Rs 16,46,000/-
Expenditure till date	: Rs 2,68,923/-
Funding source	: CLP Wind Farms (India) Pvt. Ltd
Status	: Ongoing
Collaborating agency	:

Summary

The present study was taken up further to the request from CLP Wind farms (India) PVT LTD to SACON to undertake a study about the 'impact of windmill in wildlife of the project area in general: including impact on migratory birds and roosting of raptors in particular in forest land of 56.508 hectare in Hyarada RF'. This study started in November 2013 and the present report covers the results of our preliminary observations on the avifauna of the study area that include recorded bird abundance figures in the project and nearby areas including surrounding wetlands, recorded bird mortalities at the turbine sites, birds flight height records and also presence of other wildlife species in study area.

Objectives

The scope of the study covered the Assessment of impacts of wind power on the wildlife especially on The migratory birds and their movement through the area and the raptors and their roosting sites.

Methodology

The methodology followed for the study was aimed at addressing two major aspects 1) to document the faunal abundance and its seasonal and spatial patterns 2) to assess the potential impacts (Both direct and indirect) on the avifauna. The line tranect and total counts (for wetlands) were used for documenting the bird abundance, while the intensive searches for Bird carcasses at turbine sites and flight height monnitoring of birds were used for addressing the second aspect. We followed

the line transect method (Gaston) as one of the methods for our bird surveys in field. Each transect was 1000 m length and 100 m width. We monitored four transects including two control sites. We surveyed the bird abundance in selected wetlands and its near by agriculture lands and human inhabited areas in five kilometer radius from the windmill area. To estimate the mortality of birds and bats, searches were conducted below all the 24 turbines for carcasses. We searched forty minutes per turbine within in a 100 m radial zone around the turbine base for remnants of birds and bats that might have collided with turbine.Flight activities of birds in wind turbine area including their flight height, distance of flight from turbine blade was observed during the field work.

Results

Total one hundred and fifteen species of birds belonging to eighteen orders were recorded so far from the project area and its sorroundings. It comprised of 41.59% Passeriformes, 10.62 % Charadriiformes, 7.96% Accipitriformes, 7.08 % Anseriformes & Pelecaniformes, 4.43 % Columbiformes, 3.54% Cuculiformes, 2.66% Ciconiformes, Gruiformes & Coraciiformes, 1.77% of Galliformes, Piciformes & Falconiformes, and 0.89 % of Podicipediformes, Sulliformes, Apodiformes, Bucerotiformes and Psittaciformes.Fifteen fatalities involving five species of bird (Unknown raptor, Halcyon smyrnensis, Apus affinis, Pitta brachyura) and one bat species (Taphozous melanopogon) were found during the study in CLP wind turbine area. Among the three zones monitored, we observed maximum number of birds in A zone followed by B zone and C zone and C zone respectively. Observer saw three species of birds flying through B zone and they all were raptors (Bonnelis eagle, Short toed snake eagle, Brahmini Kite). Most of the birds kept a safe distance from turbine blades and were mostly found preferring the shallow valleys separating the hills with turbines for their activities.

Discussion and recommendations

The initial data set collected so far indicated that wind turbines do cause some bird and bat mortalities in the CLP wind farm area, however a quantitative estimation would only be possible after collecting an full year of data covering all seasons. One hundred and fifteen species of birds were recorded so far from wind farm and nearby areas. Mortality records so far indicated higher mortality rates for Bats than birds.

13. Cumulative Impact Assessment study of Hydro Power Projects on river Yamuna, Tons and tributaries in Uttarakhand; Faunal Aspects

Principal Investigator	: Arun P R
Co-Investigator/ Consultant	: - Nil-
Research Fellow	: Srinivas, M & Shanthakumar, S B
Project period	: 18 Months
Date of commencement	: 04/01/13
Expected date of completion	: 31/12/14
Budget	: Rs. 43,23,000/-
Expenditure till date	: Rs. 12,31,044/-

Funding source	: Uttarakhand Jal Vidyut Nigam
Status	: Ongoing
Collaborating agency	: ICFRE Dehadun, AHEC of IIT Roorke & DCFRI Bhimtal

Summary

The river Yamuna together with its tributary Tons is identified as a major source for hydroelectric power in the st.te of Uttarakhand. The Yamuna river along with its numerous tributaries in Uttarakhand constitute about 6,000 MW of Hydro power potential, of which only 10 per cent has been tapped so far. Currently, five run of the river schemes generate a total of 550 MW of hydropower utilizing a gross available head of 240 m. The High Court of Uttarakhand at Nainital vide its Order dated 15th July 2011 had asked Government of Uttarakhand to conduct a Cumulative Environmental Impact Assessment Study of Hydropower Projects on River Yamuna and Tons & its Tributaries in Uttarakhand. Accordingly a study was assigned to Indian Council of Forestry Research and Education (ICFRE by Uttarakhand Govt. through Uttarakhand Jal Vidhyut Nigam Limited (UJVNL) for conducting a cEIA in collaboration with relevant expert organizations. Sálim Ali Centre for Ornithology and Natural History (SACON), Coimbatore was awarded with the faunal component of the study. The study was initiated in 2012 and is currently ongoing.

Objectives

The specific objectives of the study include involving Inventory of avi-fauna, and other terrestial fauna and evaluate their conservation status and threat perceptions from the Hydroelectric projects. The study's fndings on terrestrial fauna of the basin would contribute to the overall comprehensive cumulative impact assessment of Hydropower projects along the Yamuna and Tones River systems.

Methodology

Standard methodologies for faunal and floral sampling was followed to collect relevant data from the field along with secondary data sources. Time constrained Point counts, transect walks and opportunistic observations were mainly used for documenting the faunal elements. Transects varying from 500 meter to 1 kilometre were used depending on the terrain and availability of area were used during the study. Using Global Positioning System points were taken at frequent intervals for sampling. About 400 sampling points are being monitored. The study covered the vertebrate fauna (Amphibians, Reptiles, Birds and Mammals) using different sampling techniques. Visual Encounter Surveys for herpetofauna (Amphibians and Reptiles), Point count and transect methods for birds, transect and opportunistic records along with indirect evidences in the form of tracks and signs (tracks, pellets, pugmarks, markings etc) for mammals are among the field methods being used in the field. The sampling are repeated seasonally.

Results

A total of 156 species of birds under 49 families and 100 genera were recorded during the study so far. This included one endangered species (Egyptian Vulture, Neophron percnopterus), one Vulnerable species (Pallas's Fish Eagle Haliaeetus leucoryphus) and

two near Threatened species (Cinereous vulture Aegypius monachus and River Lapwing Vanellus duvaucelii). Remaining species were mostly of 'Least Concern' as per IUCN (2014). Twelve species of mammals including Central Himalayan Langur, Yellow-Throated Marten, Common Mongoose, Large Indian Civet, Red Fox, Golden Jackal Asiatic Black Bear and the Leopard were recorded during the field studies so far. Two of the species recorded (Leopard and Large Indian Civet) comes under Near-Threatened category and one (Asiatic Black Bear) under vulnerable category of IUCN (Table 3). Complete list including secondary sources are being compiled.

Discussion and recommendations

The study is due for completion by end of this year, and so far we have covered, all the three seasonal sampling cycles. The scheduled Pre-monsoon field operations in the Yamuna basin was hampered because of the natural calamity that struck the basin area in June 2013. The Pre-monsoon data collectionwas completed by June 2014. Secondary data collection from journals, books and online resources are also in progress. of the 49 Hydroelectric projects under study, Environmental Impact Assessment reports are mainly available only for few HEPs (Lakhwar, Naitwar Mori and Vyasi). Secondary data and information contained therein are being compiled. Exhaustive secondary data collection from literature and further primary data through field surveys. Final compilation and analysis of the data is expected to be completed by September 2014 as per the revised time schedule.

14. Monitoring the impacts of Jangi Wind power farm (91.8 MW)with special reference to birds and bats

Principal Investigator	: Arun P R
Co-Investigator/ Consultant	: -Nil-
Research Fellow	: Samsoor Ali and Ramesh kumar
Project period	: 36 Months
Date of commencement	: 26/07/11
Expected date of completion	: 31/12/14
Budget	: Rs. 5832800/-
Expenditure till date	: Rs. 4080308/-
Funding source	: M/s Genting energy
Status	: Ongoing
Collaborating agency	:

Summary

This is an ongoing three year study nearing completion. The impact of Wind turbines on the avifauna and bat species is being studied systematically. The final round of field surveys and compilation of the data is underway. Five interim six-monthly reports has been submitted to the funding agencey and the final report preparation is under way. The study highlighted the issue of wind turbines causing few Avifaunal and Bat mortalities by collition with the turbine blades.

Objectives

Documentation of prevailing environmental/ climatic conditions of the area|Documentation of bird and bat populations in and around the project sites Identification of roosting sites of bats and population estimations|Developing an effective monitoring protocol for bats and birds|Recording the seasonal patterns in the migratory bird population and assess the importance of the area in terms of migratory route for birds|Evaluate the impact of the project on Raptor roosting sites

Methodology

Standard methodologies for faunal and floral sampling (Transect/point counts, Opportunistic records, Tracks and signs etc). Stratified random Sampling strategy was followed to collect relevant data

Results

So far, a total of 172 species of birds belonging to 45 families and 16 orders have been reported. Among these, 3 species namely, Dalmatian Pelican, Greater Spotted Eagle and Sarus Crane were globally 'Vulnerable' and 9 species namely Darter, Painted stork, Black-necked Stork, Oriental White Ibis, Pallid Harrier, European Roller, Black-tailed Godwit, Eurasian Curlew and River Tern were globally 'Near Threatened' species (IUCN 2012). Totally 20 species of raptors were recorded, of which only five species were resident to area. Except a single nest of Shikra, no nests of raptors were recorded in the study are. However other birds like egrets, herons, starlings, bee-eaters, peafowls, mynas, etc. were regularly roosting in the study area. During winter, the wetlands support thousands of migratory birds with dominantly Pelicans and Cranes. of the 172 species recorded, 69 species were wetland species (38 residents and 31 winter migrants) belonging to 10 orders and 19 families. A total of 63 species of terrestrial birds were found wintering in the project site in large numbers. So far 38 bird fatalities of different bird species like Blue Rock Pigeon, House Crow, Indian Peafowl, Eurasian-collared Dove, Common Kestrel, Cattle Egret, Pallid Scops Owl, Steppe Eagle, Long-legged Buzzard, Black Drongo, Black-crowned Night Heron, etc were recorded. The annual mortality rate of birds during past two years from collision with turbine blades ranges between 0.1 to 0.2 birds/turbine. Only a single colony of bats (Indian Flying Fox) is present in the study area and seasonal changes of the population have been regularly monitored. Since 2011, only four instances of bat fatalities were recorded in the farm including 3 Greater Mouse-tailed Bats

Discussion and recommendations

Results indicate that the wind turbines are impacting the bird and bat populations of the area, including mortalities from collition with the turbine blades. The annual mortality rate of birds during past two years from collision with turbine blades ranges between 0.1 to 0.2 birds/turbine, which is comparatively low as against most of the reports from other parts of the world that reports more than 2 birds per turbine.

Publications (emanated from the project):

1. Ramesh Kumar, S., Samsoor Ali, A.M., and Arun PR. 2013."Bat Mortality due to Collision with Wind Turbines in Kutch District, Gujarat, India."*Journal of Threatened Taxa* 5(13): 4822–24.

2. Samsoor Ali, A M, Ramesh Kumar S, and Arun PR. 2013a. “Black Ibis Pseudibis papillosa nesting on Power Transmission Line Pylons, Gujarat, India.”*BirdingAsia* 19: 104–6.
3. ———. 2013b. “House Crow Corvus splendens, nesting on Pylons, Kutch District, Gujarat, India.”*Forktail* 29: 148–50.
4. ———. 2013c. “Waterbird Assemblage in Rural Village Ponds of Samakhiali and Jangi Regions, Kutch District, Gujarat, India.”*Bird Populations* 12: 12–18.

15. Cumulative Environmental Impact Assessment (CEIA) studies of Hydro-Electric Projects of Sutlej river basin in Himachal Pradesh; Faunal Aspects

Principal Investigator	:	Arun P R
Co-Investigator/ Consultant	:	-Nil-
Research Staff	:	Mrugesan M., Ramesh C., Shanthakumar B and Sony R K
Project period	:	12 Months
Date of commencement	:	23/05/12
Expected date of completion	:	01/06/13
Budget	:	Rs. 55,56,000/-
Expenditure till date	:	Rs. 38,75,961/-
Funding source	:	Govt. of HP through ICFRE
Status	:	Ongoing
Collaborating agency	:	ICFRE Dehradun, AHEC of IIT Roorke, DCFRI Bhimtal & HFRI Shimla

Summary
This study envisages to assess the cumulative impact of Hydro electric projects on the Satluj river basin area in the Himachal Pradesh state.

Objectives
The study attempts to evaluate the Cumulative Environmental Impact of hydropower development from the Sutlej river basin of Himachal Pradesh. The present faunal study as a part of the Cumulative Assessment addressed the following aspects of the ToR falling within its scope. 1)Inventory of avifauna and other terrestrial fauna from primary & secondary sources, 2) Evaluation of conservation importance of species (Rare, Endangered, Threatened, Endemics etc.), 3) Identification of existing Protected Areas in the study area 4) Existence of barriers and corridors for wild animals, Threats to wildlife & Identification of ecologically sensitive areas, 5) To assess the cumulative impact of hydropower projects on fauna along the Sutlej river. Prepare the suitable Environmental 6) Management Plan (EMP) and mitigation measures to reduce these impacts on fauna and rivers, 7) Examine faunal impacts of Baspa and Nathpa Jakhri projects as case studies

Methodology
Standard methodologies for faunal and floral sampling (Transect/point counts, Opportunistic records, Tracks and signs etc). Stratified random Sampling strategy was followed to collect relevant data. The sampling strategy involved subdividing the Sutlej

basin into three major sections. A total of 554 sampling points were laid/marked along the the Sutlej basin. The sampling was done at different elevations ranging from 500 to 4,600m above m.s.l. The total available area is divided into 21 elevational strata of 200 m intervals. The sampling points were selected based on the area available under each section of the 21 elevational strata. An average of 36 points covered in each stratum. Due importance was given to those areas that are potential/known wildlife habitats. Lesser sampling points were taken in high elevation areas due to proportionately lesser area availability and lack of vegetation, harsh climate and terrain as well as limited accessibility. The faunal data of impact areas of existing and under construction projects and compareable control sites were used for understanding the impacts.

Results

Hydropower development and its impact assessments are widely debated especially in the Himalayan context. Various activities associated with the ambitious hydropower development programme in the Sutlej basin can affect the biodiversity negatively, especially certain target groups of organisms that are associated with the river in various ways as discussed in detail in the report. Faunal Inventory: A total of 610 faunal species under the select faunal groups were recorded. It included 118 species of butterflies, 13 species of amphibians, 37 species of reptiles, 368 species of birds and 74 species of mammals. Forty-four species of migratory avifaunal species were recorded from the area (31 winter visitors and 12 summer visitors). Also 111 (30.16%) species were residents and local migrants with local and temporary movements, and 168 (45.65%) species are resident Birds of the area. Twenty-four threatened species as per the IUCN status are represented in the basin. There were no narrow endemic faunal species recorded from the area during the study. Seven bird species endemic to western Himalayas are also present in the area. The middle elevation zones had higher conservation important faunal species. The cumulative analysis showed that the proposed HEP sites in the middle elevation area generally had maximum faunal wealth. The water dependent bird species such as Forktails, Dippers and Redstarts were found exclusively associated with the tributaries of the Sutlej with clear waters in the Rhithron zones. Changes in the flow pattern and water quality parameters caused by hydroelectric project developments in the higher elevation zones of the tributaries especially in the zone I and II will impact such avifauna the most. Among the three zones, the middle zone is most important habitat for the wild fauna especially between 2000 and 3000 m elevation followed by the lower zone.

Discussion and recommendations

The impact of the hydropower projects on the terrestrial fauna should be be minimized through appropriate management. Since the future projects envisaged in the basin are of 'Run of the River (RoR)' nature, with minimal submergence area, the impacts expected are comaratively low. Our final report is being finalised. in the interim, the following major measures are being recommended to minimize the impacts. 1) Strict compliance to the maintenance of minimum environmental flow 2) Strengthen the conservation and management efforts targeted at sensitive faunal components. 3) Taking up projects in the basin area in a phased/ sequential manner Leaving at least an year's time gap between commissioning of a project and initiating

the work on any other project falling within the same sub-basin or within 10 km radial distance from the first site is suggested 4) Flushing of silt from desiltation chambers with coordinated efforts between multiple projects of the basin. Extended release with a higher dilution factor and opting for the flushing during night hours will have lesser impacts on terrestrial fauna. 5) A well designed futuristic power evacuation network plan should be designed. 6) Strict compliance to the environmental management plans by respective projects, especially in minimising number and intensity of blastings and scientific management of muck and debris especially from tunnels, dams and road construction activities. 7) Relevant mitigation and management suggestions with respect to sensitive faunal species such as Pheasants and Snow Leopard as discussed in the report should be followed.

Publications (emanated from the project): Final draft of the project report submitted.

WETLAND ECOLOGY

16. Wetlands of India ENVIS centre

Principal Investigator	:	Goldin Quadros
Co-Investigator/ Consultant	:	
Research Fellow	:	Hemambika B, A Julffia Begam and R Srinivasan
Project period	:	Ongoing
Date of commencement	:	December, 2003
Expected date of completion	:	Long term
Budget	:	Rs. 1274361/- (2013-2014) and Rs. 1280268/- (for 2014-2015, Sanction letter dated 17th July, 2014.)
Expenditure till date	:	Rs. 4,50, 000/-
Funding source	:	MoEF & CC
Status	:	On Going
Collaborating agency	:	--

Summary

The centre since December 2011has been collecting, collating data on wetlands and has been updating the website. The SACON envis website is now functioning from the NIC portal though it has to be still restructured into the NIC format by the ENVIS secretariat. We have appointed 3 temporary staff and have completed the publications of E-Newsletters (Monthly), Quarterly Newsletters (Print), 2 Posters, a Book on Coimbatore lakes and updation of numeric and descriptive data. In addition we have also up dated the kids section with information on wetlands, games and quizzes

Objectives

1. Database creation on Wetland Ecosystems to be added on website with regional language interface.

2. To establish and operate a distributed clearing house to answer and channel queries related to the allocated subject.
3. To establish linkages with information users, carriers and providers from government, academic, business and Non-Governmental Organizations including that with ENVIS.
4. Identification of information/data gaps in the specified subject areas and action taken to fill these gaps.
5. Publication of ENVIS newsletters for dissemination of wetland Information.

Methodology

Research articles, news and events, laws relating to the wetlands are procured from the internet. Also the information of conferences, workshops and symposia's on wetlands is been collected. The research articles are sorted into categories like birds, hydrology, hydrobiology, Migration, flyways, etc and being kept ready for uploading on the envis website. Further emails are also being sent out to several institutions and departments associated with wetland research and management to procure first hand information on the wetlands.

For the ENVIS News Letter, We have started corresponding with researchers and institutions requesting them to submit articles and findings pertaining to the wetland ecosystems.

Results

- Completed the publications of four Newsletters for the financial year 2013-14 and have compiled information for the 2014 issues no. 2 and 3.
- Up dated the numeric data and descriptive data on wetlands as required by the secretariat
- Started with the monthly E-Newsletter,
- Developed two new games for the kids and up dated the kids section with general information and quiz in the Kids section.

Discussion and recommendations

As per the MoEF & CC guidelines we are continuously updating the website on the information relating to wetlands and networking with the individuals working in wetlands.

Publications (emanated from the project)

1. Quarterly newsletters (four issues)
2. "Lakes of Coimbatore City" ISBN 978-93-5174-749-9(paper back) and 978-93-5174-750-5 (E-book).
3. Diversity of Birds from the urban wetlands of Coimbatore, Tamil Nadu, India. Hemambika B., Julffia Begam A., Kirubhanandhini V., Babu S., Mahendiran M. and Goldin Quadros Proceedings of the National Conference on Modern Trends in Zoological Research ISBN No. 978-81-909551-8-8

17. Assessment of the morphological diversity and the ecological patterns in the near threatened colonial water birds across Indian sub-continent using novel approach

Principal Investigator	:	Mahendiran Mylswamy
Co-Investigator	:	Nil
Collaborating Agency	:	NIL
Research Fellow	:	Rajneesh Dwevedi
Project Period	:	Three years
Commencement	:	24th May 2012
Date of Completion	:	23rd May 2015
Budget	:	Rs. 16, 45, 000/-
Expenditure till date	:	Rs 12,39, 689/-
Funding Source	:	Dept. of Science and Technology, Govt. of India
Status	:	Ongoing

Summary

Heronry birds are present widely across the Indian subcontinent, receiving considerable amount of conservational significance, as many of them, namely, Black-headed Ibis *Threskiornis melanocephalus*, Painted Stork *Mycteria leucocephala*, and Oriental Darter *Anhinga melanogaster* have been included in the Near Threatened by BirdLife International (2001). Although the information on their status and distributional are available many of their ecological pattern and the agents of the evolutionary process are scarcely studied. Given this background, the present work envisages to fill the existing gap by collecting information pertaining to variation in the body sizes of Painted Stork *Mycteria leucocephala* among different populations and between the sexes across Indian subcontinent. Our project employed an innovative non-invasive field approach based on video graph- morphometric method. This morphometric method imposes a zero stress on the birds in our study area since it is a noninvasive, which assumes vast conservation relevance. To achieve this, we are working on both the designing and calibration of the new video graphic method as well as the field works on the collection of the images from the different population, in both north and south Indian heronries.

Background

Heronry birds which are mostly colonial nesters, distributed widely over the Indian subcontinent (Ali and Ripley 1987). This group receives considerable amount of conservational significance, as many of them namely, Black-headed Ibis *Threskiornis melanocephalus*, Painted Stork *Mycteria leucocephala*, and Oriental Darter *Anhinga melanogaster* have been included in Near Threatened by BirdLife International (2001). However, the detail ecological information on these fish-eating, colonial nesting birds is limited (Mahendiran and Urfi 2005). Interestingly, these heronries provide an ideal place to videograph the nesting birds at close quarters. One of the main hurdles in studying morphometric in large birds is the difficulty with which the desired number of specimens can be captured or culled, due to restrictive laws and the endangered status of the species. Therefore, one has to rely upon either museum specimens or

chance encounters with dead specimens. However, it is possible to obtain reliable measurements of external characters in a wild population of birds by using innovative non-invasive field methods.

Objectives

To investigate the morphological patterns of Painted Stork *Mycteria leucocephala* at some selected heronries in North and South India using a novel video graphic method.

Methodology

Methods of morphometric measurements

Images of the individual birds were captured on a video camera. The video images downloaded to computer, and then by incorporating appropriate correction factor, these images were measured using specific software. We followed two approaches; first, the bill length was taken as a standard or reference length. The software (MOTIC IMAGES PLUS 2.0), basically developed for microscopes and the measurement of cytological and histological images, adapted for quantifying the dimensions of various external body parts. Since the video camera is not calibrated with this software the dimensions estimated were initially in arbitrary units. These were later converted into metric units by the protocol described (Urfi and Kalam 2006, Mahendiran and Urfi 2010). Secondly, the original size of the images were calibrated using mathematical function, then appropriately the sizes of the body parts of the specimens in the images were identified with approximate error of mean and standard deviation. Dimensions of the following hard body parts, using the methodology in Bosch (1996) and Wagner (1999) were employed. Bill length was estimated as the distance from the tip of the upper mandible to the corners of the mouth. Tibia length was estimated as the distance from the joint of the tibia-tarsus till the feathers. Tarsus length was estimated as the distance between the tibia-tarsus joint and foot. On each bird separate measurements were done on the right and left legs.

Calibration of Field Estimates

Calibration of measurements obtained from video images was done with those from actual specimens available in the museums of Bombay Natural History Society and Zoological Survey of India.

Results

Our results fall into four main important components namely; a) Standardization of camera methods b) Survey of Northern & southern Indian heronries and collection of video data of the Painted storks. c) Lab oriented assessment for the body sizes following standard method, using different software, taking bill length as reference unit. d) Deciphering of original image size using mathematical functions. Out of the above component, a preliminary survey of selected heronries and 70 percent of video collection has been completed in Northern and Southern India. Standardization exercise both at lab using cardboard model images of birds are in progress. Preliminary works of the online Heronry information system, an off shoot of the present project, has been initiated.

The recommendations of the last RMAC meeting of Standardization of video methods has been carried out and further all the technical issues are being sorted out. As per the advice of RMAC, the Principal investigator visited the Zoological Survey of India, Kolkata and used the stuffed dead specimens of birds for standardization of the video graphic method. Originally the specimens were manually measured which was followed by the video graphical methods as well. The images collected from the dead specimens were measured using TPS software. Finally, both the estimated lengths and the actual specimens were compared. Interestingly, our results are coming in millimeter accuracy, and hence the estimated results are very close to the actual values

EXTENSION DIVISION

18. Ecological and ethno-cultural examination of the rise and fall in rice diversity in southern India with special reference to the Western Ghats

Principal Investigator / Co-Investigator/ Consultant	: Mathew K Sebastian, P R Arun & P A Azeez
Research Fellow	: Chaithra Shree
Project period	: 2.5 years after 6 months extension
Date of commencement	: August 2012
Expected date of completion	: January 2015
Budget	: Rs. 14/- lakhs
Expenditure till date	: Rs. 6/- lakhs
Funding source	: M/s Indira Gandhi National Centre for Arts, New Delhi
Status	: Ongoing
Collaborating agency	: Nil

Summary

Rice paddies, unique in several ecological characteristics, provide food and fiber and support several other ecosystem services such as regulating quality and quantity of water, decomposition of organic wastes, formation of soil, biological nitrogen fixation, and local climate and biotic regulation. Adding to the value of this unique ecosystem, the rice paddies provide habitats for numerous species of plants and animals, which include several water bird species that are known to face serious pressures threatening their survival.

It is reported that till few decades back 50,000 to 60,000 rice varieties were cultivated in India. However it has come down to few hundred varieties now. Therefore it is imperative to identify and document the diversity of the traditional rice varieties and associated traditional knowledge available in Western Ghats and in other Important Rice Cultivating Areas (IRCA's) and to study the historical changes in rice cultivation practices and explore the reasons for the same.

Surveys were conducted in the coastal belt and traditional IRCA's such as Cauvery delta regions of Tamil Nadu, the Western Ghats region of Idukki and Wayanad districts

of Kerala, IRCA's such as Kuttanad and Palakkad areas, 'Kol' paddy fields of Trichur district, 'Pokkali' paddy fields of Trichur and Ernakulum districts and 'Kaippadu' areas of Kannur district, Mandya, Mangalore and Shimoga districts of Karnataka.

The survey could locate unique land races with neutraceutical properties such as "Rakthasali' and 'Njavara'. The 'Komban' variety, thought to be no more cultivated in Kerala, was found out from Kanthalloor area of Idukki district. 'Kunjuju, believed to be a hybrid of two traditional varieties,' once widely cultivated in Central and Eastern Kerala and Palakkad districts was located in Trichur and Idukki districts. Information regarding the cultural and religious and ritualistic aspects, agronomic practices related with each variety, and biodiversity in the paddy fields and surrounding areas were documented. One hundred and seventy three plant species, 57 bird species and 41 butterfly species from the paddy fields of Tamil Nadu, and around 200 plant and bird species each and 50 butterfly species from Kerala paddy fields were recorded. Comparative data from organic and non organic paddy fields were collected. Information about 300 traditional rice varieties was compiled.
The data collected is being mapped on a "GIS Platform'.

SACON will be organizing a joint initiative with 'SEED' programme of Mathrubhumi News paper to collect, document and disseminate information about traditional rice varieties.

A database of organizations and individuals involved in the conservation of traditional rice varieties is being prepared.
It is also proposed to conduct a regional workshop to bring together all the people on a single platform involved in the conservation of traditional rice.

