162/6/056

DARWIN INITIATIVE

FINAL REPORT

1. **Basic Project Details**

Project Title:

CONSERVATION OF ENDANGERED PLANTS AND THEIR ASSOCIATED FUNGI IN KENYA

Contractor:
CABI Bioscience (formerly the International Mycological Institute), Bakeham Lane, Egham, Surrey TW20 9TY, UK

Host country collaborating institute(s):
Principal collaborating institute:
Department of Botany, University of Nairobi, P.O. Box 30197, Nairobi, Kenya
Secondary collaborating institutes:
Forest Department, Ministry of Environment & Natural Resources, Nairobi, Kenya
Department of Forestry, Moi University, Eldoret, Kenya

Grant Round: **5** (June 1997 - July 2000)

Grant Value: £147, 114

2. PROJECT EXPENDITURE

Costs in £	06/99-03/98	04/98-03/99	04/99-03/00	04/00-06/00	Total	Budget Variance	%
UK salaries							8%
Kenya salaries							-24%
Rent, rates etc							8%
Postage, telephone etc							53%
Travel							-5%
Conference							
Capital expenses							6%
Consumables							68%
Vehicle maintenance							0%
Total							

· Total grant expenditure:

£147116

· Breakdown of expenditure (using expenditure categories in the original application form)

Please see table above

· Explain any variations in expenditure +/- 10%

Payments made to Kenyan collaborators were 24% less than originally budgeted. This was due to a combination of staff leaving the project for other employment/training, and to payments being withheld for non-production of useful project outputs. We did consider recruiting further staff to make up the shortfall, but it proved difficult to identify suitable staff in permanent employment who would continue to benefit from Darwin investment after the end of the project. In the end, project objectives were achieved with this slightly reduced Kenyan staff complement, and the cost savings compensated for increases in other budget headings.

Communications costs were 53% more than originally budgeted for. This was due to a combination of several factors. The University telephone system proved far to unreliable for effective email communication, so an independent line was installed and line rental paid, figures which were not in the original budget. Telephone bills also proved to be somewhat more expensive than anticipated. In addition, the costs of transporting the conference proceedings to Kenya and their subsequent distribution were also not included in the original budget.

A budget to support the final workshop (see the *Proceedings* presented as part of the formal project documentation) was not presented at the application stage as a smaller-scale programme dissemination event was planned. However, the opportunity was taken to hold a joint event with EAFRINET (the East African section of BioNET-INTERNATIONAL) which greatly increased the project impact. Darwin Initiative staff were informed of the projected cost implications well before the event, and the workshop was both extremely successful and cost-effective.

The consumables spending was significantly larger than the original budget. A major reason for this was emergence of the need to spend significant amounts of money on herbarium packets and cabinets as existing facilities for housing fungal specimens in the University of Nairobi were quite inadeqate. In addition, the costs of photocopying course manuals were underestimated due to their larger than planned-for size. However, the total over-spend over the three years in absolute terms is not enormous.

The costs incurred under the travel section of the budget are within the 10% virement, but please note that as the Kenyan project partners agreed to use the money in the budget heading Target Incentives for study trips to the UK in support of project

objectives, that budget item was combined with the travel budget to give a single figure.

3. PROJECT BACKGROUND/RATIONALE

Why was the project needed? Please explain the project development process.

To date, most emphasis on in-situ conservation has concentrated on prominent groups such as mammals, birds and orchids. While these policies enjoy great public support, attention should also be directed to speciose but under-researched microorganism groups such as fungi, which play a crucial role in the maintenance of ecosystem health.

The fact that fungal species are large in number but poorly studied makes their widespread conservation problematical. Nevertheless, particular fungal species may be vital to the continuing health of plants which are themselves threatened, or conversely may be factors of that threat. Many groups of fungi are host-specific, and would thus by definition be at least equally as rare as their associated plant species. A significant step towards their recognition as worthy of preservation will be the development of balanced conservation action plans which take into account survival of plants and all their naturally associated organisms.

The rationale behind the project was developed during a year-long visit to CABI Bioscience by Professor Richard Mibey (the Kenyan project leader), which was funded as a component of an earlier Darwin Initiative programme. At the time, the emphases of conservation initiatives were changing gradually from single-species preservation towards more general policies of habitat conservation. However, as conservation activities are largely funded through individual subscription, the public face of the conservation movement is still strongly biased towards a small number of generally large and charismatic species. In contrast, the myriad of small-bodied organisms are almost completely ignored. These may play important roles in ecosystem maintenance through processes such as nutrient cycling, pollination and food resources, and may have direct monetary value through production of enzymes and metabolites. In many countries, single-species conservation is still assumed to be an appropriate focus for strategy and spending by the vast majority of the population, including scientists and policy-makers in related disciplines such as agriculture and forestry. For most, small-bodied organisms are considered to be overwhelmingly negative in their actions, as their profile only becomes visible when pest or pathogenic activity causes plant or animal disease. It is therefore important to emphasize the many positive aspects of their contributions to ecosystem function, and to remind the public that it is only in disturbed habitats that pests and pathogens become important.

The ultimate goal of the programme was to raise the profile of fungi, one of the most speciose and ecologically significant groups of small-bodied organisms, within the

scientific, technical and decision-making community in Kenya. This has been achieved in a number of ways, primarily through collection and identification of fungal species associated with rare and eendagered plants. Other activities have included the organization of workshops, publication of scientific and technical papers and addressing of scientific meetings, training of scientists and forestry staff in fungal systematics and ecology, and discussions with scientists and decision-makers in Kenya, right from forest guide to ministerial level.

How was it related to conservation priorities in the host country?

Conservation has a high profile in Kenya compared with many African countries, due in large part to the historical and current importance of "big game" to tourism and the image of the country as a whole. However, the state of the country's economy has deteriorated very considerably in the last twenty years, and current signs are that further decline will occur. This is of particular concern to the conservation community. The rapidly increasing population and generally unfavourable climatic events have combined to increase pressure dramatically to clear natural vegetation (especially forested areas) for cultivation. In many areas this has caused greatly increased erosion, and loss of the water-retaining function of forests has resulted in drought/flood cycles in many areas. Reduced crop yields therefore result in further pressure to clear natural habitats, even though the land acquired is not sustainably productive.

Conservation issues in Kenya are addressed principally by two Governmental organizations, the Kenya Wildlife Service (semi-autonomous) and the Forest Department of the Ministry of Environment and Natural Resources. KWS is primarily responsible for administering and protecting the National Parks and other major protected areas. The Forest Department has gazetted a large number of forested regions (often adjacent to exploited areas) which enjoy varying degrees of protection from felling and other non-sustainable activities. In some cases (e.g. Kakamega Forest) both organizations have conservation responsibilities. KWS was originally set up as a quasi-military game management organization, and emphasis is still largely on active protection of individual species. Its semi-independence from the Government machine has allowed it to evolve effectively, and much of their work is carried out in conjunction with national and international NGOs. The Forest Department is an integral part of the Kenyan Civil Service, and suffers from the monolithic structure common to many similar Government organizations. The potential conflict between timber production and forest protection has all too often become real, and the series of training courses which we carried out with the cooperation of the Department emphasized such issues. Other organizations in Kenya also have a significant conservation remit, notably the National Museums in Nairobi which has an active plant conservation unit.

