



Darwin Initiative Annual Report

Darwin Project Information

Project Ref Number	17-012
Project Title	Belize large-mammal corridor project
Country(ies)	Belize
UK Contract Holder Institution	University of Southampton (UoS)
Host country Partner Institution(s)	Panthera University of Belize (UoB) Belize Forest Department (BFD)
Other Partner Institution(s)	n/a
Darwin Grant Value	£173,989
Start/End dates of Project	1 st April 2009 to 31 st July 2012
Reporting period	1 st April 2009 to 31 st March 2012, 2nd Annual Report
Project Leader Name	Dr C. Patrick Doncaster
Project website	http://darwin.defra.gov.uk/project/17012/ http://www.belizewildliferesearch.com/index_files/Page972.htm
Author(s) and main contributors, date	C. P. Doncaster, R. Foster, B. Harmsen, 10 June 2011

1. Project Background

This project has a three-fold purpose: (i) to plan a workable natural corridor to connect protected areas in Belize; (ii) to implement this into the framework of existing protected areas and zoning plans of Belize; (iii) to establish an in-country tradition of training skills for Belizeans to study their own wildlife.

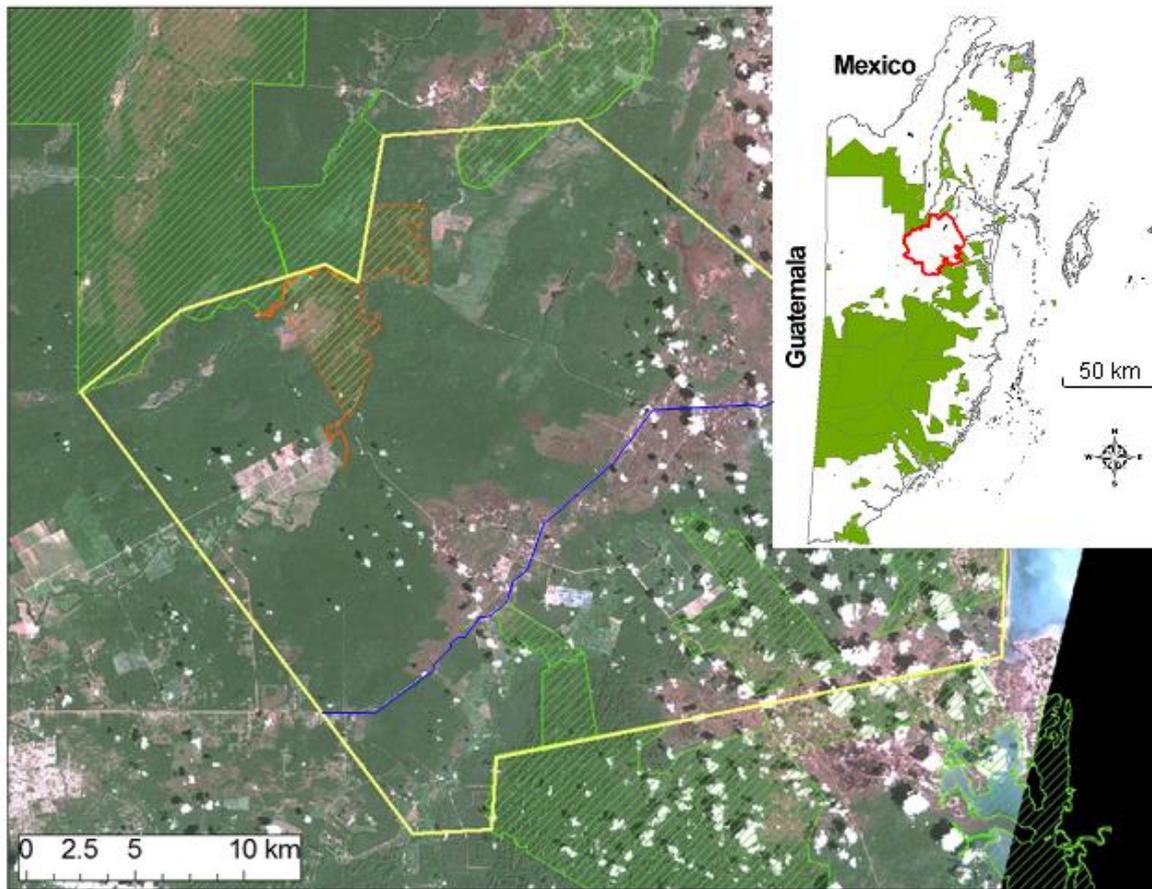


Fig. 1. Map of the corridor study area (yellow outline showing current area on main satellite image, red outline showing initial area on inset map of Belize), showing the Western Highway (blue), the newly acquired protected area 'Labouring Creek Jaguar Corridor Wildlife Sanctuary' (orange hashed), and previously established protected areas (green hashed and green on inset). Forest shows dark green, savannah dark brown, arable land in square blocks.

2. Project Partnerships

Management structure

The project is a collaborative enterprise between Panthera, The University of Belize (UoB), and the Belize Forest Department (BFD), coordinated through the UK University of Southampton (UoS).

Panthera has an unparalleled level of on-the-ground expertise in mammal monitoring in Belize, with a visiting scientist connection established to the UoS which provides scientific and management expertise to the project. Both institutions are committed to helping build research capacity in Belize. Panthera is assisting the project with matched funds amounting to 48% of the total budget. The organisation is involved at all stages of the project. Its capacity encompasses (a) employment of personnel, with Rebecca Foster contracted by Panthera to facilitate the project, Bart Harmsen dedicated to the project in his role as the Panthera-funded Wildlife Research Fellow in Wildlife Conservation at the UoB, Arturo Ramos as the field operations manager (salary jointly funded by Panthera and Darwin), and a Wildlife Corridor Officer hired at the Belize Forest Department with Panthera funding to start 1st April 2011; (b) provision of a large portion of necessary field equipment (telemetry and trapping equipment, 4WD vehicles, radios, phones).

The University of Belize provides the infrastructure and human resources for capacity building with its Environmental Research Institute (ERI) inaugurated in January 2010. The Institute's Terrestrial Science Director, Elma Kay, currently contributes ~15% of her time to the project. This institute aims to train the next generation of Belizean environmental biologists to become highly skilled in wildlife monitoring and conservation management; the Darwin project is inputting teaching personnel and expertise to the development of training programmes focused on issues with establishing wildlife corridors. Undergraduate students of the UoB are contributing to mammal monitoring, and UoB is providing the capacity for them to do the necessary laboratory work and analyses, including teaching space, computer facilities, lab space and storage space.

The Belize Forest Department (BFD) is our link to the Ministry of Natural Resources and the Environment (MNRE), which is the ministry responsible for implementing the corridor of Priority Areas that is the intended legacy of this project. The Minister of Natural Resources and the Environment has already indicated his interest in securing a wildlife corridor between the two main blocks of protected wilderness in Belize (see his original letter of support for the Darwin project). The BFD is the body with which we consult on land-use management and law enforcement pertaining to natural resources. Within the Ministry, the BFD currently has Wildlife Program Officer Rasheda García (née Sampson) advising the Darwin Project on legal logistics, and an appointment to begin 1st April in the new role of Wildlife Corridor Officer, specifically to work within the Central Belize Corridor. In addition to deployment of personnel, the BFD's capacity to be involved in the project encompasses provision of meeting rooms, and carrying out the necessary policy changes. With the hiring of the Wildlife Corridor officer, BFD's roles will also include public awareness about the corridor, and promotion and enforcement of hunting and logging laws within the corridor.

Changes to management structure over the reporting period

The Belize personnel have remained as described in the 1st Annual Report, except for the recent hiring of a Wildlife Corridor Officer for the BFD, as described above.

