

**A SYNFLORISTIC COMPARISON OF ORIBI GORGE AND
UMTAMVUNA NATURE RESERVES**

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DECLARATION

I, Edna Beatrice Meter declare that the work contained in this thesis is entirely my own work, unless specifically acknowledged, referenced or quoted in the text. These studies have not been submitted in any form to another University.

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ABSTRACT

Climatic oscillation during the Quaternary resulted in fragmentation of once more continuous ancient floras and a series of invasions of different floras into the Pondoland Centre in response to climatic change, with some elements invading more than once. This implies both a temporally complex and a floristically complex origin for the extant flora of the Centre. Data derived from analysis of the melange of extant floristic elements in the Pondoland Centre is presented in support of this hypothesis. A synfloristic comparison of Oribi Gorge (OGNR) and Umtamvuna Nature Reserves (UNR) is the basis for this study.

A comparison of the species lists generated for OGNR and UNR reveals that 24% of the 1514 angiosperm species are shared. The familial composition of the reserves is similar, with eight of the ten most diverse families contributing a similar proportion of species to the respective floras, with the exception of Acanthaceae. The ten most diverse families comprise a comparatively small proportion of the respective floras; this is indicative of high diversity over long geological periods, i.e. of refugia. Analysis at the generic level revealed similar consistency between the two gorge floras.

Approximately 4% of the UNR species and 2.3% of OGNR species are Pondoland Centre endemics. Approximately 40% of the endemic species are shared by the gorges. Data reveals that both palaeoendemic (predominantly woody, forest taxa) and neoendemic (predominantly herbaceous or suffrutescent, grassland taxa) species occur. The Pondoland Centre is thus a refugium for species trapped on the Msikaba Group sandstones as a result of climatic oscillation during the Quaternary, and a centre of neoendemism.

OGNR and UNR floras include Cape, Afromontane and tropical elements (11.3%, 2.8% and 19.1% respectively for OGNR and 16%, 3.4% and 15.3% respectively for UNR). Seventy – two percent of Afromontane species are shared, indicating a relatively recent invasion(s) and / or the relative proximity of the gorges to the Afromontane flora. The lower species overlap in the Cape element (39.2%) of the two gorges implies that the invasion of the element is ancient, with subsequent extinction of many of the taxa from OGNR in response to climatic change. It is also possible that this invasion was initially less successful; fewer species found refuge in OGNR. The tropical element comprises the largest proportion of the flora in both gorges and many (ca. 50%) of the species are shared. The degree of species overlap indicates that the invasive flora was either initially more similar or that

it is less prone to extinction. The level of overlap could also suggest that the invasion was more recent than that of the Cape taxa. The tropical element is larger in OGNR and the Cape element is larger in UNR. This is partly due to the gorges' respective proximities to the tropical and Cape floras. This trend is echoed in the endemic data.

The conservation status of the endemics and of the Pondoland vegetation types is established and recommendations for further research are made. The data support the establishment of a larger UNR, the maintenance of both Umtamvuna and Oribi Gorge as formal nature reserves and the establishment of a new reserve (or reserves) within the Pondoland Centre.

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CHAPTER 1: INTRODUCTION

1.1. NATURE, SCOPE AND OBJECTIVES

What is floristics? Jones and Luchsinger (1987) define floristics as an investigation of the flora of a given area. In this study floristics is conceived as the branch of botany concerned with identifying and listing all the plant species present in a particular area. The checklist (or species list) produced is the floristic composition of the region (Tootill & Blackmoore 1984); techniques employed to generate a checklist are primarily field and herbarium research. The focus of this study is a synfloristic comparison of Oribi Gorge and Umtamvuna Nature Reserves (OGNR and UNR respectively), or an investigation into the degree of similarity between the species lists that are developed for each of the areas.

Species lists represent the distribution of species in space and in time and are thus the raw material of biogeography (Myers & Giller 1988). Biogeography is the analysis of the distribution of plants and animals (Jones and Luchsinger 1987). It has been argued that this definition is synonymous with that of ecology. However, that different species, often of widely disparate families, occupy similar ecological niches on different continents or in different geographical locations implies that there is a historical component to current species distributions. It is the responsibility of the biogeographer to elucidate this historical element. Thus, biogeographers are concerned with both temporal and spatial factors affecting distribution, as well as with the evolutionary background of species (Ball 1975; Myers & Giller 1988). Biogeography aims to answer questions of how species came to be where they are today.

Because of the paucity of data on species distribution at global, national and regional levels¹, current biogeographic hypotheses are limited. Poor data resources

¹ A public meeting to discuss the White Paper on Biodiversity was held at the University of Natal, Pietermaritzburg in early 1996. At this meeting the Department of Environment expressed concern with the lack of data resources on the distribution and composition of South Africa's flora. Concern as to the consequences of the existing lack of data on floristic biodiversity was similarly expressed at the 1996 South African Association of Botanists (SAAB) Conference in Stellenbosch. Contributors to the XXIInd Annual Convention of the SAAB, "Plants for People", held at the University of Stellenbosch from the 15 - 20 January 1996: Arnold, T.H.; Balkwill, K.; Balkwill, M.J.; Bond, W.J.; Boucher, C.; Bredenkamp, G.J;

similarly confound attempts to conserve floral diversity. This study contributes to a more comprehensive national biodiversity database using floristic techniques, facilitating the wise and efficient conservation of the nation's rich genetic resources and the generation of biogeographic hypotheses re the origin of the flora in the Pondoland Centre.

Data on current species spatial distribution is obtained through direct observation, but as past vegetation patterns are not directly observable, understanding of the temporal aspect of distribution is complex. Fortunately, current patterns of distribution may be used to infer past vegetation history. Implicit in this hypothesis is that distribution patterns are non-random and an assumption of the existence of some general causal processes. Familiarity with the mechanics of these processes can provide a framework for reconstructing past patterns of distribution (Myers & Giller 1988).

One method of inferring past vegetation history is to investigate the relatedness of the flora of geographical areas--synfloristics. Hilliard & Burt (1987) provide a means to compare the flora of the two gorges with each other and with other floras by establishing the number of species per genus and per family. Secondly, the genera are assigned to a class dependent on the centre of species diversity. An analysis of the number of genera belonging to each class provides phytogeographical information and guidelines for areas that need closer investigation. Disjunctions in the distribution of the taxa are identified. Many of the plant taxa present on the Msikaba Formation Sandstone outcrop along the east coast of Natal (Fig. 1.1.), present puzzling biogeographical anomalies with disjunctions of 600 km or more. Some of these disjunct taxa are investigated within the context of the OGNR and UNR flora (Chapters 3, 4, 5 and 6).

Spatial distribution data derived from floristic inventories is used to identify and describe areas of species richness, and / or nested sets of endemities² at various scales (Myers & Giller 1988). In excess of 20 % of the c. 7 000 species comprising the Maputaland-Pondoland flora are endemic, with 2 endemic families and 58 endemic genera occurring in this region, necessitating a change in status for the region from the Tongaland-Pondoland Regional Mosaic (White 1983) to the Pondoland Centre within

Cron, G.V.; Cowling, R.M.; Edwards, T.J.; Hilton-Taylor, H.C.; Hutchings, A.; Linder, H.P.; Pool, R.; Potgieter, C.J.; Van Wyk A.E.; Van Wyk, B.E.; Vos, W.T. among others.

² An endemic taxon may be defined as one which is confined to a particular geographical area (Richards 1986; Jones & Luchsinger 1987; Major 1988; Myers & Giller 1988; Meffe & Carroll 1994) or to a particular substrate (edaphic endemic), or even to a particular habitat (Jones & Luchsinger 1987).

the Maputaland-Pondoland Region (Van Wyk 1989a, 1989b, 1990b). The Centre is defined by Van Wyk (WWF & IUCN 1994) as an edaphic centre of endemism³ of c. 1880 km², extending along the east coast of Natal, South Africa from the Mzimkulu River in southern Natal to the Egossa Fault (Ntsubane Region) in Pondoland. The Centre is restricted to the Msikaba Formation outcrop and includes the smaller outcrops of sandstone at Port St. John's (Mount Sullivan and Mount Thesiger) and Uvongo. In other words, the Pondoland Centre is identified as an area of both high species diversity and endemism.

Comparing the flora of the two gorges (OGNR and UNR) that evolved in isolation as part of the Pondoland Centre's diverse and highly endemic flora, provides an opportunity to clarify some of the aforementioned biogeographical questions.

The first of these questions concerns the origin and the age of the flora. Four distinct floral elements⁴ constitute the Centre's flora. The first three of these elements are floristically related to Cape, Afromontane and Tropical (Van Wyk 1989b), discussed in detail in chapters four, five and six. The fourth element comprises endemic taxa of the Centre. Endemic taxa provide a simpler and potentially more accurate means of identifying biogeographic patterns than do cosmopolitan species (Myers & Giller 1988). The study therefore concentrates on the diversity and degree of endemism in each of the gorges (Chapter 3).

Endemic taxa fall into two broad categories. A taxon may be palaeoendemic⁵, in which case its limited distribution is considered a relict of a once more widespread distribution; or neoendemic i.e. a taxon arising as a result of recent *in situ* speciation (Stebbins & Major 1965; Major 1988; Richards 1986; Myers & Giller 1988). An objective of this study is to identify, list and to assign each of the endemics to one of these categories.

Several of the woody endemics in the extant flora appear to be relictual or remnants of ancient floras (i.e. palaeoendemics), leading to the suggestion that the

³ Areas or centres of endemism are defined as geographic regions or habitats with high concentrations of endemics.

⁴ Here the concept of floristic or floral element is used in its broader sense and includes aspects of history and origin.

⁵ See Chapter 3 for a more detailed definition of these terms, as well as a brief discussion on implications of palaeo- versus neoendemism.

Pondoland Centre acted as a Pleistocene refugium (Wild & Bradshaw 1977; Moll & White 1978; Brooks 1987; Van Wyk 1989a, 1989b). The refuge theory postulates that during major adverse climatic phases of the Pleistocene, populations of plants and animals were divided into subpopulations in refugia, thus permitting allopatric speciation. Reunited by climatic amelioration, the new species remained genetically isolated. Repetition of this process due to climatic oscillation (Martin 1968; Schalke 1973; Van Zinderen Bakker 1974, 1978) led to a species 'pump' and to the accumulation of diversity (Flenley 1993). As a corollary to the theory, present day areas of high diversity are thought to indicate the location of Pleistocene refugia (Cracraft 1972). Data about the nature of the endemics are used to examine the refuge theory for sandstone vegetation (Chapter 3). Other endemics exhibit patterns of neoendemism.

Endemic type has implications for conservation as well as for elucidating the age of the habitats in which they are found, thus assisting biogeographers to establish the geological time frame for past vegetation shifts (Myers & Giller 1988).

Our knowledge of the distinct flora associated with sandstone derived soils of Natal is incomplete. Proper inventories of this flora may prevent the extinction of edaphic endemics, some of which still await discovery and description (Van Wyk 1989b). The data presented here provides a preliminary inventory for the Msikaba Group sandstone flora. These preliminary inventories are used to examine the interrelatedness of the floras and the geographical areas under investigation.

The study area incorporates sections of Natal's coastal grasslands. Recent studies have shown that these grasslands are among the most threatened vegetation types in the country, illustrating the importance of conserving the larger remnants of this habitat type (Branch & Shackleton 1988; Le Roux 1995). The adoption of appropriate conservation measures requires detailed floristic knowledge. It is hoped that this study will strengthen the case for conservation of these unique and species-rich areas and provide baseline data and suggestions for further autecological research into the flora of the Pondoland Centre (Chapter 7).

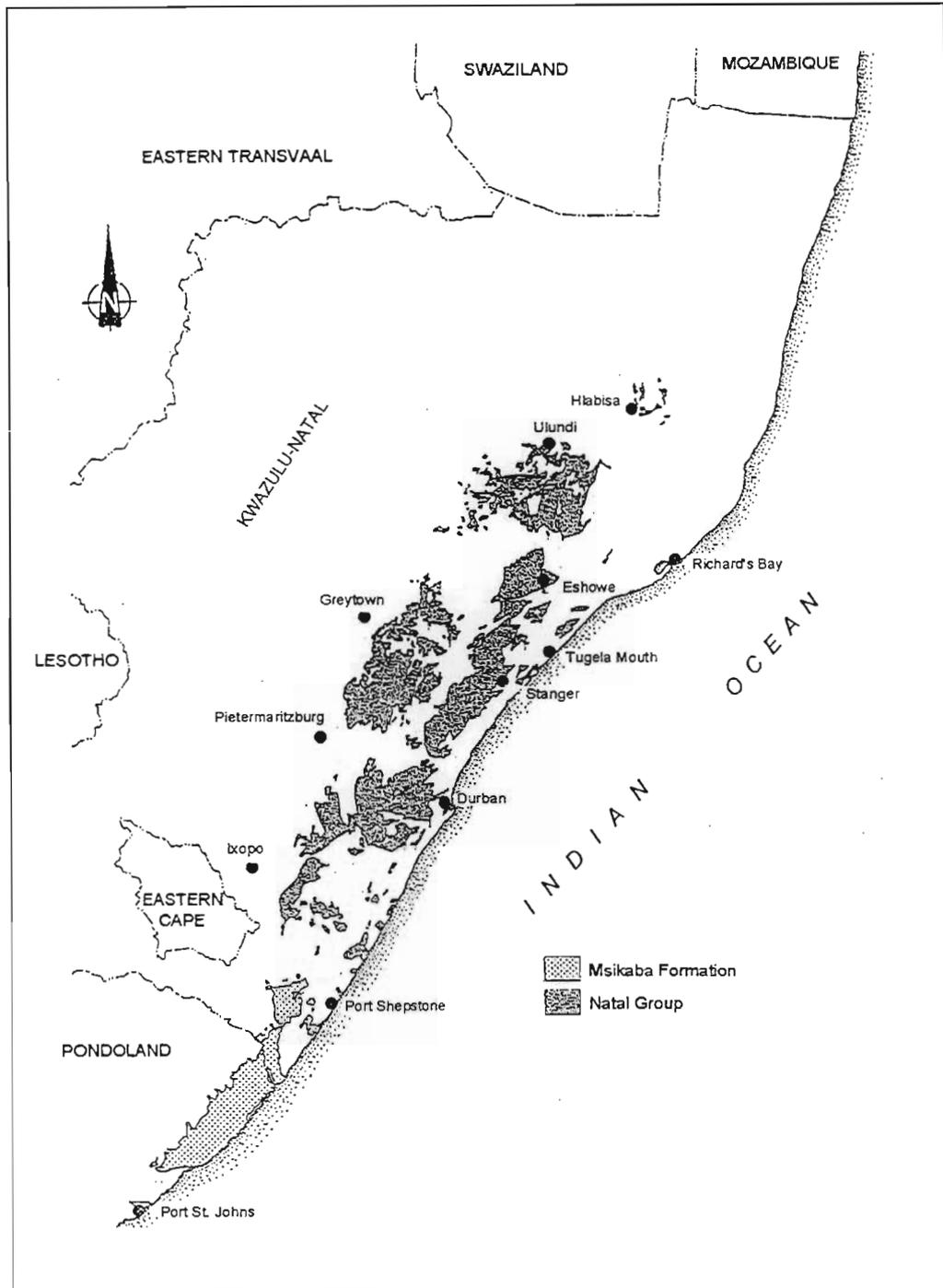


Fig. 1.1. Distribution of surface outcrops of Natal Group sandstone and Msikaba Group Formation, showing the extent of the Pondoland Centre in relation to Cape Supergroup outcrop (adapted from SACS 1980; Van Wyk 1989a).