The primary aim of the Darwin programme was to provide information on fungal incidence, distribution and rarity to contribute towards decision-making processes in

Kenyan conservation activities. To this end, most emphasis was placed on collection, identification and description of fungal species associated with rare and endangered plants which are likely to be host-limited and therefore at least as rare as their plant associates. Nevertheless, many of the project outputs contribute directly to the conservation debate in Kenya. Throughout the project we have worked closely with staff of a range of seniorities from all relevant organizations, explaining our purpose and obtaining information and opinions. Specific activities include:

- production of a manual for recognition and monitoring of fungal species in need of conservation
- hosting a two-day workshop for scientists and policy-makers which was devoted to systematics and conservation of small-bodied organisms in East Africa
- training Forest Department officers in various aspects of fungal ecology, especially diversity and contribution of fungi to forest function

How was the project intended to assist the host country to meet its obligations under the Biodiversity Convention?

The project has assisted Kenya to meet its obligations under Articles 7 (Identification and monitoring), 8 (In-situ conservation), 12 (Research and training) and 13 (Public Education and Awareness) of the Biodiversity Convention.

Most of the project's activities focused on Identification, Research and Training. Two new genera and 22 species of fungi new to science have to date been described, and about 250 taxa new to Kenya were reported. In addition, at least a further 100 unnamed taxa have been recorded which need further study to establish their identity and/or novelty. A large proportion of the fungus groups targeted are poorly known in systematic terms. The previous checklist of fungi from Kenya (published by Kung'u and Boa) contained 1162 species. With the addition of records from other herbaria and miscellaneous sources as well as those actually collected during the programme, the tally for Kenyan fungus species now stands at 2036, an increase of around 90%. A sophisticated database containing these and other project records has been installed at the University of Nairobi and the Kenyan Agricultural Research Institute.

Monitoring of key fungal species along with their host plants has been facilitated by the production of a recognition manual which contains descriptions and illustrations of the species concerned as well as information on their likely conservation status and any specific threats which have been identified.

Training was a major component of the project, with six separate courses contributing a total of about 65 person/weeks tuition. Three of these were week-long fungal systematics courses for project staff, University colleagues and employees of Government organizations requiring identification skills. The courses were designed as a series of three with each having a separate theme, although individual units were also valuable as stand-alone modules. The other three courses were less formal,

constituting three-day workshops for foresters and foresters' assistants. Biodiversity issues, fungal ecology and habitat conservation measures were included.

Was there a clear 'end-user' for the project in the host country? Who?

The stated aim of the programme was primarily to provide information on which conservation decisions could be based. As such, the two principal end-users of project data are the Forest Department and the Kenya Wildlife Service, as these have joint responsibility for species and habitat conservation in Kenya. There are also a number of subsidiary end-users, including Museum and University staff, Kenya Government organizations such as the Kenya Agricultural Research Institute (KARI) and the Kenya Forest Research Institute (KEFRI), and national and international NGOs and other organizations such as ICIPE (the International Centre for Insect Physiology & Ecology). Staff from most of these organizations have benefited from the Darwin training courses, and most have interests in natural habitat ecology.

4. PROJECT OBJECTIVES

What were the objectives of the project (as stated in the original application form)?

Specific objectives were:

- To assess the conservation status of fungi associated with a range of rare and endangered plants in Kenya, leading to the establishment of species action plans for the protection of fungi which are themselves endangered, and contributing to the development of action plans for their associated plants.
- To assess the threat to populations of rare plants from fungal pathogens, particularly those spreading from encroaching areas of agriculture, and to investigate the long-term stability of natural plant/fungus interactions.
- In the course of the mycological studies, to investigate and identify dependent insects which are either potentially damaging pest organisms or themselves in need of protection.
- To resolve the classification, relationships and nutritional status of the fungi concerned, including description of the many new taxa to be expected.
- To provide training in fungal systematics and identification for staff and students of the University of Nairobi and elsewhere, concentrating on practical skills and protocols which do not require modern equipment.
- To raise awareness within the Kenya Forest Service of the contribution that fungi make to ecosystem function and the importance of their conservation, and to train staff in collection and monitoring of rare species.

Were the objectives of the project revised? If so, how?

The overall objectives of the project have remained the same, but certain changes of emphasis took place as an evolutionary process following extended discussions with the Kenyan project partners and other agencies. The most significant of these concerned the production of species action plans for fungi known to be endangered. At the project planning stage, conservation policy in the UK and elsewhere favoured the production and carrying out of action plans for the conservation of individual species. While this process is still acceptable as a means of targeting particularly significant or valuable species, the project staff perceived throughout the lifetime of the programme that emphasis was increasingly shifting towards management plans for habitats. In these circumstances, it was felt that individual species action plans would become less relevant to conservation policy in Kenya, and that assessment and monitoring on a group basis (either in terms of fungi from specific endangered plants or from specific threatened habitats) would be more appropriate. To this end, it was agreed to produce a manual for recognition, monitoring and conservation of rare fungal species rather than a series of individual action plans. This report is included as part of the supporting documentation. Other factors supported this change in emphasis, which were difficult to predict at the time of the original project application. Firstly, we encountered many potentially endangered fungi during the course of the programme, but a high proportion were inconspicuous and could only be monitored effectively through collection by experts and subsequent laboratory analysis. Secondly, the high proportion of undescribed taxa coupled with the many belonging to genera in need of revision meant that frequently identification and species definition remained uncertain.

The number of fungal species encountered led to a further change of emphasis, from field collection to laboratory analysis. This had the effect of reducing the number of days spent on field excursions, but maintaining these at the originally envisaged level would simply have resulted in large numbers of specimens left in the lab with little or no prospect of their identification. The large numbers of taxa detected, along with difficulties in their identification, meant that some of the subsidiary objectives were not extensively pursued. The analysis of threats to endangered plants from agricultural pathogens was addressed (see for example the paper by Siboe in the workshop proceedings *Systematics and Conservation of Small-Bodied Organisms in East Africa*) but few natural habitats in Kenya are sufficiently undisturbed to provide baseline data on the incidence of necrotrophic fungal pathogens in ecosystems which have not been affected by Man. In all cases, the habitats accessible to us (especially in our principal study site Kakamega Forest) were seriously degraded in many parts through human activity, with weedy plants either interspersed with indigenous vegetation or immediately surrounding the study sites. To fulfil this objective rigorously would have meant extensive molecular analyses of the genetic diversity of the fungi concerned, to establish whether they were coevolved with the indigenous hosts or related to pathogens of surrounding crops. This clearly fell outside of the remit of the project.

Analysis of the insect populations associated with our target plants was attempted, but it was explained in the original application that this would be a subsidiary objective depending on time and finance available. In the end, two field trips to Kakamega Forest were made by the project team in conjunction with Dr Eston Mutitu (Kenya Forest Research Institute), during which assessments were made of insect herbivory of the plant species of interest, and collections made of insects feeding on them. Regrettably most of these were of immature instars (caterpillars etc) which are more or less impossible to identify even to genus level, bearing in mind the lack of reference data on insect species associated with the plants concerned. It was therefore concluded that as complete surveys would have needed long-term field work, further expenditure within the confines of the overall project budget was unjustified.

Have the objectives (or revised objectives) been achieved? If so, how?

Taking into account the slightly revised objectives detailed above, the project has achieved and often significantly exceeded the objectives set at its inception. More details of these achievements are set out below.

5. PROJECT OUTPUTS (SEE THE ATTACHED LIST OF PROJECT OUTPUTS WHICH WE WOULD LIKE YOU TO USE IN COMPILING THIS SECTION OF THE REPORT)

What output targets, if any, were specified for the project? (Please refer to the project schedule agreed with the Department where relevant.)

A list of the outputs specified for this project is given below, along with a commentary for each describing progress.