Of the external personnel, Project Leader Patrick Doncaster has visited Belize once in this reporting period for in-country management meetings and advice on fieldwork, and he communicates regularly with in-country Darwin personnel via email and telephone. Panthera's Jaguar Program Director Howard Quigley visits Belize every 6-8 weeks and communicates regularly with in-country Darwin personnel via email and phone.

Regular meetings are held at the ERI and BFD with Elma Kay, Bart Harmsen, Rebecca Foster, Omar Figueroa, Wilber Sabido, and Rasheda Sampson.

Other collaborations

Statistician Dr David Borchers at the University of St Andrews is collaborating on improved density estimation from camera-trap data.

Professional trapper Dairen Simpson is joining the project for March and April.

The Belize Zoo is collaborating with jaguar feeding trials; they are giving us discounted rates in accommodation for project personnel. One of the corridor billboards is designated to go on their land.

3. Project progress

See Annex 1 for a condensed description against the numbered logframe activities and means of verification.

3.1 Progress in carrying out project activities

1. Collection of rigorously calibrated information on movement through fragmented landscapes by neotropical mammals

Cat 1 Hurricane Richard passed directly over the corridor on 24-25 October, inflicting landscape-changing destruction. Many forest trees were felled; many more were defoliated (see Annex 3 photos). Surviving trees refoliated within a few months, though stress-induced mortality remains a risk and fruit and foliage availability is altered for tree-dwelling mammals and birds. Fallen trees and branches have greatly increased the amount of dead wood and leaf-litter, and reduced canopy shading, creating a substantial fire risk throughout the dry season, and also reducing the mobility of mammals through the forest and our ability to monitor them. Damage control and evaluation is ongoing at field sites. All forest trails have required re-cutting to camera- and live-trap locations amongst swathes of fallen trees. Delays to surveying and trapping have been an inevitable consequence.

Large-scale camera trapping was on schedule until the hurricane and is now continuing with the reopening of trails. The hurricane has provided strong motivation for an otherwise unscheduled repeat of these surveys. Five small-scale surveys were completed before the hurricane, but the infrastructure was destroyed by the hurricane (Act 1.2.5). Analysis of camera-trap data is underway. Systematic surveys of burrows (Act 1.2.1) were on schedule before the hurricane, but the hurricane destroyed the infrastructure of grids. We favour focusing effort now on the large-scale camera-trapping instead as it will tell us about the large-scale impact of the hurricane. The following actions were taken in direct response to the hurricane:

- In immediate aftermath: assessment of damage by over-flight and hikes at ground level in immediate aftermath; some baited camera traps put out to see which mammal species were present.
- Ongoing camera trapping: Arturo Ramos and two locally hired helpers are reopening the trail system and cutting new trails. All trails are opened for a large-scale camera survey on the south side of the Western Highway, which has been running since late February; trails for the other two large-scale camera surveys remain to be re-opened.

Live trapping of mammals using cage traps is underway (Act 1.3.3). We started catching pacas in the dry season of 2010, but trap success fell to zero during the wet season because of flooding. Live trapping was stopped after the hurricane while efforts focused on surveying and reopening trails; trapping began again in full from December, although the trail network in the Big Falls property for live trapping no longer exists. Trapping success with cage traps has picked up in this year's dry season starting in late January. To date, we have caught five pacas, two coatis, one tayra, one grison, and five kinkajous. Now that the forest structure has been opened up by the hurricane we are particularly interested to find out how it is being used by both tree-dwelling and ground-dwelling mammals. The fruit-eaters appear to be suffering food shortage as a direct result of leaf-loss in the hurricane, which may impact on the numbers of these mammals that we can catch in the future. Throughout March and April we are hiring professional trapper Dairen Simpson to train the team in alternative methods of live capture and boost trap success. He previously trained Omar Figueroa in trapping jaguars and pumas. The Darwin project is paying for the first month of his current stay, and he is contributing the second month free of charge in recognition of the value of the project.

We have begun telemetry of prey mammals (Act 1.4.1) and conducted an evaluation of radio-tracking accuracy and home range use by prey mammals. Senator Omar Figueroa has continued to live trap, collar and track jaguars and pumas (Acts 1.3.1 and 1.4.1). We have also investigated diet of jaguars and pumas in the corridor area, and assessed food conversion to scats in captive jaguars at The Belize Zoo, essential for estimating biomass consumption of prey in the wild. We have conducted >800 interviews to assess game meat consumption (Act 3.1.1 & 3.1.2).

The project now has use of an ATV, bought by our project partner Panthera, which will speed up the live trapping and telemetry. The 4-wheel drive vehicle bought at the end of the last reporting period has been in constant use for all fieldwork activities.

PhD student Angela Watkins at the UoS is now developing agent-based models for analysing corridor permeability (Acts 2.1), utilizing our database of movements of large and medium-sized mammals in the corridor. She has been assisting with fieldwork on the project throughout March, and will use this experience to add realism to her simulation models.

This reporting year we have had another research paper accepted for publication (Act 4.2.1): Harmsen et al (2010) Jaguar and puma activity patterns in relation to their main prey. Mammalian Biology, in press. Two papers in press last year are now out.

We have acquired a high resolution SPOT satellite image (2010) of the corridor area through a Planet Action grant to Panthera to assist with habitat mapping (Activity 1.1.1).

2. Instilling a tradition of objectively-based mammal monitoring in Belize

During June and July, ten UoB undergraduates joined a six-week internship program with the corridor project (Act. 2.1). This is the first time that UoB undergraduates have had the opportunity to participate in large-scale ecological research and applied conservation in Belize. In July these interns were joined by 11 UoS Biology undergraduates for 2 months.

The interns and students were involved in all aspects of the project from manual field labour (e.g., shifting traps) to live-trapping, telemetry, data handling and experimental design. They attended a ceremony marking the official protection of the northern part of the corridor (see section 3.2.4 below and Annex 3). After the ceremony they dined and chatted with the Deputy Prime Minister and Minister of the Environment, Hon Gaspar Vega. Hon Vega was delighted by the mix of Belizean and international students at the ceremony and impressed by their commitment to the corridor research and implementation.

In mid-January to mid-February 2011, eleven UoB undergraduates did the Wildlife Management course including a 2-day field-course in the study area. This course run by Bart Harmsen and Rebecca Foster could not have been initiated without the stimulus provided to the ERI by the Darwin project. It focuses on Belizean wildlife management with a strong component on wildlife corridor issues (Act 2.1.1).

The ERI is taking on the role of national biodiversity monitoring, including mammals, as described in section 3.2.2 below.

3. Delineation of the belt of contiguous wilderness that will constitute the wildlife corridor

We have renovated a research house as a functional research centre on a key piece of private land within the corridor (Big Falls, 150 km²). Use of the house (see photo in Annex 3), and field activities (live trapping etc) on the lands, ensures a permanent research presence on the property. The owners support this move as it helps reduce the threat of illegal hunters and loggers. We see potential to develop this area for ecotourism as an economic activity that is compatible with corridor function (Act 3.1.3). Also, given the extensive area of forest on the property we are investigating the potential of this land for carbon sequestration. Elma Kay is working with BFD to initiate REDD concessions within the corridor area.

In addition, Senator Omar Figueroa is investigating opportunities to reduce land tax for key properties within the corridor, such as Big Falls, which are otherwise taxed heavily for not developing the land.

4. Advocacy, leading to implementation of the corridor within the legal framework of Belize

BFD has committed to hire a Wildlife Corridor Officer, funded by Panthera, as part of the BFD wildlife programme, who will work directly below the BFD Wildlife Programme Officer Rasheda García.

