

# **Darwin Initiative**

## **Final Report**

### **1. Darwin Project Information**

Project Reference No.	8/064
Project title	Information System for Biodiversity and Conservation Management in Mauritius
Country	Mauritius
UK Contractor	University of Reading
Partner Organisations	(a) Mauritian Wildlife Foundation (b) National Parks and Conservation Service (c) University of Mauritius
Darwin Grant Value	£113,850
Start/End date	Sept 1999 – Sept 2002
Project website	
Authors, date	Robert W Burn, Ian C Dale, 2005/6

### **2. Project Background/Rationale**

#### **2.1 Circumstances of the Project**

The principal focus of terrestrial conservation in Mauritius was for many years characterised by attempts to save three critically endangered birds from extinction – the Mauritius Kestrel (*Falco punctatus*), the Mauritius Pink Pigeon (*Columba mayeri*) and, later, the Echo Parakeet (*Psittacula eques echo*). Using techniques which were then new and innovative, such as taking eggs from nests in the wild and rearing chicks under foster parents of a suitable species, and other methods of rearing, considerable success has been achieved. Populations of all three species have been re-established in the wild, with varying degrees of management. Organisations that have sponsored, and otherwise supported, this work over the years dating back to the 1970s include the Durrell Wildlife Conservation Trust (DWCT, formerly the Jersey Wildlife Preservation Trust), WWF, Birdlife International, New York Zoological Society, the Mauritian Wildlife Fund (MWF) and Fauna and Flora International.

The predominant cause of the earlier decline of these species was habitat loss, either owing to agriculture and other developments, or because of severe degradation due to invasive exotic plant species and introduced predators. The effects of habitat loss were exacerbated by the more or less regular occurrence of tropical cyclones, which can have devastating effects on bird populations already under stress. As a result of these fundamental causes of population decline, the focus of conservation in Mauritius began to shift away from single species and towards whole habitat conservation. Another reason for the interest in habitats was the increasing public awareness of environmental problems in Mauritius. The National Parks and Conservation Service (NPCS) was set up by the Government of Mauritius (with assistance from GEF and the World Bank) during the 1980s and early 1990s. There had already been something of a tradition of habitat restoration dating back to the 1930s, at least on a modest scale, and recent work has built on these early efforts. Two uninhabited offshore islets, Ile aux Aigrettes and Round Island, have received special attention in recent years. The former benefits from

a sustained effort to remove all exotic plants and animals and to attempt a complete restoration to a “pristine” state. Round Island has a number of endemic reptiles and plants but has suffered severe degradation resulting from introduced rabbits and goats. These were successfully eradicated in the 1970s and '80s, and the island is the object of intensive conservation and restoration effort.

The interest in habitat conservation has engendered a lively interest in the conservation of native plants in Mauritius, particularly in the surviving fragments of upland forest and in the neighbouring islands. There is a similar upsurge of activity in the status of some reptile species, in particular the endemics of Round Island. Another area in which there is a great deal of activity is in the study and control of vertebrate pests such as rats, mongooses, monkeys, deer, wild boar and feral cats (all of which are introduced species – apart from fruit bats Mauritius has no native terrestrial mammals).

Most of the conservation effort in Mauritius is either undertaken or at least coordinated by the MWF and the NPCS. Taken together, over the years, conservation activities have generated huge quantities of data, mostly retained by these two organisations. The sheer volume and diversity of the data has created an increasingly difficult challenge for the management of data. Efforts to synthesise and analyse the data for the purposes of both management and research in conservation had, by the start of the current project, become fragmentary and disconnected. The MWF is a non-governmental organisation while the NPCS is a part of the Government of Mauritius, a distinction which has sometimes exacerbated the problems of storage and sharing of information. To make matters worse, conservation organisations in Mauritius, especially MWF, regularly take on temporary volunteers and student helpers so that there is a rapid turnover in staff, leading to a lack of continuity in the organisation and management of data.

## **2.2 Problem Addressed by the Project**

Data collected on individual species and on habitats need to be collected, stored and managed in a way that enables them to be analysed jointly. The piecemeal approach to the collection, management and analysis of conservation information that prevailed in Mauritius at the time the project began was an impediment to this integration. There were significant gaps in the data collected, a certain amount of duplication of effort, and in many cases, the data collection methodology was poor, with insufficient attention paid to statistically sound sample designs. A further problem was the lack of any system that facilitated the juxtaposition and analysis of different types data in a way that could lead to important insights. Some examples are: (1) understanding the relationship between the abundance of a bird species and habitat characteristics; (2) assessing the impact of climate change on the breeding success of birds. There were no facilities for managing geographical information or for the spatial analysis of data.

## **2.3 Identifying the Need for the Project**

The project leader (RWB) was a resident of Mauritius during 1984–1997, and became familiar with the conservation activities of MWF. He collaborated with the MWF's scientific coordinator, Dr Carl Jones, in setting up a software system for the genetic management of the captive-bred population of pink pigeons. Although at the time it remained in a fairly embryonic form, this system grew into a more general database system for the general management of the data produced by the pink pigeon project and formed the basis of the data analysis required for Carl Jones' PhD (Jones, 1995). At the same time, some of the other developments outlined above were under way and when RWB left Mauritius in 1995, the idea of an integrated information system was taking shape. The idea was also discussed at length with the Director of the NPCS of the Government of Mauritius, Mr Yousoof Mungroo. The idea was generally received with enthusiasm. It was agreed that, should funding become available, the project should comprise not only the necessary hardware and software elements, but also training for key staff in data management techniques, and basic methods of data analysis and the statistical principles of sampling.

### 3. Project Summary

#### 3.1 Project Purpose and Objectives

The purpose of the project was to meet the needs of conservation management and research in Mauritius in terms of the management and analysis of data.

Specific objectives were:

- (1) to design and develop a computerised information system to serve as a tool for conservation management, research and education in Mauritius; the system will integrate data from a variety of sources, including geographical information;
- (2) to strengthen the capacity of local institutions in the management and use of conservation information.

Planned project outputs were as presented in Table 3.1.1 below.

**Table 3.1.1 Project Outputs**

Year	Output ref. no.	Details
<b>1999/2000</b>	8	UK staff in Mauritius for 4 person-weeks (Nov-Dec 1999): establish local team, collect data for functional specification of system.
<b>2000/2001</b>	10	Data entry manual completed (by Jun 2000).
	20	£10,500 assets handed to Mauritian institutions (by Jul 2000).
	6A/B	5-6 trainees each given 8 weeks training in basic computing, data coding, quality control, data entry and map digitising (Jul-Aug 2000).
	8	UK staff in Mauritius for 10 person-weeks (Jul-Aug 2000): install hardware and software, initial training of key local staff.
	12B	1 multiple database system enhanced (by Mar 2001).
<b>2001/2002</b>	12A	10 databases integrated (by May 2001).
	8	UK staff in Mauritius for 20 person-weeks (Jun-Aug 2001): training, supervision of student projects, system development, supervision of data capture and map digitising.
	4A/B	At least 4 undergraduate students to receive training of approx. 8 weeks duration in concepts of data management for conservation (Jul-Aug 2001).
	6A/B	8-10 trainees given 12 weeks training on further computer skills, data management and ecological sampling techniques (Jun-Aug 2001).
	12B	1 multiple database system enhanced (by Feb 2002).
	15A, 18A, 19A	Press releases, radio and TV news features issued and made in Mauritius (see Note (1) below), from Sep 2001.
<b>2002/2003</b>	4A/B	At least 4 undergraduate students to receive training of approx. 8 weeks duration in concepts of data management for conservation (Jul-Aug 2002).
	6A/B	8-10 trainees given 8 weeks training on data management for conservation using the new information system (by Aug 2002).
	8	UK staff in Mauritius for 14 person-weeks (during May-Aug 2002): final training, supervision of student projects, organise seminar, preparation of final report, work on research topics.
	14A	Seminar (3 days) at University of Mauritius. (Aug 2002). See Note (2) below.
	11B	At least 5 papers submitted for publication (by Aug 2002).
	15A, 18A, 19A	Press releases, radio and TV news features issued and made in Mauritius (see Note (1) below), until end of project.
	17A	Dissemination network established (by Jun 2002).
	21	A permanent research facility established (by end of project).

The project was managed by R.W. Burn (RWB, Project Leader) and I.C. Dale (ICD) of the Statistical Services Centre of the University of Reading. The local collaborating institutions were

- the National Parks and Conservation Service of the Government of Mauritius (Director: Mr Y. Mungroo),
- the Mauritian Wildlife Foundation (Scientific Co-ordinator: Dr Carl Jones),
- the University of Mauritius (Representative: Dr R. Dulymamode).