6A/B Three five-day training courses on fungal systematics for at least 10 project staff and local academics

Achieved and exceeded. Three training courses were held at the Department of Botany, University of Nairobi in July 1997, July 1998 and September 1999. The first was taught primarily by myself, the second by my senior colleague Dr P.M. Kirk and the third by both of us. In addition Prof. Richard Mibey and Dr George Siboe (Kenyan project staff) made contributions to the academic content of the courses, and Mr Simon Mathenge and Mr G. Kariuki assisted

during short field excursions held as part of the training courses. The courses attracted 12, 14 and 16 students respectively. They were designed as a complementary set, each dealing with a different set of major groups of microfungi, although a brief introduction and re-cap was provided as part of the later courses for students who were unable to attend earlier sessions. Many students attended all three courses. Teaching involved a mixture of theory and practical work, with illustrated introductions given to particular groups which led directly on to microscopical examination of example species. This was mostly based on specimens from the CABI Bioscience collections, most of which were donated to the University as teaching material. Both Dr Kirk and myself have had many years experience teaching similar courses to students from a wide variety of backgrounds and skills, and the feedback we received was universally positive (see more on this subject below). The first course was significantly disrupted by civil unrest in Nairobi (we were barricaded in our building at one point), and this caused great difficulties for some students to travel to the campus. Nevertheless, with some rescheduling the course was completed as planned. The second and third courses occurred without major incident, though accompanied by the periodic power cuts which are a fact of life in Kenya. **A total of 42 training weeks was provided**.

6A/B Three three-day training courses on fungal ecology, recognition and monitoring for at least 10 foresters

Achieved and exceeded. Three training courses were held at the Sheywe Hotel, Kakamega (Western Province), the Kenya Forestry College, Londiani (Rift Valley Province) and the Dhows Inn Hotel, Kilifi (Coast Province), in March 1998, November 1998 and March 1999, with 11, 18 and 10 participants respectively. The courses were taught by Dr Eliahu Kireger (Department of Forestry, Moi University), Prof. Richard Mibey and Dr George Siboe (Department of Botany, University of Nairobi) and I attended and taught on the final course. The courses were largely vocational in content, and were designed to give the foresters a greater appreciation of the varied roles of fungi in forest ecosystem function, the diversity of species present and the range of their ecological niches, and their many positive contributions to forest systems. Prior to the course, many only considered fungi negatively, as disease-causing organisms. The three courses followed largely the same curriculum (no student attended more than one) and attracted a great deal of positive feedback from the foresters. **A total of about 23 training weeks was provided**.

7 Training material for courses on fungal systematics and fungi in forest ecosystems produced

Achieved. The courses on fungal systematics formed a set of three. A comprehensive manual, running to around 150 pages, on microfungus systematics and identification was provided for the first course and given to all the participants. It contains keys to identification of fungal orders and families,

descriptions of key morphological features, notes on ecology and economic importance, and information (including illustrations) of the more important or prominent species, and a comprehensive reference list. The manual was originally based on that provided for one of our UK-based CABI training courses, but it was substantially upgraded and improved as part of the Darwin programme. The manual was further upgraded during the course of the project, and new editions made available to participants on the second and third courses. A copy of the manual is submitted as part of the project documentation.

The foresters' course was vocational in style and relied much more heavily on discussion and practical example. However, a short handout giving basic details of fungal diversity and ecological function in forests was produced for the participants, and a copy of this is also attached.

8 UK Project Leader (or senior deputy in Kenya for a total of 12 weeks throughout the course of the project

Achieved and exceeded. CABI project staff (Dr Paul Cannon [PFC] and Dr Paul Kirk [PMK]) visited Kenya a total of 11 times, between 2-27 July 1997 [PFC], 24 Feb - 7 March 1998 [PFC], 9-31 July 1998 [PMK], 12-15 October 1998 [PMK], 9 March - 5 April 1999 [PFC], 16 Sep - 10 October 1999 [PMK], 25 Sep - 10 October 1999 [PFC], 14-24 Feb 2000 [PFC], 2-9 May 2000 [PFC], 4-25 May 2000 [PMK], 14-25 May 2000 [PFC]. All days abroad were spenmt working in support of the project, a total of 187 days or the equivalent of about **37 working weeks**.

In addition, Kenyan project staff visited the UK a total of four times, with a total of around 9-10 further working weeks spent on collaborative project business. Face-to-face contact between the project leaders therefore occurred (in Kenya or the UK) for the equivalent of around 9 months of the 3-year project.

9 Species action plans produced for 30 fungi and 20 plants for use by the Forest Department

Effectively achieved. See discussion above in Section 4. Following evolution of the project objectives, a manual on identification and recognition of the fungal species was produced (and submitted as part of the project documentation) rather than individual action plans. This will allow monitoring of the rare species, but the expertise necessary to detect and identify most of them are beyond the current skills and resources of the Forest Department. Monitoring would therefore have to be carried out by mycologists, and the systematics training provided during the project has significantly upgraded the intellectual resources available in Kenya for this task. Please note that the

original project proposal stated that information was to be provided for species action plans for plants in Kenya, not that the plans themselves would be produced.

11 Six research papers submitted to peer-reviewed journals

Achieved and exceeded. Scientific papers produced under the auspices of the project are listed below, and copies are included as part of the overall documentation. Due acknowledgement to the Darwin Initiative has appeared in print in all cases. Several other papers are in preparation, which will be submitted to appropriate journals in due course.

Cannon, P.F. & Evans, H.C. (1999). Biotrophic species of *Phyllachoraceae* associated with the angiosperm family *Erythroxylaceae*. *Mycological Research* **103**: 577-590.

Mibey, R.K. & Kokwaro, J.O. (1999). Two new species of *Meliola* (Ascomycetes) from Kenya. *Fungal Diversity* **2**: 153-157.

Siboe, G.M., Kirk, P.M. & Cannon, P.F. (1999). New dematiaceous hyphomycetes from Kenyan rare plants. *Mycotaxon* **73**: 283-302.

Mibey, R.K. & Cannon, P.F. (1999). Biotrophic fungi from Kenya: ten new species and some new records of *Meliolaceae*. *Cryptogamie, Mycologie* **20**: 249-282.

Siboe, G.M., Kirk, P.M., David, J.C. & Cannon, P.F. (in press, accepted). Necrotrophic fungi from Kenyan endemic and rare plants. *Sydowia*, publication scheduled late 2000.

Cannon, P.F., Mibey, R.K. & Siboe, G.M. (in press, accepted). Microfungus Diversity and the Conservation Agenda in Kenya. In Moore, D., Nauta, M.M. & Rotheroe, M. (eds), *Fungal Conservation: Issues and Solutions*. Cambridge University Press, publication scheduled August 2001. [The text of this paper has also been included in the workshop proceedings submitted as part of the project documentation.]

Taylor, J.E., Cannon, P.F., David, J.C. & Crous, P.W. (in press, accepted). Two new *Phaeophleospora* species associated with leaf spots of Proteaceae. *South African Journal of Botany*, publication scheduled for 2001.