1.2. THEORY

1.2.1. Hypothesis generation

An intellectual framework provides the basis for the formulation of biogeographical hypotheses (Rosen 1988)⁶. Traditionally one adopted an inductive or a deductive approach. Gregory's (1981) argument that deduction can only operate within the framework of induction because perceptions and thus patterns are inductive, probabilistic and ultimately subjective invalidates this polarisation. The inductionist approach recognises the need for hypothetico-deduction correlated with explicit and rigorous definitions of the assumptions and methods used in scientific investigation. Biogeographical models and hypotheses have often lacked the latter. Rosen (1988) calls for a new, more explicit and integrated approach for modeling biogeographical systems. An attempt is made in this study to integrate some of the previously developed biogeographical models.

1.2.2. The models

Biogeography has a chequered past that is fraught with contention and antagonism. The main contentions within the discipline may be divided into three groups. The first is a conceptual polarisation which pits proponents of "ecological" biogeography against proponents of "historical" biogeography. The second is an equally destructive polarisation into proponents of vicariance versus proponents of long distance dispersal as the underlying cause for plant distribution patterns. These opposing viewpoints are evident in and provide the fuel for the methodological contentions affiliated with the use of the various models.

1.2.2.1. Ecological versus historical biogeography

Until recently there has been a false dichotomy between ecological and historical biogeographic approaches. Each has been proclaimed a distinct discipline, with different methodologies used to answer different questions. Under this "dichotomy" ecological biogeography is concerned with problems of species diversity within the context of the principles underpinning coexistence in communities. Therefore it is endowed with being scientifically testable whereas historical biogeography is relegated

⁶ Rosen (1988) provides an extensive and fairly comprehensive introduction to this concept.

to being narrative. The initial assumption of ecological biogeographers is that distribution patterns can be explained by contemporary processes at a small temporal and spatial scale. The present distribution of species is however the product of a pattern extending millions of years into the past. It is therefore unlikely that current distributions can be solely explained by study of present day ecological processes (Ball 1975; Cowling 1986; Myers & Giller 1988; Rosen 1988). Historical biogeography is concerned with a larger temporal and spatial scale, invoking vicariance and dispersal as explanations for species distribution. Historical biogeography is thus concerned with range description, speciation, endemism and disjunctions (Bond 1989).

Rosen (1988) defines historical patterns as those that demonstrate or appear to demonstrate long-term changes in species distributional patterns as well as those that relate such changes to long-term causal mechanisms. Short-term processes are then those which demonstrate short-term distributional effectors. The former are primarily evolutionary, but include geological and ecological factors, whereas the latter are principally ecological, but include geological factors. In other words there is a distinct overlap between current definitions of ecological and historical biogeography.

Myers and Giller (1988) recognise this overlap and attempt to heal the artificial dichotomy by recognising the relationship between the definition of pattern, the scale at which a pattern is observed and the method(s) of analysis with pattern dependent on the scale of investigation. Pattern is therefore variously defined and cognisance is given to the scale at which the pattern is observed and investigated in this study. Thus, an attempt is made to isolate and identify antecedent and contemporaneous influences on distribution in this study, following Cracraft (1985) and Davis (1986), two researchers who draw upon both historical and ecological factors to explain species distribution.

1.2.2.2. Vicariance versus dispersal

The vicariance versus dispersal debate has a long and acrimonious history in the context of historical biogeography. Southern African phytogeographers have been aware of the difference in viewpoint held by the proponents of each school since the 1960's (Poynton 1983). Neither the dispersalist nor the vicariant approach is completely new or obsolete (Thorne 1996).

Croizat (1968) coined the term vicariism as an explanation for the distribution of species. Following an original radiation of species during the Permo-Jurassic, various vicariant events such as geographic fragmentation of landmasses or changes in sea level occurred causing population fragmentation, isolation and speciation without dispersal from the original centre of the taxon. In other words, vicariant taxa are not the

result of active migration to new centres, but rather the result of fragmentation by geographic and/or climatic changes.

This is in contrast to the theory of dispersal or active migration, which is based on the assumption that taxa come into being in a centre of origin⁷, from which migration occurs by some means of dispersal (Poynton 1983).

In this study the debate is only applicable to species captured within isolated patches, namely forest species limited by the occurrence of fire and rainfall, and edaphic endemics captured on islands of sandstone derived soils. The grassland species predominantly comprise the 'sea' around these islands and thus one would expect their physical restriction to be less. Both vicariance and long distance dispersal are invoked to explain the distribution patterns observed in the data presented in this study.

1.2.2.3. The models defined

The major biogeographic models incorporate dispersal and vicariance as explanations for current taxonomic distribution patterns, to varying degrees (Stott 1994). Darwin's Migration Model necessitates each taxon emerging at a centre of origin, from which dispersal takes place (Poynton 1983). Known species occurrences are mapped as ranges or limits to distribution. There are no agreed principles or techniques of analysis. However centres of origin are usually suggested, as are migration routes. Methods of migration are discussed. Chance and extinction of a species from part of its previous range are evoked as explanations for current distributions. Migration is assumed to be the main process generating present distribution patterns and fossil evidence is often used.

No particular evolutionary process is necessarily implied, although origin of each taxon at one point in space and time is generally assumed, often at about the time of the earliest fossils of the taxon. Ecology is seen as a major factor in determining distributions and no special use of taxonomy is made in the analysis. Once centres of origin have been identified, the species occurring in them are usually assumed to be primitive. The model can explain most distributions because it invokes chance migration to explain anomalous distributions. This makes prediction difficult, making the model difficult to falsify and limiting its scientific value (Stott 1994).

⁷ The centre of origin of a taxon, for example a family, was originally assumed to be synonymous with the centre of genetic diversity of the family, in other words, synonymous with that geographic region containing a high concentration of related taxa (species) of the same family (Jones & Luchsinger 1987.)

The second model is Nelson's Vicariance model or the Cladistic model. Using only endemic taxa, distribution is mapped as presence/absence in area units (Nelson & Platnick 1981; Humphreys & Parenti 1986; Myers & Giller 1988). These units are determined at the start of the analysis and are ideally 'centres of endemism', although there is no formal methodology for determining them, and standard geographic areas are often used. The data is analysed by the formation of a taxonomic cladogram, formed by transformed cladistics, for each group (for example, genus). The historical relationship of geographic areas is determined largely on the basis of shared endemic taxa or sister taxa (Myers & Giller 1988). It is assumed that an ancestral species occurred over the whole area and that parts were subsequently isolated by, for example, plate tectonics, orogeny or geomorphological processes. Random dispersal is seen as one of the causes of incongruence as opposed to the sole reason. As fossil evidence is not used in transformed cladistics for philosophical and methodological reasons, it is not used in vicariance biogeography (Myers & Giller 1988; Stott 1994). Allopatric speciation is assumed and synchrony with geological separations may imply very early origins for groups. Ecology has no specific role in this model and no taxonomic conclusions are drawn from the taxon's distribution because of argument circularity. The incongruities between the derivative area cladograms are attributed to random migration, extinction, failure of isolates to speciate or to the selection of units of composite geological origin. The consensus may be displayed by various methods, or the incongruencies resolved by parsimonious criteria.

The model can predict the taxonomy of a group if the distribution is known and *vice versa*, but the incongruencies mentioned above reduce the predictive ability of the model in practice.

Vicariance biogeographers consider the vicariance aspect of the third model, Croizat's Panbiogeographic Model, to be of value, but believe that it should be combined with transformed cladistic taxonomy and parsimony methodology. One of the main assumptions of this model is that centres of evolution and massings followed an original Permo-Jurassic radiation. The resultant Triassic and Jurassic centres were fragmented by geological events and resulted in related taxa occurring on different continents without actively dispersing from their original centre (Croizat 1968).

In this Panbiogeographical Model, individual distribution records are plotted, then joined to produce 'tracks'. These are normally drawn subjectively although numerical methods have been proposed. The main massing is emphasized, rather than the limits of distribution. Major tracks are those which are seen in many species, baselines are the ocean bases of many major tracks, nodes are track junctions and centres of endemism

and gates are major nodes. Tracks and nodes may represent the main massing for some species, but the limits or separations for others.

This method of analysis avoids subjective assumptions on methods of dispersal, emphasizing geological history instead. Although proponents of the model display an interest in fossil evidence, it is rarely used in formal panbiogeographic analyses, and although no particularly evolutionary process is assumed, results suggest that orthogenesis and polyphyletic processes have been important processes. Ecology is determined by biogeography and geology in this model and the ecology of the species is assumed to change with habitat changes. Some taxonomic conclusions can be drawn, for example, geographical vicariants can be checked as possible sister groups. Model proponents argue that it explains many distributions (Croizat, Nelson & Rosen 1974). Prediction is possible but is less decisive than that produced by the Nelson Vicariance Model, as the analysis itself is less decisive. Much of the criticism leveled at this model revolves around the fact that current taxonomy of a group is used, as well as the implied evolutionary or dispersal processes (Stott 1994).

A synthetic approach is adopted combining principles of each of the above models and no model is used exclusively in this study (Thorne 1996). The explanations and analyses of current biogeographical models presented thus establish a framework for the study (Stott 1994).

1.2.2.4. Current paradigms

The current paradigm is perhaps more realistic and less simplistic. Thorne (1996) acknowledges that both long-distance dispersal and vicariance play a role in creating the current and past distribution of taxa. It is unlikely that a single vicariant event is the sole explanation for all similar distribution patterns (Thorne 1996).

Implicit in a synthesis of the old models is a new set of guiding principles. Firstly, biogeographic inferences and conclusions must be based upon the study of both the known past and present geographic distribution of all biotic groups, where feasible. The study provides baseline data for the floral component of the Pondoland Centre. This data will enable future researchers to honour this principle, as there is a paucity of information for the Centre.

Secondly only carefully revised groups should be used in ascertaining biogeographic patterns, tracks, or regions, with distribution maps being compiled only from reliable data. This study therefore focuses on well defined and recently researched taxa, (most specifically the endemics). The checklists validate the presence of some previously unrecorded species from the Centre. It is conceded that many of the genera

comprising the study database have not been recently reviewed. These have been identified and avoided in the analysis wherever possible.

Thorne's third principle stresses that field studies cannot be replaced by museum, herbarium, laboratory and library studies, an idea that is gaining increasing acceptance and support within the contemporary taxonomic and biogeographic fraternity. Field study makes a substantive contribution to data captured during research, complementing that derived from herbaria and libraries.

Biogeographical hypotheses demand a thorough knowledge of the fossil record, past climates and plate tectonics, as current taxonomic distributions are not in themselves necessarily indicative of past distributions. The current, often highly restricted distribution of the Pondoland endemics is a case in point. Data on past climatic conditions and past vegetation movements is introduced and developed in the text. Issues relevant to present day endemic distributions are discussed in detail in chapter three.

Biotic groups are differentially vagile. Extrapolation based on knowledge of a single group is thus inappropriate (Thorne 1996). Available information regarding the varied dispersal potential of the species under study was collected where available and considered in the final analysis.

Many biotic groups of varying taxonomic status have become subcosmopolitan in their range, propelled by a number of factors. Such factors include continental displacement, changing climates, oceanic currents and changing sea-levels. Major disjunctions on or between continents are usually due to normal short-distance dispersal with subsequent major disruption in range caused by catastrophic geological or climatic events. In other words coincidence in biogeographic patterns, tracks or range disjunctions does not guarantee similar dispersal histories. Taxa with similar ranges or disjunction patterns may have arrived in the same place, at different times, from separate sources, by different vectors and via different routes (Thorne 1996). Thus detailed studies of individual taxa in conjunction with a more synthetic approach are needed. This study focusses on individual taxa to establish plausible reasons for the observed patterns and then attempts a synthesis of these reasons into a feasible explanation for the overall pattern.

Vicariance explanations necessitate work within the context of, and with reference to, a time frame (Thorne 1996). A summary of the southern African palaeoenvironment (Section 1.2.3.) contextualises the possible origins of the Pondoland flora and provides a time frame of their development.

The principle of phylogeographic plausibility⁸ states that a phylogenetically unplaced taxon is more likely to be closely related to a sympatric taxon, or taxa, or to one in an adjoining area, rather than those on distant continents. The assumption that evolutionary rates are not constant for different organisms, allows biogeographers to infer that the degree of differentiation between vicariant groups of two disjunct areas reflects the amount of evolution that has occurred and the amount of time it has taken, as the sister groups originate from a common ancestor (Meadows & Linder 1989). This suggests that the lower the rank of the taxon under consideration, the more instructive the disjunctive distribution may be. As higher taxa have had more time to evolve and therefore more time to disperse, the factors causing the disjunctions of the higher taxon may no longer be in operation, or may be obscured by subsequent significant vicariant or dispersal events (Meadows & Linder 1989; Thorne 1996)⁹. The significance of this statement becomes apparent when the data are analysed for *Plectranthus* and *Streptocarpus* species.

Finally, getting enmeshed in arguments about procedures, one runs the risk of losing sight of the aims and the conclusions of biogeography in explaining patterns and disjunctions (Thorne 1996). Myers and Giller (1988) echo this sentiment, stating that merely redefining existing schisms or defining new ones will not clarify issues in biogeography. Instead there is a need for an amalgamation of existing methods and models into an integrated approach within which all possible biogeographical processes are assessed in a balanced and critical way. This study attempts such an approach but is limited by the paucity of primary or baseline data.

A number of topics have been introduced and the most relevant aspects discussed in brief in order to contextualise the research. However a full discussion on many of these topics is beyond the scope of the thesis. These topics are the contentions surrounding the definitions of biogeography, surrounding scientific hypothesis generation, biogeographical models and their accuracy, those surrounding the age of forest versus grasslands and the questions of measurement of biodiversity.

⁸ Parsimony in terms of cladistic biogeography.

⁹ Thorne (1996) recognises that evolution does not necessarily follow this principle, nor is it necessarily the way in which distribution patterns and disjunctions have taken place in space and time.

1.2.3. A summary of the southern African palaeoenvironment¹⁰

A basic history of the vegetation of southern Africa is presented to contextualise the present Pondoland Centre flora (the geological time scale referenced in the text is found in Fig. 1.2.). It was only in the Devonian (400-360 ma) that vascular plants colonized landmasses, forming a fairly homogeneous dwarf vegetation initially dominated by the psilophytes. Lycopods, ferns and progymnosperms followed at the end of the era. Southern Africa fell entirely within the Gondwana plant realm during the Devonian with lycopods¹¹ dominating the flora (Anderson & Anderson 1983).