It was agreed by all parties at the outset that liaison with the local collaborating institutions would be managed by the MWF, and the University of Reading had a Memorandum of Understanding with them establishing the terms of this collaboration (included with this report).

### **3.2 Changes to Project Objectives**

Feedback from the Darwin Monitoring and Evaluation Project to our 2001 Annual Report suggested that our goal of at least five peer-reviewed publications was a little ambitious and that three would be a more realistic aim. We followed that advice and altered our original objectives accordingly.

### **3.3 Articles under the Convention on Biological Diversity (CBD) Addressed by the Project**

The CBD Articles that best describe the project are:

- Article 12: Research and training
- Article 13: Public education and awareness
- Article 14: Information management for impact assessment
- Article 17: Exchange of information
- Article 18: Technical and scientific co-operation

See Appendix 1 for apportionment of the project's contribution to these Articles.

### **3.4 Brief Overview of Project Success and Impacts**

In broad terms, the project can claim success in both of its main objectives (section 3.1). An information system was set up and staff were trained in techniques of the collection, management and analysis of conservation and biodiversity data.

The success was somewhat uneven, however. Our aims were perhaps over-ambitious and some areas are less well developed than was anticipated – statistical methods and GIS, for example. The problem was not lack of enthusiasm, but lack of time within the duration of the project, and the key collaborators continued to seek further opportunities for learning well after its completion.

Some difficulties arose towards the end of the project because of a major restructuring of our principal collaborating institution (see section 9).

On the plus side, the level of participation and enthusiasm shown by students and staff of the University of Mauritius in the project's two workshops was much greater than expected.

## **4. Scientific, Training, and Technical Assessment**

### **4.1 The Local Team**

At an early stage of the project, the principal collaborators in Mauritius were recruited. They were:

- Dr John Mauremootoo (MWF Flora Manager)
- Dr Carl Jones (MWF Scientific Coordinator)
- Saoud Motala (MWF trainee, then Data Manager: see '*Local counterpart funding*')

- Jennifer Ah-King (MWF trainee; John Mauremootoo's research assistant)
- Mr Yousoof Mungroo (NPCS Director)
- Dr Rafic Dulymamode (Senior Lecturer, University of Mauritius)

John Mauremootoo was the local Darwin project leader.

Saoud Motala and Jennifer Ah-King agreed to be "key collaborators", in the sense that they themselves would eventually become trainers of local staff, under the supervision, at least initially, of John Mauremootoo.

Other members of all three organisations (MWF, NPCS and University of Mauritius) participated at various stages of the project, as did a number of visitors from overseas.

#### *Local counterpart funding*

The existence of the Darwin project enabled MWF to obtain counterpart funding from local Mauritian sources. MWF received a three-year grant from the Mauritius Research Council to cover the salary (and overheads) for the employment of Saoud Motala as Data Manager for the Darwin project.

Funding was also provided by the NPCS to purchase computing equipment matching that provided by the Darwin Initiative to MWF.

## **4.2 Technical Resource Development**

### **4.2.1 Overview**

An important component of the project was the provision of the computing tools to manage and analyse data. The project supplied hardware in the form of computing equipment – computers, printer, digitiser and plotter. The more challenging task was to deliver the means to effectively use the hardware. There were three aspects to this:

- (a) training local staff;
- (b) programming custom software solutions appropriate to the tasks in hand;
- (c) developing statistically sound methods of data collection appropriate for local conditions.

Training issues (a) are dealt with in more detail in Section 4.3 below; here we describe what the project achieved under (b) and (c). Although much of the design and programming of the software tools for the project was initiated by the Reading team, their development was used as far as possible as a vehicle for training of local staff, so that in most cases, the outputs were the fruits of collaborative efforts between the Reading team and local staff.

Software systems and procedures provided by the project comprised:

- (a) database management tools;
- (b) programs for the genetic management of captive-bred populations of birds;
- (c) procedures for the analysis of data arising from captive breeding and from monitoring released populations of birds;
- (d) GIS tools.

### **4.2.2 Database management tools**

Microsoft Access® and Visual Basic® were the main vehicles for the development of database tools. Training covered the basic use of the system, but more specialised systems were programmed and provided by the project team. (Further training was given to some staff on systems programming to enable them to design and implement their own database systems in the future – see Section 4.3).

Three major components of the information system were database systems for the management of three populations of endangered bird species: the Mauritius Pink

Pigeon (*Columba mayeri*), the Mauritius Kestrel (*Falco punctatus*) and the Echo Parakeet (*Psittacula eques echo*). Although there was some common ground in the design of the three systems, there were significant differences also, due in part to the different stages of development of the three conservation projects, but also because of differences in the biology of the three species.

Two separate but related goals defined the needs in these three systems: one was the task of record-keeping, mainly for the purposes of management; the other is to provide the data inputs for research. There are several existing software systems designed for the former goal and these were reviewed for their suitability at an early stage of the project. ARKS (Animal Record Keeping System), designed for zoos, is perhaps the most comprehensive and widely used. Its limitations for the Mauritius situation are (1) it is a large cumbersome system not well suited to the scale of operations in Mauritius which has just a few species bred in captivity; (2) it has no provision for records of animals in released populations – nest records, migrations, feeding data, etc.; (3) it is designed for management use and does not accommodate much of the observational data required for research – e.g. morphometric data; (4) it is expensive. It was decided at an early stage that custom database systems should be developed for all three species.

### ***Pink Pigeon database***

The Pink Pigeon database was based on some preliminary work done by RWB before the current project began. At the time of the start of this project, Pink Pigeons were still being bred in captivity, although captive breeding has since ceased. At the same time, pigeons were being released into the wild to form the basis of five self-sustaining populations. These populations are closely monitored by field staff. The project aimed to address questions concerning the genetic management of both captive breeding and the release programme (see Section 4.2.3 for more details of this aspect), while at the same time providing the usual record-keeping facility. Again, research questions were very much in mind when designing the system (see Section 5.1). There is considerable interest, for instance, in examining the effects of inbreeding and loss of genetic diversity on the viability of populations arising from captive-bred birds. Tables in the database include data on egg measurements and fertility, information on pairings, morphometric data and supplementary information on causes of death. The system was also designed to record detailed data on nesting and feeding behaviour, all observed and recorded in the field.

Pink pigeons are now held, and in some cases bred, in a number of collections around the world. In order to maintain the integrity of breeding data it is important to collate all pedigree information in one centralised database, the international studbook. For this species the international studbook, an ARKS based system, is maintained by the DWCT at Jersey Zoo. The Darwin Pink pigeon software was designed to facilitate exchange of data with the international studbook.

The program was designed with a user-friendly interface with facilities for data entry, data quality control and flexible outputs into spreadsheets, and from there to statistics packages for data analysis. The program was written in Visual Basic®, and constituted a platform for training in VB programming for MWF staff, in particular Saoud Motala.

### ***Mauritius Kestrel database***

By the time this project began, Mauritius kestrels were no longer being bred in captivity and the project's work consisted mainly of designing and implementing a system for the purpose of monitoring the established populations of released birds. The database program for kestrels was designed primarily for this monitoring, although in order to meet the needs of research, additional detailed information was included. Historical data deriving from the earlier captive breeding programme were also included. Intensive field operations ensured that every breeding pair of kestrels was kept under close observation during the breeding season, so that good pedigree data was available. Complete studbook data was therefore available for the entire history of the breeding

and release programmes. The difficulties of having breeding pairs in other parts of the world did not arise with the kestrels, so that by default, MWF effectively became the holders of the international studbook for the species.

Research into the reasons underlying the success of the kestrel release programme, as well as some of the problems encountered, was regarded as an important goal with implications for similar conservation efforts elsewhere. In particular, studies in kestrel genetics – inbreeding depression and the phenotypic effects of loss of genetic diversity – have been made possible by the project's database, and further work continues (see Section 5.1). The database has records of every individual egg, and its fate, since the start of the captive breeding programme. In addition, the system holds detailed data on nesting behaviour and breeding success. Responsibility for the design and programming of the kestrel database was given to the Saoud Motala, supervised by RWB and ICD.

### ***Echo parakeet database***

The Echo Parakeet database was designed along similar lines to the kestrel system, with some ideas taken from the Pink Pigeon database also. During the course of this project, Echo parakeets were being bred in captivity. The release programme was also begun during this period. The record keeping and management aspects of the system were similar to the Pink Pigeon database because it need to record data both on breeding management and on the release programme. The main differences arose from the differences in the breeding biology of the two species: Pink pigeons form essentially monogamous pairs (with occasional extra-pair copulations), while Echo parakeets form breeding groups and precise information on pairings is rarely observable. This was reflected in the structure of the database.