Cannon, P.F. (in press, accepted). *Phyllachora cynodontis*, *Phyllachora eleusines*, *Phyllachora pennisetina*. IMI Descriptions of Fungi and Bacteria, publication scheduled late 2000*

* Peer-reviewed but not by scientists independent of CABI Bioscience

12 One specimen occurrence database established and enhanced and handed over to Kenyan staff

Achieved and exceeded. Project records were keyboarded by both UK and Kenyan project workers, with details of over 1300 collections comprising about 250 named species and a further 250 taxa characterized and named to

genus level (the identification of many tropical fungi requires monographic research beyond the scope of this project). A further 1500 records were added during the project, derived from collections made prior to the inception of the programme. This added more than 600 further named species to the database. In addition, records from a previous Kenyan checklist of fungi (Kung'u & Boa, 1998) were incorporated. This involved about a further 3000 records of around 1150 species. The combined Kenyan checklist database now contains nearly 6000 records, assigned to over 2600 taxa. The database is a major resource for biological recording in Kenya.

The database structure evolved throughout the life of the project, driven primarily by upgrades to the software. The package in use for the latter half of the programme was adapted from a system designed for fungal recording for the British Mycological Society, which was developed by a CABI Bioscience staff member using MS ACCESS. It is a highly sophisticated application, including a range of dictionaries to aid accurate data entry, and facilities for report generation, mapping and herbarium label printing. The fully edited database has been installed on several computers in the Botany Department, University of Nairobi, and a complete set of the data has also been provided and installed on computers in the Kenya Agricultural Research Institute. The package is designed to facilitate data sharing between remote units, and blank copies of the software were provided to staff in Egerton and Moi Universities to act as recording packages compatible with the system in Nairobi. Various project staff have been trained extensively in use of the database package, and further liaison will take place now that the project is at an end to ensure that further data entry conforms to the high standards achieved during the project.

A copy of the database is submitted as part of the project documentation, and instructions on its use may be found as the final chapter in the Workshop Proceedings also submitted.

13 One reference collection of at least 1000 specimens established and handed over to the host country

Achieved. Prior to the project, there was no established mycological herbarium in the University of Nairobi, although an active plant herbarium existed in the University as an annexe to the collections of the National Museums of Kenya. The project therefore facilitated the inception and development of a dried fungal collection, including training in curation techniques, provision of basic cabinets and interfacing with the database. So far, about 700 fungal specimens have been identified and incorporated, with a considerable further number partially processed. In addition, the plant herbarium has been augmented with at least 500 specimens (exact numbers were not recorded) of rare Kenyan plants, many of which were previously poorly represented in national collections. Where possible, fungal collections made during the programme by UK project staff will be divided and duplicates handed over to the University of Nairobi collection, which will further

increase its size and scope. This process will take place as part of their formal incorporation into the **IMI** herbarium; the delay is due to continuing taxonomic research on many collections.

14A Two seminars (at project inception and termination)

Achieved and exceeded. At the beginning of the research programme, a seminar was held at the University (on 8 July 1977) at which the project was introduced to University staff and other interested parties. The project was formally launched in a short ceremony during which the objectives were explained to an audience of around 50. The University was represented by the Dean of Science, who read a speech from the Vice-Chancellor, who had been planning to attend but was occupied by rioting in other parts of the campus. Also present were Dr Kipkore from the Forest Department and Dr Kireger from Moi University (to be involved in future training courses), and the opportunity was taken to discuss the details of their participation in the project.

The dissemination meeting planned for the end of the project was expanded significantly, with a two-day workshop held at the Blue Posts Hotel, Thika on 7-8 May 2000 in conjunction with EAFRINET, the East African section of BioNET-International. This was an extremely successful meeting with nearly 50 participants from eight different countries, primarily from the scientific community but also including governmental representatives. The meeting theme was "Systematics and Conservation of Small-Bodied Organisms in East Africa" and proved to be an excellent forum for presenting the Darwin project findings and discussing the potential for similar work in other East African countries and for other neglected organism groups. There was widespread support for the basic tenets which underpinned the Darwin project, that conservation efforts directed solely towards individual species were inappropriate, and that habitat conservation was inappropriate without proper inventory and monitoring of at least a range of key organism groups. The Proceedings of the meeting have been prepared and are included as part of the overall project documentation.

14B Two conferences attended at which project data disseminated

Achieved and exceeded. The project has been represented by now at four international scientific meetings in addition to the workshop described above, during which the project objectives were introduced to participants, results discussed, and Darwin Initiative sponsorship acknowledged and advertised. Details of the meetings are as follows:

August 1998: **Third African Mycological Congress, Nairobi, Kenya**. Oral presentation on the programme by Prof. Richard Mibey to participants from a wide range of African countries.

November 1999: British Mycological Society meeting on **Fungal Conservation: Issues and Solutions, Kew, UK**. Oral presentation by Drs Paul Cannon and George Siboe to participants from about 8 mostly European countries; to be published by Cambridge University Press (see above).

April 2000: British Mycological Society meeting **Tropical Fungi 2000, Liverpool UK**. Poster presentation by Dr Paul Cannon and radio forum by Prof. Richard Mibey.

July 2000: **Asian Mycological Congress 2000, Hong Kong**. Poster presentation by Dr Paul Cannon.

15 Press releases available describing aims, progress and findings

Partially achieved. The project opening ceremony in July 1997 was featured by both of the national newspapers in Kenya, following contacts between the University of Nairobi and the Press. Similar coverage was obtained for the African Mycological Congress the following summer (including television coverage), and for the second systematics course when a microscope purchased with Darwin funds was presented to the University.

Formal releases for the UK press were prepared and disseminated at the beginning and mid point of the project, but did not result in published news features. The issue was discussed by the project leaders, and conclusions were that formal releases were not an effective way of promulgating information about the project. Information presented on the project website (see below) was considered to be a much more effective way of advertising the programme to the developed world.

17 Internet site established with project details and progress

Achieved. The project's website address is www.cabi.org/bioscience/darwin

20 Capital equipment purchased and donated to the University of Nairobi

Achieved and exceeded. The following items were purchased for the project and/or donated:

Daihatsu 4WD vehicle. With substantial financial assistance from the University of Nairobi, a new Daihatsu 4WD vehicle was purchased and owned jointly by the project and the University. This meant that it was available for use by other University staff when not required for the Darwin project, and it was utilised intensively throughout the life of the project. At the end of the project, it was functioning well after travelling around 80000 km. A maintenance fund was established with Darwin funds at the beginning of the project, to cover servicing, tyre replacement etc, with the University paying

the considerable insurance premiums, vehicle tax etc. Ownership of the vehicle has now passed exclusively to the University.

Computers. An IBM Pentium PC with printer and appropriate software was purchased in Nairobi at the beginning of the project. At the time, the Department of Botany had no effective computer support, and even telephoning and faxing were difficult due to a combination of the University's financial problems and the parlous state of telecommunications in the country at large. The project therefore rented an independent telephone line, linked to the Darwin computer with a modem provided by the University of Sussex. Access to email revolutionized communications between the project partners, and added very considerably to the success of the programme. Earlier this year, the Department of Botany received several computers and funds for Internet access from another donor, which has resulted in a further important boost to the Department's capabilities.

In addition to the computer which was purchased and donated to the University, three further second-hand PCs were given by CABI Bioscience to the Department of Botany, and transported to their destination in the course of project visits. In one case, British Airways kindly agreed to the waiving of excess baggage costs to allow free transport. The Darwin computers have greatly assisted the modernization and development of the Department.

Compound microscope. As the contribution made by the University of Nairobi towards the vehicle purchase resulted in savings to the project compared with the original budget, a Prior phase-contrast compound microscope was also purchased by the project and donated to the University at a ceremony in July 1998. The Department of Botany possesses a number of reasonable dissecting microscopes, but almost all of their compound microscopes (especially those for teaching) are in a dreadful condition and are almost useless for examining fungal structures. Students queued patiently to examine specimens using the few which worked adequately, but microscopes continued to be a limiting factor for teaching, both for the Darwin courses and for teaching in general. The Darwin microscope was therefore particularly appreciated, and is being used for research work as well as teaching.

