



# Darwin Initiative Annual Report

## Important note:

To be completed with reference to the Reporting Guidance Notes for Project Leaders: it is expected that this report will be about 10 pages in length, excluding annexes



**Submission Deadline: 30 April 2011**

## 1. Darwin Project Information

Project Reference	17-006
Project Title	Bushmeat hunting in Madagascar: linking science, policy and local livelihoods
Host Country/ies	Madagascar
UK contract holder institution	School of the Environment, Natural Resources and Geography, Bangor University
Host country partner institutions	Madagasikara Voakajy, Department of Water and Forests, Ecole Supérieure des Sciences Agronomiques (ESSA-Forêts), University of Antananarivo, Ministry of the Environment and Forests, Institut Pasteur Madagascar, Conservation International Madagascar
Darwin Grant Value	£299,860
Start/end dates of project	1 <sup>st</sup> May 2009 to 30 <sup>th</sup> April 2012
Reporting period	1 Apr 2010 to 31 Mar 2011, Annual Report No. 2
Project Leader name	Julia P G Jones
Project website	<a href="http://www.madagasikara-voakajy.org/index.php?option=com_content&amp;view=article&amp;id=16%3Aeducation-initiatives-for-bat-conservation&amp;catid=39%3Aprojects&amp;Itemid=61&amp;lang=en-GB">http://www.madagasikara-voakajy.org/index.php?option=com_content&amp;view=article&amp;id=16%3Aeducation-initiatives-for-bat-conservation&amp;catid=39%3Aprojects&amp;Itemid=61&amp;lang=en-GB</a>
Report authors, main contributors and date	Richard K. B. Jenkins, H. Julie Razafimanahaka, Julia P. G. Jones, 26 <sup>th</sup> April 2011

## 2. Project Background

This project is based in Madagascar, in the western Indian Ocean. For decades, species-based conservation efforts in the country have paid little attention to the issue of hunting as a pressure on native wildlife. Despite numerous accounts of hunting wild animals in Madagascar over this period, there was no systematic effort to determine the extent and impact of this activity. Madagasikara Voakajy, a Malagasy association that the Darwin Initiative helped to create in 2005, began to investigate the use of bushmeat in 2007 and quickly discovered widespread evidence of the consumption of protected and game species by people. Madagasikara Voakajy then sought appropriate technical expertise from Bangor University to assist the development of its bushmeat work. The resulting Darwin Initiative project (1127) is active in a number of regions across Madagascar (Figure S1) and aims to improve capacity within Madagascar, in terms of scientific and socio-economic understanding, and ensure that this improved capacity is applied to improving the management of harvested endemic species.

## 3. Project Partnerships

### The partnership between Bangor University and Madagasikara Voakajy

The main partnership in this project is between Bangor University (BU) and Madagasikara Voakajy (MV). The project PI is Julia Jones (BU) and she has overall responsibility for managing the project. Richard Jenkins (part-time post-doc, BU) is based with the partner NGO MV in Madagascar and is responsible for the day to day running of the project in collaboration with Julia Razafimanahaka (MV). Aidan Keane is a post-doc at Bangor University employed to analyze data collected in Y1 of the project and build capacity within MV to design robust research projects and analyze data fully. The key MV personnel involved in management of the

project are Julie Razafimanahaka and Mhy Andriamampionona. Julie manages technical aspects and Mhy oversees the financial and administration aspects. There are five other MV science staff employed on the project: Felicien Randrianandrianina, Andrinajoro Rakotoarivelo, Daudet Andriafidison, Voahirana Randriamamonjy, Tokiniaina Hobinjatovo as well as five technicians based in MV's regional office.

The partnership between BU and MV was well established during the first year of the project but the partnership has strengthened further during Y2. The main mechanisms for developing the partnership have been exchange between staff and regular communication via email and skype. Richard Jenkins was present in Madagascar, and based in the MV office, throughout the reporting period excluding two brief visits back to the UK during which he spent time in Bangor (August 2010 and March 2011). Julia Jones (PI) visited Madagascar for two weeks in September 2010. Aidan Keane was in Madagascar for 8 weeks in June and November/December 2010. Tokiniaina Hobinjatovo (MV) spent three weeks in BU working with Julia and Aidan in March 2011. Richard Jenkins and the MV technical team meet regularly when not in the field to discuss progress and report to Julia over email. Julia has regular (at least once a week but often much more frequent) email communication with Julie and Richard (and less frequent contact with other members of the team). Aidan has worked closely over email and skype with particular members of the MV team on specific technical aspects.

### **Other host country partners**

The government of Madagascar, Conservation International, ESSA-Forêts (Ecole Supérieure des Sciences Agronomiques, Département des Eaux et Forêts at the University of Antananarivo) and the Institute Pasteur are the other main partners in the project. However we also invite other conservation NGOs and researchers to our meetings where appropriate. In Y2 we organised two meetings in Antananarivo for partners, one in May 2010 and one in December 2010, where objectives, achievements and future plans for this bushmeat project were presented and discussed (see dissemination). These meetings were used to present some of the potentially sensitive results on bushmeat to key government personnel in advance of submission to journals for publication. In addition, MV organised meetings in the Sofia Region (Port Bergé) and the Alaotra Mangoro Region (Ambatondrazaka and Anosibe An'ala) to disseminate and discuss results from the bushmeat work (see Dissemination). When Julia Jones was in Madagascar she visited each of our partners in person.

ESSA-Forêts is mainly engaged in the capacity building aspect of this project and we work closely with them by providing student training and work placements. Our main focal points are Prof. Bruno Ramamonjisoa (the head of department) and Dr. Zo Hasina Rabemananjara.

The Institute Pasteur (IP) in Antananarivo specializes in diseases and leads on screening samples of bushmeat collected by MV and BU for viruses. The focal point is Dr. Jean-Michel Heraud. We maintain regular contact through telephone and meetings to facilitate the smooth operation of the blood sample collection and hold face to face meetings once or twice a year.

Because of the increasing profile of our work on illegal hunting of protected species, we started to work more closely with the Direction of Biodiversity Conservation and Protected Areas within the Malagasy government, although we still work with the Direction of Valorisation of Natural Resources for our work on sustainable use.

Conservation International (CI) provide some matched funding and manage a large new protected area (Zahamena-Ankeniheny Corridor) where a significant proportion of our field work has been carried out. CI staff attended most of the project's stakeholder meetings and Richard Jenkins met periodically with Dr James MacKinnon (CI Technical Advisor) to discuss progress and funding opportunities.

A major commercial mine (Ambatovy), which is active in one of our main study areas (close to the Zahamena-Ankeniheny Corridor) are very concerned about bushmeat hunting in and around their mine site. Building on a short contract awarded to MV before the DI project started, they have since provided more matched funding for some of our field work looking at the extent of bushmeat hunting of illegal species around their mine.

