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We thank the herbarium curators and staff who responded to the needs assessment questionnaire—we understand the limitations of questionnaires, and how much aversion people generally have towards them. Without their cooperation it would not have been possible to compile this report. Special thanks are due to Ms Rina Marais and Ms Helena Naudé for general assistance with this project. Ms Estelle Potgieter (Mary Gunn Library, National Botanical Institute, Pretoria) and Prof. Snowy Baijnath (Department of Botany, University of Durban-Westville) provided valuable assistance in sourcing material for the library and literature section.

Although we tried not to impose our own view on the information provided by the responding herbaria, our inputs were required in instances where details were incomplete or inaccurate (particularly regarding literature needs), and we intervened in a very few cases where a question was clearly misunderstood. The authors accept full responsibility for the information provided in this report.

This publication was made possible through support provided by the Global Environment Facility (GEF) through the United Nations Development Programme (UNDP). The National Botanical Institute (NBI) provided funds for printing and mailing some of the questionnaires.

Foreword

Increasing awareness of the rapid exploitation of the biological resources of our world has caused widespread anxiety for their conservation—for scientific and practical needs, as well as for ethical reasons. This anxiety led to the Rio Convention (Convention on Biological Diversity) in 1992. According to this convention each country has sovereignty over its own biological resources. It should therefore also be responsible for their maintenance.

While all kinds of organisms play a role in ecosystems, the group generally considered to be most fundamental is the producers—the green plants. In order to conserve plant species we urgently need to improve the infrastructure required for this task. Since we must be able to recognise the species and name them, we need botanical taxonomists. Furthermore, to aid in collecting and documenting the knowledge required, well equipped herbaria with a competent staff are a necessary prerequisite.

The main difficulties for tropical and subtropical countries in this respect are that while most of the botanical diversity occurs in the South, most taxonomists and herbarium collections are found in temperate Boreal countries, and that the available botanical infrastructure is much less adequate in the South than in the North. For the intensified work required for inventory and documentation of the flora of southern Africa, massive support will be needed, as suggested before, for example in our earlier survey of herbarium resources of the SADCC countries (Hedberg 1990, 1991; Hedberg & Hedberg 1992).

The SABONET/NBI needs assessment makes a fundamental contribution to the possibilities of surveying and documenting the plant resources of southern Africa and should greatly facilitate mobilising the resources required.

Olov and Inga Hedberg
Uppsala, April 1999

Abbreviations and acronyms

AETFAT	Association for the Taxonomic Study of the Flora of Tropical Africa
ARC	Agricultural Research Council
CBD	Convention on Biological Diversity
CFR	Cape Floristic Region
CoP	Conference of Parties
FSA	Flora of southern Africa
FZ	Flora zambesiaca
GEF	Global Environment Facility
GTI	Global Taxonomy Initiative
IUCN	The World Conservation Union
LOOP	Locally Organised and Operated Partnership
NBI	National Botanical Institute
NBRI	National Botanical Research Institute
NETCAB	Networking and Capacity Building Initiative for Southern Africa
PPRI	Plant Protection Research Institute
RAMSAR	Convention on Wetlands of International Importance especially as Waterfowl Habitat, adopted in Ramsar, Iran, in 1971
SABINET	South African Bibliographic and Information Network
SABONET	Southern African Botanical Diversity Network
SAFRINET	The Southern African LOOP of BioNET-INTERNATIONAL
SADC	Southern African Development Community
SADCC	Southern African Development Coordination Conference
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
WWF	World Wide Fund for Nature

Appendix 2 lists all herbarium acronyms used in this report.

Executive summary

Southern Africa contains over 30 000 species of flowering plants and ferns, including the whole of one of the world's six floristic kingdoms. Despite this great botanical diversity, the countries of the region are poorly equipped in both infrastructure and human resources to inventory, monitor and evaluate this heritage. Over the last few decades, support for the national herbaria and botanic gardens of southern Africa has been intermittent and sub-critical. Many plant species are threatened with extinction, mainly through agricultural, mining, industrial and urban activities.

One of SABONET's objectives is the expansion and improvement of herbarium collections in southern Africa. The first step towards achieving this objective was determining the needs of as many herbaria as possible within the region. A total of 55 herbaria in the following countries were surveyed: Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe.

The SABONET/NBI needs assessment survey is the most detailed and comprehensive survey yet conducted in the region. Previous botanical surveys did not cover all the southern African countries, and not all the main collections in the subcontinent were targeted. The communication network established by SABONET has made it possible to survey all important collections in the ten SABONET countries. In addition, all the needs of the herbaria have been translated into financial terms. For the first time, policy makers and managers of collections will have a clear indication of the exact monetary needs of specific collections for maintenance and development.

The report presents the survey results in five sections: taxon holdings, libraries and literature, capital equipment, staffing, and computerisation. Each section consists of a summary of the results for the entire region, which is followed by a more detailed discussion for each country, where applicable. The appendices provide detailed information for individual herbaria, arranged by country.

Taxon holdings The 55 southern African herbaria included in this survey hold approximately 3 830 000 specimens. Of these, more than half (2 108 636 specimens) are held in the three major herbaria, PRE, SRGH and NBG & SAM. The percentage representation of bryophytes, pteridophytes, gymnosperms and angiosperms in southern African herbaria corresponds closely with the number of taxa of these groups known to be present in the region.

Libraries and literature A strong dichotomy exists between the needs of the South African and other southern African herbaria. In general, most of the larger South African herbaria have fairly easy access to general botanical literature. Few of the herbaria in the rest of southern Africa receive the majority of important publications. The library facilities of most southern African herbaria are inadequate and insufficient, and in some cases non-existent. Even in some of the larger herbaria with long traditions of taxonomic research, a comprehensive expansion of library holdings is urgently required. There is also a lack of contact with and knowledge of recently published botanical books in these herbaria. Very few herbarium libraries are currently catalogued or computerised.

Capital equipment Respondents from the various southern African herbaria have indicated that there are many needs in terms of capital equipment in the herbaria surveyed. The total estimated cost of equipment needed by the region's herbaria is US\$ 1 019 575. Capital equipment needs are larger in South Africa (US\$ 590 555) than in the remaining nine southern African countries put together (US\$ 429 020), owing to the large number of herbaria in the country.

Staffing Staffing and training needs in the southern African herbaria assessed can be divided into three groups: physical curation, scientific curation, and databasing. Survey results show that 140 additional staff members are required for physical and scientific curation, at a total estimated cost of US\$ 1 213 976 per year. Herbaria have indicated that 69 additional staff members are needed for dedicated databasing work.

Computerisation Just over half of the southern African herbaria (28 herbaria, 51%) are computerised to some degree. Just under half (27 herbaria, 49%) are not computerised at all. A total of 983 445 specimens had been computerised at the time of the survey. This is 26% of the 3 829 883 specimens housed in southern African herbaria. Various database systems are used for computerisation; most herbaria (57%) use PRECIS Specimen Database, developed by South Africa's NBI. Of the 983 445 specimens that have been computerised so far, 793 735 (81%) have been entered using PRECIS Specimen Database. It is estimated that US\$ 2 081 373 will be necessary to computerise all specimens in all surveyed herbaria in the region.

Summary The total amount required for the 55 southern African herbaria surveyed is made up as follows:

Libraries and literature	(variable)
Capital equipment	\$ 1 019 575
Staffing	\$ 1 213 976
Computerisation	<u>\$ 2 081 373</u>
Total	US\$ 4 314 924

Introduction

Southern Africa (Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe, Figure 1) contains over 30 000 species of flowering plants and ferns, including the whole of one of the world's six floristic kingdoms, the Cape Floristic Region (CFR) (Good 1947; Goldblatt 1978; Takhtajan 1986).

Over 24 000 plant taxa are known to occur in the *Flora of southern Africa* (FSA) region (Namibia, Botswana, Swaziland, Lesotho, South Africa). The flora of this area of southern Africa is extremely species-rich in terms of species/area ratios with a value of 0.0081 species/km². This value is higher than those recorded for humid tropical floras such as Brazil (0.0044) and Asia (0.0041) (Gibbs Russell 1987).

Eleven plant families are endemic to the region (Achariaceae, Bruniaceae, Geissolomataceae, Greyiaceae, Grubbiaceae, Lanariaceae, Penaeaceae, Retziaceae, Rhynchocalycaceae, Roridulaceae and Stilbaceae) and a further five families are endemic to Africa with the main centre of diversity in southern Africa (Eriospermaceae, Heteropyxidaceae, Melianthaceae, Myrothamnaceae and Oliniaceae) (Dahlgren & Van Wyk 1988). Nearly all of the families endemic to the southern African region are concentrated in the winter rainfall region in the southwestern subcontinent (Cowling & Hilton-Taylor 1994). In addition, 80% of the species and 29% of the genera of the FSA region are endemic. This endemism has largely been attributed to the diverse ecological conditions of southern Africa relative to the rest of the continent, as well as the high speciation within some of the genera endemic to the region (Cowling & Hilton-Taylor 1994). Peculiarities of the flora include an unusually high proportion of petaloid monocots, a wealth of succulents, large numbers of sclerophyllous to microphyllous shrubs, and very few annuals (Goldblatt 1978; Smith, Van Jaarsveld, Arnold, Steffens, Dixon & Retief 1997).

Much of the species richness of the FSA region lies in South Africa's CFR, where there are 8 550 species (of which 73% are endemic) in an area of only 89 000 km² at the south-western tip of Africa (Goldblatt 1978). Yet even excluding the CFR, the FSA region is still botanically rich with some 1 732 genera and 12 280 species occurring outside the Cape region, in an area of 2.5 million km². This figure is high when compared with that characteristic of the adjacent *Flora zambesiaca* area (Botswana, Zambia, Zimbabwe, Malawi, Mozambique) of some 2.6 million km², with an estimated 6 000 (Exell 1971) to 8 000 species (Morat & Lowry 1997). It even exceeds the total for the Democratic Republic of Congo, Burundi and Rwanda (*Flore d'Afrique Centrale*)—an area with more than 10 000 species and an estimated 33% endemism in 2.3 million km² (Brenan 1978) in a region with a rich tropical flora, and it is far richer than west tropical Africa which has an estimated 7 500 species in 4.5 million km² (Goldblatt 1978).

Angola, which covers an area of 1.2 million km², is considered to be one of the most important centres of endemism in southern tropical Africa (Brenan 1978). Approximately 5 000 vascular plant species are reported for the country (Lebrun 1976; Morat & Lowry 1997), of which 1 260 are believed to be endemic (Stuart & Adams 1990).

Southern Africa also includes

- Seventeen centres of plant diversity as identified by the WWF/IUCN (Davis 1994; WWF & IUCN 1994)
- Arid and semi-arid ecosystems which contain roughly half of the world's known succulents
- Coastal, marine and freshwater ecosystems, including several RAMSAR and World Heritage Sites
- Forest ecosystems, most of which are under some form of threat
- Mountain ecosystems—Chimanimani, Drakensberg, Mount Mulanje, Nyika and the Huambo and Huila highlands of Angola

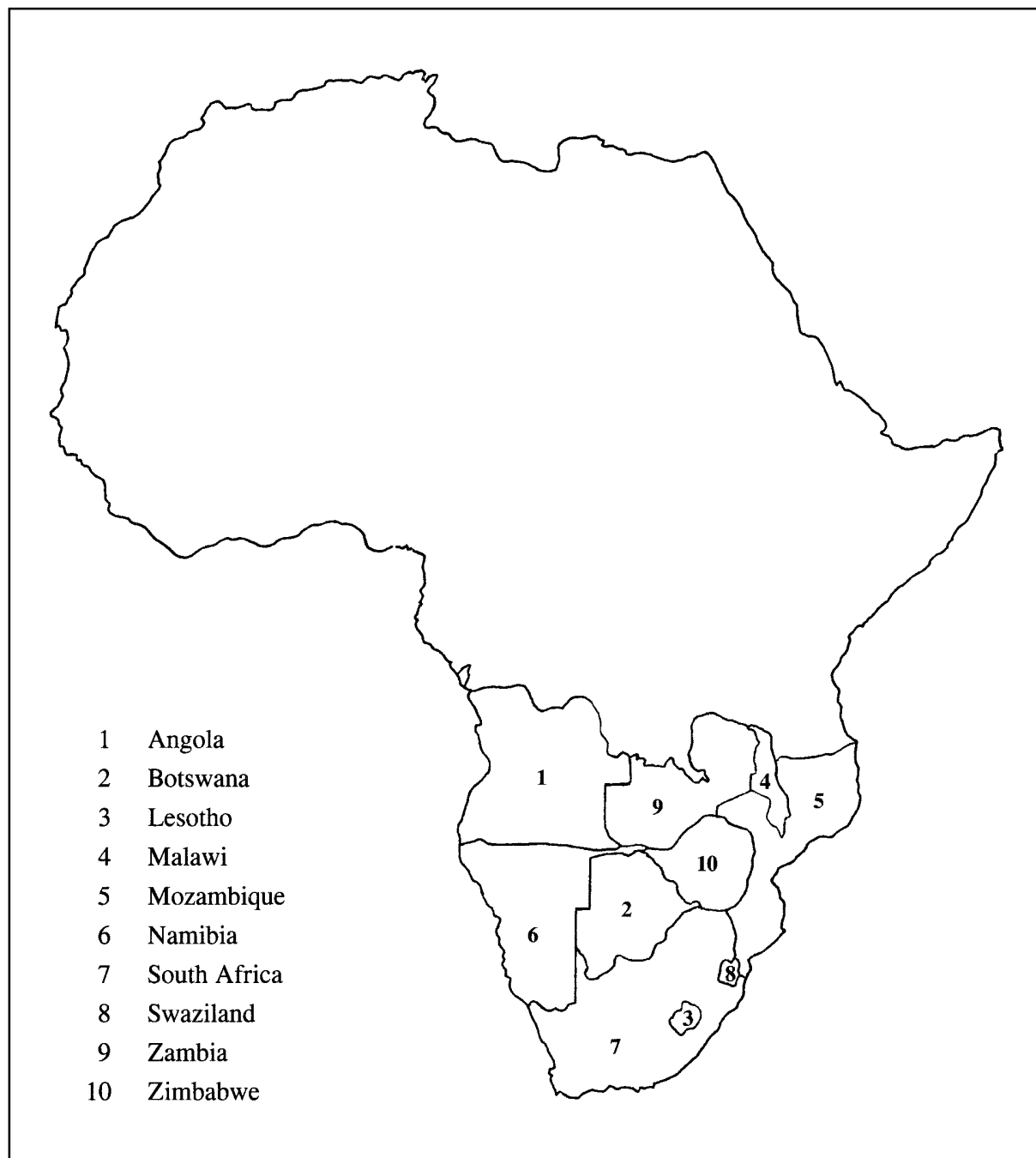


Figure 1. Countries participating in the SABONET Project.

Despite this great botanical diversity, the countries of the region are poorly equipped in both infrastructure and human resources to inventory, monitor and evaluate this heritage. Over the last few decades, support for the national herbaria and botanic gardens of southern Africa has been intermittent and sub-critical. In addition, many plant species are threatened with extinction, mainly through agricultural, mining, industrial and urban activities. The 1997 *IUCN Red List of Threatened Plants* (Walter & Gillett 1998) lists 2 652 plant species as threatened in the ten countries of southern Africa. Hilton Taylor (1996) estimates an even higher figure of 3 435 globally threatened species in the FSA region.

One of SABONET's objectives is the expansion and improvement of herbarium collections in southern Africa (Huntley, Matos, Aye, Nermark, Nagendran, Seyani, da Silva, Izidine, Maggs, Mannheimer, Kubirske, Smith, Koekemoer, Dlamini, Phiri, Nobanda & Willis, 1998). The first step towards achieving this objective was determining the needs of as many herbaria as possible within the region. Although other surveys have been conducted of herbaria within the Southern African Development Community (SADC) region (Hedberg 1990, 1991; Hedberg & Hedberg 1992; Baijnath & Kabuye 1994; Baijnath 1995; Schrire & Pope 1995), it was felt that a more comprehensive and up-to-date assessment was necessary.

Further support for the SABONET/NBI needs assessment came from the recommendations made by the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) to the Conference of the Parties (CoP) of the Convention on Biological Diversity (CBD)—“each country should conduct a taxonomic needs study”. SBSTTA, in its recommendations to the CoP of the CBD, found an extraordinary level of agreement among delegates that enhanced taxonomic capacity is a *sine qua non* for the implementation of the CBD and recommended that the CoP consider the following: “Where appropriate, national taxonomic needs assessment and action plans should be developed by setting national priorities, mobilising available institutional resources, and identifying available funds. Countries could benefit from regional and subregional collaboration.” (Australian Biological Resources Study 1998).

Calls for needs assessments to be conducted have also been made at various international workshops. A workshop held in Darwin, Australia, from 2–5 February 1998, made the following recommendation: “The [CBD Secretariat Program] officer should especially coordinate actions to meet the need, recognised by the meeting, for each country to conduct a national taxonomic needs assessment in conjunction with national reporting under the CBD...” (Environment Australia 1998). A follow-up meeting was held in London, UK, in September 1998 (Australian Biological Resources Study 1998). As part of the actions needed to progress with the Global Taxonomy Initiative (GTI), the meeting suggested the following: “Also essential is to undertake a focused needs assessment within developing countries.” (Australian Biological Resources Study 1998).

The SABONET/NBI needs assessment also forms part of a broader strategy aimed at establishing the exact requirements of all preserved collections in the subregion, encompassing collections of micro-organisms, invertebrates, vertebrates, and plants. Both the Southern African LOOP of BioNET-INTERNATIONAL (SAFRINET) and the Southern African Society for Systematic Biology have recently done needs assessments for micro-organism, invertebrate, and vertebrate collections.

SAFRINET is a SADC programme that focuses on the biosystematics (taxonomy) of micro-organisms and invertebrates in the twelve member states of SADC. SAFRINET is currently coordinated by the Agricultural Research Council's (ARC) Plant Protection Research Institute (PPRI) in South Africa. The purpose of SAFRINET is to enable developing countries to become “realistically self-reliant in biosystematic capacity”. SAFRINET has five work programmes for capacity building

through institutional strengthening and human resources development (Eardley & Jones 1998). As part of SAFRINET's initial activities, a needs assessment of institutions housing invertebrate and micro-organism collections was conducted in 1997 and the results were published in 1998 (Eardley & Jones 1998). The needs assessment was designed to determine which SADC member country institutions should be developed into "Centres of Excellence" (Eardley & Jones 1998). However, Angola, Mozambique and South Africa were not surveyed as part of this assessment.

More recently, a survey of South African institutions housing micro-organism, invertebrate and vertebrate collections has been conducted (parallel to the SABONET/NBI herbarium needs assessment) through the Southern African Society for Systematic Biology (Smith & Willis 1999). The results of this survey had not been published at the time the SABONET/NBI needs assessment report went to press.

Methodology

Although other surveys have been conducted of herbaria within the Southern African Development Community (SADC) region (Hedberg 1990, 1991; Hedberg & Hedberg 1992; Baijnath & Kabuye 1994; Baijnath 1995; Schrire & Pope 1995), the SABONET/NBI needs assessment survey is the most detailed and comprehensive survey yet conducted. Previous botanical surveys did not cover all the southern African countries, and not all the main collections in the subcontinent were targeted. The communication network established by SABONET has made it possible to survey all important collections in the ten SABONET countries. In addition, all the needs of the herbaria have been translated into financial terms. For the first time, policy makers and managers of collections will have a clear indication of the exact monetary needs for maintaining and developing specific collections.