Herbarium cabinets. Although the University provided a large room, the establishment of a mycological herbarium required the acquisition of cabinets to house the specimens. By the stage of formal inception of the herbarium, the budget for capital equipment was very restricted, but a series of six locally made cabinets was purchased with project funds. These do not provide storage in ideal conditions, but are a great deal better than nothing.

Small items of equipment. Several smaller items were purchased, as funds available through the University are inadequate even for small pieces of equipment. A Magellan GPS unit was purchased and donated at the beginning

of the project, which proved valuable in some areas but little practical use in densely forested reasons as it was difficult for the unit to lock-on to the satellites. Other small items included a pair of binoculars to assist in identification of large trees, and collecting knives, secateurs, a folding saw, machetes, cmprehensive first-aid kit etc. All of these pieces of equipment continue in use by members of the Department of Botany.

Books and CD-ROMs. One of the major impediments to progress in taxonomic initiatives in Kenya is the lack of reference materials. The project was able to acquire a number of books and serial publications, donated by CABI Bioscience, the Centraalbureau voor Schimmelcultures (Netherlands), SAFRINET (the South African section of BioNET-INTERNATIONAL) and the University of Stellenbosch. While the Botany Department's need for such materials remains acute, their reference holdings have been significantly extended through the project.

23 Value of resources raised from other sources

Financially quantifiable donations from other sources:

University of Nairobi (joint purchase of project vehicle)
University of Nairobi (insurance of project vehicle)
British Airways Assisting Conservation (air ticket and waiving of excess baggage)
Kenya Wildlife Service (waiving of national park entrance fees for project staff)
CABI Bioscience (books and serial publications)
Centraalbureau voor Schimmelcultures (serial publications)
SAFRINET (CD-ROM identification aids)
University of Stellenbosch (book)
EAFRINET (estimated cost of air fares for six workshop participants)
CABI Bioscience (discount on commercial overhead rates)
CABI Bioscience (cost of identifications carried out at commercial rates)

Total: £104410

Benefits in kind:

University of Nairobi:

Provision of two rooms within the Department of Botany, one for project administration/laboratory work and one to house the collections, provision of training laboratories for systematics courses

Provision of transport (a large 4WD vehicle with driver was loaned free of charge for two project field trips to allow larger numbers to participate

Provision of secretarial support (a secretary was assigned to the prject for about six months to assist with administration)

Provision of electricity (no overhead charges were made by the University)

Forest Department (Ministry of Environment & Natural Resources)

Provision of training facilities (facilities of the Londiani forest training school were provided during one of the foresters' training courses)

Assistance from foresters and forest staff (staff were assigned during fieldwork to assist in location of rare plants, clear paths etc)

Kenya Wildlife Service

Assistance from National Parks staff (help in locating rare plants, protection against large mammals etc)

Kenya Forest Research Institute

Paid leave of absence for an entomologist to assist with fieldwork

6. PROJECT OPERATION/MANAGEMENT

· Research projects - please provide a **full** account of the scientific work undertaken, outlining the methodology adopted, the staff employed and the research findings. The extent to which research findings have been subject to peer review should be addressed.

Please refer to the document "Recognition, monitoring and conservation of fungal species associated with rare and endangered plants in Kenya"

- Training projects - please provide a **full** account of the training provided. This should cover the content of the training, arrangements for selecting trainees, accreditation, etc.

Systematics courses

Three courses were provided, each covering different aspects of the systematics of the Ascomycota, their asexual morphs and other microfungi. The first of these concentrated on ascohymenial pyrenomycetes, the second on ascolocular ascomycetes, and the last on ascomycetes with cup-shaped fruit bodies, other brightly coloured forms and the zygomycetes. Time did not permit a comprehensive coverage of these topics, but most emphasis was placed on tropical non-lichenized groups (especially those of economic importance).

Samples for study were mostly brought from CABI Bioscience's teaching collections in the UK, with some freshly gathered material from the environs of the University of Nairobi. Practical difficulties with transporting and maintaining living cultures reduced the scope for teaching some groups, although in many instances dried cultures were used successfully as illustrative material. In most cases the dried samples were donated to the University as teaching materials, along with permanent prepared slides showing typical fungal structures.

The classification of microfungi has changed out of all recognition in the last twenty years, and most of the students had little idea of modern systematic concepts. Examples of these changes include:

- integration of asexual and sexual morphs in a single classification
- reduction in emphasis of fruit-body type in ascomycete classification
- contributions made by molecular phylogenetic studies
- integration of classifications of lichenized and non-lichenized ascomycete fungi
- appreciation of the morphological plasticity of fungal forms
- reduction in the use of jargon terms
- major changes in understanding of the mode of production of asexual spores

Many of these subjects represent sea-changes in understanding of fungal evolution, and present stark contrasts to traditional teaching which is simplistic and excessively rule-driven. This has often led to great difficulties for non-experts in reconciling what they see down the microscope with the traditional systems they have been taught. There was therefore a great deal of emphasis during the Darwin courses on interpretation of observations in the light of the new thinking. For many students this proved initially confusing, but repeated exposure to the new ideas paid dividends.

The courses followed an overall structure which has proved effective over many years at CABI Bioscience teaching students with a wide variety of abilities and from very varied backgrounds. In most cases theory and practical work was effectively

integrated. Introductions to topics were given in the laboratory, followed immediately by practical sessions where the students made their own slide preparations from the material provided, and attempted to observe the structures discussed during that session's theory tuition. In all cases close interaction between teacher and students, and between the students themselves, ensured that everyone benefited to a maximum extent.

Preparation of material for microscopic examination requires some experience in order to make informative slides, and most of the students required education in these techniques. The quality of their preparation improved noticeably during the course of the training.

For two of the three systematics courses, one day was devoted to field work, with a morning spent collecting specimens in the Nairobi Arboretum (which is within walking distance of the laboratories) with the team botanist on hand to advise on host identifications, followed by examination of the material back at the lab in the afternoon. These sessions proved popular and instructive (many students had had little previous experience of sample preparation from field specimens), although the very dry conditions during both courses reduced the number of samples acquired.

Selection of candidates for tuition was carried out by Professor Mibey, the Kenyan project leader, following application and recommendation from managers/heads of department. The specialized nature of the tuition, coupled with the lack of funds for paying travelling expenses, meant that few potential participants had to be refused. The successful applicants came from a wide range of sources, including postgraduate students, University staff members (many of whom were studying part-time for higher degrees), staff of the National Museums of Kenya, and mycologists/plant pathologists from governmental research institutions.

Initial assessment of abilities was carried out using a short written test, in conjunction with verbal questioning of the group as a whole. Results demonstrated very basic knowledge for most of the students, and directed the academic and technicial level of the tuition. The test was re-taken at the end of the course, and demonstrated a satisfying increase in knowledge for most participants. Final assessments were also made using a group discussion session. The students were universally complimentary about the courses and their usefulness, with some suggestions for alterations/improvements which were acted upon if possible during further courses. Regrettably, one issue proved difficult to resolve, the poor quality of the compound microscopes available for the training courses. A number of these proved more or less impossible to obtain acceptable images, which meant that students had to share the more acceptable instruments. However, we were able to provide one new phase-contrast microscope from project funds which went a small way towards resolution of the difficulty.

