Darwin Initiative for the Survival of Species

Annual Report

1. Darwin Project Information

Project Ref. Number	162/12/014
Project Title	*Biodiversity and functional value of Amazonian primary, secondary and plantation forests*
Country(ies)	*UK, BRAZIL*
UK Contractor	*UNIVERSITY OF EAST ANGLIA*
Partner Organisation(s)	*MUSEU PARAENSE EMILIO GOELDI (MPEG/CNPq)*
Darwin Grant Value	*£125,999*
Start/End dates	*1/MAY/2003 – 30/APRIL/2006*
Reporting period (1 Apr 200x to 31 Mar 200y) and report number (1,2,3..)	1 May 2004 - 30 April 2005 (annual report no. 2)
Project website	*http://www.uea.ac.uk/~e079/Projects/Jari.html*
Author(s), date	*Barlow, Jos; Peres, Carlos; Ferreira, Leandro 05/05/2005*

2. Project Background

- This project is being conducted in the 1.7 million ha landholding owned by Jari Celulose S.A./ORSA Florestal, located on the border between Amapá and Pará in the north-eastern Amazon basin (00°27'00" -- 01°30'00" S; 51°40'00" -- 53°20'00" W). This landholding was purchased in 1967 for the establishment of large-scale fast-growing tree plantations of *Gmelina arborea*, *Pinus caribaea*, and *Eucalyptus urograndis*. The area is currently dominated by extensive areas of plantation forestry dominated by *Eucalyptus urograndis*, undisturbed primary forest, and second-growth that has regenerated on plantations that were harvested but not replanted. The project aims to identify the biodiversity consequences of land-use change from natural to planted forests, and to describe the relative benefits of native versus non-native regeneration on degraded lands. By doing so, it is expected to contribute to the setting of restrictions and provision of incentives relevant to this land use change.

3. Project Purpose and Outputs

- The original purpose of this project was to "To quantify the biodiversity value of exotic plantation forests and native second-growth stands in Amazonia, critically assessing their value in terms of ecosystem functions and carbon sequestration, helping the Brazilian government and other developing countries to optimise their options in meeting international biodiversity and carbon commitments". This was refined following consultation with Patrick Hardcastle (Mid-Term Review), so that the overal purpose is to make a "First stage analysis of biodiversity and livelihood impact of forest clearance, plantation establishment and forest recovery in Jari, Brazil". Project outputs are summarised in our revised logical framework (Annex 1), and are as follows: To 1) sample and identify key biodiversity taxa in three forest types – plantation, secondary and primary forest; 2) undertake comparative analysis of indicator taxa in three forest types, 3) improve national capacity in forest biodiversity surveys in terms of technician skills, trained students and reference material, and to 4) study the socio-economic and livelihood values derivable from the three forest types.

- The proposed biodiversity sampling has been significantly augmented from the original plan, and we are now sampling many additional faunal taxa (see Tables 1-4), including all groups of terrestrial vertebrates and 11 groups of invertebrates. These groups have been added due to the important contribution they make to Amazonian biodiversity and ecosystem functioning, the high level of expertise within our principal collaborating institution (Museu Goeldi, MPEG/CNPq), and in some cases the relative ease and low cost of sampling. Furthermore, since beginning our fieldwork we have become increasingly aware of the number of small extractive communities (n = 32) lying within the plantation/second-growth/primary forest matrix in our study region. As a result of this we have secured additional funding to initiate a year long sustainable livelihood analysis in 5 of these communities, adding a strong social component to the project and the subsequent analyses. Outputs 1 and 2 focus on the biodiversity component rather than on ecosystem functioning. This is because it became apparent that the project needed to focus on biodiversity to maximise success in this area. Furthermore, Jari Celulose itself has detailed studies on soil carbon and hydrology within plantations and areas of second growth. However, the project does include a detailed examination of litter cycling and decomposition across the three habitats, and we plan to make accurate measurements of above-ground carbon stocks using our own 1-ha vegetation plots, and wood density measurements available from Jari Celulose. The training component has been modified in that we decided to concentrate on more intensive one-to-one supervision of a smaller number of Brazilian MSc and PhD students and technicians. We feel this decision is preferable over the original objective of organising cost-inefficient short courses for 30+ students, as it allows our capacity building program to achieve a much longer-term contribution towards improving

future biodiversity surveys in the Brazilian Amazon. Participating students have benefited from very high supervision levels, and have been trained in field techniques, analytical methods and statistics, as well as receiving help with publishing some of their previous works in international journals.