Objectives

1. Identify and document the diversity of the traditional rice varieties of Western Ghats and associated traditional knowledge
2. Identify Important Rice Areas (IRAs) based on rice biodiversity, ecological status, agronomical practices, commercial and socio religious importance
3. Study the historical changes in rice cultivation practices and explore the reasons for the same
4. Assess and compare the ecological values / services of rice / rice paddies, traditional vs modern

Methodology

a) Identification of important Rice Cultivating Areas (IRCAs)

The traditional important RCAs will be located/ identified by using historical imageries and maps including irrigation maps/ forest survey maps / shikar maps and also from grey literature and reports published /unpublished. Further, extensive field surveys throughout identified talukas in the Western Ghats will be carried out. RCAs will be identified based on the rice biodiversity richness, dependence on the population on rice as food and/or as a source of income or for socio religious and/or cultural purposes and/or the extent of rice cultivation.

b) Customized questionnaire survey

A customised questionnaire survey will be conducted at each location using standard sampling protocols. The questionnaire will be designed in such a way to collect data on varieties, pattern of cropping, water requirements, use and type of fertiliser, yield /productivity of local rice culture, preservation of seeds, storage of rice, reasons for cultivating the traditional varieties and such related information. It will also document land type, associated local plants, animals and local hydro-meteorological conditions and rituals if any associated with sowing and harvesting.

c) Ecological assessment of Important RCAs

A comparative analysis of the traditional and modern rice culture will be carried out using standard analytical tools / methodologies to estimate the water foot print and virtual water content of rice paddies and economics of traditional practices. Similarly life cycle analyses (LCA) is proposed to be performed to compare the modern and traditional systems.

Results

Surveys were conducted in the coastal belt and traditional Important Rice Cultivating Areas (IRCA's) such as Cauvery delta regions of Tamil Nadu, the Western Ghats region of Idukki and Wayanad districts of Kerala, IRCA's such as Kuttanad and Palakkad areas, 'Kol' paddy fields of Trichur district, 'Pokkali' paddy fields of Trichur and Ernakulum districts and 'Kaippadu' areas of Kannur district, Mandya, Mangalore and Shimoga districts of Karnataka.

Information regarding the cultural and religious and ritualistic aspects, agronomic practices related with each variety, and biodiversity in the paddy fields and surrounding areas were documented. One hundred and seventy three plant species, 57 bird species and 41 butterfly species from the paddy fields of Tamil Nadu, and around 200 plant and bird species each and 50 butterfly species from Kerala paddy fields were recorded. Comparative data from organic and non organic paddy fields were collected.

The survey could locate unique land races with neutraceutical properties such as "Rakthasali' and 'Njavara'. 'Kunjuju, believed to be a hybrid of two traditional varieties,' once widely cultivated in Central and Eastern Kerala and Palakkad districts was located in Trichur and Idukki districts It was revealed that several land races such as 'Komban' are surviving in isolated patches ranging from 10 cents to few acres due to religious, cultural and agroclimatic reasons by the efforts of communities (tribal and non tribal), individuals and Non Governmental Organisations. Many individuals such as Cheruvayal Raman of Wayanad who cultivates 37 varieties, Mrs. Indira of Kodakara who cultivates 50 varieties, Mr Ghani Khan of Mandya who cultivates around 700 hundred varieties were contacted. A database of organizations and individuals involved in the conservation of traditional rice varieties is being prepared.

Information about 300 traditional rice varieties was compiled. Samples of 100 varieties collected for educational purposes.

Historical data on the rise and fall of paddy cultivation were collected. The data collected is being mapped on a "GIS Platform'.

Discussion and recommendations

Several traditional rice varieties are being cultivated in different parts of the country in isolated patches for various reasons; cultural, religious and dietary being few of them. Our survey could also trace out few varieties which were thought to be lost forever, being cultivated by few committed individuals. "Kunjunju', a high yielding traditional variety, once very popular in Central Kerala and Palakkad district was located. 'Rakhtasali', a traditional variety, purported to having high iron content also could be traced.

The Kurumbas of Muthanga area of Wayanad cultivate around 130 acres of paddy with traditional rice varieties organically. Mr. Cheruvayal Raman of Wayanad, Mr. Krishnan of Koppam, Palakkad, Mr Jayaraman of Thruthiraipoondy, Thiruvarur, Mr Ghani Khan of Hassan are some of the individuals cultivating several rice varieties for conservation purposes selflessly spending time and energy. Unless governmental/institutional support is extended to them, their efforts cannot be sustained in the long run.

Corporates and commercial enterprises are eyeing the neutraceutical properties of many varieties and recently the anti-diabetic property of a traditional rice variety was patented. Therefore it is imperative that intellectual property rights of the communities who have conserved the numerous land races are recognized at the earliest ensuring appropriate sharing of the benefits accrued through the commercialization of traditional varieties are ensured.

A network of individuals and organizations involved in the cultivation/conservation of traditional varieties should be developed. At present there is a tendency among individuals/organizations to keep the varieties among them without sharing it with any interested people.

Publications (emanated from the project) : Nil

NATURE EDUCATION DIVISION

19. Nature Education Activities for Coimbatore

Principal Investigator:	:	P. Pramod, Senior Scientist (Nature Education)
Research Fellows	:	Nil
Project Period	:	Long term
Date of Commencement	:	Not applicable
Date of Completion	:	Not applicable
Budget	:	3lakhs
Funding Source	:	SACON & local sponsors for various programmes

Status	:	Ongoing
Collaborative Agencies	:	Schools and colleges of Coimbatore, Salim Ali Naturalist Forum and local NGOs

Summary of activities

Nature and natural resources awareness programmes were conducted in the campus as well as outside. Nature Education programmes at SACON campus includes lectures, One-Day nature camps for school and college students.

One day Nature Camps

27 nature one day nature awareness programmes for school children, 11 such programmes for colleges and two for college teachers and two for forest officials conducted in the campus this year. 1914 students participated in these programmes.

Salim Ali Trophy Nature Competitions

Inter-school competitions for the Salim Ali Trophy Nature Awareness for this year conducted on 10th November 2013. 2100 students from 50 schools participated the competitions and 133 students from 18 schools won the prizes. G D Mat. Hr. Sec. School, Coimbatore claimed the overall Rolling Trophy for the best school.

Sálim Ali Naturalist Forum (SANF) is a platform of Nature Education for all who love nature and wanted to contribute towards Conservation of Nature facilitated by SACON. Nature lovers of Coimbatore from different walks of life like, businessmen, engineers, Computer professionals, Professors, Doctors. Students and many others came to SACON for a common cause, learn, enjoy and advocate Nature. SANF conducted many the bird watching and trekking programmes in forests, wetlands and other natural Ecosystems in and around Coimbatore.

HSBC Coimbatore Bird Race SACON and Salim Ali Naturalist Forum together have organized the third Coimbatore Bird Race in December 2013 with the support of HSBC bank and Yuhina Eco-Media, Mumbai. Twenty five registered teams participated in the race covering bird habitats in and around the Coimbatore city. Some of the teams have members as old as seventy and many were smart budding birdwatchers from the Coimbatore schools. All of them spend an entire day spotting and identifying birds in an effort to **record** as many species of birds as possible. All of them together identified more than 200 species of birds in a day of counting.

Participants in the Bird Race have made teams of four members with an experienced bird watcher as the team leader. As it is the migratory season many of the birds sighted are long distance migratory birds such as Montagu's Harrier, Rose finch, Sandpipers and short distance migratory birds such as Spot billed Pelican and Painted stork. There are many excitements as they sighted many forest bird species in the city areas such as Bonelli's Eagle, Black eagle, Crested serpent eagle and Changeable Hawk eagle it was thrilling to many birders. This celebration brought most of the birdwatchers and nature lovers of Coimbatore to come together and work together for the same cause.

20. Monitoring Nature through Birds

Principal Investigator	: P Pramod
Research Fellows	: Divyapriya C
Project Period	: 2013-2016
Date of Commencement	: 1st April 2013
Date of Completion	: 31st March 2016
Budget	: Rs 18.4/- lakhs
Funding Source	: Department of Science and Technology
Status	: Ongoing
Collaborative Agencies	: Schools, colleges and NGOs (to be identified)

Summary

Monitoring Nature through birds (MNTB) is a science education programme of Salim Ali Centre for Ornithology & Natural History (SACON) Coimbatore executed in collaboration with many partners such as India Biodiversity Portal, NCSTC Network, Nature Conservation Foundation, NCBS etc.

This programme is catalyzed and supported by the National Council for Science and Technology and Communication of Department of Science and Technology, Government of India.

These project intents to communicate the scientific temperament, habit of careful observation, and learning directly from Nature among children and nature lovers.
MNTB nurtures careful observation and systematic documentation which in turn is creating participatory data generation on the status of biodiversity, with the participation of students and teachers. This will also motivate children to understand and appreciate well of our environment and the role of birds in it.

MNTB is aimed also to develop a web portal to collate and present the data, connect and coordinate the teams working in various parts of the country. An activity-based-learning module will be prepared that could be used in class rooms as well as in field by students.

As part of the project a Brain storming workshop is conducted on 18th and 19th of June 2013 for all the master resource persons and partners of the project and made a road map for the future implementation of the project. A module of education materials including three books and four postures is prepared.

A National Orientation Programme for the resource persons/mentors of the programme was arranged at SACON on 13th and 14th August 2014. 45 Participants attended the programme. Plan for the up-scaling and expanding the reach of the project with the plan of action for the next one year discussed and finalized in the meeting Primary filed level activities are started and progressing.

Publications

1. **Pramod P,** Rajan P and Suhirtha Muhil M (2014) **How to Study Birds** published by Salim Ali Centre for Ornithology and Natural History, Coimbatore India 232 pp ISBN 81-902136-0-6
2. **Pramod P**, Divyapriya C and Rajan P(2014) **Learn about Birds** published by Salim Ali Centre for Ornithology and Natural History, Coimbatore India 232 pp ISBN 81-902136-0-7
3. **Pramod P**, Divyapriya C and Rajan P (2014) **Fun with Birds** published by Salim Ali Centre for Ornithology and Natural History, Coimbatore India 232 pp ISBN 81-902136-0-8.
4. Posture on common Woodland birds
5. Posture on common Wetland birds
6. Posture on common Farmland birds
7. Posture on common Human Associated birds

Agenda No: 4/27

COMPLETED PROJECTS

1. Conservation of the Endangered Species and Habitats - The Edible-nest Swiftlet in the Andaman and Nicobar Islands

Principal Investigator	: Manchi Shirish S.
Co-Investigators/Consultants:	Not Applicable
Research Fellows	: Miss. Akshaya M Mane and Mr Punyamurthi Kristodas
Project Period	: Five Year (60 Months)
Date of Commencement	: April 2009
Date of Completion	: March 2014
Budget	: Rs. 51,24,814/- (Sanctioned) Rs. 27,41,400 (Received)
Expenditure till Date	: Rs. 28,24,204/-
Status	: Completed
Collaborative Agencies	: Department of Environment and Forests, Andaman and Nicobar Islands

Summary

The project continues with the usual routine like each year. The continuous in-conservation efforts at Chalis-ek and Baratang resulted in the growth of population, whereas in Interview island cave the population continues to fall down. The reason for the drop in population is not yet clear. Roosting pattern studies show that, there is no significant difference in arrival time of birds for roosting with respect to different lunar phases. However breeding stage is proven to be affecting the roosting pattern of the species. In ex-situ house at Tugapur, Middle Andaman Island three individuals of the Edible-nest Swiftlet were observed roosting. No breeding attempt was seen. Discovery of the urban populations on different islands in Andaman group is a major success of the program. These successfully breeding colonies allow us to believe there may be more populations in the urban areas. Immediate detailed survey of the urban areas in

the islands is required to explore new urban breeding colonies of the species. The species is now delisted from the schedules of Indian Wildlife Protection Act (1972). Further plan of action is under preparation and in collaboration with the Andaman forest Department it will be submitted to the Ministry of Environment and Forests, Govt. of India in a proposal format for funding support.

Objectives

I. Research and development

1. To develop the technology and the methodology to attract and induce Edible-nest Swiftlet to breed in human habitation.
2. To continue ongoing studies on the breeding and foraging ecology of the species
3. To study longevity and dispersal patterns of the Edible-nest Swiftlet

II. in-situ conservation

1. The consolidation and expansion of cave sites where conservation action is being implemented from the existing two to eight (5 in the Andaman and 3 in the Nicobar), where nest-collectors will be organized and supervised in scientifically managing Swiftlet colonies;
2. To establish scientific harvesting systems

III.Ex-situ conservation

1. The development, and expansion of the number of houses in which the Edible-nest Swiftlet breed, thus establishing alternate populations and enabling widespread ranching of swiftlets from houses;
2. To establish scientific harvesting systems in Edible-nest Swiftlet colonies in houses

IV. Swiftlet Conservation Co-operative

The establishment of a co-operative that will establish market linkages for nests harvested under supervised scientifically managed systems, which is fundamental to the conservation of the Edible-nest Swiftlet.

Methodology

All the caves (one at Interview Island, 29 at Chalis Ek and 175 at Baratang Island) with Edible-nest Swiftlet population were protected round the clock by appointing the motivated nest collectors. The protection is done during breeding season of the species between January and July. Nest count method was used to know the breeding populations in the caves. Weekly round the clock roost/entry-exit count method at the cave opening was used to know the roosting population and patterns of the species in the protected caves. Daily nest survey was done to know the breeding chronology of the species. More than 300 chicks were marked to explore the dispersal patterns of the species. Body weight and morphometric measurement of 140 chicks of

different age were recorded. Presence of different owls was studied by recording the calls at two Swiftlet Protection sites (Baratang and Interview Island). Under Ex-situ conservation, playing calls using MP3 players continued in all the four Swiftlet houses at Tugapur, Khara Nallha, Ramnagar and Baratang and house temperature and humidity was recorded to check the house environment. Efforts to augment the Edible-nest Swiftlet population in the man-made construction also continued through the cross-fostering method. Towards identifying the potential site for expansion of the in-situ conservation sites in Andaman Islands the survey was conducted and the results are given in the next project funded by WWF Small Grant Program.

Results

During 2013 the population of the Edible-nest Swiftlet showed 3% and 14% growth at Chalis-ek and Baratang Island respectively, whereas in a cave on Interview island 3% decline in population was observed. Reason for the decline yet to be understood. With continuous growth, overall estimated protected population at all three sites was 5855 birds during 2013. Almost 2127 chicks were fledged by 2241 breeding pairs (number of nests) in 204 caves of all three sites with average breeding success of 78 %. Protection camps at Chalis-ek and Baratang were closed during June 2013 and at Interview It continued till July end. The protection camps were started during January 2014 as usual and by March 2014 the egg laying was on its on-going in all the camps. Scientifically managed harvesting of the nests is on-going with involvement of the forest department and the nest protectors. Total 2053 nests (1243 from Chalie-ek and 133 from Interview Island and 677 from Baratang Island) were harvested during the year 2013. All the harvested nests are numbered, registered, air dried and packed in air tight container after complete drying. Roosting pattern studies show that, there is no significant difference in arrival time of birds for roosting with respect to different lunar phases. However breeding stage is proven to be affecting the roosting pattern of the species. During may and June 2013, 101 Edible-nest Swiftlet eggs were cross fostered in the nests of the Glossy Swiftlets in ex-situ swiftlet house at Tugapur from Chalis-ek caves. More than 71% of chicks of the Edible-nest Swiftlet fledged successfully from the ex-situ Swiftlet house. Roost count was taken outside ex-situ Swiftlet house at Tugapur during January 2013 between 17:00 and 20:00hrs. Three individuals were observed roosting in the house. No breeding attempt was recorded during the season. One of the major achievements in the project was the delisting of the Edible-nest Swiftlet from Schedule-I of the Wildlife Protection Act, 1972.

Discussion and recommendations

Overall increase in the population of the Edible-nest Swiftlet is quite noticeable (Figure 1). Whereas, the population in a cave at Interview Island is under continuous observations to know the reasons for decline even after continuous successful breeding

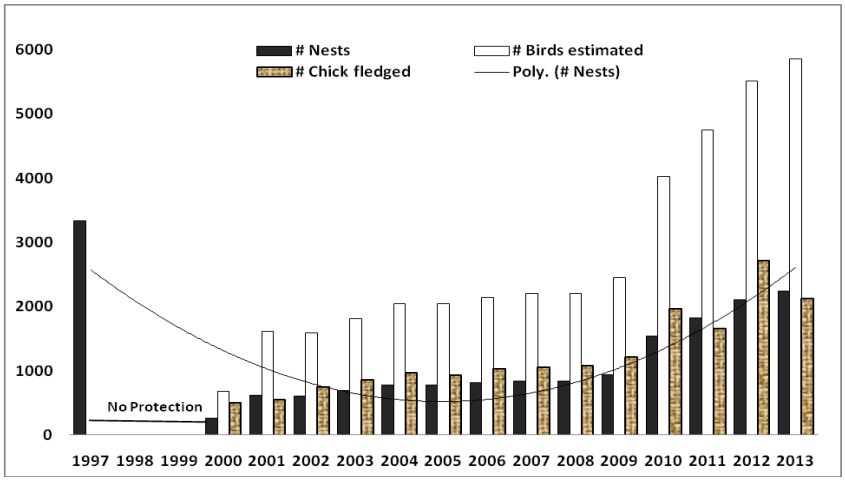


Figure 1: Effect of Protection on the population of Edible-nest Swiftlet in Andaman and Nicobar Island

The population: Capture-recapture studies conformed presence of the old birds in the colony. Study on dispersal initiated to understand the breeding and natal dispersal of the species. The roosting pattern is now known to be related with the breeding stage of the colony rather than the lunar cycle. Now the attempt is being made to standardize the roost count method to understand total the breeding or nesting population in any cave and also to know the breeding stage of the colony from the rooting pattern of the individuals. Regular, scheduled playing back of the calls and transfer of Edible-nest Swiftlet eggs into the Glossy Swiftlet nests may result in settlement of the Edible-nest Swiftlet populations in the ex-situ Swiftlet houses. Scientifically monitored, post-breeding nest harvesting is successful at all three protection sites. After conditional de-listing of the species, the conservation program has achieved most of the objectives and successfully demonstrated population growth of the species at the focal in-situ conservation sites, nesting attempts in the ex-situ houses and exploration of the new urban breeding colonies of the Edible-nest Swiftlet.

The urban populations should be observed and multiplied for the benefit of the species and the people. It is now important after delisting of the species from the schedules of Indian Wildlife Protection Act (1972) to allow protectors to get their deserving incentive, with scientific guidance and local administration, from this high priced, local natural resource. Long term research and conservation of the species should be assured to strengthen the on-going conservation efforts. Andaman Forest Department and SACON should assure further continuation of the on-going Edible-nest Swiftlet conservation in the Andaman and Nicobar Islands. Discovery of the urban populations is one of the most important outcomes of this survey. These successfully breeding colonies allow us to believe there may be more populations in the urban areas. Immediate detailed survey of the urban areas in the islands is required to explore new urban breeding colonies of the species.

Publications (emanated from the research study)

Scientific Journals

1. Pankaj Koparde & **Manchi Shirish S.**, (in-Press), Sighting of Siberian Stonechat *Saxicola maurus* on North Andaman Island, India. *Indian Birds*.
2. Manchi S. and R. Sankaran, (2014), Effect of Protection on White-nest Swiftlet *Aerodramus fuciphagus* population in Andaman Islands, India - an assessment, *Oryx* 48 (2): 213-217.

Papers in conferences/ seminars/ proceedings/ edited volumes

1. Akshaya M. Mane & Manchi Shirish S, (2013), Abundance of the potential predators around the Edible-nest Swiftlets breeding caves at Baratang Island, in Ecosystem Services and Functions of Birds. Proceedings of the Second International Conference on Indian Ornithology, 19-23 November. Salim Ali Centre for Ornithology and Natural History, Coimbatore, India.
2. Akshaya M. Mane & Manchi Shirish S., (2013), Does breeding stage affect the roosting behaviour of birds? - A case study of the Edible-nest Swiftlet in Andaman Islands, in Ecosystem Services and Functions of Birds. Proceedings of the Second International Conference on Indian Ornithology, 19-23 November. Salim Ali Centre for Ornithology and Natural History, Coimbatore, India.
3. Akshaya M. Mane & Manchi Shirish S., (2014), "Participatory approach towards species conservation and livelihood generation in Andaman Islands, India: A Case-study", in Society for Conservation Biology Fiji 2014 conference on Resilient Island Ecosystem and Communities held in *Suva, Fiji* from 9th to 11th July 2014.

2. Reassessment of the impact of nest collection on the Edible-nest Swiftlet in the Andaman Islands

Principal Investigator : Manchi Shirish S.
Co-Investigators/Consultants: NOT APPLICABLE
Research Fellows : NOT APPLICABLE
Project Period : 1 Year (12 Months)
Date of Commencement : September 2011
Date of Completion : August 2012 (extended up to May 2013)
Budget : Rs. 1,95000/-
Expenditure till Date : Rs. 1,56,805/-
Status : Final Report Submitted
Collaborative Agencies : NOT APPLICABLE

Summary
The population survey of the Edible-nest Swiftlet was conducted to know the population trends in the unprotected caves of the Andaman Islands. As part of the on-going conservation program major objective of this survey was identifying the caves with the potential populations to expand the in-situ conservation efforts towards protecting the maximum area possible. During the survey ten new caves and one new population of the Edible-nest Swiftlet on Landfall Island, the Northern most island of Andaman group, were discovered. The survey shows that in Andaman only two sites are available with the potential population for setting up the protection camps but

both these islands are isolated and practically very difficult to approach during unfavorable weather conditions. The unprotected population seems to loss more than 56% of population and also the Edible-nest Swiftlet populations from more than 37% of the caves are lost between 1997-98 and 2012-13. As the rate of population decline seem to be rapid, immediate survey in Nicobar Islands is very important to know the potential caves sites available with populations of the Edible-nest Swiftlet.

Objectives

1. to estimate the breeding population of the Edible-nest Swiftlet throughout the Andaman Islands
2. to evaluate intensity and impact of the nest collection on the breeding populations of the Edible-nest Swiftlets in Andaman Islands
3. to identify the potential populations existing for the expansion of the on-going conservation program in the Andaman Islands

Methodology

Of the 384 caves identified in the Andaman and Nicobar islands 325 caves were surveyed by Sankaran (1998) in the Andaman Islands. In addition to these 10 new caves were identified during present survey. Among total 335 caves, 304 caves were revisited and 10 caves were first time visited between February and April 2012 & 2013 to estimate population of the Edible-nest Swiftlet. Remaining 21 caves in South Andaman could not be surveyed during present study because of the inaccessibility during the field visits. These remaining 21 caves were also removed from the analyses part while comparing the data with the present survey. Of these 314 caves surveyed around 95% caves were surveyed physically. Information about the population of the Edible-nest Swiftlet in remaining more than 4% caves was obtained from the nest collectors. Information from 3 caves located on rock cliffs of the White Cliff Island could be collected, neither by Sankaran (1998) nor during the present survey. The nest collectors / field assistants (were part of last survey during 1997) from different islands were identified and involved in the survey. All the caves visited were surveyed to know/estimate breeding population of the Edible-nest Swiftlet using nests count method. All the nests (completely or partially built) were counted with their breeding/nesting stages. To estimate the breeding populations inside the caves, wherever possible discussions were done with the nests collectors to understand intensity of nest collection in different islands.

Results

Among 314 caves surveyed in Andaman Islands, more than 64% were occupied by swiftlets. Edible-nest and Glossy Swiftlet were occupying around 57% and 15% caves respectively. More than 37 % caves were deserted by the Edible-nest Swiftlet between 1998 and 2013 (Figure 1).

Of 34 islands visited during the survey 14 islands were found with the population of the swiftlets. Additional seven islands previously known to support the Swiftlet population could not be visited and two islands Inglis and Outram in the Rani Jhansi National Park of South Andaman Islands were found deserted by swiftlets. Simultaneously, new Swiftlet colony was explored on Landfall Island where they were

never seen before. Though not much change observed about overall presence of Swiftlets on different islands more damage was recorded in case of the Edible-nest Swiftlet. The species is now observed to be occurring only on seven islands and seem to be deserting four previously known islands. The colony of the Edible-nest Swiftlet found on East Island of the North Andaman Islands is the new population and can be considered as northern most known population of the species. In 314 caves visited 2445 nests were observed. From total observed 2111 nests were recorded in the 205 protected caves at Interview Island, Chalis-ek of North Andaman and Wraffter's Creek of Baratang Island. Only 334 nests were observed in 109 undefended caves revisited to know breeding population of the Edible-nest Swiftlet. Present investigation depicts that more than 56% of undefended/unprotected population is lost between 1997-98 and 2012-13. During survey in March and April 2012-13, more than 99.8 % nests of 2108 nests in the protected caves were found built completely whereas, only 40% of unprotected nests were found built completely (Figure 2).

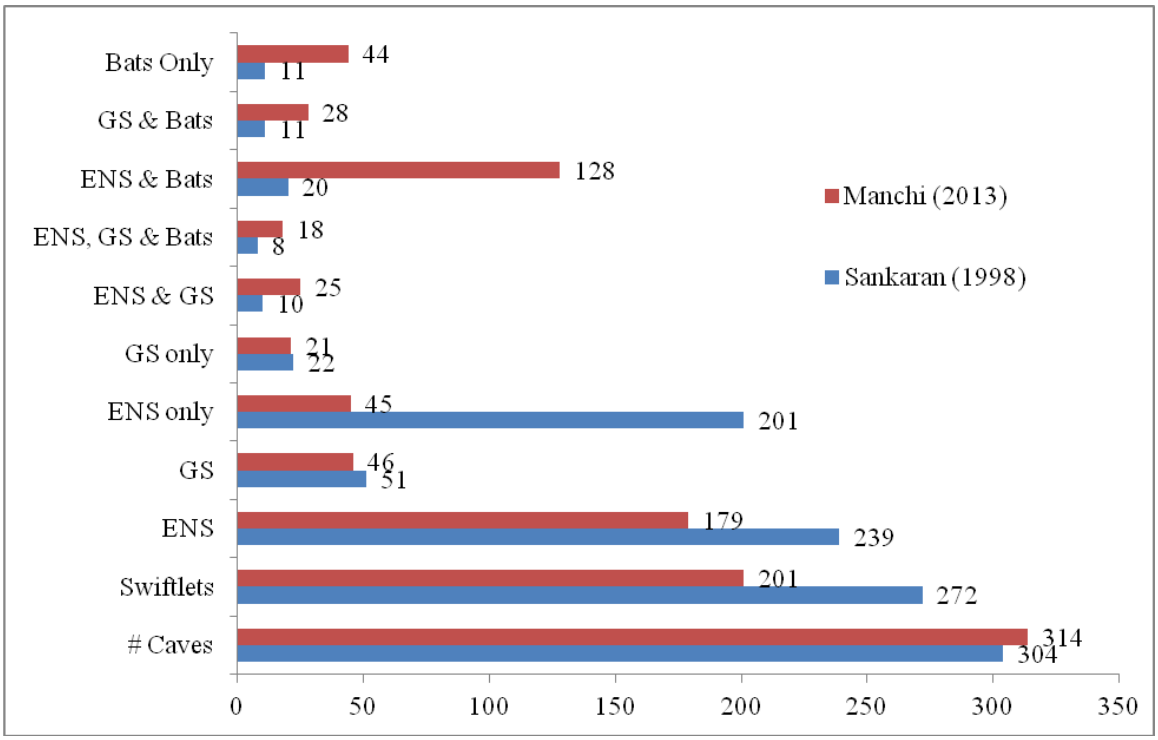


Figure 1. Number of caves occupied by the Edible-nest and Glossy Swiftlet in the Andaman Islands during 1998 and 2013 (ENS = Edible-nest Swiftlet & GS = Glossy Swiftlet).