A comprehensive questionnaire was drawn up by G.F. Smith and C.K. Willis for the SABONET/NBI needs assessment (Appendix 1). The questionnaire covered the following areas:

- General herbarium information
- Libraries and literature
- Capital equipment
- Staffing
- Taxon holdings
- Computerisation

The questionnaire was mailed to 62 herbaria in South Africa and to 22 herbaria in the rest of southern Africa in February 1998. The following countries were surveyed: Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe.

Of the questionnaires mailed to herbaria outside South Africa, 19 completed forms (86%) were returned. For South Africa, 22 completed forms (36%) were returned. In cases where questionnaires were not returned by mail, they were completed during follow-up visits by G.F. Smith, C.K. Willis and M. Mössmer to the institutions. A total of 55 herbaria eventually completed questionnaires (Tables 1 and 2). A comprehensive list of all the herbaria that responded, with addresses and the names of contact persons, is given in Appendix 2.

Table 1. Number of herbaria surveyed in each of the ten southern African countries.

Country	Number of herbaria
Angola	1
Botswana	3
Lesotho	2
Malawi	1
Mozambique	2
Namibia	1
South Africa	32
Swaziland	1
Zambia	4
Zimbabwe	8
Total	55

The data from the questionnaires were subsequently incorporated in a custom-designed Microsoft Access database, which facilitated analysis of the survey information.

Notes on specific herbaria

The Selmar Schonland Herbarium (GRA, Grahamstown, Eastern Cape, South Africa) consists of two herbaria, RUH, the Rhodes University Herbarium, and GRA, the Albany Museum Herbarium. This amalgamated herbarium, known under the acronym GRA, is housed in the Albany Museum, but receives some of its facilities from Rhodes University. However, the needs of the herbarium have been reflected under GRA only, regardless of whether the items (for example, literature, computer hardware) are provided by the University or the Museum. For the purposes of the SABONET/NBI needs assessment, the Selmar Schonland Herbarium is treated as a single unit.

The Tsitsikamma National Park Herbarium (no acronym) of the South African National Parks (former National Parks Board, South Africa) is being incorporated into the Kimberley South African National Parks Herbarium (KSAN). However, the Tsitsikamma National Park Herbarium completed a needs assessment questionnaire and the information is reflected in this report. This does not imply that we are according the Tsitsikamma National Park Herbarium a status not intended by the South African National Parks. Herbarium collections of all South African National Parks, except the Kruger National Park, are currently being transferred to the KSAN Herbarium (H. Bezuidenhout, pers. comm.).

Table 2. Names of herbaria surveyed, arranged by country.

Herbarium name	Acronym
Angola	
Luanda Herbarium	LUAI
Botswana	
National Herbarium	GAB
Peter Smith Herbarium	PSUB
University of Botswana Herbarium	UCBG
Lesotho	
Herbarium, Department of Biology, NUL	ROML
Maseru Herbarium	MASE
Malawi	
National Herbarium	MAL
Mozambique	
Eduardo Mondlane University Herbarium	LMU
INIA Herbarium	LMA
Namibia	
National Herbarium	WIND
South Africa	
A.P. Goossens Herbarium	PUC
Bolus Herbarium	BOL
C.E. Moss Herbarium	J
Compton Herbarium	NBG & SAM
Donald Killick Herbarium	CPF
Geo Potts Herbarium	BLFU
Goegap Nature Reserve Herbarium	
H.G.W.J. Schweickerdt Herbarium	PRU
Herbarium of the National Museum, Bloemfontein	NMB

Herbarium name	Acronym
Herbarium of the Rand Afrikaans University	JRAU
Herbarium of the University of North-West	UNWH*
Hermanus Herbarium	HER
Hortus Botanicus Johannesburgensis	JBG
McGregor Museum Herbarium	KMG
Mpumalanga Regional Herbarium	LYD/MPUM
Natal Herbarium	NH
National Herbarium	PRE
Roodeplaat Herbarium	ROO
Saasveld Herbarium	SAAS
Selmar Schonland Herbarium	GRA
Southern Cape Herbarium	SCHG*
Towoomba-ADC Herbarium	
Tsitsikamma National Park Herbarium	
University of Natal-Durban Herbarium	UNDH*
University of Natal-Pietermaritzburg Herbarium	NU
University of the North Herbarium	UNIN
University of Stellenbosch Herbarium	STEU
University of Transkei Herbarium	KEI
Venda Herbarium	VENDA
Ward Herbarium	UDW*
Williams Herbarium	FFS
Worcester Field Reserve Herbarium	
Swaziland	
National Herbarium	SDNH
Zambia	
Chinzombo Herbarium	MFUWE*
Herbarium, Forestry Department	NDO
Mt Makulu Herbarium	MRSC
University of Zambia Herbarium	UZL
Zimbabwe	
Botanical Collection, Natural History Museum	BUL
Chase Herbarium	UMT
Gonarezhou Chipinda Pools Herbarium	GCPH*
Grasslands Research Station Herbarium	GRS*
Matopos Research Station Herbarium	MRSH*
National Herbarium	SRGH
Rifa Conservation Camp Herbarium	RIFA*
University of Zimbabwe Herbarium	CAH

* Proposed acronym

Results and recommendations

The results of the survey are presented in five sections that correspond to the sections of the questionnaire:

- Taxon holdings
- Libraries and literature
- Capital equipment
- Staffing
- Computerisation

Each section consists of a summary of the results for the entire region, which is followed by a more detailed discussion for each country, where applicable. The appendices provide detailed information for individual herbaria, arranged by country.

Taxon holdings

Summary

The 55 southern African herbaria included in this survey hold approximately 3 830 000 specimens. Of these, more than half (2 108 636 specimens) are held in the three major herbaria, PRE, SRGH and NBG & SAM. Table 3 lists the 15 herbaria with the largest numbers of specimens. For a comprehensive list of specimen numbers per herbarium, see Appendix 3.

Table 3. The fifteen largest herbaria in southern Africa, listed in order of decreasing number of specimens.

Position	Herbarium	Country	Number of specimens
1	PRE	South Africa	1 087 900
2	SRGH	Zimbabwe	513 736
3	NBG & SAM	South Africa	507 000
4	BOL	South Africa	335 500
5	GRA	South Africa	200 800
6	NU	South Africa	120 000
7	J	South Africa	100 000
8	NH	South Africa	100 000
9	PRU	South Africa	100 000
10	MAL	Malawi	84 000
11	WIND	Namibia	64 879
12	LMU	Mozambique	63 070
13	LMA	Mozambique	51 536
14	NDO	Zambia	50 000
15	KMG	South Africa	32 150

We have found it useful to group the southern African herbaria into three categories according to the number of specimens held (Lanjouw & Stafleu 1964). Table 4 shows a summary of the number of herbaria in each of these category.

The percentage representation of bryophytes, pteridophytes, gymnosperms and angiosperms in southern African herbaria corresponds closely with the number of taxa of these groups known to be present in the FSA region (Table 5, Figure 2). We have assumed that the percentage of taxa in these groups in the rest of southern Africa is probably not far from percentages in the FSA region. Generally, angiosperms make up more than 90% of the specimens held in southern African herbaria.

Herbaria with the largest collections of algae are GRA (20 000), BOL (19 500) and NU (14 400). The largest collections of bryophytes are held by PRE (54 000), BOL (7 000), SRGH (4 100) and UZL (1 500). PRE also has a lichen collection numbering 12 000 specimens. The largest pteridophyte collection is held by GRA (15 000). The largest gymnosperm collections are held by NDO (20 000), GRA (15 000) and MRSC (10 000).

Table 4. Distribution of southern African herbaria amongst three size classes.

Category	Number of herbaria
SMALL	
< 100 000 specimens	46
MEDIUM	
100 000 – 500 000 specimens	6
LARGE	
> 500 000 specimens	3

Results and Recommendations

Table 5. Percentage representation of bryophytes, pteridophytes, gymnosperms and angiosperms in southern African herbaria. "PRECIS taxa" indicates the percentage of the four plant groups in the southern African flora (specifically the *Flora of southern Africa* (FSA) region, comprising Botswana, Lesotho, Namibia, South Africa and Swaziland).

Category	Bryophytes	Pteridophytes	Gymnosperms	Angiosperms
Angola	0.00	3.10	3.10	93.80
Botswana	0.87	1.10	0.07	97.90
Lesotho	0.33	1.94	0.33	97.40
Malawi	1.20	1.20	1.20	95.20
Mozambique	0.00	1.46	0.33	97.55
Namibia	0.15	0.93	0.03	98.60
South Africa	0.44	2.37	2.87	92.93
Swaziland	0.00	2.00	0.40	97.60
Zambia	1.61	2.44	18.64	77.24
Zimbabwe	0.23	2.03	2.36	94.80
PRECIS taxa	2.18	1.49	0.18	96.15
All southern African herbaria	0.51	2.16	3.59	92.79

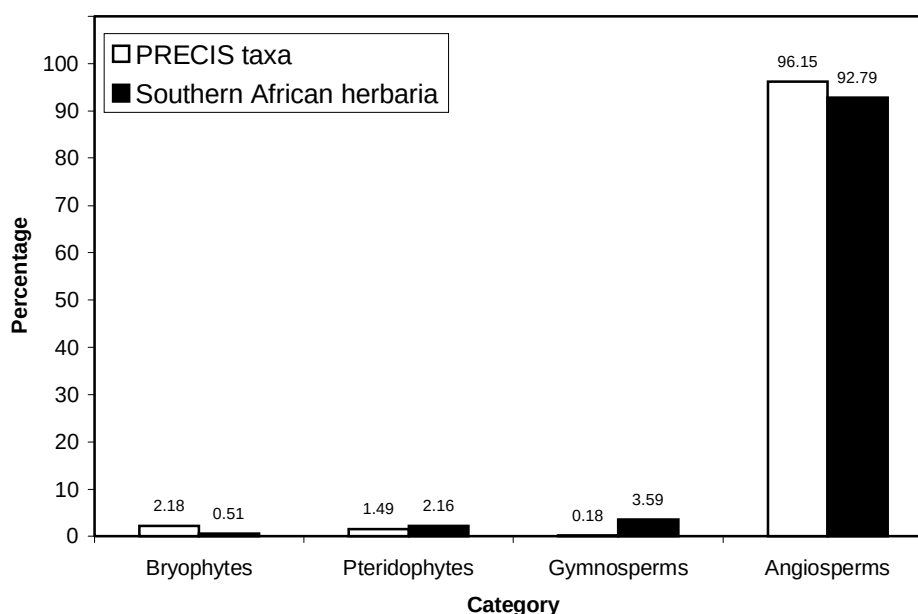


Figure 2. Average percentages of bryophytes, pteridophytes, gymnosperms and angiosperms in southern African herbaria compared with percentages of the same groups represented in PRECIS.

Library and literature needs

Background

Taxonomic research is dependent on both historical and current published information. In the words of Stuessy and Stuckey (1997): "Taxonomists hardly need to be reminded of the importance of having library resources close to specimens for productive teaching, research and service. We

continually seek information from books and observe phenomena on herbarium sheets, comparing localities and illustrations with variations in morphological features, written itineraries with site localities, published handwriting with notations on the labels...”.

The importance of libraries to staff working in herbaria has been referred to as long ago as 1858 by Bentham (Warnement 1997): “A botanical library is useful without a herbarium, but not a herbarium without a library”. Bentham also mentioned that the botanical library should be “in the same house ... as the specimens”. This is not the case in many southern African herbaria, especially those herbaria attached to universities.

Hedberg (1990) and Baijnath and Nicholas (1994) have previously described the library facilities in several southern African herbaria (Table 6). Hedberg (1990) surveyed eight of the ten countries comprising SADCC at that time, excluding Angola and Namibia. South Africa only became a member of SADCC (now known as SADC) in 1994. In 1990, when the survey was done, the SADCC member states were Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zambia and Zimbabwe.

In another publication, Hedberg (1991) mentioned as part of his minimum requirements for southern African herbaria that library grants should be increased “... to procure basic botanical working libraries”.

Table 6. Comparison of library facilities existing in selected southern African herbaria (based on Hedberg 1990; Baijnath & Nicholas 1994).

Herbarium	Country	Library facilities
LUA	Angola	Inadequate
LUAI	Angola	Insufficient
GAB	Botswana	Insufficient
UCBG	Botswana	Needs improvement
ROML (NUL)	Lesotho	Not seen, probably too small
MASE (MOA)	Lesotho	Insufficient
MAL	Malawi	Fairly good base, but much more needed
LMA (INIA)	Mozambique	Large with ancient rare books, but needs additions
LMU	Mozambique	Small, but the university (faculty) library fairly good
PRE	South Africa	Good but should continue to be built up
SDNH (Malkerns)	Swaziland	Small (of journals only South African available), substantial increase desirable (particularly Floras and textbooks)
UZL	Zambia	Not seen
MRSC	Zambia	Quite large
SRGH	Zimbabwe	By far the largest botanical library in the SADCC region* but money needed for new books, completing some journals and for microfiche

* Hedberg (1991) surveyed eight (excluding Angola and Namibia) of the then ten countries comprising SADCC from 20 August to 19 September 1990. Angolan information (1991) was supplied by Ms E. Matos (Baijnath & Nicholas 1994). The correct acronyms for NUL and MOA in Lesotho are ROML and MASE, respectively. In Mozambique, INIA should be listed as LMA. In Swaziland, the National Herbarium based at Malkerns Agricultural Research Station was given an official acronym SDNH by Patricia Holmgren in 1997 (Holmgren & Holmgren 1997; Smith & Willis 1997). South Africa only became a member of SADCC (now known as SADC) in 1994. In 1990, when the survey was done, the SADCC member states were Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zambia and Zimbabwe.

In July 1996, a planning workshop was held at the National Herbarium (PRE) in Pretoria, South Africa, to assess the status of national herbaria in the ten countries of southern Africa (Willis 1997). The following comments regarding libraries and literature in some of the national herbaria were made by workshop participants, and provide a good insight into the conditions that were, and in many cases still are, being experienced in these institutions:

- **Angola** Many invaluable volumes from the Huambo Herbarium (LUA) library were stolen from the herbarium in 1995 for sale in the market as notebooks or wrapping paper. Some of the material was recovered in the market, and is now being temporarily held, together with the specimens, in Luanda Herbarium for safe-keeping (Matos 1997).
- **Botswana** The University of Botswana Herbarium (UCBG) does not have adequate books, journals or floras as the department cannot get the budget for the herbarium library (Aye 1997). The National Herbarium (GAB) has a small collection of books. The main library is, however, in town, about 6 km from the herbarium (Aye 1997).
- **Lesotho** The National University of Lesotho's Biology Department "would also like to have a small library attached to the herbarium, but according to the university library policies, departments are not allowed to keep libraries. There is only one main library and the book collection does not meet the herbarium needs" (Moteetee 1997).
- **Malawi** The National Herbarium (MAL) has a small library with about 800 volumes and 300 periodicals. Some key reference materials such as *Index Muscorum* are missing. This situation hampers the capability of members of staff to carry out research (Magombo 1997). According to Magombo (1997), there is not enough space for shelves in the library and the reference collection itself is also very small.
- **Mozambique** The LMU Herbarium library in Maputo "is not being updated, which means there is a need for books, newsletters and other sources of information" (Da Silva 1997).
- **Namibia** The library at the National Botanical Research Institute (NBRI) receives many different botanical publications, although not all the relevant taxonomical publications (Kubirske 1997).
- **Swaziland** In the Swaziland National Herbarium (SDNH), there is a "need to improve the sourcing of literature" (Dlamini 1997).

Summary and recommendations

A comparatively strong dichotomy exists between the needs of the South African and other southern African herbaria. The library facilities of most southern African herbaria are inadequate and insufficient, and in some cases non-existent. Even in some of the larger herbaria with long traditions of taxonomic research, a comprehensive expansion of library holdings is urgently required.

Access to botanical literature

In general, most of the larger South African herbaria have fairly easy access to general botanical literature. Should this not be possible through their institutional libraries, it can usually be arranged through interlibrary loans. Most of the larger regional libraries such as the NBI's Mary Gunn and Harry Molteno Libraries and some university libraries are linked to regional or international search facilities. These libraries are indispensable sources of photocopies of essential reading matter for herbaria without access to search facilities. The process of acquiring literature would be much simplified if all the herbarium libraries were linked to regional or international search facilities. Although interlibrary loans are subject to strict copyright legislation and are becoming increasingly expensive, it is still a more economical option than subscribing to a wide range of taxonomic literature, the costs of which escalate annually.

Serial works and journals

We regard the following serial works as critical to herbarium staff working in southern Africa:

- ◆ *Bothalia*
- ◆ *Conspectus florum angolensis*
- ◆ *Flora de Moçambique*
- ◆ *Flora of southern Africa*
- ◆ *Flora zambesiaca*
- ◆ *Kirkia*
- ◆ *South African Journal of Botany*

The results of the survey indicate that most of the larger South African herbaria (BOL, FFS, GRA, J, NBG & SAM, NU, PRE, STEU and UDW) either receive or have access to these journals. In stark contrast, few of the herbaria in the rest of southern Africa, with the exception of WIND (Namibia) and SRGH (Zimbabwe), receive the majority of these publications. This is particularly worrying as far as regionally important journals such as *Kirkia* (the Journal of Botany of Zimbabwe) are concerned. PRE, SRGH and WIND all benefit directly from being involved in the publication of the taxonomic journals *Bothalia* (one of the house journals of South Africa's National Botanical Institute), *Kirkia* and *Dinteria*, respectively. The results of a short SABONET survey of these journals (April/May 1997) show that the Mary Gunn Library (associated with South Africa's National Herbarium, PRE) receives over 150 journals in exchange for *Bothalia*. The library in Zimbabwe's National Herbarium (SRGH) receives approximately 60 journals in exchange for *Kirkia*. The Harry Molteno Library in the Kirstenbosch Research Centre, which houses the Compton Herbarium (NBG & SAM), uses the *South African Journal of Botany* for exchange. The journal is published jointly by the NBI and the South African Association of Botanists (Smith, G.F., Leistner, O.A. & Willis, C.K., unpublished report).

Herbaria that are currently not receiving the critical journals should gain access to these works as a matter of priority. There are several possible ways of doing this. One possibility is to create a comprehensive funding proposal which includes an amount for journal subscriptions. In this case, however, herbaria should realise that payment for the journals would have to be absorbed into their institutional budgets once external funding ceases.

The following method of obtaining relevant literature is used at the moment by SABONET: participating institutions are requesting and receiving photocopies from the Mary Gunn Library of the NBI. Expenses associated with this service are borne by SABONET. The staff time involved in this activity is currently part of the NBI's in-kind contribution to the project. If the service were expanded to other herbaria in southern Africa, additional contract staff would probably be required in the library.

Another method of acquiring literature is the exchange of publications for herbarium specimens, as was suggested during a pre-congress symposium on "Publicity and information dissemination by African herbaria", held in April 1991 prior to the 13th AETFAT Congress in Zomba, Malawi (Baijnath & Kabuye 1994). This practice is already employed in some countries, for example, in South Africa's C.E. Moss Herbarium (J), and could perhaps be expanded. However, there is concern that this is not sound practice as it could lead to over-collecting in some areas or the rushed collecting of poor specimens to pay for the next book or journal.

