

1. Basic project details

Title: Repatriation of Herbarium Data for the Flora of Bahia, Brazil

Contractor: Royal Botanic Gardens, Kew

Host country collaborating institutes: Herbário da Universidade Estadual de Feira de Santana (HUEFS); Herbário do Centro de Pesquisas do Cacau (CEPEC); Herbário do Instituto de Pesquisas Agropecuárias de Pernambuco (IPA).

Grant round: 6

Grant value: £ 38,307.00

2. Project Expenditure

See Annex 1 (Financial Statement) for total grant expenditure and breakdown of expenditure.

Explanation for the variation in expenditure in covering letter for Annex 1.

3. Project Background/Rationale

Need for the project. The Brazilian state of Bahia is climatically and vegetationally the most diverse in the country, with a flora estimated between 15-20,000 species. It has been the object of collaboration between RBG Kew and Brazilian research institutions for more than 20 years. Recently, Bahian botanists set up a Flora da Bahia project. The aims of this project are to name, catalogue and describe all species of flowering plants collected in Bahia, providing identification keys and other useful tools to enable other people to determine them. The success of this floristic project will depend on access to critically important Bahian data held in the Kew herbarium.

Project Development. Traditionally, Brazilian taxonomic researchers have travelled to Kew and other European herbaria to study the material deposited here, in order to establish the correct application of names in their group of plants, by reference to types and other authoritatively named material. Such researchers are normally undertaking doctoral or post-doctoral research on different groups of plants, and they take back with them small, private sets of data and images relating to the theme under study, often a particular genus or a whole plant family within a restricted area.

The production and supply of high quality photographic images (cibachromes) of types upon request by researchers from other institutions has long been part of Kew's

policy, but the effectiveness of this sporadic process is questionable. The data sets supplied in this way are not complete, as they answer only the immediate needs of individual researchers, and their accessibility is low, as they tend to remain within the control of individual researchers even after completion of the project for which they were requested.

Systematic approaches to repatriation have been proposed in the past, but were not funded, partly because of the difficulty of estimating the scale and duration of the task, and the funds required to bring it to completion. Examples include: Myrtaceae type-image repatriation (proposed by E. Nic Lughadha and Carolyn Proença, from Universidade de Brasília, in the early 1990's for British Council funding) and elements of a larger project designed to support taxonomic research by Northeastern Brazilian botanists (PATAX), by members of the Plantas do Nordeste (PNE) group at Kew and in Brazil. Our smaller, self-contained project represents a contribution to estimating the costs, efforts and feasibility of taking on board a larger repatriation initiative.

Our idea was to present some key Brazilian institutes with the possibility of having complete sets of data per family, organized by our in-house specialists, in order to enhance the capacity of Brazilian botanists to identify the plants they are working with. It was also fundamental to train a Brazilian, the Darwin Initiative Bahia Repatriation Officer (DIBRO), to select the dataset and develop the database, bearing in mind that the technical work required did not necessarily fall within the scope of a PhD thesis (so it would not get easily funded by Brazilian funding bodies).

In mid 1997 we entered a phase of consultation with our collaborators, to find out whether they thought the project was feasible and whether a suitable candidate could be found to take the position as DIBRO during 1998-1999. Other topics discussed included whether we should restrict the project to type images of type specimens held at Kew or whether a database of all Kew's holdings from the area would be useful. All the Brazilian counterparts opted for a complete repatriation of data exercise rather than a type-only approach. They also ratified our choice of families for this pilot phase. Taking their answers into account, our grant proposal for a repatriation pilot project was prepared, dealing with 6 families for which we have expertise at Kew.

Relation to conservation priorities in the host country. The present project was designed to help Brazilian botanists to gain access to Kew's collections in order to name and study plants from Bahia, recognizing that without correctly identifying the biodiversity it is difficult to undertake its conservation.