Assessment was also attempted through contact with the students' managers/heads of department, but our written requests for information were hardly ever replied to. We were however able to speak subsequently to some of the people involved, who assured

us that the students were putting the knowledge gained to good use. In many cases the Kenyan institutions who gave staff leave of absence for the training courses are critically short of funds, with even small items such as postage in practice the personal responsibility of the staff concerned. Perhaps in these circumstances the low level of response is not surprising.

Foresters' courses

Three three-day workshops for Government foresters and forest assistants were held, in Kakamega (Western Province), Londiani (Rift Valley Province) and Kilifi (Coast Province), in March 1998, November 1998 and March 1999, with 11, 18 and 10 participants respectively. The courses were taught by Dr Eliahu Kireger (Department of Forestry, Moi University), Prof. Richard Mibey and Dr George Siboe (Department of Botany, University of Nairobi) and I attended and taught on the final course. The courses were vocational in content, and were designed to give the foresters a greater appreciation of the varied roles of fungi in forest ecosystem function, the diversity of species present and the range of their ecological niches, and their many positive contributions to forest systems. Prior to the course, many only considered fungi negatively, as disease-causing organisms. The three courses followed largely the same curriculum (no student attended more than one) and attracted a great deal of positive feedback from the foresters.

The curriculum included:

- an overview of fungal diversity, especially the range and variety of species to be found within small survey areas
- a jargon-free outline of fungal classification
- slides of more prominent fungi likely to be found in the local forests
- field study and collecting procedures
- the importance of mycelial structures in appreciation of fungal lifestyles
- the importance of fungi in nutrient cycling
- the range of nutritional relationships between fungi and plants
- beneficial interactions such as mycorrhizas as well as disease-causing organisms
- the contribution of fungi as food sources for other organisms
- the potential for inclusion of fungi and other speciose small-bodied organism groups in conservation policy
- procedures for detecting and monitoring individual species

Foresters were selected for participation by the Forest Department, and at least one representative attended from almost all of the departmental administrative regions within the provinces in which the courses were held. Initial assessment of knowledge was carried out informally by question and answer, and in almost all cases knowledge of fungi and their role in the ecosystem was found to be very poor. Most of the participants had forestry degrees, but the courses are presumably heavily biased towards timber production rather than ecosystem preservation, and for many the

University course was not taken recently. In most cases prior knowledge was heavily biased towards tree diseases, and apart from basic lay knowledge of fungi as human food, fungi were almost universally considered as malign organisms. A major theme of the workshops was therefore to encourage reassessment of fungi as positive contributors to forest health. Final assessment was carried out using a group discussion format focusing on the differences between guardianship of natural ecosystems and commercial timber production. These were very lively sessions, during which almost all foresters played active and voluble roles, and many displayed knowledge gained during the workshop.

The Forest Department is a monolithic and bureaucratic organization. Individual foresters in practice have considerable personal autonomy, but very restricted funds for developing natural forest policies seem to filter through the system. There are repeated accusations in the national press of corruption at many levels of seniority within the Department, with gazetted forests being unsustainably logged, and we saw direct evidence of these practices. The workshops therefore had an important subsidiary function in raising conservation issues within the Forest Department, specifically the need to maintain biotically valuable natural forest ecosystems in an undisturbed state and to make clear distinctions between these and forests designated for timber production.

TRAINING COURSE PARTICIPANTS

SYSTEMATICS OF THE ASCOMYCOTA AND THEIR ANAMORPHS I

(Department of Botany, University of Nairobi, 8-12 July 1997)

Paul Kamote (Department of Crop Science, University of Nairobi)
Rhoda Kariba (Department of Botany, University of Nairobi)
George Kariuki (Department of Crop Science, University of Nairobi)
Martin Langat (Kenya Agricultural Research Institute)
Prof. Richard Mibey (Department of Botany, University of Nairobi)
Dr E.O. Monda (Department of Botany, Kenyatta University)
George Mugambi (National Museums of Kenya)
Patrick Mutiso (Department of Botany, University of Nairobi)
Sheila Okoth (Department of Botany, University of Nairobi)
Ann Osano (Department of Botany, University of Nairobi)
Dr George Siboe (Department of Botany, University of Nairobi)
Mary Wanyoike (Njuguna) (Department of Botany, University of Nairobi)

SYSTEMATICS OF THE ASCOMYCOTA AND THEIR ANAMORPHS II
Department of Botany, University of Nairobi, 27-31 July 1998)

T. Ang'inya (Department of Crop Protection, University of Nairobi)
Francis Gathuma (Department of Crop Protection, University of Nairobi)
Paul K. Kamote (Department of Crop Protection, University of Nairobi)
Rhoda Kariba (Department of Botany, University of Nairobi)
George M. Kariuki (Department of Crop Protection, University of Nairobi)
Martin Langat (Kenya Agricultural Research Institute)
Peter Maina (Department of Botany, Jomo Kenyatta University)
Dickinson Mathenge (Department of Crop Protection, University of Nairobi)
Prof. Richard Mibey (Department of Botany, University of Nairobi)
W. O. Momanyi (Department of Botany, Jomo Kenyatta University)
Peter Mungai (Kenya Agricultural Research Institute)
Linus Mwangi (Kenya Forestry Research Institute)
Ely Mwanza (Kenya Forestry Research Institute)
R. D. Narla (Department of Crop Protection, University of Nairobi)
Sheila Okoth (Department of Botany, University of Nairobi)
Dr George Siboe (Department of Botany, University of Nairobi)
Too Tepeny (Department of Botany, University of Nairobi)

SYSTEMATICS OF THE ASCOMYCOTA AND THEIR ANAMORPHS III
(Department of Botany, University of Nairobi, 27 September -1 October 1999)

T. Ang'inya (Department of Crop Protection, University of Nairobi)
Francis Gathuma (Department of Crop Protection, University of Nairobi)
Rhoda Kariba (Department of Botany, University of Nairobi)
Paul Kamote (Department of Crop Science, University of Nairobi)
George M. Kariuki (Department of Crop Protection, University of Nairobi)
Alex Kuria (Kenya Agricultural Research Institute)
Martin Langat (Kenya Agricultural Research Institute)
Peter Maina (Department of Botany, Jomo Kenyatta University)
Dickinson Mathenge (Department of Crop Protection, University of Nairobi)
W. O. Momanyi (Department of Botany, Jomo Kenyatta University)
Prof. Richard Mibey (Department of Botany, University of Nairobi)
Silas Muguna (Department of Crop Protection, University of Nairobi)
Lizzy Mwamburi (Department of Botany, Moi University)
Sheila Okoth (Department of Botany, University of Nairobi)
Peter Otieno (Department of Botany, Egerton University)
Valerie Palapala (Department of Botany, Moi University)
Dr George Siboe (Department of Botany, University of Nairobi)
Too Tepeny (Department of Botany, University of Nairobi)

FORESTERS' WORKSHOP I (Sheywe Guest House, Kakamega, 31 March - 2 April 1998)

J.I. Ashioya (Vihiga Forest Station)
Gilbert Gulavi (Ribiri Forest Station)
Julius W. Khisa (Kakamega Forest Station)
Wellington Mahelo (Tiriki East Forest Station)
C.S. Nandwan (Kakamega Forest Station)
E.O. Nyariro (Kakamega Forest Station)
M.O. Odhiambo (Ileho Forest Station)
A. Omau (Kakamega Forest Station)
W.O. Onyayo (Shinyalu Forest Station)
Dorothy A. Opili (Malava Forest Station)
P.O. Oyugi (Vihiga Forest Station)

