Darwin Initiative for the Survival of Species

Final Report

1. Darwin Project Information

Project Reference No. 162/12/012 **Project title** Xaté palms (*Chamaedorea* spp.) in Belize: conservation and sustainable management
Country 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, Royal Botanic Gardens Kew **Darwin Grant Value** £173,723 **Start/End date** May 2003–April 2007 **Project website** http://www.nhm.ac.uk/research-curation/projects/xate/ **Author(s), date** Dr. S. Bridgewater, Dr. N. Garwood, Prof. R. Bateman, Dr. M. Penn, Dr. S. Russell, S. April 3rd 2007.

2. Project Background/Rationale

Chamaedorea (xaté) is the largest palm group in the Neotropics (80–100 species), 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 impacted adversely on many wild populations of xaté in Guatemala and Mexico. With yields plummeting elsewhere, in the late 1990s xaté collectors (xateros) began to illegally cross into Belize from Guatemala to exploit a previously pristine resource. These transgressions have repeatedly provoked diplomatic tension between the two countries, and threaten what was the last wild regional stronghold of the xaté species popularly known as fishtail (*C. ernesti-augustii*). Although several *Chamaedorea* species are traded in Mexico and Guatemala, to date in Belize only fishtail has been targeted by harvesters. Although the presence of wild xaté in Belize presents a potential economic opportunity for Belizeans, no data have previously been available to describe the extent and abundance of this resource. This knowledge gap has hindered the establishment of a regulated Belizean industry. In addition, harvesting of wild xaté leaf in Mexico and Guatemala has not proven sustainable; wild populations in these countries have declined. However, there is a paucity of ecological information on xaté distribution patterns, xaté ecology and the impacts of long-term harvesting on xaté populations making it impossible to set sustainable quota levels in Belize.

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 was a collaborative venture between the Belize Forest Department (BFD), the Natural History Museum, London (NHM) and the Belize Botanic Garden (BBG). The aim of the initiative was to assess the native xaté palm resource and to develop Belize's capacity to manage it wisely. The initiative resulted from a request to the NHM from the BFD to assist them in this endeavour.

3. Project Summary

The broad project purpose was 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 lacked the funding and expertise to develop an urgently needed management plan to harvest sustainably xaté palms for the floral trade and to develop supplementary methods to reduce over-exploitation. The project used 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. Specifically we investigated (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 aimed to produce practical outputs that would provide a lasting legacy to enable sustainable management of this important resource and contribute to the management of Belizean forests. In particular, the project sought to (1) better understand the taxonomy and ecology of the xaté species that 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 and 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 genetic markers to underpin a verifiable certification scheme; (8) investigate the potential to cultivate xate in different silvi-agricultural systems; (9) improve public and farmer awareness of xaté; (10) produce a user-friendly palm guide for use in resource assessment.

A detailed logical framework for the project is provided in Appendix V, with the measurable outputs listed in Appendix VI and the implementation table outlined in Appendix VII. The operational plan was slightly modified in the first year, certain activities being brought forward and others delayed. In particular, these related to the maternity leave of Sally Henderson, the NHM scientist tasked with conducting the majority

of the molecular work, and Chris Minty, who retired as Station Manager of the Las Cuevas Research Station in the autumn of 2003. In addition, in a pragmatic decision prompted primarily by the rapidly escalating rate of border incursions, the NHM withdrew from the management of the Las Cuevas in November 2004. Soon after, project PI Richard Bateman was replaced by Sam Bridgewater. These changes caused a brief hiatus in many project activities during the initial year. All such changes were communicated to the Darwin Secretariat and subsequently approved. The new PI spent over nine months in Belize in 2004, focusing on the work programme, and the project quickly regained its momentum. Since that time it has gone from strength to strength, delivering its expected outputs on time. In addition, substantial unscheduled outputs were produced to meet the needs of the nascent Belizean xaté industry and to ensure that the project remained both sociologically and scientifically relevant. The only minor change to the operational plan since 2004 related to Ivis Chan and Percival Cho, two employees of the Belize Forestry Department. They were initially scheduled to visit the NHM for three weeks' training in GIS techniques in August 2004, but in practice they undertook the training nine months later in May 2005.

The project contribution to Articles under the Convention on Biological Diversity (CBD) are roughly calculated as: General Measures for Conservation & Sustainable Use (20%); Identification and Monitoring (20%); Sustainable Use of Components of Biological Diversity (20%); Research and Training (20%); Public Education and Awareness (20%). These values have been added to Appendix 1.

We believe that the project has been very successful in achieving its aims because:

(1) There is now a far better understanding of the abundance and distribution of Belize's *Chamaedorea* resource (see various reports and peer-reviewed scientific papers listed under Outputs), together with an improved understanding of *Chamaedorea* ecology and the effects of harvesting on wild xaté populations (see Outputs). In addition, molecular work has helped to revise and refine species delimitations within this complex genus (see scientific papers listed below). All reports are already in the public domain; they are available online via Belize's national Clearing House Mechanism (http://www.chm.org.bz/) and the Biodiversity and Environmental Data Resource System of Belize (BERDS) (http://www.biodiversity.bz/).

(2) Project science outputs have helped the Forest Department to draft practical, ecologically-informed guidelines and requirements governing legal xaté concessions (enclosed [1]). For example, Section 8 of the Forest License stipulates that '*the licensee shall only: (i) harvest adult palms; (ii) harvest one (1) leaf per individual palm; (iii) enter the harvesting area once per year in order to minimize disturbances to the xate and surrounding vegetation, and animals in the area; (iv) remove market quality leaves from plants; (v) pay by quality of leaves rather than by quantity*

of leaves.' We are confident that these guidelines provide an excellent legislative basis for a sustainable national industry.

(3) The first legal Belizean xaté concessions were granted in 2006, the first successful exports direct from the country occurring in 2007. This progress was facilitated by continuous advice provided by project personnel over the project lifespan to the Belize Forest Department and the governmental 'Belize Xaté Technical Committee'.

(4) The Darwin Initiative has helped farming cooperatives in Belize to initiate xaté trials under a natural secondary forest canopy or under organic cacao. In Toledo, in the south of Belize, approximately 50,000 xaté seedlings are now growing in three trial cultivation plots under forest canopy in the Golden Stream Corridor Preserve (2 acres), Indian Creek community lands (1 acre) and under mature cacao (1 acre) near San Jose. In Cayo District, central-western Belize, 20 farmers from the communities of San Antonio and Cristo Rey have planted out a further 40,000 seedlings of *C. elegans* and *C. ernesti-augustii* (10 acres). The training work related to these horticultural initiatives has been facilitated by the Belize Botanic Garden, the demonstration xaté nursery and plantation plots at the BBG acting as a focal point for regional education. In addition, two of the project partners (BBG and YCT) have produced and disseminated a cultivation manual for the production of organic xaté. This is available online at: www.belizebotanic.org/xate_manual.pdf

(5) Due to the continuation of illegal harvesting in Belize, it was not deemed appropriate to produce a theoretical, but impractical, xaté management plan for the Chiquibul Forest Reserve. We cannot ignore the changed realities and needs of the current xaté industry during the life of the project. In its place, an alternative document outlining recommendations for the sustainable management the *Chamaedorea* resources of the Chiquibul Forest Reserve has been produced and submitted to the BFD. A hardcopy of this document is submitted with this Final Report [2] and is also available online from the BERDS website (see above).

(6) User-friendly photographic field guides to *Chamaedorea* and Belize's palms have been produced and disseminated widely in country; they are already being widely used in biodiversity research by rangers, scientists and students. Another Darwin Initiative project based in Belize is hoping to replicate the successful format for other important plant groups (e.g. Melastomataceae). Both photoguides are submitted with this report ([3] & [4]) and are also available online at: http://fm2.fieldmuseum.org/plantguides/rcg_intro.asp In addition, a book on Belizean palms is being prepared, with publication expected in 2008.

(7) Darwin Initiative funding has improved the BBG's capacity for botanical education and conservation extension. A report on activities during 2006–2007is enclosed with this submission [5]. For copes of recent palm-related BBG events see [21].

Regarding the assessment of the genetic status of xaté in Belize, as outlined in the Annual Report of 2005–2006, we have encountered a series of frustrating difficulties related to the establishment of laboratory protocols, and the extraction and sequencing of DNA from *Chamaedorea* from the substantial, carefully orchestrated collections made by the project in March 2005. However, significant progress on this component has been made by attracting new project collaborators, including Christine Bacon (University of Mexico) and Angelica Cibrtian Jaramello (American Museum of Natural History). Work has focused on developing AFLP and microsatellite markers, and a further scientific paper is being drafted (see [6]).

In addition to the original stated project outputs, numerous other initiative 'spin-offs' relating to the Darwin work have been established. For example, scientific personnel from the project are now part of the Sustainable Palm Initiative that produced their first Working Paper in 2007. This output has provided advice on xaté certification to the Forest Stewardship Council [7]. In addition, a regional paper on the *Chamaedorea* industry is being prepared by an international network of *Chamaedorea* experts [8], the Belize component being contributed by Darwin personnel. Also, the Darwin project has fed its scientific outputs to Smartwood, who are the primary accredited certification organisation in Central America, and who are responsible for drafting regional NTFP and xaté guidelines. One of the most important aspects of the work has been building new research and education partnerships, both within Belize and internationally; Darwin funding has enabled strong working relationships to be developed. This progress culminated with the submission of a Darwin Post-Funding project [9, 10], although this was not subsequently funded by the Darwin Initiative. Darwin funds have also helped us to lever funding from other agencies worth almost US$1M (see Section 12).