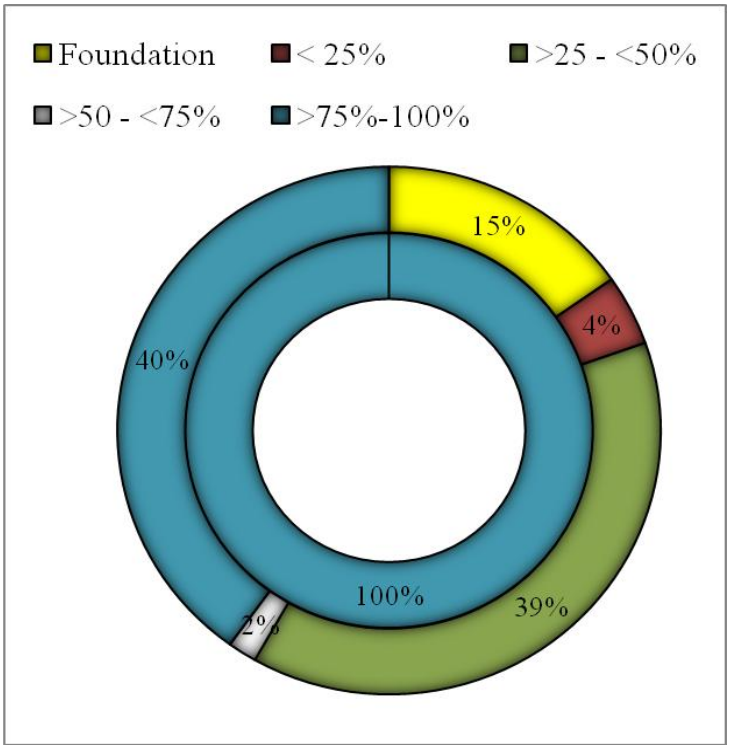


Figure 3. The graph shows the number of nests observed in different stages in the unprotected (Outer Circle) and protected (Inner Circle) caves during the survey (Here: Foundation = Saliva laid attached to rock; <25% = >Foundation < 25%; >25%-<50% = nest built was > 25% but < 50% ; >50%-<75% = Nest built was > 50% but < 75%; Full Nest = nest built was > 75%-100%)

Discussion and recommendations

Results clearly show that the undefended population on the islands is still under tremendous nest collection pressure. Among all the surveyed sites at present only South Button and part Landfall islands have potential populations remaining, which can be focused for expansion of the ongoing in-situ conservation of the Edible-nest Swiftlet. Both these islands are like big rocks in the middle of the open sea, where it seem to be practically difficult to setup the protection camps there. As both these uninhabited islands are with no fresh water source inaccessible in harsh climatic conditions, it may not be feasible to make people stay here for protection. From the discussion with local nest collectors (used to collect nests in past) it is understood that the undefended populations in Andaman Islands is also under tremendous pressure and also not found on some islands. This information is depicted by our observations from the population trend and the current nest harvesting pressure (Figure 2). These outcomes make us believe that there may be no other potential areas remaining for in-situ conservation of the Edible-nest Swiftlet in Andaman Islands. That means the present populations under protection are the key populations for survival of the species in the Andaman Islands. As the protected populations are the only viable populations in the Andaman Islands continuous protection should be assured. It is imperative to survey the caves in Nicobar Islands to understand the population trend and also identify the potential sites for in-situ conservation of the Edible-nest Swiftlet.

Publications (emanated from the research study)

Scientific Journal

Manchi, S., (2013), Records of the Andaman Barn-owl Tyto deroepstorfii in North-, and Middle Andaman Islands. Indian Birds 8 (3): 66–67.

Reports

Manchi S. S., (2014), Reassessment of the impact of nest collection on the Edible-nest Swiftlet in the Andaman Islands. Sálim Ali Centre for Ornithology and Natural History, Coimbatore. SACON Technical Report – 126. Submitted to WWF-India, New Delhi. 34 pp.

3. Status, Ecology and Conservation of Narcondam Hornbill *Aeceros narcondami* on Narcondam Island, India

Principal Investigator	:	Manchi Shirish S.
Co-Investigators/Consultants	:	NOT APPLICABLE
Research Fellows	:	NOT APPLICABLE
Project Period	:	18 Months
Date of Commencement	:	May 2011
Date of Completion	:	October 2012 (extended up to April 2014): May get further extended
Budget	:	Sanctioned Rs. 6,07,200.00/- and Received Rs. 3,26,688/-
Expenditure till Date	:	Rs. 3,54,368/-
Status	:	Progress Report Submitted
Collaborative Agencies	:	NOT APPLICABLE

Summary

Its restricted distribution and single, small population makes the Narcondam Hornbill probably the most threatened hornbill species in the world and one of the most priority bird species. The present study was designed to estimate population of the species, identify the threats and collect basic information about its habitat and biology. Population of the Narcondam Hornbill as compare to the earlier report shows considerable growth. The population has grown more than two fold and is estimated to be 800-900 individuals. This number of estimated birds in 6.82 km2 area makes Narcondam Hornbill may be the most densely populated hornbill in the world. But on the other hand the breeding population has shown considerable fall from 50-60% in 1999 to 6-7% in 2013. This is an alarming reduction. Most of the birds seen on the island were of the age between 2-4years. The observed 18 nests showed successful breeding (15 nest with complete success and 3 nests with partial breeding success). The vegetation study using quadrate method shows forest regeneration rate as normal in any evergreen forest. There was no direct or indirect evidence of presence of feral goats on the island. Also the species was not seen facing any unnatural threat at present. The population has to be studied immediately for its genetic diversity. Also the resource availability for the population should be quantified. Detailed long term studies have to be planned to understand the evolution of the species. Major recommendation from the project is not to disturb the species and its habitat on the

island and conduct periodic population monitoring to keep status of the species in check.

Objectives

1. to investigate population status of the Narcondam Hornbill
2. to study the nesting and foraging habitat requirements of the Narcondam Hornbill
3. to study breeding and non-breeding biology of the Narcondam Hornbill
4. to identify threats, formulate and advocate conservation measures

Methodology

Three belt transects of variable length were laid on different hill slopes to understand population status of the Narcondam Hornbill. Each transect was walked six times. Nests were located by searching middens bellow the nest and by calls by female or chicks. Once the nests were located different parameters of the nest hole and nest tree were recorded. Towards understanding breeding biology of the species Focal nest sampling was used. Three nests were observed once in a week between 4:30 to 17:30 during March to May. All the nests were also observed periodically to know the breeding success of each nest. To study the foraging habitat available on the island, total 130 10X10m vegetation plots were laid following stratified random sampling method. Total 520 1X1m subplot were laid to measure impact of goats on forest regeneration through intensity of browsing. Vegetative and fruit samples of all the species are collected and preserved. The herbarium is prepared and species identification is on-going. Opportunistic survey was done to know food and foraging habits of the species, also seeds were collected from the middens bellow the nest hole. Discussions were made with the Police personal to understand current level of hunting, fire wood collection, and other disturbances by human on the island.

Results

The Narcondam Hornbills were found to be abundant on the Island. The encounter rate along the transects was 30.36±5.79. The estimated density of Narcondam Hornbill was 129±63 birds/km^2 i.e. total 883 birds (estimated). On comparison with previous studies the population shows considerable growth within a decade (Figure 1). More than six percent population was observed to be nesting with the nesting density of more than eight nests/km^2. Of the 18 nests observed, 15 nests could fledge both the chicks and only one chick was fledged from remaining three nests. The nests of the Narcondam Hornbill were found on nine different tree species of different heights between 4m and 11m. Nest height, nest opening direction and nest tree GBH did not show any direct correlation with the nest success. Male was observed feeding female and chicks in the nest. Frequency of male visiting the nest did not show any significant difference between different stages of fledgling period. Both the fledglings seem to be morphologically identical from a distance. Once the chicks are fledged male, female and fledged chick/chicks were observed staying with 50m range circle of the nest. Narcondam Hornbills were found quite opportunistic in their diet. Though males at the nests were seen bringing omnivorous food, majority of food items were fruits of different types, Mantids, spiders and grasshoppers. Total 21 types of seeds were

collected from middens. The population structure of the tree community shows normal reverse 'J' shaped curve (Figure 2). The good recruitment rate of young individuals observed and also stem density estimated (598 stems / hectare) on the Narcondam Island seems to be normal. No direct or indirect signs of presence of feral goats were seen on the island. Narcondam Hornbills did not seem to be disturbed by the Police personals.

Discussion and recommendations

Major goal of the study is to understand status, biology and habitat requirements of Narcondam Hornbill for immediate conservation action and also recommend further detailed studies to develop appropriate conservation measures/strategies for the species and its habitat on the Narcondam Island. The high Encounter rate of the Narcondam Hornbill shows that either there is a noticeable increase in the Narcondam Hornbill population. High rate of successful fledglings shows that the species is breeding very successfully on the island. Further, survival of the fledglings has to be studied to understand the population recruitment of the species on the island. Only two observations depicted the natural control of the Narcondam Hornbill population on the island. In one incidence an individual was seen entangled in the climbers at the top of lower canopy and in another incidence a Monitor Lizard was observed climbing the Narcondam Hornbill nest tree, may be to predate on the nest. One of the major outcomes of this study is conformation of no goats on the island. As the observations were done up to the highest peak from the zero elevation on more than 60% of the island it can now be confidently said that there are no feral goats, considered to be the biggest threat to the habitat, on the Narcondam Island. Also we could get indirect evidences of no poaching by the policemen on the islands because of the strong warnings from the higher officials. An LPG facility to the Police Outpost has reduced the firewood collection.

It is recommended to have an arrangement made for commuting to and from the Narcondam Island and the nearest human habitation, to boost morale of the Police personal posted on the Narcondam Island. Additional LPG should be provided to the Police Outpost to completely ban the firewood collection. Solar power system on the island should be repaired and used instead of the Diesel Generators to reduce disturbance to the nocturnal fauna on the island. In case the feral goats are encountered in future police personals should be allowed to eliminate them from the island. It is strongly recommended that there should be no more interference of any sort on the island as the Narcondam Hornbill and its habitat seem to be recovering greatly. It is recommended to take necessary action for on time release of grants for proper implementation of the project.

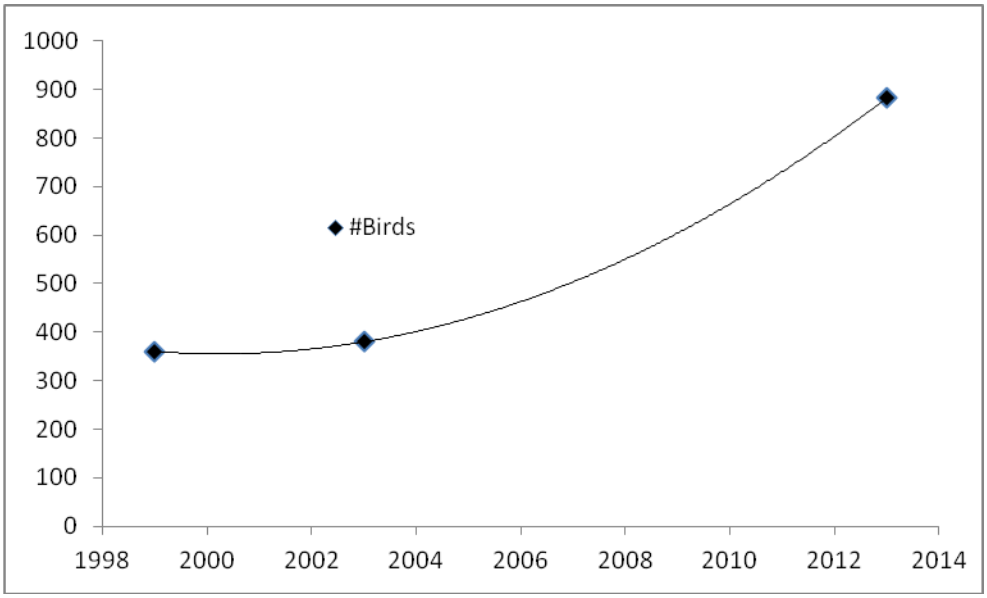


Figure 1. Population trend of the Narcondam Hornbill in last 15 years

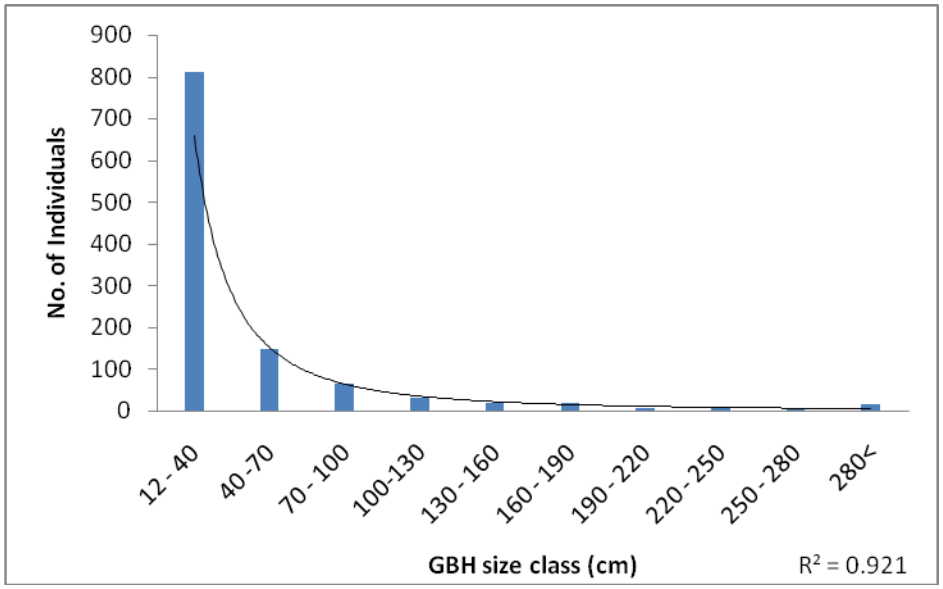


Figure 2. The population structure of the tree community on the Narcondam Island shows normal reverse 'J' shaped curve.

Publications (emanated from the research study)

1. Shirish Manchi, Asad Rahmani and Dhritiman Mukherjee, (in-Press), Grey-faced Buzzard Butastur indicus: First record from India. Journal of Bombay Natural History Society.

2. Manchi S. S. and Kumar J. S., (2014), Sighting of the Blue-winged Pitta Pitta moluccensis on Narcondam Island, Andaman and Nicobar Islands, India. Indian Birds 9 (1): 23-24

4. A survey of slender Loris in parts of Kerala and Tamil Nadu, India

Principal Investigator	:	Honnavalli N. Kumara
Co-Investigator	:	R. Sasi
Research Fellow	:	-
Project Period	:	23 months
Date of Commencement	:	February 2012
Expected date of Completion:		December 2013
Budget	:	Rs. 1.97/- lakhs
Expenditure till date	:	Rs. 1.73/- lakhs
Funding source	:	Primate Conservation Inc
Status	:	Completed
Collaborative agencies	:	-

Summary

The distribution of the nocturnal primate of South India, *Loris lydekkerianus* is known only from limited areas in its entire range. Two sub species are known for the Peninsular India, and their distributions are known to overlap each other. To address the distribution, population abundance, sub species overlaps and conservation status of the slender loris, a research project was initiated three years back. That project had covered only half of the original distributional range because of limited resources and time limits. As a second and final phase of that project we propose to survey the remaining forested areas in the two states of India viz., Tamil Nadu and Kerala to study the presence of loris and its habitat characteristics. This present study will fulfill the gap by generating precise information on the distribution pattern and conservation of the two sub species of slender lorises. This information is crucial in planning protected area network with a focus to conserve the slender lorises in the Eastern and Western Ghats forested mountain areas of South India.

Objectives

1. To survey Slender Loris in Southern Kerala and Northern Tamil Nadu
2. To assess the Abundance of slender loris in forest units
3. To assess the Habitat parameters and Threats
4. To spatially characterize and configure the landscape of suitable habitats in GIS for conservation prioritization.

Methods

Possible sites for the survey were selected based on extent of forest cover within each forest range of forest division. We used (a) field sightings of the species during night transects, and (b) information from Forest Department personnel and local villagers, to confirm the presence of lorises in an area. Night surveys were conducted between 20:00 h and 04:00 h on pre-determined transects using flashlights and headlamps. Existing natural trails were used as transects in the forests for the surveys. The eyes of slender lorises gives a typical orange-red shine in response to a flashed light that can be seen from a distance of over 100 m and this was used to detect the presence of the loris. Vehicle survey or the foot transect was adopted and followed depending on the access and topography of the terrain for the surveys. Vehicle speed was maintained at an average of 5 km/h, whereas foot transects was done with an average speed of 1 km/h. The slender loris relative abundance is projected as the number of animals

surveyed per km. A handheld global position system was used to calculate the distance covered during the survey, and geographical location of the sighted animals. For each sighting of a loris, number of individuals, subspecies and habitat type was noted. Morphological characteristics like body size, coat colour and shape of circumocular patches distinguish the Mysore slender loris from the Malabar slender loris. The survey was carried out between November2012 and December 2013. A total of 782 km and 641 km of vehicle transect or walk was made to survey the slender loris in Tamil Nadu and Kerala respectively.

Results

A total of 23 forest ranges in 11 forest divisions in southern Kerala was surveyed. A total of 47 lorises were sighted during the 641 km of walk or vehicular transects. Slender loris was sighted in all the forest divisions except Ranni division. The encounter rate highly varied between the ranges, the highest encounter rate was in Naduvathumuzhy range (0.50) of Konni forest division and Paruthipally range (0.50) in Thiruvananthapuram, which was followed by Palode range (0.21±0.24) in Thiruvananthapuram forest division and Peppara (0.21 ± 0.29) in Pappara WLS. The overall encounter rate was 0.07 (±0.13). Four lorises sighted in Kottayam forest division was not deduced to subspecies level, where all other sightings in other forest divisions were of *Loris lydekkerianus malabaricus*, except in Neyyar WLS where the subspecies was *L. l. lydekkerianus*.

A total of 12 forest divisions were surveyed in the Tamil Nadu, among them one is Biological Park which is a protected area, where all other surveyed areas were outside the protected area. A total of 782 km of walk or vehicular sampling was made sighted 60 lorises. All the lorises sighted in the present survey in Tamil Nadu were identified as *L. l. lydekkerianus*. The overall encounter rate of loris was 0.08 lorises/km. The encounter rate highly varied between the forest divisions. The encounter rate was high in the Krishnagiri forest division (0.25-0.71 lorises/km), which was followed by Dharmapuri division (0.21 lorises/km).

Discussion and Recommendations

The distributional range of *L. l. malabaricus* is confined to the western slopes of the Western Ghats. Ariankavu pass and Palghat gap has created a major barrier over a period of time for the movement of animals across theses gaps, which has resulted in separate populations for *L. l. malabaricus*. Thus the population of *L. l. malabaricus* in Kerala can be considered as three populations i.e. Neyyar WLS in the southern tip to the south of Ariankavu pass, population present north of Ariankavu pass up to south of Palghat Gap and north of Palghat gap up to Aralam WLS. The relative abundance of *L. l. malabaricus* in most of the forest divisions of Kerala remain <0.2 lorises/km except at Aralam WLS, Konni, Thiruvanthapuram, Nemmara and Chimmoney, which are spatially distributed in all the three population areas.

In Tamil Nadu, lorises are confined to the forests of Western Ghats, Eastern Ghats and its adjoining forests. The populations of lorises are contiguous with the population in Karnataka and Andhra Pradesh in north. Population contiguity of lorises is dependent

on habitat contiguity; the loss of suitable habitat probably has resulted in the fragmentation of large population of them into many small populations. Apart from the population found along the Western Ghats, other major populations include -1) Karur- Dindigul- Madurai- Tiruchirapalli- Pudukottai, 2) Shevroy hills of Salem, 3) Krishnagiri, 4)Vellore- Thiruvannamalai, and 5) Chennai-Thiruvallur.

The habitat loss may be the important threat for the conservation of lorises in Tamil Nadu. Habitat loss has already driven the population into isolation, thus conserving the scrub forests of Eastern Ghats can only help the long-term conservation of lorises. The existing remnant forest patches require be protected and upgraded for the conservation.

Publications

-Nil-

5. Evaluating the status of NTFP trees and development of a model for sustainable harvest of *Garcinia gummi-gutta* in Aghanashini -Lion tailed Macaque Conservation Reserve, Western Ghats, India

Principal Investigator	:	Honnavalli N. Kumara
Co-Investigator	:	-
Research Fellow	:	K. Santhosh
Project Period	:	21 months
Date of Commencement	:	April 2012
Expected date of Completion	:	December 2013
Budget	:	Rs. 8.85/- lakhs
Expenditure till date	:	Rs. 8.74/- lakhs
Funding source	:	Rufford Small Grants
Status	:	Completed
Collaborative agencies	:	-

Summary

The population of Macaca silenus in Sirsi-Honnavara is the largest one in its distribution rage. in the area, many low income class people leading livelihood using forest products of which many are food trees of LTM. The status of NTFP species is unknown of which Garcinia an understory tree valued for its fruit as food for the LTM and important NTFP for people. An evaluation of NTFP abundance with a study to develop a model for sustainable harvest of Garcinia having minimal effect on forest and LTM and its impact on stand structure and regeneration is vital

Objectives

1. Distribution and abundance of NTFP tree species in Aghanashini LTM CR
2. To develop a model for sustainable harvest of *Garcinia gummi-gutta*
3. To evaluate the impact of sustainable harvest on stand structure and regeneration of *Garcinia gummi-gutta*

Methods

The status of NTFP tress was assessed in five selected sites in the habitat of lion-tailed macaque. Series of interactions and public meetings with local people was held to influence them for proper and sustainable harvesting system at right phenophases of Uppage and also seeking inputs by them in minimizing their dependence on forest. Meetings with the processing firms and factories to exclude middle men from the trade, and thus ensure getting quality raw materials directly from harvester to the factory was also held. As a consequence to get higher profits for the initiatives that was taken.

Results

Highest IVI was exhibited by *Garcinia morella* (12.03±2.74SD) across the sites followed by *Garcinia gummi-gutta* (8.06±1.80), *Myristica dactyloides* (4.35±3.03), *Mangifera indica* (2.77±0.80), *Cinnamomum malabathrum* (2.09±0.39), *Myristica malabarica* (1.97±0.68), *Canerium strictum* (1.22±0.68), *Calophyllum apetalum* (0.95 ± 0.88) and *Artocarpus lakoocha* (0.81±0.74). The number of seedlings (<10 cm girth) across the sites were dominated by *Garcinia gummi-gutta* (1408±980.88), which was followed by *Calamus pseudotenuis* (376±163.95), *Calamus twaitessi* (76±47.75) and *Myristica dactyloides* (32±33.47). No individuals of *Myristica malabarica* and *Artocarpus lakoocha* were recorded in any of the sites. The basal area of *Garcinia gummi-gutta* varied from 0.68 in Kodagi to 4.76 in Kanthota, where the IVI also show variation from 5.05 in Kodagi to 9.97 in Hosthota. Interaction with local people, the harvesting and marketing of the *Garcinia gummi-gutta* fruits was developed

Discussion and recommendations

Among NTFP tree species, the IVI of *Garcinia gummi-gutta* varied from 5.1 to 10 in the study sites and in the southern part of the same landscape was 7.9 that fell within a range, which indicates the variation in distribution of the species across the ACR. The IVI value of *Caryota urens* in southern ACR was 5.5, where in the northern ACR was between 0 and 2. *Myristica malabarica* and *Myristica dactyloides*, which are known to be highly exploited by people for NTFP, showed variation from 1.2-2.9 and 2.4-9.7 respectively indicating high degree of variation across areas. The quantity of *Garcinia gummi-gutta* harvested and its income forms one of the major contributions to the yearly income of the local people. Unstable markets, controlled trade by elite and fluctuating quantities in the forest always makes more challenges to the harvesters.

The high dependence of people for firewood to process the rind of *Garcinia gummi-gutta* has lead to severe fragmentation of habitat. To mitigate severe fragmentation there is a need for decreasing firewood usage by people. We recommend distribution of ASTRA ovens to people that decreases the rate of utilization of firewood. Additionally restoration of the degraded areas also has to be considered. The species important for both LTM and people needs to be raised in existing nurseries of the forest department for this purpose. Streamlining the process of harvesting and marketing will also have a large impact in decreasing pressure on the forest. The suitable models are also suggested for proper marketing strategy to have a control over the harvesters on the collection of appropriate crop and process of the fruits.

Publications
-Nil-

6. Monitoring bird diversity and abundance in the Vellode Bird Sanctuary, Erode

Principal Investigator	:	P. Balasubramanian
Co-investigator	:	Nil
Research Fellow	:	S. Silambarasan
Project Period	:	4 months
Date of Commencement	:	February 2014
Date of Completion	:	May 2014
Budget	:	Rs. 42,600/-
Expenditure till date	:	Rs. 39,748/-
Funding Source	:	Tamil Nadu Forest Department
Status	:	Completed
Collaborative agency	:	Nil

Summary
As a part of bird monitoring programme in various bird sanctuaries of Tamil Nadu, the State Forest Department (Tamil Nadu Biodiversity Greening Project) has entrusted a small grant project to SACON, to survey and monitor the avifauna at the Vellode Bird Sanctuary, Erode. Bird censuses and nesting observations were carried out from February to May 2014. A total of 98 bird species belonging to 47 families was recorded. Nine species including the threatened Spot-billed Pelican were found breeding in the Sanctuary.

Introduction
The Vellode Bird Sanctuary is located in the Erode District of Tamil Nadu which extends to an area of 77.185 ha. The Sanctuary is a storage tank which was planted with *Acacia nilotica* trees. Profuse growth of *Prosopis juliflora* is seen all along the bunds. The sanctuary receives rainfall from the Northeast monsoon.

Objectives
i. Prepare a checklist of birds of Vellode Bird Sanctuary
ii. Find out the abundance of different bird species

Methodology
Total count method was used to census the birds. Twice in a week, census was carried during morning hours (6-8 hrs). Study was carried out from February to May 2014.

Results
During the study period, a total of 98 bird species belonging to 15 orders and 47 families were recorded. Of these, terrestrial birds were represented by 59 species and water birds constituted 39 species. Among the 15 orders, Passeriformes dominated with 35 species followed by Ciconiiformes (21). Out of the 47 families, Ardeidae (8 species-herons & egrets) constituted the most dominant family. Of the total 98 bird

species, 81 were residents, and 17 migrants. Cattle Egret (1885.25±1067.59) followed by Spot-billed Duck (1740.25±712.019) and Little Cormorant (1665.75±907.624) were found to be the most abundant species in the sanctuary. Other abundantly occurring water birds include Common Coot, Black-crowned Night Heron and Little Egret. Rosy Starling, a migratory terrestrial bird species was also seen in large numbers. The avifauna of the sanctuary included four near-threatened species namely Indian Darter, Oriental White Ibis, Painted Stork and Spot-billed Pelican.

Nine bird species were found breeding here. It includes Little Cormorant, Little Egret, Grey Heron, Black-crowned Night Heron, Indian Pond Heron, Median Egret, Eurasian Spoonbill and Baya Weaver.

Recommendations

As the vegetation along the fringes of sanctuary bunds is dense, researchers, bird watchers and tourists find it difficult to observe birds. Prosopis bushes are found to be overgrown and form a hindrance. Hence it is suggested to clear the Prosopis bushes at some vantage points along the trials, so that birds could be clearly sighted from those observation points. Water management strategies may be worked out to maintain at least a minimum level during summer. Also, it is suggested to allocate sufficient funds for monitoring the birds throughout the year.