FORESTERS' WORKSHOP II (Kenya Forestry College, Londiani, 23-26 November 1998)

Ezekiel K. Busienei (Marakwet Forest Station)
John Kamande (Londiani Forest Station)
S.K. Kamati (Kericho Forest Station)
Joseph K. Kingori (Nakuru Forest Station)
Johnson K. Komu (Keiyo Forest Station)
John M. Mahiuha (Laikipia Forest Station)
Josephat O. Makokha (Kitale Forest Station)
Joseph G. Mbugua (Nakuru Forest Station)
Joash K. Morogo (Baringo Forest Station)
Mwai Muraguri (Kericho Forest Station)
A.N. Nyaswabu (Bomet Forest Station)
H.A. Ogira (Kericho Forest Station)
Ruben K. Selim (Baringo Forest Station)
Andrew C. Soy (Timboroa Forest Station)
Nelson K. Too (Keiyo Forest Station)

FORESTERS' WORKSHOP III (Dhows Inn Hotel, Kilifi, 23-26 March 1999)

Kahindi S. Fondo (Witu Forest Station)
Severinus M. Jembe (National Museums of Kenya, Kilifi)
Samuel M. Kavoo (Ganze Forest Station)
Joseph M. Kibugi (Kwale Forest Station)
Chiro Lawrence (National Museums of Kenya, Diani)
Charles Makworo (Kilifi Forest Station)
Peter Mwanu (Tana River Forest Station)
Franton D. Mwasaha (Malindi Forest Station)
Erastus Ochieng (Wundanyi Forest Station)
Amini Hamisi Tengeza (National Museums of Kenya, Diani)

7. PROJECT IMPACT

- To what extent has the project assisted the host country to meet its obligations under the Biodiversity Convention, or to what extent is it likely to do so in the future? Please take account of the following in preparing this section of the report:

  - **The way in which research findings have been used to address biodiversity objectives**. What actions have been taken, or are expected to be taken, as a result of the project? How will these contribute towards the conservation of biodiversity in the host country concerned?

In common with very many biodiversity projects, the lack of reliable baseline information (in this case comprehensive surveys of the fungi present in protected areas in Kenya, and inadequate existing classifications of many groups) is a major constraint to the appropriate application of the data in a conservation context. The basic survey and identification work necessary for a successful outcome of this project was a major part of the programme for the first two years. Nevertheless, it was clear from the steadily increasing species tally that in few cases were we able to provide comprehensive information on fungal diversity associated with the rare plants we studied. We experienced particular problems with weather conditions, as many of our study sites were at least partially inaccessible during the wet season when the greatest diversity of fungi would be expected. In addition, unusually dry conditions over much of Kenya throughout the project (which have been and continue to be periodically in the news here) have restricted the numbers of species sampled.

Despite these difficulties, emphasis over the second half of the project changed from basic survey to monitoring of previously studied sites to obtain information on on fungal seasonality and reliability of fruiting (which is almost always necessary for

detection and identification.) Attempts were also made to search for target fungi associated with plant species related to the rare and endangered host taxa. Interestingly, these attempts almost always proved negative, emphasizing that fungal distribution is usually driven by a combination of host characteristics and environmental conditions.

At completion of the project, a series of fungal species has been identified which are at least likely to be threatened, although in most cases further monitoring will be necessary to establish their conservation status unequivocally. This information has been transferred to all appropriate bodies in Kenya which are concerned with conservation. As stated in the original project application, responsibility for continuing the monitoring process and establishing conservation policies for fungi in Kenya rests with those organizations.

The project has significantly raised the profile of fungi as contributors to ecosystem function and as deserving of conservation within Kenya, through interaction at all levels of seniority within appropriate organizations from forest guard to the Minister of Environment and Natural resources himself. The workshop in May 2000 also played a major role in promoting the project findings to a wide variety of scientists and policy-makers throughout East Africa, and importantly made a significant contribution to the development of EAFRINET. Given the resources currently available for conservation in East Africa, it would not be reasonable to expect immediate measures for conservation of individual fungal species. However, the importance of including fungi and other important small-bodied organism groups within overall strategies has been well emphasized.

Further developments for conservation of small-bodied organisms will rely on interaction between various organizations in Kenya, especially between the University of Nairobi, the Forest Department, the Kenya Wildlife Service and the National Museums of Kenya. Linkages between all of these bodies have been strengthened by the project. CABI Bioscience will continue to play a support role as promised at the project inception, assisting in identification of species where needed and encouraging further collaborations.

> **The extent to which training provision has improved the capacity of the host country to conserve biodiversity** in the future, and the extent to which the training has addressed real skill needs. Information should be provided on what **each** student/trainee is now doing (or what they expect to be doing in the longer term), and the extent to which their skills are being used in a positive way to promote biodiversity conservation in the host country.

Identification is a basic skill for biodiversity conservation, and with the exception of a few scientists, the overall national skills in fungal systematics and systematics teaching were very poor at the inception of the project. This was for a combination of reasons, including the lack of appropriate mentors following independence, reliance on overseas expertise for identification, and lack of appropriate reference materials.

The project has provided training in identification and related skills for over 20 scientists, most of which are permanent employees either of Universities or of Government institutions. At least most of these people are using the knowledge gained directly in their employment, through teaching others, assisting in research, identifying disease-causing organisms etc. The forestry workshops were provided exclusively for tenured Government employees, and to my best belief almost all are continuing in their positions, thus making good use of the information and skills provided. Due to the large numbers of trainees and the short-term nature of the training, I do not have information on the nature of the current occupation for all of the course participants, but will provide further information if that is required.

The wider impacts of the project in terms of the level of collaboration achieved between UK and host country institutions, and the prospects for greater joint working/information exchange in the future. To what extent has good collaboration been achieved?

Collaboration between CABI Bioscience and the University of Nairobi significantly predated the project inception, and included a year-long training visit by the Kenyan project leader Professor Mibey to CABI Bioscience which was funded through a previous Darwin Project. Collaboration between the two lead institutions during the programme has been excellent, with:

- frequent communication (facilitated by the funding of email)
- 11 visits to Kenya by the UK project leader or senior deputy
- four visits to the UK by Kenyan project staff
- further links through CAB International's Nairobi office
- four academic papers written jointly by CABI Bioscience/University of Nairobi staff
- shared teaching on a number of training courses
- joint organization of a major project workshop

The project has greatly strengthened links between the two lead organizations, and preparations are being made for further collaboration in several subject areas, dependent on joint applications to appropriate grant bodies.

8. SUSTAINABILITY

Did the host country institute(s) contribute resources to this project (these may have been provided in-kind, for example staff, materials etc)?

Yes. The University of Nairobi contributed about £5000 to the joint purchase of a 4WD vehicle for the project, an estimated £2400 for its insurance during

lifetime of the project. Other less easily quantifiable but clearly significant contributions included the provision of two rooms within the Department of Botany, one for project administration/laboratory work and one to house the collections, provision of training laboratories for systematics courses, provision of transport (a large 4WD vehicle with driver was loaned free of charge for two project field trips to allow larger numbers to participate) and provision of secretarial support (a secretary was assigned to the project for about six months to assist with administration). No overhead charges were made by the University. **Please see also information provided above as Standard Output no. 23**

- To what extent was Darwin funding a catalyst for attracting resources (including in-kind contributions) from other sources? Please provide details on the other sources from which resources were secured for this project.

Please see information provided above as Standard Output no. 23

- What is the monetary value of resources generated for the project from other sources (please provide an estimate for each funding source)?