4. Scientific, Training, and Technical Assessment

Primary project scientific staff (addresses current)

Dr. Samuel Bridgewater, Natural History Museum, London (NHM)
Dr. Malcolm Penn, NHM
Dr. Steve Russell, NHM
Dr. Nancy Garwood, University of S. Illinois, Dept. of Plant Biology and Centre for Ecology Carbondale
Professor Richard Bateman, Jodrell laboratory, Royal Botanic Gardens Kew
Holly Porter Morgan, New York Botanical Garden
Meredith Murphy Thomas, University of Cambridge
Christine Baker, University of New Mexico
Nick Wicks, Ya'axaché Conservation Trust, Belize
Angelica Cibrian Jaramello, American Museum of Natural History
Philippa Pickles, BMT Cordah Ltd, Pentlands Science Park, Edinburgh

Methodologies of primary scientific studies

A. Regional and national xaté assessments

Surveys within the Chiquibul Forest Reserve (CFR) – the primary focus of the study – and other forest reserves within Belize were conducted during 2003 and 2004. Within the Chiquibul, 209 plots, each 20 x 20 m, were established, with a further 252 plots completed within other forest reserve (see previously submitted reports). Given the great size of the study areas, a systematic sampling method was chosen, although a degree of pragmatism was necessary due to the inaccessibility of many areas. Wherever possible, plots were placed at 1.5 km intervals, thereby sampling a wide variety of topographical locations. Dependent on the toss of a coin, at each site the sample plot was established 100 m either left or right of the GPS location from the direction of the transect walked to reach the site. UTM GPS coordinates (WGS Zone 17) were recorded for each site. Within each plot, all *Chamaedorea* palms greater than 20 cm in height were identified to species level and the following data were recorded for each plant: number of leaves; number of cut leaves (easily ascertained as cut petioles); and number of high quality (unblemished), commercially valuable leaves. Site details were also recorded. For further information can be found in the peer-reviewed paper enclosed with this report [11]:

Bridgewater, S., Pickles, D., Garwood, N. C., Penn, M., Bateman, R.M., Porter Morgan, H., Wicks, N. & Bol, N. 2006. *Chamaedorea* (xaté) in the Greater Maya Mountains and the Chiquibul Forest Reserve, Belize: an economic assessment of a non-timber forest product. *Economic Botany* 60(3): 265–283.

B. Economic assessment

A literature review on the economics of xaté was conducted to obtain a historical and regional perspective on the xaté industry. Information on local supply chains and economics was gathered via semi-structured interviews undertaken with those involved in the xaté trade in Belize and Guatemala. This survey included Guatemalan xateros (interviewed both in Belize, where they were operating illegally, and in Guatemala where they were operating legally), xaté buyers in the Petén, and several NGOs attempting to establish commercial xaté plantations in Guatemala, notably Alianza para un Mundo Justo (AMJ) and the Asociación Coordinadora Indígena y Campesina de Agroforestería Comunitaria Centroamericana (ACICAFOC). For those informants who did not wish to be identified (mostly illegal xateros), confidentiality and anonymity were assured. For further information see:

Pickles, P. 2004. *Eco-labelling xaté: the potential of certification to aid the development of a sustainable Belizean palm industry*. MSc thesis, Edinburgh University.

Bridgewater, S., Pickles, D., Garwood, N. C., Penn, M., Bateman, R.M., Porter Morgan, H., Wicks, N. & Bol, N. 2006. *Chamaedorea* (xaté) in the Greater Maya Mountains and the Chiquibul Forest Reserve, Belize: an economic assessment of a non-timber forest product. *Economic Botany* 60(3): 265–283.

The paper is submitted with this report [11, see above]. The Masters thesis and resultant report have already been submitted to the Darwin Initiative.

C. Understanding *Chamaedorea* growth rates

Initial sampling was performed annually between 2003 and 2005, at two sites close to the Las Cuevas Research Station (LCRS, 16Q 028 N, UTM 185 E) in the Chiquibul Forest Reserve. In each site, two sampling areas of 25 ha were placed within long term Forest Planning and Management Project logging plots located in two different forest types. Within each hectare of the sampling areas a 20 x 20 m plot was randomly placed. GPS co-ordinates were noted for each plot. All individuals of *Chamaedorea* spp. between 10 and 300 cm were measured for stem length, number of leaves, length of top leaf and the number of leaves that were 'harvestable'. For the purposes of this study a 'harvestable' leaf was defined as one that was completely free from epiphyll and visible damage. Leaf turnover rate was determined by marking the newest leaf on each plant, and recording how many leaves were subsequently produced in the year. However, in some cases after the study was established, harvesting by xatéros occurred, removing these leaves with their corresponding mark. For this reason, data could not be collected for all plants. For further information on methodology see please consult the report below which has already been submitted to the Darwin Initiative.

Wicks, N. 2004. *Preliminary Fishtail Xaté (*Chamaedorea ernesti-augustii*) growth survey data in the Chiquibul National Forest Reserve, Belize.* Darwin Initiative Report.

4. Understanding the effects of leaf harvesting on *Chamaedorea* populations

Five 20 x 20 m plots were established in four different locations in the vicinity of LCRS in June 2003. Locations one and two were situated in the deciduous seasonal forest type, whereas locations three and four were in semi-evergreen forest. In each plot, all individuals of *Chamaedorea ernesti-augustii* and *C. oblongata* were tagged. These two species are the most valuable *Chamaedorea* in the Chiquibul Forest and were therefore the focus of the defoliation experiments. All harvestable individuals in each plot were tagged for use in the study. For the purposes of this study, harvestable palms were those that had one of more leaves that met the size requirements described by managers at the xate collection facilities in the Petén, Guatemala (pers. comm., 2006), the closest collection center to the study area. The following information was recorded for each study individual: stem height, number of leaves, number of leaf buds, and number and phenological state of inflorescences or resulting infructescences. In addition, for each tagged palm, both the top node and all leaves were marked with a permanent marker. Harvestable palms were assigned to one of two life stages: Juvenile or Adult. Juveniles were defined as palms with

either no stem or plants that have a stem but are under 20 cm in total height (stem plus leaves). Adults were defined as palms that are greater than 20 cm in height, have an established stem; they can be immature or reproductive. In terms of treatments, a total of six different treatment classes were used. The classes were chosen in order to mimic the harvest of leaves, informed by conversations with, and observations of, xateros (pers. obs.). Within every plot, the treatment class for each study individual was chosen randomly. Adults and juveniles were placed in separate pools when assigning treatments. Treatments were established to reflect two factors: (1) number of leaves removed; (2) harvest intensity (number of defoliations performed per year). These factors were considered to be primary issues in sustainability of this resource after observations of harvested areas, discussions with *xateros*, and a review of the available literature (e.g. Reining et al., 1992). Treatment classes were identified as follows: (1) 0 leaves removed (control), (2) 1 leaf removed, once a year, (3) 1 leaf removed, every 6 months, (4) 2 leaves removed, once a year, (5) 2 leaves removed, every 6 months, (6) 4 leaves removed, once a year.

If an individual had less leaves than the number assigned to be cut, the maximum number of leaves were cut during any particular harvest session. Defoliation of study plants will continue where applicable for treatment class approximately every 6 months for several years. For further details see a report already submitted to the Darwin Initiative.:

Porter Morgan, H. 2005. *Towards the Sustainable Use of Xate Palms in Belize (*Chamaedorea *spp.): The Effects of Defoliation on Leaf Growth and Reproduction*. Darwin Initiative Report

5. Genetic assessment

DNA was isolated from 241 *Chamaedorea ernestii-augusti* individuals collected in Belize by project personnel in 2004, with additional replicates and extractions from other species. After repeated difficulties encountered in attempting AFLP analyses at the NHM, the DNA samples were sent to Christine Bacon (University of New Mexico) and Angelica Cibrian (American Museum of Natural History, New York) where they were amplified using PCR, with a total of 155 samples genotyped from 11 main collections sites in Belize, for nine nuclear microsatellites. More loci are currently being amplified for 11 loci from 95 samples from additional sites. A peer-reviewed scientific paper of this work is being prepared. A rough, confidential draft is submitted with this report [6, see above]. Initial evaluation of the dataset shows that the loci employed are variable and informative for population-level analysis in this species. They also offer an excellent comparative case study with other datasets obtained from Mexican populations of *C. ernesti-augustii*. Specific analyses are still being conducted to measure genetic variation and population structure using traditional population genetics software such as Genalex and Genetix, as well as novel analytical methods such as Bayesian measures of genetic structure implemented in the STRUCTURE program. The primary aim of these analyses is to understand the

spatial distribution of allele frequencies and their relationship to the geography and history of each site, as well as to the biology of the species. It is also of our interest to add information concerning xaté harvest in Belize, which will yield a basic guideline for the conservation of its genetic resources and allow prediction of the extent of negative effects likely to result from the present over-harvesting.

6. Xaté modelling

A geostatistics method (Kriging), based on the semi-variogram approach, has been used to model the relationship between data counts and inter-sample distance (lag). The semi-variogram defines the degree of similarity between data points and models it statistically, such that greater spatial distance between points leads to a greater degree of dissimilarity in values, and at a certain distance the influence that data points have on each other becomes negligible, (range). Therefore, data points should not influence the modelled surface at that location. Kriging represents the Best Linear Unbiased Estimate of the data variable at any given point using interpolation weights to optimise the interpolation. A peer-reviewed paper on this work is currently being drafted for submission in 2007 by Malcolm Penn of the NHM. Initial modelling maps based on this work are included in the following document [2]:

Bridgewater, S., Garwood, N., Bateman, R., Penn, M., Porter Morgan, H., Wicks, N., & Pickles, P. 2007. *Recommendations for the sustainable management the* Chamaedorea *(xaté) resources of the Chiquibul Forest Reserve*. Darwin Initiative Report.

