Darwin Initiative Main Project Annual Report

Darwin Project Information

Project Reference	22-002
Project Title	**Complete Altitudinal Rainforest Transect for research and conservation in PNG**
Host Country/ies	Papua New Guinea
Contract Holder Institution	University of Sussex
Partner institutions	Binatang Research Center, Papua New Guinea
Darwin Grant Value	£292,171
Funder (DFID/Defra)	Defra
Start/end dates of project	1 April 2015 – 31 March 2018
Reporting period (e.g., Apr 2015 – Mar 2016) and number (e.g., Annual Report 1, 2, 3)	1 April 2015 – 31 March 2016 Annual report 1
Project Leader name	Dr Alan J A Stewart
Project website/blog/Twitter	
Report author(s) and date	AJA Stewart, V Novotny, MR Peck; 4th May 2016

1. Project Rationale

New Guinea includes the world's third largest rainforest, supporting 5% of global biodiversity. However, 24% of Papua New Guinea's forests have been destroyed in the past 30 years. Only 4.5% of land is protected and this protection is ineffectual. PNG's biodiversity is also among the least known in the world. For instance, only 0.2 papers per bird species in PNG, compared with 2.9 papers in Australia, were published in the last 50 years. Furthermore, only 24% of the 396 research papers on PNG biology from the last 10 years had a PNG author. Ecological research is hampered by the lack of permanent study sites, especially along key altitudinal and disturbance gradients with background information on their biota to enable environmental change monitoring. Training the next generation of PNG biologists is a top priority as they are better placed to implement conservation measures than overseas experts. In summary, PNG needs (i) new conservation strategies and conservation areas, (ii) more biodiversity research, including new molecular approaches, (iii) better research training of Papua New Guineans, and (iv) better field research facilities. This project was designed to address all these needs in an integrated program of conservation, research and training for Mt. Wilhelm, a globally important biodiversity hotspot.

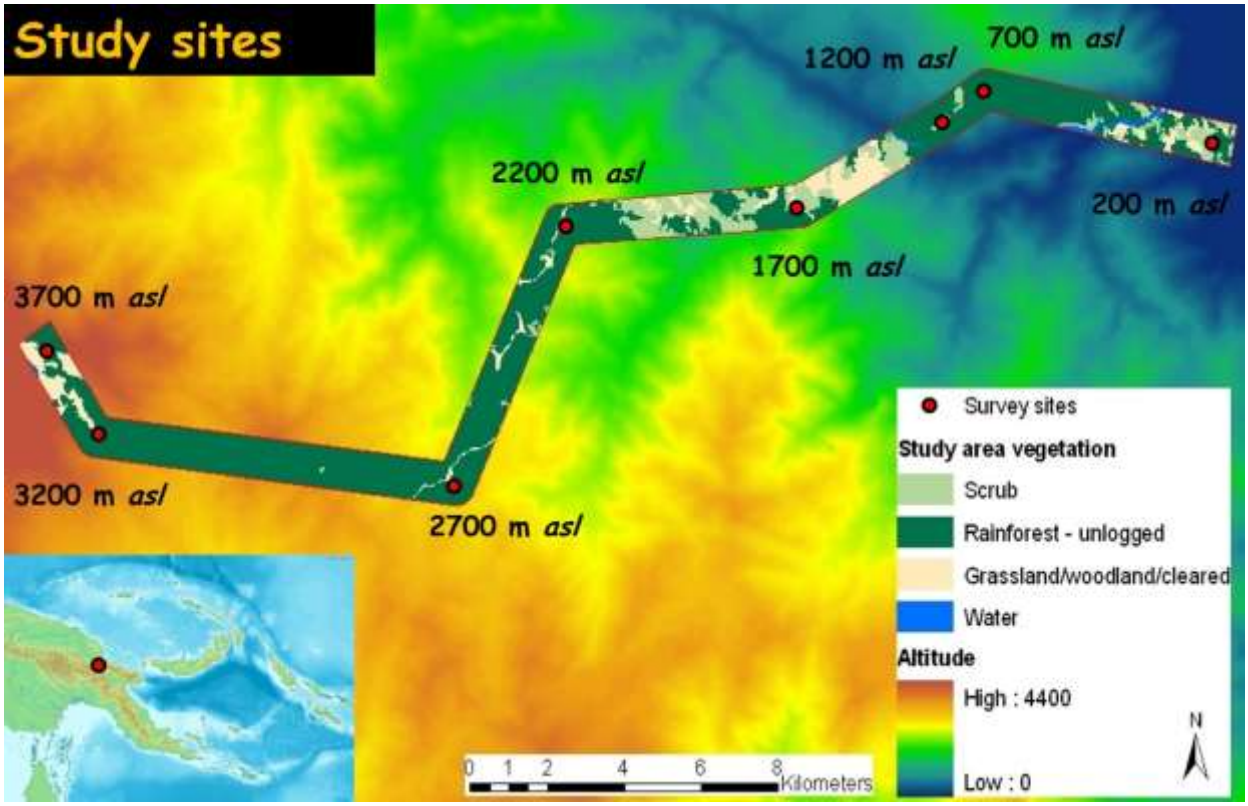

Figure 1: Map of Complete Altitudinal Rainforest Transect (CART) from 200m to 3700m on Mt Wilhelm. Inset top left shows position of transect within outline map of Papua New Guinea.

2. Project Partnerships

The close partnership between the University of Sussex (UoS) as Lead institution and the Binatang Research Center (BRC), the principal partner in PNG, is substantially based upon the long history of association between the two partners (Alan Stewart and Vojtech Novotny) including on five previous Darwin Initiative projects. The partnership works well with free flow of email discussion and prompt resolution of issues.

Alan Stewart is responsible for day to day management of the project, including co-ordination of visits to the UK by the para-ecologists as well as visits by UK personnel to PNG. The New Guinea Binatang Research Center (BRC), under the directorship of Prof Vojtech Novotny, is our principal partner in project management, training and research. It is the leading biological research institution in PNG with a staff of 24 researchers, students and highly-skilled research technicians (para-ecologists). Mika Peck (Lecturer in Biology at the University of Sussex) has contributed his expertise on REDD+, forest carbon stock assessment and remote sensing for biodiversity assessment. Dr Peck brings a wealth of experience of South American rainforest ecosystems, including from a previous Darwin Initiative project (14/040) on primate conservation in Ecuador.