Senator Omar Figueroa and Elma Kay meet regularly to discuss land-use issues with government ministers and representatives. We consider it more appropriate and effective for the Ministers to meet with such highly-respected Belizeans as Elma and Omar Figueroa than with foreigners associated with the corridor project (Patrick Doncaster, Bart Harmsen or Rebecca Foster).

3.2 Progress towards Project Outputs

1. Collection of rigorously calibrated information on movement through fragmented landscapes by neotropical mammals

Live trapping of medium-sized mammals (Acts 1.4) has progressed more slowly than expected. Nevertheless, we currently have radio-collars on three pacas, two coatis, one tayra, and four kinkajous (with high failure rate on the latter). Omar Figueroa has GPS-tracking data on two puma and nine jaguars.

During the dry season 12 months ago, camera traps at locked-open and baited live traps revealed frequent visits by target species. Delays in sourcing and importing anaesthetics stalled live trapping until the end of that dry season. We then caught three pacas in 6 days (one too young to collar). Trap success declined dramatically once the rains began. The corridor is in the lowest part of the country, so frequent wide-scale flooding is a problem here. Our field crew are constantly monitoring and moving traps.

During the wet season in July through to the October hurricane, and now ongoing since December, the following datasets have been collected and are now being analysed (Act. 2.1.3):

- Paca density from small grids of camera traps; burrow density from surveys; home range sizes from radio-tracking data; propensity to cross savannah. First reports of analyses due in April 2011. Early results indicate that savannah does not inhibit paca ranging, and burrow densities correlate strongly with camera-trap estimates of density.
- Kinkajou home range sizes from radio-tracking data, awaiting conversion of bearings to locations. Early results indicate higher than expected diurnal activity 4 months after the hurricane, with some individuals underweight and forced to the ground by sparse canopy cover.
- Jaguar and puma ranging behaviour; propensity to cross the Western Highway. Ongoing data collection for PhD thesis of Omar Figueroa. Early results indicate unexpectedly high mobility, attraction to the two major rivers and avoidance of citrus plantations. They cross roads at relatively fixed access points with forest cover approaching the road from both sides. Jaguars and pumas partition their activity schedules.
- Jaguar and puma diet from ~75 jaguar and 35 puma scats collected by Omar Figueroa in the corridor area. First reports of analyses due in April 2011. Early results indicate relatively low dietary overlap of < 30% between species, and important differences between diet in the corridor and in the protected areas to the south.
- Calibration of biomass eaten by jaguars to biomass in faecal remains from feeding trials at zoo. First reports of analyses due in April 2011. Early results indicate that standard published calibrations for large carnivores will need readjustment for jaguars.

- Tapir density and ranging behaviour from camera-trap data; propensity to cross roads. First reports of analyses due in April 2011. Early results indicate low mobility relative to body size and potential barrier effect of the Western Highway contrasting with a corridor effect of logging roads.
- Jaguarundi, ocelot and margay coexistence within the corridor; propensity to cross roads (first reports of analyses due in April 2011). Early results indicate generally lower mobility than larger cats, and a potential barrier effect of roads though the Western Highway has been crossed by one ocelot and has killed one margay.
- Calibration of radio-tracking accuracy. First reports of analyses due in April 2011. Early results indicate variation by habitat and by transmitter location above or below ground.
- Interview survey of game-meat consumption. First reports of analyses due in April 2011. Early results indicate variation in the consumption of game meat by district but not by income bracket.
- Ground-truthing interview survey of the proposed corridor area to determine jaguar and prey-species presence. Conducted by Panthera consultants for the Mesoamerican jaguar corridor.

2. Instilling a tradition of objectively-based mammal monitoring in Belize

BFD Wildlife Officer Rasheda García is now on the Advisory Board of the ERI.

The Working Group to develop the National Biodiversity Monitoring Programme has designated the ERI to take on the role of national biodiversity monitoring, including mammals. The first meeting of the Biodiversity Monitoring Group was held in late March 2011 with the objective of defining programme goals for harmonising methods, and discussing current indicators of biodiversity already in use. For example, our camera-trapping and survey data from the Darwin project show that counting paca burrows is an accurate indicator of their density.

The interns and the undergraduates described in Section 3.1 above are all now trained in use of camera traps, live trapping, and telemetry. The undergraduates trained on dummy animals, and then witnessed a live capture of a kinkajou. Within the Wildlife Management course, the undergraduates learned about the wider context and theory of mammal monitoring.

Of the students who graduated last year, one is working for us, one is working for The Nature Conservancy, one is doing a Masters at Nottingham University, one works for the Global Environmental Facilities Small Grants Program, two work for the Belize Agriculture and Health Authority, one works for the Department of the Environment, one works at the Community Baboon Sanctuary, one works for the Natural Resources Programme, one works at the BFD, one was hired by Panthera to do the corridor ground-truthing on jaguar presence and later hired by Darwin to conduct the surveys of game meat consumption. One graduate won a prize for her thesis work to pay for a trip to present it at the Mesoamerican Society for Biological Conservation in Costa Rica in November.

Omar Figueroa presented a talk on the Central Belize Corridor at the same Costa Rican conference.

3. Delineation of the belt of contiguous wilderness that will constitute the wildlife corridor

The Lands Information Centre has a consultancy to provide us with information on land ownership and proposed development in the corridor. Said Gutierrez will join the consultants and receive advanced GIS training during this period. Since the beginning of the project, we have been in communication with the person who owns one third of the corridor lands; we continue to engage with this person and with the owners of all the other significant portions of land.

The radio-tracking data on jaguars and pumas being collected by Omar Figueroa is telling us about highway crossing points. Because we are behind schedule on radio-tracking of other species, we are not yet using that data for fine-scale delineation of the corridor.

4. Advocacy, leading to implementation of corridor within the legal framework of Belize

Thanks to the high-profile large-scale ecological research in the corridor, and the hard work of Darwin consultant Senator Omar Figueroa, the Belize Government has protected the last remaining crown land (36 km²) within the corridor area (Acts 4.1.5 and 4.1.7). Its new status as a Wildlife Sanctuary means that “no person shall hunt, shoot, kill or take any wild animal, or take or destroy any egg of any bird or reptile or any nest of any bird”(Belize National Parks System Act). This is a crucial link in the corridor, being the only section of the Belize River that still retains riparian forest on both banks. Hon Gaspar Vega gave the keynote speech at the ceremony on 29th July to mark his official declaration of Labouring Creek Jaguar Corridor Wildlife Sanctuary and the signing of a Letter of Understanding between the Belize Government and the in-country Darwin partner Panthera, acknowledging the importance of connectivity at a national level. The ceremony, jointly funded by the Darwin Initiative and Panthera, was attended by Government officials, regional Ambassadors, the University of Belize, national NGOs, and the press. We are now developing a needs assessment for the new sanctuary and seeking funding for its management through Panthera.

Bart Harmsen and Rebecca Foster ran a livestock predation workshop in June, with Panthera jaguar-cattle conflict co-ordinator (veterinarian and jaguar expert) Dr Rafael Hoogesteijn.

Advocacy is on schedule. See section 8 for dissemination of publicity on the corridor. It would be premature to present means of verification of government-level advocacy at this stage of discussions with policy-makers, since most of these issues involve sensitive information of land use change at a national level. There has been no change to the assumptions underpinning project goals.