The relationships with these various partners are defined by the text in protocols of collaboration that were developed and signed in the first year of the project, between (1) BU and MV, (2) MV and ESSA-Forêts, (3) MV and Institute Pasteur and (4) MV and Ministry of

Environment and Forests (submitted, awaiting signatures). Grant agreements define the relationship between MV and CI and between MV and Ambatovy.

### **Other Collaboration**

The project established contact with TRAFFIC's bushmeat programme in Eastern and Southern Africa following a meeting between Richard Jenkins and Thomasina Oldfield in Cambridge. MV are keen for Madagascar to be more involved in the wider effort to deal with bushmeat in Africa.

The PI is in regular contact with researchers working on related subjects (both in Madagascar and internationally). In Y2 this included working closely with the Imperial College Conservation Science group who carry out a lot of research on the drivers of and solutions to bushmeat hunting throughout Africa and Asia. We have exchanged discussion of possible methodology for assessing hunting with this group and PHD and MSc students in that group are now using methods which we trialled during this project for investigating levels of illegal hunting.

### **Link with CBD**

The project maintains a close link with the primary CBD focal point in Madagascar: Mrs. Laurette Rasoavahiny who attended two meetings during Y2. We also helped support the Malagasy government meet their CBD commitments by preparing a written report (requested by Mrs. Rasoavahiny) for the 14<sup>th</sup> Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) meeting in Nairobi in May 2010 on how MV's work was contributing to CBD targets. Mrs. Rasoavahiny is supportive of our project and she was instrumental in obtaining ministerial clearance for a poster we have produced explaining the protected status of lemurs and the sanctions against lemur hunting. The project also made a prominent contribution to the government's three day festival that celebrated International Year of Biodiversity (see Dissemination) led by Mrs Rasoavahiny.

## **4. Project Progress**

### **4.1 Progress in carrying out project activities**

#### **Outputs 1 Review of vertebrate species that are listed as game under Malagasy law with respect to their distribution, biology, status and the extent to which they are hunted**

All activities completed in Y1

#### **Output 2: Determine the factors that influence patterns of exploitation**

*Activity 2.1-2.3* (see annual report Y1)

*Activity 2.4 Field data collection (schools, markets, households, hunts):* The factors that influence patterns of exploitation of bushmeat are complex. We have carried out a significant study looking at the role that socio-economic status, taste preferences and traditional taboos play in driving bushmeat consumption and using this information to develop recommendations to address the problem. The study provides strong evidence that protected species are widely eaten (Figure S2), particularly in rural areas with 95% of people having eaten at least one game species and 45% having eaten protected species. However, we also found that generally bushmeat is not a preferred meat relative to domestic meat (Figure S3). Traditional taboos (*fady*) offer protection for some protected species (Figure S4) but unfortunately these are rapidly breaking down, particularly in areas where illegal gold mining is causing rapid social change.

We suggest that because bushmeat is seen as an inferior substitute to domestic meats, efforts to increase the supply of domestic alternatives will reduce the exploitation of bushmeat. We also stress the importance of enforcement of wildlife laws to protect threatened species, particularly in regions undergoing rapid social change. The work has been submitted for publication (March 2010). We expect the study to generate considerable debate and publicity both within Madagascar and internationally and we are preparing press releases in French and English and working with government and NGO partners in Madagascar in advance of the release of the paper to ensure any attention it generates can be put to the best possible use in generating policy responses.

## Output 3

### Determine the impact of hunting for species that make important contributions to rural livelihoods

*Activity 3.1 Identify key species for advanced studies on life history and hunting:* We decided to focus on three game species. However, as described below the details of the sorts of data we are collecting for each species and how we will use it has evolved. As mentioned in Y1 and our Y2 half year report, because of the surprising levels of illegal exploitation we have uncovered in this project, the project's focus has evolved and we have focused more on illegal hunting (of protected and mostly threatened) species than we had originally planned.

#### **Legal bushmeat (game species)**

##### The Madagascar rousette (*Rousettus madagascariensis*)

We started a mark recapture study in Y1 of this project to estimate basic population parameters for this small endemic fruit bat which is widely hunted. The original aims of this were a) To build a population model to investigate what level of hunting might be sustainable, b) To understand more about movements of bats between roosts to understand whether incentives for roost protection make sense, c) To establish baseline population estimates for the roosts.

*Activity 3.2 Field data collection:* Three additional mark and recapture visits were made to fruit bat roosts during Y2 (July, October and February). In total (across the 3 sites), 2,183 uniquely identified bats were captured, of which 448 were subsequently recaptured. Only 115 individuals were recaptured two or more times.

*Activity 3.3 Analyses, report writing:* A major activity of the second year has been modelling this data. We used a 'robust design' which makes it possible to estimate the degree of temporary emigration and immigration into the population. We found that there are extremely high levels of movement between roosts: a bat has a 75% chance of changing roosts between capture occasions. However, we found relatively few bats in one roost and captured in another roost within our study area (Figure S5), suggesting that bats are moving extensively around unsurveyed roosts. We also found that bats are extremely trap shy; probability of recapture is 10 time slower than the probability of initial capture. These two factors (high degree of movement to unmonitored roosts and very low capture and recapture probability) make it difficult to estimate population parameters accurately and call into question the value of building a population model at the scale planned.

We are in the progress of writing up for publication what we have learnt from this study about mark and recapture of fruit bats (there have been relatively few examples of this). The paper will include analysis of the cost of carrying out mark and recapture for bats and what information it was possible to get. We will publish estimates of the population size at these roosts, how they vary over time and how simple visual counts compare to the much more expensive estimates of population size from mark recapture. The mark recapture at these roosts was carried out alongside an on-going engagement by MV with surrounding communities to create new protected areas and the information we have about how roosts are connected to other roosts in the area will be fed back to the community.

##### Common tenrec (*Tenrec ecaudatus*)

The common tenrec consistently features as the most commonly consumed bushmeat in both eastern and western Madagascar.

*Activity 3.2 Field data collection:* In Y1 we piloted methods for estimating population size of tenrecs with the aim of building a sustainable harvesting model and using this to investigate optimal ways of managing the harvest. As described in the Y1 report, we had very little success. We decided to redirect effort away from demonstrating unsustainable harvesting through ecological surveys and modelling, towards documenting community's experience of changes in tenrec availability. A pilot project conducted last year revealed that people reported growing commercial demand, and were concerned about resource availability. Regional stakeholders encouraged us to repeat the research in other sites within Mahabo District. Accordingly, the new research in February and March 2011 was located in three other Fokontany: Mahabo, Bepea and Andoviana.

*Activity 3.3 Analyses, report writing:* The results of this research are currently being analyzed (see Output 8).

#### The Commerson's leaf-nosed bat (*Hipposideros commersoni*)

The Commerson's leaf-nosed bat is the largest insectivorous bat in Madagascar and is hunted and consumed throughout its range.