We continue to benefit from collaborations with long-standing partners in the UK. Dr Mike Wilson (National Museum of Wales, Cardiff) has been generous with his own time and that of his staff in the Entomology Department in hosting the BRC para-ecologist visitors. Unfortunately, a long-standing and productive collaboration with the Herbarium staff at the Royal Botanic Garden at Kew, who had trained our para-ecologist visitors in plant identification in the past, could not continue due to substantial institutional restructuring and changes in charging policy for training. However, we developed a new arrangement with BRC collaborators in the Zoology Department at Oxford University (Prof. Owen Lewis, Dr Becky Morris and Dr Sofia Gripenberg) who hosted our para-ecologist visitors for the first time.

3. Project Progress

3.1 Progress in carrying out project activities

3.2 Progress towards project outputs

The first year of the project has gone well, with significant progress on a number of activities. In general, activities have been carried out as planned and on schedule. We are confident that the planned outputs will be achieved by the end of the project. The output indicators remain appropriate. The following account reports against the project implementation timetable (see table at end of Annex 2). Activity descriptors below are taken from the logframe and presented in italics.

Output 1:

Activity 1.1 Establish 8 study sites spaced at 500m elevation intervals from 200 to 3700 m asl; design replicated study plots at each site.
This activity was initiated by four BRC paraecologists visiting all eight potential study sites for the CART project to gauge the level of interest amongst the local communities, discuss the logistics of biodiversity surveys and their interest in hosting research and developing conservation areas on their lands. One prospective site at 1,700 m had to be abandoned due to community disputes regarding land ownership that would ultimately have made conservation difficult. All eight sites (at 200, 700, 1200, 1700, 2200, 2700, 3200 and 3700 m asl) have now been established, including a re-located 1700 m asl side where the newly engaged community approved their participation in the project.

We have worked on clarification of the conservation plans with all landowner communities and at the same time engaged them in biodiversity research. The first landowner "conference" took place at BRC in April 2016, with the principal landowners from six stations along CART (200 – 2700m asl) attending (see photos); stations at 3200-3700 are already within the National Park. BRC shared its ideas about conservation, using the Wanang Conservation Area (subject of our previous DI project, 19-008) as an example and suggested that the principal landowners and community leaders (two for each of the six elevations) would open community consultations and discussions based on these ideas.

Activity 1.2 Design and test sampling protocols for the six focal taxa (plants, ants, moths, butterflies, amphibians and birds); execute the sampling

In the first year, BRC has been active in developing protocols for biodiversity research on plants, ants, moths, birds and bats along the CART gradient. This research is partly driven by our BRC research team, partly by visiting overseas researchers, but in both cases it involves productive collaborations with BRC researchers and paraecologists, PNG postgraduate (Hons., MSc and PhD) students and locally recruited village assistants. The studies are thus bringing employment opportunities to local communities, in addition to research data. The following account summarises the organismal groups that have received attention in the first year of the project:

a) **Birds (K. Sam, R. Hazell, B. Koane et al.):** Bird communities were resurveyed along the Mt Wilhelm transect (200-2,700m.asl) in October and November 2015, as a follow-up to surveys conducted previously by K. Sam during her Ph.D. research (http://tvardikova.weebly.com). This work aims to document and understand the changes in bird assemblages that have taken place due to severe droughts related to the El Nino effect in 2015. Observational point-count and MacKinnon surveys and mist-netting were conducted at each of the site elevations along the CART. Significant decreases in abundance of birds at lower elevations (200–700m.asl) were observed. Some species previously common in the lowlands were not recorded during this survey, and birds were

not in breeding condition as would be expected for the season in which the survey was done. Communities of birds at high elevations were much less affected. 25 additional species were recorded which were previously unreported for Mt. Wilhelm, eight significant extensions to upper elevational range limits and no extensions to lower range limits (a manuscript describing these new observations has been submitted to the Bulletin of the British Ornithologist's Club, and another one is in preparation). Specialist ornithological training was provided during the survey to five new para-ecologists. A new project to study frugivory in birds has been prepared and is due to start in April 2016, led by R. Hazell, a new PhD student based at UoS supervised by Mika Peck and Alan Stewart.

b) **Bats (P. Amick et al.):** Peter Amick is an Honours student at the University of PNG working on samples from bat surveys along the CART and preparing them for molecular analysis.

c) **Fig trees (*Ficus* spp.) and fig wasps (S. Segar, B. Bau, G. Aubona et al.):** Collections of figs and fig wasps have been made since September 2015 from along the CART (200-2,700m) for population genomic analysis. This work aims to understand the evolutionary processes that have generated sister species of lowland and highland *Ficus*. Genetic differentiation and speciation along elevational gradients may be an important process generating PNG's incredible diversity of *Ficus* species (it has more species than any other country in the world). Leaf tissue samples have also been analysed for plant defensive compounds, showing trends in chemical content and diversity that match percentage herbivory in some species. The analysis of proteases was the focus of BSc Hons dissertation by Gibson Aubona, who successfully graduated at the University of PNG.