3.3 Standard Measures

Table 1 Project Standard Output Measures

Code No.	Description	Year 2 Total	Number planned for this reporting period	Total planned from application
Established codes				
3	Number of people attaining qualifications ¹	21	22	40
4A	Number of undergraduate students having received training ²	38	38	40
4C	Number of postgraduate students to receive training ³	4	4	2-4
4D	Number of training weeks to be provided	18	18	55
5	Number of people having received at least one year of training (excluding those above) ⁴	3	1	2-4
7	Number of training materials produced for use by host country ⁵	1	1	4
8	Number of weeks spent by UK PI Doncaster on project work in the host country	2	2	9
9	Number of species/habitat management plans (or action plans) to be produced for Governments, public authorities, or other	0	0	3

	implementing agencies in the host country			
10	Number of individual manuals produced to assist work related to species identification, classification and recording	0	0	1
11A	Number of papers published or in press in peer reviewed journals ⁶	3	3	3+
11B	Number of papers to be submitted to peer reviewed journals	0	0	4-8
12A	Number of computer based databases to be established and handed over to host country	0	0	3
14A	Number of workshops organised to disseminate Darwin project findings ⁷	1	1	3
14B	Number of conferences/workshops attended to disseminate Darwin project findings ⁸	5	1	3
15A	Number of national press releases in host country ⁹	3	3	5
15B	Number of local press releases in host country	0	0	5
15C	Number of national press releases in UK ¹⁰	1	1	1
15D	Number of local press releases in UK	0	0	0
17B	Number of dissemination networks enhanced ¹¹	3	0	1
18A	Number of national TV features in host country ¹²	5	2	3-5
19A	Number of national radio interviews in host country	0	0	5
20	Estimated value (£'s) of physical assets to be handed over to Belize ¹³	£12,852	£11,850	£35,526
21	Number of permanent educational, training and research organisations established	0	0	1
22	Number of permanent field plots established ¹⁴	5	0	60
23	Value of resources raised from other sources (i.e. in addition to Darwin funding) for project work – confirmed funding ¹⁵	£77,404	£53,605	£155,107
New - Project specific measures	n/a			

¹ 17 of 18 undergraduates passed the UoB Wildlife Management course in 2010; 4 of 4 field staff passed the First Aid course for fieldworkers.

² 25 UB undergraduates, 11 UoS undergraduates, and one undergraduate from US.

- ³ Four post-graduates have received training: two graduates from The Netherlands and two graduates from UK.
- ⁴ Two Belizeans (Arturo Ramos and Said Gutierrez) and one English (Angela Watkins).
- ⁵ Foster, R. J. (2010) *The Central Belize Corridor*. Brochure disseminated to the public to raise awareness about the Central Belize Corridor. Available in English and Spanish.
- ⁶ Harmsen, B.J., Foster, R.J., Silver, S.C., Ostro, L.E.T. & Doncaster, C.P. (2011). Jaguar and puma activity patterns in relation to their main prey. *Mammalian Biology*, in press.
- Foster, R.J., Harmsen, B.J., and Doncaster, C.P. (2010) Sample size effects on diet analysis from scats of jaguars and pumas *Mammalia* 74: 317-321. [Reported as in press in the 1st Annual Report]
- Harmsen, B.J., Foster, R.J., Gutierrez, S.M., Marin, S.Y. & Doncaster, C.P. (2010) Scrape-marking behavior of jaguars (*Panthera onca*) and pumas (*Puma concolor*). *Journal of Mammalogy*, 91: 1225-1234. [Reported as in press in the 1st Annual Report]
- ⁷ Livestock protection workshop; 17th June 2010, University of Belize Central Farm Campus, Cayo, Belize
- ⁸ Harmsen, B. J. (2010) *Wildlife Connectivity and the Central Belize Corridor*. VIII International Mobile Seminar on Protected Areas: Integrating People, Protected Areas and Landscapes. Cockscomb Basin Wildlife Sanctuary, Belize.
- C. P. Doncaster and R. J. Foster (2010) *The Darwin Initiative: Wildlife corridor project in Belize*. UK Belize Association Conference, Oxford.
- Figueroa, O. Harmsen, B. J., Foster, R. J., Kay, E., Rabinowitz, A., Gutierrez, S. and Quigley, H. (2010) *The Central Belize Corridor: a model for connectivity science and conservation*. IX Congress for the Mesoamerican Society for Biology and Conservation, San Jose, Costa Rica.
- Harmsen, B. J. & Foster R. J. (2010) *Creation of the Central Belize Corridor, a case study*. Belize Chapter National Congress for the Mesoamerican Society for Biology and Conservation, Belmopan, Belize.
- Gutierrez, S. and Harmsen, B. J. (2011) *The Central Belize Wildlife Corridor*. First Belize-Mexican Symposium for Research Collaboration on Biodiversity and Natural Sciences, Belmopan, Belize.
- Foster, R. J. (2010) *The Central Belize Corridor*. Regional Panthera Meeting, Costa Rica.
- ⁹ Matola, S. (2010) *The Darwin Initiative: Outstanding research at the Belize Zoo*. The Reporter (National Belizean newspaper).
- Lucas, A. (2010) *Belize and Mexico to discuss environmental cooperation*. The Reporter (National Belizean newspaper) www.belizenews.com Report on discussions between Mexico and Belize about the Mesoamerican Biological Corridor.
- Anon (2010) *The Central Belize Wildlife Corridor*. Belize Forest Department News Letter, December 2010, Issue 2.
- ¹⁰ Jones, T. (2010) *Belizean jaguar populations 'well-connected'*. NERC Planet Earth Online <http://planetearth.nerc.ac.uk/news/story.aspx?id=809>.
- ¹¹ Production and sale of corridor postcards to enhance knowledge about the Central Belize Corridor among foreign tourists.
- Dissemination of Central Belize Corridor brochures to the general public at the annual National Agriculture show, the largest public event of the year in Belize.
- Deputy Prime Minister's speech at COP10, Nagoya, Japan (web link in Annex 3).
- ¹² Channel 7 national news report on TV and online (2011) *Omar, The Jaguar Man*. www.belizenews.com Publicity about the research of Omar Figueroa and the Central Belize Corridor.

Channel 7 national news report on TV and online (2011) *Jaguar package, reloaded*. www.belizenews.com Publicity about the research of Omar Figueroa and the Central Belize Corridor.

Channel 7 national news report on TV and online (2010) *The lesson of the jaguar*. www.belizenews.com Publicity about the jaguars and the Central Belize Corridor.

Channel 5 national news report on TV and online (2010) *New reserve established but APAMO*.

Channel 5 national news report on TV and online (2010) *Contest winners get to spend a day with jaguars*. www.belizenews.com. Publicity about the Central Belize Corridor.

¹³ This is the year-2 expenditure on capital equipment, all of which was purchased for Belize.

¹⁴ Five small-scale camera grids (each with 25 camera stations) cut and maintained by field staff, infrastructure lost during hurricane; one large-scale trail system re-opened post-hurricane (for 21 camera stations)

¹⁵ UoS: £4,271 in overheads; BFD: ~£5,000 in staff time; UoB: £8,800 in time spent by Elma Kay and her ERI staff of Ian Sangster and Julissa Bardalez, overheads, office and lab rental for Said Gutierrez, use of equipment; Panthera: £59,333 in salaries, office space and telephone/internet costs for Rebecca Foster, Bart Harmsen and ½ salary for Arturo Ramos, project-related travel to UK, vehicle fuel and maintenance, use of ATV, shipping and import taxes, repairs to Big Falls road.