*Activity 3.2 Field data collection:* Four weeks fieldwork was conducted in Mahafaly Plateau (Ampanihy District) in the south to assess hunting. 91 people from seven Fokontany (villages) were interviewed, 40% of which have eaten *H. commersoni*. The bat is consumed mainly to overcome seasonal food shortages. Colony sizes were estimated at three caves in the north-west using the mark-recapture method. Two fieldworks of four weeks each were conducted in September-October and November-December 2010. A total of 1,152 bats were captured.

*Activity 3.3 Analyses, report writing:* Data are being analysed while two additional fieldwork missions are planned for Y3.

#### ***Illegal bushmeat (protected species)***

Following the successful testing of the Random Response Technique (RRT) in Y1 of the project (see annual report Y1), we have adapted and applied the method during Y2.

#### Extent of illegal hunting around a major commercial mine

*Activity 3.2 Field data collection:* The MV team assessed the extent of consumption of eight species around the Ambatovy nickel mine (with matched funding from the mine). 294 RRT interviews were conducted in communities around the mine and a further 250 are underway in communities where the mine is thought to have no direct influence. This part of the project is important because it demonstrates (i) the profile of bushmeat hunting as an issue is being raised, resulting in a commercial stakeholder being willing to fund work on bushmeat hunting, (ii) the application of the refined RRT approach that the project developed in the first 18 months and (iii) that MV has acquired a tool, and the capacity to use it, that will be of use in many other sites in Madagascar.

*Activity 3.3 Analyses, report writing:* The results from this study will be presented to the Ambatovy mine in June 2011.

#### Establishing a baseline for monitoring the impact of lemur hunting

*Activity 3.2 Field data collection:* To know the impact of hunting on lemurs, it would be useful to have a robust method for monitoring changes in lemur population over time or differences between sites exposed to different levels of hunting. There is a rapidly growing literature on the potential value of occupancy modelling (which depends on simple presence/non-detection data and so is low cost) for monitoring trends in wild species but the approach has not yet been used on forest primates despite the apparent value of the approach. MV is very concerned about lemur hunting in the new protected areas which they are involved in managing (particularly Mangabe). We decided that it would be a valuable use of project resources to carry out a pilot to investigate the potential of occupancy modelling. We visited 40 randomly chosen 200m by 200m squares 3 times and noted the presence or non-detection of 5 species of lemur (and evidence of illegal mining).

*Activity 3.3 Analyses, report writing:* This was only a pilot study and the estimates are not particularly precise however preliminary analysis of the data suggests this may be a useful approach for monitoring lemur populations over time. However because of very different detectability and occupancy for different species (Figure S6), designing an optimal study design which suits both Indri and brown lemur for example may be challenging. We will write up this preliminary work for publication. We will also present the results to others in Madagascar interested in lemur monitoring.

## **Outputs 4 Recommendations for revisions to national legislation prepared with the Malagasy government**

*Activity 4.1 Prepare report based on 3.0*

*Activity 4.2 Present results to stakeholders*

This is a minor inconsistency in our initial log frame as in fact activities listed under Output 1 (Review of vertebrate species that are listed as game under Malagasy law with respect to their distribution, biology, status and the extent to which they are hunted) has contributed most strongly to this output and this was completed in Y2 (rather than Y3 as suggested on the log frame). In Y2 we completed the literature review on hunting legislation, identifying any anomalies in the law given the threat status or ecology of specific species and used this to identify where revisions to national legislation might be needed. We have discussed these findings with partners in the Malagasy government and written the work up as a paper for the journal Madagascar Conservation and Development which we invited them to comment on. We selected this journal as it is published in French and is open access. We have received the referees' comments from the journal and will re-submit soon.

## **Output 5: Assess the knowledge of rules concerning hunting of wild species among relevant groups**

*Activity 5.1 Training of project personnel to standardise methods (completed in Y1)*

*Activity 5.2 Field data collection:* The research part of this output was completed during the second year of the project. In total 138 interviews with those working for conservation NGOs and government officials in relevant departments in Antananarivo were carried out investigating their knowledge of protected species classification for 13 species (whether they were legally strictly protected, protected, game or considered as pests). A further 81 opportunistic interviews were undertaken with those with responsibility for wildlife law enforcement in different localities throughout Madagascar. The study revealed some important gaps in the knowledge of people who should know protected species laws.

*5.3 Analyses, report writing:* We presented the results of this work to project partners and stakeholders and the subsequent discussions resulted in a decision to make and distribute a poster about hunting laws. Discussions with stakeholders resulted in a decision to focus on lemur hunting in the poster. Two thousand A4, 100 A2 and 1000 small stickers were produced and a distribution plan will be discussed with regional stakeholders in the first quarter of YR3.

## **Output 6: Greater recognition of traditional knowledge incorporated into regional policy**

*Activity 6.1 Meetings with governmental and traditional authorities in study areas:*

*Indri Indri indri*

Our field work in one commune located within Conservation International's new protected area (Zahamena-Ankeniheny Corridor) revealed high hunting levels of protected species. MV organised a workshop in Moramanga during August 2010 to inform community representatives and other stakeholders about the extent of illegal lemur hunting in the commune. The workshop was attended by 40 people, including Prof. Jonah Ratsimbazafy (lemur specialist) as well as local traditional and elected leaders. The data we presented revealed high hunting pressure on the indri lemur – a species that has traditionally been protected by taboo. The tangalamena (respected elders) who attended the workshop lamented the decline of the taboo (fady) associated with the indri but were adamant that it could not be restored. Community representatives requested additional time and consultations in their villages before providing alternative ideas for reducing hunting and invited MV to visit the commune in October 2010. MV collected a total of three written responses from workshop participants during the October visit and each of these identified the creation of new community-based organisations as the first step in reducing hunting. The next step is currently under negotiation with Conservation International.

## Common tenrec *Tenrec ecaudatus*

The results collected by the MV team and Mirana Rajaonera, an ESSA-Forêts student, during the first year on trends in tenrec populations and hunting provided alarming evidence that the common tenrec is over-hunted. MV organised a workshop in the town of Mahabo in the Menabe Region on 16 and 17 February 2011. This event was endorsed by the Malagasy government and the regional director of the Ministry of Environment and Forests sent out official invitations. The workshop was attended by 36 people each day, including representatives from the Ministry of Environment and Forests, mayor's office, police, NGOs and communities where the project worked. Key project results about tenrec hunting (and flying fox disease, see Output 7) were presented to the participants. Tenrecs, although a traditional source of food, have become scarce because hunters no longer respect the taboo once given to killing females and young. The workshop resulted in a list of possible actions for improving the management of tenrec hunting. In the commune where the project worked, a natural resource dina (traditional law with legal recognition) had been formalised previously and this included prohibiting the killing of pregnant and baby tenrecs. Dinas are only effective when enough people know about them and when they can be enforced. It was suggested therefore that a campaign to inform people about the existing dina would have the best and quickest results. It was also recommended to include the existing dina within the regional dina that is currently being prepared by the government. Longer term, and more ambitious ideas included changing the legal hunting season and prohibit hunting with dogs.