Certain phases of the break-up of Gondwanaland began in the Jurassic (Partridge & Maude 1987), but this date of initial dispersal is hardly relevant for biogeography as Africa was still connected to South America in the early Cretaceous (Cracraft 1972; Partridge & Maude 1987). Data derived from geomorphology, seafloor spreading and stratigraphic palaeontology indicate that the final separation of Africa and South America probably took place in the upper part of the lower Turonian, that is, early in the late Cretaceous (Partridge & Maude 1987).

During the Carboniferous (360-300 ma), the southern third of Gondwanaland, including Africa south of latitude 60°S, was covered in ice and marked climatic belts existed. No sediments from this age have been found in sub-Saharan Africa (Anderson & Anderson 1983). During the Permian (300-245 ma) Gondwana had become part of the supercontinent Pangaea, but four distinct plant realms were evident: Gondwana, Euramerica, Cathaysia and Angara (Partridge & Maude 1987). Initially the lycopods were dominant both within the Gondwanaland realm and throughout the supercontinent, but the Sphenophyta, specifically *Glossopteris*, superceded the lycopods in both diversity and abundance in the Gondwana realm by the end of the age. The genus was endemic to the realm (Anderson & Anderson 1983).

Gymnosperms replaced the pteridophytes during the Triassic (245-200 ma) with ginkgos, conifers, cycads, bennettitaleans and new seed fern orders diversifying in the warmer, drier climates. *Dicroidium*, an endemic seed fern of the realm, replaced *Glossopteris* in abundance and diversity during this age.

¹⁰ Knoll (1983) presents a comprehensive text on Precambrian biological evolution.

¹¹ Lycopods are small, simple, poorly differentiated, homosporous, organisms that exhibited dichotomous branching, but lacked true roots and leaves (Anderson & Anderson 1983).

Fig. 1.2. Summary of the geological time-scale, showing the divisions of the Quaternary into stages or climatic episodes (glacials and interglacials; Lowe & Walker 1984).

The earliest signs of the fragmentation of Pangaea became evident in the Jurassic (200-140 ma) when lava flows were initiated by crustal fissuring, and the Gondwana Realm was covered in, and dominated by coniferous forests. This continental drift became increasingly evident throughout the Lower Cretaceous (140-100 ma) and in fact is still in progress (Partridge & Maude 1987), but the dominant gymnosperms were replaced midway through this age by the angiosperms (Anderson & Anderson 1983).

Axelrod and Raven (1978), and Deacon (1983) argue that forest covered large areas of southern Africa during the early Tertiary (6.5 ma), but the forest belt subsequently narrowed and eventually became fragmented due to environmental change and increasing aridity. Later in the Tertiary, during the Miocene (24.6 ma), the climate became progressively drier, restricting forest distribution while new vegetation forms, such as thorn scrub and grassland developed and spread (Knight, Crowe & Siegfried 1982). In the final Tertiary epoch, the Pliocene (5.1 ma), the climate became cooler and more diverse, and aridity increased resulting in the formation of deserts. There was much uplift and mountain building, with widespread glaciation in the northern hemisphere. The uplift of Panama joined North and South America during this time (Lowe & Walker 1984; Raven, Evert & Eichorn 1986).

The Pleistocene is the last epoch of the Quaternary before present and it was during this epoch that the uplift of many of the present-day mountain ranges occurred (Lowe & Walker 1984; Raven *et al.* 1986). During the last two million years (late Quaternary) climatic cyclicity in the form of approximately twenty glacial and interglacial cycles, each lasting about 100 000 years, has affected the extent of different vegetation types in Africa (Tyson 1986). Forests are especially likely to have expanded and contracted in extent during these climatic changes creating refugia (Moreau 1966; Van Zinderen Bakker 1978). Many of the present-day disjunctions in forest taxa distributions have been ascribed to at least the last glacial maximum (18 000 years ago), when the climate was drier and cooler than at present. The consequent physiological drought and resultant death of individuals in unprotected parts of the previous range, reduced the present day distribution of the taxa. The range of Afrotropical forest in the Natal midlands and highlands was particularly affected and the cool desiccating winds draining off the escarpment may have restricted forest taxa further (Lawes 1989).

During this shift from a wet regime to a drier one, protected gorges on the windward side of mountains acted as refugia (Knight, Crowe & Siegfried 1982; Flenley 1993). It is only in these protected areas that sufficient moisture could be retained for the support of past, "super-saturated", climax communities of trees. The same argument

may be applied to the coastal area along the eastern seaboard of Africa where only the distal sheltered coastal scarp forests survived as small remnants (Lawes 1989). These areas currently display high species richness.

Deglaciation proceeded rapidly from 16 000 to 13 000 years ago, plateauing until 10 000 years ago (Ruddman & Duplessy 1985). As the hypothermal receded, southern Natal would have experienced orographic rainfall due to the proximity of the escarpment to the coast. This implies that some of the well sheltered mistbelt forest would have survived, together with the coastal scarp forests (Lawes 1989). Thus many forest taxa, both faunal and floral, were restricted to refugia in the eastern Cape, coastal scarp forests of Natal and the south eastern Transvaal during the last hypothermal. This pattern is evidenced in the present day Pondoland flora, both within the endemic element (Chapter 3) and comprising the Afromontane element (Chapter 5). With the return of warmer interglacial conditions, between 6 500 and 4 000 years ago forest spread was again favoured with the radiation of tropical elements down the eastern coastal plain approximately 6 000 years ago. This may explain the presence of some of the tropical floral taxa present in the Pondoland Centre today (Chapter 6).

1.3. STUDY AREA

The study focuses on the Natal/Pondoland coastal region which extends along the eastern seaboard of Africa from south-eastern Somalia to Port Elizabeth (South Africa) (Fig. 1.3.). This belt is divided into a mosaic of various vegetation types due to abrupt small-scale changes in climate and soil. These range from edaphic grasslands to tall forest (Goldblatt 1978; Moll & White 1978). On a finer scale the Maputaland-Pondoland Region includes Acocks' (1988) veld type numbers 1, 2, 3, 5, 6, 10, 23 & 24, and was previously referred to as the Tongaland-Pondoland Regional Mosaic (Werger 1978). This study is concerned mainly with the forests and grasslands present in coastal belt that approximately correspond to Acocks' (1988) Pondoland Coastal Plateau Sourveld, the smallest of his 70 veld types.

According to White's (1983; Moll & White 1978) classification, the study area falls into the Tongaland-Pondoland Coastal Mosaic. Five forest types have been identified within this mosaic. Four of these types, namely sand forest, swamp forest, dune forest and fringing forest, are all associated with specific habitats. The fifth type is undifferentiated lowland forest and is more widespread. Cooper (1985) accepted these forest classifications, but divided 'Undifferentiated Lowland Forest' into Coast Lowlands Forest and Coast Scarp Forest, divisions maintained in this study.

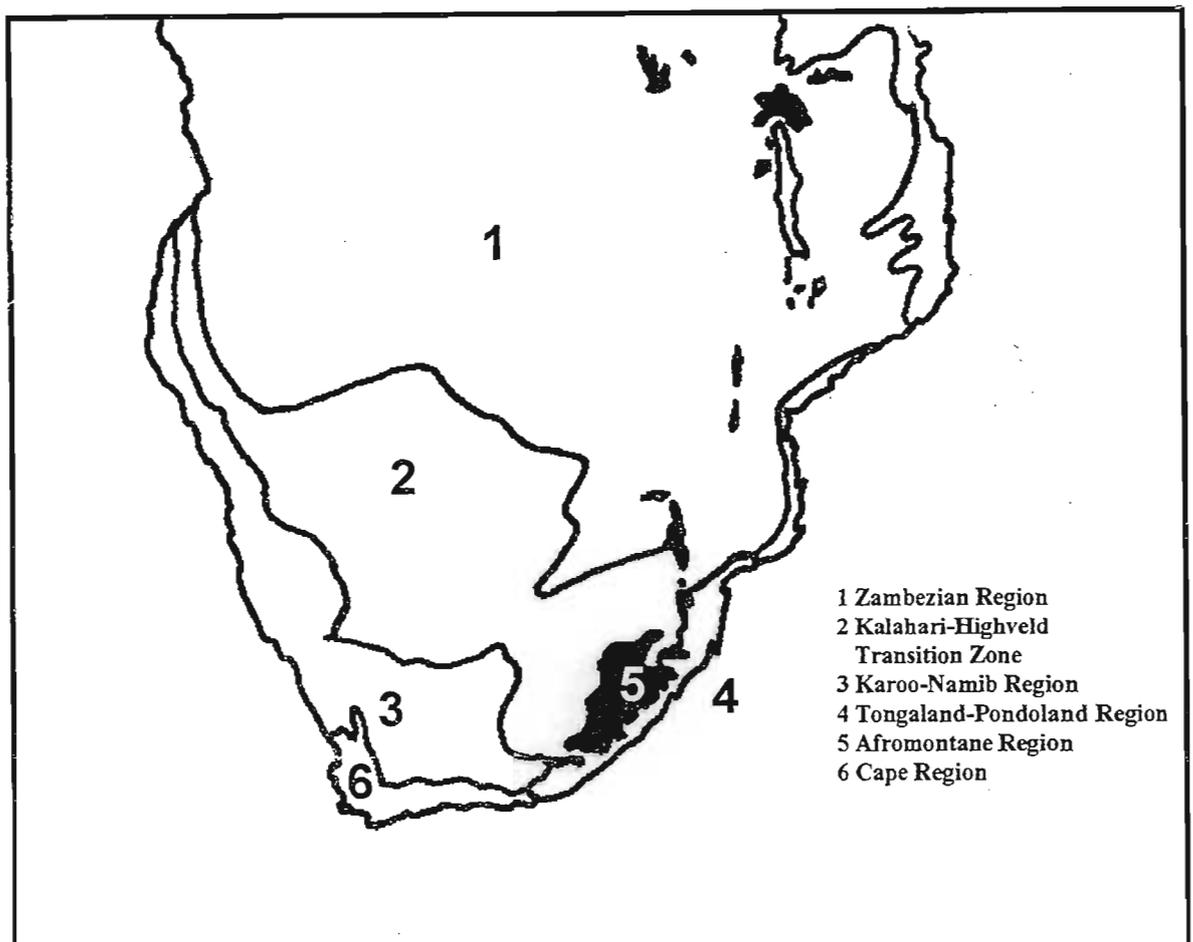


Fig. 1.3. Phytogeographical Regions of southern Africa following White (1976a, 1976b), with some changes to the Cape Region (Goldblatt 1978).

Although Acocks (1988), Moll & White (1978) and White (1983) did not attribute any special significance to the Pondoland vegetation, it has subsequently been shown that outcrops of Sandstone (Msikaba Formation, Natal Group Sandstone; Fig. 1.3.) in Natal and Pondoland harbour numerous plant species that are either rare or absent on the surrounding substrates (Moffett 1988; Takhatjan 1986; Goldblatt 1989; Pooley 1993; Van Wyk 1981, 1982, 1983, 1984, 1987, 1989a, 1989b, 1990 a, 1990 b, 1995; Van Wyk & Lotter 1982; Van Wyk & Botha 1984; Van Wyk & Schrire 1986; Van Wyk & Archer 1987; Van Wyk & Mostert 1987; Van Wyk & Prins 1987; Van der Merwe, Van Wyk & Kok 1988; Van Wyk & Potgieter 1994). The presence of this unusual flora has been attributed partly to the relatively recent exposure of the Msikaba Formation sandstones and to their associated acidic soils (Abbott 1993). Two other factors contribute to the high species diversity of the area. Firstly, the Pondoland Centre seems to have acted as a refugium during the Pleistocene (Van Wyk 1989a, 1989b, 1990b), and secondly much of the Centre comprises isolated gorges. Gorges exhibit high habitat diversity and niche diversity. A variety of niches means that a variety of species occupy them, with areas of high habitat diversity exhibiting higher species diversity than less differentiated environments (the "heterogeneity" hypothesis; Knight, Crowe & Siegfried 1982).

The narrow band of Msikaba Formation sandstone stretches from the Mzimkulu River in southern Natal to the Egossa Fault (Mbotyi Region) in Pondoland. This region is referred to as the Pondoland Centre (Van Wyk 1989a) (Fig. 1.3.) being one of the principal centres of floral biodiversity in southern Africa. Within this rich area Umtamvuna and Oribi Gorges have been selected as study sites, given the intactness of their floral resources. Both reserves are managed by Natal Parks, Game and Fish Preservation Board (NPB). The environmental determinants of each of the gorges is summarised in Table 1.1.

1.3.1. Oribi Gorge Nature Reserve (OGNR):

The OGNR (30°41' - 30°45'S; 30°10' - 30°18'E) was proclaimed on 22 March, 1950 and was expanded in 1957 to include Lot. G.E.L. 12 833. The reserve covers approximately 1 600 ha (Glen 1972) and lies 21 km from Port Shepstone in KwaZulu-Natal along the Umzinkulwana River between the Oribi and Murchison Flats (King 1942) which are north and south respectively. King (1942) maintains that these Flats are structural plains or pseudo-peneplains which were formed by the weathering and erosion of a layer of softer rock on top of a harder layer. The Msikaba Sandstone, deposited in the Devonian, overlies old granite (Fig. 1.4.). The west facing cliffs at the

Rocks (at the westernmost point of the reserve), Hell's Gate and the Chalk Mine (east of the reserve) were caused by faulting in the Middle Cretaceous (Glen 1972). The reserve has an altitudinal range of 150m to 517m.

The annual temperature range is minimum 13⁰C, maximum 23⁰C (IUCN/UNEP 1987). The mean annual rainfall is 1 120 mm, falling mainly in October through March. The rainy season is generally associated with a southerly to south-westerly wind (Glen 1972). Oribi Gorge Nature Reserve is further inland, and thus appears to be somewhat drier than the Umtamvuna Gorge.

Three main soil forms are recorded from the reserve are:

- 1) Cartref form on the sandstone of the well-drained parts e.g. on the plateau near the line of cliffs;
- 2) In the wetter places the Cartref form may merge into a Longlands form, where the lithocutanic B horizon is replaced by a soft plinthic B horizon as a result of a fluctuating water table. This form can be expected near the river and the Baboon's Spruit.
- 3) A Glenrosa form on the eastern side of the reserve along the river, comprises an orthic A on a lithocutanic B horizon (NPB 1985).

The vegetation type in the reserve is Acocks (1988) Valley Bushveld (Veld Type 23). The gorge harbours forest, evergreen riverine thicket, evergreen and deciduous (mixed) thicket, evergreen sclerophyllous shrubland [including *Leucadendron spissifolium* (Salisb. ex Knight) Williams and *Tarchonanthus trilobus* DC.], induced open woodland with clumped trees, dwarf-shrub grassland, grassland and lithophytic communities (Glen 1972; IUCN/UNEP 1987). The vegetation in the Gorge is typical of coastal krantzes, with *Loxostylis alata* Spreng. f. ex Reichb., *Ekebergia pterophylla* (C. DC.) Hofmeyr, *Ficus glumosa* (Miq.) Del., *Tarchonanthus trilobus* DC., *Alberta magna* E. Mey. and *Cryptocarya wyliei* Stapf being quite common (Pooley, 1993). However, there are floral elements linking the forests here with Ongoye Forest (near Empangeni, Natal) in the north and with the Pondoland Mosaic (and Umtamvuna) in the south. The Reserve is the northern limit for some sandstone endemics (Chapter 3).