There was no breeding of Echo parakeets at sites in other countries, at least at the time of the project, and the database was correspondingly somewhat simpler than the Pink pigeon system. As with the kestrel database, much of the implementation was done by Saoud Motala.

### ***Other databases***

A number of databases were designed and implemented. The development of these systems was largely undertaken by local staff, Jennifer Ah-King and Saoud Motala in particular, supervised from Reading by ICD. The databases included:

- Nursery management system for Ile aux Aigrettes: a nursery of native plant species has been established on the island for the purposes of the restoration programme. The database was designed and set up by Jen Ah-King and is now a functioning part of the management of the nursery.
- Weed control management system for Ile aux Aigrettes.
- Rare plants catalogue: a database, set up by Jen Ah-King, of rare native species encountered in the field. It was used as the basis of a new field identification guide for native plants in Mauritius, prepared by Malika Veerasawmy.
- Propagation Database for Native Plants of Rodrigues: a database to underpin the management and monitoring of a MWF project based on Rodrigues, which has the goal of assisting local people in identifying and propagating native plants.
- Round Island Petrel Database: focusing on the breeding biology of the endemic petrel. Database designed and set up by Saoud Motala; data being entered by Vikash Tatayah (research student, University of Mauritius).
- MWF 'Reference Library' database: in an attempt to introduce some order into the accumulation of reports, reference papers, articles and books at the MWF offices, steps were made towards producing a catalogue of these materials.

### 4.2.3 Genetic management software

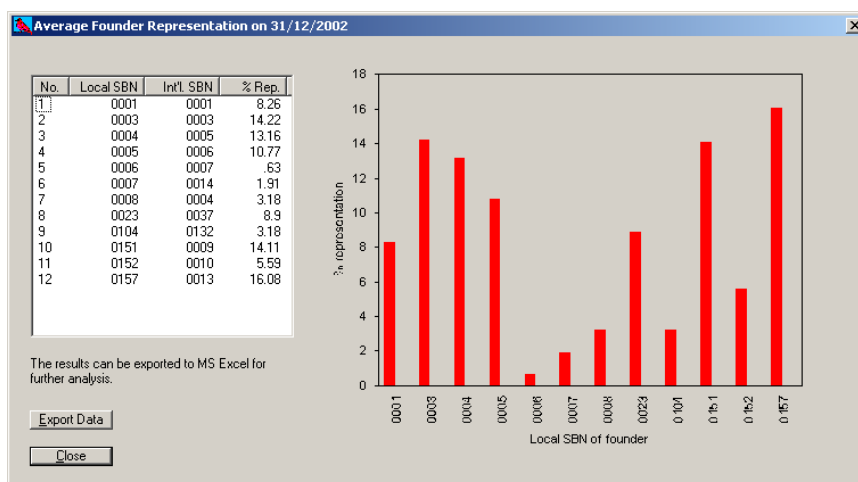
For captive breeding programmes, a particular aspect of the management requirement is for the quantitative analysis of pedigree data to enable an informed genetic management of the population. The principal goals in genetic management are to minimise inbreeding and to maximise genetic diversity. The latter objective is achieved by monitoring the founder representation (proportions of genes from the founding individuals that are present in the extant population). The software is therefore required to produce inbreeding and kinship coefficients and founder representations. Again, there are existing programs that do these tasks – SPARKS (Single Population Animal Record Keeping System), an offshoot of ARKS, is well-known; PM2000 is a more recent program which is similar. However, neither of these systems was thought to be entirely suitable, partly for the same reasons that ARKS was rejected.

The genetic management features of the Pink Pigeon system provide profiles of founder representations and inbreeding coefficients, and include at least one feature not found in other similar systems – computation of kinship coefficients for trial pairings – which was found useful in the captive breeding phase. Although captive breeding of the Pink Pigeon ceased during the course of the project, the pedigree data was more complete and extensive for this species than for the others. It was therefore decided to develop the software for this species first with a view to generalising to other species later. The genetic management component of the Pink Pigeon system has been programmed as an integral part of the database system. However, it was possible to detach it and use it as a stand-alone system for other species (undertaken by Saoud Motala). In this way it was used with the Echo parakeet and Mauritius kestrel databases

The genetic facilities in the program are:

1. *Inbreeding coefficients* – the program calculates all inbreeding coefficients in a single operation.
2. *Kinship coefficients (historical)* – calculated for every pairing in the database.
3. *Kinship coefficients for a trial pairing* – for a given male and female (in the database), calculates the kinship coefficient, i.e. the inbreeding coefficient of any offspring that arose from the pairing.
4. *Average founder representation* – the proportion of genes from each founder in the extant population.
5. *Individual founder representation* – the distribution of founder genes in a given individual.
6. *Descendants* – list all descendants of a given individual.

To illustrate how these features can be used to improve the genetic management of a captive breeding programme, we could look at the founder representation – for example:





To maximise genetic diversity we would want this distribution to be as uniform as possible. For example, we see that the founder identified by Local SBN 0006 is particularly poorly represented and should attempt to breed from that individual. The database records show, however, that it is dead. So we try to identify any surviving descendants – the program yields the result ...

Descendants of 0006				Local SBNs of Founders ...									
Local SBN	Int'l SBN	Age(yrs)	Sex	Site	Inbr Coeff	Status	0001	0002	0003	0004	0005	0006	0007
1968		17	M	Antwerp	0.000000	A	0.00%	0.00%	6.25%	6.25%	0.00%	50.00%	0.00%
1970		15	F	Jersey Zoo, Channel Islands	0.104004	A	0.00%	0.00%	12.11%	12.11%	7.81%	25.00%	0.00%

Two individual offspring have been located. These would be important individuals to breed from in order to ensure the survival of the genes of founder 0006.

#### 4.2.4 GIS & habitat mapping

The key to making full use of database information is the spatial context. To this end the ArcView GIS package was installed on computers at the MWF office, together with a digitizer tablet, a scanner and an A3 format colour printer. Training in GIS was given to the MWF staff, principally Jen Ah-King, and the painstaking process of digitizing base maps of the principal locations was commenced.

Due to the unavailability at the time of suitable georeferenced digital maps, digitization of areas of interest was based on various published paper maps of Mauritius. The outputs were 'approximately' georeferenced – a compromise that allowed training to proceed. However, the resulting maps have still to be correctly georeferenced, to facilitate the integration of records from handheld GPS devices.

Thematic maps of Ile aux Aigrettes, Round Island, and the Brise Fer Conservation Area were prepared, and plans were made for the digitization of larger areas – specifically the Black River Gorges and the Bambous Mountains.

Methods were established for linking the digitized maps to the information in the databases; this was taken furthest for the Weed Management database for Ile aux Aigrettes. Maps were generated to help manage the progress of the weed eradication programme.

### 4.3 Training and Capacity Building

#### 4.3.1 Capacity Building in data management and GIS

Training was provided to MWF staff on the use of the specialised software systems (GIS and database management) provided by the project and, to some staff, instruction and practice in the programming skills needed to further develop the tools. Further training included instruction in the routine use of standard office software, and good practice in the use of IT equipment generally.

Once the National Parks and Conservation Services had acquired the hardware and software suitable for doing similar work to that done in MWF, staff from NPCS (initially Vimal Nundloll and Souraj Gopal) were trained by the MWF staff in basic data management, elements of GIS, and setting up databases relevant to their conservation projects.

To give a boost to the training, Saoud Motala was brought to the UK in August 2002 to work on databases with ICD at Reading, and to attend a workshop (14-20 August) on Distance Sampling at the Centre for Research into Ecological and Environmental Modelling (CREEM) at St Andrews University, Scotland. He also made study visits to the Natural History Museum in London, for discussions about maintaining entomological collections, and (with ICD) to the DWCT in Jersey to work with the current maintainers of the international studbooks for Mauritian fauna, held in ARKS/SPARKS files.

#### 4.3.2 Workshops

Two training workshops (9–15 July 2001 and 1–14 July 2002) under the umbrella title of 'Biodiversity Assessment' were run as collaborative ventures involving MWF, the University of Mauritius (UoM), and the Darwin Initiative project. They were hosted by

UoM, with additional funding from a Global Environment Facility grant, administered by UNDP, for projects on the conservation of upland forest in Mauritius. Although the workshops involved several organisations, the Darwin project's role was central.

The forty or so participants on each workshop included biology students from UoM, staff of the Parks & Conservation and Forestry Services, volunteers and staff from MWF, and several members of interested local organisations. In addition to RWB and ICD, the trainers included UoM lecturers, MWF staff, and guest speakers from the Mauritius Herbarium (part of MSIRI, the Mauritius Sugar Industry Research Institute) and the Forestry Service. Lists of the trainers, resource people and students on the two workshops are in Appendix V.