The majority of the scientific results outlined above already been submitted to the Darwin Initiative in previous years. Enclosed additional research outputs for the reporting year 2006–2007 include:

1. Bridgewater, S., Pickles, D., Garwood, N. C., Penn, M., Bateman, R.M., Porter Morgan, H., Wicks, N. & Bol, N. 2006. *Chamaedorea* (xaté) in the Greater Maya Mountains and the Chiquibul Forest Reserve, Belize: an economic assessment of a non-timber forest product. *Economic Botany* 60(3): 265–283. [11, see above]
2. Bridgewater, S., Garwood, N., duPlooy, H., Porter Morgan, H. & Wicks, N. In press. Belize's *Chamaedorea* conundrum. *Palms*. [12]
3. Bridgewater, S., Garwood, N., Bateman, R., Penn, M., Porter Morgan, H., Wicks, N. & Pickles, P. 2007. *Recommendations for the sustainable management the Chamaedorea (xaté) resources of the Chiquibul Forest Reserve*. Darwin Initiative Report. [2, see above].

To date, two peer-reviewed research papers have been published (*Economic Botany* [11, see above]); *Molecular Phyolgenetics and Evolution* (see below – previously submitted), and another paper in press (*Palms* [12, see above]). Four further papers relating to the modelling of *Chamaedorea* within the Chiquibul, its population genetics ([6], see above), a regional review of *Chamaedorea* ([8], see above),

and the effects of harvesting on population health [17], are currently being prepared. Thus, the project has already exceeded its peer-reviewed publication target.

Peer-reviewed scientific paper, a copy of which was previously submitted to the Darwin Initiative

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.

The project involved a significant component of scientific, horticultural and educational training, outputs in all areas greatly exceeding those planned. Full details of these have been provided in past annual reports, and further information is provided in the final report of the BBG (copy enclosed). A general summary is provided below:

On the scientific side, over 25 Belizeans from the Forest Department and local NGOs, including the Ya'axaché Conservation Trust, received training in conducting biological surveys such as those related to palms. As part of the training, between the 30th and 31st August 2004, 12 participants from three organisations attended a workshop on inventory skills at Las Cuevas Research Station. During the project lifespan, 25 professional Belizeans in teams of between three and six worked in the field for a total period in excess of six months. Participants were carefully selected by the directors of the organisations involved. In addition, over 53 high-school students and Belizean undergraduates from the University of Belize received 2-3 days of ecological field training through the project, facilitated by Darwin education outreach officer Kimo Jolly. In addition, Kimo Jolly conducted secondary school and university visits, exposing *ca*. 250 students to the ecological, economic and social issues that surround xaté.

In May 2006, Ivis Chan and Percival Cho from the Belize Forestry Department visited the NHM for three weeks in order to be trained in GIS techniques by Dr. Malcolm Penn, using the data from the project's xaté surveys in the Chiquibul 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 in order to take up a post with another Darwin-funded project in Belize.

Heather Duploy, curator of the Belize Botanic Garden (BBG), visited Royal Botanic Gardens Kew between July 5th to August 27th (2004) to attend the International Diploma in Botanic Garden Management. This qualification strengthened her curatorial skills, and the Belize Botanic Garden is benefiting greatly as a result.

Three farmers from San Antonio village were trained at the BBG in horticultural techniques, the individuals being chosen by the co-operative to which they belong. One (Virgilio Coh) was in charge of the San Antonio Famers Co-operative and hence provides a crucial link to farmers. All three now provide much of the xaté agricultural extension support around San Antonio. As part of this training Rudolpho Lopez, a xaté expert from of the Asociaciòn Coordinadora Indígena y Campesina de Agroforestería Comunitaria Centroamericana (ACICAFOC), visited BBG from Guatemala. He provided training in transplanting techniques. In addition, one- and two-day workshops organized by the BBG have provided short horticultural training to 97 farmers. For example, on Saturday March 11th 2006, a workshop was organised by the BBG to distribute the Darwin-funded xaté grower's manual, thereby updating local communities on the xaté industry. In total, 22 people attended the workshop, and a summary of the proceedings was submitted to Darwin in last year's annual report. In addition, three half-day teacher education workshops were organised by the BBG (February 14th, March 7th, March 14th 2006). The BBG also hosted two horticultural technicians from YCT in November 2005, and two Belizean student internships were supported by the project at the BBG (see last year's Darwin report). Another workshop on organic horticulture and local gardening with native plants was hosted by the Belize Botanic Garden between the 23rd and 26th January 2006. This was partly designed to promote xaté as a native landscaping plant, and partly to raise awareness of environmentally friendly organic practices. In total, 19 participants attended the workshop; all received a certificate of completion. 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. The Ya'axche Conservation Trust held a workshop on March 4th 2006 at YCT's Field Centre to illustrate xaté cultivation activities. This was attended by over 60 men, women and children from northern Toledo.

5. Project Impacts

As highlighted in Sections 3 and 4, we believe there is good evidence that the project achievements have led to the accomplishment of the project purpose. Belize now has excellent legal guidelines governing the issuing of xaté licenses [1], illustrating that Darwin science has effectively been fed into government policy. The first Belizean licenses have been granted (2006), the first national xaté exports occurring in 2007. Thus, one of the primary aims of the project – to improve economic benefits to Belizeans – is clearly being achieved. For a review of the latest developments in the national industry, the reviewer is referred to the article (in press) submitted to the journal *Palms* [12]. In addition, with over 90,000 xate seedlings now growing in national plantation trials (facilitated by the BBG and YCT), the production of a cultivation manual, and the training of farmers in cultivation techniques between 2004

and 2007, Belize now has a greatly increased capacity to grow *Chamaedorea*. Assuming the current xaté exporter (ChicoMex) maintain their sorting house in Santa Elena (Cayo District), there should now be a demand for cultivated xaté leaf, providing modest but reliable financial benefits to farmers. One continuing problem for wild-harvested *Chamaedorea* leaf is that of ongoing illegal xatero activity. This hinders the development of a sustainable national industry. However, resolving these issues lies outwith the scope of this project, as it relates in part to border control, law enforcement and political negotiation/arbitration between the Belizean and Guatemalan governments. However, a positive impact could be made by applying pressure on regional xaté exporters. Such an initiative was suggested by Darwin personnel to Rafael Mananero, the Program Director of the newly formed Chiquibul–Maya Mountains Program (letter attached, [13]) in 2007, with a promise of necessary support from the Darwin initiative xaté team members.

The project has certainly successfully forged new scientific partnerships. Darwin initiative scientists have become part of a broad network of researchers (see Section 8) developing new research initiatives and publications far in excess of the two scientific publications originally envisaged. One of the most exciting of these is the Sustainable Palm Initiative, which brings together xaté experts from across the Central American region (highlighted above). One working paper on certification has been produced to date ([7], see above).

The capacity for Belize to manage its xaté resources sustainably is also greatly strengthened. The necessary information now exists to grant and monitor concessions, and designate 'annual allowable cuts', with the Forest Department in possession of all the necessary data. However, illegal harvesting makes monitoring problematic. In this way, Belize has been helped to fulfil its obligations under the Biodiversity Convention (CBD) to conserve its biodiversity whilst ensuring tangible benefits are generated for Belizeans (see Appendix 1). However, there are still significant institutional, data management and educational weaknesses hindering the long-term management of Non-Timber Forest Products in Belize. An attempt to address these issues was made by the broad network of project partners in the drafting of a Post Project funding proposal [9 & 10]. Although unsuccessful, this illustrates that strong collaboration remains.

There is good evidence that Darwin funding has increased local capacity to conduct biological surveying. One of the Darwin GIS trainees (Ivis Chan) now coordinates scientific research for the Belize Audubon Society, who have been undertaking xaté surveys independently of the Darwin project. In addition, YCT received a GEF small grant (*ca*. £48K) in 2004 to conserve *Biodiversity and Reduce Poverty amongst Indigenous Communities through Organic Agroforestry NTFP Development* (BZE/04/04), a component of which focuses on xaté. In part, this developed from the experience YCT gained as a research partner of the Darwin Initiative project (see YCT Chronicle [14]).

6. Project Outputs

All anticipated project outputs were achieved; they are listed in Appendix II where they are measured against the original estimated project outputs. Details of publications and materials that can be publicly accessed are listed in Appendix III. Several additional educational outputs were achieved. These include the development of a schools educational programme in Cayo District co-ordinated by Kimo Jolly, in addition to that coordinated by the BBG. This resulted in an additional 550 students receiving school visits, and *ca.* 100 students spending one or two days in the rain forest funded by the project. For many students this was their first experience of visiting the rain forest. In addition, partial funding by Darwin of the YCT education and outreach officer enabled a further 13 schools throughout Toledo to be introduced to xaté and taught aspects of sustainable forest management. BBG has greatly exceeded its education outputs through its educational outreach programme, its facilitation of horticultural trials, and its development of educational workshops (six organised), and now has a highly respected, self-sustaining education programme. It is well-established as an important source of environmental information and advice with a well-developed extension programme. See, for instance, the discussion of the March 31st 2007 Palm Fair in the BBG final report.

On the scientific component, every effort was made to ensure that appropriate additional interim reports were provided to the Belize Forest Department in a timely fashion so that project results were relevant to the ever-changing political and economic realities of the xaté industry. Urgent decisions on xaté management needed to be made by the Belizean government (Forest Department/National Xaté Technical Committee) early in the project's lifespan. Consequently, several additional project outputs in report form relating to xaté resource abundance and economic value were produced (see Appnedix II). In addition, the project expanded its national network of partners, and its horticultural and educational extension coverage, to include other relevant and active NGOs, including the Ya'axaché Conservation Trust. Through participating in the regional Sustainable Palm Initiative, the project has helped to provide advice on xaté certification to the Forest Stewardship Council. These reports are all in addition to the three that have been published and the one currently in press (the original target number was two). With regards to the dissemination of outputs, 10 workshops were delivered (the original target number was 5), and project results were presented at 23 conferences (target number was 2). In addition, all outputs are available on the Internet via the two Belizean national biodiversity portals, including the National Clearing House Mechanism and BERDS (details above). The number of weeks NHM personnel spent in Belize far exceeded the time originally envisaged (116 weeks compared with an original target of 70 weeks).

