Darwin Initiative

Annual Report

1. Darwin Project Information

Project Ref. Number	162/12/012
Project Title	Xaté palms (*Chamaedorea* spp.) in Belize: conservation and sustainable management
Country(ies)	Belize
UK Contractor	Natural History Museum (London)
Partner Organisation(s)	Belize Forest Department; Belize Botanic Garden; Ya'axche Conservation Trust, Teakettle Enterprises, New York Botanical Garden, Kew Gardens
Darwin Grant Value	£170,222
Start/End dates	May 2003 – April 2007
Reporting period (1 Apr 200x to 31 Mar 200y) and annual report number (1,2,3..)	1st April 2005 – 30th April 2006 Annual Report Number 3
Project website	Extra information at: http://www.nhm.ac.uk/research-curation/projects/xate/ http://www.nhm.ac.uk/nature-online/science-of-natural-history/science-at-the-museum/our-global-reach/
Author(s), date	Dr. Samuel Bridgewater, 26th April 2006

2. Project Background

Chamaedorea (xaté) is the largest palm group in the Neotropics (80-100 spp.), and the most heavily exploited. The harvesting of leaves from this understorey genus has been supplying the international floral trade for decades. However, this usually unregulated activity has decimated many wild populations in Guatemala and Mexico. With yields plummeting elsewhere, in recent years xaté collectors (xateros) have been illegally crossing into Belize from Guatemala to exploit a pristine resource. This has provoked diplomatic tension between the two countries and has threatened what was the last wild regional stronghold of the xaté species popularly known as fishtail (*C. ernesti-augustii*). Although a number of different *Chamaedorea* species are

traded in Mexico and Guatemala, to date in Belize it is only fishtail which has been the target of harvesters.

The presence of wild xaté in Belize presents an economic opportunity for Belizeans although no data has been available on the extent and abundance of this resource. This has hindered the establishment of a regulated Belizean industry. In addition, it is known that the harvesting of wild xaté leaf in Mexico and Guatemala has not been sustainable as wild populations in these countries have been decimated. The fact that in order to make money, xateros in Belize have consistently moved into new areas - in the past 5 years moving essentially across Belize in their quest to find leaves – suggests that current wild harvesting in Belize is also not sustainable. However, there is still a paucity of ecological information on how fast xaté grows making it impossible to set sustainable quota levels. Neither is it known what the long-term impacts of harvesting are on wild populations.

In an attempt to answer some of these questions the Darwin Initiative project 'Xaté palms (*Chamaedorea* spp.) in Belize: conservation and sustainable management' was established in 2003. This project is a collaborative venture between the Belizean Forestry Department, the Natural History Museum, London and the Belize Botanic Garden. The aim of the initiative is to assess the native xaté palm resource and to develop Belize's capacity to sustainable manage it.

3. Project Purpose and Outputs

The broad project purpose is to develop local capacity for conserving and sustainably managing the xaté palms (*Chamaedorea* spp.) of Belize and for improving the economic benefits to Belizeans from xaté collection.

Belize lacks funding and expertise to develop an urgently needed Management Plan to harvest sustainably xaté palms for the floral trade and to develop supplemental methods to reduce over-exploitation. This project uses UK expertise, in collaboration with Belizean institutions, industry and communities, to assist Belize in meeting its obligations under the CBD while helping eliminate poverty and promote sustainable livelihoods among local people primarily by investigating, 1) the feasibility of harvesting xaté sustainably in the wild to provide long-term benefits for Belizeans, and, 2) the potential to cultivate xaté in silvi-agricultal systems. The combined systematic, ecological, forestry and horticultural expertise of partners yield practical outputs providing a lasting legacy to enable sustainable management of this important resource and contribute to the management of Belizean forests.

In particular the project seeks to: 1) better understand the taxonomy and ecology of the xaté species which occur in Belize; 2) quantify Belize's xaté resource base; 3) provide data on the effects of harvesting on wild xaté populations; 4) determine sustainable yields of xaté leaves & seeds; 5) develop a Management Plan for the Chiquibul Forest Reserve; 6) assess the genetic status of xaté to determine the danger of depletion of genetic variation; 7) identify the existence of markers to underpin a verifiable certification scheme; 8) investigate the potential to cultivate xaté in different silvi-agricultural systems; 9) improve public and farmer awareness of xaté; 10) publish a user-friendly palm guide for use in resource assessment.

A detailed logical framework for the project is provided in Appendix 1.

The objectives and project operational plan have not changed during the 2005 – 2006 reporting year.

4. Progress

The project has developed according to plan, and in many ways has now far exceeded initial expectations of what it might achieve. In part this has been due to a continual strengthening of local networks, the adoption of a flexible approach to respond to the constantly changing needs of Belize, and the natural evolution of the xaté industry in Belize. In the project's initial year there were significant changes in the project personnel at the Natural History Museum resulting in a delay of the initial project outputs. However, the project is now on target to achieve its aims on time, and within budget.

All outputs of the achievements listed below are provided as Appendices.

Good progress has been made in 2005/2006. The primary scheduled work outputs (Appendix 2) were to: complete the xaté resource inventory of Belize (completed in March 2006), to provide local training in xaté horticulture and xaté resource assessments (continual; completed March 2006), to provide training in GIS data collection and analysis (completed in May 2005), to hold workshops on xaté cultivation (completed March 2006), to produce a xaté monitoring and assessment guide (completed March 2006), to produce a xaté cultivation manual and a xaté sustainable use poster (completed March 2006).