Table 2 Publications (published and in press)

Type (e.g. journals, manual, CDs)	Detail (title, author, year)	Publishers (name, city)	Available from (e.g. contact address, website)	Cost £
Journal article (in press)	Harmsen, B.J., Foster, R.J., Silver, S.C., Ostro, L.E.T. & Doncaster, C.P. (2011). Jaguar and puma activity patterns in relation to their main prey.	Mammalian Biology	C. Patrick Doncaster	-
Journal article (published)	Foster, R.J., Harmsen, B.J., and Doncaster, C.P. (2010) Sample size effects on diet analysis from scats of jaguars and pumas	Mammalia	C. Patrick Doncaster	-
Journal article (published)	Harmsen, B.J., Foster, R.J., Gutierrez, S.M., Marin, S.Y. & Doncaster, C.P. (2010) Scrape- marking behavior of jaguars (<i>Panthera onca</i>) and pumas (<i>Puma</i> <i>concolor</i>).	Journal of Mammalogy	C. Patrick Doncaster	-

3.4 Progress towards the project purpose and outcomes

The purpose of the project is to have the Government of Belize adopt and implement a zoning plan for a corridor that connects two wilderness blocks in north and south Belize, supported by a national, objectively-based, mammal monitoring programme. All original assumptions (Annex 2) still hold true; indicators are adequate for measuring outcomes. Two documents provide evidence of the assumption of continued government commitment. (1) the government declared the northern part of the corridor as a Wildlife Sanctuary (see Fig. 1 and Annex 3); (2) the government signed an agreement with the in-country Darwin partner Panthera, acknowledging the importance of connectivity of wildlife populations.

A change in government structure since November means that policies and legal structures for the corridor will now be implemented by the newly created government body: National Protected Areas Secretariat. The job of its director Dr Colin Young is to restructure the protected areas system in Belize, achieved through various consultancies funded by the UNDP and GEF. The restructuring will involve a comprehensive review of existing protected areas legislation in order to harmonise it into a single law. The Secretariat plans to have a suggested structure and proposed system act in place by mid-2011, moving to public hearings by the end of 2011. Darwin personnel have secured a meeting with the National Protected Areas Secretariat in April 2011, where they will be granted the opportunity to argue for incorporating the Central Belize Corridor into the National Protected Areas System Plan. If the Secretariat chooses to recognize the corridor based on our initial monitoring data, it will initiate a formal commitment to cover the gaps in the law for areas that fall within private lands (the principal objective of Output 4). Final delineation of the corridor will be based on our final total of rigorously collected field data.

3.5 Progress towards impact on biodiversity, sustainable use or equitable sharing of biodiversity benefits

The project is having an impact on biodiversity in terms of the expert advice provided by Rebecca Foster, Bart Harmsen and Omar Figueroa to the Deputy Prime Minister and Minister for the Environment, the Hon Gaspar Vega, for his keynote speech at the November meeting of the 10th Conference of the Parties (COP10) for the Convention on Biological Diversity at Nagoya, Japan. Here he announced the re-launching of the Mesoamerican Biological Corridor project under the CBD Life Web initiative. He stated: "Just last month, my government established our newest reserve - the Central Biological Corridor - that will provide critical habitat for the jaguar and other species" (web link to text in Annex 3).

The job of the new BFD Wildlife Corridor Officer will involve publicising and enforcing laws on wildlife game hunting, promoting sustainable game hunting, and assisting with minimizing livestock predation. At this stage in the project we cannot verify other impacts on biodiversity, sustainable use or equitable sharing of biodiversity benefits. Our objective remains unchanged, to prevent future loss of biodiversity by implementation of the wildlife corridor.

4. Monitoring, evaluation and lessons

Project monitoring and evaluation

The measurable indicators of progress against the scheduled activities in the logframe are described in Section 3 above in relation to the project purpose, with outputs listed in Section 3.3, and summarized in Annex 1. In addition, Bart Harmsen and Said Gutierrez both have formal work plans designed to ensure timely implementation of the Darwin project activities. Elma Kay monitors their progress with monthly staff meetings and quarterly written reports. Rebecca Foster writes monthly reports to Panthera, detailing project progress. The reports are reviewed by Howard Quigley to ensure that the corridor research is moving forward.

Lessons learned from this year's work

We are learning much about the resilience of the forest ecosystem to hurricane damage, and its susceptibility to long-term perturbations, including loss of fruiting trees and fire risk.

We are continually learning to trap more efficiently, and have benefited enormously from expert advice and demonstrations by the professional trapper. This reporting period, we learned that live trapping during the rainy season is not productive, and camera trapping leads to high failure rate and loss of cameras.

We are constantly learning to improve telemetry efficiency in the forest. We have learnt that our kinkajou collars need modifying to prevent them from chewing through the antenna. We have developed protocols to optimise accurate and safe tracking by telemetry.

We are continuing to find that local people are crucial to the success of the project through their knowledge of the environment and its fauna and flora, their dedication, enthusiasm, and speed of learning. We are also continuing to experience public relations benefits to hiring local people in terms of promoting the corridor and a positive attitude towards wildlife.

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

The review of the 1st Annual Report made three suggestions, only the last one requiring a response.

1. *Recommendation that more effort is placed on ensuring capacity and willingness within BFD to assume responsibility of project outputs.* BFD has committed to hire a Wildlife Corridor Officer, funded by Panthera, as part of the BFD wildlife programme, who will work directly below the BFD Wildlife Programme Officer Rasheda García. Rasheda is now on the Advisory Board of the ERI.

2. *The project leader may wish to consider an assessment of, and strategy for, ERI to acquire national and international research and literature subscription funding in the future.* For the duration of the project, the UoS is providing project personnel Bart Harmsen, Rebecca Foster, and Said Gutierrez with full access to its vast electronic resources, including the full range of research journals in its libraries and site-licensed software. UoS has agreed to extend associate researcher status to include Elma Kay for as long as UoB and UoS sustain the collaboration initiated by the Darwin project. UoB is also tackling the issue of literature subscription from alternative angles. The ERI is spearheading the development of a regional MSc in Biodiversity Conservation and Sustainable Development which involves three other universities: Anton de Kom University of Suriname, the University of Guyana, and the University of the West Indies at St. Augustine; all associated staff will share the common pool of resources as associate members of each others universities. The ERI Publications Repository on the web is set to become one of the databases of reports and peer-reviewed literature that contribute to the Clearing-House Mechanism for biodiversity as required by CBD Article 18.3.

3. *Further evidence should be provided for the more significant activities in future (more congruence between activities and outputs).* Annex 3 presents evidence of the main outcomes of the year. On congruence between activities and progress towards Output 4, the Lands Information Centre has a consultancy to provide us with information on land ownership and proposed development in the corridor. Said Gutierrez will join the consultants and receive advanced GIS training during this period (section 3.2.3). On 'action towards Output 4: implementation of the corridor', we are starting to raise the level of advocacy from private meetings with ministers to reporting to the newly formed National Protected Areas Secretariat. Our first meeting is set for April 2011, at which we will argue for inclusion of the Central Belize Corridor into the National Protected Areas System Plan. Inclusion of the corridor will guarantee its consideration in all subsequent legislation for protected areas (Section 3.4).

No issues were raised by the half-year reports.

6. Other comments on progress not covered elsewhere

Significant difficulties encountered during the year and steps taken to overcome these

Cat 1 Hurricane Richard passed directly over the corridor on 24-25 October, as described in Section 3.1.1 above, causing damage to trails and delays in live trapping and camera trapping. We have directed many man-hours of fieldwork to reopening trails, in order to secure valuable datasets from large-scale camera surveys replicated before and after the hurricane. These are being kept on schedule at the expense of small-scale surveys.

Live trapping of medium-sized mammals (Acts 1.4) has progressed more slowly than planned, as described in Sections 3.1.1 and 3.2.1 above. We have responded to this situation by learning to focus trapping effort into the dry season, and by bringing in professional trapper Dairen Simpson to train key field personnel in safe use of snares and corrals. Despite the slow start to collection of telemetry data, we are now amassing datasets on a diversity of target species which will result in publishable analyses (section 3.2.1).