### New protected areas

Three rainforest patches in eastern Madagascar are being developed as new protected areas by MV (a temporary decree has been granted and MV are working for full legal recognition). With matched funding from FFEM/IUCN France, the project employed 18 local observers to monitor the use of bushmeat in and around these forests. Following presentation of results and discussion with local communities, MV has drafted a dina and sent it out for consultation with local people the relevant authorities in the Anosibe An'ala District. A number of specific articles of the dina deal with bushmeat. Only three articles correspond to wildlife legislation whilst Article 35 is based on local fady. Similarly, although national law permits the hunting of fruit bats, this dina protects the bats at their roosts. This demonstrates how dinas can be used both to reinforce national laws and incorporate locally relevant rules.

## **Output 7: Analysis of the risk of disease transfer from humans eating bats**

*Activity 7.1 Training for project personnel to sample and preserve fruit bats (completed Y1)*

*Activity 7.2 Sample (blood) collection: 73 *R. madagascariensis* were collected from Anjoihibe in western Madagascar and 46 samples from *P. rufus* in Mahabo by a joint MV-IP team.*

*Activity 7.3 Screening for viruses: Samples from a total of 54 *P. rufus* and 72 *R. madagascariensis* have been analyzed by IP with no trace of paramyxoviruses (includes nipah virus and a wide variety of other illnesses) or lyssaviruses (rabies group), but two samples of *P. rufus* (from Mahabo) tested positive for corona virus (same group as SARS). This work is outside the Darwin project as we only had funding for screening for the paramyxoviruses and lyssaviruses (although the importance of using the samples for other analyses was recognised at the outset and included in the MOU). IP are carrying on with the interesting leads they have from the samples we collected which they screened for Corona viruses. The corona virus found seems to be new since they are clustering away from other virus from bats especially from Kenya bats viruses*

*Activity 7.4 Reporting to authorities*

We held a stakeholder workshop to report on project findings in Mahabo during February 2011 and IP attended this workshop to provide specialist information about bats and diseases. The IP representative explained that there was a risk to people from eating and handling bats up until the time that the meat is well cooked and that because they are mobile, the presence of corona virus in a distant locality confers no protection to people in other localities. We will work with IP to ensure that the relevant authorities in Madagascar are kept informed about the progress of the Corona virus work.

**Output 8: Malagasy masters students (five in total) graduated (Diplôme d'Etude Approfondies) and trained in the skills needed to undertake applied research in conservation science. Six undergraduates undertaking work experience with MV**

*Activity 8.1 Recruit Malagasy research students, 8.2 Malagasy students masters courses, 8.3 Malagasy students masters research projects:* Two Malagasy DEA (Diplôme d'Etude Approfondies) students graduated during Y2, taking the total to three. Each of these is now involved in conservation or further study. Mirana has a job with the Ministry of Environment and Forests. Vohirana is working for MV and Acyl has returned to university to do his DEA. Three new DEA students have completed data collection, whilst an additional two DEA students began their taught course in April 2011. All full list of students and their theses is available in Table S1.

*Activity 8.4 Malagasy student's work experience:* MV also hosted 3 professional placement students for three weeks each.

## **4.2 Progress towards project outputs**

**Output 1 Review of vertebrate species that are listed as game under Malagasy law with respect to their distribution, biology, status and the extent to which they are hunted:** This output is included within the publication submitted to Madagascar Conservation and Development. For practical reasons this output was implemented alongside Output 4. There are no plans to further develop this output in Y3.

**Output 2: Determine the factors that influence patterns of exploitation:** We carried out a detailed analysis of the drivers of bushmeat exploitation in one region of Madagascar. We expect the paper which came out of this work to be published early in Y3 and we plan extensive publicity and engagement with policy makers to discuss appropriate responses to this work. An urgent issue is to look at how illegal hunting can be reduced. Education has been raised as a possible way of reducing pressure but there has been little critical investigation of how education programmes may act. In Y3 therefore we will investigate the role that conservation education plays on knowledge of lemurs and attitudes to lemurs. Although this is slightly different from the work we originally envisaged under this output, it still contributes directly.

**Output 3: Determine the impact of hunting for species that make important contributions to rural livelihoods (revised to: Determine the extent of hunting and impact on their populations for game and protected species):** This output has focused on flying foxes, tenrecs and insectivorous bats and analysis will be completed towards the end of Y3. We have had to adapt work planned under this output to reflect the requests by stakeholders to focus more on the extent and impact of illegal hunting of protected species. In Y3 therefore, field work will focus on establishing the extent of exploitation of a number of key protected species (the critically endangered freshwater turtle *Erymnochelys madagascariensis* and the critically threatened Alaotran bamboo lemur *Hapalemur aloatrensis*). We also plan to continue investigating whether occupancy modelling can be used to study trends in lemur populations and may compare occupancy in areas known to be heavily hunted and un hunted.

**Output 4: Recommendations for revisions to national legislation prepared with the Malagasy government:** The project's review of national legislation has highlighted some anomalies. For example, marine mammals are listed as protected species in international treaties ratified by Madagascar and Malagasy fisheries law, but are not included on the 2006 list of protected species. We are therefore recommending that the list of protected, game and pest species is updated. However enforcement of the current law is a higher priority than improvements to the existing law which. In addition, the ongoing political transition in Madagascar does not create an amenable background to changing legislation and this is unlikely to happen during the life of the project.

**Output 5: Assess the knowledge of rules concerning hunting of wild species among relevant groups:** This output has been delivered and the results presented to stakeholders on the 16<sup>th</sup> December 2010. The final step is to produce a publication. We found that many people don't know that lemurs are protected or what the penalties for breaking the law are. Following discussion with stakeholders the project produced thousands of posters and stickers (endorsed by the Ministry of the Environment and Forests) to inform people that lemur hunting is illegal. Distribution will occur in Y3.

**Output 6: Greater recognition of traditional knowledge incorporated into regional policy:** We are working with communities to tackle over exploitation of tenrecs by reviving a commune-level dina that sought to support sustainable tenrec hunting based on traditional knowledge. A similar approach is being used in the District of Anosibe An'ala to promote the sustainable use of tenrecs by creating a dina that prohibits the killing of pregnant females or females with dependent young. This dina is currently under consultation and work will continue in Y3.

**Output 7: Analysis of the risk of disease transfer from humans eating bats (Nipah and Corona viruses):** The work with IP is proceeding well. A Malagasy vet student (Lalaina Arivony Nomenjanahary) based with IP is carrying out his research for his masters degree using data collected by the project. We will continue sampling into Y3. Although we have not found lyssaviruses and paramoyviruses (Nipah), it doesn't mean they are not present and are not a risk to humans. The risk of humans eating bats in Madagascar won't be fully understood within this project. It is impossible to prove a negative and this part of the project was only ever a small component so sampling is limited. The work on corona virus is likely to lead to further work by IP.