In addition extra outputs have been achieved. These comprise: 1) the production of a colour photo guide to *Chamaedorea* (completed November 2005), 2) the submission of a review paper to the journal Economic Botany on xaté in Belize (submitted October 2005; accepted for publication March 2006) and a stakeholders workshop to discuss the future of xaté in Belize (held October 2005).

1) During 2005/2006, xaté resource assessments were conducted in the following national Forest Reserves: Freshwater creek, Sittee River, Deep River, Maya Mountain and Colombia River. In addition, surveys were conducted in the Sarstoon-Temash National Park. In total (including the ca. 240 surveys conducted in the Chiquibul, Manatee and Sibun Forest Reserves during 2004-2005), 342 surveys across Belize have been completed by the project to date, and the results disseminated to local NGOs and the Belize Forest Department. A first draft of a report being prepared by YCT based o surveys conducted in the south of Belize during 2006 is provided in Appendix 3. Reports already submitted to the Darwin secretariat from work conducted in preceeding years have not been included again here. The data from the surveys is supplied on the accompanying CD. Much of the survey work in the south of the country was done in partnership with the Ya'axche Conservation Trust, a local Mayan community NGO, and it was particularly satisfying to support this relatively recent NGO, and to strengthen through training their long-term capacity to conduct local biodiversity and monitoring assessments. Related to the assessment work, 20 copies of a xaté resource inventory manual were produced and distributed to the Forestry Dept, and the local NGOs who conduct xaté surveys. This document (Appendix 4) outlines the protocols and methodology used to conduct quantitative evaluations and it is hoped that it will act as an appropriate archive of what has been done, and ensure that the permanent sample plots currently established under this programme are monitored in the long term. A report making a preliminary economic assessment based of project data was given to the Belize Forest Department in August 2006 (Appendix 5).

2) In May 2006, Ivis Chan and Percival Cho from the Belize Forestry Department visited the NHM for three weeks where they were trained in GIS techniques by Dr. Malcolm Penn using the data from the project's xaté surveys in the Chiquibul Forest Reserve. Some of the outputs from this work presented by Percival Cho at a Darwin Initiative workshop held at Las Cuevas in October 2006 are provided on the accompanying CD as part of a Powerpoint presentation. This will provide the foundation for the xaté management plan for this forest reserve. Percival Cho remains with the Forestry Department where he is responsible for the Forest Resource Planning and Management Programme, charged with ensuring the rational planning and utilization of manageable commodities. Ivis Chan left the Forest

Department in the autumn of 2005 where she took up a post with another Darwin-funded project in Belize. It is hoped that her training under the Darwin xaté project will assist her in her new post.

3) The illustrated xaté cultivation manual (Appendix 6) was completed during the reporting year. This was primarily a collaborative venture between two of the project partners – the BBG and YCT – and illustrates the capacity of these two partners to work collaboratively. It was decided to go for a 'low tech' publication that can be frequently, and cheaply, updated and made widely available to farmers and NGOs in Belize, rather than a more expensive and glossy 'one off' booklet. The manual is 'on-line' and hosted by the Belize Botanic Garden website, where it can be downloaded (www.belizebotanic.org/xate_manual.pdf). The manual is based on the experiences of the BBG and YCT in cultivating xaté. Over 100 hard copies were distributed to farmers groups, NGOs and government departments during early 2006. A list of those distributed by the BBG is provided in Appendix 7. Other references are made to the manual in the BBG Annual Darwin report (Appendix 8) and the YCT Annual Darwin report (Appendix 9). The manual provides invaluable advice to farmers who are wishing to cultivate xaté commercially, and is the first guide to xaté cultivation guide in English.

4) Although the Belizean palm guide was not scheduled until the next reporting year, it was decided that a rapidly produced 'photoguide' to the genus *Chamaedorea* would be a valuable extra project output, and one was completed by the project in October 2005. Over 100 copies of this have been produced and disseminated within Belize to the Forestry Department, and conservation and education NGOs and institutes. It was decided to adopt a guide format pioneered by Robin Foster at the Chicago Field Museum which is available and downloadable 'on-line' as pdf documents from: (http://fm2.fieldmuseum.org/plantguides/rcg_intro.asp). A copy of the *Chamaedorea* guide, which also provides information on the ecology, distribution and use, is provided in Appendix 10. The laminated format is ideal for use in the field, and can be updated on a regular basis. Although the *Chamadorea* guide is completed, it is not yet 'on-line' as it is currently being formatted to pdf. It is hoped it will go 'live' next month. In addition, a photoguide is being produced for the 24 most common palm species in Belize (excluding *Chamaedorea*). A draft copy is provided in Appendix 11. Fieldwork for this guide was conducted in November 2005. However, after initial testing it was decided that the guide could be improved further by including higher quality shots of some species, and this second guide will be field-tested again in April 2006. It is hoped that 100 copies of this will be distributed during the summer of 2006. The main project palm guide output, which is in addition to the two guides outlined above, is on-going, although is still requiring photographs of some of the rare species. This is being conducted in collaboration with Steven Brewer of the

University of North Carolina. This is a new project partnership. Field work to complete the palm guide was conducted by Dr. Brewer in March 2006, and by Dr. Bridgewater in April 2006. A rough draft of the proposed guide format is provided in Appendix 12.