Species boundaries between malvantheran *Ficus* species and their pollinating wasps collected between 700-1,700m have been examined in an MSc project by Billy Bau at the University of PNG. Fieldwork included voucher collections of all the *Malvanthera* section of *Ficus* stranglers that were also sampled previously for rearing fig wasps. Collecting included tree climbing to collect vouchers, making field notes, photographing vouchers, pressing specimens, preservation of samples (fruits and vouchers) in 75% ethanol. A total of 298 herbarium specimens and 12 sets of DNA samples were collected. The specimens have already been processed, distributed to other herbaria (BRC, PNG National Herbarium at Lae, and University of Minnesota) and data analysis is currently underway.

d) **Insect herbivores on fig trees (*Ficus* spp.) (L. Sam, G. Luke, J. Yalang, S. Tulai et al.):** Herbivorous insects from *Ficus* trees have been sampled along the CART transect, including native trees and experimental trees transplanted to elevations outside the plants' native elevational range. Selected herbivore species have been experimented with on a range of *Ficus* species in order to determine their full host plant ranges. Many of the moth species reared from *Ficus* have been barcoded to help understand species boundaries and study phylogenetic community turnover of *Ficus* feeding moths along the gradient. This research includes projects by two PNG students: BSc Hons project by G. Luke (University of PNG) and PhD project by L. Sam (Griffith University, Brisbane).

e) **Ants (J. Moses et al.):** Further analysis of ant community samples previously collected along the CART have been done. This is part of a PhD project by J. Moses at the University of South Bohemia.

f) **Moths (S. Ibalim, P. Toko et al.):** S. Ibalim was selected as a prospective MSc student for a project on phylogenetic analysis of geometrid moth communities along the CART. He is based at the University of PNG and has been working on a thesis proposal and literature review.

Output 2:

Activity 2.1 Select suitable candidates for training from local communities and BRC.
15 assistants recruited from local communities along the CART transect have been engaged to help with the above research projects; we are continuing to screen for the most suitable local assistants for intensive training. Additionally, one recent BSc graduate from the PNG University for Natural Resources and Environment, Mr Jacob Yombai, was recruited to the BRC staff and his training in insect ecology has started.

Activity 2.2 Design training programme, then implement training with regular feedback from the trainees in PNG
We have been active in para-ecologist training for the projects mentioned above, including (i) ant identification training lead by O. Mottl, a PhD student (Univ. of South Bohemia) resident at BRC, (ii) bird identification courses by K. Sam, K. Chmel (visiting researchers at BRC) and R. Hazell (a DI-sponsored PhD student resident at BRC), (iii) sap-sucking insect identification led by F. Dem, a BRC researcher, and (iv) butterfly identification training by BRC staff.
Furthermore, the training has continued for BRC researchers, resident Hons and MSc students and para-ecologists included (i) training in the analysis of molecular data by S. Segar (via email and skype interaction), (ii) regular statistical seminars led by resident students at BRC and visiting PhD students (P. Szefer, O. Mottl. M. Libra), and (iii) weekly journal club discussing interesting research papers led by resident students.

Activity 2.3 Design training programme, then implement training with regular feedback from the trainees in UK
Two BRC para-ecologists (Joachim Yalang and Salape Tulai) visited Europe for approximately two months for intensive training. They spent one month in the Czech Republic working with researchers at the Czech Academy of Sciences, gaining experience by assisting with field surveys and experiments and visiting local field sites. During a month-long stay in the UK, they spent one week at each of the following locations: University of Sussex (forest carbon estimation; GPS; visiting local temperate habitats); Entomology Department, National Museum of Wales, Cardiff (museum curatorial and insect specimen examination techniques); Stourhead National Trust estate (Basic Canopy Access course); University of Oxford (introduction to various sampling and experimental techniques with researchers who are currently working in collaboration with BRC; visits to local field sites). On their return journey, they spent two days in Singapore and two days in Brisbane visiting BRC's scientific collaborators. Once back in PNG, Joachim and Salape were able to use their expertise in the biodiversity surveys. In particular, they are taking part in the study of *Ficus* herbivores along the CART gradient (see above). The UK training helped to make them independent leaders of particular project components (J. Yalang: sampling and analysis of beetle communities, S. Tulai: botanical surveys of *Ficus* trees) that include field work, species identification, specimen processing, databasing, and data summarization.

Output 3:

Activity 3.1 Select four candidate students, enrol them at University of PNG and select suitable dissertation topics
Five PNG students have been selected and have started on their research on different aspects of biodiversity along the CART. The first four will be based at the University of PNG.

- Mr Peter Amick (BSc Hons) - working on bats
- Mr Billy Bau (MSc) - working on plants
- Mr Sentiko Ibalim (MSc) - working on moth communities
- Ms Grace Luke (BSc Hons.) - working on insect herbivore communities on *Ficus* trees
- Mr Gibson Aubona - working on anti-predator defence in butterflies. Gibson studied *Ficus* anti-herbivore defences along the CART for a Postgraduate Diploma and will continue as an MSc student based at the University of Goroka.

Each student has staged a 1-month-long field expedition along the transect to explore the study sites and establish survey protocols for their particular groups.

Activity 3.2 Continuous supervision during the field work and laboratory training, including weekly seminars
The above students have continued to receive supervision of their field work and training in field and laboratory techniques by more senior members of the BRC team and visiting scientists. All students attend weekly seminars when they are present at BRC and are expected to report back to the rest of the team periodically by giving presentations about their progress and leading seminars themselves.

Output 4:

Activity 4.1 Conduct detailed consultations with communities interested in conservation; identify land ownership in the field
Discussions on conservation with all the communities along the transect have been initiated, including a new community at 1700 m asl., and the first "conservation discussion" at BRC for the representatives of all CART communities has taken place in April 2016. This meeting was attended by two principal community leaders for each study elevation (200, 700, 1200, 1700, 2200 and 2700 m asl) and provided an opportunity for all the communities to gather together, exchange experiences and opinions, be informed about the work of BRC and develop a path leading ultimately to the declaration of their land for conservation. The meeting was also attended by para-ecologists from the Wanang Conservation Area (the focus of our previous DI project) who shared with the Mt Wilhelm landowners their experiences in conservation and working with researchers in their communities. The landowners were asked to initiate a wider discussion on conservation in their respective communities so that a follow-up meeting planned for June 2016 could already start mapping the lands proposed for conservation along the CART transect.

Output 5:

Activity 5.1 Prepare research and tourist infrastructure (trails, accommodation, research camps).
A bush materials field laboratory and accommodation quarters has been set up in Numba, the site at 700 m asl., which will be the main field camp servicing the lower portion of the CART. Equipment procurement: A Toyota Landcruiser vehicle has been purchased for the project. Unfortunately the access road to CART deteriorated and become blocked by numerous landslides in early 2016. This does not endanger the project goals, but makes the logistics more difficult, slower and more expensive, as we have to rely on carriers for transport along the entire CART transect. Further, the plant and animal communities along the CART were affected by the El Nino Drought at the end of 2015, but have recovered since.