Baijnath (1995) has suggested another option to be considered by herbaria: "Where several herbaria are in close proximity, it seems meaningful not to duplicate the purchase of taxonomic journals and microfiches. Therefore, herbaria need to explore the possibility of selectively purchasing literature and this could be facilitated by networking."

See Appendix 4 for a comprehensive list of journals referred to in the text.

Awareness of recent publications

Probably as a result of a protracted period of isolation from other botanical institutions and world botany in general, workers in many sub-continental herbaria are unaware of recent literature, especially books. This is reflected in an apparent lack of knowledge of major international publications such as Kubitzki's *The families and genera of vascular plants* (Kramer & Green 1990; Kubitzki, Rohwer & Bittrich 1993).

The lack of contact with and knowledge of recently published botanical books important to their herbaria or regions, or with a bearing on major plant groups of research interest, presents a major stumbling block to taxonomic progress in southern Africa.

It could be useful to have the addresses of these herbaria placed on the mailing lists of the relevant publishing houses to ensure that the staff are aware of what is available on the flora and vegetation of their regions.

The SABONET Newsletter, *SABONET News*, serves an important regional role through publicising recently published literature (both book and journal information) amongst botanists in the southern African region. *The Paper Chase*, a regular column by Dr Hugh F. Glen (PRE), often in collaboration with other southern African botanists, is particularly useful in this regard. A number of flyers advertising recent publications have been circulated with copies of *SABONET News*. The practice of most botanical journals to regularly publish book reviews is also an important source of information on new books.

Another useful reference publication for herbaria is *Taxonomic literature of southern African plants* (Meyer, Mössmer & Smith 1997), which provides a comprehensive listing of the literature required by herbarium workers to adequately curate their collections, identify plant specimens and research genera or families. Although many of the publications listed in Meyer *et al.* (1997) are out of print, photocopies of these sources can be obtained to ensure adequate herbarium operation. This publication should be provided to all practising herbarium workers in the region. Even though the emphasis of the book was on the FSA region, plants do not observe political boundaries and it will undoubtedly also prove useful further afield. Access to this work will at least indicate to curators what literature is available nowadays.

Cataloguing

We find it somewhat alarming that very few herbarium libraries are currently catalogued, let alone computerised. Herbaria should do their utmost to ensure that adequate records are kept of literature received through externally funded projects. Keeping and regularly auditing a catalogue of materials previously received and newly accessioned would go a long way towards ensuring that books and journals are adequately housed.

SABONET support

Thanks to the funding support provided by the GEF through the UNDP, and USAID through the regional NETCAB programme, SABONET is already providing much-needed support and relief in terms of literature to the participating southern African herbaria. Support is provided through supplying both books, key taxonomic works such as Lebrun & Stork's (1991–1997) four-volume work *Énumération des Plantes à Fleurs d'Afrique Tropicale* and selected issues of *Bothalia*, *Flora of southern Africa*, *Strelitzia* and *Flowering Plants of Africa* to these herbaria. Annual subscriptions to the plant conservation magazine *Plant Talk* have been taken out for the national and university herbaria of southern Africa. Acknowledgement must also be given to the Flora Zambesiaca Managing Committee for generously donating a full set of *Flora zambesiaca* to SABONET for use on field excursions and training courses. The Royal Botanic Gardens, Kew, also generously donate 15 copies of every issue of *Kew Scientist* to SABONET on a regular basis.

Collaboration

Closer collaboration between the Lisbon Herbarium in Portugal and herbaria in both Angola and Mozambique should be actively encouraged. At the least, all herbaria in Angola and Mozambique should be put on the mailing lists of both *Conspectus florum angolensis* and *Flora de Moçambique*. In fact, most other southern African herbaria will benefit from receiving these works. Working relations have recently been re-established between staff from Lisbon's Centro de Botânica do Instituto de Investigação Científica Tropical and staff from the LMA and LMU Herbaria in Mozambique (S. Izidine, pers. comm.). Staff from herbaria in these two countries will in future be working together in the editing and publishing of *Flora de Moçambique*. An editorial committee for *Flora de Moçambique* was established in mid-1998, and includes staff from both the LMA and LMU Herbaria in Mozambique (S. Izidine, pers. comm.).

An example of how institutions can work together is provided by the NETCAB Fellowship that was awarded to Ms Teresa Martins of the Luanda Herbarium in Angola through SABONET. Ms Martins spent eight months (October 1997 to May 1998) working closely with plant taxonomists in the Lisbon Herbarium, Portugal. During this time she was given training, in Portuguese, in various aspects of plant taxonomy and herbarium management. On completion of the fellowship Ms Martins produced an unpublished 78-page report entitled *Contribuição para o estudo sistemático de plantas vasculares de Angola—Noções de técnicas de herbariologia e de cartografia*. Collaboration between northern and southern hemisphere botanical institutions, as illustrated by this example, should be encouraged, strengthened and expanded as a matter of urgency.

Angola

Luanda Herbarium (LUA)

Luanda Herbarium regularly receives copies of *Flora zambesiaca*, *Conspectus florum angolensis* and *Flora de Moçambique*. In addition to the other regional serial works not received, the Luanda Herbarium requires *Index kewensis* from 1990, and *Advances in Legume Systematics*, Parts 1–7, published by the Royal Botanic Gardens, Kew. The library attached to the herbarium is currently not catalogued or computerised, but the computerisation process has started using Microsoft Access. The library is not connected to a regional/international search facility. The Huambo Herbarium (LUA) collection was temporarily transferred in 1995 to the Luanda Herbarium for safe-keeping (Matos 1997; Smith & Willis 1997).

Botswana

National Herbarium (GAB), Peter Smith Herbarium (PSUB) and University of Botswana Herbarium (UCBG)

The only serial work regularly received by any herbarium was *Flora zambesiaca* by the National Herbarium in Gaborone. *Bothalia* is also received by the National Herbarium, although not regularly. None of the libraries attached to the herbaria in Botswana are connected to a regional/international search facility or adequately catalogued. None of the herbaria surveyed have access to key plant taxonomic references. There is a strong need for access to southern African plant taxonomic literature in all three of the Botswanan herbaria.

SABONET has donated various numbers/issues of the following publications to Botswanan herbaria between 1996 and 1998:

- GAB: *Flora of southern Africa*, *Flowering Plants of Africa* (set of all available volumes/parts) and various other books (January 1998)
- MAH: *Flora of southern Africa* (full set), selected numbers from *Memoirs of the Botanical Survey of South Africa*, *Strelitzia* and various other books (January 1998)
- PSUB: *Flora of southern Africa* (all available volumes) and selected numbers from *Memoirs of the Botanical Survey of South Africa* (November 1996)
- UCBG: *Flowering Plants of Africa* (set of all available volumes/parts) and selected parts/

numbers in the series *Strelitzia*, *Flora of southern Africa* and *Memoirs of the Botanical Survey of South Africa* (January 1998)

These donations of botanical literature are *ad hoc* events and more sustainable ways of acquiring the necessary taxonomic literature on a regular basis need to be examined within the country.

Lesotho

Maseru Herbarium (MASE) and National University of Lesotho Herbarium (ROML)

Neither the Maseru Herbarium nor the National University of Lesotho Herbarium has access to key taxonomic literature or receives any of the southern African plant taxonomic serial works listed in the questionnaire. In neither herbarium are the library holdings adequately catalogued, and neither herbarium library is connected to a regional/international search facility. Both herbaria surveyed have an urgent need to receive key plant taxonomic publications regularly. In addition to the serial works listed in the questionnaire, ROML also requires access to *Taxon*, *Kew Bulletin* and *Annals of the Missouri Botanical Garden*.

Malawi

National Herbarium (MAL)

The library attached to the herbarium does not have access to key taxonomic references on the southern African flora, but does receive, on a regular basis, the serial titles *Flora zambesiaca*, *Bothalia* and *Kirkia*. Serial works needed by the staff of the herbarium include *Flora of Tropical East Africa* (FTEA), *Flora of West Tropical Africa* (FWTA), *Index kewensis* (on CD-ROM) and *Mycologia*. The library holdings are adequately catalogued but not computerised. The library is not connected to a regional/international search facility. Other needs of the herbarium in terms of the library/literature are additional library shelves, a library computer and ISIS software.

Mozambique

INIA Herbarium (LMA)

The LMA Herbarium has access to some key taxonomic references on the southern African flora. The herbarium regularly receives *Flora zambesiaca* and *Flora de Moçambique* but none of the other serial works listed in the questionnaire. The library holdings are neither catalogued nor computerised. The library is also not connected to a regional/international search facility. Other needs of the LMA Herbarium include software to computerise the library, serial works listed in the questionnaire but not received, and the latest publications from South Africa's National Botanical Institute.

Eduardo Mondlane University Herbarium (LMU)

The LMU Herbarium has access to some key taxonomic references on the southern African flora. The herbarium regularly receives copies of only *Flora zambesiaca*, *Kirkia* and *Flora de Moçambique*. The library holdings are neither catalogued nor computerised. The library is not connected to a regional/international search facility. Needs in the LMU Herbarium include *Index kewensis* (on CD-ROM), *Flora of southern Africa*, Brummitt & Powell's (1992) *Authors of plant names*, Mabberley's (1997) *The plant-book*, *Plants of southern Africa: names and distribution* (Arnold & de Wet 1993), De Dalla Torre & Harms (1958) and Jackson's (1905) *A Glossary of Botanic Terms*; the last three publications are all currently out of print.

Namibia

National Herbarium (WIND)

The herbarium does have access to key taxonomic references and regularly receives *Flora*

zambesiaca, *Flora of southern Africa*, *Bothalia* and *South African Journal of Botany*. Serial works not regularly received include *Kirkia*, *Conspectus florae angolensis* and *Flora de Moçambique*. Namibia's National Herbarium should receive copies of *Conspectus florae angolensis* as they become available, since Angola and Namibia share strong floristic affinities (Maggs 1998). The library holdings are adequately catalogued and the library is being computerised using CDS-ISIS (from UNESCO). Other needs include *Index kewensis* (on CD-ROM) and various other key publications (monographs and taxonomic treatments) which are still outstanding. The library is not connected to a regional/international search facility. Several issues of *Bothalia*, *Flowering Plants of Africa*, *Memoirs of the Botanical Survey of South Africa* and *Strelitzia*, as well as other botanical publications, were donated to Namibia's National Herbarium by SABONET in September 1996.

South Africa

A.P. Goossens Herbarium (PUC)

The A.P. Goossens Herbarium has access to key taxonomic references on the southern African flora, but does not regularly receive any of the serial works listed in the questionnaire. The library holdings are, however both adequately catalogued and computerised using Data Trek v. 2.1. The library is connected to a regional/international search facility using Science Citation Index, Biological Abstracts and Inside Science Plus. The A.P. Goossens Herbarium library has inadequate botanical books and journals. A need has been identified for access to Current Contents, which could be shared with other institutions.

Bolus Herbarium (BOL)

The Bolus Herbarium, together with South Africa's National Herbarium (PRE) and Zimbabwe's National Herbarium (SRGH), is one of only three herbaria in the southern African region to regularly receive all the serial works listed in the questionnaire. The herbarium has access to key taxonomic references and is adequately catalogued and computerised using BookPlus. The library is connected to the regional/international search facilities SABINET (South African Bibliographic and Information Network) and OCLC.

C.E. Moss Herbarium (J)

The C.E. Moss Herbarium does have access to key taxonomic literature and receives all journals listed except for *Conspectus florae angolensis* and *Flora de Moçambique*. The library attached to the herbarium, known as the Lynette Davidson Library, is partially computerised using a WITS Computer Centre-designed system. The library is connected to a regional/international search facility and is part of the WITS library system which has intentions of linking up with other libraries in the Gaelic Consortium in the near future. Storage space for the library is very cramped, and there is also a need for access to other journals. A suggestion made was to obtain relevant photocopies from the National Botanical Institute's Mary Gunn Library.

Compton Herbarium (NBG & SAM)

The Compton Herbarium does have access to key taxonomic references, and receives *Flora zambesiaca*, *Flora of southern Africa*, *Bothalia*, *Kirkia* and *South African Journal of Botany*. *Conspectus florae angolensis* and *Flora de Moçambique* are not received. The library is adequately catalogued and computerised using SLS Plus. The library is connected to the SABINET search facility.

Donald Killick Herbarium (CPF)

The Donald Killick Herbarium has access to key taxonomic references and regularly receives *Flora of southern Africa*, *Bothalia* and *South African Journal of Botany*. The library holdings are adequately catalogued and computerised. The library is also connected to a regional/international search facility.

Geo Potts Herbarium (BLFU)

The Geo Potts Herbarium does have access to key taxonomic references through the main university library. The only serial work received regularly is *Flora of southern Africa*. The library holdings are adequately catalogued and computerised. The library is connected to a regional/international search facility. Books that are needed include *Index kewensis*, *Index herbariorum* (Holmgren, Holmgren & Barnett 1990), *Vascular plant families and genera* (Brummitt 1992), *Authors of plant names* (Brummitt & Powell 1992), *Plants of southern Africa: names and distribution* (Arnold & de Wet 1993), *The genera of southern African flowering plants* (Dyer 1975, 1976) and *Common names of South African plants* (Smith 1966).

Goegap Nature Reserve Herbarium

The Goegap Nature Reserve Herbarium does not have access to key taxonomic references, does not receive serial works listed in the questionnaire, is neither catalogued nor computerised and is not linked to a regional/international search facility.

Herbarium of the Botany Department, University of Stellenbosch (STEU)

The herbarium has access to key taxonomic references. Serial works regularly received include *Flora zambesiaca*, *Flora of southern Africa*, *Bothalia*, *Kirkia* and *South African Journal of Botany*. The library holdings are adequately catalogued and computerised using ERIDITE. The library is attached to the regional/international search facility CALICO.

Herbarium of the Faculty of Forestry, Saasveld (SAAS)

The Forestry Faculty Herbarium does have access to key taxonomic references. The library is not attached to the herbarium but serves the whole Forestry Faculty at Saasveld. The only plant taxonomic journal regularly received, of those listed in the questionnaire, is *South African Journal of Botany*. The library holdings are adequately catalogued and computerised. The library is connected to regional/international search facilities, including SABINET, through the Port Elizabeth Technikon. Space for the library is limited, and there is a need for a wider range of journals and more specialised journals.

Herbarium of the Rand Afrikaans University (JRAU)

The herbarium does have access to key taxonomic references. Journals regularly received include *Bothalia* and *South African Journal of Botany*. The library holdings are adequately catalogued but not computerised. The library is connected to a regional/international search facility. Serial works needed, apart from those listed in the questionnaire, include *Taxon*, *Botanical Journal of the Linnean Society*, *Planta medica*, *Nordic Journal of Botany* and *Annals of the Missouri Botanical Garden*.

Hermanus Herbarium (HER)

The Hermanus Herbarium does not have access to key taxonomic references, and receives only *Flora of southern Africa*, *Bothalia* and *South African Journal of Botany* on a regular basis. The library holdings are adequately catalogued but not computerised. The herbarium library is not connected to a regional/international search facility. The herbarium apparently has a general botanical library sufficient for the needs of the herbarium staff.

H.G.W.J. Schweickerdt Herbarium (PRU)

The main library (Hans Merensky Library) of the University of Pretoria, to which the H.G.W.J. Schweickerdt Herbarium has access, only receives three of the publications listed in the questionnaire (*Flora of southern Africa*, *Bothalia*, *South African Journal of Botany*). The herbarium does, however, have access to all other key references. Easy access is facilitated by the close proximity of the herbarium to the Mary Gunn Library of the National Botanical Institute—these institutions are about 5 km apart. Library holdings are adequately catalogued and computerised. The library is

linked to SABINET, a regional/international literature search facility. Like most other herbaria, the Schweickerdt Herbarium suffers from a lack of older works, and only very few periodicals are currently received.

Johannesburg Botanic Garden Herbarium (JBG)

The library associated with the Johannesburg Botanic Garden Herbarium does have access to key plant taxonomic references on the southern African flora. Serial works regularly received include *Flora of southern Africa*, *Bothalia* and *South African Journal of Botany*. *Flora zambesiaca* has not been received since 1983. Library holdings are catalogued using dBASE IV/Lotus. The library is not connected to a regional/international search facility.

McGregor Museum Herbarium (KMG)

The herbarium does have access to key taxonomic publications. Serial works received on a regular basis include *Flora of southern Africa*, *Bothalia* and *South African Journal of Botany*. The library holdings are adequately catalogued and the library collection is partly computerised using INMAGIC. The library is not connected to a regional/international search facility. Due to financial constraints, the McGregor Museum Herbarium staff request library loans and photocopies of literature from the National Botanical Institute's Mary Gunn Library to be provided at a reduced rate.

Mpumalanga Regional Herbarium (LYD/MPUM)

This herbarium does not have access to key taxonomic references and regularly receives only *Flora of southern Africa*, *Bothalia* and *South African Journal of Botany*. Considering the proximity of the herbarium to Mozambique, the library should receive copies of *Flora de Moçambique* as they become available. The library holdings are adequately catalogued and computerised using Microsoft Word for Windows. The library is connected to the regional/international search facility SABINET.

Natal Herbarium (NH)

The National Botanical Institute's Natal Herbarium does have access to key taxonomic literature, and regularly receives *Flora zambesiaca*, *Flora of southern Africa*, *Bothalia* and *South African Journal of Botany*. The library holdings are adequately catalogued but the library is not computerised. The library is connected to a regional/international search facility through SABINET. There is a need for air conditioning to be installed in the library to protect the literature collection from damage in the warm and humid environment. Books needed include *The genera of the Araceae* (Mayo, Bogner & Boyce 1997), *An introduction to plant taxonomy* (Jeffrey 1968), and *Morphology of flowers and inflorescences* (Weberling 1989). Serial works needed include *Prodromus einer Flora von Südwestafrika*, *The Kew Record of Taxonomic Literature* and *Index kewensis* (on CD-ROM).

Natal University Herbarium (NU)

The Natal University Herbarium does have access to key taxonomic references on the southern African flora. Surprisingly, the only serial work not regularly received is *South African Journal of Botany*. The library holdings are adequately catalogued and computerised. The library is connected to the regional/international search facilities CATNIP (regional database), SABINET and CAB (CD-ROM). The library requests access to the Mary Gunn Library's database and the PPRI (Plant Protection Research Institute) literature databases.

National Herbarium (PRE)

The National Herbarium's Mary Gunn Library is situated in the same building as the herbarium, and contains key taxonomic references. It receives all the key serial works listed in the questionnaire, and is adequately catalogued. This library is regarded by many as the largest botanical

library in Africa and possibly in the southern hemisphere (Killick 1978; Fourie 1998). Founded in 1916 (Killick 1978), the library contains 10 061 books, 13 214 journal volumes and 840 journal titles, of which 258 are currently received, either through subscriptions or exchanges (E. Potgieter, pers. comm.). The library is currently being computerised using INMAGIC DB/TEXT, and is connected to the regional/international search facility SABINET. Needs for the library include a security system and a larger budget to purchase books.

National Museum Herbarium (NMB)

The National Museum Herbarium does have access to key taxonomic references. Of the serial works listed, the only journals regularly received are *Flora of southern Africa* and *South African Journal of Botany*. The library holdings are adequately catalogued but not computerised. The library is connected to a regional/international search facility through SASDI, the Internet and the University of the Orange Free State.