The programmes were a mixture of classroom-based activities (lectures and computer-based practical sessions), field study visits, and data collection at field sites. Further information is given in the Appendix.

#### **4.4 Developing Data Collection Methods**

It emerged that there is a greater need for training on methods of data collection in the field and sampling methodology than was initially anticipated. Even though data collection from the field was a routine activity, there was little awareness of the principles of sampling design at any level in the collaborating institutions. The problem was particularly keenly felt when planning studies to evaluate the status of endemic Round Island reptiles. MWF and NPCS were awarded a substantial GEF grant for the management of Round Island, and inputs from the Darwin project were requested. Although the Darwin project proposal included training on ecological sampling techniques during the last year of the project, it was decided to expand and bring some of this work forward, to fit in with work on the GEF grant. Sampling and monitoring methods for Round Island reptiles has proved to be a rather intractable problem over the years and MWF took the view that a statistician's view could make a significant contribution to the problem. RWB was invited to join a trip to Round Island in October 2000 to examine the field problems and make recommendations for appropriate sampling methods. A report on preliminary recommendations was written by RWB together with Fiona Underwood, then of the Research Unit for Wildlife Population Assessment, University of St Andrews, who also joined the Round Island trip. This document accompanies this Report. The report shows that there are special problems to be addressed in designing studies to estimate the abundance and distribution of the endemic reptiles, and sets out some recommendations for dealing with these problems.

One outcome of this work was that the Darwin team (represented by RWB and Dr John Mauremootoo) were invited, together with Dr Carl Jones, to participate in a training workshop organised in July 2001 by NPCS at the Black River Gorges Visitors' Centre of the National Park. The workshop covered general principles of sample design as well as specific approaches to dealing with some of the tricky problems encountered on Round Island, following the guidelines set out in the above-mentioned report.

## **5. Project Impacts**

### **5.1 Meeting the Project Objectives**

The project's objectives are set out in Section 3.1.

The hardware and software tools that have been provided by the Darwin project constitute the building blocks of the system. To turn these into a functioning information system requires training and a change of approach to the management and use of data. The project has made a significant contribution to bringing about this change. Given the long and somewhat haphazard history of managing conservation data in Mauritius, this change amounts to a sizeable culture shift. Data are no longer stored away in decaying box-files, but are properly entered into computer systems and carefully backed up.

Tools for genetic management are available in the system. The fact that these facilities exist encourages a more scientific approach to captive-breeding programmes, instead of the trial and error methods of the past.

GIS tools do more than produce nice maps, which of course they do very well. They also invite thinking about the spatial component of observational data.

In addition to its management role, the system has been designed to facilitate the provision of the data for research purposes. Here there have been some notable successes (see Section 5.2).

The information system that has resulted from the Darwin project is not to be seen as a static “black box”, but rather as something that can grow and develop adaptively in response to changing needs and the competence of the staff involved. By training key collaborators to be trainers themselves, we have provided a way to achieve this.

As a direct consequence of the Darwin project, MWF now has created the post of Data Manager, and this was funded for the first three years at least by the MRC (Mauritius Research Council).

The initial success of the Darwin information system has prompted more local funding from the MRC to the MWF for further developments. This includes funding for the development of

- PPDB 2.0 – version 2 of the Pink Pigeon database,
- ECH 2.0 – version 2 of the Echo parakeet database,
- RIPD 1.0 – the Round Island petrel database,
- NDB 2.0 – version 2 of the native plants database.

The local trainers train MWF and NPCS staff as well as visiting expatriate volunteers, when appropriate.

## **5.2 Research that has been facilitated by the project**

The purpose of the project was not research itself, but rather to provide the means to assist in conservation research (aside from the conservation management objectives). Several lines of research have been assisted by the existence of the data management tools that the project has provided. These include research projects both within Mauritius and in a number of overseas institutions, as well as collaborative research projects. Some examples are:

- Pink pigeon genetics
- Ecology of the Mauritius kestrel
- Effects of climatic variation on the Mauritius kestrel

The Pink pigeon database provided the data inputs for population viability assessment (PVA) that was conducted in Mauritius in 2001 by Kirsty Swinnerton and Merilee Temple (Wildlife Preservation Canada’s “New Noah”).

Mauritius Kestrel research under way at the University of Reading:

- *Aging and individual life histories in Mauritius kestrels* (Dr Malcolm Nicoll and Prof Ken Norris);
- *Population mechanisms of a restored population of the Mauritius kestrel* (Malcolm Burgess, PhD research)
- *Assessing changing rainfall patterns in Mauritius and their effect on the population dynamics of the Mauritius kestrel* (Deepa Senapathi, PhD research; also Dr Fiona Underwood).

To give a flavour of one of the research projects in progress, a working paper *A method for analysing daily rainfall data to investigate evidence of climate change* by Fiona Underwood is included with this Report.

Some papers and theses that have made more or less direct use of the Darwin project's databases and other facilities:

Swinnerton K.J., Groombridge J.J., Jones C.G., Burn R.W., Mungroo Y. (2004). Inbreeding depression and founder diversity among captive and free-living populations of the endangered pink pigeon *Columba mayeri*. *Animal Conservation* 7, 353-364.

Swinnerton K.J., Pierce M.A., Greenwood A., Chapman R.E., Jones C.G. (2005). Prevalence of *Leucocytozoon marchouxi* in the endangered pink pigeon *Columba mayeri*. *Ibis*. 147, 725-737.

Swinnerton K.J., Greenwood A., Chapman R.E., Jones C.G. (2005). The incidence of the parasitic disease trichomoniasis and its treatment in re-introduced and wild pink pigeons *Columba mayeri*. *Ibis*. 147, 772-782.

Groombridge J.J., Bruford M.W., Jones C.G., Nichols R.A. (2001). Estimating the severity of the population bottleneck in the Mauritius kestrel *Falco punctatus* from ringing records using MCMC estimation. *Journal of Animal Ecology* 70, 401-409.

Nicoll M.A.C., Jones C.G. & Norris K. (2003). Declining survival rates in a re-introduced population of the Mauritius kestrel: evidence for non-linear density-dependence and environmental stochasticity. *Journal of Animal Ecology*, 72, 917-926.

Swinnerton K.J. (2001). *The Ecology and Conservation of the Pink Pigeon Columba mayeri in Mauritius*. PhD Thesis, University of Kent at Canterbury.

Nicoll M.A.C. (2004). *The Ecology and Management of a Re-Introduced Population of the Mauritius Kestrel (Falco punctatus)*. PhD Thesis, University of Reading.

Copies of the first three of these papers are included with this Report.

An example of another research impact of the project is the paper *Monitoring Round Island Reptile Populations* (Burn and Underwood, 2001; included with this report), which continues to influence the way data on reptiles are collected and analysed.

### **5.3 Future development of genetic management software**

The genetic management software developed in this project, initially for the Pink Pigeon, has potential for further development. RWB presented and demonstrated the system at a DWCT seminar in Jersey Zoo in December 2004 (slides in Appendix VI). There was considerable interest in the potential for turning it into a generic system for birds as well as mammals, reptiles and amphibians, was discussed. It could provide an attractive and cheap alternative to the more expensive (and less user-friendly) systems currently available, especially for *in situ* and captive breeding programmes in developing countries. Possibilities for funding this development are being explored.

### **5.4 Local impacts of the project**

The immediate beneficiaries of the project were the staff who received training and guidance in the development and use of information systems. In turn, this training has helped to introduce a culture of the scientific collection, management, analysis and interpretation of conservation data in both of the main host institutions, MWF and NPCS.

The project's workshops held at the University of Mauritius reached a much wider audience, consisting of young and very enthusiastic students and volunteers. Indeed the size and energy of the participants was impressive. The project's key trainees played leading roles in running and organising the workshops. The experience gained will serve to enable similar collaborations between the University and local conservation groups in the future.

The legacy of the project is a functioning information system, comprising not only hardware and software components, but also trained people to use and manage these components. Following the project, the key collaborators have acquired the ability to

further develop elements of the information system and adapt the system to the changing needs of conservation management and research. They have also acquired competence as trainers of future staff and visiting expatriate volunteers.

After the project, Saoud Motala went on to do an MSc in Advanced methods of taxonomy and biodiversity at the University of Plymouth, with the cooperation of the Natural History Museum. Jennifer Ah-King went to the University of East Anglia to do an MSc in Applied Ecology and Conservation.

## 6. Project Outputs

Project outputs are summarised in Appendix II using the coding of the Darwin Initiative Standard Output Measures.

Publications and documents are listed in Appendix III.

Unlike many Darwin projects, the outputs were mainly tools for management and research, rather than the results of research. Consequently the outputs were largely systems that have been installed and handed over to the local collaborators, together with training of staff. Dissemination of the project outputs was confined to describing the systems to local and international audiences whenever the occasion arose, and is mentioned in sections 5 and 11 of this report.