Activity 5.2 Develop community management for research and tourist activities, structure of fees, financial management, and visitor rules.
These issues will be addressed in the second meeting of landowners from the CART area, planned for June 2016.

The table below summarises the outputs in the first year:

	Progress in Year 1	Source of evidence	Comments
Output 1:	**Focal plant and animal taxa (plants, ants, moths, butterflies, amphibians and birds) surveyed along CART as base-line information for climate change impact monitoring, and results published**		
Indicator 1.1: Specimen distribution records along CART collected and databased: on average 1,000 records per focal taxon; 6,000 records in total.	Specimens collected and/or records databased for plants, birds, bats, insects	Database records.	

Indicator 1.2: Molecular information (COI sequences) obtained for 2,000 insect specimens, building molecular identification database for CART biota	No analyses done yet.		Scheduled for project years 2-3
Indicator 1.3: 3 papers on CART biodiversity published in international research journals	No progress yet		Scheduled for project year 3
Output 2:	**Locally recruited field assistants, BRC para-ecologists and researchers trained in biodiversity surveys and biodiversity data interpretation to assist research along CART**		
Indicator 2.1: 16 local assistants recruited from CART communities each receive 10 days training per year (480 person-days of training by end of project)	18 local assistants recruited from CART communities, receiving 220 person-days of training	Employment and training records	
Indicator 2.2: 18 BRC para-ecologists each receive 10 days training per year in biodiversity survey field methods, and the analysis of ecological and molecular data, (540 person-days of training by end of project)	6 BRC para-ecologists each received 6 days training in field survey methods and analysis of ecological data.	Employment and training records	Training in molecular analyses will start in Year 2.
Indicator 2.3: 6 BRC para-ecologists each receive 15 days training in UK in biodiversity survey and molecular barcoding methods, (90 person-days of training across 3 years of project)	2 BRC para-ecologists visit UK, each receiving 20 days training, also visiting Czech Republic, Singapore & Australia.	Training programme.	Training in molecular analyses will start in Year 2.
Indicator 2.4: 2 PNG researchers each receive 45 days training in biodiversity survey field methods, and the analysis of ecological and molecular data (90 person-days of training by end of project)	One researcher received 15 days of training in molecular data analysis	Training programme.	
Output 3:	**PNG Honours and M.Sc. students trained in biodiversity research**		
Indicator 3.1: 2 BSc Honours students trained and graduated by end of project	2 BSc Honours students recruited, trained and supervised		
Indicator 3.2: 2 MSc students trained and graduated by end of project	3 MSc students recruited, trained and supervised		
Output 4:	**New forest conservation areas established by local landowners along CART**		
Indicator 4.1: Two conservation areas within the CART established by local forest landowners, 10,000 ha total, spanning 200-2700 m asl	Landowners invited to "conservation discussion" at BRC in April/May 2016 to identify land ownerships and initiate negotiations about establishing conservation areas within CART	Records of attendance at "conservation discussion" meeting.	

Indicator 4.2: Two Conservation Boards established for the Conservation Areas management			Scheduled for Year 2.
Output 5:	**Financial situation of indigenous forest owners improved along CART**		
Indicator 5.1: 80 personnel from CART communities each employed part-time for 20 day-equivalents during lifetime of project, assisting research and tourism (1,600 person-days of employment in total)	32 persons from CART communities employed for average of 40 days each (i.e. 1280 day-equivalents during first year).		
Indicator 5.2: GBP 12,000 of sustainable annual income (GBP 36,000 total during the project) received by CART communities from research and tourism	GBP 8,400 of income received across 6 CART communities for assistance with biodiversity surveys and research in first year.	Payment records	

3.3 Progress towards the project Outcome

The outcome indicators remain appropriate and adequate for measuring the outcomes. We are confident that the planned outcome will be achieved by the end of the project, but we will continue to monitor progress to ensure this remains the case.

Outcome:	Biodiversity survey of Complete Altitudinal Rainforest Transect (CART) to: prioritise and establish protected forest; improve sustainability for indigenous landowners; enable climate change monitoring; build national capacity in biodiversity data interpretation.		Comments
	Progress in Year 1	Source of evidence	
Indicator 1: Quantitative biodiversity data on focal taxa from CART – number of samples and specimens	Focal taxa determined as plants, birds, bats and insects, with total of 3,200 insect specimens, 450 plant specimens, 15,000 ecological records (species distribution and interaction data points and events) recorded & databased.	Research publications, specimens in biological collections and specimen database records	
Indicator 2: Number of field assistants, para-ecologists and researchers trained; number of person-days of training	12 field assistants trained for 230 person-days, 12 para-ecologists trained for 145 person-days,	Records of training, tests and personal projects completed to monitor the results of training	
Indicator 3: Hons. and MSc completed degrees by PNG nationals	2 Hons and 3 MSc students recruited and work started.	Hons. and MSc dissertations and resulting publications	

Indicator 4:	6 communities	Signed Community	

Community conservation areas established – number and size	identified and invited to engage in discussion.	Conservation Deeds	
Indicator 5: Income generated for indigenous forest owners – amount per year	6,200 GBP paid to forest owners for field assistance.	Financial reports by Conservation Boards established by local communities	

3.4 Monitoring of assumptions

With one exception, all the original outcome and output level assumptions still hold true.