In the UK, in addition to the numerous academic seminars listed in Appendix II (see posters [18], for

example) , scientific outputs were also communicated to the general public via a podcast *Nature Live* event on *Chamaedorea* held at the NHM on the 2nd March 2007 and a public evening event (also podcast; over 100 attendees) on certification and *Chamaedorea* held at the NHM on the 29th March 2007 [15]. Research outputs were disseminated to three high schools during an NHM Sixth-Form Day (*ca*. 30 biology students interested in a career in science; 7th February), and to 15 MSc students studying for an MSc degree in Taxonomy and Biodiversity of Plants (Edinburgh University; 1-hour lecture). In addition, there is now a permanent exhibit relating to *Chamaedorea* in the public ecology display of the NHM. The NHM receives more than three million visitors every year, many of which will see this exhibit. A popular article was published in the Ministry of Defence's wildlife magazine *Sanctuary* [19], and another was was produced for darwin News (Issue 8) [20]

7. Project Expenditure

Expenditure	Total allocation	Total spent	2003/2004	2004/2005	2005/2006	2006/2007

7. Project Expenditure cont.

The amounts allocated in each financial year are provided together with the actual amounts spent (in brackets) in the table above. In total, the budget spent equals the budget allocated. However, a number of major changes were made to the project during its implementation. Within any financial year, the cost category subtotals between those allocated and those spent do vary considerably. These changes were first approved by the Darwin Secretariat. For example, in the project's first year, due to changes in staff highlighted elsewhere in this report, expenditure was slow at the beginning of the year as the project's future was uncertain. Towards the end of the financial year it became clear that much of the budget remained unspent and carry-over of funds into the next FY were not approved by DI. Therefore, changes were made to the budget to ensure that the money was spent, and that the foundations for a strengthened project were established. Most of the Travel and Subsistence budget was unspent. These funds were mainly diverted into the Other expenditure and Capital items. In the project's second year there was an underspend in the Salaries and Other cost categories, and significant carry forwards to the next financial year were allowed by the Darwin Secretariat. This included into the 2005/2006 Salary budget, into the Travel budget (to offset the increased vehicle costs outlined elsewhere in this report), into printing (for the draft production of the photographic guides) and into the Other budget for miscellaneous costs, including lab costs. In the final year (2006/2007) further amendments were made to take into account elevated vehicle costs. All of the above changes were required to ensure that the project was able to meet its objectives. We are grateful for the financial flexibility shown to this project. As discussed elsewhere, the project had to take a flexible approach in all its activities to respond to the changing needs of the xate industry.

8. Project Operation and Partnerships

In addition to the primary project partners, the project expanded its core network to include the Ya'axché Conservation Trust, which coordinated all activities in Toledo district. It has also been necessary to develop very strong collaborative links with a range of other local organisations, including the University of Belize, the Ministry of Agriculture, the Ministry of Industry and Commerce, the Ministry of Home Affairs, the Asociaciòn Coordinadora Indígena y Campesina de Agroforestería Comunitaria Centroamericana (ACICAFOC), Alianza para um Mundo Justo (Guatemala), the World Conservation Society (Guatemala), Friends for Conservation and Development (Belize), the Protected Areas Conservation Trust, the Belize Community Service Alliance (BCSA), Conservation International (regional office), the Belize Audubon Society, the Sarstoon-Temash Institute for Indigenous Management (SATIIM), the Las Cuevas Research Station, the Belize Defence Force, the National Xaté Technical Committee, BelTraide, Earthwatch, The Itzamna Society, Amigos de El Pilar, the National Security Secretariat and the British High Commission.

Undertaking the various project activities has depended on developing partnerships and consultation with one or more of these local organisations, and the work could not have been pursued without their consent. Web-based information dissemination has depended on forging strong links with the national biodiversity Clearing House Mechanism and the Belize Biodiversity and Environmental Resource Data System (BERDS). Belize is a small country so communication networks are good. All the NGOs listed above continue to engage with environmental and developmental issues, and the wide dissemination of outputs and information achieved means that they will continue to draw on knowledge developed by the project. The strengthened capacity of the Belize Botanic Garden to conduct work in the future is mentioned in Section 13 (Sustainability and Legacy), and its education activities and extension are ongoing. The Y'axche Consevation Trust is a rapidly expanding NGO which is now undertaking its own xaté activities and horticultural extension work. More information on these bodies can be found at: *http://www.yct.bz/*. We are confident that the Darwin project has acted as an excellent catalyst for the development of both the BBG and YCT.

International partners (in addition to original project members) who have been consulted and contributed to the project include Holly Porter Morgan (New York Botanical Gardens), Dr. William Baker, Dr. John Dransfield and Dr. William Milliken (all Royal Botanic Gardens Kew), Dr. Andrew Henderson (New York Botanical Garden), Dr. Steven Brewer (University of Wilmington, South Carolina), Donald Hodel (University of California), Christine Baker (University of New Mexico), Angelica Cibrian Jaramillo (American Museum of Natural History), Dr. Bryan Endress (Oregan State University), David Wilsey (University of Florida) and John Jickling (Smartwood International; certification quality and systems manager).

8. Monitoring and Evaluation; Lessons learned

Monitoring and evaluating the project has proved relatively straightforward. In part, this reflects the large amount of time spent in Belize by the present project PI and other project personnel. This has greatly facilitated project communication. However, the ensuing delivery of outputs has primarily been due to the high degree of professionalism and dedication of the various project partners. Very strong partnerships have been forged as the project has progressed, and there has been a close working relationship between all partners. Monitoring has been performed primarily through the PI keeping a close watch on the output schedule, checking project progress monthly against the Output and Implementation (OI) timetable. The OI timetable has been most useful in reminding the project members of the core project obligations. Belize Botanic Garden's activities were monitored by Heather Duplooy, whilst Percival Cho and Nick Wicks monitored the progress and outputs of the Forest Department and Ya'axché Conservation Trust, respectively. Project partners were reminded in good time if the work programme appeared to be slipping. Informal constant monitoring was facilitated through the near-constant flow of papers, manuals, photoguides and reports circulated via email among all project partners, for comment

prior to publication. Great care was taken to ensure that all partners were included in dialogue pertaining to the project. Obviously, the delivery of project outputs does not necessarily imply that the project is achieving is broader purpose (*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*.). Our confidence that the aims were being achieved was increased by constantly checking national activities related to the development of a xaté industry (e.g. the development and release of concession guidelines; granting of concessions; establishment and upkeep of trial plantations; first export of xaté; first royalties received by the Forestry Department; first payment of Belizean xateros), and by informally monitoring project 'momentum' (e.g. expansion of project partners, readiness with which local communities and students have participated and contributed to project workshops, development of extension and scientific networks, increased demand for workshops and expansion of scientific and education outputs). There has been constant critical internal evaluation of the project, as well as annual external evaluation via the Darwin reviews. In addition, the project and its outputs have achieved high profiles in Belize and internationally, encouraging near-constant communication from external parties on aspects of our work (e.g. from the Forest Stewardship Council on certification; from international scientists on our methodology; from concessionaires requesting information on abundance; from farmers providing feedback on the cultivation manual; from field guide users on the palm guides). This has served as a powerful means of informal external evaluation, facilitating reflection on the project's performance from various active partners.

Relatively few problems were encountered. Collaborative links have grown stronger, and the in-country partners have worked hard on their aspects of the project. Significant changes in NHM staff delayed progress in the early stages of the project. In addition, several changes in staff at the highest level in the Belize Forest Department meant that new foundations of trust had to be built.
The problems associated with the NHM's withdrawal from Las Cuevas Research Station highlighted in former reports increased the cost of transport during the project. This challenge was overcome by increasing the travel budget.

One of the biggest challenges still facing the nascent national xaté industry in Belize is illegal harvesting. This impacts greatly on the development on the development of a xaté management plan for the Chiquibul. The project has therefore learnt that it has to be exceedingly flexible in achieving its objectives and ensuring that they remain relevant. 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 that 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 primary aims.

9. Actions Taken in Response to Annual Report Reviews (if applicable)

No major changes to the project structure were requested by the reviewers. Very minor comments relating to the specifics of the *Chamaedorea* industry in Belize (e.g. the potential for *Chamaedorea* to be used in craft industries) were responded to. None altered the format of the project.

10. Darwin Identity

The Darwin logo was displayed on all published project outputs, including posters, reports, field guides, talks and workshop proceedings. All popular written articles and scientific papers explicitly acknowledged the support of the Darwin Initiative. The project had a very high profile within Belize and was known as the 'Darwin xaté project' or simply 'the Darwin project' by the government, NGOs and local farming communities involved with xaté. It was the first port of call for consultation on all aspects of *Chamaedorea* management, establishing a network of participating individuals and organisations across the country. As explained above, the management of *Chamaedorea* within Belize relates to many broader political and scientific issues, including national security, forest management, local income generation, biodiversity assessments and monitoring. Thus, although the project had its own distinct identity, it has been associated with, and contributed to, many other 'larger' and 'smaller' initiatives including (1) The Conservation International 'Critically Endangered Ecosystem Partnership Funded' *Improving Management in the Core Areas of the Chiquibul/Maya Mountains*' project, (2) The Central American regional Sustainable Palms Initiative and (3) a GEF-funded project to conserve Biodiversity and Reducing Poverty amongst Indigenous Communities through Organic Agroforestry NTFP Development (Ya'axché Conservation Trust,Toledo Dictrict). In addition, it has advised the Belize Government, the British High Commission and the Organisation of American States (OAS) on xatero issues within the Chiquibul region, providing information for bilateral projects to be funded under the Global Conflict Prevention Pool.