Particular risks of the project

We foresee no particular risks of the project.

7. Sustainability

Within-country project profile and promotion of project

The project has achieved exposure at government level with: (1) the government declaring the northern part of the corridor as a Wildlife Sanctuary and formally acknowledging the importance of wildlife connectivity; (2) invitation from the newly created National Protected Areas Secretariat to present the case for including the corridor in the National Protected Areas System Plan (section 3.4 above).

Indicators of biodiversity developed in the project are set to be rolled into the National Biodiversity Monitoring Program (section 3.2.2).

The corridor continues to be promoted in the national news and in UK outlets (Table 1 and footnotes). It is explained in a brochure handed out to the public at community events, and it will be promoted to users of the Western Highway with billboards at entrance, middle and exit points (section 8 below and Annex 3).

Evidence for increasing interest and capacity for biodiversity resulting from the project

At an international level, the Central Belize Corridor merited specific mention at CBD COP10 by the Deputy Prime Minister of Belize; at a national level the job of the new BFD Wildlife Corridor Officer is to publicise and enforce laws on wildlife game hunting, to promote sustainable game hunting, and to assist with minimizing livestock predation (section 3.5). This post is creating new human capacity within the BFD.

Capacity for biodiversity is raised by the new sanctuary, and by the employment in diverse organisations within Belize of graduates from the Wildlife Management course (listed in section 3.2.2). The Darwin Project provided the impetus for the research and teaching programme in wildlife at the ERI, which will be one of its principal legacies. Four of its staff are now trained in teaching a toolbox of trapping and tracking techniques.

8. Dissemination

We remain on schedule with advocacy. We have billboards designed (see Annex 3) to put up on the Western Highway at entrance and exit to the corridor area; these should be in place by the end of April. The associated text is “You are entering the Central Belize Wildlife Corridor, please drive carefully” and “You are leaving the Central Belize Wildlife Corridor, thank you for driving carefully”. The original oil painting will be sold by auction with the proceeds going towards the corridor.

A brochure (see Annex 3) explaining the what, where and why of the corridor has been given out at a BFD and Darwin stand at the annual National Agricultural show – the biggest event in the country – in Belmopan. Three designs of postcards (camera trap photos of animals caught in corridor, with explanation on back) are currently being sold at two key tourist destinations within the corridor (zoo and restaurant). The corridor billboard will also become a postcard. The Darwin logo is on a poster campaign by the Belize Zoo against the illegal trade in jaguar body parts.

9. Project Expenditure

Table 3 Project expenditure during the reporting period (Defra Financial Year 1 April 2010 to 31 March 2011)

Item	Budget (please indicate which document you refer to if other than your project application or annual grant offer letter) As per Consortium Agreement 'Schedule 1, and Yearly Budget Breakdown including amendments agreed in January Change Request, attached in Annex 4	Expenditure	Variance
Rent, rates, heating, overheads etc			
Office costs (e.g. postage, telephone, stationery)			
Travel and subsistence			
Printing			
Conferences, seminars, etc			
Capital items/equipment (specify)			
Others (specify)			
Salaries (specify by individual)			
TOTAL			

¹ Overspend due to an oversight in the January 2011 Change Request: year-1 expenditures on the PI's second trip to Belize (March 2010) had not been accounted for in the year-1 account of expenditures.

² Underspend due to lower requirement for veterinary services in February and March than was anticipated in the January 2011 Change Request; this requirement is likely to increase in year 3.

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

We agree for LTS and the Darwin Secretariat to publish the content of this section

Two outstanding achievements this year are the high number of Belizeans that have received training in wildlife research and management, and the declaration the Wildlife Sanctuary in the corridor.

We have photographs of animals, landscapes (savannahs, forests, lagoon), and people doing fieldwork. These are available on request from Rebecca Foster

Annex 1 Report of progress and achievements against Logical Framework for Financial Year: 2010/11

Project summary	Measurable Indicators	Progress and Achievements April 2010 - March 2011	Actions required/planned for next period
<p>Goal: <i>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</i></p> <p><i>The conservation of biological diversity,</i></p> <p><i>The sustainable use of its components, and</i></p> <p><i>The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources</i></p>			<i>(do not fill not applicable)</i>
<p>Purpose.</p> <p>A corridor zoning plan connecting two wilderness blocks in North and South Belize adopted and implemented by the Government of Belize, supported by a national, objectively-based, mammal monitoring programme.</p>	<p>Submission to government of evidence-based corridor zoning plan.</p> <p>Government recognition of the proposed corridor.</p> <p>Integration of mammal monitoring within training programmes of the ERI.</p>	<p>Scheduled for end of year 3.</p> <p>Scheduled for end of year 3.</p>	<p>As per logframe.</p> <p>As per logframe.</p> <p>As per logframe.</p>
<p>Output 1. Collection of rigorously calibrated information on movement through fragmented landscapes by neotropical mammals, using (1) mapping, (2) surveying sign, (3) trapping, (4) tracking.</p>	<p>Spreadsheet, GIS and photographic databases.</p>	<p>Spreadsheet, GIS and photographic databases established and expanding daily. Available on request.</p>	
<p>Activity 1.1 Establishment of survey grids.</p>		<p>Three large-scale and five small-scale (concentrated) camera trapping grids sustained until Hurricane Richard. Post-hurricane renovation of large-scale grids, abandonment of small-scale grids for the foreseeable future.</p>	
<p>Activity 1.2 Sign and camera surveys.</p>		<p>Each grid surveyed once with one large-scale grid repeated post-hurricane. All five sign-surveys completed pre-hurricane.</p>	
<p>Activity 1.3 Trapping mammals for marking.</p>		<p>Captures of ten jaguars, two pumas, five pacas, five kinkajous, two coatis, one tayra, one grison.</p>	
<p>Activity 1.4. Radio tracking.</p>		<p>Radio-tracking locations on nine jaguars, two pumas, four pacas, four kinkajous, one coati.</p>	

Project summary	Measurable Indicators	Progress and Achievements April 2010 - March 2011	Actions required/planned for next period
Output 2. Instilling a tradition of objectively-based mammal monitoring in Belize, and institutionalising this impetus within the UoB Environmental Research Institute (ERI).	Wildlife biologist to coordinate mammal monitoring. Awareness campaigns by BFD. Mammal monitoring within the corridor becomes a defining role of the UoB Environmental Research Institute.	Said Gutierrez given responsibility for radio tracking, and is taking an increasing role in trapping and anaesthetising trapped animals. Appointment of BFD corridor officer; billboard designed for corridor entrance and exit points on the Western Highway; brochures and postcards distributed at community events. BFD Wildlife Officer Rasheda García now on the Advisory Board of the ERI. The Working Group to develop the National Biodiversity Monitoring Programme has designated the ERI to take on the role of national biodiversity monitoring.	
Activity 2.1. Courses and projects with UoB students; analysis of camera-trap and telemetry data		Nine UoB interns completed their 6-week internship; 11 UoS students completed their 2-month visit. Many graduates of the Wildlife Management course have gone on to wildlife-related jobs. Analyses due in April of questionnaire surveys of bush meat consumption, density estimates from camera-trap surveys, movement data from radio-tracking data.	
Output 3. Delineation of the belt of contiguous wilderness that will constitute the corridor connecting the northern and southern protected blocks of land.	Corridor plan, and integration within it of knowledge on wildlife abundance, distribution, movement and exploitation, and projected urban development either side of the corridor.	New Wildlife Sanctuary delineated, encompassing the only remaining area of wilderness on both sides of the Belize River. Jaguars known from radio-tracking data to cross the river in this area. On-going dialogue with key landowners of large forest blocks neighbouring the sanctuary.	
Activity 3.1. Analysis of wildlife conflicts, mapping forest exploitation and potential for ecotourism		Consultancy with the Lands Information Centre to fill in gaps in the detail of small-holding ownership. Elma Kay working with BFD to initiate REDD concessions within the corridor area. Renovation of research house in the Big Falls property within the corridor.	
Output 4. Advocacy, leading to implementation of corridor within the legal framework of existing protected areas and zoning plans within Belize, and publication of results.	Government agreement on zoning of the corridor area, following negotiations on land-use changes.	These are milestones for year 3 of the project.	