4. Progress

- Excellent progress has been made in the fieldwork over the last 12 months. Biodiversity surveys have been undertaken at all 15 sampling sites for most faunal groups, including the herpetofauna (frogs and lizards), birds, bats, terrestrial spiders, dung beetles, blowflies, house flies, flesh flies, fruit flies, fruit feeding and ithomiinae butterflies, small mammals, and mid-sized to large mammals (>500km of transects walked). In addition, leaf litter decomposition data has been collected for two of four seasonal replicates, and we have leaf-, flower- and fruit-fall data from 300 0.25m^2 traps monitored every month since May 2004. The project is already moving towards the phase of analysis and dissemination of results. We are awaiting final acceptance of a revised version of our paper submitted to Biological Conservation, while our second paper (on large mammal abundances in second growth) is in review with Animal Conservation. Three project members will give talks at the Society of Conservation Biology meeting in Brasilia (July14-19) and the Association of Tropical Biology meeting in Uberlandia (July 24-29), including an invited talk in the symposium “Large-scale conservation in expanding Amazon frontiers: integrating across scales and disciplines", which is being organized by Dr. Daniel Nepstad and Dr. Claudia Ramos. We have also given 2 talks to local stakeholders (Jari Celulose/Orsa Florestal) informing them of our progress, and one talk was given at the School of Biological Sciences at the University of York.

- Slippage in our project fieldwork schedule from year 1 (attributed to the delay in project approval from CNPq/IBAMA) has now been compensated for. This was achieved through the willingness of all project members to work very long hours, 7 days a week (Points 45-46, MTR), and was facilitated by the purchase of an extra vehicle which allowed independent fieldwork. As a result, we are now on schedule to finish our biodiversity surveys by July 2005 (Table 6, MTR), and fully expect to have a series of scientific papers *in review* or *in press* by May 2006.

- Methodologies for multi-taxa sampling have been refined considerably following liaison with experienced taxonomists and ecologists and our own experiences in the field. Some methods that apparently work well in temperate areas or in other areas of the tropics (for example, funnel trapping for herpetofauna, the use of sugar-baited coloured plates for the stingless bees) have proved of very limited value in this region, while other novel methods have been strikingly effective. Where possible, we have used more than one method for each faunal group. A list of all work (planned, finished, and ongoing) is shown below in Tables 1 - 4, including a brief description of the methodologies used. See MTR Table 6 for our project implementation timetable for 01/05/2005 – 30/04/2006.

Table 1. Basic methodological details for sampling vegetation and examining ecosystem functioning

Sampling target	Sampling methodologies used
Large vascular plants	1-ha plots for trees ≥10cm DBH and lianas ≥5 cm DBH.
Small vascular plants (<10cm DBH)	0.1 ha "Gentry" subplot located within each 1 ha plot
Vegetation structure	Twenty 10m radius circles at each site, measuring foliage stratification, understorey density, leaf litter depth, basal area, ground cover, and density estimates of herbaceous plants/saplings/lianas.
Phenology	300 50cm x 50cm litter traps examined over 13 months. Litter dried and split into 1) leaves, 2) branches, 3) fruits and 4) flowers.
Litter decomposition bags	1200 litter bags placed in 15 sites (80 per site). Each bag contains 6g of dried leaves from one of 4 species (*Vismia guianensis, Eucalyptus urograndis, Bertholettia excelsa, Bellucia dichotoma*). 300 litter bags are collected, dried and weighed every 3 months to calculate decomposition rates over 12 months.
Humidity, temperature and rainfall	15 temperature data loggers, 5 humidity data-loggers (one each site, >1 year data). 37 year-long rainfall and temperature record from Jari (3 sites).