11. Leverage

The Darwin Initiative project has assisted with the development of three significant funding applications during its lifespan, two of which have been successful. In 2006, Friends for Conservation and Development received a grant of *ca*. U$900,000 from Conservation International's Critical Ecosystems Fund and the Protected Areas Conservation Trust [16]. This money was given to help develop and implement a comprehensive and integrated management program for the Chiquibul National Park and Maya Mountains Key Biodiversity Area. Members of the Darwin Initiative project were involved in all of

the stakeholder workshops at which the project was developed, provided critical revisions of the proposal and gave presentations on the 'xaté issue' to Conservation International. One of the biggest challenges facing the Chiquibul is the reduction of illegal xatero activity. Thus, information, reports and scientific data compiled by the xaté Darwin project have been crucial in building a case for funding assistance. Dialogue continues between members of the Darwin Initiative team, FCD and CI. For example, in 2007, an initiative was proposed by the project PI to the Director of FCD and the Chiquibul National Park Advisory Committee relating to engaging xaté exporters to assist with resolving the xateros issue through improved sourcing of leaf (letter and initial responses attached). In addition, one of the primary project staff (Nicodemus Bol – formerly of the NHM, and then of Earthwatch) is now employed at the Las Cuevas Research Station. He has become the national expert on illegal xatero activity through managing the Darwin xaté survey work across the country, and will shortly be participating in a meeting with officials of the Belizean government, including the Minister of Natural Resources, Environment and Industry, where a position statement drafted by the newly established Chiquibul National Park Advisory Council relating to protected area security within the Chiquibul, xaté extraction and Ilegal Guatemalans will be discussed. Mr. Bol continues to advise the newly established Chiquibul Rangers on xaté issues.

The second new project which has been catalysed in part by the Darwin Initiative is a GEF-funded project to conserve Biodiversity and Reduce Poverty amongst Indigenous Communities through Organic Agroforestry NTFP Development, developed by the Ya'axché Conservation Trust (*ca*. U$48K)[14]. The development of small-farmer xaté plantations features strongly in this project, and through funding xaté survey work conducted by YCT in Toledo District, the provision of horticultural training by the BBG, and the joint production of the cultivation manual by BBG and YCT, the Darwin Initiative helped develop YCT's capacity to develop its proposal, and provided 'counterpart funding'. Thus, significant synergy developed between these two projects.

The final proposal was the Darwin Post Funding proposal [9 & 10, see above]. This was not successful. We have only just heard of this disappointment, but hope that the project can be redrafted and submitted to other funders. It is hoped that through developing the Post Funding proposal, all partners have strengthened their ability to capture funds from international donors.

In terms of 'additional investment' in the Darwin project, all partners have spent significantly more time and institutional resources than originally envisaged in trying to make the project a success. As we suspect is the case with many Darwin projects, it is hoped at the start of the project that the development of the specific project outputs will help achieve the project aim. However, as the project progresses and realities changes, it becomes clear that new outputs need to be added. In addition, the project has to be proactive in terms of responding to appropriate requests from the government and NGOs for information support. It is indicative of a successful project when its advice is frequently sought. However, this

success greatly increases the amount of work required.

12. Sustainability and Legacy

The project achievements that are most likely to endure are the institutional strengthening of the Belize Botanic Garden, the provision of baseline data on Belize's xaté resources to the Forest Department for concession monitoring, the drafting of xaté concession regulations, the granting of the first legal concessions, the facilitation of xaté cultivation in Belize, the provision of the user-friendly palm guides, and improved regional scientific understanding of xaté. In addition, the success and sustainability of the project can in part be gauged by the strengthening and widening of new local and international partnerships, the increasing ease with which new collaborative links have been established, the readiness with which local communities and students have participated and contributed to project workshops, the adoption of pilot cultivation projects by local communities, the continued dialogue of UK and in-country partners with Belizean governmental departments, and the desire of project partners to apply for further funding. Viewed in its entirety, this is a considerable legacy. In the 2006–2007 final report of BBG [5], Heather duPlooy wrote: *At the close of the project I am glad to say that it has been an incredibly positive endeavour for the botanic gardens. We have heightened our profile, had the opportunity to train staff and expose them to new experiences in education and outreach, produced quality educational information for dissemination and generally move the garden forward in terms of fulfilling our goals and aims in education and conservation*.' It is reassuring to hear that the experience of being involved with a Darwin project has been so positive. Project partnerships have been very strong and in the Annual Report of 2005–2006, the considerable achievements of the project partners were highlighted, one section stating: '*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 proactive 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.'

The project has not been without its problems, but the majority of these have been related to external circumstances. For example, since the onset of the project there have been two changes to the Chief Forest Officer of the Forest Department and numerous changes of more junior staff, an issue raised earlier in this report. At times this made it difficult to ensure continuity of some of the project outputs. In addition, extreme funding and personnel restrictions within the Forest Department made it impossible for them to contribute significant amounts of labour to the inventory work. This problem was highlighted in past Annual Reports, and the majority of this work has instead been conducted by local NGOs benefiting organisations such as the Ya'axché Conservation Trust. Nevertheless, the Forest Department has remained the key governmental organisation, and has been influential at the policy level. Due to their endeavours, concession guidelines relating to xaté have been produced during the project's lifespan, and the first concessions have been granted. Another impacting factor that occurred during the life of the project and that could not have been predicted was the decision of the Natural History Museum to decide to withdraw from managing Las Cuevas Research Station. The problems this caused relating to vehicles in Belize have been highlighted in reports for earlier years. Ironically, the withdrawal was actually ultimately beneficial to the amount of NHM staff time that was spent in Belize. Of course, the greatest challenge to the project, and to the establishment of a sustainable national palm leaf industry in Belize, has been the widespread illegal harvesting of xaté leaf. As mentioned above this is being tackled at high-level governmental meetings, as it is directly related to issues of national security. It has not been appropriate for the Darwin project to become involved in this controversy, but throughout its lifespan we have tried to contribute useful information to the relevant authorities at the appropriate times. This has invoved meeting with the Organisation of American States, the British High Commission and the Belize Xaté Technical Committee, which includes members of the National Security Council. The existence of illegal harvesting, for example, has made it impossible to produce a practical management plan for the Chiquibul. However, this output has been modified into recommendations for sustainable management.

One scientific legacy that remains of particular concern is the permanent sampling plots. Although these have been established and maintained over a three-year period, their continued monitoring and upkeep will depend on Belize finding the necessary resources. Sadly, it seems unlikely at this stage that the Forest Department will be able to maintain them due to staffing and funding considerations, and negotiations are now underway with Chris Minty of Las Cuevas Research Station and Professor Elma Kay of the University of Belize to see how they might be maintained by independent organisations. At present, however, the future of these plots is insecure and this should be considered a project

weakness, albeit one that a short-term project would always find problematic to address.

Regarding funding, it was hoped that a Darwin Post Funding application (enclosed) would expand the life of the project and resolve the issues that we believe currently hinder the widely desired development of a sustainable NTFP industry.

13. Value For Money

We believe that the project has been excellent value for money, particularly if the additional resources provided by the partner organisations are taken into account. From this report and the previous Annual Reports, we hope that we have demonstrated that all project partners have been engaged and delivered far more than the original outputs of the project, and that the overall aims of the project have been achieved. Indeed, it is the opinion of the Principal Investigator that organisations such as the BBG and YCT have produced superb outputs for relatively little money. This success reflects the synergy developed between this and other initiatives (e.g. Sustainable Palm Initiative; GEF-funded project to conserve Biodiversity and Reducing Poverty amongst Indigenous Communities through Organic Agroforestry NTFP Development), the catalytic effect of the project in empowering other organisations to undertake their own activities independent of Darwin funding through education (e.g. Toledo and Cayo farming co-operatives; teacher training; school and undergraduate training), and the maintenance of effective communication links between all project components.

14. Appendix I: Project Contribution to Articles under the Convention on Biological Diversity (CBD)

Please complete the table below to show the extent of project contribution to the different measures for biodiversity conservation defined in the CBD Articles. This will enable us to tie Darwin projects more directly into CBD areas and to see if the underlying objective of the Darwin Initiative has been met. We have focused on CBD Articles that are most relevant to biodiversity conservation initiatives by small projects in developing countries. However, certain Articles have been omitted where they apply across the board. Where there is overlap between measures described by two different Articles, allocate the % to the most appropriate one.

Project Contribution to Articles under the Convention on Biological Diversity		
Article No./Title	**Project %**	**Article Description**
6. General Measures for Conservation & Sustainable Use	20	Develop national strategies that integrate conservation and sustainable use.
7. Identification and Monitoring	20	Identify and monitor components of biological diversity, particularly those requiring urgent conservation; identify processes and activities that have adverse effects; maintain and organise relevant data.
8. In-situ Conservation		Establish systems of protected areas with guidelines for selection and management; regulate biological resources, promote protection of habitats; manage areas adjacent to protected areas; restore degraded ecosystems and recovery of threatened species; control risks associated with organisms modified by biotechnology; control spread of alien species; ensure compatibility between sustainable use of resources and their conservation; protect traditional lifestyles and knowledge on biological resources.
9. Ex-situ Conservation		Adopt ex-situ measures to conserve and research components of biological diversity, preferably in country of origin; facilitate recovery of threatened species; regulate and manage collection of biological resources.
10. Sustainable Use of Components of Biological Diversity	20	Integrate conservation and sustainable use in national decisions; protect sustainable customary uses; support local populations to implement remedial actions; encourage co-operation between governments and the private sector.
11. Incentive Measures		Establish economically and socially sound incentives to conserve and promote sustainable use of biological diversity.
12. Research and Training	20	Establish programmes for scientific and technical education in identification, conservation and sustainable use of biodiversity components; promote research contributing to the conservation and sustainable use of biological diversity, particularly in developing countries (in accordance with SBSTTA recommendations).
13. Public Education and Awareness	20	Promote understanding of the importance of measures to conserve biological diversity and propagate these measures through the media; cooperate with other states and organisations in developing awareness programmes.