7. Habitat assessment of Mangalavanam Bird Sanctuary

Principal Investigator	:	PV Karunakaran
Co-Investigator	:	Rajah Jaypal and Anjan K Prusty
Technical Assistant	:	Manish Kumar
Project period	:	Three months
Commencement	:	May 2014
Budget	:	Rs. 75,000/- (estimated expenditure)
Expenditure till date	:	Rs. 35,000/-
Funding source	:	Kerala Forest Department
Status	:	Completed; Draft report ready
Collaborating agency	:	Nil

Summary

The Kerala Forest and Wildlife Department through the letter DO No. WL 4-424/ 12 dated 22nd May 2013 requested Salim Ali Centre for Ornithology and Natural History (SACON) to carry out a study regarding the permanent ecological status of the Sanctuary. As per the letter, it was reported that the Sanctuary in the past attracted large number of birds both migratory and residents and in the recent years there has been a decline in arrival of many migratory birds. Among many reasons attributed, it was thought that the developmental activities taking place in and around the sanctuary and the siltation which has taken place in the water body depleting the fish population are the two major reasons for the presumed less visit of the avifauna especially migrants. The Advisory Committee on Mangalavanam Bird Sanctuary in its meeting held on 16.05.2013 has recommended to get a study done by SACON on this

issue and to identify remedial measures including the need and scope for desilting the water body.

Objectives

(i) Examine the factors that adversely impacted in the Mangalavanam Bird Sanctuary and

(ii) Suggest short term and long term measures to restore the bird population

Methodology

Secondary data available through published and unpublished sources were used for understanding the species richness and habitat use by birds; on understanding the health and quality of the physical environment, water and sediment samples were collected from different locations within and outside the Sanctuary and carried out standard analytical process to elucidate information.

Results

Birds: - in total, 95 species of birds belonging to 15 Orders and 42 Families were found to have been reliably recorded from Mangalavanam. With regard to habitats, woodland birds followed by waterbirds form the majority of the sanctuary's avifauna and raptors constitute nearly 7% of the bird species diversity. The number of species of both local migrants and winter visitors remain more or less stable through the reporting period, but number of resident species has been on decline particularly after 2012. Though open waters are getting scarcer with time, probably from expanding mangroves, the number of species of waterbirds (NOT their population size, though) seems to be relatively stable. The populations of some of the key waterbird taxa show dramatic decline over the period to the extreme that counts of three species (Black-crowned Night Heron, Large Cormorant, and Oriental Darter) drew nil in 2013. [Note that the 2014 data are based on incomplete survey and hence not considered here). What is more distressing is the fact that both the species that comprised the Mangalavanam heronry a decade back viz., Black-crowned Night Heron and Little Cormorant are the ones that underwent the steepest fall in their numbers over the years.

Physical factors:- Among the physical properties, pH of the MBS was alkaline in nature, varying between 7.93 at sewage mixing point and 8.17 at inlet point of the sanctuary, whereas the incoming sewage and the adjacent Vembanad lake had similar level of pH 7.10 - 7.97 and 8.17, respectively. The EC ranged from 22.24 to 26.67 mS/cm within sanctuary, whereas the sewage and effluent location had less conductivity 1.29 - 5.16 and 3.25 mS/cm, respectively. Similarly TDS ranged from 11.13 to 13.37 ppt within sanctuary, whereas at sewage and effluent locations it ranged 0.68-2.51 ppt and 1.58 ppt, respectively. The Salinity of the sanctuary water fluctuated from 18 to 20 ppt indicating the influence of the adjacent Vembanad Lake (inflow water). Free Carbondioxide (FCO_2) ranged between 2.0 and 3.3 mg/l in the sanctuary area, whereas the adjacent Vembanad lake water had around 4.0 mg/l. The dissolved Oxygen (DO) level in MBS water varied between 4.47 and 8.13 mg/l.

The higher level of COD, Nitrate, Nitrite etc. will harm the normal hematology of any organism and causes fatality. When the organic nitrogenous waste getting decomposes the conversion process reduces the oxygen level in the environment and repels the organism from the locality. The sediments from different sources i.e. Vembanad lake and inflow water from Ernakulum town filled the sanctuary so there were no water retention. The litters from the nearby area increase the organic matter load (10.39 %). The presence of oil and other hydrocarbons found in the samples that cause the death of aquatic animals as well as they may cover the pores of pneumatophores of mangroves which can cause the death of plant. The presence of this devastating chemical may reduce the flora and fauna of sanctuary. The lower values for nutrients were observed due to tidal flush in the sanctuary. The plankton data shows the majority of them are rotifers which are clear indication of organic and nitrogenous based pollution in the sanctuary.

Discussion and recommendations

The fact that the resident birds showed a marked decrease in their species richness after 2010 would also infer that the proverbial breaking-point for habitat deterioration in the PA was likely of more recent origin. This was substantiated by the results of the analysis of physical environment. The spread of dense-canopied vegetation would mean that all open areas available within the sanctuary precincts (including shores, tree-fall gaps, and open waters) are no longer available. This can also affect foraging efficiency of nesting waterbirds and fish population in the waters. Our inference is further strengthened by a corresponding increase in woodland bird species richness in the sanctuary noted during the same period till 2012. The recommendations are.

1. Barricading of inlet canal by hard PVC shutters to prevent the solid wastes to enter the sanctuary.
2. Diversion of raw sewage canals to prevent the organic load and pollutants to change the quality of aquatic environment inside the sanctuary. If it enters the sanctuary should ensure the biological treatment of the sewage and the quality should ranges within the limits of CPCB and WHO
3. At low tide, the sanctuary does not have adequate water holding area, and thus needs to be desilted in order to provide adequate water column for aquatic organisms to survive.
4. A judicious management of canopy of the mangroves and other vegetation is required for maintaining the habitat quality.

Publications (emanated from the project): Nil

8. **Surveillance of Waterfowl at Nalabana Bird Sanctuary, Chilika Lake, Odisha**

Principal Investigator	:	S. Muralidharan
Research Personnel	:	-
Project Period	:	6 Months
Date of Commencement	:	11th October 2013
Date of completion	:	March 2014
Budget	:	Rs. 1, 24, 194/-
Expenditure till date	:	Rs. 1, 24, 183/-
Funding Source	:	MoEF, Govt. of India
Status	:	Completed

Summary

Many species of waterfowl died in Nalabana Bird Sanctuary during winter every year since 2006. Species, namely Northern Pintail, Northern Shoveler, Brown-headed Gull and Garganey Teal were notable among them. During 2009-10, a detailed investigation was carried out to understand the reason for the mortality. Role of contaminants, particularly pesticides was investigated. None of the pesticides tested was found to be responsible for the heavy mortality of waterfowl. Hence, we carried out a study to check if there was any disease responsible for the huge mortality of birds. During the course of the study, we had collected and preserved tissue samples of many dead birds. Although SACON generated information on the levels of many pesticides in the dead birds, we did not investigate the levels of some toxic metals. Hence, it was proposed to use the preserved tissues and document the levels of select metals such as Cu, Cr, Pb and Cd. This is a rare opportunity to understand the background levels of metals which was proved responsible for mortality of many species of birds elsewhere. The present study documented the magnitude of heavy metal (Cr, Pb, Cu and Cd) load in select tissues, namely muscle, liver and kidney of seven species of birds (20 individuals) collected from Nalabana bird sanctuary, Chilika Lake, Odisha during March 2010. Species, organ and sex wise variations were compared to understand the accumulation potential of these metals. Accumulation of metals was found to be higher in liver tissues, followed by kidney and muscle. Levels of Cu (290-1057 ng/g), Cd (11-687 ng/g) and Cr (1049-2667 ng/g) significantly varied among the species ($p < 0.05$). Levels of Cu, Cr, Cd and Pb reported in the present study are well below the threshold values to birds set by US Environmental Protection Agency. Hence these levels need not create any physiological or reproductive effects to the birds studied. However, in order to evaluate any instance of metal poisoning in birds, “normal” levels of them for the species involved must be known, and the abnormal levels which tend to produce either harm or no apparent harmful effects must be recognized. Besides, bioaccumulation potential of metals, species, feeding guild, sex and organ wise exposure could play an important role in variation in metal contamination. Organs namely liver and kidney could be used as suitable indicators of metal poisoning due to their role in various physiological functions and excretion of toxic wastes. Although the present level of contamination is not alarming, it is of concern as even low level of exposure, if continuous can pose serious problem in long-run.

Objectives

Document the levels of metal contamination in select species of birds collected from Nalabana bird sanctuary, Chilika Lake, Odisha.

Chemical processing for metals

About two grams of tissues were digested in Microwave Digestion System (MDS), with concentrated nitric acid, perchloric acid. Hydrogen peroxide was added as bleaching agent. After ensuring complete digestion, vessels were cooled to room temperature and the digested solution was filtered using Whatman filter paper (Grade No. 1) and made up to 25 ml in standard measuring flask with metal free Millipore water (Millipore Direct - Q_3). Samples were stored in a well cleaned polythene bottles in refrigerator till final analysis.

Chemical analysis for metals

Determination of Cu, Cr, Cd and Pb was carried out using double beam flame Atomic Absorption Spectrophotometer (AAS PerkinElmer model AA800).

Results

During the period of study altogether 21 dead birds comprising seven species were collected from the Nalabana Bird Sanctuary, and heavy metal contamination in various body tissues, namely muscle, liver and kidney was investigated. Data have been compiled by species, organ and sex to check the overall load of these metals. Of all the four metals analysed in three body tissues, liver had significantly higher concentration of copper (1026 ng/g), than kidney (773 ng/g) and muscle (335 ng/g) tissues.

Mean Cu concentration was the maximum in Eurasian Wigeon *Anas penelope* (1057 ± 1024 ng/g) and minimum in Common Poachard *Aythya ferina* (290.75 ± 165.27 ng/g). Cu concentration varied significantly among Eurasian Wigeon*,* Northern Pintail and Garganey Teal ($p<0.05$) included in the study. Highest mean concentration of Cr was observed in Common Poachard *Aythya ferina* (2667 ± 1147 ng/g) and lowest in Northern Pintail *Anas acuta* (1049 ± 78 ng/g). Levels of Cr in livers of all the seven species of waterfowl ranged between 38.75 ng/g and 1030 ng/g. Mean Pb concentration was observed to be the maximum in Eurasian Wigeon Anas *penelope* (195 ± 0.00 ng/g), while the minimum was in Northern Pintail *Anas acuta* (19.20 ± 10.80 ng/g). However, levels of Pb were not detected in Common Poachard *Aythya ferina* and Garganey Teal *Anas querquedula.* Variation in lead concentration was not significant among the species ($p>0.05$) studied.

Discussion and recommendations

As per published information, Pb levels in the liver tissue between 2000 and 6000 ng/g to be indicative of subclinical exposure, > 3000 - 6000 ng/g to be toxic and >5000 - >20000 ng/g to be fatal. Present levels of Pb fall well below the subclinical exposure and it is not indicative of Pb toxicity. Cadmium levels in tissues ranged between 11.13 ng/g and 687.92 ng/g; the lowest was in liver of Gadwall *Anas strepera* and highest in the same organ of Northern Pintail *Anas acuta.* According to USEPA guidelines, levels of Cd above 1047 ng/g could pose problem to birds. Hence, the levels in all the birds currently studied are lower than the levels reported as conservative threshold level.

Available literature stated that concentrations of Cu between 1000 and 3800 µg/g in bird tissues did not show any sign of harmful effects or poisoning in many species of birds world over. Hence, the Cu levels found in this study are not considered toxic. Chromium often accumulates in bird tissues. The known effects of Cr in birds include embryo development, viability, hatching, kidney, liver, circulatory and nerve damages at concentrations between 6.5 and 17 µg/g. Many chromium-containing compounds used for electroplating, wood preservation, leather tanning and textile processing enter through the food chain. USEPA reported that 4 µg/g of Cr in bird tissues is considered as indicative of contamination. However, recent studies have pointed out levels at 20 µg/g significantly affected the eggshell thickness in Japanese Quail. The levels recorded in the current study are low and not indicative of any adverse effects.

in order to evaluate any instance of metal poisoning in birds, "normal" levels of them for the species involved must be known, and the abnormal levels which tend to produce either harm or no apparent harmful effects must be recognized. Moreover, in India these information are very much scarce on any species of bird. Natural and anthropogenic emissions of toxic metals not only affect birds of Nalabana Sanctuary, but also the entire bird habitats of the country. It is needless to mention that each organ has definite physiological role in handling the metal load. Further, exposure period, bioavailability of the contaminant, species capacity to accumulate and availability of binding sites govern the variations in metal contamination. Generally in birds, organs, particularly liver and kidney have been observed to accumulate toxic metals higher than the other tissues owing to their inherent metabolic responsibility in excretion of body wastes and ingested toxic materials. Hence, these tissues may serve as important indicators of metal poisoning. Although the present levels of contamination is not alarming, it is of concern as even low level of exposure if continuous, can pose serious problem in long run.

9. Study to monitor the impacts of Seismic survey activities on the mangrove fauna.

Principal Investigator	: Arun P R
Co-Investigator/ Consultant	: -Nil-
Research Fellow	: Rajan, P
Project period	: 6 Months
Date of commencement	: 29/07/13
Expected date of completion	: 19/01/14
Budget	: Rs. 10,35,000/-
Expenditure till date	: Rs.7,26,854/-
Funding source	: Oil India Ltd
Status	: Completed
Collaborating agency	:

Summary

This monitoring study originated from the recommendations of an earlier study in 2011 titled "Impacts of Proposed Seismic Survey Operations on the Avifauna and

Wildlife of Reserve Forest Areas of KG Basin Project of OIL India Ltd" done by Sálim Ali Centre for Ornithology and Natural History (SACON). The 3D Seismic survey causes disturbances to the ecosystem mainly through the movements of people and materials during the laying of Geophone, Shoot Hole Drilling and the Shooting Process. The present study monitored the response of faunal elements during the actual seismic shooting process on ground.

Objectives

The study was aimed at monitoring the impact of prospecting exploration activities by OIL through 3D seismic data acquisition on the fauna of mangrove forests at Kakinada, East Godavari district of Andhra Pradesh on the fauna

Methodology

Field surveys were conducted from August to December 2013 along with the 3D seismic data acquisition survey activities by M/s Oil India Ltd. Specific faunal taxa of the area were selected to study the impacts of 3D seismic survey in East Godavari mangrove forests. Data was collected through systematic field study and analyzed with appropriate statistical tools to understand the major impacts of 3D seismic acquisition survey in the reserved forest areas. The study was conducted from 9.00am to 4.00pm. Due to the transient nature of the disturbance from subsurface explosions used for the seismic surveys and associated tangible disturbances to the local fauna, the data on the response of different animal taxa was collected synchronously with shooting activities of the seismic survey. Specific field methods were used for sampling different representative taxa. Disturbance of seismic process on birds were measured through Point count survey at selected shooting points. Point survey stations were located few meters away from each seismic shoot hole. Birds were monitored systematically at 3 minute intervals from within a fixed radius of around 30 m from the observer. Total count method was used to count birds in wetlands nearby shot hole. Insect behavioural changes were monitored with help of All-Occurrences sampling method near to seismic shot hole. Other taxa were monitored through opportunistic observation to study the any impact of seismic process.

Results

There are various direct impacts on mangrove fauna from 3D seismic survey as observed in the field. These effects were mostly short-term impacts since the survey normally lasted only for few days in any given area. Results indicated that, seismic survey activities did disturb both migratory and resident birds' normal activities. Most of the birds flew off from their perches during the shooting time due to the vibrations/sound. People's movements in and around mangrove for shot hole drilling and transportation of materials also disturbed birds and other mangrove fauna. It was also observed that beyond 100m there was no perceivable change in the behaviour or activity pattern of birds in response to the seismic shoots.

Discussion and recommendations

The following specific safeguards were recommended for minimizing the impact of Seismic surveys on Avifauna and wildlife. 1) No cutting or destruction of natural mangroves for locations of shot holes and laying of geophones; 2) The seismic survey

activity may preferably be restricted to the period between May to November; 3) More specifically, no activity should be undertaken during December to February in the mangrove areas & 4) The survey may be avoided along the 1km wide stretch along the beaches during February to April, which is the reported breeding season of Olive Ridley Turtles (Lepidochelys olivacea) in this area. The Oil India Ltd. had meticulously attempted to adher to all our recommendations during the seismic surveys, except for some minor incidence of cutting of mangrove branches in few places. Adequate instructions to the field staff and labourers on this aspect should be ensured to avoid such damages in the future

Publications (emanated from the project): Project report

10. Study on the the potential environmental impacts of wind farm development in Agali, Attapadi, Kottathara and Nallasingam areas of Palakkad district, Kerala

Principal Investigator	:	Arun P R
Co-Investigator/ Consultant	:	-Nil-
Research Fellow	:	Rajan, P
Project period	:	1 Months
Date of commencement	:	09/04/14
Expected date of completion	:	10/05/14
Budget	:	Rs. 2,15,000/-
Expenditure till date	:	Rs. 1,27,701/-
Funding source	:	CWET, Chennai
Status	:	Completed
Collaborating agency	:	

Summary

This rapid one month study was undertaken on request from the Centre for Wind Energy Technology as a part of the DPR preparation for their proposed wind project.

Objectives

The study was aimed at providing the baseline environmental information relevant to the wind power from the Attappadi Agali area for the purpose of DPR being prepared by the CWET. Primarily it was aimed at secondary data compilation.

Methodology

A rapid survey of the proposed turbine sites of the Agali, Attappadi, Kottathara and Nallasingam areas of Palakkad district, Kerala was conducted along with CWET. This report is mainly based on available secondary information. Systematic primary data was not collected because of the short duration (one month) of this project. But investigation surveys were conducted and opportunistic observations were recorded. in the past, SACON has worked in these areas. The “Biodiversity assessment of Attappadi” is a significant work (Vijayan. et al. 2008). However, many of the available works from this region consist of “grey literature”, reports and other pieces of work that are not peer reviewed publications. The cited reports have been critically

examined and a species list of the area was compiled to serve as a baseline information.

Results

152 species of birds were reported so far from Attappadi Hills which includes 15 endemic species out of 24 in Western Ghats (Vijayan et al.2008). According to Vijayan et al., (2008) Sholayoor areas have more bird diversity as compared to the Agali and Kottathara due to presence of evergreen patches in Sholayoor area. Forest patches of Sholayoor area have higher priority for conservation. Attappadi is considered as an informal buffer zone bordering the Silent valley National Park and chances of wildlife movements will be high due to patchily distributed forest around Attappadi. Nilgiri Wood-Pigeon,*Columba elphinstonii* is a globally threatened Vulnerable species reported from this area.

Discussion and recommendations

Currently, the available information may not be sufficient enough to conclude on the exact magnitude and nature of impacts of wind farm on wildlife, however, the proposed areas of Agali, Attappadi, Kottathara and Nallasingam of Palakkad District are mostly revenue/ agricultural lands with no significant population of sensitive flora/ fauna or wildlife habitat of conservation importance involved, only minimal impact is expected from the proposed project. Although there are some reports (Telegraph 2014) there is very little information available on the bat collision with wind turbine and bat mortality from India. There are also apprehensions that the ultrasonic sound from the moving blades of wind turbines can interfere with movement of eco-locating bats. Preliminary results from the SACON's ongoing research in Gujarat and Karnataka had indicated that there is no significant risk to the avifauna from the collision with wind turbines. However, wind power being a relatively new and emerging sector of power generation, long-term scientific studies to address the lacunae in our current scientific knowledge regarding the impact of wind farms on the environment are required for better management of the wind power sector in the future.

Publications (emanated from the project): Nil

11. Simple Tasks Great Concepts'- Teachers Training programme for South India

Principal Investigator	:	P Pramod
Research Fellows	:	Chaithra Shree J
Project Period	:	2013 (four months)
Date of Commencement	:	September 2013
Date of Completion	:	December 2013
Budget	:	Rs 3/- lakhs
Funding Source	:	Dept. of Science & Technology & Ecoscience Foundation, Chennai
Status	:	Completed
Collaborative Agencies	:	31 Schools of Tamilnadu, Kerala, Karnataka and Andhra Pradesh

Summary

The Department of Science and technology, Ministry of Science and technology, Government of India, New Delhi, in consultation with Ecoscience Research Foundation, Chennai, SACON and a couple of other organizations have planned to conduct a series of workshops to school teachers and students in Andhra Pradesh, Karnataka, Kerala, Pondicherry and Tamil Nadu on concepts of 'Simple tasks great concepts', for creating awareness on science and application of simple science experiments to understand the concepts of science.

Responsibility of conducting the training in Tamil Nadu and some selected districts of Kerala, Karnataka and Andhra Pradesh is given to SACON and the trainings were conducted in 3 batches between August to December.

12. National Nature Camping Programme – Coimbatore

Principal Investigator:	:	P Pramod
Research Fellows	:	Chaithra Shree J
Project Period	:	2014 (three months)
Date of Commencement	:	January 2014
Date of Completion	:	March 2014
Budget	:	Rs 6.66/- lakhs
Funding Source	:	Ministry of Environment and Forests, GOI
Status	:	Completed
Collaborative Agencies	:	Four Schools in Tamilnadu

National Nature Camping programme is an initiative of the Ministry of Environment and Forests in environment education which is aimed at creating greater awareness, understanding and empathy of children with and for environment. Through this initiative it is hoped that every child who goes through middle school (Classes 6^{th} to 8^{th}) will get at least one opportunity for a 2-3 day camping experience during these years, so as to motivate them towards conservation-oriented lifestyles; to encourage qualities of leadership, exploration, nature observation . The 'Nature experience' to children and teachers has huge potential to trigger the sensitivity towards nature appreciation and conservation, leading to positive environmental actions at different levels.

The pilot phase of this project happened across the country. 80 camps were allotted to various organizations and institutions throughout the country out of which 8 camps were conducted in Sálim Ali Centre for Ornithology and Natural History (SACON), Anaikatty, Coimbatore, between18^{th} February 2014 and 24^{th} March 2014. of these eight, six camps were for normal school children and the last two camps were conducted for 'special children'.

Publications

Pramod P and Chaithra Shree J (2014) **Common Birds of Coimbatore** published by Salim Ali Centre for Ornithology and Natural History, Coimbatore India 232 pp ISBN 81-902136-0-5

13. Vatavaran Environment and Wildlife Film Festival and Forum

Principal Investigator **:** P Pramod
Project period : 2014 (three months)
Funding source an Collaboration: Centre for Media Studies, New Delhi
Status : Completed

Summary of Activities
SACON partnered in the 7th CMS Vatavaran Environment and Wildlife Film Festival and Forum conducted in the IGNCA Lawns New Delhi between 30 Jan to 4th Feb 2014. As Knowledge partner of the Young Champion's Lawn, SACON involved in planning and execution of the programmes in one of the five major venues of the Festival. SACON involved directly in conducting seven programmes as follows.

1. **Workshop on - Communicating Biodiversity of India through Puppetry**: Coordinated by Dr. P Pramod and Mr, Prasanth Kumar, school teacher from Malappuram Kerala was a 60 minutes programme explaining the puppetry and its role in science communication with a 28 minute long puppetry show involving school children of New Delhi.

2. **Talk Show**: A talk show with a monkey (Puppet through Ventriloquism) from Western Ghats on the issues of Biodiversity conservation in India. A thirty minute long interactive talk show with the children/youth on the conservation and scientific issues with a monkey interviewed by Dr. P.Pramod from SACON

3. **Workshop on -Waste is no more waste**. Dr. Pramod and Er. Swapnil Kumar Sharma from Tech SAS, New Delhi conducted this programme.This 60 minute long session took children and youth into a dialog and hands on working to experience how creative minds should attempt to handle the issue of waste. Even the electronic components (e-waste/ semiconductors) and plastics can be reused in different forms. The question here is why can't we may change this from the conventional ways of disposing them by adding some creativity and innovation like using e-wastes for decorating pots, if we break it down into various sections then trainers can easily visualize budding technocrats about their technical aspects, durability of plastics helps in developing rough and tough educational kits, etc. and there can be much more apart from these. This session inspired and guides the enormous energy of youth into a channelized path with a feel i.e. "waste is not really waste"

4. **Session on Mainstreaming Biodiversity in Science Education**: A lecture with 60 minutes duration given by Dr. P. Pramod for an audience of teachers, students and youth from Delhi.

5. **Session on Innovation in Environmental Education and Communication**: in this panel discussion arranged by CMS Environment Team Dr. Pramod participated as a panel member and given a brief talk and contributed to the discussion.

6. **Exhibition on the bird diversity of Western Ghats.** SACON has arranged an Exhibition on the bird diversity of Western Ghats in the venue in association with OSAI, Environment Organisation from Coimbatore. Thousands of children and visitors witnessed it.

7. **Exhibition on traditional rice varieties**: SACON has arranged a thematic exhibition on traditional rice verities. A number of varieties of traditional rice with unique characteristics exhibited in the Young Champions Lawn. Many of them now assume very high conservation importance because they are cultivated only in a small area by some committed individuals and NGO's.

14. Coimbatore Vizha (31st Jan- 7th Feb)

SACON has actively participated in Coimbatore Vizha (Coimbatore Festival). Multi institutional events lead by Young Indians of CII. This is the fifth edition of this programme. SACON showcased the following programmes as part of this event.

1. Nature **Trip to Silent Valley** in collaboration with Young Indians and FCRI
2. A special **nature trek and bird watching** programme in Anaikatty hills
3. A week long **Environmental Film Festival**: (6.00 to 7.30 p.m. Every day) (SACON in Collaboration with Salim Ali Nature Forum in PSG College of Arts and Science, Coimbatore)
4. **Coimbatore Nature Quiz** in Collaboration with Coimbatore Quiz Circle in PSG College of Arts and Science, Coimbatore.
5. **Celebrating Nature in Campus** A programme in eight schools with various programmes such as lectures, film shows, exhibitions and debate.

Agenda No: 5/27

Project Proposals submitted to various funding agencies with the approval of the Internal Research Committee of SACON

1. Understanding Dispersal Patterns in the monomorphic edible-nest swiftlet of Andaman Islands using biotechnological tools

Summary
Using biotechnological tools especially molecular sexing we planned to unveil dispersal patterns (gross and natal) of the cave dwelling, monomorphic, colony breeding, Edible-nest Swiftlet in the Andaman Islands. We are confident that the results of this study would help in identifying in-situ colonies towards population recruitment of the species at the focal sites. Also viability of the efforts to setup ex-situ population of this economically important species can be understood.

Principal Investigator	:	Manchi Shirish S.
Co-investigators	:	Ram Pratap Singh
Research Fellow	:	NOT APPLICABLE
Project Period	:	Three Years (36 months)
Budget	:	Rs. 70,02,120/-
Funding source	:	Department of Biotechnology, Govt. of India.
Collaborating agency	:	NOT APPLICABLE

Background
It is increasingly identified that dispersal have a major role in both population regulation (Lidiker, 1975) and spatial distribution (Taylor & Taylor, 1977). Movement of an animal from its birth place to a new location where it reproduce or would have reproduced can be known as dispersal (Howard, 1960 and Greenwoon, 1980). Much work has been done in the nearly three decades since Greenwood (1980) reviewed mating systems, philopatry, and dispersal in birds, but many of the driving forces behind dispersal are still poorly understood. There are different terminologies coined for different types of dispersal. This document follows the terminologies discussed by Greenwood (1980): Natal dispersal is permanent movement of a juvenile from birth site to first breeding or potentiall breeding site. Breeding dispersal is movement of an individual, which have reproduced between successive breeding sites. Gross dispersal refers to the permanent movement of an individual to a new location irrespective of whether or not they reproduce after dispersing. Natal phylopatry is return of a juvenile to its birth place after fledging. As dispersal is one of the most fundamental aspects of animal ecology and evolution for several issues of population biology (Swingland, 1983; Paradis, 1998), it is a central focus of the conservation of many vertebrate species (Sutherland et. al., 2000). Despite of several studies conducted on ecology and biology of swiftlets very little is known regarding their dispersal. On these basis the study is proposed to explore the dispersal patterns of the edible-nest swiftlet (Aerodramus fuciphagus). It is critical to understand dispersal patterns of the species towards management of this natural resource, the edible-nest, and conservation of its

producer, the colonial breeding edible-nest swiftlet, in the limestone caves of the Andaman and Nicobar Islands. Its commercial importance has ignited the curiosity of humans to understand the biological eccentricity of the edible-nest swiftlets in the oriental region. On contrary the same economic value is costing the species its survival (Koon and Cranbrook, 2002; Nguyen et. al., 2002). Towards developing management strategies of this natural resource in both in-situ and ex-situ the conservation action through scientific research is being implemented since 1999 in the Andaman and Nicobar Islands. While exploring different biological and ecological events of the species, it was observed that population recruitment as compare to the breeding success of the species is very minimal. After the primary dispersal observations (Manchi, 2009) it was recognised that an advanced study, using biotechnology, to explore the dispersal patterns of the species can unveil many important aspects of its dispersal patterns.