Table 2. Basic methodological details for sampling invertebrates

Sampling target	Sampling methodologies used
Frugivorous butterflies (Nymphalidae)	Canopy and understorey traps baited with fermented banana
Ithomiinae butterflies	understorey traps baited with Heliotrope and sweep netting
Moths (Sphingidae, Saturniidae, Arctiidae)	Nocturnal light trapping using 2x2 m sheets and UV/Mercury vapour bulbs. Sheets checked hourly (6:30PM – 6:30 AM).
Orthoptera	Sweep netting along 1km transects. Nocturnal light trapping using 2x2 m sheets and UV/Mercury vapour bulbs.
Fruit flies (Drosophilidae)	PVC Canopy and understorey traps baited with fermented banana
Carrion flies (Calliphoridae, Muscidae, Sarcophagidae)	"Tin can" traps with inverted funnel tops, baited with rotten (1-day old) cow lung.
Dung beetles (Scarabaeidae)	Pitfall traps
Euglossine bees (Euglossinae)	Methyl Salicate baited bottle traps
Stingless bees (Meliponinae)	Netting of paper baited with sugar water
Army ants	Collection of all swarms encountered along line-transect surveys.
Terrestrial spiders	Pitfall traps
General measures of invertebrate abundance.	Counts (to the level of order) of arthropods caught in malaise traps, sticky traps, pitfalls, sweep net samples, and sifted from the leaf litter.

Table 3. Basic methodological details for sampling vertebrates

Sampling target	Sampling methodologies used
Midsized to large vertebrates	5-km line transect censuses and camera traps.
Bats	Nocturnal (18:00 – 00:30) understorey and canopy mist netting (12 nets total), combined with canopy and understorey recordings of calls (using AVISOFT).
Small mammals	160 baited Tomahawk & Sherman live traps at each site. Pitfalls captures.
Birds	Mist nets (24 nets along each transect) and direct observation using point counts.
Reptiles	Pitfall, Funnel traps, sticky traps, and 500 m line transect censuses
Anurans (frogs and toads)	Pitfall, Funnel traps, sticky traps, and 500 m line transect censuses

Table 4. Basic methodological details for sustainable livelihoods analysis

Sampling target	Sampling methodologies used
Game harvest surveys	Trained community assistants record all hunting and fishing activities within 4 small communities, with an emphasis on the respective value of primary, secondary and plantation forests.
Forest Activities	The daily activities of 10 males per community are monitored, in relation to time spent harvesting forest products versus cash-crop agricultural labour etc.
Household animal protein acquisition	Consumption of purchased meats and domestic livestock also recorded.

- Project approval in CNPq (the Brazilian Science Council) and IBAMA (Brazilian Institute of Natural Renewable Resources) proved the most significant difficulty we encountered in the first year, and was dealt with through frequent contact with CNPq via the UK scientific attaché in Brasilia and our MPEG collaborators. The resulting delays was unforeseeable due to exceptional circumstances in Brazil (MTR point 6). Fewer problems have been encountered in year 2, and it has always been within our power to resolve those that have arisen. The main recurring problems are transport related (our vehicles are old, and drive a combined 600km a day on dirt roads), although the occasional inevitable breakdown has not held us back to date. One important issue that has arisen recently is financial, in that inflation was not costed on the project salaries. This means that UEA has had to look to other field budget components to fund the shortfall, but these (with the exception of overheads) remain essential for the successful completion of the fieldwork programme.

5. n/a

6. Partnerships

- The level of collaboration between UEA and MPEG investigators has resulted in the exchange of many ideas and experiences between investigators. We have also been able to collaborate with a wide range of Brazilian and non-Brazilian specialists from other institutions, which has proved enormously advantageous to the project, helping create viable methodologies and enabling additional taxa to be studied. Table 5 shows the full list of all collaborating individuals along with their role in the project and field of expertise.

Table 5. Collaborators and project associates

Name	Institution	Association with project	Principle focus
SENIOR COLLABORATORS			
Dr. Carlos Peres	UEA	Project coordinator (UK)	Midsized to large vertebrates
Dr. Leandro V. Ferreira	MPEG	Project coordinator (host country)	Floristics/host country principle collaborator
Dr. Jos Barlow	UEA	Field coordinator	Birds (mist-netting), butterflies, bees
Dr. Teresa Cristina Avila-Pires	MPEG	Senior Collaborator	Herpetofauna (lizards)
Dr. Marlucia B. Martins	MPEG	Senior Collaborator	Drosophilids
Dr. Alexandre B. Bonaldo	MPEG	Senior Collaborator	Arachnids
Dr. William L. Overall	MPEG	Senior Collaborator	Lepidoptera
Prof. Marinus Hoogmoed	MPEG	Senior Collaborator	Herpetofauna (amphibians)
Dr. Maria Nazareth Ferreira da Silva	INPA/ Coleções Zoológicas	Senior Collaborator	Small non-volant mammals
Dr. Jay Malcolm	University of Toronto	Senior Collaborator	Small non-volant mammals
Dr. Pedro Vasconcelos	IEC	Senior Collaborator	Bats
Dr. Maria Cristina Esposito	MPEG	Senior Collaborator	Diptera: Calliphoridae
Dr. Augusto L. Henriques	INPA	Senior Collaborator	Diptera: Tabanidae
Dr. Fernando Vaz de Mello	IdE	Senior Collaborator	Scarabaeidae
Dr. Malva M.I Herández	UFPb	Senior Collaborator	Scarabaeidae
Ana Lúcia Nunes Gutjahr	MPEG	Senior Collaborator	Orthoptera
Dr. Heraldo Vasconcelos	IB/UFU	Senior Collaborator	Forest functioning
Dr Catarina da Silva Motta	INPA	Senior Collaborator	Sphingid and Saturniid moths
Dr. Mike Hopkins	EMBRAPA/UF	Senior Collaborator	Floristics/Botany