Roodeplaat Herbarium (ROO)

The Roodeplaat Herbarium does not have access to key taxonomic literature and the only journal regularly received is *South African Journal of Botany*. The library is connected to the search facility SABINET, but is neither adequately catalogued nor computerised. Relevant taxonomic literature necessary for the identification of local flora is needed by the herbarium.

Selmar Schonland Herbarium (GRA)

The Selmar Schonland Herbarium does have access to key plant taxonomic references. The Rhodes University library regularly receives copies of *Flora zambesiaca*, *Flora of southern Africa*, *Bothalia* and *Kirkia*. The herbarium receives only *South African Journal of Botany* regularly. Serial works needed include *Flora of Tropical East Africa*, *Flora of West Tropical Africa* and *Conspectus florum angolensis*. The library attached to the herbarium is not computerised. The Rhodes University library is computerised and is connected to a regional/international search facility. More funding is required to cover the costs of journal subscriptions.

Southern Cape Herbarium (SCHG—proposed acronym)

The Southern Cape Herbarium does not have access to key taxonomic references. None of the serial works listed in the questionnaire are regularly received. The library holdings are adequately catalogued and computerised using Microsoft Access. The library is not connected to a regional/international search facility. Serial works needed include *Bothalia*, *Flora of southern Africa*, *Index kewensis*, *Flora capensis* and *South African Journal of Botany*. Books needed include *The genera of southern African flowering plants* (Dyer 1975, 1976), *Plants of southern Africa: names and distribution* (Arnold & de Wet 1993), *Plants of the Cape Flora: a descriptive catalogue* (Bond & Goldblatt 1984), and the Botanical Society of South Africa field guides relevant to the southern Cape (Moriarty 1982; Mustart, Cowling & Albertyn 1997; Shearing 1994).

Towoomba-ADC Herbarium

The Towoomba-Agricultural Development Centre Herbarium does not have access to key taxonomic references and does not receive any of the key serial works listed in the questionnaire. Library holdings are neither catalogued nor computerised and the library is not connected to a regional/international search facility. Other needs related to the library include general library service and regular circulation of relevant literature.

Tsitsikamma National Park Herbarium

This herbarium does not have access to key taxonomic references and does not receive any of the key serial works listed.

University of Natal-Durban Herbarium (UNDH—proposed acronym)

The University of Natal-Durban Herbarium has access to key taxonomic literature and regularly receives *Bothalia* and *South African Journal of Botany*. The library holdings are adequately catalogued and computerised. The library is also connected to a regional/international search facility using UNINET.

University of North-West Herbarium (UNWH—proposed acronym)

The University of North-West Herbarium does not have access to key taxonomic references. The herbarium also does not receive any of the serial works listed, is not catalogued or computerised and is not connected to a regional/international search facility. In addition to the serial works listed, the herbarium also needs *Kew Bulletin*, *Taxon*, *Nature* and *Annals of the Missouri Botanical Garden*.

University of the North Herbarium (UNIN)

This herbarium does have access to key taxonomic references and regularly receives only *Flora zambesiaca* and *Flora of southern Africa*. In addition to the serial works that are listed in the questionnaire but not received, the herbarium also needs *Kew Bulletin*, published by the Royal Botanic Gardens, Kew. Books required include the *Grasses of southern Africa* (Gibbs Russell, Watson, Koekemoer, Smook, Barker, Anderson & Dallwitz 1990) and *Compositae in Natal* (Hilliard 1977). The herbarium library is neither adequately catalogued nor computerised and is not connected to a regional/international search facility. There is no university funding for the herbarium library as an independent entity separate from the main university library.

University of the Transkei Herbarium (KEI)

The University of Transkei Herbarium does have access to key taxonomic references, and receives only the *Flora of southern Africa* on a regular basis. The library holdings are neither catalogued nor computerised. The library is also not connected to a regional/international search facility. The problems currently experienced are mainly administrative; for example, ordered books can take up to two years to reach the shelves. The main university library does not condone the practice of departmental (or herbarium) libraries and will not allow herbarium staff to buy books specifically for the herbarium.

Venda Herbarium (VENDA)

The Venda Herbarium has access to key plant taxonomic references, but receives none of the serial works listed in the questionnaire on a regular basis. Taxonomic literature is available through the University of Venda (*Flora of southern Africa* only).

Ward Herbarium (UDW—proposed acronym)

The Ward Herbarium has access to key taxonomic references and receives all the serial works listed in the questionnaire except *Conspectus florum angolensis* and *Flora de Moçambique*. Library holdings are adequately catalogued and computerised using UNIX-based software. The library is connected to a regional/international search facility using UNINET. Needs include a comprehensive microfiche collection of taxonomic literature and old herbaria.

Williams Herbarium (FFS)

The Williams Herbarium has access to key taxonomic references and receives all serial works listed, except *Conspectus florum angolensis* and *Flora de Moçambique*. The library holdings are adequately catalogued and computerised. The library is connected to the regional/international search facility CALICO.

Worcester Field Reserve Herbarium

The Worcester Field Reserve Herbarium does not have access to key taxonomic references on the

southern African flora, and receives none of the serial works listed in the questionnaire. Library holdings are neither adequately catalogued nor computerised. The library is not connected to a regional/international search facility. One book regarded as critical to work of the staff at the herbarium is *Plants of southern Africa: names and distribution* (Arnold & de Wet 1993).

Swaziland

Swaziland National Herbarium (SDNH)

The herbarium does not have access to key plant taxonomic references. The only serial work, of those listed in the questionnaire, received regularly is *Bothalia*. The library attached to the herbarium is not adequately catalogued and is not computerised. The library is also not connected to a regional/international search facility. Botanical books needed by Swaziland's National Herbarium include *Vascular plant families and genera* (Brummitt 1992), *Index herbariorum* (Holmgren *et al.* 1990), *The plant-book* (Mabberley 1997), *Botanical Latin* (Stearn 1973), *Trees of southern Africa* (Coates Palgrave 1984) and *Wild orchids of southern Africa* (Stewart, Linder, Schelpe & Hall 1982). Access to the following serial works is needed: *Flora zambesiaca*, *Flora of southern Africa*, *Kirkia*, *South African Journal of Botany* and *Flowering Plants of Africa*.

Zambia

Chinzombo Herbarium (MFUWE—proposed acronym)

The Chinzombo Herbarium does not have access to key plant taxonomic references and receives none of the serial works listed in the questionnaire. The limited literature holdings are neither catalogued nor computerised. The herbarium is also not connected to a regional/international search facility. There is a need for a library attached to the herbarium with up-to-date and relevant plant taxonomic literature. One of the literature needs is for Lebrun & Stork's (1991–1997) four-volume work, *Énumération des Plantes à Fleurs d'Afrique Tropicale*.

Forestry Department Herbarium (NDO)

The Forestry Department Herbarium does not have access to key plant taxonomic references. The only serial works regularly received are *Flora zambesiaca* and *Kirkia*. Library holdings are adequately catalogued but not computerised. The library is not connected to a regional/international search facility. The herbarium needs recent plant taxonomic literature including Lebrun & Stork's (1991–1997) four-volume work, *Énumération des Plantes à Fleurs d'Afrique Tropicale*.

Mount Makulu Research Station Herbarium (MRSC)

Of the serial works listed, the herbarium receives only *Flora zambesiaca* regularly. The library holdings are adequately catalogued. Computerisation of the library has been initiated using CDS/ISIS software. The library has access to regional/international search facilities through CD-ROMs (CAB International and AGRIS databases, which are current). The library is not connected to e-mail or the Internet. Books needed include *Trees of southern Africa* (Coates Palgrave 1984) and *Field guide to trees of southern Africa* (Van Wyk & Van Wyk 1997).

University of Zambia Herbarium (UZL)

The University of Zambia Herbarium does not have access to key plant taxonomic references. The only serial works received are *Flora zambesiaca* and *Bothalia*; neither is received regularly. The library holdings are not adequately catalogued or computerised. The library is also not connected to a regional/international search facility. There is a strong need in this herbarium for literature on updates of accepted plant names. The following publications were donated to the University of Zambia Herbarium by SABONET in August 1996: *Bothalia* (all available issues), *Flora of southern Africa* (all available issues), *A conspectus of the African Acacia species* (Ross 1979) and *Grasses of southern Africa* (Gibbs Russell *et al.* 1990).

Zimbabwe

Botanical Collection, Natural History Museum of Zimbabwe (BUL)

The botanical collection associated with the Natural History Museum of Zimbabwe does not have access to key taxonomic references, although *Flora zambesiaca* and *Kirkia* are received regularly by the museum library. The Natural History Museum's library is adequately catalogued and computerised using LibraryMaster. The library is not connected to a regional/international search facility.

Chase Herbarium (UMT)

The Chase Herbarium does have access to key plant taxonomic references. The only serial work received regularly is *Flora zambesiaca*. Serial works needed include *Kirkia* and *South African Journal of Botany*. The library holdings, in the same building as the herbarium, are adequately catalogued but not computerised. Interlibrary loans and exchange of publications are possible through the library. The library needs more shelves and a micro-film reader. Literature on plant collecting and preservation techniques, including techniques relevant to algae and fungi, is required.

Gonarezhou Chipinda Pools Herbarium (GCPH—proposed acronym)

The Gonarezhou Chipinda Pools Herbarium does not have access to key taxonomic references and receives none of the serial works listed in the questionnaire. The library holdings are adequately catalogued but not computerised. Books needed include *Trees of southern Africa* (Coates Palgrave 1984) and *Arable weeds of Zimbabwe* (Drummond 1984). The library is not connected to a regional/international search facility. Other needs include computer hardware and plant identification kits.

Grasslands Research Station Herbarium (GRS—proposed acronym)

The Grasslands Research Station Herbarium does not have access to key taxonomic references. The only plant taxonomic serial work regularly received is *Kirkia*. The library holdings are neither adequately catalogued nor computerised. The library is not connected to a regional/international search facility.

Herbarium of the University of Zimbabwe (CAH)

The University of Zimbabwe Herbarium does have access to key taxonomic references. Serial works regularly received through the university's main library include *Flora zambesiaca*, *Bothalia*, *Kirkia* and *South African Journal of Botany*. The library holdings are adequately catalogued but not computerised. The university library is connected to a regional/international search facility. The herbarium requires *Index kewensis* (CD-ROM).

Matopos Research Station Herbarium (MRSH—proposed acronym)

The Matopos Research Station Herbarium does not have access to key taxonomic references. The only serial work received regularly is *Kirkia*, although some copies of *Flora zambesiaca* are available in the library. The library holdings are neither adequately catalogued nor computerised. The library is not connected to a regional/international search facility. Needs include a computer, library software and access to the following serial works: *Journal of Ecology*, *Flora zambesiaca*, *African Journal of Range and Forage Science*, *Journal of Range Management* and *Oecologia*.

National Herbarium (SRGH)

The National Herbarium of Zimbabwe does have access to key taxonomic references. The herbarium regularly receives all the serial works listed in the questionnaire, mainly through exchange for *Kirkia*. The library holdings are adequately catalogued but not computerised. The library is not connected to a regional/international search facility. Needs for the library/literature include access to a search facility and grants to buy books that are not available on an exchange basis. Several

books and issues of *Bothalia*, *Flora of southern Africa* and *Memoirs of the Botanical Survey of South Africa* were donated to the National Herbarium in September 1996 by SABONET.

Rifa Conservation Camp Herbarium (RIFA—proposed acronym)

The Rifa Conservation Camp Herbarium has access to key taxonomic references, including the plant taxonomic serial works listed, through the National Herbarium of Zimbabwe's library. Resources are needed to develop a simple but accurate book on the trees of the area.

Capital equipment

Summary and recommendations

Respondents from the various southern African herbaria have indicated that there are many capital equipment needs in the herbaria surveyed. Table 7 summarises the cost of the necessary equipment by country; Table 8 shows the total cost broken down by item for the 55 southern African herbaria surveyed.

Particularly in the southern African countries outside South Africa, which have fewer herbaria, SABONET has already assisted in addressing some of the capital equipment needs of selected herbaria. Funds have been made available to participating institutions through SABONET for the purchasing of herbarium cabinets, deep freezers, GPS units, microwave ovens, dissect-

Table 7. Summary of costs (by country) of the equipment needs of the 55 southern African herbaria surveyed.

Country	Estimated cost (US\$)*
Angola	18 100
Botswana	41 445
Lesotho	50 760
Malawi	56 680
Mozambique	60 765
Namibia	15 700
South Africa	590 555
Swaziland	5 900
Zambia	63 160
Zimbabwe	116 510
Total	1 019 575

* Estimated prices based on the exchange rate of US\$1.00 = R5.70, on 6 January 1999.

Table 8. Summary of costs (by item) of the equipment needs of the 55 southern African herbaria surveyed.

Equipment	Unit price (US\$)	Number needed	Estimated cost (US\$)
Dissecting microscope	1 900	89	169 100
Compound microscope	4 500	63	283 500
Herbarium cabinets	650	487	316 550
Pentium computer (hard drive, monitor, keyboard, CD-ROM)	2 000	72	144 000
Printer (dot matrix)	265	3	795
Printer (inkjet)	530	14	7 420
Printer (laser)	950	37	35 150
Deep freezer	400	34	13 600
Microwave oven	450	42	18 900
UPS	200	43	8 600
GPS	300	45	13 500
Plant presses (including straps)	30	282	8 460
Total			1 019 575

ing/compound microscopes, cameras, camping equipment, computer equipment and e-mail/Internet access. Herbaria which have benefited, or are expected to benefit, from GEF/UNDP funds allocated to capital equipment through SABONET, are listed in Table 9.

Table 9. Herbaria that have benefited, or are expected to benefit, from GEF/UNDP funding for equipment through SABONET.

Herbarium name	Acronym
Angola	
Luanda Herbarium	LUI
Botswana	
National Herbarium	GAB
Peter Smith Herbarium	PSUB
University of Botswana Herbarium	UCBG
Lesotho	
Herbarium, Department of Biology, NUL	ROML
Maseru Herbarium	MASE
Sehlabathebe National Park Herbarium	
Malawi	
National Herbarium	MAL
Mozambique	
Eduardo Mondlane University Herbarium	LMU
INIA Herbarium	LMA
Namibia	
National Herbarium	WIND
South Africa	
Compton Herbarium	NBG & SAM
Natal Herbarium	NH
National Herbarium	PRE
Swaziland	
National Herbarium	SDNH
Zambia	
Chinzombo Herbarium	MFUWE*
Herbarium, Forestry Department	NDO
Mount Makulu Herbarium	MRSC
University of Zambia Herbarium	UZL
Zimbabwe	
National Herbarium	SRGH

* Proposed acronym

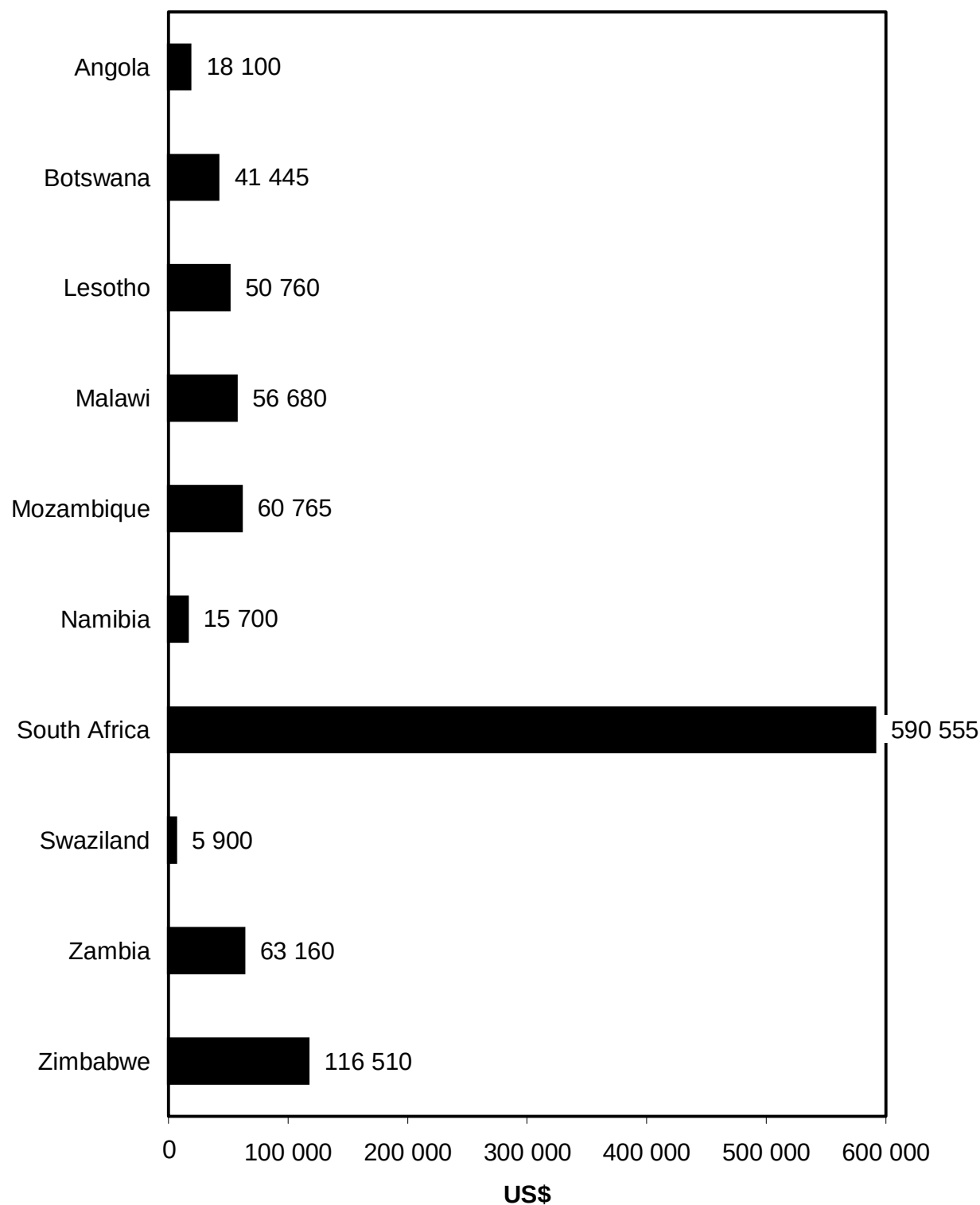


Figure 3. Costs of the equipment needs of the herbaria surveyed in the ten southern African countries.

However, SABONET will not be able to address the capital equipment needs of all the herbaria in the region. This is true particularly in South Africa, where capital equipment needs are larger (US\$ 590 555) than in the remaining nine southern African countries put together (US\$ 429 020), owing to the large number of herbaria in the country (Figure 3). Additional funds outside the SABONET project will have to be found by the region's herbaria in order to address the various equipment needs. The recently-established Southern African Society for Systematic Biology (Smith & Willis 1999) should ideally play a significant role in the development and endorsement of such a proposal for funding, whether at a national or international level.