Study Area

Baratang Island is the southernmost part of Middle Andaman and is situated between the Middle and South Andaman Islands. It has the most important cave complex in the Andaman and Nicobar Islands located between Wraffter's Creek and Naya Dhera on the Baratang Island. The forest patch comes under Reserve Forests. The forest type here is the Andaman Evergreen and Semi-Evergreen Forest. It also has a long stretch of Mangrove Forest. The area consists of over 170 caves located in a 1 sq. km. area. The entire terrain is of jagged rocks, below which is a warren of clefts, crevices, tunnels and a few caverns. Majority of these are clefts and cracks are barely 1-2 m wide, but 10-12 m deep and over 20 m long.

Since 2010 all the 170 caves, are under round the clock protection. The Edible-nest Swiftlets roosting and nesting in these caves are being studied for their breeding ecology. Apart from the forest land, the breeding habitat requirements of the Edible-nest Swiftlets and the Glossy Swiftlet are also studied in the urban areas.

Objectives

- To understand function of sex in dispersal (gross and natal) and natal philopatry in edible-nest swiftlet
- To investigate function of the colony size in dispersal (gross and natal) and natal philopatry in edible-nest swiftlet
- To examine function of the inter-colonial distance and individuals' morphometry in its dispersal.

Methodology

The study will be carried out at the limestone cave complex of 174 caves on Baratang Islands in North and Middle Andaman. During first quarter of the first breeding season, colonies of the edible-nest swiftlet will be reassessed in all possible caves of the study area. Breeding and non-breeding populations of the Swiftlet will be estimated using nest count method and roost count method respectively (Sankaran, 1998, 2001, Manchi and Mane 2012). Minimum 10% of the total caves, with different population sizes (minimum 10 and maximum 50 breeding pairs), will be selected using stratified Random Sampling for detailed study. To examine function of sex dispersal

and natal philopatry, all the adults in the selected colonies will to be captured and marked. Adults will be captured during nesting season (December-January) using Mist-nets at the cave openings (Manchi 2009). All the chicks more than 30 days old will be captured on the nests (March-April) in these selected caves. The captured adults and chicks will be marked using the aluminum/plastic Z–rings. Blood/feather samples will be collected carefully from each captured individual. All necessary precautions for the safety of each individual bird will be taken while handling them and collecting samples. Using the standard methods, blood samples (approximately 30 µl) will be taken from the wing veins (brachial or ulnar) with a sterilized needle and a microhematocrit capillary tube (Sheldon et al., 2008) or preferably 3-4 growing feathers from the ventral abdomen region will be plucked carefully. The collected blood or feather samples will be preserved and transported following the standard methods. DNA extraction and sexing will be done using commercially available DNA extraction kits and suitable primers employed by Thomassen et. al. (2005) on different swiftlet species. Feathers/Blood sample collected will be analyzed using Polymerase Chain Reaction (PCR), Electrophoresis and Gel Documentation techniques for individual birds' sex identification (Griffiths et al., 1998). Analyses in Laboratory will be mostly done during non-breeding season (July-November). To know the dispersal (gross and brood) of the individuals during the end of next breeding season (June-July) mist-netting will be done to recapture the marked individuals in the all the possible caves including the selected caves where the individuals were marked. Once the individuals' sex is identified then the data will be analysed using SPSS (an Statistical Software) to understand functions of individual sex in edible-nest swiftlet dispersal. Information available about sexing of the marked individuals recaptured will help us understand the sex-biased dispersal (gross and natal) and natal philopatry. The information available regarding sex-ratio maintained in the colonies and the immigrant or emigrant individuals from the colonies will help us understand the role of colony sex ratio in dispersal of the individuals. in case of less recapture, during second year, the unmarked adults and chicks in the selected caves will be marked to recapture them during third year and confirm the sex biased dispersal (gross and natal) and natal philopatry and dispersal.

Roosting and breeding populations of the species in the selected and other possible caves will be estimated through periodic (monthly) roost counts and nest counts (Manchi and Sankaran 2010). From the dispersal/recapture data collected during second and third years and the population data function of colony size in dispersal of the edible-nest swiftlet (adults and chicks) can be unveiled. Sex determination of the immigrant individuals in the selected colonies will help us understand the relation between the colony sex ratio and the immigrant individuals' sex.

During initial period of the project all the cave locations will be recorded using the high sensitive Global Positioning System (GPS). This data will help knowing the distance between caves holding colonies of the edible-nest swiftlet. Data regarding distance of the other caves from the selected caves and the recaptures during second and third year will help us understand dispersal ranges of the edible-nest swiftlet (adults and chicks) and also who (adults or chicks) disperse farthest?

When the adults and chicks are captured for marking and DNA material collection their morphological measurements (head, body, wing, tail and tarsus length, gape size, etc.) will also be recorded before releasing the individuals safely. Once the same individual will be recaptured, all this information will be correlated with sex of an individual and its dispersal distance to understand the function of the morphological differences in dispersal of the individuals.

Expected outcome and suggested plan of action for utilization of research outcome expected from the project

We are confident that the results of this study would help in identifying in-situ colonies towards population recruitment of the species at the focal sites. Also viability of the efforts to setup ex-situ population of this economically important species can be understood.

The proposed study with the help of biotechnological tools will conform the philopatric character of the species which is base of the setting up an ex-situ population of the species. Understanding dispersal patterns of this monomorphic, cave dwelling, colony breeding, monogamous bird in limestone caves of the Andaman Islands, will definitely help identifying the important populations contributing significantly towards population recruitment of the species. As sex biased dispersal is known to have implications in population biology molecular tools are proposed to be used for individuals sex identification. This information can unveil patterns and role of the adult and brood sex ratios maintained in the colonies, gross and natal dispersal patterns followed by the species and also the natal philopatry, in the populations of the Edible-nest Swiftlet in Andaman Islands. Outcome of the study can help us identify successful and important populations towards population recruitment in focused caves. It will also help us to understand the viability of ex-situ populations of this economically important species in the Islands.

Agencies which can utilize the results of the project

The research outcome of this study will be of interest to wildlife biologists, behavioral ecologists and institutions involved in conservation in general. Thus, within India, institutions that will find this study of interest include, but is not restricted to, the Forest Department, Wildlife Institute of India, Zoological Survey of India, the zoology / ecology / wildlife biology departments of universities and institutes such as the Centre for Ecological Sciences, Indian Institute for Science, Aligarh Muslim University, Pondicherry University, Utkal University and other national and international bodies, research institutions and universities with interests in conservation and ecology.

Work plan:

Period of study	Activities and achievable targets
6 Months	• Permits from the Department of Environment and Forests, Andaman and Nicobar Islands will be acquired to carryout research program in the study area and also for trapping and sampling. • The Project personals will be recruited. • Survey will be initiated to know the populations in the breeding colonies in different caves.
12 Months	• The survey to know the populations in the breeding colonies in different caves will be finished. • Focused 10% of the total caves for marking adults and chicks will be identified. • Individuals in the selected caves will be marked and DNA samples will be collected and stored. • Laboratory analyses for sexing birds will be initiated • Annual Report submission
18 Months	• Laboratory analyses for sexing birds continues • Recapture of birds from all the possible caves will be initiated
24 Months	• Laboratory analyses for sexing birds continues • Capture and recapture of birds continues • Data compilation, entry and analyses continues • Annual Report submission
30 Months	• Laboratory analyses for sexing birds continues • Capture and recapture of birds continues • Data compilation, entry and analyses continues
36 Months	• Writing of the Manuscript and report writing initiated • Final report submitted

Budget Summary:

Sr. No.	**Head**	**Year 1**	**Year 2**	**Year 3**	**Total**
A	Equipments	15,21,000.00	0.00	0.00	**15,21,000.00**
B1	Manpower	4,29,600.00	4,29,600.00	4,58,400.00	13,17,600.00
B2	Consumable	7,50,000.00	5,00,000.00	5,00,000.00	17,50,000.00
B3	Travel	3,00,000.00	3,00,000.00	3,00,000.00	9,00,000.00
B4	Contingency	1,50,000.00	1,50,000.00	1,50,000.00	4,50,000.00
B5	Overhead (If applicable)	3,35,920.00	2,85,920.00	2,91,680.00	9,13,520.00
B6	Others	50,000.00	50,000.00	50,000.00	1,50,000.00
B	Sub-total (B1+B2+B3+B4+B5+B6)	20,15,520.00	17,15,520.00	17,50,080.00	**54,81,120.00**
A+B	**Grand Total**	**35,36,520.00**	**17,15,520.00**	**17,50,080.00**	**70,02,120.00**

2. Conservation of the Andaman Serpent-eagle Spilornis elgini in the Andaman Islands: Phase – I

Summary

Andaman Serpent-eagle Spilornis elgini is an endemic raptor categorised in IUCN RedList as Near Threatened species. Data regarding its population, distribution and ecology is scarce and scattered. The publications regarding the species describes its occurrences on different islands and the species is always described as common. As every other raptor, it lacks focused studies. Forests of Andaman Islands are the only known primary habitat of this species. As the forests in these islands are under tremendous threat of logging it is important to know about the effects on the population of these birds. Also hunting reports of these eagles from the islands have come forth and we do not know how all of these disturbances are affecting the species. Further, now it is high time to have a species-specific study to understand the population status of the Andaman Serpent-eagle, the threats it is facing and also the habitat requirements of the species. This information will help us formulate and advocate the conservation measures for survival of this raptor species restricted to Andaman Islands. As collecting all this information is a long time process we designed the study to be executed phase wise (Phase – I, II & III). in the preliminary Phase – I, we propose to understand population status of the Andaman Serpent-eagle and the threats to the species in the Andaman Islands. This information will help us to design immediate conservation measures. During Phase – II along with advocating the conservation measures designed during Phase – I the breeding biology and habitat requirements of the species will be studied to improve the existing conservation strategies and come out with a species management plan. Phase – III will be advocacy and implementation of the species management plan for survival of the Andaman Serpent-eagle.

Through the present document we propose the phase – I of the program for financial support of Rs. 6,95,280.00/-. If the results of the phase – I are satisfactory, we request the funding agency to fund the next possible phases also, towards conservation of this magnificent endemic raptor in Andaman Islands.

Principal Investigator	:	Manchi Shirish S.
Co-investigators	:	Rishad Naoroji, Director, RRCF, Mumbai
Research Fellow	:	NOT APPLICABLE
Project Period	:	One Year (12 months)
Budget	:	Rs.6,95,280/-
Funding source	:	Raptor Research and Conservation Foundation (RRCF), Mumbai
Collaborating agency	:	Raptor Research and Conservation Foundation, Mumbai

Background

Only two Spilornis species, Andaman Serpent-eagle Spilornis elgini and Crested Serpent-eagle Spilornis cheela are known to be distributed in the Andaman Islands. As documented by Rahmani (2012) an adult Andaman Serpent-eagle with dark chocolate-

brown body, blackish chin and throat and white spots all over is the darkest among the serpent-eagles in India. Ali and Ripley (1978), Ferguson Lees & Christie (2001) and Naoroji (2006) have described field characters of the species in detail. Andaman Serpent-eagle is endemic to the Andaman group of islands. Based on the scarce literature available from the observations between 1988 and 2013, this resident species is believed to be locally common in suitable habitats (Vijayan 1999, Vijayan et. al. 2000, Naoroji 2006, Rajamamannan 2011, Rahmani 2012). The species is known to occur in different habitats viz: Evergreen, Semi Evergreen, Moist deciduous, Littoral and Mangrove Forests. However the species is also seen in the forest edges and plantations. Globally the species is classified under Near Threatened category in the IUCN red data book. As per Birdlife International (2013) Andaman Serpent-eagle qualifies to be in Near Threatened category because of its moderately small range, and that the forests (habitat of the Andaman Serpent-eagle) in Andaman islands are under tremendous pressure from agriculture and development activities and also because the species is likely to decline concurrently.

Considerably scarce and scanty documentation is available regarding population of the species. Several studies/personal visits in their checklists of Avifauna of the Andaman Islands have mentioned presence of the Andaman Serpent-eagle on different islands of Andaman group (Devidar et. al. 1996, Vijayan 1999, Vijayan et. al. 2000, Naoroji 2006, Devidar et. al. 2007, Pande et. al. 2007, Rajamamannan 2011, Koparde and Manchi 2013). Very few studies have documented number of individuals encountered while surveying the Avifauna on different islands. Devidar et. al. (1996) found total 62 individuals on 25 islands out of 45 islands surveyed between February and May 1992. According to Devidar et. al. (2007) the species seems to be present on all the islands larger than 10 km2. Rajamamannan (2011) during his Avifaunal survey encountered 100 individuals of Andaman Serpent-eagle at 78 sites. According to his findings Andaman Serpent-eagle was highest in North Andaman Islands. Similarly, Naoroji (2006) described that the species is more common on North and Middle Andaman Islands and the statement was further supported by the Nikhil Bhopale's observations of six individuals in Middle and 21 individuals in North Andaman Islands during March 2010 (Rahmani 2012). However, during survey of Indian Raptors the highest abundance of the species was recorded in South Andaman. Total 102 individuals were sighted across Andaman Islands. The species was commonly seen in Andaman Islands accept on Little Andaman Island (Samant et. al. 1995, Rahmani 2012). Except Samant et. al. (1995) part of the National Raptor Survey, all other studies were concentrated on the bird communities. At present the island groups are known to be under tremendous pressure from the increasing human activities and the natural calamities. These natural and anthropogenic interventions caused by habitat destruction forced a direct/indirect stress on the species and its habitat in the islands. Though the species could be facing extinction due to habitat destruction on almost all the islands, the major problem for the species would likely be on the inhabited islands due to increased agriculture and developmental activities in addition to hunting of the species. At present we are unaware about the current population status of the species, and it is now imperative to review the conservation status of the species and threats through focused population surveys. This basic information would then be

used to design and initiate conservation action along with further investigation to improve conservation strategies.

Collecting the desired information is a long time process, so we designed the study to be executed phase wise (Phase – I, II & III).

1. Phase – I - We propose to understand population status of the Andaman Serpent-eagle and threats to the species in the Andaman Islands. This information will help us to design immediate conservation measures.
2. Phase – II- Along with advocating the conservation measures designed during Phase – I the breeding biology and habitat requirements of the species will be studied to improve the existing conservation strategies and come out with a species management plan.
3. Phase – III - Will be advocacy and implementation of the Species Management Plan for survival of the Andaman Serpent- eagle.

Overall data available regarding all raptors in the Andaman and Nicobar islands is considerably scanty, and significant information needs to be collected through focused studies related to the raptors in these islands. Although the scope of the proposed study is limited to Andaman Serpent-eagle possible information regarding other raptors will also be collected during the study and will be reported accordingly.

Study Area

As the species is endemic to the Andaman Islands, the Survey will be conducted in the Andaman Islands.

Objectives

1. Estimate population of the Andaman Serpent-eagle in the Andaman Islands
2. Identify threats to the Andaman Serpent-eagle in Andaman islands
3. Recommend immediate conservation measures for betterment of the Andaman Serpent-eagle and also identify the key sites for implementation of Phase – II

Methodology

We believe stratified sampling methods will be best suited for the population survey of the Andaman Serpent-eagle (Fuller and Mosher 1987, Sutherland et.al. 2004). The islands will be stratified according to the habitat types. As very large areas are to be covered, we will be using regular or systematic sampling. The islands will be divided into the 4km2 grid using Q GIS. Around 10% total number of cells in the grid will be selected in each habitat and surveyed (number of survey cells and points will depend on accessibility and availability of the area). For counting the birds in field we will use Point Transects. The predefined transects of various lengths will be laid in the identified areas. Points will be fixed at every 100m distance from each other. The observer will walk along the transect and stop at each predefined point and then record all the birds seen for 10 minutes. To observe the birds we will use 8X40 Nikon Binocular. Whenever an individual of any raptor especially Andaman Serpent-eagle is

seen distance of that individual from the observer will be recorded using Nikon Forestry Pro (Model No. - N16184) Range Finder. Also the information regarding individual's perching spot, tree species, height from ground, canopy type (Lower, Middle, Upper and Above canopy), canopy cover, number of birds in a group, climate, time of the day, and others will be recorded; Whenever possible sex and age of an individual will also be recorded.

In addition the Point counts along transects we will also identify several vantage points from where observations will be taken covering a wide area. At these points observations will be made during the morning hours depending upon the weather conditions. Observations will be conducted for two to three hours at a single point. The birds encountered from the vantage points will be observed using 8X40 Nikon Binocular and telescope. The distance of the bird will be recorded using Nikon Forestry Pro (Model no:-N16184) Range Finder. Also the information regarding individual's flying height from ground, Forest type below, number of birds in a group, weather conditions, time of the day, and whenever possible sex and age of an individual will also be recorded.

Data from the point count along transects and vantage point will be treated separately. Once collected the bird count data will be entered in the Windows Excel 2007 spreadsheets. The entered data will be then analysed to estimate population of the species using DISTANCE (Version 6.0) software.

Data will also be treated according to the habitats and also according to the inhabited and uninhabited islands. The presence of species in different cells of a grid will be mapped using Q GIS.

Similar analyses will be done for other possible raptor species like Crested Serpent-eagle encountered during the data collection.

During the survey the data regarding dead individuals of the Andaman Serpent-eagle and any other raptor species encountered will collected through opportunistic observations and discussion with the local people. A questionnaire will be prepared. During such discussions questions will be asked to know about hunting frequency and reasons for hunting the Andaman Serpent-eagle and also any other raptor species. Then the data will be entered and analysed using the statistical software SPSS 16.

From the analyses we will try to understand:-

- The areas/islands where the Andaman Serpent-eagle is hunted/killed by people. .
- The reasons for hunting of the Andaman Serpent-eagle on different islands.

On the basis of the information generated from the objective 1 & 2 the key areas will be identified for implementation of the immediate conservation measures. The

conservation measures will be recommended also the advocacy will be initiated for implementation of the same at the identified key sites.

Expected outcome and suggested plan of action for utilization of research outcome expected from the project

The immediate outcome of the project towards conservation of the species is that the current status of the species as Near Threatened will be conformed or upgrading the global IUCN status of the species will be recommended. The other output is the baseline information generated for designing immediate conservation measures as discussed in the proposal (Phase – II & III).

Agencies which can utilize the results of the project

The research outcome of this study will be of interest to wildlife biologists, behavioural ecologists and institutions involved in conservation in general. Thus, within India, institutions that will find this study of interest include, but is not restricted to, the Forest Department, Wildlife Institute of India, Zoological Survey of India, the zoology / ecology / wildlife biology departments of universities and institutes such as the Centre for Ecological Sciences, Indian Institute for Science, Aligarh Muslim University, Pondicherry University, Utkal University and other national and international bodies, research institutions and universities with interests in conservation and ecology.

Work plan:

Quarter No.	Months	Activity	Achievements
1	September - November	• Applying for permissions from the forest Department for research on the species and working in the protected areas. • Recruitment of the project personal. • Initiate data collection	• Permissions from Forest Department are Ready • Project personnel appointed • Data collection initiated
2	December - February	• Data collection	• Data collection continues
3	March - May	• Mid-term report submission • Data collection and data entry • Data analyses	• Mid-term progress report submitted • Data collection and data entry continues • Data analyses initiated and continues
4	June - August	• Data collection, entry and analyses continues • Report preparation and submission • Manuscript preparation and submission	• Data collection, entry and analyses finished • Final Report Submitted • At least one manuscript submitted to a scientific journal

Budget Summary:

S No	Head	Details	Grants (Rs.)
1	Salary and wages	One Junior Research Fellow @ Rs. 15000+20% HRA per month for 12 months and one Technical Assistant @ Rs. 8000 per month for 8 months	2,94,400.00
2	Travel	Travel from Coimbatore to Port Blair and Local travel (Vehicle and Boat hiring) for PI, CoI and the project personnel	2,00,000.00
4	Consumables and contingency	stationary, internet, telephone, fax, reference photocopy & printing, torch, batteries, and other things necessary to execute the project on and off field	50,000.00
6	Report and Publications	Report and paper publishing	10,000.00
9	Medical allowance/Insurance	It is necessary as the job to be assigned to the researcher and the technical assistant needs extensive travel and stay in the forests	10,000.00
11	Other Project Costs	Any unforeseen expenditure related to the project	15,000.00
12	**Total**		**5,79,400.00**
13	Institution Charges / Administrative overheads	Project implementation cost towards administrative support and maintenance of accounts	1,15,880.00
14	**Grand Total**		**6,95,280.00**

3. Assessing the current status and distribution of the Andaman Pale-footed Bush-warbler *Cettia pallidipes osmastoni*, a long-lost endemic bird taxon from the Andamans

Summary

The Andaman Pale-footed Bush-warbler *Cettia pallidipes osmastoni* (Family Cettiidae in the Order Passeriformes) is endemic and unique to the Andaman archipelago and is reportedly found only in the South Andaman Island. Known only from four specimens and two nests collected from late 19th century to early 20th century, the bird was never reliably recorded nor reported since 1907 despite a few searches. The Andaman taxon is morphologically distinct unlike congeneric members of the genus Cettia, triggering speculations among avian taxonomists that this could be a distinct species. With this background, this study, planned for a period of 2 years and 6 months, proposes to systematically survey the South Andaman Island and nearby islands to assess the status of the bird and to locate new populations. The survey will be carried out with a potential distribution map predicted and generated using different suites of species-habitat models like ENFA, Maxent, or CART. As the target taxon is extremely shy and retiring inhabitant of dense understorey in primary and secondary forests and is detected more often by its characteristic call, extensive playback experiments will be done to locate the birds in their breeding season and mist-netting will be undertaken in non-breeding season. The proposed project will further investigate into the reasons for this extreme rarity of the Andaman Pale-footed Bush-warbler and will also undertake conservation assessment of the taxon where threats to the bird populations will be identified and quantified.

Principal Investigator	:	Rajah Jayapal
Co-investigators	:	Manchi Shirish S. & S. Babu
Research Fellow	:	To be recruited on funding
Project Period	:	2 years & 6 months
Budget	:	Rs. 35,68,920/-
Funding source	:	Submitted to MoEF, Govt. of India for funding
Status	:	Under review & consideration by the funding agency
Collaborating agency	:	Nil

Background

Though India is home to about 1300 species of birds and ranks among the top ten countries in the world in terms of bird species diversity with over 12% of the world's avifauna, its birdlife is surprisingly marked by a low degree of endemism with only 4.5 % of the birds found only in India. Remarkably, the actual number of bird species endemic to the mainland India would be even lower, if it were not for the endemic birds of the Andaman and Nicobar Islands. These islands are known to harbour 25 species of birds endemic to them: 14 to Andamans, 8 to Nicobars, and 3 shared by

both the archipelagos. Though a large number of ornithological expeditions and surveys have been undertaken in Andaman and Nicobar islands in the past, our knowledge of the island avifauna, their status and distribution is rather limited as most of the surveys were restricted to some of the better known islands on account of restricted access and logistics and cryptic bird taxa like snipes, gulls & terns, owls, pipits, warblers, and Muscicapa flycatchers are often under-recorded in the surveys. This probably explains the recent discoveries of new taxa, hitherto unknown to science, from the islands: Nicobar Scops Owl (*Otus alius*) by Pamela Rasmussen (1998) and Great Nicobar Crake (*Rallina* sp. nov.) by Rajeshkumar *et al*., 2012. In addition to these new descriptions, several endemic subspecies of birds occurring in the Andaman and Nicobar Islands have now been found to be distinct species with increasing evidences - morphological, vocal, and genetic. In this regard, further taxonomical investigations into the island avifauna are highly warranted as more endemic taxa are likely to turn out to be distinct species, thus considerably increasing the stake for conservation of the island ecosystem which is already reeling under a host of anthropogenic threats.

Chief among the subspecies of island avifauna that are morphologically distinct and deserve a much closer examination for their true taxonomic status would be the Andaman race of Pale-footed Bush-warbler *Cettia pallidipes osmastoni* belonging to the Family Cettiidae in the Order Passeriformes. Bush-warblers are tiny, unobtrusive, and non-descript birds of the Old World typically found in the dense undergrowth of jungles and are characterized by a strikingly loud and explosive call, often the only clues to their identification and detection in the field. Pale-footed Bush-warbler occurs in three geographically distinct subspecies: i) the nominate form *pallidipes* along the Himalayas from Uttarakhand to south-west China and northern Myanmar, ii) *laurentei* from central Myanmar to Vietnam, and iii) *osmastoni* restricted to South Andaman Island. Among these three subspecies of Pale-footed Bush-warbler, the Andaman race is the rarest and is currently known only from four specimens - all collected from South Andaman, that include one partly mutilated specimen from Mt Harriet in late 19th century (Butler, 1899a) and an intact type specimen collected by R.B. Osmaston at "Port Blair" in early 20th century from which E.J.O. Hartert (1908) described the taxon. Since B.B. Osmaston's collection and description of two live nests with four eggs each from Mt Harriet in 1907, the bird was never recorded again from the Andamans despite a few recent opportunistic searches.

Though the fact that the Andaman Pale-footed Bush Warbler has not been reliably recorded for over 100 years is a matter of serious concern, it did not receive much attention from ornithologists and conservationists in the country; this is probably attributed to either lack of knowledge on the current status of the taxon or universal exclusion of 'subspecies' from conservation policy and assessment. But the strong possibility that this could be a distinct species (given the significant morphological differences - rather unusual in bush-warblers) raises its conservation significance given its endemicity to the Andaman Islands and rarity of the population. Further, it is not known why the populations of the Andaman subspecies became so scarce, when the mainland taxa are still locally common. One of the major threats to the species in the sub-Himalayan tracts is the recurrent forest-fire that clears the understorey

vegetation of *Themeda* grass-and-scrub, where the birds nest almost exclusively. But forest-fires are seldom recorded in Andamans and therefore the exact causes for the putative rarity of the island form remain a mystery.

With this background, this study proposes to conduct a systematically designed survey using species-habitat models to reliably document the current population status of the taxon and map its distribution. The study also aims to examine the ecological and human factors that potentially contribute to the habitat loss and subsequent population decline of the taxon in the island.

Study Area

The survey is proposed for two years covering two summers and two winters with another six-month period for logistics and report writing. Though the focal area of the study would be Mt Harriet National Park in South Andaman Island where the type specimen was collected, the survey will also cover suitable areas in other parts of the South Andaman Island and other islets in the Andaman and Richie's archipelagos, which comprise 325 islands in total covering about 6400 sq. km. area with the highest elevation of 732 m (Saddle Peak in North Andaman Island). The exact number of islands to be sampled and the extent of survey area would be determined after the findings of a preliminary analysis on potential occupancy of the species.