14. Impact Assessment and Minimizing Adverse Impacts		Introduce EIAs of appropriate projects and allow public participation; take into account environmental consequences of policies; exchange information on impacts beyond State boundaries and work to reduce hazards; promote emergency responses to hazards; examine mechanisms for re-dress of international damage.
15. Access to Genetic Resources		Whilst governments control access to their genetic resources they should also facilitate access of environmentally sound uses on mutually agreed terms; scientific research based on a country's genetic resources should ensure sharing in a fair and equitable way of results and benefits.
16. Access to and Transfer of Technology		Countries shall ensure access to technologies relevant to conservation and sustainable use of biodiversity under fair and most favourable terms to the source countries (subject to patents and intellectual property rights) and ensure the private sector facilitates such assess and joint development of technologies.
17. Exchange of Information		Countries shall facilitate information exchange and repatriation including technical scientific and socio-economic research, information on training and surveying programmes and local knowledge
19. Bio-safety Protocol		Countries shall take legislative, administrative or policy measures to provide for the effective participation in biotechnological research activities and to ensure all practicable measures to promote and advance priority access on a fair and equitable basis, especially where they provide the genetic resources for such research.
Total %	**100%**	**Check % = total 100**

15. Appendix II Outputs

Please quantify and briefly describe all project outputs using the coding and format of the Darwin Initiative Standard Output Measures.

Code	Total to date (reduce box)	Detail (←expand box)
Training Outputs		
1a	Number of people to submit PhD thesis	
1b	Number of PhD qualifications obtained	
2	Number of Masters qualifications obtained	**1** British. Edinburgh University MSc thesis
3	Number of other qualifications obtained	**1** Belizean. Diploma in Botanical Garden Management (Kew Gardens)
4a	Number of undergraduate students receiving training	**61** (Belizean)
4b	Number of training weeks provided to undergraduate students	Equiv. of **17 weeks x 1 person** i.e. ca. 2 days per person (see 4a)
4c	Number of postgraduate students receiving training (not 1-3 above)	
4d	Number of training weeks for postgraduate students	
5	Number of people receiving other forms of **long-term** (>1yr) training not leading to formal qualification(i.e not categories 1-4 above)	
6a	Number of people receiving other forms of **short-term** education/training (i.e not categories 1-5 above)	**586 total** 20 foresters/NGO staff undertaking xaté field inventories for a combined total of 440 days 5 farmers trained in pratical techniques of xaté cultivation (97 days total combined) 300 school students attending a 2 hour xaté educational workshop (within their schools) 48 students conducting xaté fieldwork of either 1 or 2 days duration (at Las Cuevas) 12 forest officers/NGO members attending a 2 day worshop on conducting xaté resource inventories (at Las Cuevas). 50 school students receiving hands-on xaté education at the Belize Botanic Garden. 26 farmers/NGO members attending a 1-day workshop on xaté cultivation at the Belize Botanic Garden. 80 farmers attending a one-week workshop on xaté cultivation. 30 London High School biology 6th Formers 15 Edinburgh University MSc students

Code	Total to date (reduce box)	Detail (←expand box)
6b	Number of training weeks not leading to formal qualification	**128 weeks x 1 person** (assuming a 5-day week)
7	Number of types of training materials produced for use by host country(s)	**6 total** 1 x xaté educational package for schools 1 x educational xaté display at the Belize Botanic Garden 1 x xaté cultivation manual 1 x xaté inventory manual 2 x photographic palm guides
Research Outputs		
8	Number of weeks spent by UK project staff on project work in host country(s)	**121 weeks** Nicodemus Bol (NHM Belizean staff permanently stationed in Belize) 360 days Samuel Bridgewater. Project PI in-country for 396 days Nancy Garwood 35 days Malcolm Penn 35 days Meredith Murphy Thomas 20 days
9	Number of species/habitat management plans (or action plans) produced for Governments, public authorities or other implementing agencies in the host country (s)	**6**. These comprise advisory documents on the Belizean xaté resource and its management: Bridgewater, S., Garwood, N., Penn, M., Bateman, R., Porter Morgan, H., Wicks, N., Pickles, P. Bateman, R., Penn. 2007. *Recommendations for the sustainable management the* Chamaedorea *(xaté) resources of the Chiquibul Forest Reserve.* Bridgewater, S., Garwood, N., Bateman, R., Penn, M., Bol, N. and V. Quiroz. 2004. *Preliminary Xaté Resorce Inventory for the Chiquibul Forest Reserve.* Bridgewater, S., Garwood, N., Bateman, R., Penn, M., Bol, N. and V. Quiroz. 2005*. The* Chamaedorea *(xaté) resource of the Chiquibul, Sibun, Manatee and Colombia Forest Reserves.* Pickles, P. 2004. *Eco-labelling xaté: the potential of certification to aid the development of a sustainable Belizean palm industry.* Porter Morgan, H. 2005. *Towards the sustainable use of xaté plams in Belize (*Chamadorea *spp.): The effects of defoliation on leaf growth and reproduction.*

Code	Total to date (reduce box)	Detail (←expand box)
		Wicks, N. 2004. *Preliminary fishtail (*Chamaedorea ernesti-augustii*) growth survey data in the Chiquibul National Forest Reserve, Belize.*
10	Number of formal documents produced to assist work related to species identification, classification and recording.	**2 x palm photoguides** (http://fm2.fieldmuseum.org/plantguides/rcg_intro.asp).
11a	Number of papers published or accepted for publication in peer reviewed journals	**4** Bridgewater, S., Pickles, D., Garwood, N. C., Penn, M., Bateman, R.M., Porter Morgan, H., Wicks, N. & Bol, N. 2006. *Chamaedorea* (xaté) in the Greater Maya Mountains and the Chiquibul Forest Reserve, Belize: an economic assessment of a non-timber forest product. *Economic Botany* 60 (3): 265-283. 2. Bridgewater, S., Garwood, N., duPlooy, H., Porter Morgan, H., & Wicks, N. In press. Belize's *Chamaedorea* conundrum. *Palms*. 3. 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. 4. Duplooy, H & B. Adams. A little palm, a lot of palaver. 2005. *Palms*. Vol. 49 (1). In addition, three further papers are currently being drafted
11b	Number of papers published or accepted for publication elsewhere	**3** Garwood, N. 2003. *Palms - highly prized, highly endangered*. NHM Magazine 2: 28-30. Garwwood, N. 2003. *Xaté palms (*Chamaedorea *spp.) in Belize: conservation and sustainable management.* Las Cuevas Newsletter, Issue 11, p. 12 Bridgewater, S. Xaté, leaf of Gold. *Sanctuary* 35: 61-63.
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	**1** (georeferenced database on national xaté resource)
12b	Number of computer-based databases enhanced (containing species/genetic information) and handed over to host country	
13a	Number of species reference collections established and handed over to host country(s)	
13b	Number of species reference collections enhanced and handed over to host country(s)	

Dissemination Outputs		
14a	Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work	**10** 1. Xaté inventory workshop at Las Cuevas Research Station (30-31st August 2004 2. Community xaté cultivation workshop (9-14th August, 2004) 3. Xaté farmers workshop at the Belize Botanic Garden (July 29th, 2004) 4. Workshop (Las Cuevas Research Station) of 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 (27th and 28th October 2005). 5. BBG workshop 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. 22 attendees (March 11th 2006) 6. Workshop on organic horticulture and local gardening with native plants (BBG). In part this was to promote xaté as a native landscaping plant, and in part to raise awareness of environmentally friendly organic practices (23rd and 26th January 2006). 7. Introductory workshop on the xaté industry (Ya'axché Conservation Trust) to provide all interested farmers in Toledo district with an accurate picture of the xaté industry) and (21st January 2006). 25 attendees. 8. Xaté cultivation workshop (YCT). Punta Gorda. 60 attendees (March 4th 2006). 9. Workshop organised by the BBG and the Itzamna Society, conducted at the village for all Cristo Rey and San Antonio participants (San Antonio, Cayo). As the preceding March workshop resulted in a list of needs village xate stakeholders required for xate to become a viable industry, these follow-up workshops were held to address the list of needs and make

		suggestions and recommendation as to how these needs could be met (July 29th 2006*)* 10. 4-day environmental education workshop for the primary school teachers from Valley of Peace Catholic School (BBG). While this program was not specific to xate, xate featured largely in the training as the teachers received xate posters, information about the Belize xate situation and potted xate as part of the program (August 8-11, 2006).
14b	Number of conferences/seminars/ workshops **attended** at which findings from Darwin project work will be presented/ disseminated.	**23** 1. Bridgewater, S. Seminar with the Assistant Secretary of the Organisation of American States, the British High Commission and Belizean and Guatemalan Ambassadors (July, 2004) 2. Bridgewater, S. Seminar with the Belizean governmental Xaté Technical Committee (February 2005) 3. Porter Morgan, H. Sustainable use of *C. ernesti-augustii*). Poster at the International Symposium on Palms co-hosted by the Linnean Society and the Royal Botanical Gardens Kew (April 2005). 4. Thomas, M. *Chamaedorea* phylogenetics. Poster at the International Symposium on Palms co-hosted by the Linnean Society and the Royal Botanical Gardens Kew (April 2005). 5. Bridgewater, S. Economic assessment of *Chamaedorea* in the Chiquibul Forest Reserve. Poster at the International Symposium on Palms co-hosted by the Linnean Society and the Royal Botanical Gardens Kew (April 2005). 6. Porter Morgan, H. Sustainable use of the palm *Chamaedorea ernesti-augustii*: efffects of defoliation on growth and reproduction. Society for Economic Botany Conference (Forth Worth, Texas) (June 7th 2005) 7. Bateman, R. *Chamaedorea* phylogenetics presented a poster at the International Botanical Congress in Vienna in July 2005. 8, 9, 10. Garwood, N., Wicks, N., Duplooy, H. & Bridgewater, S. Seminars on *Chamaedorea* cultivation, conservation and sustainable management at the 2nd Conference of the Caribbean Botanic Gardens for Conservation hosted by the Belize Botanic Garden (October 2005)