Capital equipment needs were assessed and are discussed under the following five headings:

- **Microscopes and laboratory access** Availability of and requirements for dissecting and compound microscopes, access to an electron microscope (scanning and transmission) and access to an anatomy, molecular biology and/or cytogenetics laboratory.
- **Computer equipment** Availability of and needs for computers and printers, availability of and requirements for an Uninterrupted Power Supply (UPS) unit for the computer(s), availability of electronic mail (e-mail) and the Internet.
- **Vehicles and collecting trips** Access to an institutional vehicle for field excursions, number of days spent conducting fieldwork per year, number of kilometres covered during fieldwork per year and needs for collecting equipment.
- **Herbarium facilities** Number of herbarium cabinets available and required, access to herbarium supplies (including source), use of acid-free mounting boards, climate control inside the herbarium, access to drying facilities, control for insect infestations in the herbarium and use of a fire prevention system.
- **Other equipment** Deep freezers, microwave ovens and Global Positioning Systems (GPSs).

Microscopes and laboratory access

The survey results show a general need for microscopes in southern African herbaria: 31 herbaria (56%) indicated a need for either compound or dissecting microscopes.

A general dichotomy between South African and non-South African herbaria is apparent in the access herbaria have to electron microscopes and specialised laboratories. South African university herbaria generally have access to anatomy, molecular biology or cytogenetics laboratories. Smaller herbaria, however, usually do not have access to such facilities. In contrast, even university herbaria in the other countries of the region do not have access to specialised laboratories. Of 23 non-South African herbaria, only seven (30%) have the use of anatomy laboratories; none have access to molecular biology or cytogenetics laboratories. In contrast, 26 out of 32 South African herbaria (81%) have access to anatomy laboratories.

This situation has implications for the type of taxonomic research that can be done at any specific herbarium, as well as in the region as a whole. Without access to an anatomy laboratory, research is limited to macromorphological characters. Where taxonomists have access to anatomy laboratories, their work can include analysis of cryptic anatomical characters in addition to gross morphology. Access to electron microscopes enhances the ability of researchers to study both morphology and anatomy in greater detail. Molecular biology and cytogenetics laboratories enables taxonomists to study groups to even more fundamental levels by incorporating techniques such as chemotaxonomy and DNA analysis in their research.

Computer equipment

Many southern African herbaria have access to computers and printers, although not all those herbaria with access to computers have computers that are dedicated to the herbaria. These computers are often used for activities not directly associated with the herbaria. There is also the danger

that many existing computers in southern African herbaria are not Year 2000 (Y2K) compliant, and may need urgent upgrading before the end of 1999.

Although SABONET has already purchased computer equipment for many herbaria in the region, there is a general need for more computers in almost all the herbaria surveyed (76%). Many herbaria also indicated that they needed more powerful computers. Most existing herbarium computers are either 486s or Pentiums; the entry-level computers available today are Pentium IIs.

Uninterrupted Power Supply (UPS) units protect computers and data from being damaged by the irregular power surges experienced in many southern African towns and cities. Where these conditions are experienced, computers should be linked to UPSs as a standard procedure. Survey results show that 24% of herbaria already have one or more UPS; 60% require UPSs.

E-mail is generally recognised as being the fastest and most efficient means of communication available today, and each southern African herbarium should have access to e-mail and the Internet. Most herbaria surveyed want additional access to e-mail and the Internet, even in herbaria that already have such access. Of the 55 herbaria surveyed, 31 (56%) have access; 35 herbaria (64%) indicated that they require access. Enabling e-mail and Internet access entails the following in smaller herbaria: a modem needs to be purchased and a monthly or annual fee is paid to a service provider (ISP). Most ISPs provide e-mail and Web browser software as part of their service. For connection to an existing network in herbaria associated with larger institutions (for example, JRAU, NU, PRE), a network card, network connection, and cabling are necessary for each computer that needs access.

Vehicles and collecting trips

Survey results show large variation in the frequency, duration, and distances travelled on field trips in the region. Some herbaria reported no field trip activities, whereas staff members at other herbaria are in the field for the major part of the year (GCPH, 280 days; UMT, 200 days). The total distances travelled show similar extreme variation, with two herbaria (MAL, NBG & SAM) reporting a total of 100 000 km travelled on field trips during a single year. For the region as a whole, the median number of fieldwork days per year was 30, with a median of 5 000 kilometres travelled per herbarium per year during field excursions. Tables 10 and 11 show field trip statistics for each country.

Table 10. Summary statistics of fieldwork (days per year) conducted by staff in the 55 southern African herbaria surveyed. No data were provided for the herbaria in Lesotho and Swaziland.

Country	Herbaria	Mean – S.E.	Median	Mode	Range
Angola	1	30	30		30
Botswana	3	25 – 13	14		14 50
Malawi	1	84	84		84
Mozambique	1	24	24		24
Namibia	1	60	60		60
South Africa	21	39 – 8	30	30	0 120
Zambia	2	25 – 15	25		10 40
Zimbabwe	3	167 – 77	200		20 280
Summary	33	50 – 10	30	30	0 280

Table 11. Summary statistics of fieldwork (kilometres per year) conducted by staff in the 55 southern African herbaria surveyed. No data were provided for the herbaria in Angola, Lesotho and Swaziland.

Country	Herbaria	Mean – S.E.	Median	Mode	Range
Botswana	3	3 667 – 1 333	5 000		1 000 5 000
Malawi	1	100 000	100 000		100 000
Mozambique	1	4 000	4 000		4 000
Namibia	1	15 000	15 000		15 000
South Africa	21	14 842 – 5 174	10 000	20 000	0 100 000
Zambia	2	1 500 – 500	1 500		1 000 2 000
Zimbabwe	3	11 400 – 8601	11 400		2 800 20 000
Summary	32	15 096 – 4 635	5 000	20 000	0 100 000

Using the median figures in Tables 10 and 11, we have estimated that on average, a South African herbarium spends US\$ 43 116 on Subsistence and Travel (S&T) and US\$ 56 140 on vehicle use. We have based our calculations on the following assumptions: two persons in each of the 32 South African herbaria together doing 30 days fieldwork per year; 10 000 kilometres travelled per year for each of the 32 herbaria at a rate of R1.00 (US\$ 0.18) per kilometre. The estimated combined total of S&T and vehicle travel spent on an annual basis by South African herbaria is about US\$ 100 000.

Using GEF/UNDP funding allocated to SABONET, each participating country will have the opportunity to purchase a four-wheel drive vehicle during 1999. These vehicles will be available for field collecting expeditions. The vehicles will remain the property of the institutions for which they have been bought.

Herbarium facilities

Supplies Most of the herbaria surveyed have access to herbarium supplies, either through local suppliers or through the NBI's National Herbarium (PRE) in Pretoria, South Africa. South Africa's National Herbarium has an important role to play in providing herbarium supplies to southern African herbaria, particularly within South Africa: 17 South African herbaria (53%) purchase their herbarium supplies from PRE.

To prevent deterioration over time, herbarium specimens should ideally be mounted on archival quality acid-free board (Bridson & Forman 1992; Fish 1999). Almost half the herbaria (27 herbaria, 49%) in the region do not use acid-free mounting boards. Many herbaria were uncertain whether their specimens were mounted on acid-free mounting boards. Thirteen herbaria (24%) indicated that they did use acid-free mounting boards; 15 herbaria (27%) were uncertain. The percentage of specimens mounted on such boards ranged from 0% to 100% in individual herbaria. Using the survey percentages, we have estimated that approximately 1 000 000 specimens (26% of all specimens) in southern African herbaria are mounted on acid-free boards.

Cabinets Almost all herbaria in the region have a need for herbarium cabinets; 487 herbarium cabinets are required.

Climate control Only eight (25%) of the South African herbaria are climatically controlled, with the majority of herbaria (75%) within South Africa not having any form of climate control. In the rest of southern Africa the situation is even worse: only four of these herbaria (17%) are air-

conditioned. Considering that many of the herbaria in southern Africa are located in tropical, sub-tropical and/or humid areas (for example, LYD/MPUM, UNIN, VENDA, PSUB, LMU, LMA, MFUWE, NDO, MRSC, UZL, BUL, UMT, CAH, MRSH and SRGH), this situation needs to be addressed urgently. Even the three largest herbaria in southern Africa—PRE, NBG & SAM and SRGH—are not climatically controlled. Considering the importance of these herbaria in the southern African region, this should be considered a priority in the sourcing of funds by these herbaria.

Insect control Control of insect infestations in southern Africa is varied in terms of what systems and fumigants are used. Systems used include the following: Doom fogger, annual fumigation, domestic aerosol sprays, fumigation with methyl bromide, fumigation with butane, spraying infected specimens with ethanol, wiping cabinets out with thymol, naphthalene balls (“moth” balls), microwaving/freezing of incoming specimens, heat-drying, mercuric chloride, pest control companies, Mystox, Mystox with linseed oil, Vapona strips, fumi tabs, phostoxin, organophosphate, Cislin, Quickphos (aluminium phosphate) fumigant insecticide tablets and p-dichlorobenzene. Some herbaria indicated that they do not control for insect infestations. Whether or not this is a true reflection of the actual situation in the herbaria concerned is not known, but fumigation and treatment of specimens before entry into the herbarium should be a basic procedure in all herbaria, especially those in humid and subtropical/tropical conditions.

Fire prevention Fire prevention systems are equally varied across the region, although not as common. Some of the methods used in southern African herbaria include the use of portable CO₂ fire extinguishers, smoke sensors, halon gas (automated), NAFS III gas system, sensor electronic alarm, 24-hour security, metal shutters, asbestos entrance doors, dry powder, fire doors and smoke detectors. Of the South African herbaria, 18 (56%) indicated the use of one or a combination of fire prevention systems. In the non-South African herbaria, only 5 (22%) of the herbaria surveyed had any fire prevention system. There is a need for particularly the herbaria outside South Africa to have fire prevention systems installed. These systems should also be regularly maintained.

Other equipment

Chest freezers, items used in the decontamination process of newly acquired herbarium specimens entering herbaria or to control insect infestations in existing collections, are available in many of the herbaria surveyed, but certainly not all. According to survey results, 33 herbaria (60%) are already using freezers; 27 herbaria (49%) indicated a need for a freezer. Deep freezing at -18°C for 48 hours is considered to be one of the best general methods of decontamination in herbaria (Cowan 1980; Hall 1988; Bridson & Forman 1992): it is simple, safe and relatively cheap. For maximum effectiveness, it should be repeated at regular intervals (Clark 1986).

Survey results indicate that 9 herbaria (16%) are currently using microwave ovens; 40 herbaria (73%) indicated a need for a microwave oven. Microwave ovens are used both for decontaminating small quantities of plant material in herbaria and for drying succulent plant specimens (Fuller & Barbe 1981; Hall 1981; Leuenberger 1982; Baker, Mohlenbrock & Pinkava 1985; Eggli & Leuenberger 1996; Burgoyne & Smith 1998; Fish 1999). Although generally used, microwave ovens can have deleterious effects on specimens (Hill 1983; Philbrick 1984). When specimens have been microwaved, it is good practice to note this on the specimen sheet by adding a stamp or a label (Hill 1983; Philbrick 1984; Bridson & Forman 1992).

Global Positioning Systems (GPSs) have today become standard pieces of equipment for use during plant collecting trips. A total of 25 herbaria (45%) already have a GPS; 33 herbaria (60%) indicated a need for a GPS. Fish (1999) describes the use of the GPS as follows: “Although the latitude and longitude of a collecting site can be obtained from a map, a precise locality can be very difficult to describe when there is no direct route to it. GPS instruments are the latest technology for

providing a fairly accurate locality quickly, giving latitude and longitude in degrees, minutes and seconds or in degrees and minutes, the latter with three decimal places. Unfortunately, the satellites with which these instruments operate, give slightly inaccurate readings which may vary with time. The GPS has many other functions. On plant collecting trips it could, for example, also be used for navigation purposes. Although there is a facility for providing altitude data, this has been found to be very inaccurate and altitude should rather be obtained from a map or by using an altimeter. It is strongly recommended that the GPS should always be used in conjunction with a good, detailed map.”

Angola

The combined estimated cost of capital equipment needed in Angola is US\$ 18 100. For a detailed breakdown of costs for the country, see Table 12.

Microscopes and laboratory access

The Luanda Herbarium in Angola requires four dissecting microscopes. The herbarium does not have access to electron microscopes or anatomy/molecular biology/cytogenetics laboratories. Attempts are, however, being made to build a cytogenetics laboratory at the Agostinho Neto University in Luanda.

Computer equipment

The Luanda Herbarium requires two Pentium computers, both with CD-ROM drives, and four UPS units. The herbarium also needs e-mail and Internet access.

Vehicles and collecting trips

Staff of the Luanda Herbarium indicated that they only sometimes have access to an institutional vehicle for fieldwork, and spend about one month on field excursions per year. Field collecting equipment needed is mostly in the form of plant presses.

The Luanda Herbarium will receive a SABONET four-wheel drive vehicle during 1999.

Herbarium facilities

Supplies The Luanda Herbarium has unsatisfactory access to herbarium supplies through suppliers in Portugal and through the NBI's National Herbarium (PRE) in Pretoria, South Africa. The herbarium does not use acid-free mounting boards.

Cabinets The herbarium requires four additional herbarium cabinets.

Climate control The herbarium has an air-conditioning system.

Insect control Insects are controlled by freezing specimens and occasional use of naphthalene balls.

Fire prevention A fire prevention system is not present.

Other equipment

The Luanda Herbarium requires four deep freezers, two microwave ovens and a single GPS unit.

Table 12. Equipment needs in Angola's Luanda Herbarium (LUAI).

Equipment	Unit price (US\$)	Number needed	Estimated cost (US\$)
Dissecting microscope	1 900	4	7 600
Compound microscope	4 500	0	
Herbarium cabinets	650	4	2 600
Pentium computer (hard drive, monitor, keyboard, CD-ROM)	2 000	2	4 000
Printer (dot matrix)	265	0	
Printer (inkjet)	530	0	
Printer (laser)	950	0	
Deep freezer	400	4	1 600
Microwave oven	450	2	900
UPS	200	4	800
GPS	300	1	300
Plant presses (including straps)	30	10	300
Total			18 100

Botswana

The combined estimated cost of capital equipment needed in Botswana is US\$ 41 445. For a detailed breakdown of costs for the country, see Table 13. Appendix 5 lists the total estimated cost for equipment for each herbarium.

Microscopes and laboratory access

The National Herbarium of Botswana did not complete the section of the questionnaire relating to dissecting and compound microscopes, but indicated that they do not have access to electron microscopes or specialised laboratories. However, the University of Botswana Herbarium is not far from the National Herbarium in Gaborone and could provide access to an anatomy laboratory.

The University of Botswana Herbarium in Gaborone requires two dissecting microscopes and two compound microscopes. Currently the herbarium has a single dissecting microscope and one compound microscope dedicated to the herbarium. The herbarium staff have access to an anatomy laboratory, but do not have access to electron microscopes or a molecular biology/cytogenetics laboratory.

Staff of the Peter Smith Herbarium in Maun, Botswana, indicated that they require two dissecting microscopes and two compound microscopes. The herbarium staff do not have access to electron microscopes or specialised laboratories.

Computer equipment

The three Botswanan herbaria surveyed require a total of three Pentium computers with CD-ROM drives, one dot-matrix printer, one inkjet printer, two laser printers and a single UPS unit. Both the National Herbarium and the University of Botswana Herbarium require computers that have access to e-mail and the Internet. The Peter Smith Herbarium in Maun does have a computer with e-mail but not Internet access.

Vehicles and collecting trips

All three Botswanan herbaria surveyed have access to institutional vehicles. Days spent on field excursions range between 14 (University of Botswana Herbarium) and 50 (National Herbarium) days per year. Kilometres covered during field excursions vary from 1 000 km (Peter Smith Herbarium) to 5 000 km (National Herbarium and the University of Botswana Herbarium). Field collecting equipment needs include presses, straps, spades, picks, secateurs and camping equipment.

The National Herbarium will receive a SABONET four-wheel drive vehicle during 1999.

Herbarium facilities

Supplies The three Botswanan herbaria have access to herbarium supplies through local suppliers or through the NBI's National Herbarium (PRE) in Pretoria, South Africa, but none uses acid-free mounting boards.

Cabinets The herbaria require four additional herbarium cabinets.

Climate control None of the herbaria has climate control.

Insect control Insects are controlled by naphthalene and fumigation in two of the herbaria; the Peter Smith Herbarium does not have any insect control at present.

Fire prevention Only the National Herbarium has any form of fire prevention system: the herbarium uses a portable CO₂ fire extinguisher.

Other equipment

The three Botswanan herbaria surveyed require a total of three deep freezers, three microwave ovens and five GPS units.

Table 13. **Equipment needs in the Botswanan herbaria surveyed.**

Equipment	Unit price (US\$)	Number needed	Estimated cost (US\$)
Dissecting microscope	1 900	4	7 600
Compound microscope	4 500	4	18 000
Herbarium cabinets	650	4	2 600
Pentium computer (hard drive, monitor, keyboard, CD-ROM)	2 000	3	6 000
Printer (dot matrix)	265	1	265
Printer (inkjet)	530	1	530
Printer (laser)	950	2	1 900
Deep freezer	400	3	1 200
Microwave oven	450	3	1 350
UPS	200	1	200
GPS	300	5	1 500
Plant presses (including straps)	30	10	300
Total			41 445

Lesotho

The combined estimated cost of capital equipment needed in Lesotho is US\$ 50 760. For a detailed breakdown of costs for the country, see Table 14. Appendix 5 lists the total estimated cost for equipment for each herbarium.

Microscopes and laboratory access

The two Lesotho herbaria indicated that they require six dissecting microscopes and six compound microscopes. These figures are possibly an over-estimate of the actual needs—a single dissecting microscope and compound microscope per herbarium would probably be sufficient. Neither herbarium has access to electron microscopes or anatomy/molecular biology/cytogenetics laboratories.

Computer equipment

The Lesotho herbaria require three Pentium computers with CD-ROM drives, one laser printer and a single UPS unit. The Roma Herbarium at the National University of Lesotho has a computer with access to both e-mail and the Internet. The Maseru Herbarium needs e-mail and Internet access.

Vehicles and collecting trips

Although no response from the Lesotho herbaria was received regarding number of days of fieldwork conducted per year, both herbaria indicated that access to institutional vehicles for fieldwork was very difficult. Field equipment needs in the two Lesotho herbaria surveyed included presses and straps, picks, spades and a specimen dryer.

The National University of Lesotho Herbarium will receive a SABONET four-wheel drive vehicle during 1999.

Herbarium facilities

Supplies The two herbaria in Lesotho do not have regular access to herbarium supplies and do not use acid-free mounting boards.

Cabinets The Maseru Herbarium requires five additional herbarium cabinets.

Climate control Neither herbarium has air-conditioning.

Insect control Neither herbarium has insect control measures.

Fire prevention Neither herbarium has a fire prevention system.

Other equipment

The two Lesotho herbaria require a total of one deep freezer, two microwave ovens and a single GPS unit.

Table 14. Equipment needs in the Lesotho herbaria surveyed.

Equipment	Unit price (US\$)	Number needed	Estimated cost (US\$)
Dissecting microscope	1 900	6	11 400
Compound microscope	4 500	6	27 000
Herbarium cabinets	650	5	3 250
Pentium computer (hard drive, monitor, keyboard, CD-ROM)	2 000	3	6 000
Printer (dot matrix)	265	0	
Printer (inkjet)	530	0	
Printer (laser)	950	1	950
Deep freezer	400	1	400
Microwave oven	450	2	900
UPS	200	1	200
GPS	300	1	300
Plant presses (including straps)	30	12	360
Total			50 760

Malawi

The combined estimated cost of capital equipment needed in Malawi is US\$ 56 680. For a detailed breakdown of costs for the country, see Table 15.