Assisting 'host country' in meeting Biodiversity Convention Obligations. Bahian holdings in the major Brazilian herbaria have already been databased, and the development of such a database for the many historic collections held at Kew represents a vital step towards creating a comprehensive botanical data set for this area and meeting the requirements of the Convention on Biological Diversity with respect to the repatriation of data and the preparation of biological inventories.

The project also aimed at contributing to identifying areas of high species diversity and endemism, essential for conservation planning. Such information is critical to allow the Brazilian government to evaluate priorities for conserving its national biodiversity under the Convention on Biological Diversity.

End Users.

- Taxonomic botany researchers in NE Brazilian Universities and Institutes.
- Ecologists, Plant Anatomists, Phytochemists and associated researchers in NE Brazilian Universities and Institutes.
- Conservationists
- Centro Nordestino de Informação sobre Plantas (CNIP) and associated ONGs

4. Project Objectives

The overall objective of this one-year proof-of-concept project was to develop and refine the methodology for data capture and repatriation of data. Specific objectives included:

- preparation of a database covering all Kew holdings from Bahia of six plant families (Cactaceae, Gramineae, Loranthaceae, Myrtaceae, Rubiaceae and Verbenaceae)

- preparation of high quality photographic images for all type material included in the database.
- the accurate assessment of the resources required to database the remaining collections from Northeastern Brazil at Kew
- combination of new data sets with existing data in order to prepare a total collections distribution map for Bahia, so that future collecting programmes undertaken by the Brazilian Flora da Bahia project can be directed to lacunae in coverage

The project objectives were revised by the addition of two extra plant families to the initial list of six, and by the increase of the area covered, as follows:

- The addition of two extra plant families to the initial list of six: the decision to include the Viscaceae was made on the basis of their close relationship with Loranthaceae and the availability of expertise at Kew; and Passifloraceae were added to reflect the current research interests of the Darwin Initiative Bahia Repatriation Officer (DIBRO).
- The increase of the area covered: we extended the area to include the states of Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Sergipe and Alagoas. This decision was taken for the following reasons: to fit a wider phytogeographical region, the '*caatingas dominium*' of Northeastern Brazil, and in order to relate more easily to work being developed by Brazil and Kew in one of the Plantas do Nordeste Subprogrammes, the SIDT, which aims to repatriate and disseminate botanical data to Northeastern Brazil as a whole. This increase in scope more than doubles the geographical area covered by the project. Our decision to extend the area covered to include the whole of NE Brazil was based on preliminary figures gathered in the first weeks of the project which suggested that extending the area in this way would involve handling relatively few additional specimens but would result in the capture of many more type images. Final results indicate that 56% more types were imaged in the course of the project than would have been the case had the original geographic circumscription been adhered to.

All objectives above have been achieved on time, and to the satisfaction of our Brazilian collaborators, of Kew management (the project has frequently been

showcased as a very positive repatriation initiative) and of colleagues (M. Cheek, J. Dransfield, D. Kirkup, A. Paton), who are now planning to start/have started similar projects in different geographic areas. Data generated by our project facilitated the planning of these projects on a realistic basis.

5. Project outputs

Output targets specified for the project (as listed in Table B of Project Schedule)

6A/B DIBRO trained in herbarium and library and on Brahms database software for 2 weeks at Kew

6A/B DIBRO to obtain a Diploma in Herbarium Techniques following 8 week course at Kew

14C Poster paper presented at the Brazilian Botanical Congress

14B Workshop on Bahian plant diversity to be held at Kew and attended by c. 15 people including DIBRO and one other delegate from HUEFS

12A Computer database in Brahms established and handed over to Brazilian counterpart.

13A 2 reference collections of images of type material (cibachromes) established and handed to Brazilian counterparts

17B Enhancement of the existing dissemination network of the taxonomic research institutions involved in the Plantas do Nordeste project

9 Project report with recommendations for future data repatriation and collection coverage map prepared

Unnumbered Grant application prepared and submitted to CNPq

Analysis of the outputs

6A/B DIBRO trained in herbarium and library and on Brahms database software for 2 weeks at Kew - **achieved with modifications** in Aug. 1998. No training in Brahms was required - the DIBRO was already familiar with Access2.0 and had received training in Brahms by Denis Filer in Brazil in 1997. See also item 12A about Brahms.