5) Five workshops were concluded during the reporting year, four more than scheduled. On the 27th and 28th October 2005 a workshop was held at the Las Cuevas Research Station which brought together all stakeholders within Belize with a conservational, scientific and economic interest in xaté. In addition representatives from the Belize Defence Force and the National Security Council were present. In total, 35 participants attended, including members from seven governmental departments, six local NGOs (including three community framers groups), one botanical garden, one Belizean company and three international scientific institutes. The workshop was extremely successful and a summary of its proceedings is provided in Appendix 13. On Saturday March 11th 2006, a workshop was organised by the BBG to distribute the Darwin-funded xaté grower's manual, to update local communities on the xaté industry, to identify a list of farmer needs related to xaté cultivation, and to identify organisations and farmer groups in Belize emerging as leaders in communities. In total 22 people attended the workshop, and a summary of the proceedings of this workshop are provided in Appendix 14. A third workshop on organic horticulture and local gardening with native plants was also hosted by the Belize Botanic Garden between the 23rd and 26th January 2006. In part this was to promote xaté as a native landscaping plant, and in part to raise awareness of environmentally friendly organic practices. 19 participants attended the workshop who received a certificate of completion. A similar event will be hosted later in 2006. A timetable of the workshop and a participant list is provided in Appendix 15. Finally, two workshops were organised by the Ya'axche Conservation Trust. The first was held at the Fr Ring parish hall in Punta Gorda on the 21st January 2006 (to provide all interested people within Toledo with an accurate picture of the xaté industry) and the second was held on March 4th 2006 at YCT's Field Centre (to show local communities the Field station and to illustrate xaté cultivation activities). The first workshop was attended by 25 local farmers and NGO workers, and the second by over 60 men, women and children from northern Toledo. Further information on these workshops can be found in Appendix 9.

6) A high profile colour xaté sustainability poster was produced by the BBG targeting consumers of xaté and other unsustainably harvested products. 250 copies of the poster were produced which have been distributed across Belize. A copy of the poster is provided in Appendix 16, and a copy of the distribution list is provided in Appendix 17.

7) The educational component of the project year was extremely successful during 2005 – 2006. Kimo Jolly continued his secondary schools and university visits, exposing ca. 250 students to the ecological, economic and social issues surrounding xaté. In addition, Kimo facilitated 53 Belizean students to visit the rain forest of the Chiquibul Forest Reserve. For many, this was their first experience in the field (see Appendix 18). The BBG were extremely active in Cayo District this year, with many primary school visits to the BBG, where xaté educational featured as part of a broader educational programme. In addition, three ½ day teacher education workshops were organised by the BBG (February 14th 2006, March 7th 2006, March 14th 2006), and training of locals farmers in xaté cultivation continued in July 2005 (Appendix 8). In Toledo District, YCT organised farmer visits to their xaté cultivation demonstration plots (October 13th 2005), and the YCT education and outreach officer (part-funded by the Darwin xaté project) made 13 visits to schools throughout Toledo (Appendix 9).

8) On the scientific publication side, the molecular phylogeny of *Chamaedorea* paper appeared in the journal Molecular Phylogenetics and Evolution earlier this year (Vol 278: 398-415). This represents the project's first high profile peer-reviewed scientific output. A copy of the paper is provided in Appendix 19. In addition, a manuscript that makes an economic evaluation of *Chamaedorea* in Belize, and which serves in part as a review document for the industry, was submitted to the journal Economic Botany in October 2005 (Appendix 20), and was accepted for publication in March 2006. Two further papers are being prepared. The first will be a GIS-related xaté modelling paper, building on the work initiated by Malcolm Penn and the two Belizean GIS interns in the summer of 2005, and the second will be an assessment of Belize's *Chamaedorea* resource.

9) The progress of the molecular population study component of the project is outlined in depth in Appendix 21. There have been a number of frustrating difficulties related to the establishment of lab. protocols, and the extraction and sequencing of DNA from *Chamaedorea* from the substantial collections made by the project in March 2005. The problem appears to be due to degradation of the DNA, with extraction failing both at the NHM and at NMSU. All techniques are isolating sheared DNA that instead of resulting in consistent banding patterns on a gel, reveal large smears of 'unquantifable' DNA. AFLPs require very high quality DNA. Some preliminary results have been obtained on a small sample size confirming previous allozyme work that there is a low genetic diversity in xaté.

Meredith Thomas, who was working on this component of the project moved on from the NHM in September 2005 to start a PhD at Cambridge University, and this

component of the project is now being continued by Christine Bacon at the University of Mexico in collaboration with Steve Russell at the NHM. Christine will be presenting preliminary results from the AFLP study at the European Network of Palm Systematists (EUNOPS) in May 2006. Christine is now investigating whether microsattelite markers might be better to identify patterns of population diversity in xaté. Microsattelites can be amplified with any quality of DNA, even degraded isolations.

10) During the recording year, a number of seminars were given at various academic institutes/meetings, promoting awareness of the Darwin work, and posters were presented at two international conferences. In April 2005 Holly Porter Morgan (sustainable use of *C. ernesti-augustii*), Meredith Thomas (*Chamaedorea* phylogenetics) and Sam Bridgewater (Economic assessment of *Chamaedorea* in the Chiquibul Forest Reserve) presented posters at the International Symposium on Palms co-hosted by the Linnean Society and the Royal Botanical Gardens Kew. Drafts of the posters were provided to the Darwin Initiative on a CD in the last annual report. On June 7th Holly Porter Morgan presented a paper on Sustainable Use of the Palm *Chamaedorea ernesti-augustii*: Effects of Defoliation on Growth and Reproduction at the Society for Economic Botany Conference (Forth Worth, Texas). Richard Bateman (*Chamaedorea* phylogenetics) presented a poster at the International Botanical Congress in Vienna in July 2005. Sam Bridgewater gave three seminars in July 2005 on the conservation and management of *Chamaedorea* at the Royal Botanical Garden Edinburgh, the Natural History Museum and Kew Gardens. Nancy Garwood, Nick Wicks, Heather Duplooy and Sam Bridgewater gave talks on *Chamaedorea* cultivation, conservation and sustainable management at the 2nd Conference of the Caribbean Botanic Gardens for Conservation hosted by the Belize Botanic Garden in October 2005 (see photo on accompanying CD), and Sam Bridgewater gave a seminar at the 9th Annual Meeting of the Britain-Belize association, hosted by the Institute of Commonwealth Studies in September 2005.