Microscopes and laboratory access

The National Herbarium in Malawi has a single dissecting microscope and no compound microscopes. An additional five dissecting microscopes and six compound microscopes are required by this herbarium. The herbarium does not have access to either electron microscopes or anatomy/molecular biology/cytogenetics laboratories.

Computer equipment

The Malawi National Herbarium requires two Pentium computers with CD-ROM drives, one inkjet printer, one laser printer and three UPS units. The herbarium has three computers with access to e-mail and a single computer with access to the Internet. An additional computer with e-mail access and two computers with Internet access are required.

Vehicles and collecting trips

Staff of the National Herbarium of Malawi have access to an institutional vehicle and spend around 84 days per year on field excursions covering approximately 100 000 km. Field equipment needs include presses and straps, picks, secateurs, protective clothing, camera, tape measures, binoculars and an altimeter.

The National Herbarium will receive a SABONET four-wheel drive vehicle during 1999.

Herbarium facilities

Supplies The National Herbarium has access to herbarium supplies, which they order through the Royal Botanic Gardens, Kew, Missouri Botanical Garden, and the NBI's National Herbarium (PRE) in Pretoria, South Africa. The herbarium uses acid-free mounting boards; 20% of the collection is mounted on acid-free boards.

Cabinets The herbarium requires 15 additional herbarium cabinets.

Climate control The herbarium has air-conditioning.

Insect control Insects are controlled by freezing incoming specimens and fumigation with butane and methyl bromide.

Fire prevention A fire prevention system is not present.

Other equipment

Malawi's National Herbarium requires three deep freezers, one microwave oven and four GPS units.

Table 15. **Equipment needs in the Malawian National Herbarium (MAL).**

Equipment	Unit price (US\$)	Number needed	Estimated cost (US\$)
Dissecting microscope	1 900	5	9 500
Compound microscope	4 500	6	27 000
Herbarium cabinets	650	15	9 750
Pentium computer (hard drive, monitor, keyboard, CD-ROM)	2 000	2	4 000
Printer (dot matrix)	265	0	
Printer (inkjet)	530	1	530
Printer (laser)	950	1	950
Deep freezer	400	3	1 200
Microwave oven	450	1	450
UPS	200	3	600
GPS	300	4	1 200
Plant presses (including straps)	30	50	1 500
Total			56 680

Mozambique

The combined estimated cost of capital equipment needed in Mozambique is US\$ 60 765. For a detailed breakdown of costs for the country, see Table 16. Appendix 5 lists the total estimated cost for equipment for each herbarium.

Microscopes and laboratory access

The LMA Herbarium has two dissecting microscopes and no compound microscopes. It requires an additional two dissecting microscopes and three compound microscopes. The herbarium does not have access to either electron microscopes or anatomy/molecular biology/cytogenetics laboratories.

The LMU Herbarium situated at the Eduardo Mondlane University in Maputo has a single dissecting microscope and three compound microscopes. It requires an additional two dissecting microscopes. The herbarium has access to an anatomy laboratory but not electron microscopes or molecular biology/cytogenetics laboratories.

Computer equipment

The two Mozambican herbaria require two Pentium computers with CD-ROM drives, one dot matrix printer, two laser printers and four UPS units. The LMA Herbarium computers do not have access to either e-mail or the Internet, whereas the LMU Herbarium has two computers linked to e-mail. The LMU Herbarium requires that another two computers be provided with e-mail access and three computers with Internet access.

Vehicles and collecting trips

The LMA Herbarium staff do not have access to an institutional vehicle and thus did not indicate any days or kilometres spent on field excursions. Field collecting equipment needs include presses, straps, picks, spades and camping equipment.

The LMA Herbarium will receive a SABONET four-wheel drive vehicle during 1999.

The LMU Herbarium staff have access to an institutional vehicle, and spend approximately 24 days per year on field excursions, covering about 4 000 km. Field collecting equipment needs include secateurs, hand lenses, presses and bags for storing field collecting equipment.

Herbarium facilities

Supplies The two herbaria in Mozambique have access to herbarium supplies through local suppliers. Both are uncertain whether the boards they use for mounting are acid-free.

Cabinets The herbariums requires 45 additional herbarium cabinets.

Climate control The LMU Herbarium has air-conditioners and dehumidifiers installed, whereas the LMA Herbarium has no climate control.

Insect control Insects are controlled by freezing of incoming specimens as well as cabinet fumigation.

Fire prevention The LMU Herbarium expects to have a CO₂ fire prevention system installed soon. The LMA Herbarium has no fire prevention system.

Other equipment

The two Mozambican herbaria surveyed together require three deep freezers, three microwave ovens and a single GPS unit.

Table 16. Equipment needs in the Mozambican herbaria surveyed.

Equipment	Unit price (US\$)	Number needed	Estimated cost (US\$)
Dissecting microscope	1 900	4	7 600
Compound microscope	4 500	3	13 500
Herbarium cabinets	650	45	29 250
Pentium computer (hard drive, monitor, keyboard, CD-ROM)	2 000	2	4 000
Printer (dot matrix)	265	1	265
Printer (inkjet)	530	0	
Printer (laser)	950	2	1 900
Deep freezer	400	3	1 200
Microwave oven	450	3	1 350
UPS	200	4	800
GPS	300	1	300
Plant presses (including straps)	30	20	600
Total			60 765

Namibia

The combined estimated cost of capital equipment needed in Namibia is US\$ 15 700. For a detailed breakdown of costs for the country, see Table 17.

Microscopes and laboratory access

The National Herbarium in Namibia has three dissecting microscopes and a single compound microscope, and requires an additional two dissecting microscopes. The herbarium has access to an anatomy laboratory in the National Botanical Research Institute, but this has not yet been equipped. The herbarium does not have access to electron microscopes or molecular biology/cytogenetics laboratories.

Computer equipment

Namibia's National Herbarium requires two Pentium computers and one laser printer. The herbarium has access to both e-mail and the Internet.

Vehicles and collecting trips

Staff of the National Herbarium in Namibia have access to an institutional vehicle and spend about two months per year on field excursions, covering approximately 15 000 km. The only field collecting equipment needs are straps for presses.

The National Herbarium will receive a SABONET four-wheel drive vehicle during 1999.

Herbarium facilities

Supplies The National Herbarium has access to herbarium supplies through the NBI's National Herbarium (PRE) in Pretoria, South Africa, and does not use acid-free mounting boards.

Cabinets The herbarium requires ten additional herbarium cabinets.

Climate control The herbarium has a humidity and temperature control system installed.

Insect control Insects are controlled by fumigation, decontamination by freezing, spraying infected specimens with ethanol, and wiping out cabinets with thymol.

Fire prevention A CO₂ fire prevention system is used.

Other equipment

The Namibian National Herbarium requires a microwave oven.

Table 17. Equipment needs in Namibia's National Herbarium (WIND).

Equipment	Unit price (US\$)	Number needed	Estimated cost (US\$)
Dissecting microscope	1 900	2	3 800
Compound microscope	4 500	0	
Herbarium cabinets	650	10	6 500
Pentium computer (hard drive, monitor, keyboard, CD-ROM)	2 000	2	4 000
Printer (dot matrix)	265	0	
Printer (inkjet)	530	0	
Printer (laser)	950	1	950
Deep freezer	400	0	
Microwave oven	450	1	450
UPS	200	0	
GPS	300	0	
Plant presses (including straps)	30	0	
Total			15 700

South Africa

The combined estimated cost of capital equipment needed in South Africa is US\$ 590 555. For a detailed breakdown of costs for the country, see Table 18. Appendix 5 lists the total estimated cost for equipment for each herbarium.

Microscopes and laboratory access

Most of the herbaria attached to larger universities in South Africa have microscopes available and have access to electron microscopes (scanning and transmission), as well as anatomy and molecular biology laboratories. Relatively few of the country's herbaria, however, have access to cytogenetics laboratories. South African herbaria that do have access to cytogenetics laboratories are BOL, NBG & SAM, BLFU, NMB, NH, NU, PRE, GRA and FFS. South African herbaria require 51 dissecting microscopes and 32 compound microscopes.

Computer equipment

Several South African herbaria do not have dedicated computers and printers (for example, BLFU, Goegap Nature Reserve Herbarium, University of North-West Herbarium, LYD/MPUM, SAAS, Towoomba-ADC Herbarium, UDW and the Worcester Field Reserve Herbarium). In total, South

African herbaria require 44 Pentium computers with CD-ROM drives and one dot matrix printer, 11 inkjet printers and 18 laser printers. An additional 20 UPS units are needed. A total of 29 e-mail connections and Internet access for 53 computers are required.

Vehicles and collecting trips

Of the South African herbaria surveyed, 14 herbaria (44%) have access to institutional vehicles for collecting trips, seven did not, one indicated sometimes; ten herbaria did not respond to this question. The median number of fieldwork days per year was 39 (range 0–120 days), with a median of 10 000 kilometres (range 0–100 000 km) travelled per herbarium per year during field excursions. In the case of JBG, although an institutional vehicle was available, field collecting is not done owing to lack of staff and funds.

The National Herbarium will receive a SABONET four-wheel drive vehicle during 1999.

Several South African herbaria (PUC, BOL, NBG & SAM, CPF, NU, PRE, PRU and KEI) indicated that they did not require any additional collecting equipment. Most herbaria, however, indicated a need for some collecting equipment—varying from plant presses and drying paper, straps, spades, collecting bags, picks, secateurs, compasses, altimeters, jewellers tags (for provisional specimen identification and labelling) and telescopic pruners to camping equipment and a geological hammer.

Herbarium facilities

Supplies Most of the herbaria surveyed have access to herbarium supplies, either through local suppliers or through the NBI's National Herbarium (PRE). Only four herbaria (13%) indicated that they do not have access to herbarium supplies. Seventeen of the 32 herbaria (53%) get their herbarium supplies through PRE. Only nine herbaria (28%) in the country use acid-free mounting boards. Seventeen herbaria (53%) indicated that they did use acid-free mounting boards; six herbaria (19%) were uncertain. The percentage of specimens mounted on such boards ranged from 0% to 70% in individual herbaria.

Cabinets Half the South African herbaria indicated a need for herbarium cabinets; 326 herbarium cabinets are required.

Climate control Eight (25%) of the South African herbaria are climatically controlled, with the majority of herbaria (75%) not having any form of climate control.

Insect control Only two herbaria reported that they used no insect control measures. The other herbaria use a wide variety of controls, ranging from household insecticides to professional fumigation.

Fire prevention Just over half the herbaria (18 herbaria, 56%) in South Africa have a fire prevention system. Methods used range from smoke detectors and portable CO₂ fire extinguishers to automated halon gas systems.

Other equipment

In the 32 South African herbaria surveyed, nine deep freezers are required, as well as 18 microwave ovens and 23 GPS units.

Table 18. Equipment needs in the South African herbaria surveyed.

Equipment	Unit price (US\$)	Number needed	Estimated cost (US\$)
Dissecting microscope	1 900	51	96 900
Compound microscope	4 500	32	144 000
Herbarium cabinets	650	326	211 900
Pentium computer (hard drive, monitor, keyboard, CD-ROM)	2 000	44	88 000
Printer (dot matrix)	265	1	265
Printer (inkjet)	530	11	5 830
Printer (laser)	950	18	17 100
Deep freezer	400	9	3 600
Microwave oven	450	18	8 100
UPS	200	20	4 000
GPS	300	23	6 900
Plant presses (including straps)	30	132	3 960
Total			590 555

Swaziland

The combined estimated cost of capital equipment needed in Swaziland is US\$ 5 900. For a detailed breakdown of costs for the country, see Table 19.

Microscopes and laboratory access

The Swaziland National Herbarium does not have any microscopes, and requires one dissecting microscope and no compound microscopes. The herbarium does not have access to either electron microscopes or anatomy/molecular biology/cytogenetics laboratories.

Computer equipment

The Swaziland National Herbarium requires one Pentium computer with a CD-ROM drive, one laser printer and a single UPS unit. The herbarium computer does not have e-mail or Internet access.

Vehicles and collecting trips

The staff of the Swaziland National Herbarium do not have access to an institutional vehicle, and therefore did not indicate any days or kilometres travelled on field excursions. No field collecting equipment needs were stated.

The Swaziland National Herbarium will receive a SABONET four-wheel drive vehicle during 1999.

Herbarium facilities

Supplies The National Herbarium has access to herbarium supplies through a local supplier, and is uncertain whether acid-free mounting boards are used.

Cabinets The herbarium requires no additional herbarium cabinets.

Climate control The herbarium has no climate control system installed.

Insect control Insects are controlled by fumigation.

Fire prevention No fire prevention system is used.

Other equipment

The Swaziland National Herbarium needs a deep freezer and a microwave oven.

Table 19. **Equipment needs in the Swaziland National Herbarium (SDNH).**

Equipment	Unit price (US\$)	Number needed	Estimated cost (US\$)
Dissecting microscope	1 900	1	1 900
Compound microscope	4 500	0	
Herbarium cabinets	650	0	
Pentium computer (hard drive, monitor, keyboard, CD-ROM)	2 000	1	2 000
Printer (dot matrix)	265	0	
Printer (inkjet)	530	0	
Printer (laser)	950	1	950
Deep freezer	400	1	400
Microwave oven	450	1	450
UPS	200	1	200
GPS	300	0	
Plant presses (including straps)	30	0	
Total			5 900

Zambia

The combined estimated cost of capital equipment needed in Zambia is US\$ 63 160. For a detailed breakdown of costs for the country, see Table 20. Appendix 5 lists the total estimated cost for equipment for each herbarium.

Microscopes and laboratory access

The four herbaria in Zambia that were surveyed each require one dissecting microscope and one compound microscope. None of the herbaria have access to electron microscopes. Only the University of Zambia Herbarium has access to an anatomy laboratory. The laboratory needs microtome knives and microscope slides. None of the Zambian herbaria have access to molecular biology/cytogenetics laboratories.

Computer equipment

The four Zambian herbaria require four Pentium computers with CD-ROM drives, four laser printers and four UPS units. The only Zambian herbarium with access to e-mail and the Internet is the University of Zambia Herbarium. An additional four e-mail and Internet access connections are required in the four Zambian herbaria.

Vehicles and collecting trips

Only the University of Zambia Herbarium and the Chinzombo Herbarium indicated having access to an institutional vehicle with which to conduct fieldwork. Fieldwork days per year for these two herbaria range from 10 to 40 kilometres per year. Distances travelled on field excursions range from 1 000 to 2 000 kilometres per year. Field equipment needs at the various herbaria include presses, straps, secateurs, camping equipment, hand cutters/pruners, picks, spades, and a compass and altimeter.

The University of Zambia Herbarium will receive a SABONET four-wheel drive vehicle during 1999.

Herbarium facilities

Supplies None of the four Zambian herbaria has regular access to herbarium supplies. Two herbaria are uncertain whether acid-free mounting boards are used; the other two herbaria do not use acid-free mounting boards.

Cabinets The herbaria require 31 additional herbarium cabinets.

Climate control None of the herbaria has climate control.

Insect control Insects are controlled by freezing, fumigating and spraying.

Fire prevention Only the Mt Makulu Herbarium has a fire prevention system, but did not specify which system is in use.

Other equipment

The four Zambian herbaria require a total of four deep freezers, four microwave ovens and four GPS units.

Table 20. Equipment needs in the Zambian herbaria surveyed.

Equipment	Unit price (US\$)	Number needed	Estimated cost (US\$)
Dissecting microscope	1 900	4	7 600
Compound microscope	4 500	4	18 000
Herbarium cabinets	650	31	20 150
Pentium computer (hard drive, monitor, keyboard, CD-ROM)	2 000	4	8 000
Printer (dot matrix)	265	0	
Printer (inkjet)	530	0	
Printer (laser)	950	4	3 800
Deep freezer	400	4	1 600
Microwave oven	450	4	1 800
UPS	200	4	800
GPS	300	4	1 200
Plant presses (including straps)	30	7	210
Total			63 160

Zimbabwe

The combined estimated cost of capital equipment needed in Zimbabwe is US\$ 116 510. For a detailed breakdown of costs for the country, see Table 21. Appendix 5 lists the total estimated cost for equipment for each herbarium.

Microscopes and laboratory access

Zimbabwe's National Herbarium has a single dissecting microscope and requires an additional dissecting microscope and two compound microscopes. The other herbaria in Zimbabwe require an additional seven dissecting microscopes and six compound microscopes.

Computer equipment

The eight Zimbabwean herbaria require a total of nine Pentium computers with CD-ROM drives, one inkjet printer, seven laser printers and five UPS units. Computers with access to e-mail and the Internet are required in all the herbaria.

Vehicles and collecting trips

The only Zimbabwean herbaria having access to an institutional vehicle are the Chase Herbarium, Gonarezhou Chipinda Pools Herbarium and the Matopos Research Station Herbarium. Fieldwork days per year ranged from 20 to 280, and kilometres travelled per year ranged from 2 800 to 20 000 kilometres. Field collecting equipment needs amongst the various herbaria in Zimbabwe included presses, straps, picks, spades, secateurs, hand lenses, preservatives and jewellers tags (for provisional specimen identification and labelling).

The National Herbarium will receive a SABONET four-wheel drive vehicle during 1999.

Table 21. **Equipment needs in the Zimbabwean herbaria surveyed.**

Equipment	Unit price (US\$)	Number needed	Estimated cost (US\$)
Dissecting microscope	1 900	8	15 200
Compound microscope	4 500	8	36 000
Herbarium cabinets	650	47	30 550
Pentium computer (hard drive, monitor, keyboard, CD-ROM)	2 000	9	18 000
Printer (dot matrix)	265	0	
Printer (inkjet)	530	1	530
Printer (laser)	950	7	6 650
Deep freezer	400	6	2 400
Microwave oven	450	7	3 150
UPS	200	5	1 000
GPS	300	6	1 800
Plant presses (including straps)	30	41	1 230
Total			116 510

Herbarium facilities

Supplies Seven of the eight Zimbabwean herbaria have access to herbarium supplies through local suppliers. The Grasslands Research Station Herbarium does not have regular access to supplies. Three herbaria use acid-free boards, whereas three do not; the remaining two herbaria are uncertain. Both Gonarhezou Chipinda Pools Herbarium and the National Herbarium indicated that 100% of their collections are mounted on acid-free board.

Cabinets The herbaria require 47 additional herbarium cabinets.

Climate control None of the herbaria has climate control.

Insect control Insects are controlled by naphthalene, fumigation and spraying in six of the herbaria; the Grasslands Research Station Herbarium and Gonarhezou Chipinda Pools Herbarium do not have any insect control at present.

Fire prevention Only two herbaria have fire prevention systems (BUL and UMT).

Other equipment

The eight Zimbabwean herbaria together require six deep freezers, seven microwave ovens and six GPS units.

Staffing**Summary and recommendations**

The SABONET/NBI needs assessment collected information on both existing staff and additional staff needed at each herbarium in the survey. Table 22 summarises the present staff situation per country. Table 23 combines present staff figures with the numbers of additional staff needed per country. For a detailed list of the staffing information for each herbarium, see Appendix 6.

Table 22. Summary of existing staff in the southern African herbaria surveyed.