As in the UNR, there are a number of trails within the Reserve, giving easy access to many of the habitat types found within its boundaries. A road, built in 1932, also passes through the middle of the gorge, crossing the Umzinkulwana River and providing access to the vegetation along its embankments. A very small herbarium was housed at the rest camp, but very few specimens have been added to the collection in

the last ten years. The herbarium has subsequently been moved to Umtamvuna Nature Reserve.

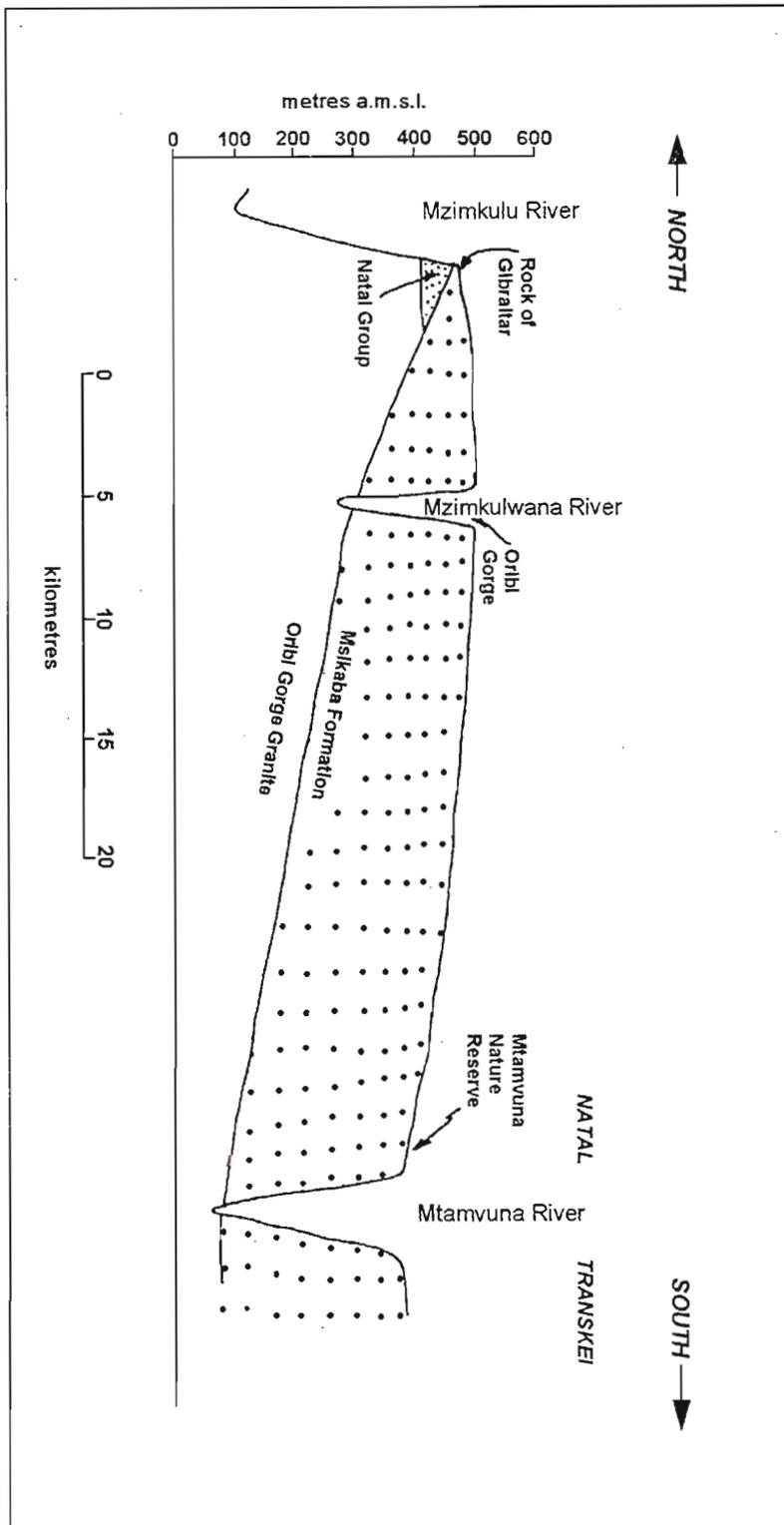


Fig. 1.4. Longitudinal section through Rock of Gibraltar, Oribi Gorge and Umtamvuna Nature Reserve, showing Msikaba Formation overlapping Natal Group (modified from SACS 1980; Van Wyk 1989a).

1.3.2. Umtamvuna Nature Reserve (UNR):

This gorge is in the Port Shepstone district, 5 km from Port Edward (31°00'S; 30°10'E), on the Natal South Coast. The reserve covers approximately 3 257 ha and was established on 25 June 1971. It lies along 25 kilometres of the northern side of a steep gorge on the Umtamvuna River which runs from north to south within the reserve rising on the Ngele Mountain at Weza and draining a catchment of 1 600 km² along its 160 km length (Abbott 1993). The altitude of the reserve ranges from sea level to about 300 m (IUCN/UNEP 1987).

The mean annual rainfall of the area is 1 200 mm, falling mainly in summer (October to April). The soils are mostly sandy. Much of the geology of the area appears to be similar to that of Oribi Gorge, with Msikaba Group sandstone predominant. Pavements of this rock type provide a habitat for interesting species associations including *Utricularia* and *Drosera* species and *Aeollanthus parvifolius* Benth.

Reserve vegetation is classified as Acocks (1988) veld type 1 - Coastal Forest and Thornveld with about half of the reserve supporting grassland and the other half (1 500 ha) supporting a lowland deciduous forest (which is an example of sub-tropical to temperate coastal forest). Pooley (1993) refers to the sandstone forest found in the Reserve as Pondoland Coastal Forest. More detail about the vegetation will be presented in later chapters.

The NPB has created a mosaic of grassland areas which are subjected to different burning regimes. This is an attempt to maintain the diversity of grassland species present in the Reserve while providing fire exclusion sites/habitats for fire-sensitive woody species, for example, *Protea roupelliae* Meisn.

The Reserve is reasonably well covered by trails ranging through a variety of habitat types. The UNR conserves a core area of the Pondoland Centre and has been relatively well collected botanically. A herbarium is housed and well maintained at the Reserve. Specimens from Oribi Gorge Field Herbarium have recently been transferred and are now housed in the UNR Herbarium.

The reserve transects the width of the Pondoland Centre, spanning a north-south climatic gradient of approximately 20 km and due to the dissected topography of the valley, contains highly diverse habitats. At least 24 of the approximately 30 shrubs and trees endemic, or largely confined to the Pondoland Centre, have been recorded in the UNR. These are discussed in more detail in chapter three.

Table 1.1. A comparison of some environmental determining factors of OGNR and UNR.

	OGNR	UNR
Size	1 600 ha	3 257 ha
Mean Annual Rainfall	1 120mm ¹² October to March	1 200 mm October to April
Average Temperature	13 ⁰ C to 23 ⁰ C	17 ⁰ C to 23 ⁰ C
Altitude	150 m.a.s.l. to 517 m.a.s.l.	sea level to 300 m.a.s.l.
Soil Type	Cartref form Longlands form Glenrosa form	No data

¹² Schulze 1982.

CHAPTER 2: FLORAL COMPOSITION AND PHYTOGEOGRAPHICAL ANALYSIS

2.1. NATURE, SCOPE AND OBJECTIVES

The objectives of this research are primarily to provide species lists for two of the gorges in the Pondoland Centre and secondarily to establish the similarities and differences in the composition of their floras. This comparison is in two parts. The first aspect of the comparison deals with the composition of the flora for each gorge following the methodology of Hilliard and Burt (1987). The number of species per genus and per family is calculated and provides a means to compare the flora of the two gorges with each other and with the composition of the Cape and southern Drakensberg flora.

Six floristic groups comprising the flora are identified based on the generic centres of diversity. The proportional elemental composition of these floristic elements is established for each gorge. This data is utilised to provide a phytogeographical context for the flora of the two reserves as well as a means of comparison between them. The nature of the research conducted is thus floristic.

The distributional data, habitat and perennial or annual nature of the species comprising the flora is investigated and discussed.

The study is limited by the fact that current revisions do not exist for many of the taxa comprising the flora. The lack of cladistic analyses of the majority of the families is a further limiting factor because the relationships between taxa are not always clear. Cowling and Samways (1995) suggest that phylogenetic methods, which consider the distribution of characters among taxa in a cladistic context, can be used to characterise endemics in terms of hypotheses of relative age and propinquity of descent. In other words low-ranking taxa correspond to neoendemics and high-ranking taxa correspond to palaeoendemics. The data implies that there may be many more discrete taxa masked by the lack of knowledge of distribution and taxonomic affiliations observed in many of the taxa under study.

2.1.1. The Composition of the flora of the Pondoland Centre

One of the ways in which the flora of an area can be assessed and then compared with other areas is to establish the relative size of the most important families and genera (Hilliard & Burt 1987). This is a relatively coarse mechanism for establishing

the similarities and differences between floras as it does not take into consideration the elemental composition of the flora concerned and some of the finer definition is lost from the data. However, it does provide an elegant starting point for a synfloristic comparison and highlights the areas needing closer investigation. Comparison in levels of endemism is similarly useful.

In an attempt to contextualise the Pondoland Centre flora, a second method is used in conjunction with the first. The Pondoland flora appears to be a melange of floristic elements including Cape and Afromontane species. Therefore the flora of each gorge is compared with that of the Cape and of the Southern Drakensberg.

2.1.2. Materials and Method

The primary materials used are species lists developed for the two gorges from field and herbaria data. Additional data collected includes distribution, habit, habitat, closest relative, conservation status and current centre of diversity. The analysis is restricted to the flowering plants. The mosses and ferns have been excluded because of the paucity of data. The ten most important families in UNR and OGNR respectively, and the percentage of the whole flora per gorge that they make up are presented (Table 2.1.). These figures are compared with each other and with those for the Cape flora and the Southern Drakensberg (Bond & Goldblatt 1984; Hilliard & Burt 1987). This allows for the contextualisation of the flora of each of the gorges in a South African sense. The figures for the gorge floras have been aligned to match the family concepts used for the Cape (Selaginaceae included in Scrophulariaceae, Liliaceae retained in a broad sense) (Hilliard & Burt 1987). The total figures used for each area are for flowering plants only and hybrids and aliens are excluded. In addition the number of species common to each gorge is calculated and presented as a percentage of the total number of species comprising the flora of both gorges.

The ten largest genera in each of the four floras are listed in table 2.2., together with their actual sizes and the percentage of the total flora that they represent. Similarly the percentage of species common to both gorges is calculated and presented.

The number of endemics present in each gorge is established and presented as a proportion of the flora for the Cape, Drakensberg and the two gorges. An attempt is made to characterise the genera containing endemics as belonging to a particular element. The elements are defined in detail in section 2.2.1. and are Eurasian, Tropical, African, Pondoland Centre, Cape and Wide.

2.1.3. Results and discussion

The total species diversities used for comparison are Cape 8504, Southern Drakensberg 1332 (Hilliard & Burtt 1987), UNR 1265 and OGNR 1002 species. The figures for ferns and fern allies are: Cape 75 species (0.9% of whole flora), southern Drakensberg 58 species (4%) (Hilliard & Burtt 1987), UNR 34 species (2.6%) and OGNR 38 species (3.8%). It is interesting that the fern and fern allies comprise a larger proportion of the flora of the gorges than they do for the Cape. This may be because forest comprises a larger proportion of the habitats in the gorges than in the Cape and many of the ferns are forest species. Alternatively, this could be a result of the gorges closer proximity to the tropics, as well as a result of relictual distributions. The comparatively lower number of ferns recorded from UNR may be an artefact of uneven collecting, rather than a real trend.

The similarity in the composition of the UNR and OGNR flora at the family level is evident from Table 2.1., indicating that the vegetation is derived from a common base. This similarity is less evident at the species level with only 24% of the species common to both gorges. This implies that the gorge floras have been separated for a sufficiently long period for speciation to occur, or that the niches available in the gorges are different. The compositional differences in species composition are discussed in more detail in the following chapters.

Asteraceae dominates all four floras. This not surprising as it is a very large, widespread family, with a large number of species in many varied habitats but virtually excluding forests. The similarity index for asteraceous species is 42% and for genera (58%). The majority of the Asteraceae species in the gorges belong to widespread genera with no clear centre of diversity (e.g. *Helichrysum*)¹, but 12 species belong to 8 genera that are centred in the Cape. The genera are *Stoebe*, *Relhania*, *Disparago*, *Pentzia*, *Othonna*, *Osteospermum*, *Ursinia* and *Gazania*. These species make up an insignificant proportion (c. 7%) of the asteraceous flora and most are widespread and occur in both gorges excluding *Gazania krebsiana*, *G. linearis* and *Othonna natalensis* which have only been collected from UNR. This implies that it is unlikely that the asteraceous component of the gorge floras is derived from similar stocks to the Cape Asteraceae.

¹ *Helichrysum* is comprised of approximately 500 species. These species are mainly African, including Madagascar, but occur in southern Europe, south-west Asia, southern India, Ceylon and Australia. There are about 245 species in South Africa, where they are widely distributed. *Pseudognaphalium* is comprised of ca. 50-60 species distributed through Africa, south-east Asia, Europe and America (Hilliard 1983).

Table 2.1. The ten largest families in the Cape, Southern Drakensberg (Hilliard & Burt 1997), UNR and OGNR floras, including the number of species per family per flora and their percentage contribution to each respective flora.