		11. Bridgewater, S. *Chamaedorea* conservation. Seminar at the 9th Annual Meeting of the Britain-Belize association, hosted by the Institute of Commonwealth Studies (September 2005). 12. Garwood, N. C., S. G. M. Bridgewater, R. Bateman and others. Conservation and Sustainable Management of *Chamaedorea* Palms in Belize. *Sigma Xi Annual Research Day* (abstract, p. 3), Southern Illinois University, Carbondale, Illinois, USA (poster). (26 March 2007) 13. Garwood, N. C., S. G. M. Bridgewater, and R. Bateman. Conservation and Sustainable Management of *Chamaedorea* Palms in Belize. Botany 2006, Chico, California, USA, *Scientific Meeting Abstracts*, p. 331. (poster) (29 July - 2 August 2006) 14. Bacon, C. D., A. Cibrian Jaramillio, M. M. Thomas, N. C. Garwood, R. M. Bateman, S. J. Russell, C. D. Bailey, S. Bridgewater. Genetic Diversity of Xaté palms (*Chamaedorea ernesti-augustii* Wendl.) in Belize: Implications for Conservation. Botany 2006, Chico, California. (poster) (29 July 29 - 2 August) 15. Garwood, N. C., S. G. M. Bridgewater, R. Bateman, N. Wicks, M. Penn, N Bol & V Quiroz. Conservación y manejo sostenible de palmeras Chamaedorea en Belice. X Congresso de la Sociedad Mesoamericana para la Biologia y la Conservacion, Antigua, Guatemala. (poster) (29 October – 3 November 2006), 16. Bridgewater, S (speaker), Pickles, P., Garwood, N., Penn, M., Bateman, R., Wicks, N., Porter Morgan, H. & Bol, N. Conservation and sustainable management of *Chamaedorea* in Belize. Natural History Museum seminar (July 2005). 17. Bridgewater, S (speaker), Pickles, P., Garwood, N., Penn, M., Bateman, R., Wicks, N., Porter Morgan, H. & Bol, N. Conservation and sustainable management of *Chamaedorea* in Belize. Royal Botanic Gardens Kew seminar (July 2005). 18. Bridgewater, S (speaker), Pickles, P., Garwood, N., Penn, M., Bateman, R., Wicks, N., Porter Morgan, H. & Bol, N. Conservation and sustainable management of *Chamaedorea* in Belize. Royal Botanic Garden Edinburgh seminar (July 2005). 19. Bridgewater, S (speaker), Pickles, P., Garwood, N., Penn, M., Bateman, R., Wicks, N.,

		Porter Morgan, H. & Bol, N. Conservation and sustainable management of *Chamaedorea* in Belize (March 2004). 9th Annual meeting of the Belize-Britain Association (Institute of Commonwealth Studies). (September 2005. 20. Bridgewater, S (speaker), Pickles, P., Garwood, N., Penn, M., Bateman, R., Wicks, N., Porter Morgan, H. & Bol, N. Conservation and sustainable management of *Chamaedorea* in Belize. University of Belize, Belmopan, Belize (October 2006). 21. Bridgewater, S (speaker), Pickles, P., Garwood, N., Penn, M., Bateman, R., Wicks, N., Porter Morgan, H. & Bol, N. Conservation and sustainable management of *Chamaedorea* in Belize. University of Belize, Belmopan, Belize.10th Annual Meeting of the Britain-Belize association, hosted by the Royal Botanic Garden Edinburgh. (September 2006) 22. Cibrian (speaker). A. Genetic connectivity in wild populations of endangered, sympatric *Chamaedorea* palms in Mexico New York Botanical Garden (February 6th 2007) 23. Cibrian (speaker). A. Genetic connectivity in wild populations of endangered, sympatric *Chamaedorea* palms in Mexico. Columbia University (March 20th)
15a	Number of national press releases or publicity articles in host country(s)	
15b	Number of local press releases or publicity articles in host country(s)	**1** duPlooy, J. *Xaté controversy heats up*. The Belize Times, 2 November 2003
15c	Number of national press releases or publicity articles in UK	
15d	Number of local press releases or publicity articles in UK	
16a	Number of issues of newsletters produced in the host country(s)	
16b	Estimated circulation of each newsletter in the host country(s)	
16c	Estimated circulation of each newsletter in the UK	
17a	Number of dissemination networks established	
17b	Number of dissemination networks enhanced or extended	
18a	Number of national TV programmes/features in host country(s)	
18b	Number of national TV programme/features in the UK	**NB. 2 x podcast Chamaedorea specials.** The first was a lunchtime public Nature Live event focusing on xaté (2nd March); the second was an evening publicate debate on certification and *Chamaedorea* (29th March)
18c	Number of local TV programme/features in host	

	country	
18d	Number of local TV programme features in the UK	
19a	Number of national radio interviews/features in host country(s)	
19b	Number of national radio interviews/features in the UK	
19c	Number of local radio interviews/features in host country (s)	
19d	Number of local radio interviews/features in the UK	
Physical Outputs		
20	Estimated value (£s) of physical assets handed over to host country(s)	
21	Number of permanent educational/training/research facilities or organisation established	**1** The DI contributed towards the development of a permanent educational facility at the Belize Botanic Garden.
22	Number of permanent field plots established	**60** 50 20 x 20m permanent growth monitoring plots. 10 20 x 20m permanent defoliation monitoring plots
23	Value of additional resources raised for project	

16. Appendix III: Publications

Provide full details of all publications and material 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 that is currently being compiled.

Mark (*) all publications and other material that you have included with this report

Type * (e.g. journals, manual, CDs)	**Detail** (title, author, year)	**Publishers** (name, city)	**Available from** (e.g. contact address, website)	**Cost £**
Manuals & Reports	1. Bridgewater, S., Garwood, N., Penn, M., Bateman, R., Porter Morgan, H., Wicks, N., Pickles, P. Bateman, R., Penn. 2007. *Recommendations for the sustainable management the* Chamaedorea *(xaté) resources of the Chiquibul Forest Reserve*.* 2. Bridgewater, S., Garwood, N., Bateman, R., Penn, M., Bol, N. and V. Quiroz. 2004. *Preliminary Xaté Resorce Inventory for the Chiquibul Forest Reserve.* 3. Bridgewater, S., Garwood, N., Bateman, R., Penn, M., Bol, N. and V. Quiroz. 2005*. The* Chamaedorea *(xaté) resource of the Chiquibul, Sibun, Manatee and Colombia Forest Reserves.* 4. Pickles, P. 2004. *Eco-labelling xaté: the potential of certification to aid the*		http://www.chm.org.bz/ http://www.biodiversity.bz/ www.belizebotanic.org/xate_manual.pdf	Free

	development of a sustainable Belizean palm industry. 5. Porter Morgan, H. 2005. *Towards the sustainable use of xaté plams in Belize (*Chamadorea *spp.): The effects of defoliation on leaf growth and reproduction.* 6. Wicks, N. 2004. *Preliminary fishtail (*Chamaedorea ernesti-augustii*) growth survey data in the Chiquibul National Forest Reserve, Belize.*			
Scientific papers (published or in press)	1. Bridgewater, S., Pickles, D., Garwood, N. C., Penn, M., Bateman, R.M., Porter Morgan, H., Wicks, N., & Bol, N. 2006. *Chamaedorea* (xaté) in the Greater Maya Mountains and the Chiquibul Forest Reserve, Belize: an economic assessment of a non-timber forest product. *Economic Botany* 60 (3): 265-283. 2. Bridgewater, S., Garwood, N., duPlooy, H., Porter Morgan, H., & Wicks, N. In press. Belize's *Chamaedorea* conundrum. *Palms*. 3. 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	Economic Botany Palms Molecular phylogenetics and evolution		Free access from a library or JSTOR, otherwise subscription needed

	and RPB2. *Molecular Phylogenetics and Evolution* 38: 398-415. 4. Duplooy, H & B. Adams. A little palm, a lot of palaver. 2005. *Palms* 49(1).			
Field Guides	1. Garwood, N. & Bridgewater, S. 2005. *Chamaedorea photoguide* 2. Bridgewater, S., Garwood, N. & Brewer, S. 2006. *Photoguide to Belizean palms.**		*http://fm2.fieldmuseum.org/plantguides/rcg_intro.asp*	free
Manuals	1. Belize Botanic Garden and the Ya'axche Conservation Trust. 2006. *Xate in Belize: a grower's guide. Version 1.* 2. Bridgewater, S., Garwood, N, Porter Morgan, H. & Wicks, N. 2006. *Resource inventory manual for* Chamaedorea.		http://www.chm.org.bz/ http://www.biodiversity.bz/ www.belizebotanic.org/xate_manual.pdf (Cultivation manual only)	free

17. Appendix IV: Darwin Contacts

To assist us with future evaluation work and feedback on your report, please provide contact details below.