Country	Physical curation	Scientific curation	Data-basing	Total
Angola	3	4	2	9
Botswana	5	3	4	12
Lesotho	2	2	2	6
Malawi	4	5	4	13
Mozambique	4	3	2	9
Namibia	1	2	2	5
South Africa	39	34	39	112
Swaziland	2	1	1	4
Zambia	6	5	4	15
Zimbabwe	6	9	9	24
Total	72	68	69	209

Results and Recommendations

Table 23. Summary of existing and required staff numbers in the southern African herbaria surveyed.

Country	Additional staff required	Existing staff	Total staff required	Percentage understaffed
Angola	9	5	14	64%
Botswana	12	7	19	63%
Lesotho	6	1	7	86%
Malawi	13	26	39	33%
Mozambique	9	21	30	30%
Namibia	5	6	11	45%
South Africa	112	111	223	50%
Swaziland	4	3	7	57%
Zambia	15	12	27	56%
Zimbabwe	24	24	48	50%
Total	209	216	425	49%

Table 24. Summary of estimated costs of additional staff for physical and scientific curation in the southern African herbaria surveyed. (The estimated costs for databasing staff are given in Table 27.)

Country	Staff	Cost* (US\$)	Staff	Cost** (US\$)	Total (US\$)
	(Physical curation)		(Scientific curation)		
Angola	3	15 789	4	49 120	64 909
Botswana	5	26 315	3	36 840	63 155
Lesotho	2	10 526	2	24 560	35 086
Malawi	4	21 052	5	61 400	82 452
Mozambique	4	21 052	3	36 840	57 892
Namibia	1	5 263	2	24 560	29 823
South Africa	39	205 257	34	417 520	622 777
Swaziland	2	10 526	1	12 280	22 806
Zambia	6	31 578	5	61 400	92 978
Zimbabwe	6	31 578	9	110 520	142 098
Total	72	378 936	68	835 040	1 213 976

* Estimated combined annual salary, based on US\$ 5 263 per person per year.

** Estimated combined annual salary, based on US\$ 12 280 per person per year.

Staffing and training needs in the southern African herbaria assessed can be divided into three groups:

- Physical curation
- Scientific curation
- Databasing

Physical curation

Physical curation entails the following responsibilities:

- Drying and mounting collected specimens
- Maintaining specimens in a good condition
- Restoring deteriorated specimens
- Generally caring for collections

Physical curators play a pivotal role in ensuring adequate specimen preparation and maintenance. Their efforts ensure the potential century-long preservation of specimens for future generations to study. A matric (Grade 12; final school year) certificate with Biology as one subject is a recommended prerequisite for assuming duties as a physical curator. An additional 72 physical curators should be employed in southern African herbaria (Table 24).

Scientific curation

Scientific curation entails the following responsibilities:

- Keeping collections scientifically up to date
- Doing systematics research on selected plant groups
- Mastering new technologies and methodologies
- Providing research leadership to young scientists
- Presenting appropriate modules in training courses
- Providing information and identification services

In addition to the scientific staff currently employed in southern African herbaria, a total of 68 botany postgraduates are required to actively perform scientific curatorial functions and to do justice to the diversity of preserved plant specimens housed in the subcontinent, through appropriate research projects (Table 24). Along with the approximately 60 scientific staff members currently employed in herbaria in southern Africa, the total scientific staff complement in herbaria should therefore ideally be in the order of 130. This figure translates to about 10% of the world's plant taxonomists (Stuessy 1993; Smith 1996). This does not seem unreasonable considering that about 10% of the global plant diversity occur in southern Africa. Providing a further 68 botanists to enter the job market with postgraduate qualifications will necessarily put pressure on existing academic university staff who will be involved in training them.

Databasing

Data typists/gatherers have the following responsibilities:

- Interpreting information (for example locality data) provided on herbarium specimen labels
- Transferring information from herbarium labels to appropriate fields in a herbarium database programme
- Performing quality control on captured information

Ideally, data capturers should have a basic botanical background, in addition to being computer literate. This will facilitate their interpretation of often inadequate label information. Pass marks in school-level biology and geography, along with typing skills or experience are preferred qualifications for this activity. It is imperative that as high a level as possible of accuracy is achieved during initial data capturing to prevent later researchers from wasting many hours on unnecessary quality improvement. An additional 69 data capturers should be employed in southern Africa to adequately document the specimen collections held in subcontinental herbaria. The costs involved in computerising these collections is discussed in more detail in the *Computerisation* section.

SABONET support

Between 1998 and 2002, SABONET will facilitate and fund the in-service training and employment of 33 herbarium research officers (scientific curators), 39 herbarium technical assistants (physical

curators, data typists/gatherers), 16 living collections managers (mostly with a scientific background) and 14 postgraduate (BSc(Hons)/MSc/PhD-level) plant diversity specialists (scientific curators) in southern Africa. These individuals will be employed in the participating institutions as full-time contract SABONET staff members. SABONET will use US\$ 1 500 000 over the four-year period to fund the training and employment of these staff members. It is hoped that these employees could ultimately be appointed to staff establishment positions after completion of the SABONET project.

In addition to these formal training and employment opportunities, several regional and national training courses aimed at improving the level of expertise available to herbaria have been hosted by SABONET since November 1996. The contents of these training courses have ranged from general herbarium management, botanical nomenclature and the compilation of plant red data lists to taxon-specific plant identification courses (for example Poaceae and Pteridophyta), and database use and management.

Computerisation of collections

Summary and recommendations

The SABONET/NBI needs assessment surveyed the following aspects of computerisation in southern African herbaria:

- Whether the herbarium was computerised or not
- What percentage of specimens had already been computerised
- The database system used for computerisation
- The estimated number of years it would take to complete computerisation using existing staff

Survey results show that just over half of the southern African herbaria (28 herbaria, 51%) are computerised to some degree. Two of these herbaria indicated that they were just beginning with computerisation. Just under half (27 herbaria, 49%) are not computerised at all.

Table 25. Summary of the degree of computerisation of collections in southern African herbaria.

Country	Total number of specimens	Specimens computerised	Not computerised	Percentage computerised
Angola	32 000	96	31 904	0.3
Botswana	36 597	1 896	34 701	5.2
Lesotho	20 366	5 833	14 533	28.6
Malawi	84 000	840	83 160	1.0
Mozambique	114 606	1 546	113 060	1.3
Namibia	64 879	12 976	51 903	20.0
South Africa	2 811 009	956 077	1 854 932	34.0
Swaziland	7 005	210	6 795	3.0
Zambia	108 020	375	107 645	0.3
Zimbabwe	551 401	3 596	547 805	0.7
Total	3 829 883	983 445	2 846 438	25.7

A total of 983 445 specimens had been computerised at the time of the survey (Table 25). This is 25% of the 3 829 883 specimens housed in southern African herbaria. Three herbaria (KEI, ROO, HER) have all their specimens computerised. The herbarium with the most computerised specimens is South Africa's National Herbarium (750 651 specimens computerised), followed by Cape Town University's Bolus Herbarium (50 325) and the C.E. Moss Herbarium at the University of the Witwatersrand (30 000). Numbers of computerised specimens and computerisation percentages for individual herbaria are listed in Appendix 7.

Table 26. **Databases used to computerise specimen information in southern African herbaria.**

Database	Herbaria
BASIC Programme	ROO
Data Ease - Herbarium Manager	J, PRU
DataPerfect	GRA
Dbase 3	FFS
Dbase IV	KEI
Dbase IV/Lotus approach	JBG
Foxbase/Access	BOL
Microsoft Access	PUC, CPF
PC File & Paradox	NMB
PRECIS Specimen Database	BLFU, GAB, KMG, LMA, LUAI, MAL, NBG & SAM, NH, PRE, PSUB, ROML, SDNH, SRGH, UNIN, UZL, WIND

Various database systems are used for computerisation in southern African herbaria (Table 26). Most herbaria (57%) use PRECIS Specimen Database, developed by the NBI. This is the database system endorsed by SABONET and is used in all SABONET-supported herbaria in the region. Of the 983 445 specimens that have been computerised so far, 793 735 (81%) have been entered using PRECIS Specimen Database.

We have used the number of specimens that are not computerised to estimate the time and money needed to computerise all specimens in all herbaria in the region (Table 27). We have assumed the following: one data typist can computerise about 1 000 specimens per month and earns an annual salary of US\$ 8 772.

The results of this analysis show that with a small number of dedicated computerisation staff, 100% computerisation can be achieved within a few years in most countries. The exceptions are South Africa and Zimbabwe, owing to the large number of specimens held in these countries' herbaria. To achieve the goal of full computerisation in these countries within a reasonable time, more databasing staff will have to be employed, especially in the three largest herbaria, PRE, SRGH and NBG & SAM. Together these three herbaria hold approximately 2 109 000 specimens (54% of the regional total) of which 1 353 000 (64%) still need to be computerised. Appendix 7 lists the estimated computerisation costs for individual herbaria.

Implementation

Computerisation of herbarium collections is one of SABONET's main objectives and has already been started in participating herbaria throughout the region, using the NBI's PRECIS Specimen

Table 27. Summary of the estimated time and cost of computerising all remaining uncomputerised specimens in southern African herbaria. The figures are based on one person computerising 1 000 specimens per month and earning an annual salary of US\$ 8 772.

Country	Not computerised	Person-years required	Total cost (US\$)
Angola	31 904	2.7	23 684
Botswana	34 701	2.9	25 439
Lesotho	14 533	1.2	10 526
Malawi	83 160	6.9	60 526
Mozambique	113 060	9.4	82 456
Namibia	51 903	4.3	37 719
South Africa	1 854 918	154.6	1 355 934
Swaziland	6 795	0.6	5 263
Zambia	107 645	9.0	78 947
Zimbabwe	547 805	45.7	400 877
Total	2 846 424	237.3	2 081 373

Database (Arnold & Willis 1998). One or more SABONET-funded data typists are employed in each of these herbaria. All participating institutions started the computerisation process by focussing on the economically important grass family (Poaceae).

PRECIS Specimen Database

PRECIS (Pretoria National Herbarium (**PRE**) Computerised Information System) is the computerised herbarium specimen and taxon database developed by South Africa's NBI. The main aims of the PRECIS herbarium database system are to make extensive herbarium specimen information available for computer search and to facilitate plant biological research. SABONET has supported the publication of a user's guide for PRECIS (Prentice & Arnold 1998). For more information on PRECIS Specimen Database and its products, see the box on page 51.

SABONET Training courses

To build expertise in using the PRECIS Specimen Database to computerise herbarium collections, SABONET has hosted several training courses:

- **Herbarium Management Training Course** A general course that included a component on the computerisation of herbarium specimens using the PRECIS Specimen Database.
- **Herbarium Specimen Database Course** An introductory course on the design, management and use of herbarium specimen databases.
- **Database Managers Course** Covered the more advanced features of the PRECIS Specimen Database.

These courses enabled participants to become proficient in the use of the PRECIS Specimen Database, and emphasised the following aspects of computerisation:

- Capturing data from existing and new specimens and generating labels for those specimens
- Generating detailed reports for selected specimens
- Providing a good understanding of the associated lookup tables and how to add data to these tables

Benefits of computerisation

Every participating herbarium will have a complete database of its own collections. Because all the herbaria are using PRECIS Specimen Database, there will also be a centralised database that contains information from all the herbaria. This centralised database will be maintained by the NBI at the National Herbarium, Pretoria.

Individual herbaria will be able to use their local databases for quick access to records and to generate lists of taxa and specimens, checklists for areas large or small, herbarium labels, and distribution maps.

The centralised database will be used to create similar outputs on a regional scale. One anticipated result will be a much more accurate estimate of the number of plant taxa (as well as herbarium specimens) in the region. At the moment such figures are at best an educated guess: researchers add together the individual estimates for the FSA region (based on PRECIS) and the *Flora zambesiaca* region. But this approach has its problems: Botswana is included in both regions, whereas Angola is excluded from both; many plant taxa occur in both regions, so are included in both counts. Once taxon holdings in all the main herbaria have been accurately computerised, however, these problems of overlap will be eliminated.

PRECIS Specimen Database

History

Development of PRECIS (Pretoria, National Herbarium (**PRE**) Computerised **I**nformation **S**ystem), the computerised herbarium specimen and taxon database of the National Botanical Institute (NBI), began in the early 1970s with the adoption of a quarter degree grid reference system for specimen localities (Edwards & Leistner 1971; Morris & Leistner 1971). Encoding of the approximately 470 000 specimens held in PRE at that time was carried out in the mid-1970s, concurrently with the development of programmes to operate the system (Morris & Leistner 1975; Morris & Glen 1978; Morris 1980). In the early 1980s the sheer size of the PRECIS database (Magill, Gibbs Russell, Morris & Gonsalves 1983) necessitated its restructuring, resulting in a more accessible system with linked programmes for particular output formats (Gibbs Russell & Gonsalves 1984).

Even in the early days of PRECIS development it became clear that implementation of the system would considerably streamline both herbarium curation and taxonomic research (Edwards & Leistner 1971; Morris 1974). Today PRECIS, maintained primarily by the NBI's northern Data Management unit and taxonomists of the National Herbarium in Pretoria, is a comprehensive system of linked literature, taxon and specimen components (Table 28).

Information retrieval

Information can be extracted from the various component databases of PRECIS in a number of ways. For example, independent searching, sorting and reporting are possible for any field stored for each encoded specimen (Gibbs Russell 1985). These data fields include collector, specimen number, date of collection, locality, habitat, type status and scientific name. Certain aspects of herbarium curation and maintenance can also be dealt with using special programmes provided for in PRECIS. Floristic and systematics research is facilitated in that taxon- or region-specific information can now be rapidly extracted from the database. Data obtainable include the number of specimens recorded in a quarter degree grid, and checklists of species found in a given quarter degree grid, or any combination of grids.

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Quality control

Errors are unavoidable due to incorrect information on specimen labels and, to a lesser extent, incorrect encoding. Surveys have shown that PRECIS contains a surprisingly low overall error rate (Gibbs Russell 1985; Rebelo & Cowling 1991). As with all databases, the improvement in the quality of extractable information is the single most important problem in maintaining a system successfully. For this reason quality control on PRECIS by taxonomists is an ongoing process. Since 1993 PRECIS is being maintained in-house at the NBI. This makes it easier to extract the information required and to carry out quality control.

PRECIS products

Some of the most important southern African botanical reference works produced during the last 15 years are the four successive approximations of the *List of species of southern African plants* (Gibbs Russell, Germishuizen, Herman, Olivier, Perold, Reid, Retief, Smook, Van Rooy, Welman & Gonsalves 1984; Gibbs Russell, Reid, Van Rooy & Smook 1985; Gibbs Russell, Welman, Retief, Immelman, Germishuizen, Pienaar, Van Wyk & Nicholas 1987; Arnold & de Wet 1993). The production of these works was directly facilitated through the database backup provided by PRECIS. Collectively these hard copy products provide historical and current lists of the plant taxa of the entire southern African flora. In essence, this series of publications emanated from the taxon component of PRECIS, which aims to continuously provide an up-to-date inventory of all families, genera, species and infraspecific taxa of southern Africa. Taxon-PRECIS is currently being developed into what has become known as the PRECIS-Flora of southern Africa (Arnold 1992). The nucleus of the project is the current and alternative names (synonyms) included in the *List of species of southern African plants*, which is the nomenclatural component of this computerised plant information database. Numerous other components such as descriptive morphology, pertinent literature (Meyer *et al.* 1997), plant uses, conservation data (Hilton-Taylor 1996) and general taxonomic information will be linked to the nomenclatural basis of the project. To enhance and fast-track the development of further components of PRECIS, a number of independent, but structurally related databases have been developed (Crouch & Arnold 1997) (Table 28).

The power of this computerised plant information system in botanical research is obvious. As one example of an application, the existing specimen component of PRECIS is accessible for the rapid production of accurate geographical distribution maps of taxa included in the Flora component (Smith *et al.* 1997). As all the NBI and other southern African herbaria make progress with computerising their collections, they too will form part of a broad network maintaining and expanding the database. Adopting this approach will ensure maximum participation by most of the taxonomists working on the southern African flora, thereby further enhancing the quality of data included in the database.

PRECIS is undoubtedly developing into one of the most important taxonomic projects ever launched on the subcontinent. As one of the ultimate aims of the project, the PRECIS-Flora component will produce a computer-aided reference system that will enable the end-users of taxonomic information to identify the entire southern African flora. Already the *Plants of southern Africa Database* includes all the information contained in *Plants of southern Africa: names and distribution* (Arnold & de Wet 1993) as well as references to the most recent taxonomic literature, together with national tree numbers of all indigenous trees. This system will regularly be enhanced and upgraded. Indeed, this is one of the major strengths and advantages of the computerised approach to the project: information in the system can be easily updated, and new information from monographs and revisions can be easily incorporated. Finally, the PRECIS experiment in computerised

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coverage of a major flora has shown that it is possible to rapidly obtain a cursory but ever improving taxonomic overview of about 10% of the world flora (Gibbs Russell & Arnold 1989).

This comprehensive database system represents one of the most powerful research tools available to plant scientists working on the rich southern African flora and vegetation. However, computerisation of a plant checklist is not seen as an end in itself. The acquired capacity in capturing and analysing fundamental botanical data serves as a catalyst for promoting associated botanical activities. The PRECIS system represents a technological breakthrough that will ultimately combine the power of the computer with the contents of the most representative southern African collections of dried plant specimens. □

Table 28. The different components of PRECIS.

Component	Name	Description	Sources
Specimen component	Specimen-PRECIS	Computerised records of specimens of all indigenous and naturalised plants in the National Herbarium, Pretoria (PRE) covering the FSA region. It is anticipated that extra-southern African specimens, for example of tropical African material, will be computerised as part of the SABONET project.	Herbarium specimens
Curatorial component	Curatorial-PRECIS	Computerised records of specimen loans (to and from other herbaria), specimen exchanges and the plant identification service.	Herbarium specimens, client records
Taxon component	Taxon-PRECIS	This is the nomenclatural component of PRECIS covering indigenous and naturalised taxa from the FSA region. The list of names is being expanded to include material from further afield in Africa as well.	Literature
Flora component	PRECIS-Flora	Species and infraspecific taxa: Floristic information about southern African plant species and infraspecific taxa, including literature references, nomenclature and data on morphology, ecology, distribution, conservation status, endemic status and utilisation.	Herbarium specimens, literature
		Families and genera: Family and genus descriptions, keys and distribution data for indigenous and naturalised taxa from the FSA region.	Primary sources, literature
Horticultural component		Horticultural attributes, and propagation and cultivation data for indigenous and naturalised taxa from the FSA region.	Primary sources, literature
Medicinal component		Medicinal uses of southern African plant species, including literature references, nomenclature and data on medicinal and other uses (for example magical), plant attributes, chemical components, plant/chemical traits, side effects/post mortem.	Literature, anecdotal
Gazetteer component		Records of southern African place names with their quarter degree grid references.	Literature, maps, herbarium specimens, other

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Appendix 1.

SABONET/NBI needs assessment questionnaire

Appendix 1. SABONET/NBI needs assessment questionnaire

- | | |
|---------------------------|-------------------------|
| ■ Herbarium name | ■ Contact telephone no. |
| ■ Acronym | ■ Fax no. |
| ■ Institution | ■ E-mail |
| ■ Compiler of information | ■ Date |
| ■ Position | |

Part 1. Library / literature

1. Do you have ACCESS to key taxonomic references on the southern African flora?
2. If not, which five books/serial works are critical to your taxonomic work?
3. Does your herbarium regularly receive copies of the following serial works relevant to your country/region?
 - *Flora zambesiaca*
 - *Flora of southern Africa*
 - *Bothalia*
 - *Kirkia*
 - *South African Journal of Botany*
 - *Conspectus florae angolensis*
 - *Flora de Moçambique*
4. Are library holdings adequately catalogued?
5. Is the library that is attached to the herbarium computerised?
6. Is the library connected to a regional/international search facility?
7. Any other needs related to library/literature? If yes, please specify.