Outcomes:	Still holds true?	Comments	Source of evidence
Assumption 1: Focal area remains accessible by road (for researchers and tourists)	No	Part of access road blocked by landslides. Access to all stations along CART is still possible but only on foot, making logistics more time consuming and expensive.	
Assumption 2: Sufficient local expertise and interest can be developed for biodiversity surveys	Yes	Most local communities have considerable indigenous knowledge of forest flora and fauna and can be enthused about developing their expertise in supporting biodiversity survey and scientific research.	
Assumption 3: Sufficient supply of students interested in honours and postgraduate training	Yes	This has never been a problem in the past. There is always high demand amongst students for such opportunities.	Full complement of students recruited
Assumption 4: Indigenous communities in the focal project area are interested in declaring forest conservation areas on their land	Mostly	Prospective site at one elevation (1700m) had to be relocated due to land ownership disputes which would ultimately have made designation of conservation area problematic	
Assumption 5: Researchers and biologically oriented tourists can be attracted to project areas, providing income from paid services	Yes	Interest amongst researchers remains high, viz. engagement of overseas scientists in using CART infrastructure and baseline data for own research. Recently, an Oxford University team started a NERC-funded project on the impact of El Nino along CART; several other projects are ongoing (see above). We expect increasing interest over the course of the project. The potential for ecotourism remains to be tested.	
Outputs:			
Output 1 assumption: Biodiversity sampling yields sufficient numbers of specimens and records (if not, change protocols); DNA extraction and sequencing successful (if not, change specimen preservation methods); data analysis sufficiently interesting for research papers (if not, refocus the field research)	Yes	Field surveys already yielding valuable data on plants, birds, bats, insects. DNA techniques will not be employed until Year 2; main analysis will be done towards end of project, but data collection being monitored to ensure that analysable data are being collected.	Data held at BRC on various taxonomic groups.
Output 2 assumption: Training adjusted to different	Yes	BRC has many years of experience in providing training at all levels from novice	Feedback questionnaires;

levels (field assistants, para-ecologists, researchers) so that it is attractive, accessible to the target audience, and sufficiently advanced to be useful (if not, based on the trainees' feedback, modify the content)		para-ecologists to senior team leaders, honours, masters and doctoral students, and researchers. Feedback to check on suitability and usefulness is provided through an annual appraisal system (1st year will be evaluated in 1st quarter of Year 2), formal questionnaires and informal one-to-one discussion with research leaders and collaborators.	results of annual appraisals.
Output 3 assumption: Student projects designed so that they are both scientifically novel and feasible, students systematically supervised and problems rapidly rectified based on their feedback.	Yes	BRC and its research collaborators has considerable experience of developing ideas for novel research, developing projects and supervising students (including through previous Darwin projects). Students receive on-going supervision with regular checks on progress and resolution of problems. Student feedback is used to adjust future research objectives and programme.	
Output 4 assumption: Landowners interested in declaring conservation areas as a way of securing research and tourist benefits (if not, either work more with the focal communities, or search for more interested communities in the CART area)	Yes	So far, communities associated with each of the eight stations along the CART have expressed interest in developing conservation areas within their land holdings. Landowner seminar at BRC in April/May 2016 will help to explore ways of securing benefits through research and tourism, exchange views between communities, and develop sense of common purpose between communities.	
Output 5 assumption: Communities are sufficiently well organized to provide quality research and tourist assistance (if not, based on customers' feedback, work with Conservation Board to rectify), researchers and tourists are aware of opportunities at CART (if not, advertise more).	Yes	BRC has 20 years of experience of working with local communities (especially Wanang through Darwin project 19-008) to assess type and level of research and tourism assistance that such communities can provide. Research opportunities being provided by CART are already being taken up by overseas scientists (e.g. Oxford University, Czech Academy of Sciences, Zoological Museum Copenhagen); tourism opportunities have yet to be explored.	

3.5 Impact: achievement of positive impact on biodiversity and poverty alleviation

The project includes a prominent biodiversity conservation component, working with the village-based landowners to establish two protected areas. These will be designed to connect with the existing Mt. Wilhelm National Park to include biologically important, yet currently unprotected, areas at altitudes below 3000 m asl. The project is also designed to bring sustained conservation-based income from research and ecologically-oriented tourism to indigenous communities of about 400 members, currently living largely in extreme poverty (<$1.25 per day), directly benefiting about 80 people employed specifically by the project. Additionally, the professional careers of 18 para-ecologists and 2 junior researchers will be enhanced by training and employment on the project, while 4 postgraduate students will obtain their degrees, opening up new career prospects for them.

4. Contribution to SDGs

By the time of its completion, our project will contribute to the following UN Sustainable Development Goals:

1.1 (eradicate extreme poverty): contributed to through employment of indigenous village people as field research assistants and ecotourism guides.
15.2 (sustainable management of forests, halt deforestation, restore degraded forest): contributed to through establishment of two forest protected areas.
15.4 (conservation of mountain ecosystems including their biodiversity): the new conservation areas will extend the existing high altitude Mt. Wilhelm National Park to biologically important lower elevations.
15.5 (reduce degradation of natural habitats, half biodiversity loss, prevent extinction of threatened species): contributed to through better understanding of species distributions and changes therein predicted by climate change models, management of habitats and their recovery after disturbance.

5. Project support to the Conventions, Treaties or Agreements

Our project is highly relevant to the CBD Aichi Biodiversity targets for 2011-2020, particularly Target 5 (halving the rate of loss of forests by 2020), Target 11 (protecting minimum areas of important habitats) and Target 19 (building research capacity and knowledge base). The project is also relevant to the *Nagoya Protocol on Access to Genetic Resources and Benefit Sharing Arising from their Utilization*, which strives for fair and equitable access to genetic resources and transfer of relevant technologies. Our project will develop extensive libraries of DNA barcodes for insect species, and make them available on-line free of charge to PNG professionals, thus facilitating identifications and biodiversity conservation decisions. It will also develop local expertise for the application of this DNA information to conservation decisions, thereby laying the foundation for future implementation of the Nagoya protocol (still to be signed and ratified by PNG).

6. Project support to poverty alleviation

An important goal for the project is to directly improve the economic status of about 80 members of the indigenous communities living along the CART. The income will come from assisting research and ecologically-oriented tourists, including entry and accommodation fees, research assistants, field guides, carriers, camp managers and cooks. The project area is exceptionally suitable for these activities. The benefits are expected to be felt by the wider communities along the CART (totalling about 400 people). People in these communities live in extreme poverty, defined as daily income <$1.25, and rely on subsistence slash-and-burn agriculture. At the same time, they own lands harbouring uniquely valuable biodiversity. The fundamental premise of our project is that additional income will be a strong incentive for these communities to consider forest conservation as an attractive alternative to other more destructive land uses.