11) Work has continued maintaining the established demonstration plots at the BBG (established during 2004/2005) which promote xaté cultivation in Belize. In addition, the BBG also supplied the Belize Agricultural Department with 7,000 seedlings, providing assistance to them to establish similar demonstration plots at their agricultural research and extension centre based at Central Farm (Cayo District). BBG continues to support farmers experimenting with xaté cultivation in the village of San Antonio. The BBG hosted two horticultural technicians from YCT in November 2005, and two Belizean student internships were supported by the project at the BBG (Appendix 8). In the south of the country, YCT established three trial xaté plots during the reporting period, totalling five acres. This includes plots attempting to cultivate

xaté under cacao, an important regional small farmers' crop. This is an additional project output.

12) Research investigating *Chamaedorea* growth rates, and the affects of leaf harvesting on population health continued during 2005-2006. Holly Porter Morgan (New York Botanical Garden) re-measured her defoliation plots in October 2005, and an update on the results from this work is provided in Appendix 22. In addition, Nick Wicks re-measured 25 of his 50 permanent sample plots in February 2006. As this work is not yet completed, a report is not submitted here. It is estimated that this work will take two weeks (three people) to complete.

- **Discuss any significant difficulties encountered during the year and steps taken to overcome them**.

Very few problems were encountered during the reporting year. Collaborative links have grown stronger, and the in-country partners have worked tirelessly on their parts of the project. There have been staff changes at the highest level in the Belize Forest Department which has meant that new foundations of trust have had to built, but the project continues to benefit from a good relationship with the new Chief Forest Officer who, like his predecessor, continues to strongly support the project.

As stated in the 2004-2005 report, the most significant difficulty is an economic one relating to the cost of transport. This was overcome by making minor changes to the travel budget. However, the majority of the fieldwork of the project has now been completed and it is not envisaged that transport will restrict too much what can be achieved in the final year of the project.

Problems related to the molecular component of the project have been highlighted elsewhere.

As in preceeding years, the project has naturally evolved to include more in-country partners and has necessarily had to adapt to the changing face of the Belizean xaté industry. For example, due in no small part to the data and reports provided by the Darwin Initiative over the last two years, harvesting of xaté has been shown not to be economically viable in the Chiquibul Forest Reserve. However, in 2005-2006, a general concession has been issued in public lands south of the Hummingbird Highway. This concession is attempting to legitimise an already illegal industry, by attempting to buy xaté from illegal harvesters at a slightly higher price than they would achieve in Guatemala, issuing permits to those who have been collecting illegally in the past, whilst still using the existing distribution and export network in Guatemala. It is still too early to know how successful this concession will be and whether it will be able to: 1) stop illegal xaté traffic out of Belize, and 2) improve

sustainability of practice, but the project has been working to provide baseline data in concession areas. It is hoped that the project can assist with initial monitoring of this concession.

The timetable for the final year has not changed as remains as stated in Appendix 2.

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

No direct changes to the project were requested by the reviewer. However, the review was discussed with the project partners. To answer some of the review queries from last year:

1) Although the project benefited from the amount of time Dr. Bridgewater spent in Belize in the first two years of the project (essential in building collaborative links), his time has decreased in 2005-2006 (three months in the field only). In part this is due to the increased importance in the project of writing up and publishing the scientific project outputs (e.g. Economic Botany paper) and the need to have access to extensive library facilities, and in part due to limited funding. However, the collaborative links have not suffered and indeed, have been further strengthened this year.

2) The reviewer made a good suggestion that xaté could perhaps be incorporated into plots with other crops to increase uptake and acceptance. Trials have been conducted with such plantation crops as citrus, but in this case were not found to be viable due to the acid nature of the shade crop. A much more likely shade crop is cacao, which provides an important cash crop for many farmers in Toledo District. These farmers grow organic cacao which they sell to Green & Blacks (the chocolate manufacturer), with each farmer cultivating a few hectares of this crop. Green and Blacks' 'Maya Gold' chocolate is a fair trade product. Through the project partner YCT in Toledo District, and the BBG in Cayo District, the Darwin initiative has supported the trails of under-planting cacao with xaté. However, some work is still needed to ascertain how farmers would communally pool their xaté leaf to provide the large shipment quantities demanded by buyers, and whether, indeed, it is economically worthwhile for the farmers to cultivate small acreages of xaté at all.

3) The reviewer enquired whether the project partners could take up broader agricultural extension roles. This has been done, with both the BBG and YCT conducting significant extension work with farmer networks (see Appendices 8 and 9). In addition the BBG collaborates with the extension arm of the Belize Agricultural Department, and assisted them in 2005/2006 to establish their demonstration plots.