A = ①
B = ②

6A/B DIBRO to obtain a Diploma in Herbarium Techniques following 8 week course at Kew - **achieved** in July 1999.

14C Poster paper presented at the Brazilian Botanical Congress in July 1999 - **one year delayed**. Neither the DIBRO nor any member of the Kew team could attend the 1999 Congress. DIBRO and D. Zappi to attend the 51st National Botanical Congress, Brasília, July 2000 and present the poster (Annex 2 - summary of the paper).

14B Workshop on Bahian plant diversity to be held at Kew and attended by c. 15 people including DIBRO and one other delegate from HUEFS - **achieved and expanded**, with five extra delegates representing 2 participating and 3 peer institutions. (Annex 3 - list of participants and programme)

12A Computer database in Brahms established and handed over to Brazilian counterpart - **achieved with modifications**, as the databases handed over were in

Access2.0 for the following reasons:

- the home institution of the DIBRO uses Access2.0 and the DIBRO was proficient in this package;
- the other recipient institutions have access to this software - but not to Brahms;
- Kew's applications development unit provides support for databases in Access2.0, which meant that professional support was always on hand when required, even at short notice.

13A 2 reference collections of images of type material (cibachromes) established and handed to Brazilian counterparts - **partly achieved and exceeded**. Instead of 2 reference collections, we prepared 3 reference collections for collaborating institutes and **one** for a Brazilian institute where a specialist on the family works. The delivery of the repatriation packages remains a problem, as some still have not reached their final destination. Because of the considerable investment of time and funds in preparing the data packs the project staff, and especially the DIBRO, were reluctant to put them at risk by entrusting them to the vagaries of the Brazilian postal system. Instead, we are relying on our frequent contacts with

Northeastern Brazil to deliver the packages by hand to ensure they get to the herbaria safely. The main collaborator, Herbarium of the Univ. Est. Feira de Santana (HUEFS) has received all their packages, but the other two collaborating institutions are still waiting for the delivery of 30% of their parcels. It is envisaged that these will be brought over to Brazil by D. Zappi in July 2000.

17B Enhancement of the existing dissemination network of the taxonomic research institutions involved in the Plantas do Nordeste project - **partly achieved** - An outcome of the workshop was a decision that the publication of the checklists resulting from our work should take place prior to the release of the data via the Centro Nordestino de Informações sobre Plantas (CNIP) website. The datasets are currently being checked by R. Allkin and E. Dalcin (CNIP) with a view to standardizing and enhancing data quality before electronic publication.

9 Project report with recommendations for future data repatriation (Annex 4) and collection coverage map (Annex 5) prepared - **achieved**.

Unnumbered Grant application prepared and submitted to CNPq - **achieved** - Unfortunately the proposal was not approved so far.

Additional outputs achieved

11A paper on Notes on The Rubiaceae of Northeastern Brazil I. *Erithalis*, *Psychotria* and *Rudgea*. D. Zappi & T. Nunes, *Kew Bulletin* (accepted June 2000). (annex 6)

14A Course on Herbarium Techniques in Jequié, Bahia, 21-24 Febr 2000, given by T. Nunes (former DIBRO) for 24 students.

14B Seminar to all Kew staff (12 August 1999) by DIBRO and D. Zappi, with participation of E. Nic Lughadha, B. Stannard & S. Atkins.

15A/C Article in the PNE newsletter (August 1999) (Annex 7)

15D Article in *Kew Scientist* (October 1999) (Annex 8)

11B Rubiaceae, Passifloraceae and Cactaceae checklists to be published later in 2000/2001.

Unnumbered - our project was cited as an example of a repatriation exercise under the needs assessment section of the Darwin Initiative report entitled 'Going Home', by M. Ruiz & R. Pooma (2000).