Tangible evidence for a contribution to poverty alleviation cannot be expected at this early stage of the project. However, a number of people have been recruited from the indigenous communities for employment as field assistants who will receive valuable training as well as an income.

7. Project support to Gender equity issues

BRC has a policy of promoting equal opportunities irrespective of gender. Whilst the great majority of people in village communities applying to become field assistants are likely to be male, a small but increasing number of students showing an interest in biodiversity research are female. One of the four students that we have recruited to start their MSc studies is female. Women in PNG have very low social status and are subject to strong discrimination in a highly male-dominated society. Gender issues therefore need to be treated with great caution and sensitivity.

8. Monitoring and evaluation

Monitoring and evaluation of the training programme for students, para-ecologists, village assistants and junior researchers is a continuing process involving both formal assessment (tests) and feedback (questionnaires) and informal day-to-day interactions between trainers and trainees. There has been no change to the initial M&E plan over the first year of the project, and none is planned for the forthcoming year.

9. Lessons learnt

The initial response by landowner communities to establishing a conservation corridor along CART was positive, but more work is needed to test the level of commitment.

10. Actions taken in response to previous reviews (if applicable)

Not applicable.

11. Other comments on progress not covered elsewhere

No significant changes have been made to the design of the project during its first year. The principal difficulty, already referred to, has been the loss of road access to sites at a number of different elevations along the CART, necessitating more time and expense in moving equipment, supplies and people between locations.

12. Sustainability and legacy

There are multiple components to the project's planned legacy including: (i) the physical infrastructure of CART (field labs, permanent plots, transects etc.) available for future biodiversity research; (ii) rainforest conservation areas organized and lead by indigenous landowners, extending the existing Mt. Wilhelm National Park to biologically important lower elevations; (iii) detailed information on plant, insect and vertebrate communities; (iv) a 20% increase in annual income for indigenous communities generated by sustainable conservation-based initiatives; (v) 4 postgraduate students qualified to Honours or Masters level and 18 para-ecologists trained to a high standard, all with enhanced career prospects.

13. Darwin Identity

The contribution of the Darwin Initiative is always acknowledged on publications (see list below) and all publicity material. All presentations and talks by students and staff at conferences and seminars use the Darwin logo on their slide presentations, as do all training workshops conducted by UK trainers and PNG staff. A recently published review paper on the role of para-ecologists in scientific research (Schmiedel et al., 2016; see details below) compares four parabiologist schemes around the world, including BRC, and refers to the Darwin Initiative as one of the principal funders of projects at BRC.

14. Project Expenditure

Table 1 Project expenditure during the reporting period (1 April 2015 – 31 March 2016)

Project spend (indicative) since last annual report	2015/16 Grant (£)	2015/16 Total Darwin Costs (£)	Variance %	Comments (please explain significant variances)
Staff costs (see below)			2.57	
Consultancy costs	n/a			
Overhead Costs			0.69	
Travel and subsistence			8.16	
Operating Costs			3.43	
Capital items (see below)			1.92	
Others (see below)			8.5	
TOTAL				

Annex 1: Report of progress and achievements against Logical Framework for Financial Year 2015-2016

Project summary	Measurable Indicators	Progress and Achievements April 2015 - March 2016	Actions required/planned for next period
Impact 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.		First steps in developing sustainable livelihood for forest-based local communities through employment in collecting biodiversity data to inform decisions on selection of protected areas.	[redacted]
Outcome: Biodiversity survey of Complete Altitudinal Rainforest Transect (CART) to: prioritise and establish protected forest; improve sustainability for indigenous landowners; enable climate change monitoring; build national capacity in biodiversity data interpretation.	1. Quantitative biodiversity data on focal taxa from CART – number of samples and specimens 2. Number of field assistants, para-ecologists and researchers trained; number of person-days of training 3. Hons. and MSc completed degrees by PNG nationals 4. Community conservation areas established – number and size 5. Income generated for indigenous forest owners – amount per year	Biodiversity survey of CART initiated which will inform decisions about establishing protected areas; employment of local field assistants helping to develop sustainable livelihoods for village communities; student training contributing to building capacity for collecting, handling and interpreting biodiversity information.	Continued training of students and local assistants in biodiversity survey, monitoring and assessment through collection of field data and specimen analysis; discussions with landowners about benefits of establishing protected areas.
Output 1. Focal plant and animal taxa (plants, ants, moths, butterflies, amphibians and birds) surveyed along CART as base-line information for climate change impact monitoring, and results published	1. Specimen distribution records along CART collected and databased: on average 1,000 records per focal taxon; 6,000 records in total. 2. Molecular information (COI sequences) obtained for 2,000 insect specimens, building molecular identification database for CART biota 3. 3 papers on CART biodiversity published in international research journals	Good progress with field surveys along CART; indicators still appropriate.	
Activity 1.1 Establish 8 study sites spaced at 500m elevation intervals from 200 to 3700 m asl; design replicated study plots at each site.		8 study sites established along CART; study plots and transects designed and established.	
Activity 1.2 Design and test sampling protocols for the six focal taxa (plants, ants,		Protocols designed and tested for plants, ants, bats, birds and butterflies;	