4) There is always a danger that the Belize government may bow to pressure to harvest despite the apparent ecological and economic non-sustainability of harvesting in some areas. The current Darwin project is only able to provide data and advise the government, and for the most part this advice has been considered by government and has influenced policy. However, the xaté issue is a complicated one politically – especially as far as the Chiquibul Forest Reserve is concerned – and national security considerations related to having an increased Belizean presence in the Chiquibul Forest may over-ride sustainability concerns. An attempt to summarise the complexities of the industry has been made in the manuscript of the Ecoomic Botany paper.

5) Both the project partners YCT and BBG undertake tourism related activities, and it is hoped that the *Chamaedorea* guides (and soon to be produced Belizean palm photo guides) will ensure that an educational component focusing on xaté will be included on future nature walks organised around the country. In addition, photo guides (and posters) have been distributed to major centres of ecotourism such as the Belize Zoo (over 30,000 visitors each year) and Programme for Belize. These organisations can now download and produce (and sell) more copies of these guides if they prove popular.

6) There is no tradition of using *Chamaedorea* leaf in crafts and the leaf is unsuited to such activity. Most Belizean crafts relating to palms involve the making of baskets with *Desmoncus*, and the carving of palm stems into sculptures.

6. Partnerships

Collaboration continues to be a great strength of this project, with all project partners, although each individually responsible for their own parts of the project, working well together and ensuring everyone is kept informed as to project progress. Communication between the partners is excellent, and as the PI, it has been a great delight to work with our collaborators. In particular, it has been very rewarding to see YCT join the project as a full partner, and to see the project network spread across Belize. Excellent collaboration has been shown between the in-country partners with the production of the cultivation manual. In addition there have been a number of training and intern exchanges between them (see Appendices 8 & 9). Despite a reduced time component of NHM staff time in Belize during the reporting year (although this has still exceeded 80 days, which continues to be significant), strong links between the UK and Belize have been maintained through almost daily email exchanges, and the constant sending of draft documents/reports/guides/manuals etc. between partners for comments. The Belize Forestry Department continue to provide the main link with the Belizean government and policy formulation, and

again, there is constant dialogue within the project to ensure that the data and information best suits the ever-changing needs of governmental resource managers.

Two new collaborative links were formed during 2005 and 2006. The first involves Dr. Steven Brewer of the University of North Carolina. It was discovered during the recording year that Dr. Brewer was working independently on a user-friendly palm guide to Belize, and after discussion it was decided to work collaboratively together. In the first instance this involved testing a draft technical key to Belizean palms produced by Dr. Brewer, and in supplying him with over 300 palm photographs from the Darwin project. The project has also part-funded a visit of Dr. Brewer to Belize (covering the cost of vehicle hire for 10 days), to obtain some final palm photos, and to try and resolve some taxonomic complexities within the palm genus *Geonoma.* Dr. Brewer has provided feedback on the project's photoguides. A second very exciting recent link has been made between the project and the Wildlife Conservation Society (WCS) and the Rainforest Alliance in Guatemala, both of whom are conducting work independent but related to the Darwin project in the Petén region. This came about as the Guatemala Programme Director of WCS reviewed the project's Economic Botany paper submission. It is hoped that both countries can learn from each other's experiences through this expanded network of partners.

7. Impact and Sustainability

The project has been fortunate in that Belize is a small country, and that xaté has recently become a very topical public and political issue. The Darwin project is the main initiative providing reliable biological data and advice at a governmental level, and as such its profile is very high. It is for this reason that there was such a good turnout from government departments at the workshop held at Las Cuevas in October 2005. In addition, due to the breadth of the project, everybody in Belize who is associated with xaté, whether it be farmers interested in cultivating it, journalists, or conservation managers, is now in some way linked to the project. It is believed that in so far as any Darwin project is able to make a long-term and significant impact on biodiversity conservation in a tropical biodiverse country, this particular project has done so.

I believe a clear exit strategy for the project is already in place with all project partners able to continue the work when the project ends. Both the Belize Botanic Garden and YCT have been greatly strengthened by the injection of funds from the Darwin initiative, and in increasing their experience in agricultural extension,

education and research. It is believed that both these organisations will remain extremely important national organisations promoting wise management of biodiversity in the future. Likewise, the Forestry Department has benefited from the project by having to consider in depth how a NTFP might be managed, and how research can provide valuable data to ensure informed decisions are made. The project has highlighted some areas of concern and capacity weakness within the Forestry Department, and it is hoped that these can be addressed through Darwin 'post funding', if a successful application is made. A brief summary of the ideas for post funding are outlined below. These have evolved from in-depth discussion with all project partners.

Towards a post funding proposal

In the course of its life, the project has highlighted a number of areas of general concern relating to the future wise management of Non Timber Forest Products (NTFPs) in Belize. It is hoped to apply to the Darwin Initiative in the autumn of 2006 to: 1) strengthen the legislative basis protecting all NTFPs in Belize, 2) improve data management of NTFPs by the Forest Department, 3) provide initial monitoring support to the Forestry Department whilst the fledgling xaté industry is established in the south of the country, 4) promote education of NTFPs throughout Belize.

The proposed primary outputs are still being finalised, but at this stage it is hoped that they will include:

- Review of existing Forestry Legislation to highlight weaknesses related to NTFP management, the outcome being suggestions for draft Statutory Instruments to address those weaknesses. At present, the legal framework under which NTFPs are governed is the Forestry Act (1921). This Act focuses primarily on timber and provides no criteria or guidance on the sustainable management of NTFPs. (**FD**).
- Establishment of a relational database (NTFP Monitoring System) using to assist in the future granting and monitoring of NTFP concessions and licenses. At present, all FD records relating to NTFPs are stored on paper only, with limited communication on concessions and petty licenses between different FD administrative centres. This component would include the databasing of all paper records relating to NTFPs. (**FD**, **NHM**).
- Review of the conservation status and the economic and social value of NTFPs in Belize. (**FD**, **NHM**).