**Output 8: Malagasy masters students (five in total) graduated (Diplôme d'Etude Approfondies) and trained in the skills needed to undertake applied research in conservation science. Six undergraduates undertaking work experience with MV.:** This is proceeding on course, with three DEA students graduated and another four currently carrying out field work and analysis or the taught component of their course). Five undergraduate students have received formal work experience from MV.

#### 4.3 Standard Measures (Table 1)

Code No.	Description	Y1	Y2	Total to date	Number planned for Y2	Total planned
2	Diplôme d'Etude Approfondies (Masters)	0	3	3	3	5
3	5-day GIS course for Malagasy students	1	0	1	0	6
	Ingénieur (Diplôme)	0	1	1	0	1
4A	Professional work experience for Malagasy undergraduate students	2	3	5	3	6
4B	Number of weeks	6	9	15	9	18
4C	Training for 3 masters students and 1 PhD student	4	3	7	3	6
4D	Number of weeks training for MSc and PhD	30	4	34	4	35
5	On-the-job training for MV staff	3	3	6	3	3
6A	Training in occupancy modelling in BU by Toki (MV)		1			
6B	Weeks training (by Aidan Keane in BU)	0	3			
8	Richard K. B. Jenkins	17	17	34	17	45
	Aidan Keane	0	8	8	8	8
	Julia J. P. Jones	3	2	5	2	7
	Total	20	27	47	27	60
11B	Paper submitted to MCD and PLOS ONE	1	2	3	2	4
12A	Database on species conservation and management status	1	0	1	0	1
14A	Stakeholder workshops (Y2: April x 2, August, December, January)	2	5	7	2	6
14B	Biodiversity day and Environment day celebrations		2	2	2	3
15D	Bangor Press Release	1	1	1	1	3
20	Motorcycle	£2,500	0	0	0	£2,500
23	Grants awarded in YR2	£93k	£48k			
New	Newsletter contributions	1	1	0	1	0

#### **4.4 Progress towards the project purpose and outcomes**

We believe that we are on course to deliver our project purpose: Improved capacity within Madagascar, in terms of scientific and socio-economic understanding, applied to improving the management of harvested endemic species. At the end of year 2, the capacity of MV to conduct scientific assessments of bushmeat hunting has been significantly improved and work undertaken by MV (along with advanced analysis in collaboration with BU) has provided a unique insight into the social and cultural aspects of hunting, the scale of the problem and possible solutions. Through working closely with other partners within Madagascar, we have improved understanding of the complexity of bushmeat hunting as an issue. Although the main findings have been disseminated, we plan a major publicity drive following the publication of the main paper submitted in Y2 which we hope will lead to significant awareness raising, thus facilitating further discussion with policy makers and other stakeholders. Improved management of game species is challenging but concrete steps are being taken as a result of this project including the revival of a traditional dina to manage tenrec harvesting in the west. Alongside this report we are formally applying to DI for permission to update and revise our logframe. The changes we request are relatively minor but we want to explicitly acknowledge that our project seeks to reduce pressure on illegally hunted species (as well as management of game species).

The purpose-level assumptions are: 1) Sustainable exploitation of natural resources remains a national priority, 2) New protected areas allow the harvest of game species, 3) Communities agree to develop and implement harvest plans for game species. The sustainable exploitation of natural resources remains a priority for the Ministry of Environment and Forests. Evidence for this comes from the renewed commitment to create sustainable use protected areas. That said, there remains a stronger emphasis on sustainable forestry, commercial export and ecotourism than on the direct exploitation of animals for food in Madagascar. The revised management code for protected areas has been in preparation since 2008 but political instability has delayed its validation. Communities which have engaged with the project are keenest to implement new harvest plans when they have detected a decline in target species.

#### **4.5 Progress towards impact on biodiversity, sustainable use or equitable sharing of biodiversity benefits**

Our project is uncovering increasing evidence that hunting of protected species (including some globally threatened lemur species) is common in many parts of Madagascar. We have uncovered particularly concerning evidence that traditional taboos (fady) which protected some species in the past are rapidly eroding in the face of social change. We believe that this threat is urgent and increasing and likely to get worse under current conditions as the issue is not yet high on the agenda of the government authorities, NGOs or civil society. This project will likely increase the profile of bushmeat hunting as an issue in Madagascar which we anticipate will leave the bushmeat issue with a deservedly higher profile as well as baselines studies for monitoring of trends and the skills and capacities to carry out such monitoring. However, without very real and concrete action, which will need the contribution of resources from the government and international donors, hunting will continue to make the status of biodiversity in Madagascar worse, not better.

We feel more positive about the progress we are able to make with respect to sustainable exploitation. Laws which legally recognise local communities' rights to manage their natural resources have been in place in Madagascar now for more than 10 years and provide a useful framework within which to work with communities to improve management of tenrecs and bats.

## **5. Monitoring, evaluation and lessons**

Julia's visit (2 weeks in Sept 2010) to Madagascar was important for formal monitoring of progress (both against planned activities and against the overall project purpose). The first few days were taken up with a series of presentations from all the MV bushmeat team on the progress of the various aspects of the project. Julia, Richard and Julie then worked intensely reviewing progress against each planned activity, assumptions and any risks. They also held meetings with other partners to assess progress and plan for the future. Richard and Julia also had a formal monitoring and evaluation meeting in March 2011 where they reviewed the logframe in detail and agreed slight changes for the final year of the project. Julia will travel to Madagascar much earlier in Y3 than in previous years as we feel it is important to have a major review of the project while there is still time to make significant changes to activities planned in the final year to ensure the work we have done so far has the greatest possible impact and legacy. Stakeholder meetings have also been important for monitoring and evaluation as have been opportunities for the team to reflect on progress with input from other stakeholders.

## **6. Actions taken in response to previous reviews (if applicable)**

The reviewer made some very helpful comments following our Y1 report.

1) *Reporting on activities is a little confusing. Future reports in section 4.1 should refer to activity numbering rather than output numbering.* I hope this section is clearer this year.

3) *It is not entirely clear how Output 6: "...greater recognition of traditional knowledge incorporated into regional policy' is to be achieved but information is welcomed in future reports.* We have provided more information on this (see section 4.2 output 6).

4) *Will attempts to survey tenrec populations be restarted or has this activity been abandoned altogether?* Due to the problems with estimating population parameters for tenrecs we have abandoned the ecological field work on this species (see section 4.2 output 3). Interviews and data on trends in prices provide strong evidence of a decline and we feel that intensive field surveys and modelling would not provide important enough information to justify the cost.

5) *Improved financial reporting is recommended.* We are sorry about the problems last year. I hope this year has been better.

## **7. Other comments on progress not covered elsewhere**

As mentioned above and in the Y2 report, the project has shifted focus slightly during this year (a process started in Y1) towards more emphasis on assessing illegal hunting and finding ways of tackling this urgent threat to biodiversity. Our work on game species has continued but we have put less effort into assessing the sustainability of hunting (through extensive ecological field work and modelling) than had been planned. This is partly to make space in the programme for the illegal hunting work but also because of realisation of the limitations and impracticalities of modelling population dynamics of either fruit bats or tenrecs given the challenges of obtaining meaningful population parameters (see section 4.2).