Part 2. Major equipment

8. Please specify number *available* and number *required* for the following:
 - a) Microscopes
 - Dissecting
 - Compound
 - b) Computers (Additional number based on number required to fully computerise collections by 2010)
 - 286
 - 386
 - 486
 - Pentium
 - Computers with CD ROM
 - c) UPS
 - d) Printers
 - Dot Matrix
 - Ink Jet
 - Laser
 - e) Computers with access to e-mail
 - f) Computers with access to Internet
 - g) GPS
 - h) Deep Freezer
 - i) Microwave oven

- j) Estimated number of herbarium cabinets
9. What are your needs in terms of field collecting equipment (e.g. presses, straps, picks, spades)?
10. Do you have ACCESS to
 - Scanning electron microscope
 - Transmission electron microscope
 - Anatomy laboratory
 - Molecular biology laboratory
 - Cytogenetics laboratory
11. Do you have ACCESS to herbarium supplies (e.g. mounting sheets, drying paper)? If yes, who are your suppliers? (Company name, country)
12. Are you currently using acid-free mounting boards?
13. What percentage (estimate) of your collection is mounted on acid-free mounting boards?
14. Is your herbarium climatically controlled? If yes, what system do you use?
15. Does your herbarium have specimen drying facilities? (e.g. heating facilities to promote drying of fresh specimens)
16. Do you control insect infestations in your herbarium? If yes, what systems do you use for pest control?
17. Does your herbarium have a fire prevention system? If yes, what system do you use?
18. Do you have access to an institutional vehicle for field work? If yes, approximately how many days *per annum* are the vehicles used for field work? Approximately how many kilometres are covered *per annum* on field trips?

Part 3. Staffing

19. What is the total staff complement of your herbarium?
20. How many staff members are involved in scientific, research and curatorial herbarium activities?
21. How many specimens are kept in your herbarium?
22. How many additional staff members are required in your herbarium for
 - Physical curation (e.g. technical assistants)
 - Scientific curation (e.g. herbarium research officer)
 - Databasing (e.g. data typist/capturer) (Number of additional data clerk positions should be based on the number required to computerise all your collections by 2010.)
23. Is your herbarium actively involved in the computerisation of specimens? If yes, what percentage of the collection has been entered into a database?
24. Name of the database used?
25. How many years will be required to computerise all your collections using EXISTING staff only?

Part 4. Taxon holdings

26. Approximately how many specimens of the following taxa do you have in your herbarium?
 - Fungi
 - Algae
 - Bryophytes
 - Pteridophytes
 - Gymnosperms
 - Angiosperms

Part 5. General comments

27. Please use this space for any other comments you might have.

Appendix 2.

Participating institutions

Appendix 2. Participating institutions

ANGOLA

Luanda Herbarium (LUAL)

Faculty of Science
University of Agostinho Neto
P.O. Box 815
Luanda
Contact person: Dr EMEF Da Costa

BOTSWANA

National Herbarium (GAB)

Private Bag 00114
Gaborone
Contact person: Ms Q Turner

Peter Smith Herbarium (PSUB)

Harry Oppenheimer Okavango Research Centre
Private Bag 285
Maun
Contact person: Dr EM Veenendaal

University of Botswana Herbarium (UCBG)

Department of Biological Sciences
University of Botswana
Private Bag 0022
Gaborone
Contact person: Dr MP Setshogo

LESOTHO

Maseru Research Station Herbarium (MASE)

Maseru Experiment Station
P.O. Box 829
Maseru
100
Contact person: Mr MF Tlali

National University of Lesotho Herbarium (ROML)

Department of Biology
National University of Lesotho
P.O. Roma 180
Contact person: Prof. CR Nagendran

MALAWI

National Herbarium (MAL)

National Herbarium & Botanic Gardens
P.O. Box 528
Zomba
Contact person: Mr DAI Kamundi

MOZAMBIQUE

Eduardo Mondlane University Herbarium (LMU)

Department of Biological Sciences
Eduardo Mondlane University
P.O. Box 257
Maputo
Contact person: Mr SO Bandeira

INIA Herbarium (LMA)

National Institute of Agricultural Research
P.O. Box 3658
Mavalane
Maputo
8
Contact person: Ms SA Izidine

NAMIBIA

National Herbarium (WIND)

National Botanical Research Institute
Private Bag 13184
Windhoek
Contact person: Dr GL Maggs-Köling

SOUTH AFRICA

A.P. Goossens Herbarium (PUC)

Department of Plant and Soil Sciences
Potchefstroom University for C.H.E.
Private Bag X6001
Potchefstroom
2520
Contact person: Dr MH Buys

Bolus Herbarium (BOL)

Department of Botany
University of Cape Town
Private Bag
Rondebosch
7700
Contact person: Ms P Lorber

C.E. Moss Herbarium (J)

Department of Botany
University of the Witwatersrand
Private Bag 3
WITS
2050
Contact persons: Prof. K Balkwill and Mrs RA Reddy

Compton Herbarium (NBG & SAM)

National Botanical Institute
Private Bag X 7
Claremont
7735

Contact person: Dr JP Rourke

Donald Killick Herbarium (CPF)

KwaZulu-Natal Nature Conservation Service
P.O. Box 662
Pietermaritzburg
3200

Contact person: Mr CR Scott-Shaw

Geo Potts Herbarium (BLFU)

Department of Botany & Genetics
University of the OFS
P.O. Box 339
Bloemfontein
9300

Contact person: Prof. HJT Venter

Goegap Nature Reserve Herbarium

Goegap Nature Reserve
Private Bag X1
Springbok
8240

Contact persons: Ms H Rösch and Mr NJ van Zyl

H.G.W.J. Schweickerdt Herbarium (PRU)

Department of Botany
University of Pretoria
Pretoria
0002

Contact person: Prof. AE van Wyk

Herbarium of the National Museum, Bloemfontein (NMB)

National Museum
P.O. Box 266
Bloemfontein
9300

Contact person: Dr PC Zietsman

Herbarium of the Rand Afrikaans University (JRAU)

Department of Botany
Rand Afrikaans University
P.O. Box 524
Auckland Park
2006

Contact person: Prof. B-E van Wyk

Hermanus Herbarium (HER)

Hermanus Botanical Society
P.O. Box 208
Hermanus
7200

Contact person: Ms PB Drewe

Hortus Botanicus Johannesburgensis (JBG)

Johannesburg Botanic Garden
P.O. Box 85481
Emmarentia
2029

Contact person: Mr P Chambers

McGregor Museum Herbarium (KMG)

McGregor Museum
P.O. Box 316
Kimberley
8300

Contact person: Ms TA Anderson

Mpumalanga Regional Herbarium (LYD/MPUM)

Mpumalanga Parks Board
Private Bag X1088
Lydenburg
1120

Contact person: Ms S Krynauw

Natal Herbarium (NH)

National Botanical Institute
Botanic Gardens Road
Durban
4001

Contact person: Ms R Williams

National Herbarium (PRE)

National Botanical Institute
Private Bag X101
Pretoria
0001

Contact person: Ms M Koekemoer

Roodeplaat Herbarium (ROO)

Range and Forage Institute
Agricultural Research Council
Private Bag X05
Lyn East
Pretoria
0039

Contact person: Dr RH Westfall

Saasveld Herbarium (SAAS)

Faculty of Forestry
Saasveld
Port Elizabeth Technikon
Private Bag X6531
George
6530

Contact person: Mr PL Peens

Selmar Schonland Herbarium (GRA)

Department of Botany
Rhodes University
P.O. Box 2281
Grahamstown
6140

Contact persons: Dr NP Barker and Mr A Dold

Southern Cape Herbarium

P.O. Box 564
George
6530

Contact person: Mr NS Cole

Towoomba-ADC Herbarium

Private Bag X1615
Warmbaths
0480

Contact person: Mr JJ Jordaan

Tsitsikamma National Park Herbarium

Tsitsikamma National Park
South African National Parks
P.O. Storms River
6308

Contact person: Mr N Hanekom

University of Natal–Durban Herbarium

School of Life and Environmental Sciences
King George V Avenue
Durban
4041

Contact person: Mr D von Ahlefeldt

University of Natal–Pietermaritzburg Herbarium (NU)

School of Botany and Zoology
University of Natal-Pietermaritzburg
Private Bag X01
Scottsville
Pietermaritzburg
3209

Contact person: Dr TJ Edwards

University of North-West Herbarium

Department of Biological Sciences
University of North-West
Private Bag X2046
Mmabatho
2735

Contact person: Dr SD Phalatse

University of Stellenbosch Herbarium (STEU)

Department of Botany
University of Stellenbosch
Private Bag X1
Matieland
7602

Contact person: Dr P Vorster

University of the North Herbarium (UNIN)

Botany Department
University of the North
Private Bag X1106
Sovenga
0727

Contact person: Mr PJD Winter

University of Transkei Herbarium (KEI)

Department of Botany
University of the Transkei
Private Bag X1
Umtata
5100

Contact person: Ms E Cloete

Venda Herbarium (VENDA)

Department of Environmental Affairs
Thohoyandou Botanical Gardens
Private Bag X2654
Sibasa
0970

Contact persons: Ms CB Todd and Mr NR Mudau

Ward Herbarium

Botany Department
University of Durban-Westville
Private Bag X54001
Durban
4000

Contact person: Prof H Baijnath

Williams Herbarium (FFS)

Faculty of Forestry
University of Stellenbosch
Private Bag X1
Matieland
7602

Contact person: Mr C Ham

Worcester Field Reserve Herbarium

Worcester Field Reserve
P.O. Box 80
Worcester
6849
Contact person: Mr JC Botha

SWAZILAND

National Herbarium (SDNH)

Malkerns Agricultural Research Station
P.O. Box 4
Malkerns
Contact persons: Mr GM Dlamini and Mr T Dlamini

ZAMBIA

Chinzombo Herbarium

Chinzombo Research Station
National Parks and Wildlife Services
P.O. Box 18
Mfuwe
Contact person: Mr K Changwe

Forestry Department Herbarium (NDO)

Division of Forest Research
P.O. Box 22099
Kitwe
Contact person: Ms E Chupa

Mount Makulu Herbarium (MRSC)

Genetic Resources Unit
Mount Makulu Research Station
Private Bag 7
Chilanga
Contact person: Mr B Luwiika

University of Zambia Herbarium (UZL)

Department of Biological Sciences
University of Zambia
P.O. Box 32379
Lusaka
Contact person: Dr PSM Phiri

ZIMBABWE

Botanical Collection, Natural History Museum of Zimbabwe (BUL)

Natural History Museum of Zimbabwe
P.O. Box 240
Bulawayo
Contact person: Mr A Kumirai

Chase Herbarium (UMT)

Mutare Museum
P.O. Box 920
Mutare
Contact person: Mr TC Masango

Gonarezhou Chipinda Pools Herbarium

Department of National Parks and Wildlife Management
Private Bag 7003
Chiredzi
Contact person: Mr C Tafangenyasha

Grasslands Research Station Herbarium

Grasslands Research Station
Private Bag 3701
Marondera
Contact person: Mr L Lungu

Matopos Research Station Herbarium

Matopos Research Station
Private Bag K5137
Bulawayo
Contact persons: Mr C Moyo and Mr S Dube

National Herbarium (SRGH)

National Herbarium and Botanic Garden
P.O. Box CY550
Causeway
Harare
Contact person: Ms N Nobanda

Rifa Conservation Camp Herbarium

Rifa Conservation Camp
P.O. Box HG548
Highlands
Harare
Contact person: Ms L Maasdorp

University of Zimbabwe Herbarium (CAH)

Department of Biological Sciences
University of Zimbabwe
P.O. Box MP167
Mount Pleasant
Harare
Contact person: Ms C Mupamhanga

List of acronyms of the surveyed herbaria.

Acronym	Herbarium name
BLFU	Geo Potts Herbarium
BOL	Bolus Herbarium
BUL	Botanical Collection, Natural History Museum of Zimbabwe
CAH	Department of Biological Sciences Herbarium
CPF	Donald Killick Herbarium
FFS	Williams Herbarium
GAB	Botswana National Herbarium
GCPH*	Gonarezhou Chipinda Pools Herbarium
GRA	Selmar Schonland Herbarium
GRS*	Grasslands Research Station Herbarium
HER	Hermanus Herbarium
J	C.E. Moss Herbarium
JBG	Hortus Botanicus Johannesburgensis
JRAU	Herbarium of the Rand Afrikaans University
KEI	University of Transkei Herbarium
KMG	McGregor Museum Herbarium
LMA	INIA Herbarium
LMU	Eduardo Mondlane University Herbarium
LUAI	Luanda Herbarium
LYD/MPUM	Mpumalanga Regional Herbarium
MAL	National Herbarium, Malawi
MASE	Maseru Herbarium
MFUWE*	Chinzombo Herbarium
MRSC	Mt Makulu Herbarium
MRSH*	Matopos Research Station Herbarium
NBG & SAM	Compton Herbarium
NDO	Forestry Department Herbarium
NH	Natal Herbarium
NMB	Herbarium of the National Museum, Bloemfontein
NU	University of Natal-Pietermaritzburg Herbarium
PRE	National Herbarium, South Africa
PRU	H.G.W.J. Schweickerdt Herbarium
PSUB	Peter Smith Herbarium
PUC	A.P. Goossens Herbarium
RIFA*	Rifa Conservation Camp Herbarium
ROML	Herbarium, Department of Biology, National University of Lesotho
ROO	Roodeplaat Herbarium
SAAS	Saasveld Herbarium
SCHG*	Southern Cape Herbarium
SDNH	Swaziland National Herbarium
SRGH	National Herbarium, Zimbabwe
STEU	University of Stellenbosch Herbarium
UCBG	University of Botswana Herbarium
UDW*	Ward Herbarium
UMT	Chase Herbarium
UNDH*	University of Natal-Durban Herbarium
UNIN	University of the North Herbarium
UNWH*	Herbarium of the University of North-West
UZL	University of Zambia Herbarium
VENDA	Venda Herbarium
WIND	National Herbarium, Namibia

* Proposed acronym

Appendix 3.

Taxon holdings per herbarium

* Proposed acronym
** No data provided

Appendix 4.

Journals, magazines, newsletters and reports

Appendix 4. Journals, magazines, newsletters and reports

African Journal of Range and Forage Science [1993–]:

Journal of the Grassland Society of Southern Africa [1984–1992]

Annals of the Missouri Botanical Garden [1914–]

Botanical Journal of the Linnean Society [1969–]

Bothalia [1921–]

Conspectus florae angolensis [1937–]

Dinteria [1968–]

Flora de Moçambique [1969–]

Flora of southern Africa [1963–]

Flora of Tropical East Africa [1952–]

Flora of West Tropical Africa [1954–]

Flora zambesiaca [1960–]

Flowering Plants of Africa [1994–]:

The Flowering Plants of Africa and Die Blomplante van Afrika [1948–1993]

The Flowering Plants of Africa [1945–1947]

The Flowering Plants of South Africa [1921–1944]

Journal of Ecology [1913–]

Journal of Range Management [1948–]

Kew Bulletin [1946–]:

Bulletin of Miscellaneous Information [1887–1941]

Kew Scientist [1992–]

Kirkia [1960–]

Memoirs of the Botanical Survey of South Africa [1975–1994]:

Botanical Survey Memoir [1919–1972]

Mycologia [1909–]

Nature [1869–]

Nordic Journal of Botany [1981–]

Oecologia [1968–]

Planta medica [1953–]

Plant Talk [1995–]

SABONET News [1996–]

SABONET Report Series [1997–]

South African Journal of Botany [1985–]:

Journal of South African Botany [1935–1984]

Strelitzia [1994–]

Taxon [1951–]

Appendix 5.

Equipment costs per herbarium

Herbarium name	Acronym	Cost (US\$)
Angola		
Luanda Herbarium	LUAI	18 100
Botswana		
National Herbarium	GAB	4 450
Peter Smith Herbarium	PSUB	18 500
University of Botswana Herbarium	UCBG	18 495
Lesotho		
Herbarium, Department of Biology, National University of Lesotho	ROML	37 210
Maseru Herbarium	MASE	13 550
Malawi		
National Herbarium	MAL	56 680
Mozambique		
Eduardo Mondlane University Herbarium	LMU	24 550
INIA Herbarium	LMA	36 215
Namibia		
National Herbarium of Namibia	WIND	15 700
South Africa		
A.P. Goossens Herbarium	PUC	4 880
Bolus Herbarium	BOL	4 000
C.E. Moss Herbarium	J	34 700
Compton Herbarium	NBG & SAM	37 900
Donald Killick Herbarium	CPF	5 150
Geo Potts Herbarium	BLFU	3 250
Goegap Nature Reserve Herbarium		
H.G.W.J. Schweickerdt Herbarium	PRU	28 230
Herbarium of the National Museum, Bloemfontein	NMB	16 700
Herbarium of the Rand Afrikaans University	JRAU	11 550
Herbarium of the University of North-West	UNWH*	10 405
Hermanus Herbarium	HER	480
Hortus Botanicus Johannesburgensis	JBG	2 100
McGregor Museum Herbarium	KMG	7 750
Mpumalanga Regional Herbarium	LYD/MPUM	
Natal Herbarium	NH	6 400
National Herbarium	PRE	146 060
Roodeplaat Herbarium	ROO	4 950
Saasveld Herbarium	SAAS	7 500
Selmar Schonland Herbarium	GRA	35 030
Southern Cape Herbarium	SCHG*	25 300
Towoomba-ADC Herbarium		6 250
Tsitsikamma National Park Herbarium		740
University of Natal-Durban Herbarium	UNDH*	2 600
University of Natal-Pietermaritzburg Herbarium	NU	7 750
University of Stellenbosch Herbarium	STEU	4 850
University of the North Herbarium	UNIN	12 480
University of Transkei Herbarium	KEI	3 400
Venda Herbarium	VENDA	17 200

Herbarium name	Acronym	Cost (US\$)*
Ward Herbarium	UDW*	26 200
Williams Herbarium	FFS	116 750
Worcester Field Reserve Herbarium		
Swaziland		
National Herbarium	SDNH	5 900
Zambia		
Chinzombo Herbarium	MFUWE*	13 300
Herbarium, Forestry Department	NDO	17 200
Mt Makulu Herbarium	MRSC	15 310
University of Zambia Herbarium	UZL	17 350
Zimbabwe		
Botanical Collection, Natural History Museum of Zimbabwe	BUL	10 700
Chase Herbarium	UMT	10 500
Gonarezhou Chipinda Pools Herbarium	GCPH*	14 070
Grasslands Research Station Herbarium	GRS*	2 850
Matopos Research Station Herbarium	MRSH*	13 390
National Herbarium	SRGH	41 280
University of Zimbabwe Herbarium	CAH	18 500
Rifa Conservation Camp Herbarium	RIFA*	5 220

* Proposed acronym

Appendix 6.

Staffing information per herbarium

Appendix 7.

Computerisation of collections per herbarium

* Proposed acronym
** No data provided