- Providing monitoring support to the Belize Forest Department through xaté 'sorting house' surveys, and field site checks, with the data incorporated into the newly established NTFP Monitoring System.
- Cultivation trials of threatened and/or valuable NTFPs. (**BBG**).
- Public and schools education programme on NTFPs. (**BBG**).
- Production of an education publication on NTFPs (**NHM**, **FD**, **BBG**).

8. Outputs, Outcomes and Dissemination

There are no significant differences between actual outputs and those agreed in the initial 'Project implementation Timetable' and the 'Project outputs Schedule'. Dissemination activities have already been highlighted above with supporting documentation provided in the Appendices.

- Please expand and complete Table 1. **Quantify** project outputs over the last year using the coding and format from the Darwin Initiative Standard Output Measures (see website for details) and give a brief description. Please list and report on appropriate Code Nos. only. The level of detail required is specified in the Guidance notes on Output Definitions, which accompanies the List of Standard Output Measures. Only the summarised totals after the end of your project will be recorded on the Darwin project database from your final report (the totals below will help you to keep track on a yearly basis).

Table 1. Project Outputs (According to Standard Output Measures)

Code No.	Description	Year 1 Total	Year 2 Total	Year 3 Total	Year 4 Total	TOTAL
4A	Belizean school/ undergraduates to receive xaté and ecological survey field training			53		
4B				14		
6A	Horticultural training (Belizeans)			97		
6B				20		
7	Xaté cultivation manual; resource inventory manual			2		
8	S. Bridgewater & N. Garwood			11		
10	*Chamaedorea* photoguide			1		
11A	*Chamaedorea* phylogenetics paper			1		
11B	Economic assessment of *Chamaedorea* in			1		

	Belize		
14A	Project organised workshops		5
14B	International/Belizean conferences attended & seminars/posters presented.		9
15A	Belizean press releases mentioning the project; copies of these have not been included in the Appendix here, as copies are only in Belize at present. This is the PI's omission. However, they will submitted with the final report.		2
17B	The existing Darwin dissemination network ahs been strengthened and broadened.		1
18A	Channel 5 Belize news item		1

- In Table 2, provide full details of all publications and material produced over the last year that can be publicly accessed, e.g. title, name of publisher, contact details, cost. Details will be recorded on the Darwin Monitoring Website Publications Database. Mark (*) all publications and other material that you have included with this report.

Table 2: Publications

Type * (e.g. journals, manual, CDs)	Detail (title, author, year)	Publishers (name, city)	Available from (e.g. contact address, website)	Cost £
Journal	Thomas, M. M., Garwood, N. C., Baker, W. J., Henderson, S. A. Russell, S. J., Hodel, D. R., Bateman, R. M. 2006. Molecular phylogeny of the palm genus *Chamaedorea*, based on the low-copy nuclear genes PRK and RPB2. *Molecular Phylogenetics and Evolution* 38: 398-415.		www.sciencedirect.com	free
Cultivation manual	Belize Botanic Garden and the Ya'axche Conservation Trust. 2006. *Xate in Belize: a grower's guide. Version 1.*		http://www.belizebotanic.org/xate_manual.pdf	free
Xate resource inventory	Bridgewater, S., Garwood, N, Porter Morgan, H. & Wicks, N. 2006. *Resource*		Sam Bridgewater	free

manual	*inventory manual for* Chamaedorea*.*		
Palm photoguide	Garwood, N. & Bridgewater, S. 2005. *Chamaedorea* photoguide	Although not yet online, it will shortly be available at: http://fm2.fieldmuseum.org/plantguides/rcg_intro.asp Until this time it can be obtained from: s.bridgewater@nhm.ac.uk	free
Report	Bridgewater, S., & Garwood, N. 2005. *The conservation, management and economic potential of* Chamaedorea *in Belize: Workshop summary.* Darwin Initiative Report.	Sam Bridgewater	free
Report	Bridgewater, S., Pickles, P., Garwood, N. Penn, M. Bateman, R & Bol, N. 2005. Chamaedorea *(xaté) in the Greater Maya Mountains and the Chiquibul Forest Reserve, Belize: a preliminary economic assessment of a non-timber forest product.* Darwin Initiative Report.	Sam Bridgewater	free
Report	Thomas, M. & Bacon, C. 2006. *Xaté palms (*Chamaedorea *spp.) in Belize: conservation and sustainable management: update on molecular studies*. Darwin Initiative Report	Sam Bridgewater	free
Report	Duplooy, H. 2006. *Third Year Darwin Initiative Report of the Belize Botanic Gardens*. Darwin Initiative Report.	Sam Bridgewater	free
Report	Wicks, N. 2006. YCT Darwin initiative Report.	Sam Bridgewater	free

9. Project Expenditure

- Please expand and complete Table 3.