The political situation in Madagascar has yet to return to normal and remains unpredictable. Presidential elections should be called soon and may lead to periods of greater instability.

A possible risk is the reaction of the government when the scientific results will be published in 2011. MV is now working to assist the government prepare for some challenging publicity about lemur hunting and we hope that by acknowledging the enormous challenge faced by the government and their limited resources and by giving credit to positive interventions so far achieved, we can avoid unhelpful blame and recriminations and ensure the results are a spur to positive action. However to some extent this is outside our hands.

## 8. Sustainability

The project, as implemented by the host country partner, is well known with local, regional and national stakeholders. However we expect the prominence of the project and (most importantly) the issue of bushmeat hunting will rise in profile significantly when a paper we have submitted is published. We are working with partners to prepare for this as feel it will be very important to capitalize on the momentum provided by extensive publicity. The exit strategy outlined in the original proposal remains valid. The project will be a success if MV can continue, to take a lead in bushmeat research, monitoring, and through positive interventions within the protected areas it manages. For this to happen, MV needs to conduct appropriate dissemination, to retain its core team of bushmeat scientists and to obtain future contracts for bushmeat work.

## 9. Dissemination

**Ambatondrazaka, Alaotra-Mangoro Region (9 April 2010):** To present the project's bushmeat results to regional stakeholders. It was attended by 20 people, including Mr. Rakotonirina Ramenason (Regional Director of the Ministry of Environment and Forests) and Raherimanantsoa Jean Michel (Conservation International; project partner).

**Anosibe An'ala, Alaotra-Mangoro region (13 April 2010):** To present the project's bushmeat results stakeholders in the Anosibe An'ala District. It was attended by 28 people, including Mr Rakotoarinosy Marcel (Chef District Anosibe An'Ala) and Mme Razafindrahanta Hanitriniaina (Chief of the Circonscription de l'Environnement et des Forêts – Moramanga)

**Moramanga, Alaotra Mangoro Region (5 and 6 August 2010):** To present the results about lemur hunting to stakeholders from a single commune. It was attended by 40 people, including Mme Razafindrahanta Hanitriniaina (Chief of the Circonscription de l'Environnement et des Forêts – Moramanga), Mme Andrianjohaninarivo Tokihenintsoa (Conservation International), mayor and representatives of the communities from the Commune concerned.

**Port Bergé, Sofia Region (16 June 2010):** This meeting was held to present the project's bushmeat preliminary results to regional stakeholders in the Sofia Region and to inform about the general work of MV and its partners. It was attended by 28 people, including Mr. Zamany Ruffin (Regional Director of the Ministry of Environment and Forests), Mr Randriamaro Désiré (Directeur Régional du Développement Rural)

**Port Bergé (3 and 4 February 2011):** To present the results bushmeat and other activities to key stakeholders in the Sofia Region. It was attended by 39 participants, including Mr Zamany Ruffin (Regional Director of the Ministry of Environment and Forests), Harison Randrianasolo (Conservation International).

**Antananarivo, Analamanga Region (16 December 2010):** To present the results bushmeat and other activities to key stakeholders and project partners. We gave two presentations on bushmeat and drafts of two scientific papers were distributed. It was attended by eight participants, including Mrs. Laurette Rasoavahiny (CBD Focal Point), Mrs. Lydie Raharimaniraka and Mrs. Sahondra Rabesihanaka (Direction of Valorisation of Natural Resources), Prof. Bruno Ramamonjisoa (ESSA-Forêts) and Michèle Andrianarisata (Conservation International).

**Antananarivo, Analamanga Region (6 May 2010):** Organised by the Ministry of the Environment and Forest at the request of MV. The ministry invited project partners and presentations were given by MV and BU on some of the preliminary results from the bushmeat studies. It was chaired by Mrs. Laurette Rasoavahiny (CBD Focal Point and Head of the Direction for Biodiversity Conservation and Protected Areas) and also attended by staff of relevant government departments, the University of Antananarivo.

In addition, we have participated **International Year of Biodiversity Festival (3-day event organised by the CBD Focal Point in Antananarivo):** The project gave a public lecture on bushmeat to ca. 300 school children and presented a poster and at this event to highlight the issue of bushmeat hunting. We also contributed to the travel costs for 750 school children to attend the festival and visit the zoo. **World Environment Day (1 day event in Mormanga):** Project results and activities were presented in poster form.

## 10. Project Expenditure

**Table 2: project expenditure during the reporting period (1 April 2010 – 31 March 2011)**

Item	Budget	Expenditure	Variance
Staff costs Richard Jenkins Aiden Michael Keane J Hanta Razafimnahaka F Randrianandrianina J Rakotoarivelo D Adriafidison R Andrianairoariveleo Casual local salaries TOTAL STAFF COSTS			-10%
Overhead costs			<1%
Travel and subsistence			+10%
Operating costs			-5%
Capital items/equipment Tents			-71%*
Others (please specify) Malagasy Students Henipavirus analysis Consumables			-10% +10% +180%*
TOTAL			-5%

\* the variance was >10% of the budget for capital items (tents) where we under spent and for consumables (mostly office supplies) where we overspent. Although the % variances are large the absolute amounts are relatively small as these are small budget lines. We spent less on tents as bought some using matched funding, we spent more on consumables due to rising costs in Madagascar of office supplies and lots of printing for our dissemination events.

## 11. OPTIONAL: Outstanding achievements of your project during the reporting period (300-400 words maximum). This section may be used for publicity purposes

I agree for LTS and the Darwin Secretariat to publish the content of this section (please leave this line in to indicate your agreement to use any material you provide here)

### Lay summary of project achievements thus far (focused on one element of the project- understanding and tackling illegal hunting)

When many people think of Madagascar they think of the country's amazing wildlife, particularly the iconic and charismatic lemurs. It is well recognised that rapid habitat loss threatens many Malagasy species, but until recently very little attention was paid to the extent to which hunting is an important threat.

Studying hunting of protected species is challenging as people may not be willing to discuss it. We have therefore adapted methods developed by social scientists for studying sensitive behaviour (such as drug use) to get accurate estimates of hunting prevalence. For example, we may ask a question such as 'have you eaten a lemur in the last year?' Before the respondent answers we ask them to pull a ball out of a bag (they don't reveal the colour to the interviewer). If they have got a black ball we ask them to simply say 'yes', if they have a white ball to say 'no', and only if they have a red ball to answer the question honestly. Therefore the individual doesn't reveal any incriminating evidence about themselves but, using simple rules of probability, we can estimate what proportion of the population have eaten lemurs.

Such methods are not always necessary as other research by our project found that in some areas people may not be aware that lemur hunting is illegal. People can only follow laws they know about, so in collaboration with our partners in the Malagasy government, we have produced and distributed a hard hitting poster making the law on lemur hunting clear.