6. Project Operation / Management

Methodology adopted

As first steps, the DIBRO was trained in Kew herbarium and library procedures and library; the fields to be used in the databases were defined and the database format was discussed with the Applications Development staff in Kew's Information Services Department and within the project team.

For each family, a search for all Northeastern Brazilian specimens was carried out using the following methodology. A shortlist was prepared by querying an existing database (N. Brummitt, unpubl.) which documents all genera represented in the Kew herbarium and their geographic distribution on a regional basis. In the case of all genera reported to occur anywhere in Brazil, the herbarium holdings were searched systematically for NE Brazilian material or material of unspecified origin which might prove to be from NE Brazil. All such material was removed from the cupboards for further checking. A certain degree of expertise on South American botanical history and on the Kew Herbarium holdings was necessary to identify the specimens from Northeastern Brazil amongst the Eastern South American collections (known as Area 16 at Kew). Many specimens bear only field notes, with old names of locations which have long since changed, and some research is required in order to ascertain their provenance. Others are annotated with unclear handwriting, which is easily recognized by an experienced eye. Members of the project team and other members of staff and associates (S. Mayo, N. Hind, R. Harley, N. Taylor) advised the DIBRO on localities and plant collectors.

Revision of specimen identification was then undertaken by the family specialists. This was done to certify that there was uniformity of naming amongst collections from several historic periods, named by different specialists over the years. This was the moment when most taxonomic and nomenclatural novelties were spotted by the

specialists, through the process of forming a species concept for the taxa occurring in the region. The names and authorities were standardized against agreed bibliography. Afterwards, the specimens were databased and barcoded.

The type-specimens, which are the specimens linked to the description of a new taxon, are stored inside special red folders at Kew Herbarium. The standards of curation vary from family to family at Kew, and sometimes the specimens found within red covers are not actually types, while, on the other hand, some types may not have been identified as such and may not be protected by red folders. All 'putative' types located during the DIBRO's search were assessed by specialists and annotated. Additional information added to the type specimens included further data concerning locality, collector, and status of type. The types were reproduced by Kew's Information Service Department, using a cibachrome process, resulting in high quality photographs that can be studied under the microscope. Four cibachrome copies of each type sheet were produced.

Details of the types found were databased and a library search for the original descriptions, or protologues, of the names concerned was carried out. Photocopies of each protologue were added to the cibachromes of types. This extra information increased the value and utility of the types, as many of those original works are not easily available in Northeastern Brazil.

For each family, a package containing a full report from the database (in the format of a 'preliminary checklist') and a collection of labelled cibachromes with added protologues was prepared.

As the four sets of the first Repatriation package (family Rubiaceae) were prepared, the first troubleshooting meeting was held at Kew. The specialist copy was then sent on to the Brazilian specialist in the family, Dr M. Regina Barbosa, in order to obtain feedback.

The remaining 7 families were subsequently databased, and the type-material was identified and imaged using the same process described above. 7504 specimens

belonging to more than 1200 different taxa were databased, and 556 cibachromes of types were sent back to each institution.

Estimates based on other Northeastern Brazilian vegetation surveys suggested that the project had covered around 15% of Kew's holdings of the flora of the region by databasing the 8 chosen families.

A collection coverage map was prepared, using data from all 8 families covered by project. This was achieved out with help of Kew's GIS expert, Justin Moat, and Sandwich Student Amy Town. The map was produced using ARC/INFO software (Annex 5). The map was discussed during the project workshop (see next paragraph).

Once the databasing work was finished, a workshop was held at Kew to consult Brazilian counterparts and users as to whether the product was adequate and whether there should be a continuation with/without modifications. The work was formally presented by the DIBRO and Kew members of the team, and figures and estimates were provided. All participants were extremely positive about the outcome of the project, and very few modifications in the methodology were suggested. Our collection coverage map showing undercollected areas was compared to another map produced by the Flora da Bahia project, and the priority areas for collection were established. (Note: the Flora da Bahia project has since raised funds within Brazil and, in January 2000, intensive collecting began in Western Bahia, an area which had been identified during the workshop as under-collected). This workshop resulted in the preparation of a report on recommendations for repatriation and the submission of a grant proposal to the Brazilian Research Council (CNPq), for a continuation of the project, focusing on the remaining plant families of NE Brazil.