Project Title	Xaté palms (*Chamaedorea* spp.) in Belize: conservation and sustainable management
Ref. No.	162/12/012
UK Leader Details	
Name	Dr. Samuel Bridgewater
Role within Darwin Project	PI
Address	Natural History Museum, Cromwell Road, London, SW7 5BD
Phone	
Fax	
Email	
Other UK Contact (if relevant)	
Name	Prof. Richard Bateman
Role within Darwin Project	Initial project PI. Researcher
Address	Royal Botanic Gardens Kew, Richmond Surrey
Phone	
Fax	
Email	
Partner 1	
Name	**Percival Cho**
Organisation	Belize Forest Department
Role within Darwin Project	Forestry Department liason/legislation/forest planning
Address	Forest Drive, Belmopan, Belize
Fax	
Email	
Partner 2 (if relevant)	
Name	Heather duPlooy
Organisation	Belize Botanic Garden
Role within Darwin Project	Education, horticultural extension
Address	P.0. Box 180, San Ignacio, Cayo, Belize, Central America
Fax	
Email	

APPENDIX V. LOGICAL FRAMEWORK

18. *Please enter the details of your project onto the matrix using the note at Annex B of the Guidance Note. This should not have substantially changed from the Logical Framework submitted with your Stage 1 application*

Project summary	Measurable indicators	Means of verification	Important assumptions
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	Licensing agreements incorporate management plan recommendations; Surveys of monitoring plots, BFD records of Commercial harvest; Reports of GoB, IUCN, & CITES	BFD or NGOs continue to monitor plots and make data public Records of harvests made public
Outputs 1) Management plan for sustainable xaté harvest 2) Field Guide to Belizean Palms published 3) Xaté information base increased (permanent, experimental & demonstration plots; databases) 4) Publications/reports/ manuals: Xaté abundance, diversity, distribution in Belize determined; Feasibility of xaté eco-labelling explored; Nursery protocols developed 5) Training & education: BFB, BBG, students & local people trained; group educated about xaté	1) Plan completed and given to BFD 2) Guide tested in field; peer-reviewed; 500 copies distributed 3) Forest plots surveyed, effects of defoliation quantified, harvestable yields calculated; cultivation demonstration plots established & compared 4) GIS analysis completed; maps produced; regional yields calculated; buyers, end-users & local suppliers interviewed; genetic analysis completed; nursery techniques described 5) 30 individuals trained (horti-culture, resource assessment, monitoring or GIS); group visits to BBG increase	1) Acknowledgement by BFD 2) Guide published & reviewed 3) Databases, maps, and protocols distributed in Belize; demonstration plots reviewed 4) Background Reports, Final Reports and publications submitted & disseminated 1-4 Copies sent to DI 5) Trained individuals obtain jobs; numbers of visiting groups	1) Technically possible; BFD adopt plan; outputs 2-4 successful & incorporated into Plan; income to BFD sufficient to carry out Plan 2) Guide used for monitoring & education 3) BFD & BBG continue to monitor plots; sufficient local seed available for BBG work 4) Sampling sufficient to scale up to national levels; interviews successful 5) Students & local people interested in participating and continue to work with xaté
Activities	**Activity Milestones (Summary of Project Implementation Timetable)**		
Field research & training	Yr 1: visit xaté harvesting areas in Guatemala & Mexico; establish defoliation & survey plots in Chiquibul Forest; Yr 2 & 3: resample plots; Yr 2: establish survey plots elsewhere in Belize; Yr 1-3: training in resource assessment & monitoring		
Belize Botanic Gardens research & training	Yr 1: visit tropical botanic gardens growing *Chamaedorea* spp. (including xaté spp.); test nursery techniques in Belize; grow stock for planting experiments; Yr 2: develop demonstration plots at BBG, identify local growers, study market interest in eco-labelling; Yr 3: enhance demonstration plots; Yr 1-3: training in horticultural techniques		
Lab research & training	Yr 2: GIS modelling of distribution/abundance of Chiquibul survey data; Yr 3: revised GIS modelling, including resampling from defoliation & survey plots; GIS modelling throughout Belize; Yr 2-3: training in GIS; Yr 2-3: genetic analysis of xaté palms		
Reports, plans & guides	Yr 1: prepare Belize palm guide and test in field; prepare and disseminate background reports on (a) success of other sustainable xaté harvesting programmes in Selva Maya & (b) nursery techniques for xaté; Yr 2: publish & disseminate palm guide; Yr 3: prepare and disseminate Management Plan		
Workshops:	Yr 1: Project planning workshop in Belize after fact-finding visits to Guatemala, Mexico & neotropical botanic gardens; Yr 3: training workshops for BFD staff in xaté monitoring, workshops in xaté cultivation		

Appendix VI. MEASURABLE OUTPUTS

18. Project Outputs

Year/ Month (starting 7 April)	Standard Output Number (see standard output list)	Description (include numbers of people involved, publications produced, days/weeks etc.)
		(New; moved forward 1 FY; moved backward 1 FY)
2003/2004		
May	14A	Planning workshop
June	14A	Presentation to government officials (1)
September	14B	Conferences attended & talks given: 2 (formerly TBA)
October	14A	Local xate workshop at BBG
March	21	Education centre established & equipped at BBG
March	8	NHM staff in Belize on project (2 [NG, MP], total 6 weeks; 1 [SB] – supervision February-April)
2004/2005		
July	3 or 6A/B	BBG staff receives BG management training at RBG Kew (1; 2 mon)
August	4A;4B	Training in xaté horticulture: undergraduate agricultural student (1; 3 months)
August	4A; 4B	Training in GIS data collection and analysis: 1 undergraduate (8 wks, Belize; 4 wks, UK)
October	6B	Training in xaté resource assessment: BFD staff (8 person-months + 16 person-months)
October	8	NHM staff in Belize on project (2 [SB, NB], total 24 weeks full-time, supervision throughout year)
November	4A; 4B	Training in xaté horticulture: undergraduate agricultural student (1; 3 months)
March	6B	Training in xaté resource assessment: BFD staff (8 person-months)
March	8	NHM staff in Belize on project (2 [NG, MP], total 10 weeks)
2005/2006		
June	7	Training materials, 2 types: xaté cultivation techniques manual (1), xaté sustainable use poster (1)
June	4A; 4B	Training in xaté horticulture: 1 undergraduate agricultural student, 3 months
July	6B	Training in xaté resource assessment: BFD staff (16 person-months)
July	6A; 6B	Training workshop for teachers (15; 3 days)
July	8	NHM staff in Belize on project (2 [SB, NB], total 10 weeks full-time, supervision throughout year)
August	7	Training materials, 1 types xaté monitoring and assessment guide (1)
August	4A; 4B	Training in GIS data collection and analysis: 1 undergraduate (8 wks, Belize; 4 wks, UK)
November	6A; 4B	Training workshop: local growers in xaté cultivation (15; 3 days)
March	6B	Training in xaté resource assessment: BFD staff (8 person-months)
March	8	NHM staff in Belize on project (2 [NG, MP], total 10 weeks)
2006/2007		
May	10	Field Guide to Belizean Palms
June	6A; 6B	Training workshop: Forest Dept. staff in xaté monitoring (15; 3 days)
July	8	NHM staff in Belize on project (2 [CM, NB], total 10 weeks full-time, supervision throughout year)
August	9	Permanent xaté cultivation demonstration plots at Botanic Gardens (?number)
March	12A	Geo-referenced database, and GIS maps, given to Belize Information Centre and BFD (1)
March	22	Network of permanent xaté monitoring plots handed to BFD (1 network)
March	5	Education officer completes 3-year period, receiving training and experience in production of educational materials for and teaching schools, teachers, farmers, and local community groups and NGOs

March	9	Management Plan for sustainable xaté harvesting in Chiquibul Forest, including (a) distribution and abundance of xaté; (b) harvesting potential and (c) feasibility analysis of eco-labelling scheme and supplemental local cultivation of xaté (1)
TBA		
TBA	14B	Conferences attended & talks or posters presented: 1 remaining
TBA	11B	Papers submitted to peer-reviewed journals: 2

APPENDIX VII. PROJECT IMPLEMENTATION TIMETABLE

Project implementation timetable	
Date	Key Milestones (New; moved forward 1 FY; moved backward 1 FY; split between 2 FYs)
	Activity areas: F – Field research and training in Belize; B – Belize Botanic Gardens research and training; L – Laboratory research and training at NHM, London; R – Reports, plans and guides; W – workshops
2003/2004	
May	Planning workshop in Belize completed (W)
May	Defoliation plots in Chiquibul Forest established (F)
September	Tropical botanic garden growing Chamaedorea (xaté) species visited (B)
March	Seeds collected in Belize and germination trials established (B)
March	Xaté harvesting areas in Guatemala an visited (F)
2004/2005	
May	Defoliation plots resampled in Chiquibul Forest (F)
May	Xaté harvesting areas in Mexico visited (F)
June	Background report on nursery techniques for xaté prepared and disseminated (B)
August	Tropical botanic gardens growing Chamaedorea (xaté) species visited (B)
October	Survey plots in Chiquibul Forest established (F)
December	Background report on sustainable xaté harvesting in Selva Maya prepared and disseminated (R)
December	Nursery techniques tested in Belize and stock grown for planting experiments (B)
December	Xaté distribution/abundance survey data from Chiquibul modelled using GIS; map prepared (L)
January	Potential local growers identified and market interest in eco-labelling assessed (B)
February	Demonstration plots at BBG established (B)
March	Survey plots in Chiquibul Forest resampled (F)
March	Genetics of xaté palms from Chiquibul Forest analysed (L)
March	Initial consultations with local farmers, communities and businesses completed (B)
March	Training for 2004/05 completed (F, B, L)
2005/2006	
May	Defoliation plots resampled in Chiquibul Forest (F)
May	Draft of Belize palm guide (L) prepared and tested in field (F)
June	Educational materials completed for schools, growers, and harvesters (B)
July	Survey plots elsewhere in Belize established (F)
July	Training workshop(s) held for teachers, using xaté as model for sustainable use of non-timber forest products and presenting xaté plants to schools (W)
August	Xaté cultivation manual disseminated (R)
October	Xaté distribution/abundance survey data from other Belize sites modelled using GIS and map prepared (L)
November	Training workshop(s) in xaté cultivation and market needs held for potential local growers (W)
March	Survey plots in Chiquibul Forest resampled (F)
March	Genetic analysis of xaté palms from elsewhere in Belize completed (L)
March	Training for 2005/06 completed (F, B, L)
2006/2007	
April	Training workshop(s) for BFD staff in xaté monitoring (W)
May	Regular school education visits to BBG in place (B)
May	Belize palm guide published and disseminated (R)
August	Demonstration plots enhanced throughout year and completed (B)
October	Resampling data from Chiquibul included in GIS model, map revised, sustainable yields predicted (L)
November	Management Plan prepared and sent to Forest Department for comment (R)
March	Management Plan revised and presented to Forest Department
2007/2008	
May	Drafts of peer-reviewed papers completed
April	Final Report submitted to Darwin