Objectives

a) To systematically survey the islands for the presence of the bush-warbler using potential distribution maps, predicted and generated from spatial models of species-environment relationships
b) To assess current population status of the bird in sites where the occurrence of the taxon is confirmed
c) To identify the threats to the bush-warbler population in the island and to suggest conservation measures to protect the taxon

Methodology

The first objective of the study would be to develop species distribution models based on their habitat features as quantified from known points of their occurrence so that the predicted sites of species occurrence can be mapped and used in subsequent field surveys (Soberòn & Peterson, 2005; Elith *et al*., 2006; Basille *et al*., 2008). More popularly known as 'Ecological Niche Models', the species-habitat distribution models are increasingly used in surveys to locate new populations of a rare species (e.g. Raxworthy *et al*. 2003 for reptiles in Madagascar; Hirzel et al., 2004 for Bearded Vulture in Swiss Alps; Peterson & Papes, 2006 for Bugun Liocichla in Arunachal Pradesh). Suitable suites of software like BioMapper (v. 4.0.7) or MaxEnt (v. 3.3. 3k) would be used in the study to build species distribution models and to predict the potential distribution of the bush-warbler in the Andamans. Survey of India's topographic maps of 1:50,000 scale along with remotely sensed spatial data (NOAA / NGDC-GLOBE DEM along with GIMMS-AVHRR data of NOAA-16 inter-calibrated with MODIS data) would be used to derive topographic and NDVI layers for model-building. The second part of this objective would be to systematically survey the potential areas for the presence of the species using the predictive distribution maps, as generated by

the species-environment models. Once the target area is identified and assessed for the habitat suitability, intensive searches will be made using both visual and auditory cues. We plan to use non-interactive playback experiments (Mcgregor, 2000) wherever necessary to detect the presence of the species. Since there is no documentation of the vocalization of *osmastoni*, we will make use of the characteristic territorial calls of the nominate race in the mainland India. Extensive mist-netting will be carried out particularly outside breeding season, as this seems to be the only survey method that returns a reasonable likelihood for detection of the members of genus *Cettia* in the field.

The second objective of the study would be to assess the current population status of the taxon at sites where the birds are confirmed to occur and breed in the survey. Since Pale-footed Bush-warbler is known to be extremely shy and skulking, detection rates would be too low for distance-based sampling (line transect or point count) to estimate population size unless the number of true replicates is reasonably high (Buckland *et al*., 2005). This is not possible given the extreme rarity of the taxon and patchiness of expected distribution if found to be extant. The best alternative would be to employ call-count (Bibby *et al*., 1992) as bush-warblers have typical territorial calls which are unmistakably loud and repetitive through the day, though they are less vocal outside the breeding season. In case a site is identified to have significant population in non-breeding season, it will be re-visited again during the nesting season for population estimation by means of call-count.

The third objective of the study is to investigate into reasons for the perceived rarity of the taxon in the island and to suggest measures to protect both the populations and habitats of this endemic bush-warbler. In the absence of reliable point-data on occurrence of the bird in the past and its micro-habitat requirements, it is rather challenging to identify the exact factors for the decline in the bird population. We intend to overcome this data-constraint by adopting a comparative approach between randomized sets of structurally and floristically homogeneous habitats: one where the taxon is detected in the survey and the other where it is found to be absent. All the micro-habitat variables will be measured and an index of human disturbance will be developed on the basis of threat perceptions and quantification. Suitable statistical approaches like Path Analysis / Structural Equation Model (SEM) or CART classification tool will be employed to identify the factors for the rarity of the taxon and to quantify the strength and direction of the relationships between the predictors and the response variable in a hierarchical manner.

Expected outcome and suggested plan of action for utilization of research outcome expected from the project:
The project will have the following outcomes at the end of the tenure:

1. The taxon Andaman Pale-footed Bush-warbler is already feared to be on the verge of extinction from the island. In view of this gloomy scenario, any finding / corroboration of the occurrence of the taxon or new populations in nearby islands would be a remarkable and encouraging sign for the avian biodiversity in the island.

2. In case the taxon is re-discovered in the island, the study will produce the first documentation on the current status and distribution of the bird – a significant output considering the fact that the species is little-known even in the mainland.
3. The study will also bring out a concept document, at the end of the study, for investigation into molecular systematics and comparative morphology to ascertain its true taxonomic status.
4. A comprehensive blueprint for conservation of the taxon will be developed and submitted to the Forest Department for implementation.
5. The survey will also bring out the status of the other small passerines in the islands as these are generally neglected in ornithological explorations.
6. We will also publish all the findings of the study in peer-reviewed journals of national and international repute.

Agencies which can utilize the results of the project

The main beneficiaries of the project findings would primarily include national (like MoEF and ZSI) and state government agencies (Forest Department & biodiversity boards) as they would add information value to the biodiversity data of the Andaman Islands immensely. The findings will also have greater implications for global conservation agencies like BirdLife International. If the taxon turns out to be a distinct species, as suspected by molecular taxonomists, this will also greatly boost birding tourism in the Bay islands – a relatively new, yet promising venture in India to evolve in recent times.

Work plan:

Activity	**YEAR 1**				**YEAR 2**				**YEAR 3**	
	Quarter				**Quarter**				**Quarter**	
	I	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**
Appointment of project staff	***									
Liaisoning with FD & obtaining research permit	***	***								
Pilot survey & base-camp estt.		***	***							
Procurement of spatial data and equipment	***	***	***							
Field-work & survey			***	***	***	***	***	***		
Annual progress reports				***				***		
Data analysis & Report writing									***	***

Budget Summary:

	GRAND TOTAL				
	Head	**Year 1**	**Year 2**	**Year 3**	**Total**
A	Salaries & wages	398400	412800	240720	**1051920**
B	Permanent equipment	162000	0	0	**162000**
C	Expendables / consumables	125000	60000	60000	**245000**
D	Travel	500000	550000	300000	**1350000**
E	Other project costs	60000	40000	80000	**180000**
F	Contingencies	150000	100000	100000	**350000**
G	Dissemination of research work	20000	55000	155000	**230000**
H	Institutional charges	0	0	0	**0**
	Grand Total	**1415400**	**1217800**	**935720**	**3568920**

4. Non Timber Forest Products and Livelihood Improvement – an analysis of forest type based availability and utilization in Wayanad District, Kerala

Status: To be presented in the internal research Committee

Summary

Non-timber forest products (NTFP) are integrated components of the forestry sector and have been widely recognized as potential resources for promoting sustainable livelihoods, conservation and capacitating development organizations. NTFP contributes to about 20% to 40% of the annual income of forest dwellers. Kerala with a rich tradition of Ayurveda contributed much to the development of herbal based medicine system and most of the products are collected from the forests as NTFPs. Among the raw drugs used, only 7 per cent is obtained from cultivated sources and the remaining are collected from the forests of the State by the tribal and local communities. Forests alone provide almost 40-50% of the raw drugs required for Ayurvedic preparations. Planning Commission identified high exploitation and poor regeneration, inadequate NTFP baseline data and mapping, poor attention for conservation, absence of sustainable harvesting protocols, inadequate capacity and knowledge in NTFP management and poor progress in research and development as some of the major issues and challenges for the conservation and management of NTFP resources. Hence a study has been proposed to understand the availability of different NTFP with different forest types in Wayanad district of Kerala and their role in livelihood improvement of tribal people.

Principal Investigator	:	PV Karunakaran
Co-Investigator/Consultant		
Research Fellow	:	
Project Period	:	Two and half years
Budget	:	Rs. 17.05/- lakh
Funding source	:	Western Ghats Development Programme-State Planning Board, Kerala

Collaborating agency : Nil

Background

The subject of NTFP and its dependency for livelihoods has been a topic of investigation in the country for more than three decades. Nevertheless the studies were largely anecdotal in nature and related to collection, marketing, and income generation (Sasidharan, et al 1997, Sasidharan and Muraleedharan, 2000, Nambiar et al 1985, Pusphangadan *et al* 1988, Shahabudin and Prasad 2004). Only a few species of trees have been studied quantitatively and over adequate spatial and temporal scales for discerning possible harvesting impacts; there are next to no studies on herbs and shrubs (Shankar *et al 1*998; Shahabudin and Prasad 2004). The degree to which plant populations are adversely affected by harvesting depends on natural history attributes of plant species, harvesting techniques adopted, the extent of extraction and the plant part used (Rai 2003). There is also evidence from the published literature that NTFP extraction and accompanying forest use practices may be leading to overall forest ecosystem simplification due to selective extinctions of plant species in the long term. Though information is not available on long-term studies, from current knowledge of plant-animal interaction, we can infer that collection of NTFP may have an impact on specialist animal species (Kumar 1985). The studies related to the availability of NTFP to forest types and attempt to estimate the productivity of NTFP resources in different forest types are never attempted (Shahabudin and Prasad 2004). Sasidharan and Muraleedharan (2000) described the quantity of more than 100 medicinal herbs collected from the districts of Wayanad including forest source, but no link was drawn with the extent of existing landcover (forest) with availability. Most of the studies are concentrated in the Attapady Valleys (Shalija and Karunakaran, 2013) and southern districts and very less attempt was carried out in the northern districts especially in Wayanad which is one of the largest tribal areas in the State. Anthropological issues such as stock or availability and potential competition among the ethnic and non ethnic group seldom get any attention in the NTFP study

Study area

Wayanad District, Kerala

Objectives

1. To identify different vegetation (forest) types in Wayanad district
2. To estimate the availability of different NTFP with respect to the forest types
3. To study the quantity of each NTFP collected from the forests, current collection practices and conflicts
4. To develop strategies for NTFP based livelihood improvement of dependant community

Methodology

The study will be limited to NTFPs which are plant origin and those products that could be assigned to specific vegetation (forest) types. The overall approach of this study is participatory in nature wherein state level and local institutions will be involved. The State level stakeholders such as forest department (resource managers)

and SC/ST Federation (marketing agency) will be involved through their local units. At local level, the major partners are Vana Samarakshana Samithi (VSS) or Ecodevelopment Committees (EDC), the institutional arrangements for participatory forest management (PFM) as the case may be involved. In addition to this, the local NGOs and self help groups, if any, working in this area will also be approached. Remote sensing and GIS based analysis will be carried out for landcover mapping and field based sampling protocols will be used for studying the availability of different NTFPS in each forest types. Exploratory and ethnographic methods will be used for collecting information on collection practices, cross checking the data collected through records and any conflicts exist among and between different stakeholders

Expected outcome and suggested plan of action for utilization of research outcome expected from the project

The proposed study will provide the updated information on the vegetation (forest) types of Wayanad district. The information on type and quantity of NTFP available in each forest types will be an important database for the scientific community and other stakeholders such as forest department, SC/ST Federation, dependant population, planning and implementing agencies. The demographic data of each NTFP species will help in identifying remedial measures including re-stocking. The role played by different NTFPs in the livelihood security of tribal people is important information in facilitating strategy development.

Agencies which can utilize the results

Kerala Forests and Wildlife Department, State Planning Board, Tribal Department, Academic and Research Communities, NGOs, etc

Work plan

SN	**Activities**	**Year I**				**Year II**				**Year III**	
		Quarter									
		1	2	3	4	1	2	3	4	1	2
a.	Recruitment of Research Fellow										
b.	Permission from Forest Department										
c.	Procurement of equipments										
d.	Procurement of satellite images										
e.	Spatial analysis and preparation of base map and study design										
f.	Field Data collection on flora, fauna, social aspects										
g.	Preparation and submission of Interim reports including inception report										
h.	Consultation meetings and										

	workshops										
i.	Statistical analyses and Final Report preparation										
j.	Submission of Draft report										
k.	Submission of Final Report										

Budget summary (year wise)

SN	Item	Year I	Year II	Year III	Total
1	Manpower				
	i. Project Fellow (30 months) @Rs.16,000/PM+15%HRA for year 1&2 years and 18,000/PM for 3 year	220800.00	220800.00	124200.00	565800.00
	ii. Technical Assistant (30 months) @Rs.7,000/PM	84000.00	84000.00	42000.00	210000.00
2	Consumables (satellite data, survey of India topo sheets and stationeries)	200000.00	50000.00	100000.00	350000.00
3	Equipments (One GPS-Garmin E-trax)	25000.00	-	-	25000.00
4	Travel expenditure	100000.00	150000.00	50000.00	300000.00
5	Contingencies	25000.00	50000.00	25000.00	100000.00
	Total				1550800.00
	Institutional charge (@10%)				155080.00
	Grand Total				1705880.00

5. Study on Extent and Status of Mangroves in Kerala

Summary

The assessment by Forest Survey of India during 2005 and 2009 recorded an area of 5 km^2 as mangrove in Kerala where as in 2011 it was 6 km^2. Once, the extent of mangroves in Kerala was estimated at 700 km^2 and during 1992 it reduced to about 17 km^2, of which 36% are in degraded condition. The mangroves in Kerala are largely estuarine since no major delta is present and distributed in several patches compared to other coastal states in India. The 41 west flowing rivers of the State support positive habitat requirements such as estuarine formation for mangrove establishment but due to varying degrees of anthropogenic pressures the extent has been reduced considerably in the recent past. Many coastal local self government institutions (Panchayath, Municipality and Corporation) expressed their willingness to take up coastal restoration activities during the post Tsunami period but could not be carried

out due to the lack of appropriate information. Most of the studies in the Kerala coasts are on floristic and selected faunal groups and for more than two decades no assessment was carried out except the periodic reporting by FSI in a broad scale which is insufficient for local specific management strategies. It was also reported earlier that majority of the mangrove area falls into private property (> 70%) and the remaining portion under public lands which need to be evaluated since the tenurial rights are not established in many estuarine and non estuarine coastal areas. The impact of various conservation and management inputs employed over the mangrove areas such as implementation of coastal zone management plan, biological diversity act, and so on are not known. On the other hand major and minor developmental projects such as Goshree, Vallarpadam Container Project, Naval Base, fishing harbors, many tourism projects and infrastructure projects at different scales were also being implemented by both governmental and non governmental agencies. The cumulative impact of these coastal interventions are not known to different stakeholders including Forest and Wildlife Department, who is the custodian of biological diversity of the State. A recent survey for fishing cat in the mangrove area of the State reported that there are many potential areas for restoration of mangroves indicated by sparse representation of mangroves or allied species and many patches are too small leaving the habitat vacant without any seedlings or saplings. The mapping and updating of information is also required since the mangrove patches act as habitat for extensive faunal diversity, protection of coasts against erosion, breeding and roosting site for many birds including migrants, some of the sites have been acclaimed as International IBA by the Birdlife International due to the presence of thousands of water birds and others.

Principal Investigator	: P V Karunakaran
Co-Investigator	: M Balasubramanian
Research Fellow	:
Project Period	: Three years
Budget	: Rs. 41.23/- lakh
Funding source	: Kerala Forests and Wildlife Department
Collaborating agency	:

Background

Mangrove ecosystem is considered to be one of the most productive habitats in the world on account of the large quantities of organic and inorganic nutrients released in the coastal wetland. Once, the extent of mangroves in Kerala which are estuarine in nature was estimated at 700 km^2 and during 1992 it reduced to about 17 km^2, of which 36% are in degraded condition. The 41 west flowing rivers of the State support positive habitat requirements such as estuarine formation for mangrove establishment but due to varying degrees of anthropogenic pressures the extent has been reduced considerably in the recent past. Many coastal local self government institutions expressed their willingness to take up coastal restoration activities during the post Tsunami period but could not be carried out due to the lack of appropriate information. Most of the studies in the Kerala coasts are on floristic and selected faunal groups and for more than two decades no assessment was carried out except the periodic reporting by FSI in a coarse scale which is insufficient for local specific

management strategies. It was also reported earlier that majority of the mangrove area falls into private property (> 70%) and the remaining portion under public lands which need to be evaluated since the tenurial rights are not established in many estuarine and non estuarine coastal areas. The impact of various conservation and management inputs employed over the mangrove areas such as implementation of coastal zone management plan, biological diversity act, and so on are not known. On the other hand major and minor developmental projects such as Goshree, Vallarpadam Container Project, Naval Base, fishing harbors, many tourism projects and infrastructure projects at different scales were also being implemented by both governmental and non governmental agencies. The cumulative impact of these coastal interventions are not known to different stakeholders including Forest and Wildlife Department, who is the custodian of biological diversity of the State. A recent survey (Mukherjee *et al*, 2013) for fishing cat in the mangrove area of the State reported that there are many potential areas for restoration of mangroves indicated by sparse representation of mangroves or allied species and many patches are too small leaving the habitat vacant without any seedlings or saplings. The mapping and updating of information is also required since the mangrove patches act as habitat for extensive faunal diversity, protection of coasts against erosion, breeding and roosting site for many birds including migrants, some of the sites have been acclaimed as International IBA by the Birdlife International due to the presence of thousands of water birds and others.

Study area

Coastal Kerala

Objectives

1. To map (preferably 1:25000 scale) the distribution and extent of the of mangrove forests in the west coast of Kerala
2. To find out the ownership (tenurial rights) status such as private, government, reserved forests, revenue puramboke, etc of the mangroves in Kerala and the willingness of private owners to change the ownership status for better management and conservation
3. To study the biodiversity richness of the mangrove cover especially on flora (both true mangroves and associates) and fauna (different taxa like mammals, birds, herpatofauna, etc)
4. To study the present landuse patterns and livelihood dependencies on mangroves by different stakeholders and identify patches/areas for bringing under different conservation status such community reserves, conservation reserves and biodiversity heritage sites under BDA, 2002.

Methodology

1. Mapping: GIS and Remote Sensing based standard protocols
2. Tenurial rights: Interaction with officials of different departments and individuals, perusal of revenue records, etc
3. Biodiversity richness: Field based methods for selected groups
4. Current landuse: Field based sampling and GIS & remote sensing application

5. Developmental threats: Interaction with local people and field based observations
6. Site specific management options: The draft strategies will be finalized through consultative meetings

Expected outcome and suggested plan of action for utilization of research outcome expected from the project

1. Location and extent of all mangroves of the State irrespective of the size
2. Status of mangroves indicating extent of mangrove forests under the ownership of private, government, declared reserved forests, puramboke, etc.
3. Biodiversity richness of mangrove forests viz., mangrove species, mangrove associates, other flora and fauna present in the mangroves.
4. Present landuse pattern of mangroves such as tourism, fishing and other livelihood dependence on mangroves by local communities and others.
5. Information on different types of developmental threats existing on each mangrove patches
6. List of mangrove patches suitable for declaring as Biodiversity Heritage Sites, Community Reserves, Conservation reserves, etc and other management strategies
7. List of private owners who are willing to sell their mangrove areas for conservation program.

Agencies which can utilize the results

Forests and Wildlife Department, Local Self Government agencies, NGOs, research and academic institutions, etc

Work plan

SN	Activities	Year I				Year II				Year III			
		Quarter											
		1	2	3	4	1	2	3	4	1	2	3	4
a.	Recruitment of Research Fellow												
b.	Permission from Forest Department												
c.	Procurement of equipments												
d.	Procurement of satellite images												
e.	Spatial analysis and preparation of base map and study design												
f.	Field Data collection on flora, fauna, social aspects												
g.	Preparation and submission of Interim reports including inception report												

h.	Consultation meetings and workshops												
i.	Statistical analyses and Final Report preparation												
j.	Submission of Draft report												
k.	Submission of Final Report												

Budget summary (year wise)

S.N	Particulars	Year I	Year II	Year III	Total
1	Research Fellow (2 nos)@ Rs.16000/ month+15% HRA for first two years and Rs.18000/month + HRA for 3rd year	441600	441600	496800	1380000
2	Wages for Field Assistant (3 Nos @ Rs. 7000/ month	252000	252000	252000	756000
3	Data (IRS P6 LISS IV, topo sheet; Equipment (1 No of water resistant GPS, pH meter)	250000	-	-	250000
4	Consumables (stationeries and chemicals	50000	50000	50000	150000
5	Consultation meetings and workshops with stakeholders	50000	50000	100000	200000
6	Field Travel expenditure (all the coastal districts (10 Nos.) of Kerala)	100000	100000	100000	300000
7	Contingency	200000	200000	150000	550000
	Sub Total (1-7)	1343600	1093600	1148800	3586000
	Institutional charge (@15%) of sub total	201540	164040	172320	537900
	Total	1545140	1257640	1321120	4123900
		(Rupees forty one lakh twenty three thousand nine hundred only)			

6.Land use dynamics, Disturbances and Landscape patterns in the Mountain regions of South Asia

Status: To be presented in the internal research Committee

Summary

Mountain ecosystems offer an opportunity for understanding anthropogenic influence on land cover/land use changes including climate changes. So far, comprehensive studies on land use dynamics, disturbances and landscape patterns have been scarce

in mountain regions of South Asia. Hence, knowledge of spatial dynamics, the magnitude of different land use types, factors driving the changes, and the implications of these changes is important to drive sustainable policies in mountain regions. Recent land use studies in different mountain regions of south Asia show that there has been an increase in cropland at the expense of forests and grasslands due to population growth and changing land use policies. Understanding the impacts of these drivers and LCLUC in mountain regions of South Asia is an urgent task.

Principal Investigator	:	Dr. Krishna Prasad Vadrevu, Associate Research Professor, Department of Geographical Sciences, University of Maryland College Park (UMCP)
Co-Investigator	:	P V Karunakaran, Principal Scientist, SACON
Research Fellow		
Project Period	:	Three years
Budget	:	App. 50 lakh for SACON component
Funding source	:	NASA, USA
Collaborating agency	:	University of Maryland, CWRDM, NRSC

Background

To understand LCLUC in mountain regions, we must understand the current state of the land, the forces of change that have created the current landscape, and the causes and consequences of the change. In several mountain regions, no other human activity has modified the structure and function of the ecosystems as much as agriculture. In recent times, increasing population, associated demand for food, modern agricultural practices changing attitudes and perceptions are causing overwhelming impact on mountain ecosystems (Lele and Srinivasan, 2013). Due to short-rotation cycles from slash and burn agriculture including plantation activities native forests are being threatened (Rhoades, 1997). Understanding the drivers of agricultural expansion and how they are impacting the mountain environments is an important area of research. Further, policy frameworks to generate economic growth and development in mountain regions have to be consistent with the geography of the area including the current understanding of land use/cover. For example, given their natural resources and scenic beauty, the mountain regions are ideally suited for the development of the tourism sector. However, the chances of success will depend on the development of physical and social infrastructure and willingness of local people to adapt to the new land use/cover changes. Six different sectors impact LCLUC in the mountains of South Asia. They include a) Agricultural expansion; b) Forest conversion due to slash and burn agriculture; c) Mining activities; d) Tourism; e) Real estate and f) Urbanization. In addition, extreme events such as fires, landslides, floods and droughts also impact mountain environments. Understanding the impacts of these drivers and LCLUC in mountain regions of South Asia is an urgent task. Overall, the proposed project will address the following questions:

- How did the landscape change over the last forty years as a result of human activities and climate variations in the mountain regions of South Asia?
- What are the major anthropogenic drivers of LCLUC in the mountain regions of South Asia?

- What are the spatial and temporal variations (frequency, severity, extent, and duration) in extreme events (fires, droughts, floods, landslides) that influenced the mountain ecosystems in South Asia?
- What indicators can be used to forecast land use changes in mountain environments?

Study area: Western Ghats
High Ranges

Objectives

1. Characterize the nature, magnitude and causes of land cover/land use changes in mountain regions using remote sensing datasets at multiple scales.
2. Develop a historical database on extreme events over mountain regions to assess disturbances in land cover/use: Extensive databases on extreme events will be developed and used to assess LCLUC changes.
3. Identify and analyze LCLUC drivers based on demographics, tenure, socio-economics, forest and agricultural practices in the mountain regions of South Asia.
4. Develop comprehensive land cover/land use change modelling scenarios to assess vulnerability of mountain ecosystems to anthropogenic disturbances.

Methodology
LCLUC in the mountain regions of South Asia will be analyzed using both optical (mostly NASA data) and microwave data at multiple resolutions. A robust socioeconomic database integrated with structured interviews and modeling framework will be used to identify LCLUC drivers and factors influencing land management decisions.

Expected outcome and suggested plan of action for utilization of research outcome expected from the project

1. Quantification of nature, magnitude and causes of LCLUC in a range of mountain regions in South Asia;
2. Development of extensive land use/cover data and extreme events (floods, fires, landslides, earthquake databases) for six different mountain regions.
3. Development of spatially gridded biophysical and socioeconomic databases for mountain regions.
4. Quantitative assessment of landscape structure in mountain regions over long-time periods from extreme disturbances using landscape metrics.
5. Projections of land cover in response to anthropogenic drivers based on simulation modelling.
6. Benchmarking of land use transition process in different mountain regions and comparisons among different mountain environments.
7. Statistical analysis that relate both physical and social variables to LULCC, economic growth and environmental change.

Agencies which can utilize the results

National and regional Planning agencies

Work plan

SN	Activities	Year I				Year II				Year III			
		Quarter											
		1	2	3	4	1	2	3	4	1	2	3	4
a.	Inception Meeting of project partners and preparation of implementation strategy												
b.	Permission from relevant management agencies												
c.	Procurement of secondary data and equipments												
d.	Spatial analysis and preparation of base map and study design												
e.	Field Data collection												
h.	Consultation meetings and workshops												
i.	Statistical analyses and Final Report preparation												
j.	Submission of Draft report												
k.	Submission of Final Report												

Budget Summary

S.N	Particulars	Year I	Year II	Year III	Total
1	Research Fellow (2 nos)@ Rs.16000/ month+15% HRA for first two years and Rs.18000/month + HRA for 3rd year	441600	441600	496800	1380000
2	Wages for Field Assistant (3 Nos @ Rs. 8000/ month	288000	288000	288000	864000
3	Data (IRS P6 LISS IV, topo sheet; Equipment (1 No of water resistant GPS)	150000	-	-	150000
4	Consumables (stationeries and chemicals	100000	100000	100000	300000
5	Consultation meetings and workshops with stakeholders	100000	100000	100000	300000
6	International travel		100000	150000	250000
7	Field Travel expenditure	50000	100000	100000	250000
8	Publishing	200000	200000	250000	650000
9	Contingency		100000	100000	200000
	Sub Total (1-7)	1329600	1429600	1584800	4344000
10	Institutional charge (@15%) of	199440	214440	237720	651600
	Total	1529040	1644040	1822520	4995600
		(Rupees forty nine lakhs and ninety five thousand only)			

7. Enhancing Livelihood options among forest dependent tribal communities of Kerala: Exploring innovative mechanisms by income-health promotion

Summary

Kerala with a rich tradition of Ayurveda contributed much to the development of herbal based medicine system and most of the products are collected from the forests as NTFPs. Among the raw drugs used, only 7 per cent is obtained from cultivated sources and the remaining are collected from the forests of the State by the Tribal and Local Communities. The project therefore visualizes the possibility of enhancing livelihood options with respect to medicinal plants with a holistic approach and by using the facilitated and local knowledge for the advantage of the targeted community and the general population. Major problems identified by earlier studies and reports are: landlessness and lack of entitlement; extremely high magnitude of poverty and vulnerability among indigenous forest-based communities, indigenous people and small and marginal farmers; lack of micro-level planning; high levels of alcohol and tobacco addiction; poor nutrition and; poor access to health and educational institutions. The project considers that it is not possible to address livelihood without corresponding improvements on several domains which affect the life and culture of such communities. Health and nutrition are important mechanisms which enhance the capabilities of communities and especially tribal societies where there are specific health problems as well as high prevalence of alcoholism. The major task of this project is to develop strategies, action plans and a sustainable program for NTFP based holistic livelihood security of local people (dependant population) involving income-health promotion in the district of Wayanad in Kerala.