Tackling the issue of lemur hunting requires a good understanding of who is hunting and why. We have recently completed in depth study to investigate the role that wealth, traditional taboos and food preferences play in driving bushmeat consumption. What we found was that most bushmeat species, including lemurs, are not preferred food but are considered inferior to domestic meats such as chicken. This suggests that efforts to improve small animal husbandry and reduce the cost of these meats will reduce hunting pressure. We also found worrying evidence that traditional taboos, which have limited hunting of the Indri (the largest lemur in Madagascar), are breaking down as the advent of illegal mining leads to rapid social change in some areas. The issue of illegal hunting as an important threat to biodiversity in Madagascar is only now being fully recognised. Urgent action is required to ensure that heavily hunted species are adequately protected.

## **Pictures**

We have lots of images of Malagasy wildlife (both protected species and game species) being used for bushmeat. We also have images of the team in the field (interviewing, trapping bats, sampling bats to screen for viruses), project meetings and dissemination events, members of MV visiting BU to work with BU staff on analysis.

## Annex 1: Report of progress and achievements against Logical Framework for Financial Year 2010-2011

Project summary	Measurable Indicators	Progress and Achievements April 2010 - March 2011	Actions required/planned for next period
<p><b>Goal:</b> To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but constrained in resources to achieve</p> <ul style="list-style-type: none"> <li>⇒ The conservation of biological diversity,</li> <li>⇒ The sustainable use of its components, and</li> <li>⇒ The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources</li> </ul>		<p>(report on any contribution towards positive impact on biodiversity or positive changes in the conditions of human communities associated with biodiversity eg steps towards sustainable use or equitable sharing of costs or benefits)</p>	
<p><b>Purpose</b> Improved capacity within Madagascar, in terms of scientific and socio-economic understanding, applied to improving the management of harvested endemic species</p>	<p>Policies developed, advocated and implemented to improve management of bushmeat Exploitation of game species included within management plans of new protected areas Traditional management given greater recognition Students in a position to be recruited to responsible positions MV able to attract funding in the future and influence policy</p>	<ul style="list-style-type: none"> <li>- A number of stakeholder meetings have raised the issue of illegal bushmeat hunting and this has a higher profile among NGOs, government and corporate (mining companies), a poster has been approved by the ministry raising profile/awareness of illegal hunting,</li> <li>- New protected area management plans using project data on hunting</li> <li>- Traditional management of focal species discussed and stakeholder priorities identified</li> <li>- Students graduated and found employment in relevant fields</li> <li>- New funding obtained for work on bushmeat</li> </ul>	<ol style="list-style-type: none"> <li>1. Work with government to prepare for likely national and international coverage following publication of a significant output of the project to ensure the attention is capitalised upon</li> <li>2. Finalize protected area management plans with consideration of hunting issues fully integrated;</li> <li>3. The remaining DEA students to complete valuable research, be awarded degrees and obtain relevant work</li> <li>4. Obtain sufficient funding to support MV to continue working on bushmeat to capitalise on the successes of this project;</li> </ol>
<p><b>Output 1.</b> Review of vertebrate species that are listed as game under Malagasy law with respect to their distribution, biology, status and the extent to which they are hunted</p> <p><b>Output 4.</b> Recommendations for revisions to national legislation prepared with the Malagasy government</p>	<p>1.a Report (French &amp; English) 1.b Peer-reviewed publication 1.c Seminar to discuss results 1.d National-level government involvement</p> <p>4.a Report in French and English produced for the government (national and regional) containing recommendations 4.b Meetings/small workshops held with key staff of relevant government departments</p>	<p>Review completed and draft results (in French) presented to stakeholders in meetings; draft publication (in French) circulated to stakeholders before submission to the journal Madagascar Conservation and Development. We are currently revising the paper following invitation of the journal.</p>	

Activity 1.1 Preparation and submission of a scientific paper on hunting legislation in Madagascar		Submitted to Madagascar Conservation and Development in December 2010, reviewers comments received April 2011
<b>Output 2.</b> Determine the factors that influence patterns of exploitation	2.a Field data collected and analysed	Better understanding of the drivers of exploitation(e.g. secondary impact of illegal mining, lack of alternative meats) obtained at key study sites and is being used to inform the direction and content of future conservation work
Activity 2.1. Large data set on household interviews in eastern Madagascar analyzed and written for publication		Manuscript submitted in March 2011. Poster presentation at the Cambridge Student Conservation Conference, March 2011
<b>Output 3.</b> Determine the impact of hunting for species that make important contributions to rural livelihoods	Data collected on hunting levels and biological parameters and analyzed and published	Alarming insights into the extent of hunting on protected species obtained alongside evidence for worrying declines in legal game species because of over-hunting. These parallel initiatives are being used to advocate greater enforcement of wildlife legislation and application of traditional forms of harvest and management
Activity 2.4. Field data collection (schools, markets, households, hunts)		Comprehensive and expanding set of initiatives focussing on a small number of game species (bats, tenrecs) and an increasing number of protected species (lemurs, freshwater turtles).
<b>Output 5.</b> Assess the knowledge of rules concerning hunting of wild species among relevant groups	5.a Data collected on knowledge of hunting rules and socio-economic predictors of this knowledge in two regions of Madagascar	The data collection phase of this output is completed and results have been shared with stakeholders. This resulted in us producing a poster about lemur hunting laws
Activity 5.3. Analysis and report writing		The results will be submitted for publication in the final year of the project.
<b>Output 6.</b> Greater recognition of traditional knowledge incorporated into regional policy	6.a Local management of hunted populations (eg local <i>dina</i> to protect bat roosts, <i>fady</i> governing timing of hunting) recorded and given regional recognition	Although the project uncovered significant desire to restore protective <i>fady</i> , it may only be feasible in a few cases. The best candidate for where traditional knowledge and rules can help support sustainable harvests is the case of the common tenrec.
Activity 6.1 Meetings with governmental and traditional authorities in study areas		Stakeholder meetings in two sites discussed traditional management of species to (i) prevent illegal hunting of indri lemurs and (ii) return to traditional methods of harvesting tenrecs. Participants in these meetings were more positive about achieving (i) than (ii). Site-based local <i>dinas</i> are being developed in a number of sites managed by MV. Using the results of research collected in this project, specific clauses within each <i>dina</i> , and actual forest management zones, will reflect existing legal and illegal forms of hunting.
<b>Output 7.</b> Analysis of the risk of disease transfer from humans eating bats	7.a Biological samples collected and analysed 7.b Results communicated to national government on risk level and avoidance 7.c Dissemination plan to hunters designed and implemented with national government	Sampling is ongoing but preliminary results have already been given to stakeholders in one of the collection sites. These results will be written up for publication in the final year.
Activity 7.2 Sample (blood) collection		Sampling of <i>P. rufus</i> and <i>R. madagascariensis</i> continued in the second year