## 7. Project Expenditure

<b>Expenditure</b>	<b>Actual for project life</b>	<b>Budget</b>	<b>Balance in (out) of hand</b>	<b>Percentage in/out of hand</b>
<b>Heading</b>				
<b>Total Expenditure</b>	<b>113,850</b>	<b>113,850</b>	<b>0</b>	

The percentage differences in the figures above represent a change to the Darwin Initiative project agreed with Sylvia Smith at DEFRA by email to RWB on 6 June, 2002 (emails attached to this report) – namely, to divert unused funds on the staff costs budget to provide specific training for Saoud Motala, one of the project's key collaborators in Mauritius.

## **8. Project Operation and Partnerships**

### **8.1 Local participation**

Local participation turned out to be broader than anticipated, and this was true of all three of the collaborating institutions.

MWF: John Mauremootoo, Saoud Motala, Jennifer Ah-King were the key participants and, to varying degrees, received training as trainers. Other local MWF staff who participated in the project were Malika Veerasawmy and the local staff of the Black River Aviaries, especially Marie-Michelle Townsend and Frédérique de Ravel. Vikash Tataya was also always interested, and very helpful with the project.

UoM: In addition to Dr Rafic Dulymamode, our key collaborator at the university, Vincent Florens was an enthusiast of the project. We were pleased by the unexpectedly large number of university undergraduates who attended the two workshops.

NPCS: in addition to the main participants, Vimal Nundloll, Suraj Gopal and Nita Sooritan, the NPCS Director, Mr Yousoof Mungroo followed the project very closely and was enormously helpful throughout.

Community participation has taken off in the Island of Rodrigues, where John Mauremootoo is working to involve local people in the propagation of native plants. This work is managed with the aid of databases developed by the Darwin project.

### **8.2 International participation**

MWF/NPCS projects were frequently visited by researchers and conservationists from organisations, and some of these made significant contributions. They included:

- Dr Gordon Rodda (USGS, Guam), a herpetologist who was visiting with Dr Tom Frits,
- Dr Nick Arnold, then Head of Reptiles at the Natural History Museum, London (since retired),
- Dr Diana Bell, Senior Lecturer in the School of Biological Sciences, University of East Anglia.

Other links arose from visits by staff of the Universities of Bristol, Kent and Queen Mary College, several of which concern PhD and MSc projects for UK students.

## **9. Monitoring and Evaluation, Lesson learning**

The anticipated external monitoring and evaluation by a review panel was hampered by problems of availability, and in one case serious illness, and was abandoned. Instead, a less formal review process was agreed with Mr Ian Wilson (then Director of the SSC at Reading), Dr Carl Jones of MWF and Mr Yousoof Mungroo, Director of NPCS. Dr Jones and Mr Mungroo were able to monitor developments in Mauritius, while Mr Wilson provided feedback on progress in Reading.

Problems that occurred were in the following areas:

- prioritising different facets of the work;
- issues arising from administrative difficulties in Mauritius;
- difficulties arising from structural and organisational changes in MWF, the main local partner.

Problems of the first type were generally quite easy to deal with. Local bureaucratic problems were more difficult. For instance, early on in the project, contact was made with the Remote Sensing Centre of the Government of Mauritius with a view to including them as an additional local collaborator. The Director and staff of the Centre were very enthusiastic about the project, but required approval from the Ministry of Agriculture. In

spite of several letters, including one from Mr Mungroo, no reply was received, and the idea was abandoned.

Cooperation between the local collaborating partners was not always easy. There were different expectations of the project from the various partners, occasionally leaving the project team in the middle trying to accommodate all parties.

During the final year of the project, MWF underwent a major review by DWCT, at the time its principal source of funding. The review was undertaken by Dr John Fa and Dr Steve Cobb on behalf of DWCT.

This review had major implications for the Darwin project that arose from changes in staffing. It eventually led to changes in staffing and a change of premises. One problem was a series of delays in uptake of Darwin project outputs, which extended well beyond the duration of the project. Another difficulty for the project was that Dr John Fa was originally one of our project team, but felt that there could be a conflict of interest over the review and therefore left.

A lesson to be drawn is that choosing several local collaborators can lead to difficulties. Great care is needed in acquiring a prior understanding of their needs and expectations. In the event that these diverge, a strategy for coping needs to be worked out in advance. If this proves to be difficult then the need for several partners should be reconsidered.

## **10. Actions taken in response to annual report reviews (if applicable)**

The review of the 2001 Annual Report suggested that our target of “at least five” peer-reviewed papers was a little ambitious. This turned out to be correct!

## **11. Darwin Identity**

- The project was presented and discussed at a one-day conference, “Evolution and Conservation in the Mascarene Islands”, held at the Natural History Museum, London, in September, 2000. RWB was invited to present the Darwin project.
- The local company Talipot Productions Ltd created a multimedia package on Mauritius to celebrate the millennium. The package comprised four CDs (and accompanying documentation) containing information and articles on the history, politics, culture and natural history of Mauritius. The Darwin project was invited to contribute material.
- RWB contributed an article on the Darwin project to Reading Reading, the University of Reading’s alumni magazine. This has a very wide international distribution.
- The project was featured in the 2002 Annual Review of the University of Reading; this also has a large circulation.
- The genetic management and analysis components of the project were presented by RWB to the DWCT in Jersey Zoo in December 2004.

## **12. Leverage**

As a direct consequence of the Darwin project, local funding was sought and obtained from the Mauritius Research Council for the salary and overheads for the MWF to appoint Saoud Motala as Data Manager.

The MRC also provided funds to the MWF, after completion of the project, for the development of further database systems, detailed in section 5.1.

### **13. Sustainability and Legacy**

Conservation in Mauritius had an excellent record in collecting data, mostly in the form of notebooks and paper records stored in box files. Although computers had made a modest intrusion before the Darwin project, there were virtually no systematic attempts at managing data and turning it into usable information for the purposes of management and research.

By developing data management tools and an entire information system together with local participants, the Darwin project has made a significant contribution to building a culture of scientific management and analysis of conservation data. Contacts between the SSC at Reading and the local collaborators are fairly frequent, not least because of the research that continues at Reading and that makes use of data from the Mauritius system.

It is likely that there are centres of conservation activity in other developing countries that could benefit from similar efforts. Indeed, lessons that have been learnt from the Mauritius are proving invaluable to the SSC in other projects in conservation – notably our work on designing monitoring systems for elephant populations and the ivory trade for the CITES MIKE and ETIS programmes.

### **14. Value for money**

The project has provided the means to manage and analyse complex data arising from a range of conservation activities and has trained some key staff to act as trainers for future activities. The immediate benefits to the collaborating organisations are an information system comprising computer hardware, software and the means to use them. In our view, in spite of the drawbacks mentioned in section 9, the cost has been relatively modest. As evidence for this claim:

- The project has attracted local funding for further developments (section 5.1);
- Research projects, both locally and in a number of universities in the UK, are utilising the fruits of the information system;
- The project has inspired local staff to pursue higher degrees in the UK.



## 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.*

<b>Project Contribution to Articles under the Convention on Biological Diversity</b>		
<b>Article No./Title</b>	<b>Project %</b>	<b>Article Description</b>
<b>6. General Measures for Conservation &amp; Sustainable Use</b>		Develop national strategies that integrate conservation and sustainable use.
<b>7. Identification and Monitoring</b>		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.
<b>8. In-situ Conservation</b>		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.
<b>9. Ex-situ Conservation</b>		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.
<b>10. Sustainable Use of Components of Biological Diversity</b>		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.
<b>11. Incentive Measures</b>		Establish economically and socially sound incentives to conserve and promote sustainable use of biological diversity.
<b>12. Research and Training</b>	70%	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).