Please see information provided above as Standard Output no. 23

- To what extent is work begun by the project likely to be continued in the future (if this is relevant - some projects may come to a natural end at completion)? This is more likely to be relevant for research-based projects.

See discussion above under Project Impact. The concept of inclusion of fungi and other small-bodied organisms in conservation policy has been widely accepted by the relevant scientific community in Kenya, but further funding would be needed in order to maintain these initiatives. The amount of money needed to develop new initiatives might not be particularly large, but competition for conservation funds continues to be intense and such projects are difficult to "sell" to donors who are reliant on individual donations. Nevertheless, the issues will continue to be raised by the scientists concerned, especially through joint initiatives such as EAFRINET.

- Has the project acted as a catalyst for other projects/initiatives in the host country? Is it likely to do so in the future?

Some small initiatives have occurred. The most obvious example of this is a research project organized by Jomo Kenyatta University to study saprobic fungi and their enzyme systems which are associated with some of the plants targeted by the project, but regrettably the main worker, W.O. Momanyi, was killed in a car crash earlier this year and it is unlikely the programme will continue. Other activities have been planned, including studies of insects in natural communities by staff at the Kenya

Forest Research Institute, but as explained above most initiatives rely on external funding due to the critical lack of funds available through Government sources.

9. OUTCOMES IN THE ABSENCE OF DARWIN FUNDING

- Had Darwin funding been unavailable for the project, what would have been the most likely outcome:

  - The project would have proceeded with other funding? From whom?
  - The project would have proceeded at a reduced scale? Please explain.
  - The project would have been delayed? Please explain.
  - The project would not have proceeded?

It is unlikely that the project would have proceeded. The Darwin Initiative is almost the only source of funds for biodiversity initiatives in developing countries which places emphasis on systematic research.

- Had this project not been undertaken, how would the users/beneficiaries of the project have met their requirements? Would other organisations/ initiatives have been able to meet their needs (at least to some extent)?

The conservation aspects of this project are unlikely to have been met by other organizations, due to the lack of understanding prior to programme inception of the significance of fungal diversity for natural environments, compared with the perceived need to stress survival of large charismatic mammals. Some of the training in identification might possibly have been provided through development organizations, but with current emphasis on direct issues such as poverty eradication rather than building frameworks in developing countries to promote self-reliance, the climate is not good for such initiatives.

10. KEY POINTS

- **What would you identify as the key success factors of this project?**

The primary key to running any collaborative project is commitment from all partners. Especially in developing countries, the prospect of financial rewards may encourage the promising of unrealistic outcomes, and experiences in the past of lax financial stewardship threaten to exacerbate these practices. An important secondary factor is therefore an open accounting system, which is clearly tied to achievement of specific outputs.

Factors influencing the success of this project are no exception to these general principles. Discussions were held over a period of some months between the UK and

Kenyan primary investigators, and the programme was put together as a joint effort. The commitment from the Kenyan side became evident with the financial and in-kind resources made available to the project by the University of Nairobi, and it was clear from conversations with many senior staff that the University considered the acquisition of the Darwin project as a model for other staff to emulate. Financial accountability was also stressed from the start, with the able assistance of staff from CABI's Nairobi office. Funds were allocated in small tranches (salaries were paid in three-monthly instalments rather than one-off grants) which meant that individuals who did not perform according to expectations did not continue to receive funds. I would like to pay tribute here to the Kenyan project team, whose members displayed and excellent spirit of commitment throughout.

- **What were the main problems/difficulties encountered by the project?**

Most of the difficulties experienced were common to many developing nations - the uncertain electricity supply, civil unrest (which disrupted the first training course), difficulties in obtaining even basic medical supplies while in the field, and above all dealing with bureaucracy and lack of imagination within Government organizations. To give an example, the Kenyan project leader (Professor and Head of the Department of Botany) had to obtain a letter of invitation from myself to obtain leave of absence to carry out project field work, which had to be read and signed off by *four* different people in the University administration. There were also considerable difficulties in obtaining cooperation at national level from the Forest Department, although wardens of individual reserves were universally helpful. Specifically, the Chief Forest Conservator expressed initial enthusiasm for the project and ensured that Forest staff were available for training courses, but his is a political appointment and he appeared to be spending most of his time safeguarding his position. He was eventually relieved of his office by the President, but a permanent successor had still not been appointed by the end of the project and this power vacuum adversely affected plans for cooperation after the completion date.

- **What are the key lessons to be drawn from the experience of this project?** Please try to provide as much information on this point as you can so that others can learn from the experiences of your project.

Don't be too ambitious at the planning stage. The initial competition for grants is intense and there is a strong temptation to promise extra-impressive outputs. Almost any Darwin Initiative project is likely to be far more time-intensive than originally expected: this one involved three times as much time abroad as originally planned and probably more than twice the overall paid staff time allocated. However, the benefits of this extra commitment are self-evident.

- **Does the experience of this project imply a need to review arrangements** for developing and managing projects funded as part of this Initiative?

No particular issues have arisen.

11. PROJECT CONTACTS

To assist future evaluation work, please provide contact details (name, current address, tel/fax number, e-mail address), for the following:

- UK project leader (and other key UK staff involved in the project)

Dr Paul F. Cannon
CABI Bioscience, Bakeham Lane, Egham, Surrey TW20 9TY, UK.
Tel 01784 470111,
Dr Paul M. Kirk (

- Host country project leader/co-ordinator (and other key people involved in the project at the host country collaborating institute)

Professor Richard Mibey
Department of Botany, University of Nairobi, P.O. Box 30197, Nairobi, Kenya
Telephone unreliable
Dr George Siboe (en

Dr Dennis Rangi
CAB International Africa Regional Office, PO Box 633, ICRAF Complex, Village Market, Nairobi, Kenya.

- 'End users' for the output produced by the project in the host country (ie. government departments, agencies, universities, local communities etc)

The Chief Forest Conservator, Forest Department, Ministry of Environment and Natural Resources, Nairobi, Kenya. Position currently vacant: contact D.M. Mbithi
Dr Richard Bagine, Research & Planning Department, Kenya Wildlife Service, Nairobi, Kenya.
National Museums of Kenya, P.O. Box 40658, Nairobi, Kenya: contact Dr George Mugambi.
EAFRINET: coordinator Dr Wanja Kinuthia, National Museums of Kenya, P.O. Box 40658, Nairobi, Kenya.

- **Project trainees/students**

See lists in Section 6 above.

- **Other project beneficiaries**

Mr Simon Mathenge (Department of Botany, University of Nairobi, P.O. Box 30197, Nairobi, Kenya): botany specialist

Dr Sheila Okoth (Department of Botany, University of Nairobi, P.O. Box 30197, Nairobi, Kenya): mycology specialist

Mr George Kariuki (Department of Botany, University of Nairobi, P.O. Box 30197, Nairobi, Kenya): mycology specialist and project administration

Dr Eliahu Kireger (Department of Forestry, Moi University, Eldoret, Kenya): forestry course teacher

Dr Eston Mutitu (Kenya Forest Research Institute, P.O. Box 20412, Mugugu, Kenya): entomology assistance

Mr W.O. Momanyi (Department of Botany, Jomo Kenyatta University, P.O. Box 62000, Nairobi, Kenya): mycologist and enzymologist; deceased.

PLEASE REMEMBER TO ATTACH COPIES OF ALL DOCUMENTATION PRODUCED BY THE PROJECT IE. REPORTS, PAPERS, MANUALS GUIDES, CONFERENCE/WORKSHOP PROCEEDINGS TRAINING MATERIALS ETC