	RA		
Dr. Giorgio Venturieri	EMBRAPA/CPATU	Senior Collaborator	Euglossines and Melliponine bees
Dr. Patricia Shanley	CIFOR	Senior Collaborator	Sustainable livelihoods analysis
STUDENTS and TECHNICIANS			
N. Oi Chan Li	MPEG	MSc Candidate	Arachnids
M. A. Ribeiro Jr.	MPEG	MSc Candidate	Herpetofauna
J. E. Costa	MPEG	MSc Candidate	Drosophila
Ivanei Araujo	MPEG	MSc Candidate	Ithomiianae butterflies
Elias de Souza Braga	MPEG	MSc Candidate	Orthoptera
Ronildon Miranda	MPEG	Research Associate	Drosophila
Toby Gardner	UEA	Doctoral candidate	Dung beetles/herpetofauna
Luke Parry	UEA	Research Associate	Sustainable livelihood analysis
Joseph Hawes	UEA	MSc Candidate	Sphingid moths
Gita Kasthala	UEA	MSc Candidate	Camera trapping/Malaise trapping
Sandra Peters	University of Toronto	Doctoral candidate	Bats
Oswaldo Araujo	IEC	Technician	Bats
Paulo R.N. da Silva	MPEG	Technician	Lepidoptera
Jarilson G. Vilar	MPEG	Technician	Lepidoptera
Luiz A.M. Mestre	INPA	Research Associate	Avifauna (point counts)
Rafael Leite	INPA	MSc Candidate	Small mammals
Agostinho Lima	Embrapa/CPATU	Technician	Euglossines and Melliponine

Institutional abbreviations: MPEG (Museu Paraense Emilio Goeldi, belem, Para); INPA (Instituto Nacional de Pesquisa da Amazonia, Manaus, Amazonas); EMBRAPA (Empresa Brasileira de Pesquisas Agropecuárias, Belém, Pará); EMBRAPA/CPATU (Centro de Pesquisa Agropecuaria do Tropico Humido, Belem, Para); UFPb (Universidade Federal da Paraiba, João Pessoa, Paraiba); IB/UFU (Instituto de Biologia, Universidade Federal de Uberlândia, Minas Gerais); IEC (Instituto Evandro Chagas, Belem, Para); UEA (University of East Anglia, Norwich, UK), CIFOR (Center for International Forestry Research), IdE (Instituto de Ecologia, Xalapa, Mexico)

- We have also been in close contact with local IBAMA (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis) officials in charge of the 230,000-ha Estação Ecológica do Jari, the only strictly-protected area in the Rio Jari region, and have undertaken the first ever quantification of the birds and large vertebrates of this reserve, making an essential and important contribution towards the reserves first ever management plan. Furthermore, recent meetings with Orsa Florestal and Jari Celulose S.A. have been very positive, and all partners expect this project to result in a long-term research partnership between UEA, the Museu Goeldi, and Orsa Florestal and Jari Celulose S.A. An umbrella research agreement is already being drawn up to include such a possibility, and Jari Celulose has shown itself willing to fund a UEA/MPEG collaborative team to investigate the biodiversity value of primary forest corridors. The project has also been collaborating with TEAM (Tropical Ecology, Assessment, and Monitoring

Initiative) members in Brazil, in developing and fine-tuning field sampling methods and analytical techniques.