Principal Investigator(s)	:	K Rajasekharan Nayar (Santhigiri Social Research Institute), N Anil Kumar (MSSRF –CabC), P V Karunakaran (SACON)
Co-Investigator/Consultant	:	D Nandakumar, O G Sajitha, SE Sajeev Kumar (all from Santhigiri Social Research Institute)
Research Fellow	:	
Project Period	:	Two years
Budget	:	App. I crore (SACON component including part of key personal salary)
Funding source	:	*InFoRM program of USAID*
Collaborating agency	:	Santhigiri Social Research Institute, Thiruvananthapuram, MSSRF –CabC, Kalpetta, Wayanad

Background

The contemporary perspective on poverty and livelihoods of tribal communities is saddled between processes of marginalisation (lack of entitlement to forest resources) on the one hand and mainstreaming (into the non-farm urban economy) on the other hand (Shah and Sajitha, 2009). An estimated population of 350-400 million people depend on forest in India (MoEF, 2009) and several field based studies have only documented the adverse impact of forest dependents pattern on the forest quality

(MoEF, 2011). They do not consider the inherent limitations of the tribal societies in adapting to such imposed culture. As far as the forests are concerned, mitigation measures especially in the form of afforestation, assume special importance as such measures may simultaneously help enhancing livelihood support to the poor through creation of wage employment on the one hand and regeneration of Non-Timber Forest Products (NTFPs) on the other hand. A study by the World Bank (2006) indicated that, if properly operationalised, Joint Forest Management could bring as high as Rs 1 million worth of forest produce for supporting the livelihood of the communities. An estimated three fourth of the forest-based income is from NTFPs (MoEF, 2009) and hence related enterprises can contribute significantly, to livelihood enhancement in forested areas. However, the lack of sustainable harvesting practices, productivity, collection mechanisms, sustainable marketing etc. needs to be prioritized and operationalised. The present proposal is an attempt in that direction.

Study area

Wayanad District Kerala

Objectives

1. Assessing the role and availability of NTFP in market economy of the local people and identification of Medicinal Plants suitable for the agro-climatic zone in Wayanad district
2. Estimating the quantity of each NTFP collected from the forests, current collection practices and conflicts
3. Classification of medicinal plants in terms of diseases and value.
4. Baseline survey of identified clusters of forest dependent communities
5. Identification of social capital in the community such as SHG and other organizations including agencies for tribal governance

Methodology

1. Quantification of NTFP based on landcover: Field based sampling and application of GIS and Remote Sensing tools
2. Marketing: Perusal of SC/ST Federation documents
3. Baseline line survey on clusters forest dependent communities: Social science survey tools and qualitative field based studies
4. Involvement of local social capital: The major local level institutions involved in the collection and marketing of NTFPs are community based PFM institutions such as Vana Samrakshana Samithis (VSSs) and Eco Development Committees (EDCs) and local unit of the state based Scheduled Caste/Scheduled Tribe Cooperative Society or Federation

Expected outcome and suggested plan of action for utilization of research outcome expected from the project

1. Landcover based data on NTFP
2. Information on NTFP availability, collection, and revenue generation by different clusters of tribal communities
3. Role of social institutions in NTFP management

4. Information on geo specific health problems
5. Health package for women and children
6. Agencies which can utilize the results
7. Tribal Welfare department, Forests and Wildlife department, NGOs, Local self government institutions, etc

Work plan

SN	**Activities**	**YEAR I**				**YEAR II**			
		Quarter				Quarter			
		1	2	3	4	1	2	3	4
a.	Inception meeting with partners								
b.	Recruitment of Research Fellow								
c.	Permission from Forest Department								
d.	Procurement of data & equipments								
e.	Preparation of base map and study design								
f.	Field Data collection on NTFP, marketing, Livelihood and other social aspects								
g.	Preparation and submission of Interim reports								
h.	Consultation meetings and workshops								
i.	Statistical analyses and Final Report preparation								
j.	Submission of Draft report								
k.	Submission of Final Report								

Budget summary (year wise)

SN	**Head**	**Year 1**	**Year 2**	**Total**
1	Staff			
	Honorarium for key Personnel			
	40000X12X1	480000	480000	960000
2	Salary for facilitators/Researchers			
	16000X12X2	384000	384000	768000
3	Salary for field Staff			
	10000X12X2	240000	240000	480000
4	Purchase of Equipments/ Data Cost	1000000	1000000	2000000
5	Lab running Expenses	800000	1500000	2300000
6	Stationary and Consumables/ Contingencies	600000	600000	1200000

SN	Head	Year 1	Year 2	Total
7	Travel for key personnel, Facilitators/ Field Staff	500000	300000	800000
8	Organization of Meetings	200000	200000	400000
	Sub-Total	4204000	4704000	8908000
9	Institutional overhead @ 15%	797400	842400	1639800
	Grand Total	5001400	5546400	10547800

8. Ecology of benthic invertebrates from the Myristica swamps along the Western Ghats.

Summary

Freshwater swamps occur in many parts of the world - in the valleys of Mississippi and its tributaries, in Sweden, Swamp forests fringe the Amazon and its tributaries, Odzala National Park, Congo, in the Malaysian region, Papua New Guinea etc.. In India, freshwater swamps are reported from the Siwalik and Doon Valley and the Brahmaputra Valley. The Western Ghats, one of the well known global centres of biodiversity and endemism are home to very special kind of Myristica swamps. Krishnamoorthy (1960) reported the Myristica swamp for first time as a special type of habitat from the Travancore region of South Indian Western Ghats, over five decades ago. The Myristica swamps have high ecological and economic value; however, due to man interventions the last fragments of these valuable patches are on the road to extinction.

Myristica swamps are dominated by members of Myristicaceae, the Western Ghats have three genera and five species; all of them are trees associated with evergreen to semi-evergreen forests. ***Gymnacranthera canarica*** and ***Myristica fatua***var. ***magnifica*** are exclusive to the swamps. ***M. malabarica*** is occasional to the swamps. The other species are ***M. dactyloides*** and ***Knema attenuata***. All these except ***M. dactyloides*** are endemic to the Western Ghats.

Despite its classification and importance as an endemic species swamp forest very little scientific information is available. Since the 1990s scientist started documenting the floral aspects and mapping the swamps i.e. 51 in Karnataka and 60 in Kerala. From Karnataka region 88 plant species including the new species *Semecarpus kathalekanesis* and 41 endemics were documented Chandran et al. (1999). Nair et al (2007) reported 220 plant species from the southern Western Ghat swamps with 49 endemics. The location of swamps in Northern Kerala has been reported by Jayarajan and in the Satari taluka of Goa by Shantakumaran et al. (1995).

The interest in the documentation of fauna from the Myristica swamps has been much recent with remarkable outcomes. The survey from the five swamps of Uttara Kannada resulted in 15 species of mammals, 59 species of birds, 22 species of reptiles, 29 species of amphibians, 16 species of fishes, 109 species of butterflies and 6 species of damselflies; eleven species being endemic to the Western Ghats (Arvind et al. 2004, Subramaniam 2005 and Ali et al. 2006). Nair et al (2007) in their

comprehensive study covering 19 swamps from the Southern Western Ghats documented 362 invertebrates and 281 vertebrates with 16.32% of the endemic.

Benthic invertebrate species perform a variety of functions in freshwater food webs. The focus of faunal studies among the Myristica swamps has been on the mega fauna while the benthic fauna has been neglected despite the fact that benthic invertebrates are a major source of food for vertebrates. With this understanding the study is proposed with the following objectives.

Principal Investigator	: Goldin Quadros
Co-Investigator/Consultant	: --
Research Fellow	: Two research fellows (will be appointed after the Grant of the project)
Project Period	: Three years
Budget	: Rs. 4902600/-
Funding source	: MoEF & CC
Collaborating agency	: --

Background

In India the fresh water swamps are found along the Shivaliks, Doon valley, Brahmaputra valley, the Kalakkad Mundanthurai Tiger reserve, Tamil Nadu. The Western Ghats have a special type of freshwater habitat called the Myristica swamp characterized by the two endemic species of plants belonging to the Myristiceae family (Chandra and Mesta 2001, Nair et al. 2007).

Myristica is a primitive family of flowering plants having 18 genera and 300 species. The nutmeg, ***Myristica fragrans,*** a native of Mollucas Island, and cultivated widely in the gardens of the Western Ghats, is a well known spice. Prior to Krishnamoorthy (1960), who reported for the first time Myristica swamp as a special type of habitat from the Travancore region of South Indian Western Ghats, over five decades none ever referred to such endangered habitats. Myristica swamps are dominated by members of Myristicaceae. The Western Ghats have three genera and five species of Myristicaceae; all of them are trees associated with evergreen to semi-evergreen forests. Of these, ***Gymnacranthera canarica*** and ***Myristica fatua***var. ***magnifica*** are exclusive to the swamps. ***M. malabarica*** is occasional in the swamps and more frequent in the evergreen forests. The other species of trees are ***M. dactyloides*** and ***Knema attenuata***. All these except ***M. dactyloides*** are endemic to the Western Ghats.

Despite its classification as a swamp forest and its importance as an endemic specie forest very little attention was paid in terms of gathering scientific information about the swamps. It was only since the 1990s that scientist started documenting the floral aspects and mapping the swamps in Karnataka and Kerala. Chandran et al. 1999 reported 51 Myristica swamps from Uttara Kannada while Nair documented 60 swamps from the southern Kerala region. From the five swamps studied in detail from the Karnataka region 64 trees and 24 species of shrubs and herbs were documented including the description of the new species *Semecarpus kathalekanesis* (Swaminath

2000) that is restricted to the swamps. From the species recorded 41 are endemic to the Western Ghats (Ali et al. 2006). Nair et al (2007) reported 92 herbs and shrubs, 49 climbers and 79 trees from the southern Western Ghat swamps with 49 endemic species. Further, Jayarajan reported the locations of swamps in Northern Kerala following which there have been a few preliminary studies on the floral aspects of the swamp. While the northern most swamp despite report of its occurrence in the Satari taluka of Goa (Shantakumaran et al. 1995) has remained neglected.

The interest in the documentation of fauna from the Myristica swamps has been much recent with remarkable outcomes. The survey from the five swamps of Uttara Kannada resulted in 15 species of mammals, 59 species of birds, 22 species of reptiles, 29 species of amphibians, 16 species of fishes, 109 species of butterflies and 6 species of damselflies; eleven species being endemic to the Western Ghats (Aravind 2004, Subramaniam 2005 and Ali et al. 2006). Nair et al (2007) for the first time carried out a more comprehensive study covering a large number of phyla in the 19 swamps from the Southern Western Ghats. They documented about 362 invertebrates and 281 vertebrates (this also included the benthic invertebrates from two swamps) with 16.32% of the animals recorded as endemic to the Western Ghats. The emphasis however in the faunal studies has been on the mega fauna while the benthic fauna has been neglected despite the fact that benthic invertebrates are a major source of food for vertebrates.

Benthic invertebrate species perform a variety of functions in freshwater food webs. First, they provide essential ecosystem services by accelerating detrital decomposition (van de Bund et al. 1994, Wallace and Webster 1996). Dead organic matter is one of the main sources of energy for benthic species in shallow water habitats. Second, benthic invertebrates release bound nutrients into solution by their feeding activities, excretion and burrowing into sediments. Bacteria, fungi, algae and aquatic angiosperms can quickly take up these dissolved nutrients accelerating microbial and plant growth (Wallace et al. 1997). Third, many benthic invertebrates are predators that control the numbers, locations and sizes of their prey (Crowl and Covich, 1994). Fourth, benthic invertebrates supply food for both aquatic and terrestrial vertebrate consumers (e.g., Fishes, Reptiles and birds). Finally, benthic organisms accelerate nutrient transfer to the overlying waters (Clarke et al. 1997).

The extent of understanding of the effects of benthic organisms on freshwater ecosystem processes varies with the type of freshwater systems, necessitating its study.

Study area

As per the available information there are 67, 51 and 1 Myristica swamps are located along the Western Ghats spread over three states of Kerala, Karnataka and Goa respectively. The benthic invertebrates and physicio-chemical parameters from the 119 Myristica swamps will be sampled seasonally during a period of two years.

Objectives

1. Describe the benthic invertebrate community occurring in the Myristica swamps.
2. Study the factors that influence the diversity and abundance of the benthic invertebrates i.e. physico-chemical, sediment, biological including the vegetation type.

Methodology

The methodology used in other fresh water swamps will have to be adapted and standardized as no attempt has been made to study benthic community from the Myristica swamps. Taking the driving environmental factors into consideration while doing the preliminary study the number of swamps that will be sampled may be reduced.

Objective 1.

Describe the benthic invertebrate community occurring in the Myristica swamps.

As per the literature available, the documented Myristica swamps vary from 0.1 to 16 hectares. Hence in order to get a complete understanding of the swamps the larger swamps will be divided in sub plots and geo located From each of the subplots the benthos will be sampled from three locations of each swamp / subplot i.e. the edge of the swamp/ subplot, the centre and the point in between the edge and the centre of the swamp/ subplot.

The collection will initially involve two different methods and depending on the results only one will be standardized and continued. One method will be collecting the sediment from each location using a hand held grab of 0.01 m^2 size (Kiceniuk and Williams, 1987). The benthos will be narcotized using 10% $MgCl_2$ and sieved through a 0.45 mm mesh sieve (Bachelet, 1990) to collect the benthic samples and pooled together to form one sample. The second sampling method will be done using scoop nets (according to Chapman et al. (2004) scoop nets are better suited and easy to standardize in varying swampy habitats) at each of the three locations and pooled to form one sample.

The benthic samples collected will be preserved in 5 % formalin and will later be identified to the best possible taxonomic level.

Objective 2:

Study the factors that influence the diversity and abundance of the benthic invertebrates i.e. physico-chemical, sediment, biological including the vegetation type.

The changes in the microhabitat of the swamp due to varying pH, nutrients, organic content and the moisture are known to important in restricting the species composition of swamps. To assess this influence, the water samples will be collected in clean plastic carboys from the sampling stations and will be analysed for physico-chemical aspects including the temperature, pH, salinity, Dissolved Oxygen and nutrients on the field using standardized portable kit preferably Delta Tox II.

Sediment samples will be collected up to a depth of 15 cm following the standard procedures (Jackson 1973). The samples will be pooled from the collecting points and air dried for later chemical studies in the laboratory. The soil will be quantified for soil moisture using gravimetric method (Gupta 2006) Soil pH using the potentiometric method (Tandon 2004), organic carbon (Walkey and Black 1934), sediment texture using pipette method (Buchanan, 1984), total nitrogen using Kjeldhal's distillation method (FAO, 1975), available and total phosphorus using ammonium molybdate method (Grasshoff et al. 1999) and Available Phosphorus using ammonium acetate method (Tandon 2004).

Plankton sampling will be undertaken from the preferably from the midstream of the swamp / subplot using plankton net of 41µm mesh size for phytoplankton and 120 µm mesh size net for zooplankton. The Phytoplankton samples will be preserved using Lugol's iodine solution and the zooplankton will be preserved in 4% buffered formalin and analysed later in the laboratory and identified using the taxonomic keys (Krishnapillai 1986, Santhanam & Srinivasan 1994, Bellinger & Segee 2010). The density and diversity of plankton will be assessed to analyse the aquatic profile.

At the each of the locations swamp / subplot of benthic sampling a 10 x 10 m quadrat will be plotted to document the vegetation for the diversity and density of trees, herbs and shrubs. The methods used by Chandran et al. (1999) and Nair et al (2007) will be followed. Further along with the benthic samples the sediment samples will also be collected, air dried and used for chemical analysis in the Laboratory. The benthos associated with the litter in these quadrats will also be collected. The parameters that will be assessed include soil pH, Organic carbon, nutrients NPK and soil texture as per the procedure mentioned above.

Expected outcome and suggested plan of action for utilization of research outcome expected from the project

The anticipated deliverables from the project are as follows:

1. The major research output will be the scientific documentation and a base line data of the benthic invertebrates from the Myristica swamps along the Western Ghats.
2. The study will help in understanding if the seasonal variations, environmental parameters and habitat size influence the diversity and abundance of species in the Myristica swamps.
3. Two individuals to work for their PhD degree,
4. Research publications in peer reviewed journals, and
5. The study may become instrumental in replicating the methodology to assess the benthic invertebrates from the other fresh water swamps of India.
6. This study will help in achieving a number of Aichi targets namely Targets 1, 2, 5, 6, 8, 9,11,12 and 14.

Agencies which can utilize the results

The results from the study will be useful to the Ministry of Environment and forests, Government of India, as it will help in promoting the conservation of an endemic highly endangered Myristica swamp, it can even showcase it as an example of achieving a multiple of Aichi targets. The study will be helpful to the Zoological Survey of India as well as the Botanical Survey of India. The methods will be useful to the academic institutions as well as research organizations who would like to undertake the study of the benthos from the freshwater swamps. The state governments and forest departments could also use the results to showcase their conservation activities.

Work plan

Activities	Months											
	1st Year				2nd Year				3rd Year			
	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27	28-30	31-33	34-36
Appointment of staff	xxx											
Reconnaissance survey	xxx											
Procurement of equipment	xxx											
Procurement of permissions	xxx											
Field work / Data collection*		xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	
Sample and data Analysis		xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Report writing			x		x		x		x		x	xxx
Annual reports submissions					x				x			
Final report submission												x

* - the first six months will be needed for standardize the sampling methodology

Budget summary (year wise)

Budget	Ist Year	IInd Year	IIIrd Year	**Total**
Year wise budget in Rs. (Including equipment**)**	2475000	1250000	1177600	**4902600**

9. **Study On Raptors in The Heronries of Vedanthangal Bird Sanctuary (Vbs), Tamil Nadu**

Summary

The colonial waterbirds represents unique system of reproduction and survival strategies and heronries represent their spectacular grand scale of breeding events. The Vedanthangal Bird Sanctuary is one such grand old heronry that dates back to two centuries, where as many as 17 species of colonial waterbirds breed annually. This mass colonial breeding attracts lot of avian predators, and so far as many as 11 species of raptors has been recorded at this site. As predators, they constitute the top link in the ecological chain and therefore could be indicators of the environment health. Being found in diverse habitats, they are among the first to be affected by disruption of the food chain, by chemical pollution, adverse exploitations and decline of their habitats. However, except for some listing of raptors, not any serious ecological and conservation studies have been undertaken in the Vedanthangal Bird Sanctuary. in this project we envisage to address those ecological and conservation questions pertaining to the raptors namely their seasonal abundance, their richness, predation pressure on breeding colonies and conservation issues at Vedanthangal Bird Sanctuary.

Principal Investigator	:	Mahendiran M
Co-investigators	:	S Babu, P A Azeez
Research Fellow	:	
Project Period	:	One year
Budget	:	Rs. 2,60,700/-
Funding source	:	RAPTOR RESEARCH & CONSERVATION FOUNDATION
Status	:	Submitted
Collaborating agency	:	Nil

Background

Birds of prey keep a constant check on populations of amphibians, reptiles, mammals and birds – even on themselves as predators, they constitute the top link in the ecological chain and therefore indicators of the health of the environment. Found in diverse habitats, they are among the first to be affected by disruption of the food chain, by chemical pollution, adverse exploitations and decline of their habitats. of approximately 338 species of diurnal raptors worldwide, at least 69 occur in the Indian Subcontinent, either as residents, migrants, or casual visitors (Naoroji 2011).

Wintering raptors are known to supplement their diet from nestlings of colonial waterbirds breeding in the heronries (Naoroji 1990). Though raptors are widely seen in heronries across India, only little or scanty ecological information is available on them (Urfi 2002), expect for the report by Naoroji (1990) from Keoladeo National Park. Therefore, it is important to investigate the ecological and conservation aspects of raptors and thus it helps in understanding the relationship between the raptors and the heronries.

Study Area

Vedanthangal Bird Sanctuary (12˚ 32′ 02′′ N and 79˚ 52′ 29′′ E) is a unique area effectively protected by the Forest Department and Vedanthangal villagers. This 30 hectare area is the oldest breeding water bird reserve in southern India, located 85 km south-west of Chennai City. More than 40 species of water birds both resident and migrants visit every year during November-April and departs during July-August after breeding (Paulraj 1984; Santharam & Menon 1991; Krishnan 1993, 2001; Santharam 1981, 2000, 2004). Among them, Painted Stork (*Mycteria leucocephala*), Spot-billed Pelican (*Pelecanus philippensis*), Black-headed Ibis (*Threskiornis melanocephalus*) and Oriental Darter (*Anhinga melanogaster*) were Near / Threatened birds (BirdLife International 2013), nesting over a long period of time (Santharam, 1985, 1986; Paulraj & Gunasekaran 1988; Kannan & Manakadan 2005; Subramanya 2005; Muralidharan et al. 2008).Eleven species of raptors namely, Black-shouldered Kite *Elanus caeruleus*, Black Kite *Milvus migrans*, Brahminy Kite *Haliastur indus*, Shikra *Accipiter badius*, Egyptian Vulture *Neophron percnoterus*, Pallid Harrier *Circus macrourus*, Montagu's Harrier *Circus pygargus*, Western Marsh Harrier *Circus aeruginosus*, Short-toed Snake-Eagle *Circaetus gallicus*, Peregrine Falcon *Falco peregrinus*, Common Kestrel *Falco tinnunculus* were reported in Vedanthangal Bird Sanctuary (Krishanan 2001).

Objectives

1. Assess the density of raptor species in the heronries (VBS) during breeding and non-breeding seasons

2. Estimate predation pressure over the heronries during breeding seasons and non-breeding seasons

Methodology

Density

Census of the raptors is possible only through density estimator as the individual bird count is difficult to achieve, owing to the widely spaced nature. Thus, the density estimator of the raptor will be done by counting all the raptor individuals in a specified area and specified time interval (Ralph 1981).

Two set of procedures will be employed to estimate the density of the raptors using foot survey method and direct count methods.

Foot survey method: Raptors, in and around the vicinity, of the VBS will be estimated by following the foot survey method of Fuller and Mosher (1987). As the area is surrounded by agricultural field, this method is an ideal choice. Weekly and biweekly foot surveys along the specified transect will be performed by a two member team, during clear weather days. The exercise will be done in the morning, afternoon and evening by walking (with speed 2 km/hr) stopped at specified points to count flying and perched birds. This will allow large areas of the heronries to be searched efficiently for raptors. A pair of good binoculars, spotting scope and digital camera will be used to aid identification of distant birds.

Direct count method

Raptors moments and their numbers will be counted at specific location, preferably using the watchtower, at specific time intervals using direct count method.

Nesting population of heronry species will be estimated using complete direct count. The nest and nesting species count will be done at an hour after sunrise in a clear weather by a team of three persons. Boat will also be used in poor visibility areas or areas inaccessible by foot during counting. Data on colony size, composition, numbers of active nests (with birds either incubating or making nest) per tree will be counted for different heronry species.

Data analysis

All the data including the raptor abundance, nesting abundance will be collected in the field and their data on respective variables will be entered in the excel sheet. Analysis will be performed by using software Minitab. Descriptive statistics, simple t test, ANOVA, and regression will be performed on the appropriate data sets. Our focus will be to understand the nature of the relationship between the raptor abundance and nesting heronry birds.

Expected outcome and suggested plan of action for utilization of research outcome expected from the project

The anticipated and immediate output and deliverables from the project are a minimum of two M Phil/PhD degrees, research publications in peer reviewed journals, and popular articles in local and national press / media

The major research output will be the scientific documentation and identification of the ecological patterns of the raptors in response to a heronry, breeding colony of heronry species in a wetland ecosystem. The study will provide the base line data on interactions of raptors, heronry birds, raptor species richness and conservation management issues. Furthermore, the study will help in assessing the various predatory aspects of top level raptors of wetland ecosystem.

The study will also help to determine and evaluate ecosystem services provided by raptors. In addition the aim will be to formulate and implement conservation measures for the benefit of both the species of birds, the wetland ecosystem and human social-economic system.

Agencies which can utilize the results of the project

The research outcome will be used to educate the inhabitants from the adjoining villages of the study sites. This will be achieved by having regular interactions, workshops and awareness drives among the villagers, local schools and colleges. The data generated will also be disseminated through the press and television media. The internet is a very strong medium of communication and hence the important findings will also be popularized through blogs, the ENVIS website, the SACON web site and if possible the websites of funding agency. Regular progress reports will be submitted to

the funding agency, for the dispersal of the salient features and for advocating appropriate policy decisions on conservation and management.

Work plan

Period of study	***Achievable targets***
1-3 Months	Appointing field Staffs, calibrations of the equipment and initiation of research work
4-6 Months	Field data will be collected during the non-breeding time of the birds, Data Analysis, Publications (simple monographs)
7-9 Months	Field data will be collected during the breeding time of the birds
10-12 Months	Final data analysis, Publications, Preparation and submission of final technical report.

Budget Summary

Head	**Amount**
Technical Assistant (2 nos.) @ Rs. 8000/m (fixed)	1, 92,000
Field Cost (experimental/ Monitoring costs/ Costs incurred for undertaking field works -Long and short distance -travel (vehicle hire) and --Field allowances	45,000
Total	2,37,000
Overheads @ 10% of Total	23,700
Total Budget	**2,60,700**

10. **Assessment of Impact and Management Strategies of Bird Hazard to Aircraft in India**

Summary

Bird strike to aircraft has been a problem for the aviation globally. In India, this problem had magnified effect when IAF lost numerous aircraft in the post 80s. Currently, within the IAF, bird strikes forms nearly 25% of total flying incidents. Though, over the years, the numbers of crashes due to bird strike have come down, there has been a steady raise in the number of incidents of bird strike in the recent past. This has been a cause of concern. In the proposed study the factors influencing the bird strikes will be studied by collecting line transact data and time series data apart from analyzing the past data of bird strike available with IAF. Various parameters (such as species, number, area of activity, direction of movement, cause for their presence, habitat weather and other suitable factors considered appropriate from time to time) will be recorded at selected two IAF airfields. In addition, secondary data will be collected from selected eight IAF airfields spread across the country to cater to the different geographical regions of the country.

Efficacy of the existing methods will be tested by implementing a module at a place and comparing it with earmarked area of the same airfield under control conditions (either at test and control areas separated in time at the same area or separated by space at the same time).

Principal Investigator	:	P Pramod
Coinvestigator	:	Wing Commander S. Srinidhi, IAF
Research Fellows	:	Yet to be identified
Project Period	:	2014-2017
Budget	:	Rs. 48/- lakhs
Funding Source	:	Directorate of ER & IPR, Govt. of India
Status	:	Proposal submitted for funding
Collaborating Agency	;	Indian Air force

Background

Bird strike to aircraft has been a problem for the aviation globally. In India, this problem had magnified effect when IAF lost numerous aircraft in the post 80s. Currently, within the IAF, bird strikes forms nearly 25% of total flying incidents. Though, over the years, the numbers of crashes due to bird strike have come down, there has been a steady raise in the number of incidents of bird strike in the recent past. This has been a cause of concern. Assessment of impact and management strategies of bird hazard to aircraft in India will methodically look into the problem of bird strikes in India. Bird hazard management is a complex problem which has its solution in various branches of science such as Ornithology, Ecology, Entomology, Botany, electronics, Radar Technology and even in administration and operation planning itself. The problem has been studied in piecemeal by different operational people and sporadically by scientists for short duration. An integrated approach to the problem at selected airfields as envisaged in this project is expected to give an

incremental enhancement in understanding. Such understanding will help in designing modules which can be later extended to other airfields with suitable modifications.

Different countries have approached this problem from different direction and have found their own workable solutions, though not a complete solution. In fact, it is believed that there is no single and complete solution to the problem. However, this study is aimed at scientifically evaluate some the modules employed by Indian Air Force and statistically as well as Ornithologically understand the efficacy of them. This will help any of the options such as continuing the module with more rigors or enhance the efficacy through specific modifications or even rejection of modules if they are found to be economically not viable or even proved to be counter-productive. A specific focused study of the grass management will evaluate the efficacy of specific commercially available grass and look at the economical alternative of managing the bird population through grass height management of naturally occurring grass.

Objectives:

1. To study the factors influencing BS in and around airfields.
2. Record and analyse the species-wise economic damage caused by various bird species through BS to military flights in India.
3. To record and scientifically gauge the effect of various methods employed by different airports in India.
4. To gauge the importance of grass species and their height at various airfields for bird hazard management.
5. To recommend ecological, operational and administrative measures to reduce number of bird strikes and damages caused by them.

Methodology

The factors influencing the bird strikes will be studied by collecting line transact data and time series data apart from analyzing the past data of bird strike available with IAF. Various parameters (such as species, number, area of activity, direction of movement, cause for their presence, habitat weather and other suitable factors considered appropriate from time to time) will be recorded at selected two IAF airfields. In addition, secondary data will be collected from selected eight IAF airfields spread across the country to cater to the different geographical regions of the country.