Table 3: Project expenditure <u>during the reporting period</u> (Defra Financial Year 01 April to 31 March)

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

10. Monitoring, Evaluation and Lessons

As for 2004/2005, monitoring and evaluating the project this year has been relatively straightforward. UK personnel spent 11 weeks in the field during the reporting period, and the strong links established during 2004/2005, when Dr. Bridgewater was stationed in Belize for nine months, have ensured that a close working relationship was developed. Monitoring was done primarily through the PI keeping a close watch on the output schedule, and reminding partners in good time if the work programme was slipping. However, the in-country partners are very effective, and so this was not a problem. Informal constant monitoring was achieved through the near constant flow of papers, manuals, photoguides and reports circulated between all project partners, for comment prior to publication, by email. Great take was taken to ensure that all partners were included in dialogue pertaining to the project. The Belize Botanic Garden's activities were monitored by Heather Duplooy, and YCT's activities by Nick Wicks. Project finances were monitored through the NHM's usual accounting mechanism.

The project purpose is to '*develop the capacity in Belize for conserving and sustainably managing the xaté palms (Chamaedorea spp.) of Belize and for improving the economic benefits to Belizeans from xaté collection*. As for 2004/2005, indicators provide a clear indication that the project purpose is being met. These

include: 1) the strengthening and widening of new local and international partnerships, and the ease with which new collaborative links have been established 2) the readiness with which local communities and students have participated and contributed to project workshops, 3) the adoption of pilot cultivation projects by local communities, 4) the continued dialogue of UK and in-country partners with Belizean governmental departments, and the desire of project partners to apply for post funding 5) the influence that project science has had on informing management decisions 6) the increased public access to information on xaté.

In terms of 'lessons learned', there is little more to say here than was stated in 2005/2006 i.e. that multi-disciplinary projects need to be exceedingly flexible if they are to obtain their objectives. The political, economic and social landscapes in which Darwin projects operate are constantly evolving, and to be successful projects need to constantly observe what is happening around them, and adapt accordingly. Projects must be able to respond to other new related initiatives which might arise, be willing to forge new partnerships as necessary, and evolve stated outputs if it is perceived that changing these will best enable the project to achieve its aims.

11. OPTIONAL: Outstanding achievements of your project during the reporting period (300-400 words maximum)

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

Although it is not possible to pinpoint any one particular output from the Darwin initiative Belizean xaté project during 2005/2006 as an 'exceptional achievement', such has been the general and combined achievements of the project across its broad reach, that I feel it is appropriate to highlight what I believe is a highly successful model for how the Darwin Initiative can use UK scientific expertise to make a long-lasting impact on biodiversity conservation. In particular I would like to mention the achievements of our in-country partners.

Wise management of wild *Chamaedorea* for its valuable leaf in Central America has been hindered by the lack of information on its abundance, ecology and growth rates. In addition, despite a recent surge in regional interest in the establishment of *Chamaedorea* plantations as a sustainable alternative to wild harvesting, there has been a lack of information for farmers on how to cultivate this economically significant species.

Project research, guided by the Natural History Museum and the New York Botanical Garden, has provided data from which we now have an understanding of how fast xaté grows, and the long-term affects of leaf harvesting on wild population health.

This information is essential for the establishment and subsequent monitoring of a sustainable industry. In addition, with over 300 sites samples across Belize providing abundance data on this genus, the Belizean government is now able to make informed decisions about the granting of xaté concessions, and has baseline data enabling it to assess and monitor such concessions. Economic assessments of the xaté resource have also provided potential concessionaires with data to aid their decisions on where, and where not to harvest, and have highlighted environmentally sensitive areas to the Belize Forest Department. This information has already influenced decisions regarding the management of the Chiquibul Forest Reserve, Belize's largest forest area. Photoguides to *Chamaedorea* produced by the project enable resource managers and potential concessionaires to identify the many xaté species, and also act as a useful resource for education centres promoting conservation and sustainable management.

The Belize Forestry Department has guided the work to ensure it is relevant to the needs of the country, and has provided the route whereby advice on xaté management generated by the project can be formally adopted into governmental policy. This has been the case, for example, for leaf harvesting guidelines, which now state that concessionaires can only remove one leaf from each plant per year. The other two primary in-country partners – the Belize Botanic Garden and the Ya'axche Conservation Trust – have provided two strong and geographically separated regional nodes acting as local centres of xaté education. Both organisations have established demonstration plots for farmers who can learn techniques of xaté cultivation, and their agricultural extension mechanisms extend far into the two Districts where they are based. Many local farmers are now cultivating xaté on a trial basis as a result. The cultivation manual produced by these organisations provides these farmers with the essential information they need to start growing xaté.

Both the Belize Botanic Garden and the Ya'axche Conservation Trust were already very effective conservation and education organisations prior to Darwin Initiative support. However, assistance from the project has enabled them to expand their horizons, extend their networks, and strengthen their capacity to be regional leaders in conservation and sustainable resource management. The numerous workshops funded by the project, and hosted by these organisations, have been very well attended and their regional and international profiles have been significantly enhanced. The project has involved a two-way learning process, with the Natural History Museum benefiting from the practical experience of our partners, and during the course of the project we have learned much about how to make our science relevant to society and to conservation. In addition, as an employee of a major and relatively well-funded UK institute, it has been humbling to see how effective poorly-resourced overseas organisations can be with small additional injections of funds and

support, and how innovative and cost-efficient approaches can provide the solution to funding problems which might well hinder other bigger foreign organisations.

The educational component of the project has been of paramount importance, and Darwin funding has enabled school and undergraduate students from across Belize to visit the rain forest for the first time. Although Belize is famous for its biodiverse ecosystems, ironically few Belizean's have the opportunity to experience them, and Darwin funding has facilitated access of young ecologists/conservationists to their own forest reserves. It is hoped that this will help inspire a new generation of home-grown talent to develop careers in science and biodiversity conservation.