7. Impact and Sustainability

- The extensive level of consultation and contact with a range of Brazilian scientists from many institutions has helped raise the project profile within the Brazilian scientific community. Over time, it has become increasingly apparent that the project has helped Brazilian taxonomists to become involved in broader environmental and ecological issues, thus escaping their traditional isolation in established herbaria and zoological collections. Close collaboration between conservation biologists, ecologists and taxonomists is imperative for enabling effective conservation planning and research. However, scientists involved in these separate disciplines rarely have the opportunity to collaborate and combine their collective expertise. Researchers of the Museu Goeldi, INPA, EMBRAPA and other collaborating institutions have all demonstrated considerable interest and enthusiasm, ensuring the success of this project and helping to advance the future remit of work conducted by these collaborators. Moreover, the project continues to be warmly received within the management team of Jari Celulose and Orsa Florestal, a critical stage in ensuring the development of environmental awareness within these timber/cellulose companies. All stakeholders have demonstrated an interest in ensuring sustainability through the continuation of project activities. MPEG has very little funds, and is dependent on external funding sources to allow MSc, Doctoral and undergraduate students the opportunity to engage in field research. MPEG also receives a large number of specimens for their collections. Jari Celulose/Orsa Florestal both require environmental research for FSC certification, and clearly benefit from this being carried out by independent and renowned national and international institutions. UEA hosts a range of skilled academics interested in deriving economic and ecological models that could be used to promote best practice in tropical plantation management.

- **Post-Project Follow up Activities**

  Our multi-taxa biodiversity surveys in the economically active landscape of Jari have made us aware of the importance of developing practical and detailed guidelines on forest conversion practices that help minimise negative biodiversity impacts during plantation management (see conclusions of MTR). All project partners have shown an interest in securing post-project funding in order to pursue this aim. The work already completed in this project provides a solid starting point, allowing us to choose a small number of indicator taxa that can be efficiently sampled in plantations of different age classes (0-7 years), sizes, productivity/soil types, and management histories. The feasibility of such a study has been confirmed by a pilot study which sampled fruit-feeding butterflies at 40 sites. The output would be a model that combines social, environmental and economic costs and benefits of different management strategies. This would initially be specific to the 1.7Mha of Jari, but we also envisage producing a more general model with a much wider scope for application.

  The sustainable livelihoods component of the project continues to grow. Five communities are involved within the scope of a game harvest and wildlife management study and forest livelihoods activity assessment. Collaboration with CIFOR (Centre for International Forest Research) has been formalised through the award of the 2005 Sustainable Forests Livelihoods Fellowship to Mr Luke Parry. In addition, a recent grant from the Rufford Foundation opens up the possibility of funding a Brazilian MSc student in natural resource management during 2006.

8. Outputs, Outcomes and Dissemination

- Year 2 activities have been largely fieldwork based, and we have been successful in completing the vast majority of our planned biodiversity surveys. Much of the material has already been curated and identified, and around 50% of our data has been entered into a database. The training of Brazilian student counterparts has been ongoing throughout the year, and we have provided detailed training for 6 MSc students and two doctoral level candidates (MTR point no. 65).
- Results have been disseminated to local stakeholders (Jari Celulose and Orsa Florestal) in year 2 during two 30-minute presentations to the directors and managers of both forestry companies. Both presentations were met with enthusiasm, and were important in making all sectors of the company aware of the rationale and progress of our work. We intend to continue these six monthly presentations until the termination of fieldwork.

Table 6. Project Outputs (According to Standard Output Measures)

Code No.	Quantity	Description
4A & 4C	6	Local Brazilian MSc students to receive 30-180 days detailed training on quantitative biodiversity surveys (Table 5)
8	68 weeks	Fieldwork; 60 weeks (Dr. J. Barlow), 8 weeks (Dr. C. Peres)
11	2	1st paper reviewed and awaiting final editorial comments (Biological Conservation); 2nd paper in review (Animal Conservation).
14B	8	4 project members have had talks accepted at international and national conferences (SCB, Brasilia; ATBC Uberlandia; Congresso Brasileiro de Herpetofauna, Belo Horizonte). One talk given at University of York, UK.