Information on species involved in BS incidents will be taken from IAF directly. (IAF uses carcass identification/ feather identification and DNA bar-coding techniques for identifying the species involved). The economic damage caused due to each species will be assessed based either on actual cost of repair or approximation done based on prima facie material damage/ repair cost/ replacement cost.

Efficacy of the existing methods will be tested by implementing a module at a place and comparing it with earmarked area of the same airfield under control conditions (either at test and control areas or separated in time at the same area). One airfield in

two cities (Coimbatore and Bengaluru) has been chosen for the conduct of these studies. Some of the modules likely to be tested are placed at Annexure C1.

The existing species of grass will be recorded and their life cycle will be studied apart from assessing the commercially available grass (2-3 types) for managing the airfield. Few patches of natural grass with varied height will also be selected for assessing the bird activity over them. It is proposed to grow them in an area of 100 X 100 m (or as feasible and considered appropriate) and compare the bird activity over them.

Finally, recommendations will be made for possible safe conduct of aircraft operations based on the integral analysis of all the above mentioned data including ecological issues and economical concerns.

Expected outcome

By application of the findings of this study, it is expected to save huge amounts of money to the Government exchequer apart from saving the invaluable national assets of aircraft and more importantly the trained pilots.

Work plan

Activities	Months											
	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27	28-30	31-33	34-36
Appointment of staff	xxx											
Reconnaissance survey	xxx											
Procurement of permissions & equipment	xxx											
Marking of study locations	xxx											
Field work / Data collection		xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	Xxx	Xxx	
Data Analysis		xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	Xxx	Xxx	xxx
Report writing			x		x		x		X		X	xxx
Annual reports submissions					x				X			
Final report submission												x

Budget summary

Proposed expenditure on (Rs. in lakhs) during	Year 1	Year 2	Year 3	Line total
a) Staff :	2.00	2.00	1.00	5.00
b) Equipment (including spares thereof)	20.00	0.50	0.25	20.75

c) Operation and maintenance of equipment	2.00	2.00	1.00	5.00
d) Expendables	0.75	0.75	0.50	2.00
e) Travel	6.00	6.00	1.50	13.50
f) Contingencies	0.50	0.50	0.25	1.25
g) Visiting Faculty or Research Consultant(s)	Nil	Nil	Nil	Nil
h) Procured services (other than (g)) and metered utilities	-	-	-	-
Add: Institutional overheads @ 10% of (a) only	0.20	0.20	0.10	0.5
Column totals	31.45	11.95	4.60	48.00

Any other item with the permission of the Chair

FOR INFORMATION OF THE RMAC

1. **A Committee constituted by the MoEF to look** into the issue on examining the need for salary support with respect to the Centres of Excellence, visited SACON on 4th July 2014. The Committee comprised of following:

   1. Additional Secretary of CoE Scheme (Chairman)
   2. Jt. Secretary in charge of CoE Scheme (Member)
   3. Advisor Incharge of the particular CoE (Member)
   4. Dy. Secretary / Director IFD (Member)
   5. Dy. Secretary / Director Incharge of CoE (Member)

   The Committee visited SACON on 4th July 2014 perused the works of SACON, had extensive discussions with the faculty members of the Centre on various research programmes, and visited the infrastructure facilities available at the Centre. The committee was apprised about the need for augmentation of the infrastructure. The Committee was of the opinion that the status of SACON should be elevated to a higher status at par with Wildlife Institute of India / GB Pant Institutute of Himalayan Environment and Development from that of a Centre of Excellence of the MoEF & CC, Govt. of India.

2. **Special Invitees to the RMAC Meeting:** The Governing Council at its 66th meeting held on 30th July 2014 asked SACON to invite the following officials of the MoEF & CC, Govt. of India by designations to the meetings of the Research, Monitoring and Advisory Committee since their inputs will be immensely beneficial to SACON.

   1. Inspector General of Forests, MoEF
   2. Adviser (I/C – SACON matters), MoEF
   3. Scientific Officer (handling subject of wetlands/SACON)
   4. Official from the Research Division of the MoEF

As instructed by the Governing Council the above officials have been invited to the 27th meeting of the Research, Monitoring and Advisory Committee scheduled to be held on 5th September 2014 at SACON, Coimbatore

3. **Second International Conference on Indian Ornithology:** The 2nd International Conference on Indian Ornithology (ICIO – 2013) with a theme of 'Birds *and their Ecosystem Functions & Services*' was organized by SACON 19-23 November 2013 at Coimbatore. From abroad, Dr Cagan Sekercioglu (University of Utah, USA), Dr Per Alstrom (Swedish Species Information Centre, Swedish University of Agricultural Sciences, Sweden), Dr Taej Mundkur (Wetland International, Netherlands), Dr Judit K Szabo (East Asian Migratory Flyway – Science Officer & Charles Darwin University, Australia), Dr Ian Barber [Royal Society for Protection of Birds -RSPB, United Kingdom), participated in the conference. Nearly 250 researchers from various research centers, universities and colleges from across the country attended the conference and deliberated on various important issues under different symposia.

   The Conference was inaugurated by Dr. J.R. Bhatt, Advisor to the Government of India, Ministry of Environment and Forests, and special guests of honor at the inaugural included Dr. K. Ramasamy, Vice-Chancellor, Tamil Nadu Agricultural University, Coimbatore, Dr. V.K. Melkani IFS, APCCF (Project Tiger), Tamil Nadu Forest Department, Dr. E.J. James, Vice-Chancellor (i/c), Karunya University, Coimbatore, and Dr. N. Krishnakumar IFS, Director, Institute of Forest Genetics and Tree Breeding, Coimbatore.

   In total, 120 papers were presented in the Conference, of which 37 were oral presentations, 15 were speed talks, and 68 were posters. Geographically, the participants represented 18 States/UTs in India and bird studies from 24 States were showcased in the proceedings. In addition, research works of ornithologists from 10 countries including Sweden, Australia, USA, UK, Turkey, South Africa, Singapore, France, Vietnam, and the Netherlands were also presented in the Conference. Altogether, 127 institutions and organizations pursuing avian research and bird conservation took part in the Second edition of the ICIO.

   The Conference formally concluded on 22 November 2013 with a valedictory session in which Dr G. James Pichai, Vice-Chancellor, Bharathiar University delivered the presidential address. The closing ceremony was also marked by special addresses by Dr. Jay Samant (Advisor & Trustee, DEVRAAI, Kolhapur) and Dr. H.S.A. Yahya (Professor, Aligarh Muslim University, Aligarh). A post-conference field trip to the Silent Valley National Park (SVNP), Palakkad district, Kerala was organized for all the participants and delegates on 23 November 2013.

   The MoEF released Rs. 14/- lakhs and the Indian Council of Agricultural Research has sanctioned Rs. 3.00/- lakhs.

4. **First DST-SERB School in Avian Biology:** The Department of Science and Technology (GoI) granted Rs 18.50/- lakhs to SACON to conduct a School in Avian Biology at SACON. The first of the five schools was held during 26th December to 7th January 2014 at SACON, Coimbatore.

   The School, a two-week long advanced course in avian biology was a capacity-building programme that aimed to train young biologists pursuing research in avian biology in India. The School had one Orientation Module and six Core Modules covering different disciplines namely evolution, systematics and biogeography, physiology of seasonal processes, bird behaviour, ecology of bird communities, science of bird conservation, and frontiers in avian biology. 24 candidates from different institutions attended the first School. Nearly 25 experts from various institutes served as faculties.

   The first three days of the School were covered by the Orientation Module and included introductory lectures on topics ranging from birds as model systems, biogeography of Indian birds, avian evolution, avian brain and neurobiology, population genetics and molecular ecology, vocalizations in birds, to avian frugivory. This was followed by six Core Modules: i) avian phylogeny and biogeography, ii) physiology of seasonal processes in birds (incl. avian chronobiology, neurobiology, and endocrinology), iii) bird behavior, iv) ecology of bird communities, v) conservation biology, and vi) frontiers in avian biology.

   Besides the faculty from SACON, several leading experts were drawn from other institutions as teaching faculty in the School. They included Dr. Vinod Kumar (University of Delhi, New Delhi), Dr. Sangeeta Rani (University of Lucknow, Lucknow), Dr. K.S. Krishnan (National Centre for Biological Sciences, Bangalore), Dr. Dinesh Bhatt (Gurukula Kangri Vishwavidyalaya, Haridwar), Dr. Suhel Quader (Nature Conservation Foundation, Mysore), Dr. Kartik Shanker and Dr. S.P. Vijayakumar (Indian Institute of Science, Bangalore), and Dr. Monika Sadananda (Mangalore University, Mangalore). In the meanwhile, Dr. Doyil T. Vengayil, Scientist with DST, also visited the School and interacted with the participants.

   A field trip to the Silent Valley National Park, Kerala was undertaken for a day on 6 January, 2014 to expose the participants to conservation issues at the grassroots level and the strategies for effective protected area management being successfully adopted in the Park.

   The School formally closed on 7 January 2014 with a Validation Ceremony in which Dr. Dinesh Bhatt, Professor and Dean, Faculty of Life Sciences, Gurukula Kangri Vishwavidyalaya, Haridwar and Dr. P.A. Azeez, Director, SACON spoke on the need for such advanced training schools for capacity-building and gave away certificates and awards to all the participants who successfully completed the course. Ms. Parveen A. Shaikh of Bombay Natural History Society and Mr. Pankaj Koparde of SACON topped the course. A couple of participants also spoke on their personal experiences with the School and appreciated the programme in terms of the

course structure, teaching inputs, logistics, and exposure to modern trends in avian biology.

5. **Fulbright Awards**: Dr. P. Pramod and Dr R P Singh have received the Fulbright Award for Academic Professional Excellence 2014. This award is given to a selected group of academicians every year after undergoing a serious selection procedure. Using this award Dr. Pramod will be working in Michigan State University and MSU Museum as a visiting scholar and also visiting universities such as Cornell's Lab of Ornithology, Smithsonian Institution and University of Utah in 2014. Dr Singh will be working (For 2 years) at Smithsonian Institute of Conservation Biology to work on reproductive toxicity and germ plasm conservation of endangered avian species).

6. **INSA 'Medal for young Scientist'** award to Dr R P Singh, Scientist, SACON, for making major contribution in avian reproductive potentials. The award includes a medal, a cash price (Rs 25000/-), one three-year research project and one fully funded foreign trip for attending seminars, conferences, or training.

7. **EIA Bids submitted:** During this period we have submitted the following bids along with brief proposals to various agencies as given below

   a. Preparation of Five year Management Action Plan for Panna Biosphere Reserve

   Funding source : Environmental Planning & Coordination organization, Bhopal
   Project period : 12 Months
   Budget : 16.15 Lakhs
   Submitted : Nov 2013

   b. Birds Census during 2013-14 Pallikaranai Marsh land

   Funding source : Forest Dpt., Tamilnadu
   Project period : 12 Months
   Budget : 6.40 Lakhs
   Submitted : Nov 2013

   c. Rapid ecological assessment and Bird/Bat monitoring - Rayala wind project

   Funding source : Greenko Group Ltd
   Project period : 10 Months
   Budget : 12.22 Lakhs
   Submitted : Dec 2013

   d. Study on impact of Wind Power Project on Wildlife of the project area in general and roosting of Raptors

   Funding source : Forest Dpt., Karnataka

Project period : 36 Months
Budget : 102.72 Lakhs
Submitted : Dec 2013

e. Study on environmental characteristics of the proposed offshore Wind power sites at Rameshwaram and Kanyakumari

Funding source : CWET, Chennai
Project period : 6 Months
Budget : 10.48 Lakhs
Submitted : Mar 2014

f. Wildlife Hazard Assessment and Wildlife Hazard Management Plan for HAL Airport, Bangalore

Funding source : HAL, Bangalore
Project period : 18 Months
Budget : 34.09 Lakhs
Submitted : Mar 2014

g. Study on "Impacts of primary and secondary pollutants on crops around NTPC-Ramagundam Super Thermal Power station

Funding source : NTPC, Ramagundam
Project period : 27 Months
Budget : 50.68 Lakhs
Submitted : Jul 2014

h. Study on "Impacts of primary and secondary pollutants on crops around NTPC-Dadri

Funding source : NTPC Dadri
Project period : 27 Months
Budget : 50.68 Lakhs
Submitted : Jul 2014

i. Biodiversity study of Apollo Tyres Campus

Funding source : Apollo Tyres
Project period : 12 Months
Budget : 14.86 Lakhs
Submitted : Jul 2014

j. Study on impact of Primary & Secondary Pollutants on Crops nearby NTPC Faridabad

Funding source : NTPC, Faridabad

Project period : 27 Months
Budget : 50.68 Lakhs
Submitted : May 2014

8. **IT Exemption:** The Ministry of Finance has notified SACON as a "Scientific Research Association" as per the Income Tax Act -1961. As per the provisions of this notification several benefits are available to those who contribute research funds to SACON irrespective of their status (i.e. Company, individual, firm etc). Further, any donation [up to Rs 10000/- (by cash)] and any amounts of donations (By Cheque/ DD/ TT/ NEFT) made to SACON are eligible for 100% exemption. This exemption can be availed by all assessees on production of a receipt from SACON to the concerned authority

9. **Resignation**: Dr B Anjan Kumar Prusty, Scientist, Division of Environmental Impact Assessment of SACON resigned from SACON Services.

10. **Demise**: Dr S Bhupathy, Head & Principal Scientist, met with a fatal accident on 28th April 2014 during a field work related to a DBT project. Dr Bhupathy slipped down from a slanting rocky patch in the Agasthyamalai Hills and fell on his face down on to a bamboo bush that pierced through his eyes damaging his vitals. Dr Bhupathy was heading a three-year study on the patterns of distribution of selected faunal groups on the Agasthyamalai hills and had gone to Agasthyamalai to monitor the field survey of his research students at Agasthyamalai areas.

PUBLICATIONS

A. Journals; National and International

National

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Karunakaran PV. Manual for Identification of Ecologically Sensitive Areas in the Coastal Zones of India. Submitted to National Centre for Sustainable Coastal Zone Management, Anna University, Chennai

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Mukherjee S (2013). Small Cats of Rajasthan. Inin B.K. Sharma et al. (Eds) Faunal Heritage of Rajasthan, India. General Background and Ecology of Vertebrates. DOI 10.1007/978-1.4614.0800.0_18. Springer Science +Business Media New York 2013. Pp 481-490.

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Thangalakshmi, R., R. Eswaran and M. Mahendran (2013) Preliminary observations on the bird diversity, environmental and sociological aspects of selected wetlands of Madurai IN (ed John Joseph) *Food security, issues and concerns, Shanlax publications Madurai.*

Thinh Duc Nguyen and M Mahendiran (2013) Foraging behavior of White-headed babbler Turdoides affinis – A model organism for ecosystem services (Eds Raja Jayapal, babu….Azeez) Ecosystem services and functions of birds. Proceedings of the Second international Conference on Indian Ornithology, SACON, Coimbatore, INDIA ISBN 81 -902136-0-4

D. Technical Reports

Arun, P R, and Rajan, P. 2014a. Impacts of Proposed Seismic Survey Operations on the Avifauna and Wildlife of Reserve Forest Areas of KG Basin Project of Oil India Ltd. Coimbatore: SACON. EIA report.

Arun, P R, and Rajan, P. 2014b. Study on the the Potential Environmental Impacts of Wind Farm Development in Agali, Attapadi, Kottathara and Nallasingam Areas of Palakkad District, Kerala. Coimbatore: SACON. EIA report.

Kumara, H.N. and Santhosh, K. (2014). Evaluating the status of NTFP trees and development of a model for sustainable harvest of *Garcinia gummi-gutta* in Aghanashini Lion-tailed Macaque Conservation Reserve, Western Ghats, India. SACON Technical Report-130, submitted to Rufford Small Grants, SACON,

Kumara, H.N. and Sasi, R. (2014). Distribution Pattern of Slender Loris in Parts of Kerala and Tamil Nadu, India. SACON Technical Report-125, submitted to Primate Conservation Inc., USA. SACON, Coimbatore, India. (PR-125)

Manchi S. S., (2014) Reassessment of the impact of nest collection on the Edible-nest Swiftlet in the Andaman Islands. Sálim Ali Centre for Ornithology and Natural History, Coimbatore. SACON Technical Report – 126. Submitted to WWF-India, New Delhi. 34 pp.

Muralidharan S, Sivasubramanian C, Jayakumar S, Dhanajayan V and Navamani P (2014). Impact of agricultural pesticides on the population status and breeding success of select species of fish-eating birds in Tamil Nadu. Final report submitted to MoEF, 155pp.

Pramod P (2013) Simple Tasks Great Concepts ; Report of the teachers Training programme Submitted to Department and Science and Technology Govt. of India.

Pramod P, Chaithra Shree J (2014) National Nature Camping Programme at SACON Campus, Coimbatore. Report submitted to Ministry of Environment and Forests, Govt. of India

Pramod P, Rajan P and Suhirtha Muhil (2013) DNAClubs of Andaman and Nicobar Islands 2009-2013. Report submitted to Department of Science and Technology Govt. of India

E. Talks Delivered

Arun PR: Presentation made before the World Bank committee on the Cumulative impacts study of Sutlej Basin at state Environment Dept. Office, Shimla on 20th August 2013

Arun, PR: Delivered Invited lecture on 'EIA Processes and Case Studies' in the Training-cum- Workshuop on 'Legal issues in Forestry & Wildlife' for the in-service State Forest Service Officers of various State Forest Departments organised by CENTRAL ACADEMY FOR STATE FOREST SERVICES, Coimbatore on 16 September 2013

Arun, PR: Delivered invited talk on "Biodiversity, Development and EIA; Past lessons and Future Prospects" at National Seminar on Biodiversity conservation; Issues and Challenges, BJM College, Chavara, Kollam on 18th December 2013

Babu S: on "Occupancy and conservation of large mammals in Megamalai Landscape" as part of the workshop on the science and practice of linking Periyar-Agastiyamalai landscape for large mammal conservation.

Balasubramanian, P. Gave a talk on Common birds around us" through FM Radio, Nagerkoil.

Balasubramanian, P. Lecture delivered on "Plant-animal interactions" for the DST sponsored Avian Biology Course participants at SACON.

Balasubramanian, P. Lecture on "Plant-animal interactions" delivered for refresher course (Evolutionary Ecology of Plants and Animals) participants at PSGR Krishnammal College for Women, Coimbatore.

Goldin Quadros: on "Sustainable Development of Wetland and Terrestrial ecosystems" during 14th to 17th February, 2014 - organised by the Academic Staff college of University of Mumbai in collaboration with B.N. Bandodkar College of Science, Thane. Conducted a practical session on the wetland benthic evaluation and a interactive session.

Karunakaran, PV: 'Wetland Conservation" Training programme to the field officers of Kerala Forests and Wildlife Department. Arippa Forest Training School 18.3.2014

Karunakaran, PV: "An introduction to Landscape Ecology" Talk to the Asst. Professors of different colleges as part of Orientation training programme. Academic Staff College. Calicut University. 22 July 2014

Karunakaran, PV: "Biodiversity of Western Ghats – past, present and future" Gregor Mendel Birthday Memorial Lecture. 21 July 2014

Karunakaran, PV: "Role of other sectors in biodiversity conservation" Training to the Class I officers of other departments. IFGTB 14.2.2014

Karunakaran, PV: "Understanding the Landscape" Talk to the staff of Silent Valley National Park Kerala Forest Department as part of Training on 04.2.2014

Karunakaran, PV: "Western Ghats as a repository of natural resources" talk to the Media Persons in ECOLOGUE-organised by Jaijee Peter Foundation at Tahttekkad. 4.5.2014

Karunakaran, PV: Wetland Conservation. Seminar as part of International Year for Water Cooperation-Kannur and Thalassery for Teachers of Higher Secondary and High School on 15 and 16th July 2013

Karunakaran, PV:A Talk on Biodiversity conservation on the occasion of inauguration of Eco Club at Kendriya Vidyalaya, Kannur. 24.4. 2014

Karunakaran, PV:Grassland and Forest Fire – Talk on World Wildlife Day at Thhiruvananthapuram on 3.3.2014 organised by Kerala Forests and Wildlife Department

Karunakaran, PV:National Consultation on Ecologically Sensitive Area (talk on coastal habitat). National Centre for Sustainable Coastal Zone Management, Anna University, Chennai. 10-11 October 2013.

Karunakaran, PV:Talk on Western Ghats to M Sc students from St. Alosius College, Thrissur on 14 March 2014

Manchi S. S., on "Avian Conservation in India" on the occasion of "Inauguration of Zoology Association" at Sangamam Hall, PSG College of Arts and Science, Coimbatore on 6th September 2013

Manchi S. S., on "Conservation of the Narcondam Hornbill" during two days workshop on "Hornbill Conservation" at Kulgi Nature Camp, Kulgi on 28th September 2013.

Manchi S. S.,on "Bird Capture and Morphometry" at the DST-SERB School in Avian Biology" at SACON held during 26th December 2013 to 7th January 2014.

Manchi S. S.,on "Bird Conservation Strategies" at the DST-SERB School in Avian Biology" at SACON held during 26th December 2013 to 7th January 2014.

Muralidharan, S: Birds - indicators of environmental contamination: An Indian scenario at Periyar University, Salem on 18th February 2014.

Muralidharan, S: Corrosion and the Environment at Avinashilingam University for Women, Coimbatore on 27th January 2014.

Muralidharan, S: Elements of a strong application with particular focus on writing a good research proposal, linking it to previous, current and future objectives and implications of plagiarism: Workshop organized by USIEF in Coimbatore on 4th June 2014.

Muralidharan, S: Incidences of pesticide poisoning in birds in India at Bharathidasan University on 26th February 2014.

Muralidharan, S: Pesticide contamination in birds in India - A status report at Avian School of Biology, SACON. 1st January 2014.

Shomita Mukherjee on "Quotes, coats, tails and tales. Are all cats grey in the dark?" at ATREE, Bangalore, 14th July 2014. "

Shomita Mukherjee on "Phylogeny and Systematics" SACON School of Avian Biology 27th December 2013

Shomita Mukherjee on "Snoop through poop: understanding the ecology and distribution of elusive nocturnal mammals through non-invasive sampling", in a workshop on "Methods to study nocturnal animals." at SCCS, Bangalore on 27th September 2014

Shomita Mukherjee on Introduction to Conservation Genetics to an audience of TNAU Master's students on 19th March 2014 at SACON.

Singh R P 'Avian Reproduction' in DST-SERB School in Avian Biology at SACON (3 January 2014)

Singh R.P. 'Application of real-time PCR and gene based mechanism of sex determination in birds' in International training course on 'gene based techniques for research in biotechnology' in Indian Veterinary Research Institute, Izatnagar (8 March 2014).

Singh R.P. 'Molecular Sexing in day old chicks by PCR' in International training on 'Vent chick sexing' in Central Avian Research Institute, Izatnagar (10 Feb 2014).

G. Popular Articles

Aarif, KM. and Babu, S. 2013. Heaven for migratory birds. PATHEMARI-INTACH January-June 2013: 11-12.

Fishing for cat in Coastal Kerala, Shomita Mukherjee, P V Karunakaran and Ranjini. SACON News (Vol. 10 (2): April - June 2013 5-6

Karunakaran P.V, Mukherjee S, Ranjini J (2013). Some observations on the mangroves of Kerala. SACON News, Vol 10 (2): 3-4.

Ramesh Kumar S, Samsoor Ali, A M, and Arun PR. 2013. "Wild Nilgai in Company with Domestic Cattle."SACON News 10(1).

Ramesh S., Samsoor Ali M & Arun P R (2014) Peculiar nest site of Indian Robin Saxicoloidesfulicatus. Sacon News 11 (1), P 7

Singh, RP (2014). Application of real-time PCR and gene based mechanism of sex determination in birds. International training course on gene based techniques for research in biotechnology, 11th Feb to 11th March, 2014. Ministry of External Affair, India.

Singh, RP (2014). Molecular Sexing in day old chicks by PCR. International training on 'Vent chick sexing' in Central Avian Research Institute, Izatnagar (20 January to 18 February 2014).

Singh, RP. Antibiotics: A new threat for birds. SACON news letter volume 10(2): April-June 2013.

Singh, RP. Chicken eggs crawling with antibiotic-resistance salmonella. SACON news letter volume 10(1): January-April 2013.

Singh, RP. Threat of Poultry rogue bug. in: The Telegraph (12/8/2013).

H. Participation in Seminar/ Conference/Meeting; National and International

National

Arun, PR: Attended National Conference on NBR Silver jubilee Celebration –NBRSJC at Udhagamandalam during 29-30 August 2013

Arun, PR: AttendedESRI India Regional Seminar Series on Education (Esri India Regional Seminar Series Y'13-14) at JENNEYs Residency, Coimbatore on 27th August 2013

Balasubramanian, P. "2nd Orientation meeting on status assessment of threatened plants of Tamil Nadu" organized by the Tamil Nadu Forest Department at Coimbatore (1 July 2014).

Balasubramanian, P. "National workshop on Tree seed science and Silviculture" (28-29 November 2013) at IFGTB, Coimbatore.

Balasubramanian, P. Attended Board of studies meeting at Vellalar College for women, Erode (26 April 20

Balasubramanian, P. Workshop on shola reforestation (17 February 2014), Tamil Nadu Forest Department, Ooty.

Goldin Quadros: MoEF-GIZ workshop on "Conservation and sustainable management of Existing and Potential Coastal and Marine Protected Areas" during 5th and 6th Sept. 2013.

Goldin Quadros: National Conference on Biodiversity: Status and Challenges in Conservation FAVEO 2013. 29- 30 November, 2013. B.N.Bandodkar college of Science, Thane Maharashtra.

Goldin Quadros: National Conference on Recent trends in Zoological research. St. Allyosius College, Thrishur

Goldin Quadros: National Consultation Workshop on Wetlands, August 8, 2014, New Delhi. organised by Wetlands International and MoEF & CC.

Goldin Quadros: World forestry Day and International Water Day program during Anokha 2014 (20 to 22 March) at Amrita University

Karunakran, PV: National Conference on Nilgiri Biosphere Reserve. Organised by Government College, Ooty. 29-30 August 2014, Ooty, Tamil Nadu

Karunakran, PV: National Seminar on Forestry and Agriculture. Organised by KFRI and Gregor Mendel Foundation. 7-8 November 2013. KFRI, Peechi Thrissur

Karunakran, PV: Strategies for Management of Large Landscapes in India - presented a paper on Landscape Level Conservation in India – an approach. National Workshop - New Delhi hosted by MoEF & CC and World Bank

Karunakran, PV: Western Ghats Portal Consortium partner meeting and workshop conducted by French Institute of Pondicherry on 5-6 August 2013

Shomita Mukherjee: Wildlife Institute of India, Dehradun, Annual Research Seminar 21st to 23rd August 2014

Shomita Mukherjee; NCF, Mysore, Annual Academic Meet 24th to 26th July 2014

Shomita Mukherjee; YETI, Lumami, Nagaland December 2013.

Singh RP: Convener of Pre-conference workshop, ICIO 2013.

Singh RP: Served as a member in MoEF & CC, committee on "Conservation of the Great Indian Bustard and rationalization of Desert National Park in Rajsthan".

Singh, RP: Served as a member in MoEF & CC, committee on "Alteration of Schedules of Wild life (Protection Act), 1972".

International

Shomita Mukherjee; SCCS, Bangalore September 2013

Goldin Quadros: 2nd International Conference on Indian Ornithology during November 19-23, 2013 at Coimbatore

Arun, PR: Participated in the 2nd ICIO conference, Coimbatore during 20-22 November 2013

Manchi S.S., Member of the Organizing committee in the Internation Conference "Ecosystem Services and Functions of Birds: Second International Conference on Indian Ornithology, 19-23 November. Salim Ali Centre for Ornithology and Natural History, Coimbatore, India.