moths, butterflies, amphibians and birds); execute the sampling		sampling started.
Activity 1.3 Process the specimens, sort into species, using morphological and DNA evidence, and database the results		Specimens processed with preliminary sorting to species using morphological evidence, databasing the results; DNA analyses planned for 12 months starting in second half of Year 3.
Activity 1.4 Analyse the data, write and publish in research journals		Planned for Year 3.
Output 2. Locally recruited field assistants, BRC para-ecologists and researchers trained in biodiversity surveys and biodiversity data interpretation to assist research along CART	1. 16 local assistants recruited from CART communities each receive 10 days training per year (480 person-days of training by end of project) 2. 18 BRC para-ecologists each receive 10 days training per year in biodiversity survey field methods, and the analysis of ecological and molecular data, (540 person-days of training by end of project) 3. 6 BRC para-ecologists each receive 15 days training in UK in biodiversity survey and molecular barcoding methods, (90 person-days of training across 3 years of project) 4. 2 PNG researchers each receive 45 days training in biodiversity survey field methods, and the analysis of ecological and molecular data (90 person-days of training by end of project)	Good progress with developing and initiating training programme; indicators still appropriate.
Activity 2.1 Select suitable candidates for training from local communities and BRC		Local assistants and BRC para-ecologists selected for CART and field work started.
Activity 2.2 Design training programme, then implement training with regular feedback from the trainees in PNG		Training programme designed and implemented with informal feedback received from trainees.
Activity 2.3 Design training programme, then implement training with regular feedback from the trainees in UK		2 para-ecologists visited UK for intensive training over 4 weeks; also visited collaborators research projects in Czech Republic, Singapore and Australia.
Activity 2.4 Review results of training using practical tests and questionnaires		Training tests to be designed and implemented in Year 3.
Output 3. PNG Honours and M.Sc. students trained in biodiversity research	1. 2 BSc Honours students trained and graduated by end of project 2. 2 MSc students trained and graduated by end of project	All students selected, enrolled and training started; indicators still appropriate.

Activity 3.1 Select four candidate students, enrol them at University of PNG and select suitable dissertation topics		Five student candidates selected and enrolled at UPNG with suitable dissertation projects chosen and designed.
Activity 3.2 Continuous supervision during the field work and laboratory training, including weekly seminars		Supervision on-going. Mandatory attendance at seminars.
Activity 3.3 Data analysis, dissertation writing, submission and defence		Preliminary data analysed as results collected, but main analyses will be done in Year 3.
Activity 3.4 Publication of results in research journals		Planned for Year 3.
Output 4. New forest conservation areas established by local landowners along CART	1. Two conservation areas within the CART established by local forest landowners, 10,000 ha total, spanning 200-2700 m asl 2. Two Conservation Boards established for the Conservation Areas management	Process of discussing protected/conservation areas concept with local communities along CART has been initiated; indicators still appropriate.
Activity 4.1 Conduct detailed consultations with communities interested in conservation; identify land ownership in the field		Consultations started with local communities along CART; communities invited to "conservation discussion" workshop at BRC.
Activity 4.2 Form Conservation Boards; set rules for Conservation Areas,		Planned for Years 2 & 3
Activity 4.3 Sign Conservation Deeds and declare Conservation Areas		Planned for Year 3
Output 5. Financial situation of indigenous forest owners improved along CART	1. 80 personnel from CART communities each employed part-time for 20 day-equivalents during lifetime of project, assisting research and tourism (1,600 person-days of employment in total) 2. GBP 12,000 of sustainable annual income (GBP 36,000 total during the project) received by CART communities from research and tourism	Indigenous forest communities along CART already benefitting from income for field assistants; income from tourism to be developed; indicators still appropriate.
Activity 5.1 Prepare research and tourist infrastructure (trails, accommodation, research camps)		Research camps planned or installed at 8 sites along CART; more experience with local communities and wildlife needed before planning for tourism development can begin (planned for Year 3)
Activity 5.2 Develop community management for research and tourist activities, structure of fees, financial management, and visitor rules		Considerable experience already gained from working with Wanang community in previous Darwin project (19-008) which can be applied to communities along CART starting in latter part of Year 2

Activity 5.3 Advertise new research and tourist opportunities	Planned for Year 2.
Activity 5.4 Host research and tourist visits and assist in their activities	Planned for Year 2 & 3.

Annex 2 Project's full current logframe as presented in the application form

Project summary	Measurable Indicators	Means of verification	Important Assumptions
Impact: 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.			
Outcome: Biodiversity survey of Complete Altitudinal Rainforest Transect (CART) to: prioritise and establish protected forest; improve sustainability for indigenous landowners; enable climate change monitoring; build national capacity in biodiversity data interpretation.	1. Quantitative biodiversity data on focal taxa from CART – number of samples and specimens 2. Number of field assistants, para-ecologists and researchers trained; number of person-days of training 3. Hons. and MSc completed degrees by PNG nationals 4. Community conservation areas established – number and size 5. Income generated for indigenous forest owners – amount per year	1. Research publications, specimens in biological collections and specimen database records 2. Records of training, tests and personal projects completed to monitor the results of training 3. Hons. and MSc dissertations and resulting publications 4. Signed Community Conservation Deeds 5. Financial reports by Conservation Boards established by local communities	1. Focal area remains accessible by road (for researchers and tourists) 2. Sufficient local expertise and interest can be developed for biodiversity surveys 3. Sufficient supply of students interested in honours and postgraduate training 4. Indigenous communities in the focal project area are interested in declaring forest conservation areas on their land 5. Researchers and biologically oriented tourists can be attracted to project areas, providing income from paid services
Outputs: 1. Focal plant and animal taxa (plants, ants, moths, butterflies, amphibians and birds) surveyed along CART as base-line information for climate change impact monitoring, and results published	1. Specimen distribution records along CART collected and databased: on average 1,000 records per focal taxon; 6,000 records in total. 2. Molecular information (COI sequences) obtained for 2,000 insect specimens, building molecular identification database for CART biota 3. 3 papers on CART biodiversity published in	Specimen database records (at www.entu.cas.cz/png/caterpillars/index_n.php?s=xbrc), specimen DNA sequence records (at http://www.boldsystems.org/), publications.	Biodiversity sampling yields sufficient numbers of specimens and records (if not, change protocols); DNA extraction and sequencing successful (if not, change specimen preservation methods); data analysis sufficiently interesting for research papers (if not, refocus the field research)