Cape			S. Drakensberg			UNR			OGNR		
Family	Spp	%	Family	Spp	%	Family	Spp	%	Family	spp	%
Asterac. ²	986	11.6	Asterac.	285	21.4	Asterac.	139	11	Asterac.	108	10.7
Ericaceae	672	7.9	Poaceae	108	8.1	Fabac.	101	8	Fabac.	82	8.2
Mesembry.	660	7.8	Liliaceae	84	6.3	Poaceae	66	5.2	Poaceae	65	6.5
Fabac.	644	7.5	Orchidac.	83	6.2	Liliaceae	58	4.6	Liliaceae	41	4.1
Iridaceae	612	7.1	Scroph.	79	5.9	Rubiaceae	54	4.3	Rubiaceae	41	4.1
Liliaceae	412	4.8	Fabac.	65	4.9	Euphorbia.	47	3.7	Cyperac.	39	3.9
Proteaceae	320	3.7	Iridaceae	65	4.9	Orchidac.	43	3.4	Euphorbia.	38	3.8
Restion.	310	3.6	Cyperac.	59	4.4	Cyperac.	41	3.2	Acanth.	35	3.5
Scroph.	310	3.6	Asclep.	44	3.3	Scroph.	36	2.8	Lamiaceae	28	2.8
Rutaceae	259	3	Ericaceae	26	1.9	Acanth.	35	2.8	Scroph.	22	2.2

Fabaceae is the second largest family in both of the gorges. Its position in the gorges top ten family table is similar to its position in the Cape table, but the generic and specific composition of the family in the two areas differs considerably. Cape centred fabaceous genera (e.g. *Aspalathus*) do not comprise a large proportion of the UNR and OGNR's fabaceous flora. The fabaceous genera in the gorges are more closely aligned with the predominantly tropically centred Drakensberg genera (e.g. *Indigofera* and *Tephrosia*). In addition, there are few arborescent fabaceous taxa in the Cape whereas ca. 30% of the fabaceous species in the gorges are arborescent. Although the difference in species composition can be partly attributed to habitat factors, the family is primarily a grassland one in the context of the Natal vegetation.

Rubiaceae is a pan-Tropical family of trees, shrubs or rarely herbs that produce capsules, drupes or berries. Birds are often the primary vectors. This implies that the taxa are capable of long distance dispersal and are unlikely to be indicative of vicariant events. Many of the species are adapted to forest. Wooded or forested patches make up a large proportion of the habitat in both UNR and OGNR. This partly explains the

² The abbreviations used in this table are as follows: Asteraceae – Asterac., Fabaceae – Fabac., Mesembryanthemaceae – Mesembry., Orchidaceae – Orchidac., Scrophulariaceae – Scroph., Euphorbiaceae – Euphorb., Cyperaceae – Cyperac., Restionaceae – Restion., Acanthaceae – Acanth. and Asclepiadaceae – Asclep.

presence of a large number of Rubiaceae species in the two gorges. The proportion of species common to both gorges is significantly high at 70%. This implies a more recent invasion or series of invasions of these species into the Pondoland Centre and a fairly high degree of habitat similarity.

The monocotyledons comprise 35% of the southern Drakensberg flora, 23% of that of UNR, 22% of that of OGNR and 24% of that of the Cape (Hilliard & Burt 1987). The monocotyledons, although less imposing than in the Drakensberg, are well represented in the flora of the two gorges, with four families making the list of the ten most diverse families for UNR and three for OGNR. Cyperaceae, mostly tufted or creeping herbs, often rhizomatous, is well represented in the Pondoland gorges. This is not unexpected because of the large number of perennial and non-perennial wetland areas in the gorges resulting from the combination of sandstone pavements and rugged topography giving rise to many seepage lines. In addition, both gorges contain a perennial river and a number of streams, providing many niches for hygrophilous species. What is surprising is the low degree of similarity in the species composition of this family comprising each gorge. Only 18% of the Cyperaceae species are common to both gorges.

Grasslands make up a significant proportion of the habitat in both of the gorges and this is evidenced by the fact that the mostly bulbous or tuberous Liliaceae *s.l.* is on the top ten family table for both of the gorges. Approximately a third of the species are shared by the two gorges. The absence of Iridaceae from the top ten family table in the two gorges and its presence in both of the other areas is significant. The similarity index for Iridaceae species in the gorges is low (17%). The family is predominantly centred in the Cape (Goldblatt 1979; Goldblatt 1991) and the S. Drakensberg is rich in these mostly fire adapted geophytes (Hilliard & Burt 1987). The discrepancy in species similarity is partly due to undercollecting in OGNR, but the family patterns are discussed in more detail in chapter 3.

There are 43 species of orchid recorded from UNR but only 16 from OGNR. This warrants a closer look at the generic and specific composition of the families' contribution to the two gorges. The low number of orchid species collected from OGNR is indicative of paucity of collection as most of the species in UNR also occur to the north of OGNR. The proportion of orchid species common to both gorges is 20% giving further support to the need for a more in depth discussion and analysis.

The presence of Acanthaceae (tropical) and Lamiaceae on the top ten most diverse family table for OGNR is interesting. Taxa of the former produce a bi-loculicidal capsule that is elastically dehiscent from the apex downwards. Lamiaceae species

produce fruits, usually of 4 achenes or nutlets enclosed within the dry, or sometimes fleshy, persistent calyx (Ross 1972). Taxa of both families exhibit local dispersal, so neither is capable of long distance dispersal. Both families are discussed in more detail in the subsequent chapters.

However, table 1.2. highlights the differences in familial composition of the Cape flora and of the two gorges rather than the similarities between these floras, warranting an investigation at the generic level.

Table 2.2. The ten largest genera in the Cape, Southern Drakensberg (Hilliard & Burt 1997), UNR and OGNR floras, including the number of species per family per flora and their percentage contribution to each respective flora.

Cape			S. Drakensberg			UNR			OGNR		
Genus	spp	%	Genus	spp	%	Genus	spp	%	Genus	spp	%
<i>Erica</i>	526	6.1	<i>Helichrys.</i> ³	85	6.3	<i>Helichrys.</i>	34	2.7	<i>Helichrys.</i>	24	2.4
<i>Aspalat.</i>	245	2.9	<i>Senecio</i>	76	5.7	<i>Senecio</i>	27	2.1	<i>Senecio</i>	22	2.2
<i>Ruschia</i>	138	1.6	<i>Erica</i>	25	1.9	<i>Crassula</i>	15	1.2	<i>Crassula</i>	15	1.5
<i>Phyllica</i>	133	1.6	<i>Disa</i>	24	1.8	<i>Indigofera</i>	14	1.1	<i>Plectranth.</i>	15	1.5
<i>Agathos.</i>	130	1.5	<i>Sebaea</i>	19	1.4	<i>Plectranth.</i>	13	1.0	<i>Cyperus</i>	14	1.4
<i>Oxalis</i>	129	1.5	<i>Crassula</i>	19	1.4	<i>Rhus</i>	13	1.0	<i>Rhus</i>	14	1.4
<i>Pelargo.</i>	125	1.5	<i>Argyrolob.</i>	18	1.3	<i>Maytenus</i>	12	0.9	<i>Indigofera</i>	11	1.1
<i>Senecio</i>	113	1.3	<i>Moraea</i>	16	1.2	<i>Polygala</i>	12	0.9	<i>Tephrosia</i>	10	1.0
<i>Cliffortia</i>	106	1.2	<i>Thesium</i>	15	1.1	<i>Euphorbia</i>	11	0.9	<i>Maytenus</i>	10	1.0
<i>Muraltia</i>	106	1.2	<i>Hypoxis</i>	15	1.1	⁴ <i>Eriosema,</i>	10	0.8	<i>Eragrostis</i>	10	1.0
						<i>Gnidia,</i>					
						<i>Vernonia</i>					
TOTAL	1751	20.4		311	23.2		166	13.1		145	14.6

There are many differences in the composition of the four lists, but UNR and OGNR are relatively similar at the generic level. The most striking difference between the two gorges is the presence of two monocotyledonous genera, *Cyperus* and *Eragrostis* in the top ten table for OGNR, whereas monocotyledonous genera do not feature at all in the table for UNR.

Two Fabaceous genera (*Indigofera* and *Tephrosia*) are among the top ten table for OGNR, whereas only *Indigofera* is present on the UNR top ten table. The gorges share 33% of their *Indigofera* species. The sections *Hilares* and *Hedyanthes* contain a number of species with large woody rootstocks from which the leafy shoots emerge following fire (Schrire 1991). Populations of *I. rubroglandulosa*, *I. hilaris* (*Hilaris*), *I. tristis*

³ The following abbreviations have been used in this table: *Helichrysum* – *Helichrys.*, *Aspalathus* – *Aspalat.*, *Plectranthus* – *Plectranth.*, *Agathosma* – *Agathos.*, *Pelargonium* – *Pelargo.* and *Argyrolobium* – *Argyrolob.*

⁴ All three of these genera contribute ten species to the flora of UNR, but the number of species used in calculating the total number of species contributed by the ten most important genera is ten and not thirty.

and *I. hedyantha* (*Hedyanthes*) occur in both gorges. The gorges share 80% of their *Tephrosia* species.

Although the number of *Crassula* species is the same for the two gorges, only 33% of these species are common to both. The genus is mainly centred in southern Africa, but is represented in Europe, the Americas, Australia, New Zealand and southern islands, by a few annual species. Most of the species occur in the southwestern Cape. The 22 species in the gorges belong to 5 of the 20 sections in the genus, with most (11) species of section *Rosulares*. The section is not concentrated in the southwestern Cape and the species are widely distributed throughout South Africa. Four of the 11 species are shared by the gorges. The other *Rosulares* species have only been collected from OGNR, but the species distributions (Toelken 1985) suggest that all of the species, except perhaps *C. capitella* Thunb. subspecies *meyeri* (Harv.) Toelken should also occur in UNR. The same is true for *C. perfoliata* L. var. *heterotricha* (Schinz) Toelken (Section *Crassula*) which is found mainly along the eastern escarpment from south-east tropical Africa into Transvaal, Swaziland, Natal and north-eastern Cape province. Three of the six *Anacampseroideae* species are shared. Populations of *C. spathulata* Thunb., the endemic *C. streyi* Toelken and *C. multicava* Lem. var. *multicava* occur in UNR, but not in OGNR. The latter species occurs rarely in southern Natal near Port Shepstone and into the eastern Cape Province to near Port Elizabeth. Although UNR may be the northernmost limit of the species, it seems likely that populations do occur in OGNR. The section appears to be concentrated in the eastern Cape and Natal as does section *Globulea* (with a few species in Namibia). Populations of both *C. cultrata* L. and *C. nudicaulis* L. var. *nudicaulis* occur in UNR but not in OGNR. The attenuation of Cape affiliated species from UNR to OGNR may be due to the UNR's proximity to the Cape.

The majority of genera in both the top ten gorge tables are herbaceous with *Maytenus* and *Rhus* being the most notable exceptions. The gorges share 77% and 69% of these species respectively.

In total the ten largest genera contribute 20.4% for the Cape, 23.2% for the southern Drakensberg (Hilliard & Burt 1987), 13.1% for UNR and 14.5% for OGNR: if the figures are extended to include the twenty largest genera they are 29.6%, 32.3%, 19.3% and 22.3% respectively. Smaller contributions by the top 10 or 20 families imply a paucity of niches for new species. This indicates historically high diversity over long periods, i.e. that the gorges have acted as refugia. The figures for the gorges are also lower because there is a proportionally bigger representation of tree genera and tree genera tend to be smaller than herbaceous genera. Thus a larger proportion of the gorge floras is composed of representatives of smaller genera: correspondingly a

smaller percentage is contributed by the largest genera. A third implication of the figures for the two gorges is that the floras are composed of taxa from a number of floristic elements, including Cape and tropical.

The endemic portion of the Cape flora constitutes 68.2% (an area of 89×10^3 km²) (Bond & Goldblatt 1984), of the Drakensberg flora the proportion is 29.5% (an area of 40 000km²) (Hilliard & Burt 1987) and of UNR and OGNR the proportions are 3.7% and 2.3% respectively. The comparison is inappropriate in terms of relative areas and figures for the endemic portion of the Pondoland Centre flora as a whole would be preferable here. Cowling and Hilton-Taylor (1997) calculate the total endemism in the Pondoland Centre (an area of 1880km²) as 8%. The importance of this figure is apparent when one realises that the Centre is the smallest area listed by Cowling and Hilton-Taylor (1997) and yet it does not exhibit the lowest percentage endemism.

The endemic species belong to the following genera:

Genus	Centre of development	Genus	Centre of development
<i>Dahlgrenodendron</i>	Pondoland Centre	<i>Manilkara</i>	Tropical
<i>Raspalia</i>	Cape	<i>Tricalysia</i>	Tropical
<i>Rhus</i>	Wide	<i>Canthium</i>	Tropical
<i>Maytenus</i>	Unclear ⁵	<i>Anthospermum</i>	Cape
<i>Pseudosalacia</i>	Pondoland Centre	<i>Tephrosia</i>	Wide
<i>Catha</i>	African	<i>Watsonia</i>	Cape
<i>Putterlickia</i>	South African	<i>Raphionacme</i>	Tropical
<i>Apodytes</i>	Unclear	<i>Plectranthus</i> ⁶	Section – Natal
<i>Colubrina</i>	African	<i>Syncolostemon</i>	Unclear
<i>Rinorea</i>	African	<i>Eriosema</i>	Unclear
<i>Grewia</i>	African	<i>Crassula</i>	Cape
<i>Pseudoscolopia</i>	Cape ?	<i>Helichrysum</i>	Wide
<i>Rhyncocalyx</i>	Pondoland Centre	<i>Polygala</i>	Wide
<i>Eugenia</i>	Unclear	<i>Streptocarpus</i>	Wide
<i>Syzygium</i>	African	<i>Struthiola</i>	Cape
<i>Memecylon</i>	East Coast (Natal)	<i>Eriosemopsis</i>	Unclear
<i>Podalyria</i>	Cape		

⁵ This genus includes about 200 species worldwide, particularly in South America. About 15 species occur in South Africa. A number of species are the subject of further investigation, particularly the *Maytenus heterophylla* complex – a very variable group probably including 5 separate species (Pooley 1994).

⁶ This refers to Section *Plectranthus*.

Many of these genera, including *Helichrysum* are difficult to characterise as belonging to any particular element. But it is significant that the typically arborescent genera tend to have an African centre of distribution, whereas the herbaceous genera tend to have centres of distribution in the Cape or Natal⁷ and are frequently secondary sites of species radiation. This implies that the endemic tree genera are the product of an older pattern and corroborates the refugia hypothesis introduced previously.

2.2. PHYTOGEOGRAPHICAL ANALYSIS OF THE FLOWERING PLANTS OF UNR AND OGNR

Phytogeographical analysis consists of the search for similar patterns of distribution and their grouping into a number of classes. The proportions of these classes in the whole flora of the area under study then give an estimate of the importance of each component in the composition of the flora - (Hilliard and Burt 1987)

The objectives of this analysis are primarily to gain insight into the flora of UNR and OGNR and thus make some comparison between them. Secondly to gain insight into the flora of the Pondoland Centre, of which the two gorges are considered, for the purposes of this study, to be a significant sample⁸, with respect to the melange of taxonomic elements present in the centre.

The analysis at the generic level elucidates the broad affinities of the flora, which may be obscured at the level of specific analysis. The question of affinities (northerly or southerly) is one of the main questions posed in the previous section. Consequently a classification of the genera is formulated by defining six groups of genera.

2.2.1. Method

The data was analysed at both the generic and the specific level, but the two cannot be divorced. At the generic level both the number of genera per group and the number of species in each of these genera is important. At the specific level it is both the total number of species and the proportion of them contributed by the different generic groups that is important.

⁷ The old names for the four provinces, namely Cape, Orange Free State, Natal and Transvaal are used throughout the thesis to facilitate the use of available distributional information for the taxa examined.