Staff employed funded by DL

- DIBRO - Teo Nunes, our Darwin Initiative Brazilian Repatriation Officer, 100% committed to the project.

Staff funded by Kew

- Managers - D. Zappi (line manager) [30%] incl. project management and identification of Rubiaceae and Cactaceae; E. Nic Lughadha [15%] incl. budget and project management and identification of Myrtaceae;
- Specialists - B. Stannard [15%] incl. herbarium training and identification of Loranthaceae & Viscaceae; S. Atkins [15%] incl. logistics and identification of Verbenaceae; S. Renvoize [5%] identification of Gramineae.
- Logistics - E. Lucas [10%] incl. herbarium training and logistic support

Scientific and technical findings

- report on herbarium data repatriation
- data on 7504 specimens of more than 1200 taxa repatriated
- images of 556 type-sheets repatriated to 3 collaborating institutes and one Brazil-based specialist in each plant group
- projections prepared of numbers of specimens, species and type-sheets remaining to cover all plant families of Northeastern Brazil
- input to Kew's internal report on herbarium databasing and barcoding techniques
- collection coverage map indicating undercollected areas in Bahia
- taxonomic and nomenclatural novelties and stabilization of name use in the region
- one peer-reviewed scientific paper accepted for publication to date.
- eight family checklists envisaged as peer-reviewed publications eventually.

7. Project Impact

The project has caused very positive reactions both in Bahia and in Northeastern Brazil as a whole, as it left a lasting impression that Kew is really committed to the CBD and, in a way, 'putting things back where they came from'.

The repatriation packages represent a capacity building tool for botanists and other scientists interested in biodiversity in Northeastern Brazil, and have been the subject of very positive feedback from the three institutes which received them, as well as from the Centro Nordestino de Informações sobre Plantas.

This project was the first at Kew to barcode herbarium specimens, as well as our first herbarium data repatriation initiative. A number of colleagues have started similar projects based on our findings.

8. Sustainability

Monetary value of Resources contributed by host country.

HUEFS contributed staff-time to this project - 100% of DIBRO's local salary US\$, as well as 3% of Dr Giulietti and 3% of Dr Queiroz

Resources attracted from other sources.

During our project, Margaret Mee Fellowships also helped us to bring over three more collaborators from Brazil to attend the workshop (contribution £ 3918.00 towards airfares and accommodation for 3 Brazilian delegates)

Likelihood of continuation of project in the future.

The work is very likely to be continued in the future, in order to achieve complete coverage of plant families that occur in NE Brazil. We envisage that this continuation should be funded by other source, perhaps the Brazilian Research Council (Conselho Nacional de Pesquisas Científicas e Tecnológicas – CNPq) or funds raised via the Associação Plantas do Nordeste (APNE).

Role of project as a catalyst for other projects/initiatives in host country.

The project has acted as a catalyst for the preparation of grant proposals for similar projects in Brazil, but these have not, as yet, had a successful outcome. At Kew, it has caught the imagination of staff working in other regions of the world, such as Southeast Asia and Cameroon. A Darwin Initiative funded project, 'The Plants of Western Cameroon', started in 1999.

9. Outcomes in the Absence of Darwin Initiative Funding

In the absence of Darwin funding the project would not have proceeded. Selected users (PhD level and above) would continue to have direct access to Kew's collections in order to undertake research on the Flora of Bahia. However, the databasing and

image repatriation to the leading NE Brazilian institutes would be, at best, patchy, rather than covering complete families for the whole of NE Brazil.