Project summary	Measurable Indicators	Progress and Achievements April 2010 - March 2011	Actions required/planned for next period
	Activity 4.1. Student questionnaire surveys of local people; discussions, reports, and negotiations with government, signing official agreements.	Analysis of questionnaire surveys due in April; official protection of new wildlife sanctuary within the corridor and government commitment to the value of connectivity; discussion of corridor with new National Protected Areas Secretariat planned for April.	
	Activity 4.2. Acceptance of papers in peer-reviewed journals	Two papers related to the project have been published in peer-review journals and one is in press.	

Annex 2 Project's full current logframe

Project summary	Measurable Indicators	Means of verification	Important Assumptions
<p>Goal:</p> <p>Effective contribution towards 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.</p>			
<p>Sub-Goal:</p> <p>To secure connectivity for all larger land mammals within Belize, currently threatened by segregation into isolated blocks in the north and south of the country, thereby enhancing connectivity with natural areas outside Belize.</p>	<p>Identified minimum conditions of habitat structure and quality for allowing free movement of medium to large mammals between existing PAs.</p> <p>Indicator species: jaguar, puma, ocelot, tapir (CITES I), white lipped and collared peccaries (CITES II, hunted), red brocket and white tailed deer, coati, armadillo and paca (unlisted reference species).</p>	<p>Continued presence of target species throughout corridor areas, connecting freely with protected blocks at either end.</p>	
<p>Purpose</p> <p>A corridor zoning plan connecting two wilderness blocks in North and South Belize adopted and implemented by the Government of Belize, supported by a national, objectively-based, mammal monitoring programme.</p>	<p>Already declared interest by the Belizean government in a plan for zoning a corridor connecting the two protected wilderness blocks in north and south Belize, and conditions for implementation.</p> <p>Submission to government of evidence-based corridor zoning plan.</p> <p>Government recognition of the proposed corridor.</p> <p>Integration of mammal monitoring within training programmes of the ERI.</p>	<p>Continued existence and free movement of all studied taxa throughout the proposed corridor.</p> <p>Corridor protection implemented into law, thereby contributing towards Belize's commitment to the CBD.</p> <p>Recognition of corridor as integral to the proposed Mesoamerican Biological Corridor.</p> <p>Yearly increase in numbers of Belizean students studying wildlife and human-wildlife interactions within the corridor.</p>	<p>Government remains committed to the corridor (see Section 14).</p> <p>No major development severs the corridor before implementation of protection.</p> <p>UoB remains committed to its Environmental Research Institute.</p>

Project summary	Measurable Indicators	Means of verification	Important Assumptions
<p>Outputs</p> <p>1. Collection of rigorously calibrated information on movement through fragmented landscapes by neotropical mammals, using (1) mapping, (2) surveying sign, (3) trapping, (4) tracking.</p>	<p>Collection of data on density and movement of key neotropical mammal species within and through the corridor. Analysis by least-cost and other techniques to identify a corridor path with highest mobility.</p>	<p>Publications in peer-reviewed journals concerning movement and dispersion through corridor areas by neotropical mammals, co-authored by Belizean collaborators on the project.</p>	<p>Continued access to corridor area for fieldworkers throughout the data-collection period, and for post-project monitoring.</p>
<p>2. Instilling a tradition of objectively-based mammal monitoring in Belize, and institutionalising this impetus within the UoB Environmental Research Institute (ERI).</p>	<p>Appointment of a dedicated mammal-monitoring coordinator, and training for teaching courses in natural resource management at the ERI.</p> <p>Establishment of intensive training courses in natural resource management and wildlife monitoring, including GIS, offered to students, teachers and professionals in natural resource management.</p> <p>Collaboration of UoB with BFD to design an awareness campaign on wildlife law and potential conflicts, to be run by UoB students on their Bachelor programme in Natural Resources Management.</p> <p>Mammal monitoring within the corridor becomes a defining role of the UoB Environmental Research Institute.</p>	<p>Appointed coordinator trained in delivery of courses by Darwin core UK and Belize-based staff and consultants.</p> <p>ERI teachers trained in GIS techniques and field craft.</p> <p>Wildlife management training courses at the ERI outlive the Darwin project.</p> <p>Belizean scientists continue publishing in peer-reviewed journals on tropical mammalogy and conservation.</p>	<p>Continued commitment of the UoB to the ERI and to Belizean students in general for programmes monitoring neotropical mammals.</p> <p>ERI sustains success with securing outside funding sufficient to continue the wildlife teaching appointment after the end of the Darwin project.</p>

Project summary	Measurable Indicators	Means of verification	Important Assumptions
<p>3. Delineation of the belt of contiguous wilderness that will constitute the corridor connecting the northern and southern protected blocks of land.</p>	<p>Comprehensive corridor plan for connecting the two existing protected blocks in the north and south of the country.</p> <p>Integration within this plan of knowledge on wildlife distribution, movement and exploitation, and projected urban development either side of the corridor.</p>	<p>Published report of corridor plan.</p> <p>Distribution of report to government, BFD, and all local stakeholders.</p>	<p>Government through BFD upholds its current agreement to divulge development plans for the area.</p> <p>Continued access to private land to monitor movement and abundance of existing wildlife populations.</p>
<p>4. Advocacy, leading to implementation of corridor within the legal framework of existing protected areas and zoning plans within Belize, and publication of results.</p>	<p>Government agreement on zoning of the corridor area, following negotiations on land-use changes.</p>	<p>Lawfully binding document stating specifically which areas can be used for what purpose within the designated corridor area.</p>	<p>Government remains committed to the corridor and is willing to negotiate concessions against development as necessary and practical.</p>