<b>13. Public Education and Awareness</b>	10%	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.
<b>14. Impact Assessment and Minimizing Adverse Impacts</b>	5%	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.
<b>15. Access to Genetic Resources</b>		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.
<b>16. Access to and Transfer of Technology</b>		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.
<b>17. Exchange of Information</b>	5%	Countries shall facilitate information exchange and repatriation including technical scientific and socio-economic research, information on training and surveying programmes and local knowledge
<b>18. Technical and Scientific Cooperation</b>	10%	Countries shall promote international and scientific cooperation in the field of conservation and sustainable use of biological diversity, where necessary, through the appropriate international and national institutions.
<b>19. Bio-safety Protocol</b>		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.
<b>Total %</b>	<b>100%</b>	<b>Check % = total 100</b>

## 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)
<b>Training Outputs</b>		
1a	Number of people to submit PhD thesis	
1b	Number of PhD qualifications obtained	
2	Number of Masters qualifications obtained	
3	Number of other qualifications obtained	
4a	Number of undergraduate students receiving training	8 UoM BSc projectstudents
4b	Number of training weeks provided to undergraduate students	At least 4 weeks each
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 <b>long-term</b> (>1yr) training not leading to formal qualification( i.e not categories 1-4 above)	
6a	Number of people receiving other forms of <b>short-term</b> education/training (i.e not categories 1-5 above)	6 up to 2001 Including training of trainers). Further training for these 6 beyond 2001, plus >10 trainees trained by them.
6b	Number of training weeks not leading to formal qualification	As in 6a.
7	Number of types of training materials produced for use by host country(s)	
<b>Research Outputs</b>		
8	Number of weeks spent by UK project staff on project work in host country(s)	1999 – 2000: 4 person-weeks 2000 – 2001: 10 2001 – 2002: 20 2002 – 2003: 14
9	Number of species/habitat management plans (or action plans) produced for Governments, public authorities or other implementing agencies in the host country (s)	
10	Number of formal documents produced to assist work related to species identification, classification and recording.	Data entry manuals installed on-line (one for each database)
11a	Number of papers published or accepted for publication in peer reviewed journals	
11b	Number of papers published or accepted for publication elsewhere	
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	10 separate component systems
12b	Number of computer-based databases enhanced (containing species/genetic information) and handed over to host country	10 DB systems integrated in an information system
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)	

<b>Code</b>	<b>Total to date (reduce box)</b>	<b>Detail (←expand box)</b>
<b>Dissemination Outputs</b>		
14a	Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work	Two major workshops at the UoM: 9-15 July 2001 and 1-14 July 2002.
14b	Number of conferences/seminars/ workshops <b>attended</b> at which findings from Darwin project work will be presented/ disseminated.	Project presented at conference at the Natural History Museum, London, Sept 2000.
15a	Number of national press releases or publicity articles in host country(s)	Regular press releases during the project, and continuing.
15b	Number of local press releases or publicity articles in host country(s)	
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)	2 MWF newsletters which included Darwin project news
16b	Estimated circulation of each newsletter in the host country(s)	800
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	
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	
<b>Physical Outputs</b>		
20	Estimated value (£s) of physical assets handed over to host country(s)	£10,178
21	Number of permanent educational/training/research facilities or organisation established	One information system.
22	Number of permanent field plots established	
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 *	Detail	Publishers	Available from	Cost
(e.g. journals, manual, CDs)	(title, author, year)	(name, city)	(e.g. contact address, website)	£
* journal article	Swinnerton KJ, Groombridge JJ, Jones CG, Burn RW, Mungroo Y. Inbreeding depression and founder diversity among captive and free-living populations of the endangered pink pigeon <i>Columba mayeri</i> . 2004	Animal Conservation	The Zoological Society of London.	
* journal article	Swinnerton KJ, Peirce MA, Greenwood A, Chapman RE, Jones CG. Prevalence of <i>Leucocytozoon marchouxi</i> in the endangered pink pigeon <i>Columba mayeri</i> . 2005	Ibis	British Ornithologists' Union	
* journal article	Swinnerton KJ, Greenwood A, Chapman RE, Jones CG. The incidence of the parasitic disease trichomoniasis and its treatment in reintroduced and wild pink pigeons <i>Columba mayeri</i> . 2005	Ibis	British Ornithologists' Union	
* Technical report	Burn RW, Underwood FMU, Monitoring Round Island Reptile Populations. 2001	MWF/SSC	Mauritian Wildlife Foundation, and from <a href="http://www.reading.ac.uk/ssc">www.reading.ac.uk/ssc</a>	
* journal article	Nicoll MAC, Jones CG, Norris K. The impact of harvesting on a formerly endangered tropical bird: insights from life-history theory. 43 (3), 567-575, 2006	Journal of Applied Ecology	The British Ecological Society	

## 17. Appendix IV: Darwin Contacts

<b>Project Title</b>	Information System for Biodiversity and Conservation Management in Mauritius
<b>Ref. No.</b>	8/064
<b>UK Leader Details</b>	
Name	Robert W. Burn
Role within Darwin Project	Project leader
Address	Statistical Services Centre Harry Pitt Building, PO Box 240 Whiteknights Road Reading RG6 6FN
Phone	
Fax	
Email	
<b>Other UK Contact (if relevant)</b>	
Name	Ian C. Dale
Role within Darwin Project	Computing/GIS specialist
Address	Statistical Services Centre Harry Pitt Building, PO Box 240 Whiteknights Road Reading RG6 6FN
Phone	
Fax	
Email	
<b>Partner 1</b>	
Name	Dr Carl G. Jones
Organisation	Mauritian Wildlife Foundation
Role within Darwin Project	Scientific Coordinator of collaborating institution
Address	Grannum Road Vacoas Mauritius
Fax	
Email	
<b>Partner 2 (if relevant)</b>	
Name	
Organisation	
Role within Darwin Project	
Address	
Fax	
Email	

## 18. Appendix V: Training Workshops in 2001 and 2002

Training for biodiversity assessment was provided by ICD, RWB and other trainers listed below, to the participants listed overleaf. The trainees in 2001 and 2002 included thirty biology students (Year 2 and Year 3) from the University of Mauritius (UoM), and staff from institutions in Mauritius and Rodrigues. In 2002 the group also included staff from institutions in Madagascar, the Seychelles and the Comoros Islands.

Several of the trainees from the 2001 workshop were subsequently recruited by MWF, and assisted in the training on the 2002 workshop.

### Resource People on the Biodiversity Workshops

#	Name	Affiliation(s)	Role(s)	Nationality
1	Zaynah Budullah	UoM (2001), MWF (2002)	Student/Assistant Trainer	Mauritian
2	Deeraj Chooramun	UoM (2001), MWF (2002)	Student/Assistant Trainer	Mauritian
3	Charles Heeroo	UoM (2001), MWF (2002)	Student/Assistant Trainer	Mauritian
4	Steves Buckland	UoM (2001), MWF (2002)	Student/Assistant Trainer	Mauritian
5	Shivananden Sawmy	UoM (2001), MWF (2002)	Student/Assistant Trainer	Mauritian
6	Nathraj Chadee	UoM (2001), MWF (2002)	Student/Assistant Trainer	Mauritian
7	Christiane Victoire	MWF	Student/Assistant Trainer	Mauritian
8	David Simpson	MWF	Volunteer	British
9	Audrey Royo	MWF	Volunteer	French
10	Jennifer Ah-King	MWF	Trainer/Administrator	Mauritian
11	Saoud Motala	MWF	Trainer	Mauritian
12	Bob Burn	SSC	Trainer (statistics)	British
13	Ian Dale	SSC	Trainer (data processing)	British
14	John Mauremootoo	MWF	Trainer (ecology)	Mauritian
15	Nancy Bunbury	MWF	Volunteer	British
16	John Tayleur	MWF	Volunteer	British
17	Frankie Hobro	MWF	Volunteer	British
18	Isabelle Lenoir	MWF	MWF Administrator	Mauritian
19	Malika Veerasawmy	MWF	Trainer	Mauritian
20	Vincent Florens	UoM	Trainer	Mauritian
21	Danielle Florens	MSIRI	Trainer (herbarium)	Mauritian
22	V Tezoo	MSIRI	Assistant Trainer	Mauritian
23	Kirsty Swinnerton	MWF	Conservation biologist	British
24	Rafic Dulyamode	UoM	UoM Administrator	Mauritian
25	Carl Jones	MWF	MWF Scientific Director	British
26	Eveline Bellouard	MWF	Assistant Trainer	Mauritian
27	Richard Gibson	MWF	Herpetologist	British
28	Kenneth Auld	MWF	Volunteer	British
29	Sarah-Jane Barbe	MWF	Aviary Assistant	Mauritian
30	Marie-Michelle Townsend	MWF	Aviary Assistant	Mauritian
31	Frederique de Ravel	MWF	Aviary Manager	Mauritian

The topics covered dealt with the requirements of biodiversity assessment and included:

- Biological history of Mauritius; in- and ex-situ conservation of Mauritian flora and fauna; the diversity of the Mauritian snail fauna and its conservation.
- Quantitative methods to assess the effects of conservation management on biodiversity; using computers to organize data for conservation management; descriptive and summary statistics, simple inferential statistics.
- Assessment of insect biodiversity inside and outside Brise Fer conservation area (field work using mist-blowing techniques).
- Vegetation monitoring and conservation management on Ile aux Aigrettes (field survey); using keys and field guides to identify plants found in surveys; value of a herbarium in conservation.