⁸ Note: The endemic portion of the flora is slightly under-represented because many of the Pondoland endemics are confined to the area surrounding Port St Johns and do not occur in either of the gorges.

The groups are defined following Hilliard and Burtt (1987) according to the areas that, in terms of number of species, are their present day centres of diversity. This implies nothing about their centres of origin, nor from which direction they entered the Pondoland Centre.

The six groups are:

- | | |
|-------------|--------------------------------|
| 1. Eurasian | 4. Pondoland Centre (Endemics) |
| 2. Tropical | 5. Cape |
| 3. African | 6. Wide |

1. Eurasian

The generic links are to SW Asia and the genera fall into two subgroups. The first of these are genera that show little differentiation in southern Africa, as in *Ajuga* (with one endemic species in southern Africa). The second are those genera in which distinctive alliances of species have developed, as in *Ranunculus* and *Rumex*. Some of these Eurasian genera have centres of speciation around the Mediterranean, but their southern African species are not concentrated in the part of the Cape with a Mediterranean, winter-rainfall, climate (Hilliard & Burtt 1987).

2. Tropical (or subtropical)

These genera are well represented in Tropical Africa with extensions, often considerable, to the tropics and subtropics of Asia and/or America (Hilliard & Burtt 1987). The group includes genera that are pantropical and those that are predominantly palaeotropical e.g. *Canthium*. Many of the grass genera in the gorges, e.g. *Heteropogon* and *Panicum*, are tropical.

3. African

These genera are well represented in the Eastern Mountain Region and at lower altitudes in Natal, the Transkei and eastern Cape, but are too widespread in Africa as a whole to be regarded as having a south-eastern centre. *Streptocarpus* is a good example of this group. These genera tend to be montane in tropical Africa and are poorly represented in the Cape Region (Hilliard & Burtt 1987).

4. Pondoland Centre

These genera comprise the Pondoland Centre endemics in the broadest sense, with some genera wholly confined to the Centre, and others with extensions into the Natal sandstone outcrops e.g. *Rhynchochalyx*. It is these outliers which raise the questions of neoendemism or palaeoendemism, questions which have no simple answer. Certain genera are loosely centred in the Pondoland Centre, having several species here but others scattered from Transvaal through lower altitudes in Natal to the eastern Cape.

5. Cape

These genera are centred in the Cape Region (e.g. *Raspalia*) based on the number of species found there. Some of the genera are almost equally well represented further north making it difficult to attribute genera to this group. Included in this group are genera that are mostly represented by perennials in the Drakensberg and neighbouring mountains but have many annual species further south especially in the western Cape. Most of these genera are also found further north, but with far fewer species.

6. Wides

This group of genera may be found almost anywhere in the world and, at the generic level, have very little phytogeographical significance. Both *Helichrysum* and *Senecio* (Asteraceae) are good examples of this group, as is the grass genus *Eragrostis*.

2.2.2. Results and discussion

The data regarding generic affiliations is presented in Table 2.3. Not all genera can be placed satisfactorily in one of the groups, the figures presented do not therefore add up to the total flora. Nevertheless, the observed trends represent the primary phytogeographical affiliations of the two gorges as approximately 40% of the genera and at least 50% of the species are classified for each gorge. The first figure denotes the number of genera allocated to the group and the second figure is the total number of species in the flora of each gorge belonging to it.

Table 2.3. The number of genera and (species) per gorge for each of the six phytogeographical groups defined in section 2.2.1.

GROUP	UNR	OGNR
Eurasian	26 (48)	20 (28)
Tropical	43 (136)	44 (128)
African	76 (207)	65 (124)
Pondoland Centre	5 (5)	4 (4)
Cape	33 (107)	26 (66)
Wide	32 (178)	29 (151)
Total no. allocated⁹	218 (684)	191 (504)
Total¹⁰	571 (1265)	487 (995)

On analysis, the proportion of genera (calculated as a percentage of the total allocated genera per gorge) that each group contributes to the flora of each gorge is very similar. The exceptions are in the proportion of the Tropical and Cape groups. The former group is slightly higher in OGNR (23%) than in UNR (19.7%) and the latter group is slightly better represented in the UNR flora (15.1%) than in the OGNR flora (13.2%). The similarity in species contributed by Cape genera is 37%, whereas that for the tropical genera is 42%. The similarities and difference in the species composition for each of these elements is discussed in the following chapters, but the primary difference in the Cape species is in Iridaceae and in the tropical species, within Poaceae.

The flora in both of the gorges is predominantly comprised of genera that are African, with 34.9% and 34% for UNR and OGNR respectively. The relatively weak links with the Eurasian flora are illustrated by the fact that only 11.9% and 10.5% of the genera of UNR and OGNR respectively have Eurasian centres of distribution.

When similar calculations are made for the proportion of species that each allocated generic group contributes to the flora of UNR and OGNR the following trends emerge. The Eurasian genera contribute a very similar proportion of species (between 6% and 7%) to each gorge. The 'wides' and the African genera contribute just over half of the species present in each gorge with the cosmopolitan genera making a slightly higher contribution in OGNR than in UNR. The Cape genera contribute a slightly higher proportion of species to UNR (15.6%) than they do to OGNR (13.1%). The results for the proportion of species contributed by Tropical genera are much more dramatic (19.9% for UNR; 25.4% for OGNR). This may be due to the greater proximity of OGNR to more inland flora, greater distance from the coast and comparatively higher altitude, with resultant ecological constraints. Alternatively, the trend may be phytogeographically significant in terms of the history of the OGNR flora.

⁹ The total number of genera successfully allocated to one of the six phytogeographical classes.

¹⁰ This figure refers to the total number of genera (species) per gorge.

Similarly the relatively high proportion of species contributed by the Cape genera may be explained by relative proximity to the Cape Floral Region and current ecology of the UNR. This explanation disregards the historical aspect of the composition of the flora of the gorge. An alternative hypothesis, and one which incorporates the historical aspect, is that the UNR has acted as a refugium for species trapped on the sandstone during the geological past as a result of past vegetation movement due to climatic oscillation during the Pleistocene. It is likely that these species have survived due to the ameliorating effect of the Indian Ocean on the current ecology of the UNR. This is the hypothesis put forward by Van Wyk (1989a, 1990b).

The climatic oscillation hypothesis implies a series of invasions of different floras as opposed to a single invasive event for each floristic group. The data presented here is too coarse to provide more than guidelines for the development of this hypothesis although the familial disjunction in the *Bruniaceae* (between UNR and the Cape) provides tantalising evidence for at least one ancient invasion of Cape flora into the Pondoland Centre. Likewise the predominance of tropical grasses in the gorges implies that the tropical flora has migrated at least once into the Pondoland Centre. The dissimilarity in the species composition of the *Iridaceae*, *Liliaceae s.l.* and *Orchidaceae* in the two gorges may be related to or be the result of climatic oscillation and resultant vegetation flux.

To investigate these tantalising observations the taxa comprising the phytogeographic groups are analysed in the following chapters. The definition of each of the six floristic groups is broad and the taxa representing them in each gorge are fairly widespread. This does not diminish the taxa's usefulness as indicators of floristic affinity, but does make the conclusions drawn from the data very crude. This necessitates the use of endemic taxa to answer the phytogeographical questions raised with greater clarity.

2.3. GROWTH FORMS

The three broad categories of growth-form, trees, shrubs and herbs are too rigid a classification to accurately represent the flora of the gorges, as there are many intermediates between these categories. Rutherford and Westfall (1994) advocate the use of Raunkiaer's (1934) life form scheme because of its simplicity, consistency and ease of application. Only the structural characters that reflect the essential dependence of the plants upon climate are used. The assumption that the life forms evolved in the present prevailing climate is accepted with caution, as the distribution of the climate

could have been different at the time when the life form was developed. The effect of past climates can result in anomalous relationships between the life form present and the current climate of an area, as may well be the case in the proposed refugium, the Pondoland Centre. Raunkiaer's (1934) five main life form categories are used in this study. The life forms are:

1. *Phanerophytes* (P): Perennial plants, usually woody, with the mean height of the renewal buds greater than 0.7m above ground level. Because plant height is usually greater than the mean height of the renewal buds, the mean plant height of phanerophytes is seldom less than 1m.
2. *Chamaephytes* (Ch): Perennial plants, generally woody or partly woody, with the mean height of the renewal buds less than or equal to 0.7m. Following the rationale applied in phanerophytes, mean plant height of chamaephytes is seldom greater than 1m.
3. *Hemicryptophytes* (H): Perennial plants, generally herbaceous, with the renewal buds at or, more often, close to ground level, but seldom exceeding 0.1m in height.
4. *Cryptophytes* (Cr): Perennial plants, usually herbaceous geophytes, with renewal buds below ground level.
5. *Therophytes* (T): Ephemeral plants that complete their entire life cycle in one year or less.

Life form (or growth form) is important because endemics from southern African centres are not a random assemblage with regard to growth form. Endemics tend to be forbs and shrubs, with other growth forms less frequent among endemics than among non-endemics. The Pondoland Centre is one of only two in South Africa with endemic trees (Cowling & Hilton-Taylor 1997). We propose that growth form is intricately linked to the palaeo or neoendemic nature of taxa. This hypothesis is based on the fact that mean youth period (the period from germination to formation of first seed) tends to decrease from phanerophytes to therophytes, but to decrease more strongly from phanerophytes to chamaephytes, than from hemicryptophytes to therophytes. Hemicryptophytes, therefore, may reach early reproductive capacity despite their relative longevity.

Because phanerophytes require considerably longer periods to reproductive maturity, they are more vulnerable to longer-term unfavourable episodic events for establishment. But because resource allocation to generative reproduction is lower, phanerophytic populations can afford to endure a number of years without re-establishment from seed. Because hemicryptophytes and chamaephytes require shorter

periods to reproductive maturity, chances are that the accumulation of novel genetic combinations is more rapid. The accumulation of new genetic combinations in isolated populations can lead to speciation.

2.3.1. Classification and discussion

Each species on the list was assigned to one of the five life form categories defined above excluding parasitic and hemi-parasitic species, insectivorous taxa¹¹ (e.g. *Drosera* and *Utricularia*) and the epiphytes. The results are presented in figure 2.1.

Some plants are easy to classify, like *Podocarpus latifolius* (Thunb.) R. Br. ex Mirb. and *P. falcatus* (Thunb.) R. Br. ex Mirb. which are tall trees and are examples of phanerophytes. Phanerophytes include a wide range of morphological types, for example single stemmed trees, larger multi-stemmed shrubs, palms, tree ferns, lianas and plants resembling the banana plant. Shrubs are well represented in both of the gorges, with some being distinctly woody, e.g. *Xylothea kraussiana* Hochst. Some species like *Thunbergia dregeana* Nees are semi-scandent, becoming woody climbers with age. Several plants in the gorges are creepers or climbers. Some of these are herbaceous as in *Ipomoea* species, *Convolvulus farinosus* L. and *Rumex sagittatus* Thunb., while others, like *Capparis brassii* DC. are more robust. These have all been classified as phanerophytes.

Chamaephytes include dwarf shrubs, low succulents and cushion plants. Typical examples are *Stoebe vulgaris* Levyns, *Erica* species and *Pentzia incana* (Thunb.) Kuntze. Some chamaephytes are woody, while others are less distinctly woody, e.g. *Dissotis canescens* (E. Mey. ex R.A. Grah.) Hook. f. A number of plants are biennial, forming basal rosettes in year one and flowering and fruiting in the following year. The plants die after fruiting. There are few examples of this growth-rhythm in the gorges, but a large number of herbaceous perennials have a biennial shoot system like *Scabiosa columbaria* L. species of *Berkheya*, *Senecio* and *Helichrysum* produce new rosettes while the rosettes from the preceding year are flowering. The new rosettes flower in the following year, perpetuating the cycle. Many of these plants have a diffuse system of underground branching rhizomes. These species are included in the chamaephyte category.

Hemicryptophytes include perennial graminoids, aphyllous restioids and perennial broad-leaved herbs (forbs). Typical taxa include *Heteropogon contortus* (L.) Roem. & Schult. and *Themeda triandra* Forssk.

¹¹ These taxa are not easily categorised as they are too specialised.

Geophytes include plants with bulbs, corms, tubers, non-graminoid rhizomes and rootstocks as well as geoxylic suffrutices. These include the woody caudices, producing annual shoots in *Indigofera rubroglandulosa* Germishuizen, in *I. eriocarpa* E. Mey. and *Eriosema* species and in many of the other grassland plants. The annual shoots are woody as in *Dichilus reflexus* (N.E. Br.) A.L. Schutte, *Indigofera hedyantha* Eckl. & Zeyh., *Rhus discolor* E. Mey. ex Sond. or they may be herbaceous as in *Helichrysum platypterum* DC., *Vernonia hirsuta* (DC.) Sch. Bip. and others. This category includes the endemic grassland suffrutex, *Eriosemopsis. Pelargonium luridum* (Andr.) Sweet is a perennial acaulescent geophyte with a woody subterranean tuber. Similarly *Hypoxis* species are geophytes which survive the dry season with corms or rhizomatous rootstocks. *Brachystelma australe* R.A. Dyer and *B. blepharantha* Huber have enormous tubers from which clusters of flowers are produced in spring and summer.

This adaptation to a suffrutescent habit is common in frequently burned grasslands. Some plants are difficult to classify conclusively e.g. *Gnidia kraussiana* Meisn., *G. caffra* Meisn., *G. calocephala* (C.A. Mey.) Gilg. and *G. anthylloides* (L.f.) Gilg. These species behave like cryptophytes, producing new shoots from woody rootstocks when their grassland habitat is burnt, but are shrubby and exhibit sympodial growth in unburnt grassland. The species have been included in the cryptophyte category for the analysis.

Therophytes include herbaceous graminoids and forbs that are annual or ephemeral. There are comparatively few true annuals in either the UNR or OGNR, but *Lobelia erinus* L. is a small herbaceous annual and some *Senecio* species (*S. madagascariensis* Poir., *S. pellucidus* DC., *S. polyanthemoides* Sch. Bip. and *S. pterophorus* DC.) complete their life cycle within a year and survive the dry season as seeds. *Conyza attenuata* DC. and *Matricaria nigellifolia* DC. are sometimes annuals (Hilliard 1977). This category makes up less than 1% of the flora of the gorges.

Some species have variable habits and can not be conclusively categorised. Examples of these are *Eriosema preptum* C. H. Stirton, *Anthospermum herbaceum* L.f. and *Commelina diffusa* Burm. f.