	international research journals		
2. Locally recruited field assistants, BRC para-ecologists and researchers trained in biodiversity surveys and biodiversity data interpretation to assist research along CART	1. 16 local assistants recruited from CART communities each receive 10 days training per year (480 person-days of training by end of project) 2. 18 BRC para-ecologists each receive 10 days training per year in biodiversity survey field methods, and the analysis of ecological and molecular data, (540 person-days of training by end of project) 3. 6 BRC para-ecologists each receive 15 days training in UK in biodiversity survey and molecular barcoding methods, (90 person-days of training across 3 years of project) 4. 2 PNG researchers each receive 45 days training in biodiversity survey field methods, and the analysis of ecological and molecular data (90 person-days of training by end of project)	Staff records at BRC, staff CVs	Training adjusted to different levels (field assistants, para-ecologists, researchers) so that it is attractive, accessible to the target audience, and sufficiently advanced to be useful (if not, based on the trainees' feedback, modify the content)
3. PNG Honours and M.Sc. students trained in biodiversity research	1. 2 BSc Honours students trained and graduated by end of project 2. 2 MSc students trained and graduated by end of project	Dissertations and graduation records at the University of PNG	Student projects designed so that they are both scientifically novel and feasible, students systematically supervised and problems rapidly rectified based on their feedback.
4. New forest conservation areas established by local landowners along CART	1. Two conservation areas within the CART established by local forest landowners, 10,000 ha total, spanning 200-2700 m asl 2. Two Conservation Boards established for the	Records at the PNG Department of Environment and Conservation	Landowners interested in declaring conservation areas as a way of securing research and tourist benefits (if not, either work more with the focal communities, or search for more interested communities in the

	Conservation Areas management		CART area)
5. Financial situation of indigenous forest owners improved along CART	1. 80 personnel from CART communities each employed part-time for 20 day-equivalents during lifetime of project, assisting research and tourism (1,600 person-days of employment in total) 2. GBP 12,000 of sustainable annual income (GBP 36,000 total during the project) received by CART communities from research and tourism	Financial reports of the Conservation Boards	Communities are sufficiently well organized to provide quality research and tourist assistance (if not, based on customers' feedback, work with Conservation Board to rectify), researchers and tourists are aware of opportunities at CART (if not, advertise more).

Activities (each activity is numbered according to the output that it will contribute towards, for example 1.1, 1.2 and 1.3 are contributing to Output 1)

Activity 1.1	Establish 8 study sites spaced at 500m elevation intervals from 200 to 3700 m asl; design replicated study plots at each site.
Activity 1.2	Design and test sampling protocols for the six focal taxa (plants, ants, moths, butterflies, amphibians and birds); execute the sampling
Activity 1.3	Process the specimens, sort into species, using morphological and DNA evidence, and database the results
Activity 1.4	Analyse the data, write and publish in research journals
Activity 2.1	Select suitable candidates for training from local communities and BRC
Activity 2.2	Design training programme, then implement training with regular feedback from the trainees in PNG
Activity 2.3	Design training programme, then implement training with regular feedback from the trainees in UK
Activity 2.4	Review results of training using practical tests and questionnaires
Activity 3.1	Select four candidate students, enrol them at University of PNG and select suitable dissertation topics
Activity 3.2	Continuous supervision during the field work and laboratory training, including weekly seminars
Activity 3.3	Data analysis, dissertation writing, submission and defence
Activity 3.4	Publication of results in research journals
Activity 4.1	Conduct detailed consultations with communities interested in conservation; identify land ownership in the field
Activity 4.2	Form Conservation Boards; set rules for Conservation Areas,
Activity 4.3	Sign Conservation Deeds and declare Conservation Areas
Activity 5.1	Prepare research and tourist infrastructure (trails, accommodation, research camps)
Activity 5.2	Develop community management for research and tourist activities, structure of fees, financial management, and visitor rules
Activity 5.3	Advertise new research and tourist opportunities
Activity 5.4	Host research and tourist visits and assist in their activities

Annex 3 Standard Measures

Table 1 Project Standard Output Measures

* Undergraduates and postgraduates receive continuous training; figures in table allow for study time at university and holidays.

Code No.	Description	Gender of people (if relevant)	Nationality of people (if relevant)	Year 1 Total	Year 2 Total	Year 3 Total	Total to date	Total planned during the project
1A	Number of people to submit thesis for PhD	Male	UK	0			0	1
2	Number of people to attain Masters qualification (MSc, MPhil etc.)	Male	PNG	0			0	3
3	Number of people to attain other qualifications	1 male, 1 female	PNG	0			0	2
4A	No. undergrads receiving training	1 male, 1 female	PNG	2			2	2
4B	No. of training weeks received			40*			40*	120*
4C	No. postgrads receiving training	Male	PNG	3			3	3
4D	No. of training weeks received			40*			40*	120*
5	Other training (field assistants)	Male	PNG	18			15	18
9	No. of habitat / protected area management plans			0			2	2
10	No. of field guides			0			0	3
11A	No. of papers published			2			2	5
11B	No. of papers submitted			2			2	5
12B	No. of computer databases enhanced			0			0	5
13B	No. of species reference collections enhanced			1			1	3
14A	No. of conferences, workshops organised			0			0	2
14B	No. of conferences, workshops attended			1			1	3
20	Value (££s) of			29,500			29,500	29,500

	physical assets handed over to host country (vehicle)							
22	No. of permanent field plots & sites established			8			8	8
23	Value (££s) of other resources raised			67,331			67,331	164,551

Table 2 Publications

Title	**Type** (e.g. journals, manual, CDs)	**Detail** (authors, year)	**Gender of Lead Author**	**Nationality of Lead Author**	**Publishers** (name, city)	**Available from** (e.g.weblink or publisher if not available online)
Fruit sizes and the structure of frugivorous communities in a New Guinea lowland rainforest	Journal	Ctvrtecka, Sam, Miller, Weiblen & Novotny (2016) Austral Ecology 41: 228-237.	Male	Czech	Ecological Society of America	http://onlinelibrary.wiley.com/doi/10.1111/aec.12326/abstract
Contributions of paraecologists and parataxonomists to research, conservation, and social development	Journal	Schmiedel, et al. (2016) Conservation Biology (early view)	Female	German	Wiley	http://onlinelibrary.wiley.com/doi/10.1111/cobi.12661/pdf