- Visits to sites of importance for bird conservation: Brise Fer, Ile aux Aigrettes, Black River; demonstration of management activities for pink pigeons and echo parakeets; predator control in conservation; dissection of trapped animals.

### **Participants on the UNDP/GEF/Darwin Biodiversity Workshop held at the University of Mauritius, 9–15 July 2001**

<b>#</b>	<b>Name</b>	<b>Institution</b>	<b>Role</b>	<b>Nationality</b>
1	Aronassala Patten Shunmoogum	UoM, Year 2	Student	Mauritian
2	Auchoybur Gunesh	UoM, Year 2	Student	Mauritian
3	Auckloo Asha	UoM, Year 2	Student	Mauritian
4	Auckloo Bibi Farzanah	UoM, Year 2	Student	Mauritian
5	Aumeeruddy Nushrat	UoM, Year 2	Student	Mauritian
6	Aurdally Ushra Banon	UoM, Year 2	Student	Mauritian
7	Burhooah Rucheeta	UoM, Year 2	Student	Mauritian
8	Charles Coralie	UoM, Year 2	Student	Mauritian
9	Coothoopermal Deepti	UoM, Year 2	Student	Mauritian
10	Dindoyal Vickramsingh	UoM, Year 2	Student	Mauritian
11	Gaungoo Ramsing	UoM, Year 2	Student	Mauritian
12	Jahangeer Shaheen	UoM, Year 2	Student	Mauritian
13	Jhumka Zayd	UoM, Year 2	Student	Mauritian
14	Koodun Doorgesh	UoM, Year 2	Student	Mauritian
15	Manaroo Tayree	UoM, Year 2	Student	Mauritian
16	Prang Niteeraj	UoM, Year 2	Student	Mauritian
17	Rambaruth Neela Devi Sing	UoM, Year 2	Student	Mauritian
18	Ramjaun Javed A	UoM, Year 2	Student	Mauritian
19	Ramlugun Gawree Devi	UoM, Year 2	Student	Mauritian
20	Woosye Gopaldev	UoM, Year 2	Student	Mauritian
21	Mahomoodally Fawzi	UoM, Year 2	Student	Mauritian
22	Veemal Chungoora	UoM, Year 3	Student	Mauritian
23	Zaynah Budullah	UoM, Year 3	Student	Mauritian
24	Deeraj Chooramun	UoM, Year 3	Student	Mauritian
25	Charles Heeroo	UoM, Year 3	Student	Mauritian
26	Steves Buckland	UoM, Year 3	Student	Mauritian
27	Shivananden Sawmy	UoM, Year 3	Student	Mauritian
28	Nathraj Chadee	UoM, Year 3	Student	Mauritian
29	Priya Thaanoo	UoM, Year 3	Student	Mauritian
30	Ladan Shameemah	UoM, Year 3	Student	Mauritian
31	Luxshmee Bojnauth Rani	UoM, Year 3	Student	Mauritian
32	Christiane Victoire	MWF – Ile aux Aigrettes	Nursery Manager	Mauritian
33	Arnaud Meunier	Rodrigues – MWF	Horticulturalist	Rodriguan
34	Anieta Shan-Yu	Rodrigues – MWF	Fieldworker	Rodriguan
35	Jean Claude Raboude	Rodrigues – Forestry	Forester	Rodriguan
36	Casimir Louis Gonzague	Rodrigues – Forestry	Forester	Rodriguan
37	Ushalini Seeruttun	Mauritius – NPCS	Technical Officer	Mauritian
38	Mahandra Gobin	Mauritius – NPCS	Forest Guard	Mauritian
39	Mohummad Rafick Jumoorty	Mauritius – NPCS	Forester	Mauritian
40	Myriam Narainsamy	Mauritius Girl Guides Association		Mauritian
41	David Simpson	MWF	Volunteer	British
42	Audrey Royo	MWF	Volunteer	French
43	Hans Paupiah	Conservator of forests	Forestry	Mauritian
44	Alven Soopaya	Jeune Chambre Economique	Project Coordinator	Mauritian

NPCS: National Parks and Conservation Service



**Participants on the UNDP/GEF/Darwin Biodiversity Workshop  
held at the University of Mauritius, 1–14 July 2002**

#	Name	Institution	Role	Nationality
1	Saheen Faranaz Auhummud	UoM, Year 2	Student	Mauritian
2	Shetal Banka	UoM, Year 2	Student	Mauritian
3	Marie Juanita Fabiola Bell	UoM, Year 2	Student	Mauritian
4	Leena Bhaw	UoM, Year 2	Student	Mauritian
5	M. Djamil Cassoomally	UoM, Year 2	Student	Mauritian
6	Devtee Chundydyal	UoM, Year 2	Student	Mauritian
7	Ghirish Dhawotal	UoM, Year 2	Student	Mauritian
8	Praneeta Gajadhur	UoM, Year 2	Student	Mauritian
9	Priya Gobardhun	UoM, Year 2	Student	Mauritian
10	Joelle Martine Goder	UoM, Year 2	Student	Mauritian
11	Meera Goodur	UoM, Year 2	Student	Mauritian
12	Veeraj Goyaram	UoM, Year 2	Student	Mauritian
13	Dyana Gunoo	UoM, Year 2	Student	Mauritian
14	Sheinaz Banon Jauhangeer	UoM, Year 2	Student	Mauritian
15	Artee Jheengut	UoM, Year 2	Student	Mauritian
16	Wardah Bibi Khodabux	UoM, Year 2	Student	Mauritian
17	Wandana Luximon	UoM, Year 2	Student	Mauritian
18	Vijaya Lakshmi Madhoo	UoM, Year 2	Student	Mauritian
19	Sanjana Devi Mathura	UoM, Year 2	Student	Mauritian
20	Gerard Ludovic Ng Fong Lin	UoM, Year 2	Student	Mauritian
21	M. Rizwaan Peerally	UoM, Year 2	Student	Mauritian
22	Marie Georgina Rabail	UoM, Year 2	Student	Mauritian
23	Kavita Ramtohol	UoM, Year 2	Student	Mauritian
24	Bibi Nabiihah Roomaldawo	UoM, Year 2	Student	Mauritian
25	Diane Runghasawmi	UoM, Year 2	Student	Mauritian
26	Jayshree Sarup	UoM, Year 2	Student	Mauritian
27	Bharati Synthegadu	UoM, Year 2	Student	Mauritian
28	Zeyn Zmanay	UoM, Year 2	Student	Mauritian
29	Ashvine Ramsing	UoM, Year 3	Student	Mauritian
30	Veerendrasingh Gunessee	UoM, Year 3	Student	Mauritian
31	Mirandray Ranorlatandra	NPCS	Fieldworker	Madagascan
32	Jean Daniel Perrine	Rodrigues – Forestry	Forester	Rodriguan
33	Lamvohee Davy-Jones	Rodrigues – Forestry	Forester	Rodriguan
34	Alfred Jean Begue	Rodrigues – MWF	Fieldworker	Rodriguan
35	Harel Jean Begue	Rodrigues – MWF	Fieldworker	Rodriguan
36	Wilna Francoise Accouche	Seychelles		Seychellois
37	Marcel Jean Baptiste Dufrene	Seychelles		Seychellois
38	Said Abbas Mohamed	COMOFLORA		Comoros
39	Ibrahim Yahaya	CNDRS		Comoros
40	Ahmed Ben Ali Halidi	Action Comores		Comoros
41	Ahmed Saanyane	Service Forestier	Forester	Comoros

## 19. Appendix VI: Slides for Presentation at DWCT December 2004

### Pink Pigeon Information Management System

#### History

Mauritius, mid 1980s - captive breeding programmes for Pink Pigeon & Mauritius Kestrel.

Needed to begin making effective use of existing data.

Information needed for - management,  
- research.

Management needs - record keeping,  
- genetic management (studbooks).

Few usable software tools available at that time.

Started by producing some user-friendly software for managing data on captive breeding of Pink Pigeon.

Later added programs for genetic analysis of pedigree data.

Further development under Darwin Project 1999 – 2003.

#### Darwin Initiative Project

Project title: *Information System for Biodiversity and Conservation Management in Mauritius*

Aimed to build an *integrated* information management system.

Partners: - Mauritian Wildlife Foundation  
- National Parks and Conservation Service  
- University of Mauritius  
- Statistical Services Centre, University of Reading

Outputs: - software tools for information management  
- GIS tools  
- training in data collection, management and analysis.

Early work on software was consolidated and extended.

## Some existing systems (2004)

- ISIS software:
  - CMS ... Collection Management System
    - comprises ARKS4 + Specimen Reference
  - SPARKS ... Single Population Analysis and Record Keeping System
  - EGGS ... a DOS add-on for ARKS & SPARKS
  - MedARKS ... for veterinary records
  - REGASP ... a regional collection planning tool
- ZIMS ... Zoological Information Management System ... under development.