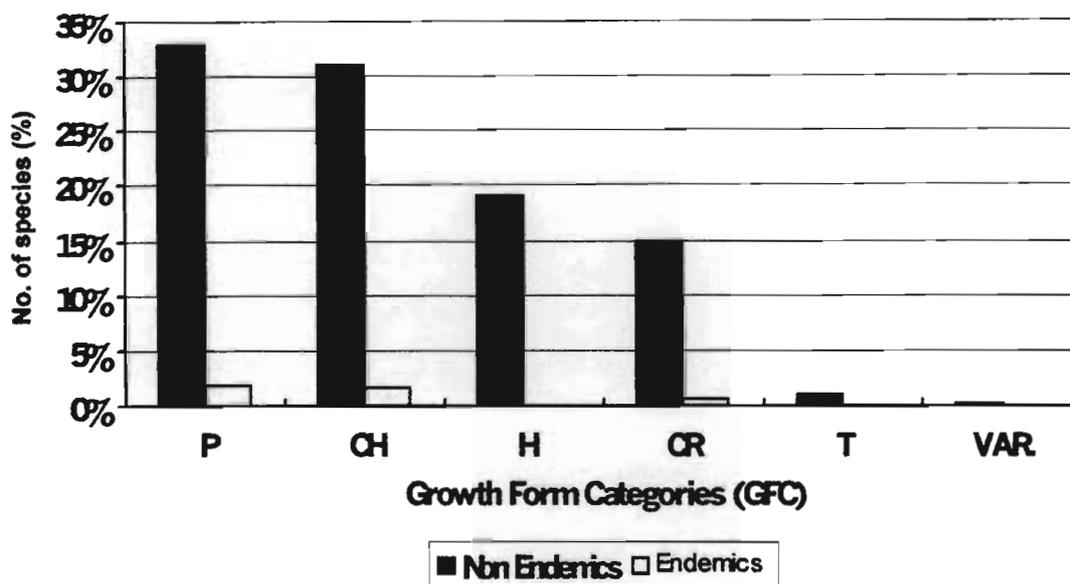


Fig. 2.1. Association between endemism and growth form in floras (angiosperms only) from two gorges in the Pondoland Centre. **Non endemics** is the number of species present in the gorges as a percentage of the species successfully allocated to one of the five growth form categories. The five growth form categories are **P** – phanerophyte; **CH** – chamaephyte; **H** – hemicryptophyte; **CR** – cryptophyte; **T** – therophyte and **VAR.** – species that are variable in habit, i.e. are perennial under certain conditions, but are annuals under others e.g. *Eriosema preptum* C. H. Stirton. and *Anthospermum herbaceum* L.f.

The endemic species are calculated as a percentage of the total endemic population in the gorges. It is clear that the phanerophytes (1) predominate, comprising 51% of the endemic species. This situation is unique to the Pondoland Centre. The proportion of endemic phanerophytes in the endemic population is higher than the proportion that non-endemic phanerophytes contribute to the whole flora, emphasising the significance of this habit type in the Pondoland Centre. However this life form also predominates in the species of the flora as a whole.

Although hemicryptophytes make a 19% contribution (Non-endemics A) to the overall flora of the two gorges, there are no hemicryptophyte (3) endemics.

As expected from the trends identified by Cowling and Hilton-Taylor (1997) Chamaephytes (2) make a significant (28%) contribution to the endemics. But the 16% contribution of endemic cryptophytes (4) is interesting. All of the cryptophytes are grassland species and this result highlights the importance of the grassland habitat as one that promotes the evolution of endemics. The data shows that there is a greater than average chance that an endemic will be a cryptophyte or a phanerophyte.

The trends to woody, herbaceous and arborescent habit relate primarily to fire susceptibility. The geophytic habit in particular is a highly effective means of surviving in grasslands that are susceptible to frequent burning. The habit is one adopted by the majority of the Iridaceae and many of the Liliaceae *s.l.* species present in the gorges as well as by a large number of the grassland dicots. The grassland species illustrate the most diverse adaptations in habit, ranging from true annuals to biennials (as described above), through geophytes to shrubs. The grasslands are home to another set of habit specialists, taxa with assimilating stems.

The forest species tend to be less fire-resilient, comprising mainly trees and woody shrubs. Habit constraints in the forest are not primarily related to survival from frequent burning, but are more often related to low light conditions. It is among the forest species that the epiphytic and lithophytic habit is well represented. The forested areas in the UNR and OGNR are host to a number of epiphytic plants from *Peperomia* species to the often-lithophytic *Streptocarpus* species. A number of epiphytic orchids and ferns also occur in these forests. The climbing habit of many of the previously mentioned phanerophytes is a further adaptation to the low light conditions present in forest.

Seepage lines are plentiful in the reserves and these are host to a number of interesting plants including aquatic and subaquatic taxa. *Nymphaea nouchali* Burm. *f.* and *Nymphoides indica* (L.) Kuntze are aquatic dicotyledons and *Utricularia* species are frequent in seepage lines edging sandstone pavements. There are many subaquatic sedges and grasses in the gorges that grow rooted in the mud in shallow water or along the margins of seeps and wetlands in the gorges.

A few habit adaptations are not restricted to one of the two main habitats found in the gorges, parasitic plants and succulent species are examples of these taxa.

2.3.2. Parasitic plants

Parasitic and hemi-parasitic plants exist in both grassland and forest. *Cycnium adonense* E. Mey. ex Benth. is a partial parasite, drawing on its host's resources, but still able to photosynthesise through its own green leaves. Other hemiparasites present in UNR are *Alectra orobanchoides* Benth., *Alectra sessiliflora* (Vahl.) Kuntze, *Striga elegans* Benth., *Thesium acutissimum* A. DC., *T. angulosum* A. DC., *T. cupressoides* A.W. Hill, *T. impeditum* A.W. Hill, *T. natalense* Sond. and *T. pallidum* A. DC. *Harveya coccinea* Schltr. and *Harveya silvatica* Hilliard & Burt have no green leaves and are holo-parasites attached to their hosts' root systems through which they draw all their sustenance. *Tapinanthus kraussianus* (Meisn.) V. Tieghem and *T. natalitius* (Meisn.) Danser parasitise tree species in both gorges. Populations of *Erianthemum dregei* (Eckl.

& Zeyh.) *V. Tieghem* occur in UNR. Populations of *Viscum anceps* E. Mey. ex Sprague, *V. combreticola* Engl. and *V. obovatum* Harv. occur in OGNR. Populations of *V. nervosum* Hochst. and *V. rotundifolium* L.f. occur in UNR, whereas populations of *V. obscurum* Thunb. occur in the both UNR and OGNR.

2.4. HYBRIDS

A putative hybrid, *Streptocarpus haygarthii* x *S. polyanthus* has been collected from OGNR. Populations of *Crassula setulosa* Harv. var. *setulosa* x *C. natalensis* Schönl. occur in OGNR. *Asplenium dregeanum* Kunze x *A. sandersonii* Hook, a putative hybrid has been collected from UNR. The hybrid *Hypoxis angustifolia* Lam. var. *buchananii* x *H. membranacea* Bak. has been collected from both of the gorges. *Erythrina* x *dyeri* Hennessy has been collected from OGNR. *Syzygium cordatum* Hochst. x *S. guineense* (Willd.) DC. has been collected from UNR.

CHAPTER 3: THE ENDEMIC ELEMENT

3.1. INTRODUCTION

3.1.1. Nature, scope and objectives of the chapter

Endemics are elucidators in a number of areas because of their multifactorial dependency. Patterns of endemism are central to biogeography because the hierarchical taxonomic level of endemism is related to the age of the vicariant event giving rise to the taxon, or to the period during which dispersal resulted in a disjunct distribution of the taxon thus providing correlation between phylogenetic patterns of monophyletic lineages and historical events (Chapter 1; Clayton 1983; Major 1988; Cowling & Samways 1995). The distribution of endemic taxa elucidates the interrelatedness of floras and of geographical areas, the age of floras and the origin of floras (Wild 1964; Wild & Bradshaw 1977; Nelson & Platnick 1981; Clayton 1983; Oliver, Linder & Rourke 1983; Kruckeberg & Rabinowitz 1985; Hilliard & Burt 1987; Major 1988; Van Wyk 1993).

The distinction between centres of origin and refugia is fundamental to the development of a hypothesis for the origin of a flora (Clayton 1983). Distinguishing between palaeoendemism and neoendemism is a way to differentiate between a centre of origin and a refugium. Cladograms can be used to characterize endemics in terms of hypotheses of relative age and propinquity of descent. In this context, low-ranking taxa correspond to neoendemics and high-ranking taxa to palaeoendemics (Cowling & Samways 1995).

In this chapter profiles of palaeo and neoendemics are presented and each endemic taxon in OGNR and in UNR is investigated and assigned accordingly. Results only partially support Van Wyk's (1989a, 1989b, 1990b) refugium hypothesis for the origin of the endemic element extant in the Pondoland flora.

Van Wyk (1989a, 1989b, 1990a, 1990 b; Van der Merwe, Van Wyk & Kok 1988; Van Wyk & Schrire 1986) identifies the Pondoland endemics as palaeoendemics, because the Centre acted as a refugium during the Pleistocene, with the species being "trapped" on edaphic islands of sandstone after the break up of Gondwanaland and

subsidence of the Falkland Plateau¹. This is true for many of the endemics present in the gorges. Some taxa do not fit the palaeoendemic profile.

We propose neoendemic origins for these taxa with evolution and adaptation to the sandy, acidic and nutrient poor, sandstone-derived soils of the Pondoland Centre having occurred in recent geological time. Neoendemism is facilitated by short generation time, with resultant high genetic turnover characteristic of many herbaceous taxa. This implies a correlation between the type of endemic and the habit of the taxon. This correlation is investigated, as is that between habitat and endemic type. In addition we probe the extent of the similarity between the endemic element in each of the gorges.

3.1.2. Biogeographical hypothesis for the origins of the endemic element in the Pondoland Centre

Van Wyk (1989a, 1989b, 1990a, 1990b) hypothesised that the Falkland Plateau provided a link between the Cape Supergroup and the Natal Group sandstone during the mid-Cretaceous to late Tertiary. The vegetation of this region thus comprised a mutual floristic element consisting mainly of lowland subtropical forest taxa. Two other elements were present in the sandstone flora, namely more temperate forests on the Cape Fold Mountains (harboured due to the compensating effects of altitude) and an edaphic endemic component in the lowland regions². The climate was wet and warm with weak latitudinal zonation (Van Wyk 1989a, 1989b, 1990b).

With the break up of western Gondwanaland, the sandstones were separated and each acted as a trap for taxa unable to compete on the surrounding non-sandstone substrates (Van Wyk 1989a, 1989b, 1990b). An alternative and possibly complementary explanation for the separation of the sandstone is that sedimentary material laid down after the Gondwana breakup effectively resulted in the fragmentation of these two edaphic islands (SACS 1980).

¹ The Plateau abutted on the African plate when Gondwanaland was largely intact and thus provided the sandstone link between the Cape Supergroup and Natal Group Sandstones for a distinct mutual floristic element (Lorenzo & Mutter 1988).

² This is because floristic provincialism reflects edaphic rather than climatic conditions in lowland regions (Van Wyk 1989a, 1989b, 1990b).

The climate also changed following the break-up, resulting in the extinction of many tropical lowland forest taxa, especially those trapped on the sandstone substrate. However, a few of these edaphically dependent taxa did manage to survive in small isolated populations. The Natal/Pondoland coast provided the perfect refuge for these taxa because of the moderating influence of the ocean on the climate. In the Cape, the pre-fynbos flora underwent rapid expansion, filling in the void left by the lowland forests, but pockets of temperate montane forests still remained in wet areas at lower altitudes. Southward and northward migrations of taxa followed this period, coinciding with the climatic fluctuations associated with the glacial and interglacial periods of the Quaternary (Van Zinderen Bakker 1978³; Lawes 1989; Meadows & Linder 1989).

Both evidence from the geological record (fossil pollen and wood fragment data) and current floristic disjunctions corroborate this hypothesis. In fact, evidence from each of the four floristic elements identified by Van Wyk (1989a, 1989b, 1990b) as being present in the Pondoland Centre supports this hypothesis.

3.2. MATERIALS AND METHODS

3.2.1. Creating the database

A species list (Appendix C) for each area under study is created from all the OGNR and UNR specimens housed at: Natal Herbarium, C.E. Moss Herbarium, Umtamvuna Nature Reserve Herbarium, National Botanical Institute Herbarium, NPB Herbarium and the Herbarium of the University of Natal, forming a database. Unpublished species lists for the two gorges were obtained from Mr A. T. Abbott⁴ (UNR) and Dr K. Balkwill⁵ (OGNR) and were added to the database. Distributional data, taxonomic affinity and degree of taxonomic advancement were collected from herbarium records, literature, field sampling and personal communication with the relevant taxonomic experts (listed in the Acknowledgements) and added to the database. These data are used to establish endemic type.

³ Van Zinderen Bakker (1978) describes this period in detail. Flint (1971) and others (Sparks & West 1972; Goudie 1977; West 1977) also provide reviews of this period.

⁴ Mr A. T. Abbott at Clearwater Farm, P.O. Box 111 Port Edward.

⁵ Kevin Balkwill; The Curator; C.E. Moss Herbarium; Department of Botany, University of the Witwatersrand; Private Bag 3; Wits; 2050; South Africa.

Data on habitat and habit were similarly collected and are correlated with endemic type. Habit may be roughly correlated with generation length, trees have a longer generation length than annuals. Five habit categories have been identified: a) phanerophyte; b) chamaephyte; c) hemicyptophyte; d) cryptophyte and e) thanerophyte (Raukiaer 1934).

The database is used to establish how many of the Pondoland endemic taxa identified by Van Wyk (1989a, 1989b & 1990b) occur in each gorge respectively (Table 3.1., Appendix A & B). Data on the number of endemic taxa per family and per genus are also established for each gorge. The distribution patterns of the remaining taxa on the database were investigated where available to establish whether additional taxa are endemic to the study area.

3.2.2. Geological record data

Relevant fossil data for the Pondoland Centre and environ is limited. Nevertheless, data for fossilised wood fragments from the Mzamba fossil beds and south western Cape fossil pollen exist and have been allocated to extant families or to their predecessors (Muller-Stohl & Madel 1962; Coetzee 1983). The number of endemic species belonging to these families is quantified for each gorge.

The fossil pollen data from the south-western Cape identifies some of the families present in the region during the Upper Cretaceous (Coetzee 1981; Coetzee, Scholtz & Deacon 1983; Coetzee & Muller 1984). The proposed links between the flora of the Cape and the Pondoland Centre are investigated.

3.2.3. Endemic data

Endemics are classified as palaeo or neoendemic. The data set compiled for each endemic taxon present in the gorges comprises taxonomic affinity, current distributional data, degree of taxonomic advancement, reproductive vigour and recruitment potential. The number of neo and palaeoendemics is established for each gorge. This information provides the basis for a comparison of the endemic flora of the two gorges where endemic type is presented as a percentage of the endemic component.

The taxonomic level at which the endemism occurs is recorded, as it is assumed that the higher the taxonomic level of endemism, the older the endemic (Myers & Giller

1988). The correlations between endemic type and habit is investigated, as is the correlation between endemic type and habitat.

Nomenclature, Annotations and Abbreviations

The arrangement of families and genera follows the Engler system, both within the text and in the appendices. Species are arranged and presented alphabetically within this system. The nomenclature and abbreviations of author names follows that of Arnold and De Wet (1993), unless otherwise indicated. Naturalised, or non-indigenous species are indicated by an asterisk (*). Herbarium acronyms follow *Index Herbariorum* (Holmgren, Holmgren & Barnett 1990).