Activity 7.3 Screening for viruses	The Institute Pasteur continued to screen the samples for viruses
Activity 7.4 Reporting to authorities	A representative of the Institute Pasteur participated in a stakeholder workshop organised by the project and gave a presentation about fruit bats and diseases (including preliminary results of the screening)
<b>Output 8.</b> Malagasy masters students graduated (Diplôme d'Etude Approfondies) and trained in the skills needed to undertake applied research in conservation science. Six undergraduates undertaking work experience with MV	8.a Student proposals 8.b Student field project data 8.c Student theses 8.d Student graduation certificate 8.e Government staff involved in project e.g. as external examiners\
8.1 Recruit Malagasy research students	Two new Malagasy research students recruited for 2011/12
8.2 Malagasy students masters courses	Two Malagasy research completed taught masters courses component 2010/11
8.3 Malagasy students masters research projects	Two Malagasy masters research students completed their degrees Two Malagasy masters research students undertaking project work
8.4 Malagasy 3 <sup>rd</sup> year students work experience	Three 3 <sup>rd</sup> year university students embedded in MV as part of their professional placement

## Annex 2 Project's full current logframe

Following a detailed analysis of priorities during Y2, we have reviewed our logframe and made some small changes, to reflect findings in the early stages of the project and the priorities of our stakeholders. The changes are highlighted in yellow.

Project summary	Measurable Indicators	Means of verification	Important Assumptions
<b>Goal:</b>			
Effective contribution in support of the implementation of the objectives of the Convention on Biological Diversity (CBD), the Convention on Trade in Endangered Species (CITES), and the Convention on the Conservation of Migratory Species (CMS), as well as related targets set by countries rich in biodiversity but constrained in resources.			
<b>Sub-Goal:</b> Madagascar's hunted endemic species more sustainably managed.	Revised legal framework for sustainable harvesting of game species Sustainable and legal exploitation of wildlife for food explicitly considered in management plans of the new protected areas Traditional rules ( <i>dina</i> ) receiving regional recognition	Copies of research outputs (reports and papers). Agenda, meeting records and management plans. Evidence from outputs of workshops and government committees Copies of <i>dinas</i> signed by traditional authorities and government officials	
<b>Purpose</b> Improved capacity within Madagascar, in terms of scientific and socio-economic understanding, applied to improving the management of harvested endemic species and to reducing pressure on illegally hunted species.	Policies developed, advocated and implemented to improve management of bushmeat and reduce pressure on protected species. Exploitation of game species included within management plans of new protected areas Traditional management given greater recognition Students in a position to be recruited to responsible positions MV able to attract funding in the future and influence policy	Project reports, management plans for new protected areas, student records and theses, MV annual report	Sustainable exploitation of natural resources remains a national priority. New protected areas allow the harvest of game species. Communities agree to develop and implement harvest plans for game species
<b>Outputs</b> 1 Review of vertebrate species that are listed as game under Malagasy law with respect to their distribution, biology, status and the extent to which they are hunted	1.a Report (French & English) 1.b Peer-reviewed publication 1.c Seminar to discuss results 1.d National-level government involvement	Copies of reports, publication, seminar and workshop attendance record and agenda	Government representatives are available and willing to engage
2. Determine the factors that influence patterns of exploitation	2.a Field data collected and analysed	Copies of data, student theses, publications	Cooperation of the general public

<p>3. Determine the extent of hunting and impact on their populations for game and protected species</p>	<p>3.a Data collected on extent of hunting of protected species, methods established to monitor trends in harvested species (lemurs), the sustainability of hunting of game species analyzed.</p>	<p>Copies of data, student theses and publications</p>	<p>Cooperation of the general public, field logistics allow planned data to be collected</p>
<p>4 Recommendations for revisions to national legislation prepared with the Malagasy government</p>	<p>4.a Report in French and English produced for the government (national and regional) containing recommendations  4.b Meetings/small workshops held with key staff of relevant government departments</p>	<p>Reports and meeting records</p>	<p>Assumes that our research does find some areas which need revision</p>
<p>5 Assess the knowledge of rules concerning hunting of wild species among relevant groups</p>	<p>5.a Data collected on knowledge of hunting rules and socio-economic predictors of this knowledge in two regions of Madagascar</p>	<p>Copies of questionnaires, data, student thesis and publication.</p>	<p>Willingness to participate in the surveys among local people</p>
<p>6. Greater recognition of traditional knowledge incorporated into regional policy or new protected area management plans</p>	<p>6.a Local management of hunted populations (e.g. local <i>dina</i> to protect bat roosts or govern management of tenrecs, <i>fady</i> governing timing of hunting) recorded and given regional recognition</p>	<p>Signing of locally agreed <i>dina</i> with regional recognition.</p>	<p>Support of local communities, that appropriate <i>dinas</i> and <i>fady</i> are operating in the study area (preliminary data suggests they are)</p>
<p>7. Analysis of the risk of disease transfer from humans eating bats (Nipah, lyssa viruses and Corona viruses)</p>	<p>7.a Biological samples collected and analysed  7.b Results communicated to national government on risk level and avoidance  7.c Dissemination plan to hunters designed and implemented with national government</p>	<p>Publication, copies of meeting records with government, evidence of the dissemination plan implemented (radio broadcast, posters)</p>	<p>Institute Pasteur continues to be independently funded, government dissemination plan only required if risks are detected</p>

8. Malagasy masters students (five in total) graduated (Diplôme d'Etude Approfondies) and trained in the skills needed to undertake applied research in conservation science. Six undergraduates undertaking work experience with MV	8.a Student proposals 8.b Student field project data 8.c Student theses 8.d Student graduation certificate 8.e Government staff involved in project e.g. as external examiners	Copies of theses, certificates and lists of external examiners/advisors, work experience reports	That high quality masters candidates can be found who want to undertake projects in line with the priorities of the project, that undergraduates want to undertake the work experience offered.

## Annex 3 Supplementary material (optional but encouraged as evidence of project achievement)

### Checklist for submission

	Check
<b>Is the report less than 5MB?</b> If so, please email to <a href="mailto:Darwin-Projects@ltsi.co.uk">Darwin-Projects@ltsi.co.uk</a> putting the project number in the Subject line.	Yes
<b>Is your report more than 5MB?</b> If so, please discuss with <a href="mailto:Darwin-Projects@ltsi.co.uk">Darwin-Projects@ltsi.co.uk</a> about the best way to deliver the report, putting the project number in the Subject line.	No
<b>Have you included means of verification?</b> You need not submit every project document, but the main outputs and a selection of the others would strengthen the report.	Yes
<b>Do you have hard copies of material you want to submit with the report?</b> If so, please make this clear in the covering email and ensure all material is marked with the project number.	No
Have you involved your partners in preparation of the report and named the main contributors	Yes
Have you completed the Project Expenditure table fully?	Yes
Do not include claim forms or other communications with this report.	