Table 7: Publications

Type * (e.g. journals, manual, CDs)	Detail (title, author, year)	Publishers (name, city)	Available from (e.g. contact address, website)	Cost £
				-

9. Project Expenditure

Table 8: Project expenditure during the reporting period (Defra Financial Year 01 April to 31 March)

Item	Budget (please indicate which document you refer to if other than your project schedule)	Expenditure	Balance

10. Monitoring, Evaluation and Lessons

- The success of this project in the coming year can be monitored by comparing it against our work plan (Table 6, MTR) formulated in February 2005. The purpose of the project will be achieved if we can ensure the 1) completion of surveys of the faunal and floral taxa across the Jari landscape, 2) the successful curating and identification of specimens, 3) the compilation of the database, 4) handover of all equipment to Brazilian partners, and 5) the analysis, dissemination and publication of results and conclusions. Success in our training of Brazilian students will be monitored by examining their progress during their respective courses and throughout any subsequent activities. Our revised log-frame provides a more detailed list of means of verification.
- We have learned the importance of maintaining clear lines of communication with all stakeholders, and appreciating the differences between their respective interests. As an example, on three occasions the operations side of Jari planned to fell our study areas without consulting the research side of the company, with whom we have our closest ties. However, these potential setbacks were avoided because we have always tried to maintain direct and frequent communication with all sectors of the company.
- We have also learnt, through consultation with Pat Hardcastle, how to use log-frames to our advantage. A lack of familiarity with the concept of log-frames meant that these were initially filled in as an 'afterthought' instead of being used as a planning tool. An appropriate understanding during project conception would have helped diagnose areas where our project was overly ambitious considering the people involved and the time and money available.

11.

■ **We agree for ECTF and the Darwin Secretariat to publish the content of this section**

One of the most outstanding achievements of this project is the sheer scale of the amount of fieldwork being conducted in Jari. As far as we know, this is the biggest and most complete biodiversity survey taking place in tropical forests today, which will result in the Jari fauna becoming one the of best known in Amazonia. Even at this early stage our research has led to numerous range expansions, new records for

Brazil and the Amazon basin, and identifications of previously undescribed species which will be monographed. A project of this size would clearly be impossible without the enthusiasm of all participating and collaborating Brazilian project members, and we have been exceptionally successful in achieving and maintaining strong working relationships with some of the leading Brazilian ecologists and taxonomists working in Brazilian Amazonia today.

The hard work contributed by all project members means this has all taken place within a very tight operating budget. Many visiting researchers have compared the scale and size of our project to the BDFFP project in Manaus, which at any one time hosts a similar number of researchers as us, but which has a large annual budget from the Smithsonian Institute and hires 5 full time staff to run logistics. While the Darwin grant has been able to cover the core biodiversity element, we have also been successful at introducing additional components, such as the sustainable livelihood analysis, through ongoing fundraising efforts and collaboration with Jari Celulose/Orsa Florestal.

Annex 1. **REVISED LOGICAL FRAMEWORK (MTR 02/2005)**

Intervention Logic	***Indicators***	***Means of Verification***	***Assumptions***
Purpose			
First stage analysis of biodiversity and livelihood impact of forest clearance, plantation establishment and forest recovery in Jari (Pará, Brazil)	Useful indicator taxa identified for comparative studies between and within 3 forest types	Validated report from sample analysis Curated specimens available for use	Groups sampled will include discriminating indicator species
	Local capacity increased for forest biodiversity surveys	Field competent scientists and technicians available and utilised	Local partners interested in future surveys and resources available to them for this
Outputs			
1 Sample and identify key biodiversity taxa in 3 forest types – plantation, secondary and primary forest	Sample design agreed and laid out in field by month 12	Transects mapped and labelled on Jari GIS database	Transport available at time required Brazilian partners cooperate as agreed in MoU Majority of collected material can be identified
	Field data collection completed by month 26 and identification of specimens completed by month 30	Field data sheets processed and specimens curated in MPEG Relational database created and validated	
	Peer reviewed conference paper reporting field work	Papers accepted for SCB July 2005 Brasilia conference	
2 Undertake comparative analysis of indicator taxa in 3 forest types	Bulk of analysis completed by month 30	Detailed report on findings Peer reviewed scientific papers	Full cooperation with data exchange and identification
3 Improve national capacity in forest biodiversity surveys in terms of technician skills, trained students and reference material	Expertise in forest biodiversity surveys increased	5 MScs completed by EoP 3 Technicians fully competent in agreed standard field procedures by EoP 2 candidates improve eligibility for Doctoral studies before EoP	Students awarded stipend Technicians maintain interest and have right aptitude
	Curated specimens and equipment handed over to MPEG/IMPA	Equipment in place and being used	Museum makes use of material
4 Pilot study of socio-economic and livelihood values derivable from the 3 forest types	Sample areas identified by month 18 and effective sampling undertaken by month 30	Maps and validated data	Village health assistants willing to undertake data recording
	Comprehensive analysis undertaken	Peer reviewed reports and scientific papers	