## Pink Pigeon information system

The kernel is a studbook database, including facilities for computing

- inbreeding coefficients
- founder representations
- kinship coefficients for trial pairings.

Additional information

- egg records
- morphometric data
- cause of death
- locations.

Extensions to the system to cater for Pink Pigeon release programme:

- nest records.

Uses:

- management, including genetic management
- research (e.g. survival studies)
- provide inputs for PVA.

Demo: <..\..\..\Desktop\Pink Pigeons.lnk>

## Research application - an example

Study to investigate factors affecting post-release survival.

Survival time measured by Kaplan-Meier estimate

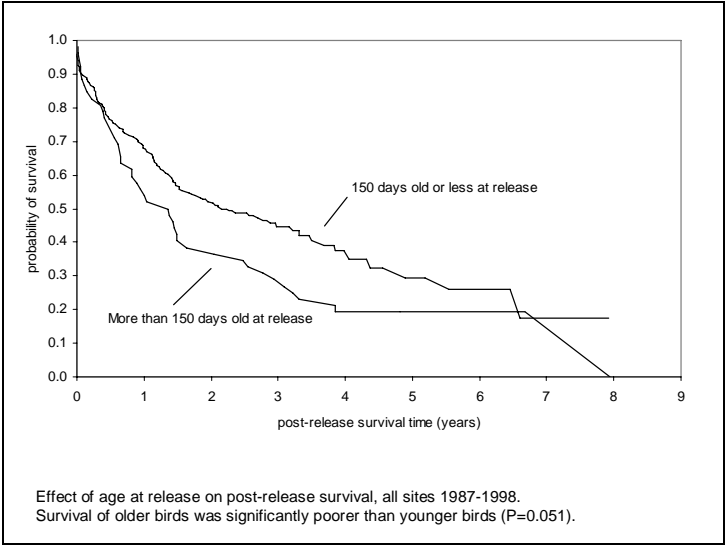
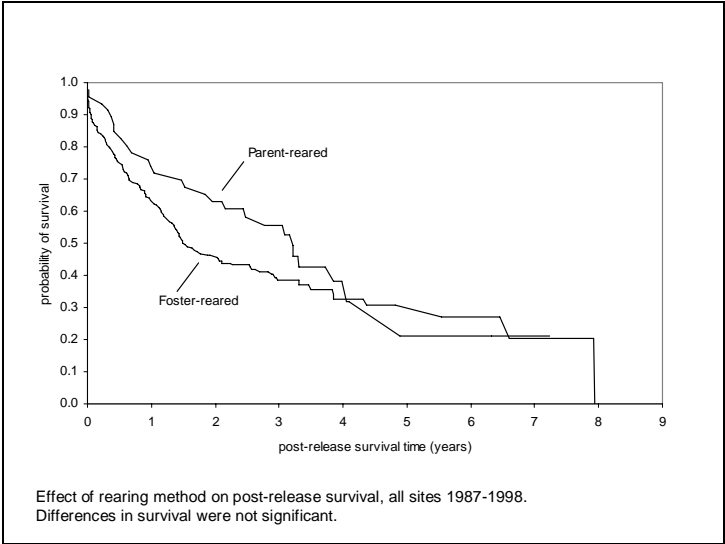
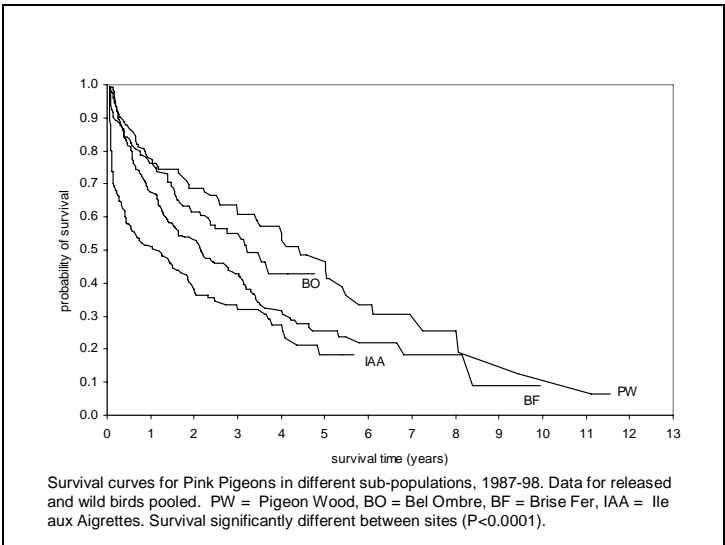
- takes account of *censored* survival times.

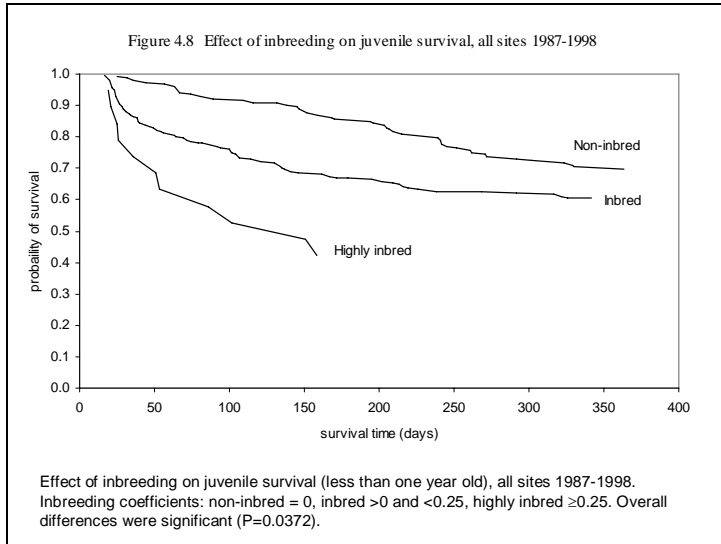
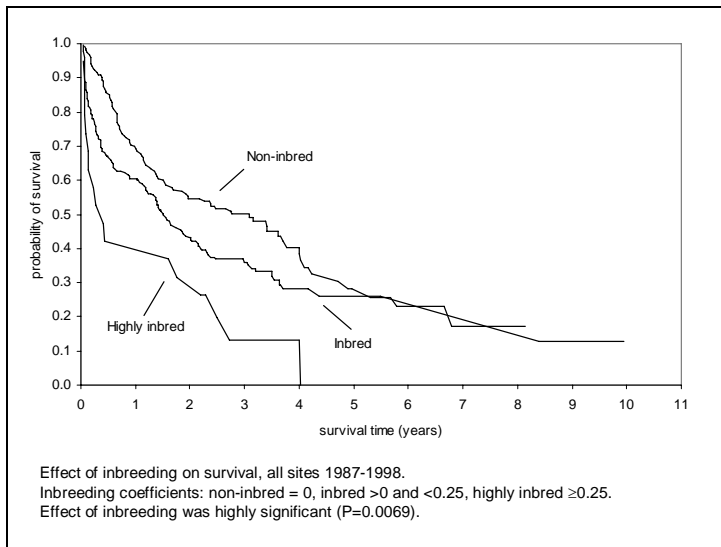
Comparisons between wild and released populations.

Survival analysis by fitting Cox proportional hazards model - from which can get significance of effects on survival.

Effects analysed included

- rearing method
- age at release
- inbreeding





**Acknowledgements**

Darwin Initiative  
 Kirsty Swinnerton (formerly MWF)  
 Carl Jones (MWF & DWPT)  
 Georgina Mace (IoZ)  
 David Todd (formerly MWF)  
 Richard Lewis (formerly MWF)

## 20. Appendix VII: Abbreviations and Acronyms

ARKS	Animal Record Keeping System
CREEM	Centre for Research into into Ecological and Environmental Modelling
DWCT	Durrell Wildlife Conservation Trust (formerly the JWPT)
GEF	Global Environment Facility
GIS	Geographical Information System
ICD	Ian Dale (SSC staff)
JWPT	Jersey Wildlife Preservation Trust (now the DWCT)
MRC	Mauritius Research Council
MSIRI	Mauritius Sugar Industry Research Institute
MWF	Mauritian Wildlife Foundation
NHM	Natural History Museum
NPCS	National Parks and Conservation Service
PVA	Population viability analysis
RWB	Bob Burn (SSC staff, project leader)
SBN	Studbook number
SSC	Statistical Services Centre (University of Reading)
SPARKS	Single Population Animal Record Keeping System
UoM	University of Mauritius
USGS	United States Geological Survey
VB	Visual Basic
WPC	Wildlife Preservation Canada
WWF	Worldwide Fund for Nature