Although the primary aims of the project have been to provide relevant local outputs that facilitate the conservation and management of *Chamaedorea*, research findings from the project have been brought to a broader international scientific audience through the production of peer-reviewed papers, with one published in 2006/2007, and another submitted during this period. Further papers will be published in the final year of the project.

There are many challenges that face projects attempting to provide long-lasting solutions to some of the world's pressing environmental and social problems, and it is certainly the experience of this project that such solutions can only result from strong partnerships between scientists, community-based organisations, businesses and government. Attempting to manage Belize's *Chamaedorea* resource sustainably is economically, ecologically and politically problematic, and there is still much to be done before the long-term goals of the project are achieved. However, as the project PI, I believe that Darwin funding has provided the necessary momentum, focus, training and support that will enable the work to continue once the project is complete. Essential to its success has been the adoption of a pro-active and a flexible approach, and we would like to thank the Darwin Initiative for supporting the small changes requested by the project managers throughout its lifespan. Although none of the outputs have changed, the ever-changing social, economic and political needs of Belize have meant that the means by which these objectives are achieved has necessarily had to evolve. The Darwin Initiative xaté project has one final year to run, but is on target to achieve its aims and leave a strong legacy that will benefit Belize long into the future. One mark of its success is that every year, the project's network of participating organisations has expanded, and that communication between the project partners now continues independently of the project, and is resulting in heightened ambitions, new initiatives being discussed, and the leverage of new sources of funding.

Annex 1 Report of progress and achievements against Logical Framework for Financial Year: 2005/2006

Project summary	Measurable Indicators	Progress and Achievements April 2005-Mar 2006	Actions required/planned for next period
Goal*:* To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but poor in resources to achieve • The conservation of biological diversity, • The sustainable use of its components, and • The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources			
Purpose *To develop capacity in Belize for conserving and sustainably managing xaté palms (*Chamaedorea *spp.) and improving economic benefits to Belizeans from xaté collection*	*Belize capacity developed and used to ensure xaté populations and harvests do not decline and economic benefits from xaté increase*	*Belizean Forest Department and local NGO's trained in xaté assessment; baseline data on Belize's xaté resource compiled and disseminated; recommendations on harvesting practice adopted into forest policy; Belizean industry established (2006) following principles of Darwin project; identification guide to xaté produced and disseminated.*	*Initiate monitoring programme for newly established Belizean industry; develop closer relationship with concessionaire; monitor enthusiasm of farmers to continue cultivation trials.* *Unfortunately illegal harvesting in the CFR from Guatemala continues. Other than continuing to provide reliable data and taking an increased advocacy role, the Darwin project is not able to prevent this as the solutions relate to broader political and security aims. However attempts will be made in 2006/2007 to widen the project network to include Guatemalan counterparts, and to facilitate dialogue between both countries by providing appropriate communication forums.*
Outputs			
1) Management plan for sustainable xaté harvest	*1) Plan completed and given to BFD*	*The delivery of the plan is scheduled for 2007. However, three reports pertaining to the Chiquibul Forest*	*To integrate GIS data to produce management plan for the CFR; liase further with Forest Department to*

		Reserve have already been submitted. A concession was granted by the Forest Department in the CFR, but was subsequently not taken up by the concessionaire on economic grounds, based in part on Darwin data.	*ensure document provides the information it needs.*
2) Field Guide to Belizean Palms published	*2) Guide tested in field; peer-reviewed; 500 copies distributed*	*Draft palm guide almost complete and ready for field testing; interim photoguide to Chamaedorea complete and 100 copies disseminated; draft photoguide to Belize' s common palms produced ready to be field tested.*	*Ensure widespread testing of main field guide by intended users and academics & that resultant product is a high-quality publication which is widely adopted and used.*
3) Xaté information base increased (permanent, experimental & demonstration plots; databases)	*3) Forest plots surveyed, effects of defoliation quantified, harvestable yields calculated; cultivation demonstration plots established & compared*	*Over 340 plots surveyed; 60 permanent sample plots established and monitored over a two-year period; effects of harvesting on plant health described and disseminated as reports; harvestable yields calculated and disseminated as reports and submitted as a scientific publication; demonstration plots established in 2004 (BBG) and 2005 (YCT)*	*Ensure one final survey is conducted on all permanent sample plots. Ensure demonstration plots are maintained and extension work to farmers who are conducting cultivation trials continues.*
4) Publications/reports/ manuals: Xaté abundance, diversity, distribution in Belize determined; Feasibility of xaté eco-labelling explored; Nursery protocols developed	*4) GIS analysis completed; maps produced; regional yields calculated; buyers, end-users & local suppliers interviewed; genetic analysis completed; nursery techniques described*	*Provisional GIS analyses have been completed (see accompanying CD); reports making an economic assessment of the xaté resource of the Chiquibul Forest Reserve have been completed and disseminated; buyers, end-users and local suppliers were interviewed in 2004, and the results published in a report and submitted as an academic paper; genetic analyses still underway; nursery techniques have been perfected, described and disseminated through a cultivation*	

		manual.	
5) Training & education: BFB, BBG, students & local people trained; group educated about xaté	*5) 30 individuals trained (horti-culture, resource assessment, monitoring or GIS); group visits to BBG increase*	*Over 90 individuals trained in xaté cultivation in 2005/2006 alone; 53 school and university students trained in field ecology and given access to forest field trips.*	*Monitor adoption of xaté cultivation practices.*

Note: Please do NOT expand rows to include activities since their completion and outcomes should be reported under the column on progress and achievements at output and purpose levels.