Project summary	Measurable Indicators	Means of verification	Important Assumptions
Activities (details in workplan)			
1.1.1 Systematic mapping of the whole corridor zone in terms of habitat characterisations including urban parts (milestone for 1 st 6 months).			
1.1.1 Establishment of line transects and survey grids throughout the area, using a combination of a stratified design including all habitat types, and an even distribution throughout the zone. Project Leader to advise on data collection design during visits in years 1 and 2 (milestone for 1 st 6 months).			
1.1.3 Establishment of camera trap grids and locations throughout study area (milestone for 1 st 6 months).			
1.2.1 Systematic surveys for burrows of armadillos and pacas throughout the survey area in survey grids and survey lines (reporting milestones at yearly intervals).			
1.2.2 Systematic surveys for footprints for all species along survey lines and in survey grids (milestones at yearly intervals).			
1.2.3 Systematic sighting surveys (distance sampling surveys) for the ungulate species and coatis (milestones at yearly intervals).			
1.2.4 Systematic nocturnal sighting surveys for armadillos and pacas (milestones at yearly intervals).			
1.2.5 Camera trapping for identifiable species (ocelots, jaguars) for mark-recapture analysis and capture rates for prey species (milestones at yearly intervals).			
1.3.1 Trapping of jaguars, pumas and tapirs with the use of snares, using existing expertise in Panthera (milestones at yearly intervals).			
1.3.2 Peccary species stalked-down wind and darted, using existing expertise in Panthera (milestones at yearly intervals).			
1.3.3 Ocelot, coatis, armadillos and pacas will be cage trapped as the safest means of trapping (milestones at yearly intervals).			
1.3.4 Both deer species will be captured by down-wind stalking and darting, using existing expertise in Panthera (milestones at yearly intervals).			
1.4.1 Radio tracking of all species with teams on the ground (milestones at yearly intervals).			
2.1.1 Mammal-monitoring coordinator appointed to ERI (milestone for 1 st 6 months), to coordinate the logistics of mammal monitoring and the interface between students and Darwin personnel, to be trained for teaching wildlife management by Darwin core personnel and consultants (milestones at yearly intervals).			
2.1.2 Courses to UoB students in data collection, analysis and GIS for wildlife monitoring and natural resources management, initially run by Darwin UK and Belize-based personnel with assistance of mammal-monitoring coordinator; in final year run by coordinator now trained for teaching (milestones at yearly intervals).			
2.1.3 Implementation of UoB projects to assist with end parts of activities 1, all of activities 2 and activities 4. Some responsible students will assist with activities 3 but this will always be done under expert guidance (milestones at yearly intervals).			
2.1.4 Writing up of undergraduate projects and potentially master projects (milestones at yearly intervals).			
2.1.5 Analyses of mammal-monitoring data from cameras and telemetry for least-cost optimal corridor path (milestones in years 2 and 3).			
3.1.1 Study of potential conflicts with wildlife at corridor edges, through the Forestry Department and the Agriculture Department (milestones at yearly intervals).			
3.1.2 Mapping hunting and forest extraction and studying the socioeconomic implications of this for corridor design (milestones at yearly intervals).			
3.1.3 Mapping the potential and willingness by the local community to partially convert to ecotourism and explore possibilities through the Belize Tourism Board. (milestones in years 2 and 3, and final output).			
4.1.1 Student questionnaires to residents to test willingness to buy into the corridor and economic incentives necessary to encourage buy in.			
4.1.2 Meet regional MPs, to assess needs of constituents and public-relations strategy to encourage local buy-in to the corridor.			
4.1.3 Meet Ministers of Agriculture, Lands, Tourism, to provide input to plans for an economic stimulus package in the corridor region.			
4.1.4 Discussions with Dept Agriculture and Livestock Association, on minimising human/wildlife conflict in the corridor region.			

Project summary	Measurable Indicators	Means of verification	Important Assumptions
<p>Monitoring activities:</p> <p>Indicator 1.1 Fulfilling all sample-size assumptions necessary to run models to create habitat maps, estimate abundance from camera trapping and surveys.</p> <p>Indicator 1.2 Get adequate numbers of sign, sightings and photo captures to calculate abundance.</p> <p>Indicator 1.3 Capture high enough numbers of individuals from each species based on expectation from indicator 2.</p> <p>Indicator 1.4 Sufficient sample size of accurate fixes from each tagged individual and each species. Accuracy of trackers will be tested with fixed known collars.</p> <p>Indicator 2.1 Adequate functioning of coordinator as an organiser, teacher/assistant, practical work, quality of work and understanding by students within the program.</p> <p>Indicator 3.1 High cooperation from stakeholder communities.</p> <p>Indicator 4.1 Implementation of corridor according to minimum requirements as discovered through the project.</p> <p>Indicator 4.2 Acceptance of papers in well established peer reviewed papers.</p>			

18. Provide a project implementation timetable that shows the key milestones in project activities. Complete the following table as appropriate to describe the intended workplan for your project.

Activity	Months	Year 1				Year 2				Year 3			
		1	2	3	4	1	2	3	4	1	2	3	4
1.1.1 Mapping of corridor area	4	X	X										
1.1.2 Establishment of line transects and survey grids	3	X	X										
1.1.3 Establishment of camera trap grids	3	X	X										
1.2.1 Systematic surveys of burrows for Paca and Armadillo	6			X	X		X	X		X	X		
1.2.2 Systematic surveys for footprints of all species	6			X	X		X	X		X	X		
1.2.3 Systematic sighting surveys for all ungulates and coatis	6			X	X		X	X		X	X		
1.2.4 Systematic night time sighting surveys for pacas and armadillos	6			X	X		X	X		X	X		
1.2.5 Camera trap surveys	8			X	X		X	X		X	X		
1.3.1 Trapping of jaguars, pumas and tapirs	4-6			X		X		X		X			
1.3.2 Trapping of peccaries	4-6				X		X		X		X		
1.3.3 Trapping of ocelot, coatis, armadillos and pacas	4-6			X		X		X		X			
1.3.4 Trapping of both deer species	4-6				X		X		X		X		
1.4.1 Radio tracking of all collared species	25			X	X	X	X	X	X	X	X	X	X
2.1.1 Mammal-monitoring coordinator appointed to ERI and trained for teaching	30	X	X	X	X	X	X	X	X	X	X		
2.1.2 Course work to UoB students	5		X			X				X			
2.1.3 Field projects to UoB students	8			X	X			X	X			X	X
2.1.4 Marking and assisting with reporting stage	3				X				X				X
2.1.5 Analyses of mammal-monitoring data for optimal corridor path (least-cost analyses)						X	X	X	X	X	X		
3.1.1 Study of Human-wildlife Conflict at edges of study area	6				X		X		X		X		
3.1.2 Study extraction and hunting levels within the study area	5					X		X		X			
3.1.3 Study potential for tourism for surrounding stakeholder communities	6				X		X		X		X		
4.1.1 Student questionnaires to residents on willingness and incentives to buy	4	X							X				

	into the corridor												
4.1.2	Meet regional MPs, to assess needs of constituents and PR strategy	3	X			X			X				
4.1.3	Meet Ministers of Agriculture, Lands, Tourism, to devise economic stimulus package	3	X			X			X				
4.1.4	Discussions with Dept Agriculture and Livestock Association, on human/wildlife conflict	3	X			X			X				
4.1.5	Reports to government	7				X			X		X	X	
4.1.6	Workshop negotiations with government	5				X			X			X	X
4.1.7	Signing of official agreements with government concerning corridor	1											X
4.2.1	Writing and submitting peer reviewed papers	4							X				X

Annex 3 Onwards – supplementary material (optional but encouraged as evidence of project achievement)

See separate document of Annex 3 materials:

- Photographs of project activities
 - o Said Gutierrez and Arturo Ramos fitting a radio-transmitter to a tayra
 - o UoB students radio-tracking
 - o Radio-tracked kinkajou about to enter a cage trap
 - o The Big Falls house renovated as a research centre
 - o The signing ceremony for the new protected area within the corridor
 - o Students from UoB and UoS with the Deputy Prime Minister of Belize
 - o Aerial photos of hurricane damage in the corridor region
 - o The billboard painting in preparation
 - o One of the postcards for the Central Belize Corridor
 - o The brochure for the Central Belize Corridor

- Websites
 - o Keynote speech by the Deputy Prime Minister at COP10
 - o The corridor project on the website for the ERI at UoB

Checklist for submission

	Check
Is the report less than 5MB? If so, please email to Darwin-Projects@ltsi.co.uk putting the project number in the Subject line.	YES
Is your report more than 5MB? If so, please advise Darwin-Projects@ltsi.co.uk that the report will be send by post on CD, putting the project number in the Subject line.	NO
Have you included means of verification? You need not submit every project document, but the main outputs and a selection of the others would strengthen the report.	YES
Do you have hard copies of material you want to submit with the report? 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.	