10. Key Points

Key success factors

- resources: the availability under one roof of
 - 1) such a rich collection of NE Brazilian material including
 - 2) such a high proportion of type specimens along with
 - 3) excellent library facilities,
 - 4) taxonomic expertise in the selected families, and
 - 5) many years of research experience in Brazil including gazetteers, collectors data and notebooks etc.

meant that the work could be concentrated in one centre, resulting in maximal efficiency and control over the quality of products.

- small scale - because it only dealt with the families in which we have expertise, so the output is guaranteed to present high quality data, and keep the scale small enough for the management time spent in the project to be in keeping with other responsibilities of staff involved.
- many fold - capacity building in the form of training of the DIBRO and provision of comprehensive research materials for Brazilians seeking to pursue taxonomic work were addressed by the project, as well as scientific research on biodiversity and even mapping for conservation purposes. A multi-faceted project like this brings many different benefits for those involved in it, making the time/benefit equation well balanced.
- DIBRO - The choice of an excellent, well prepared and committed DIBRO made all the difference in meeting targets and completing the outputs efficiently and on time.

Problems/difficulties encountered

- the process of 'importing' the DIBRO to work in the UK was complicated, and we did not know whether we should try for a scientific visa or a work permit. Although a work permit seemed appropriate for her case, this proved impossible

to obtain, so we settled for a student visa to last for one year, and as a result paid the DIBRO on a subsistence basis rather than a salary. We suggested in our first report that perhaps the Darwin Initiative could give useful advice in this subject, as many projects involve work in the UK as means of training people from developing countries.

- we experienced minor on purchasing the portable computer and the air ticket for the DIBRO due to the budget having been prepared more than one year in advance.

Key lessons and considerations for future projects

- taking into account the small size of the project, the management input required to make it run smoothly was larger than it seemed at first, perhaps because it involved several different researchers within the institution.
- Brazilian funding sources restrict the academic level of the personnel that can be sent abroad on grants and, therefore, reduce the possibilities of choice of DIBRO for an eventual continuation.
- Such high quality data could not be produced for families lacking Kew-based specialists, except by involving other researchers in the project. We are currently exploring possible mechanisms for involving other specialists in the process.

11. Project Contacts

UK project leaders – Dr E. Nic Lughadha & Dr D. Zappi

Herbarium
Royal Botanic Gardens, Kew
Richmond, Surrey
TW9 3AE

other Kew Participants: B. Stannard

Brazil country project leader – Dr A. M. Giuliatti & Dr L. P. Queiroz
Herbário HUEFS

Other important contacts:

Curator of Herbarium CEPEC – Dr A. M. Carvalho

Curator of Herbarium at IPA – Dra A. L. du Bocage Neta

Instituto Pernambucano de Pesquisa Agropecuária

Av. General Sao Martin, 1371

Caixa Postal 1022

Bonji

50.761-000 Recife - PE

Brasil

Curator of Herbarium at UFPB – Dra M. R. V. Barbosa

End users:

Brazilian Herbaria and Universities (including the ones cited above):

Curator and staff of Herbarium ALCB, Univ. Federal da Bahia - M. Lenise

Guedes.

Staff at the Botany Department of the Univ. Federal de Pernambuco - Katia

Porto

Isabel Cristina Machado.

Curator and staff at Herbarium at Univ. Rural de Pernambuco PEUFR -

Carmen Sílvia Zickel

; Margarete Sales.

Curator and staff of Herbarium at Univ. Estadual de Sta Cruz, Bahia - Luiz

Mattos; Emerson Rocha

Dr R. Allkin () and E. Dalcin () of
the Centro Nordestino de Informação sobre Plantas – CNIP, Associação
Plantas do Nordeste (PNE)
Conselho Nacional de Pesquisas Científicas e Tecnológicas - CNPq

Project trainee (DIBRO) – T. S. Nunes
Herbario HUEFS

Other key players

Dr Simon Mayo, chair of the Margaret Mee Fellowships Programme (funded the visit
of Drs Barbosa, Carvalho and Queiroz to attend the Workshop) –