3.2.4. Descriptive terminology

3.2.4.1. Endemism - a definition

De Candolle (1855) coined the term endemic to describe plants with a restricted distribution. Engler (1882 in Myers & Giller 1988) refined the term, differentiating between palaeo and neoendemics. Endemics are generally stenotopic with narrow ecological requirements and are often morphologically specialised (Myers & Gillert 1988).

The suite of characters defining the nature of an endemic are its taxonomic affinity, current distributional data, degree of taxonomic advancement, reproductive vigour and recruitment potential (Engler 1882 in Myers & Giller 1988; Stebbins & Major 1965; Richards 1986; Major 1988).

3.2.4.2. Profile of a palaeoendemic

Palaeoendemics are relicts, isolated phylogenetically by extinction of any close relatives, are often of high polyploidy, and are typically sexual species with widely interrupted distributions. These wide disjunctions are indicative of a once more widespread distribution with subsequent disruption. Each criterion is insufficient on its own to predict the nature of an endemic, so the taxa under investigation should not be judged on isolated characters, but should fit the overall profile. The classic palaeoendemic is therefore taxonomically isolated and ancestral, with a narrow disjunctive distribution, low recruitment potential and reduced reproductive vigour (Engler 1882 in Myers & Giller 1988; Stebbins & Major 1965; Richards 1986; Major 1988).

3.2.4.3. Profile of a neoendemic

A neoendemic is primarily closely related to neighbouring taxa of the same taxonomic group, exhibits a narrow (perhaps expanding, but never widespread) distribution, and is taxonomically advanced. Neoendemics often occur in ecologically recent habitats and have not been widespread (Stebbins & Major 1965; Major 1988). The restricted geographical distribution of a neoendemic is a function of its recent origin and not a result of vicariance (Engler 1882 in Myers & Giller 1988; Stebbins & Major 1965; Richards 1986; Major 1988).

3.2.4.4. Speciation: a definition and processes

Mayr (1942) defines allopatric speciation as speciation that occurs when reproductive isolation is reached while the diverging populations occupy distinct ranges⁶. Parapatric speciation is speciation in peripheral founder populations (Mayr 1982). Many authors contend that these two modes of speciation apply to speciation events within the same land mass, even in the absence of major oro- or hydrographic barriers. The continuity of a given habitat type over very large distances cannot be guaranteed for long time spans. Seemingly continuous habitats are divided into small or large fragments, which act as refugia and centres of divergence. Later as conditions change, they provide a source for bursts of speciation (Haffer 1969; Flenley 1993; Renno, Berrebi & Boujard 1990). Mayr (1982) identifies three mechanisms for speciation: Chromosomal, Hybrid and symbiotic speciation and provides a useful review on the subject.

⁶ For example, when they are isolated by geographic barriers such as islands, or in different caves. This is the classic Darwinian scenario of speciation by geographic isolation.

3.3. RESULTS

The species lists in Appendix C are the core database for this study and are drawn upon throughout the text. The data for the nature of the endemics is presented in Appendices A and B and is summarised in figure 3.1.

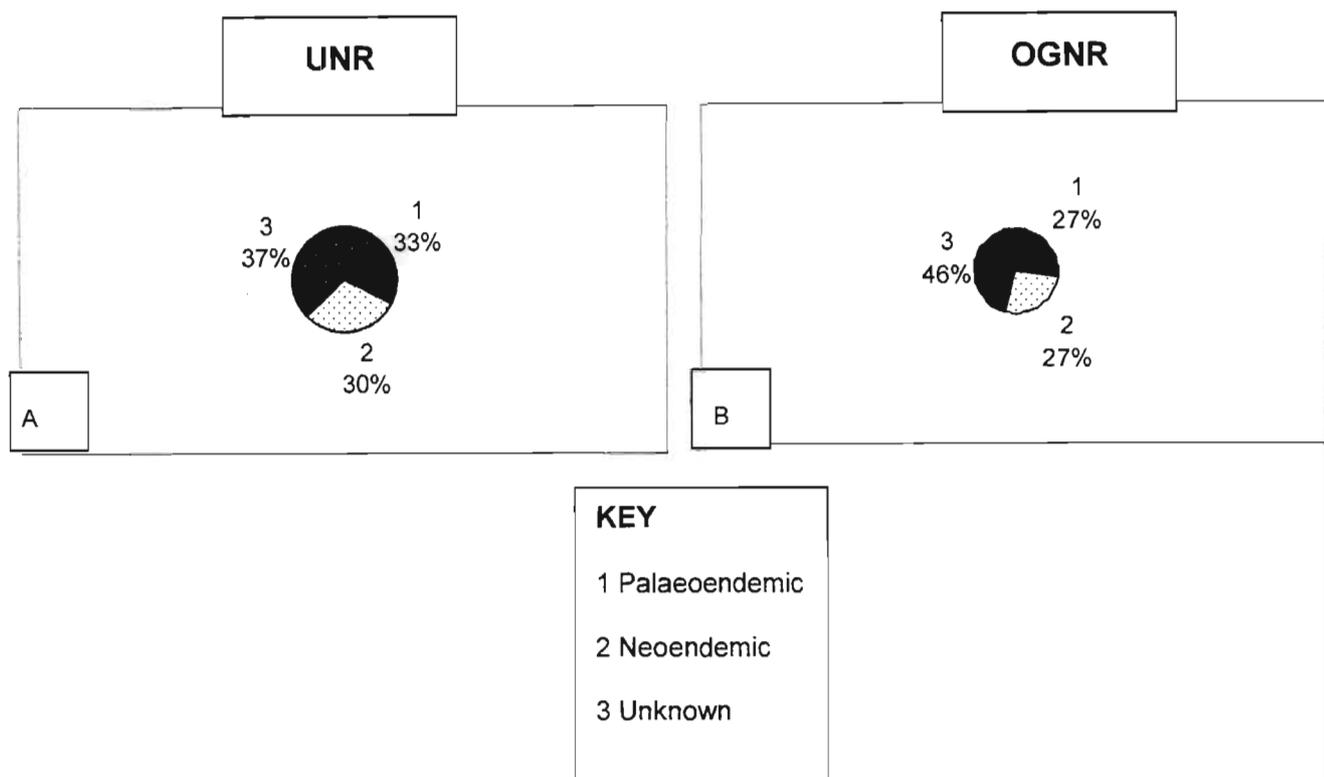


Fig. 3.1. The proportion of palaeoendemic, neoendemic and endemics of unknown status present in UNR (A) and in OGNR (B).

3.3.1. Evidence from the geological record

Although sandstone is sedimentary⁷ it usually contains no fossils. The rock formations in OGNR and UNR consist mainly of sedimentary sandstone, and no fossils of any kind have been found here because the coarse grain allows oxygen and soil-water to penetrate and weathering can thus take place (Glen 1995; Anderson 1994).

The Mzamba fossil beds in the Transkei near Port Edward however contain remnants of a forest of the Upper Cretaceous period. Seventy six fragments of gymnosperm wood, 59 of Monimiaceae⁸ wood and 3 of Euphorbiaceae wood were found (Muller-Stohl & Madel 1962).

Euphorbiaceae wood is not distinguishable from wood belonging to the families Flacourtiaceae, Violaceae, Celastraceae, Apocynaceae, Rubiaceae and Burseraceae, so that the specimens from Mzamba could belong to any of these families. All of the families are represented in the modern flora of both UNR and OGNR. Flacourtiaceae, Violaceae and Celastraceae have endemic representatives in UNR and OGNR (Appendix A).

Fossil pollen from the Tertiary recorded from the south-western Cape belongs to: Myrtaceae, Celastraceae, Melastomataceae, Sapotaceae, Arecaceae, Rubiaceae, Sapindaceae, Proteaceae, Euphorbiaceae and Anacardiaceae (Coetzee 1981, 1983; Coetzee, Scholtz & Deacon 1983; Coetzee & Muller 1984). Myrtaceae, Celastraceae, Melastomataceae and Anacardiaceae have endemic representatives in both gorges, with eight more species found in UNR than in OGNR. The endemic *Manilkara nicholsonii* (Sapotaceae) only occurs in UNR, whereas the Proteaceae and Arecaceae endemics are not found in either gorge, but do occur elsewhere in the Pondoland Centre. No endemic species have been identified from the three remaining families. Celastraceae is the only family represented in the south-western Cape fossil pollen data and the Mzamba fossil wood fragments represented by populations of extant endemic species in both UNR and OGNR. This family also has the highest number of woody species endemic to the Pondoland Centre, with seven endemics in UNR and three in OGNR (Appendix A).

⁷ Plant fossils are usually found in sedimentary rock formations in reducing environments, such as marine, salt and freshwater shales, limestones, bituminous coal, lignite and peat (Anderson & Anderson 1983).

⁸ An extinct family.

3.3.2. The endemics

Thirty shrubs and trees are endemic, or largely confined to the Pondoland Centre (Van Wyk 1993). There are, in addition, many (35 identified) herbaceous endemics in both the grasslands and the forests of the Centre (Appendix A & B). The phenomenon of endemism in the Pondoland Centre is not restricted to a particular taxonomic rank with species through families endemic to the Centre.

3.3.2.1. Woody endemics

Rhyncocalycaceae (*Rhynchocalyx lawsonioides* Oliv.) is a taxonomically isolated, monotypic South African member of the Myrtales endemic to the Pondoland Centre (Johnson & Briggs 1984; Van Wyk 1993). The family (species) may or may not have been more widespread in the geological past. Tobe & Raven (1984) refute previous assumptions of its relatedness to Lythraceae on the basis of embryology and state that it has no direct links to any other group. The taxon is therefore a classical example of a palaeoendemic family.

Many of the endemics present in the gorges fit the palaeoendemic profile with six genera endemic or nearly endemic to the Pondoland Centre. *Dahlgrenodendron* J.J.M. van der Merwe & A.E. van Wyk [*D. natalense* (J.H. Ross) J.J.M. van der Merwe & A.E. van Wyk], *Eriosemopsis* Robyns (*E. subanisophylla* Robyns), *Jubaeopsis* Becc. (*J. caffra* Becc.), *Pseudosalacia* Codd (*P. streyi* Codd), *Pseudoscolopia* Gilg. (*P. polyantha* Gilg.) and *Rhynchocalyx* are monotypic, woody and, except for *Eriosemopsis* (a grassland suffrutex), are all associated with forest (Van Wyk 1989a, 1989b, 1990b, 1995)⁹. Four of these genera are represented in both UNR and OGNR. Populations of *Jubaeopsis caffra* occur in neither of the gorges and *Pseudosalacia streyi* is absent from OGNR, but present in UNR (Table 3.1.).

⁹ The following publications are relevant for more specific data on the endemic genera (Hilliard & Burt 1971; Strey 1972; Hilliard 1977; Toelken 1977; Moffett 1988; Van Wyk 1979a, 1979b, 1982, 1983, 1984, 1987, 1990a, 1991, 1993; Van Wyk & Lotter 1982; Codd 1985; Tobe & Raven 1984; Robbrecht 1985; Schrire 1985; Stirton 1986; Van Wyk & Schrire 1986; Tilney & Kok 1987; Tilney, Kok & Van Wyk 1987; Schrire 1987; Van Wyk & Archer 1987; Van Wyk & Mostert 1987; Van Wyk & Prins 1987; Van der Merwe, Van Wyk & Kok 1988; Moffett 1993; Archer 1992; Van Wyk & Potgieter 1994; Weigend & Edwards 1994; Retief & Van Wyk 1996; Van Jaarsveld & Edwards 1997).

Table 3.1. The presence (√) or absence (-) of the six palaeoendemic genera identified by Van Wyk (1989a, 1989b, 1990b) as endemic or nearly endemic to the Pondoland Centre, in OGNR and UNR.

Family	Genus	OGNR	UNR
Arecaceae	<i>Jubaeopsis</i>	-	-
Lauraceae	<i>Dahlgrenodendron</i>	√	√
Celastraceae	<i>Pseudosalacia</i>		√
Flacourtiaceae	<i>Pseudoscolopia</i>	√	√
Rhynchocalycaceae	<i>Rhynchocalyx</i>	√	√
Rubiaceae	<i>Eriosemopsis</i>	√	√

Pondoland Centre woody endemic species not mentioned above are listed in Appendix A. These additional endemics belong to the following families: Arecaceae, Proteaceae, Lauraceae, Bruniaceae, Anacardiaceae, Celastraceae, Icacinaceae, Rhamnaceae, Tiliaceae, Violaceae, Flacourtiaceae, Myrtaceae, Melastomataceae, Sapotaceae, Periplocaceae, Rubiaceae and Fabaceae. The following Pondoland endemics have not been collected from OGNR or UNR: *Leucadendron pondoense*, *Tricalysia africana*, *Aristea platycaulis*, *Plectranthus praetermissus*, *P. purpuratus*, *Streptocarpus johannis*, *S. modestus*, *S. primulifolius* subsp. *primulifolius* and *Cyphostemma rubroglandulosa*. Populations of the woody endemics, *Plectranthus oribiensis* and *Kleinia fulgens* are only found in OGNR, whereas populations of *Rhus pondoensis*, *Maytenus oleosa*, *M. vanwykii*, *Catha abbottii*, *Rinorea domatiosa*, *Eugenia umtamvunensis*, *E. verdoorniae*, *Syzygium pondoense* and *Manilkara nicholsonii* only occur in UNR.

Fabaceae is an anomaly in this section as the majority of the fabaceous endemics are herbaceous (Appendix B). However the near endemic *Tephrosia pondoensis* (Codd) Schrire is a shrub or often tree, reaching 5 m. It has been collected from dry evergreen forest margins, on moister slopes or drainage lines by A.T.D. Abbott, G.R. Nichols and the author in both the UNR and the OGNR. The species is palaeoendemic indicated by its large, uncharacteristic, orange flowers, arborescent habit and restricted distribution (Schrire 1985). The species was originally described as *Mundulea pondoensis* Codd, but was transferred to *Tephrosia* on the basis of the pods (Codd 1979; Schrire 1985). The species is a relict of a once more widespread tropical flora (Schrire 1987).

3.3.2.2. Non-Woody Endemics

Van Wyk (1990b) estimates that there are at least 100 herbs and sub shrubs endemic to the Pondoland Region, and some to the UNR for example *Eriosema umtamvunensis* C.H. Stirton, *Indigofera rubroglandulosa* Germishuisen and *Crassula streyi* Tölken. Thirty five non-woody endemic species have been identified from the two gorges (Appendix B). The relevant families are Lomariopsidaceae, Iridaceae, Orchidaceae, Periplocaceae, Lamiaceae, Fabaceae, Crassulaceae, Asteraceae, Polygalaceae, Gesneriaceae, Thymelaeaceae and Vitaceae. Characteristics of select endemics are presented under the relevant family headings.

Iridaceae

This family of perennial herbs comprises 1665 species in ca. 78 genera and has a worldwide distribution, with centres of diversity in South Africa, the eastern Mediterranean and Central and South America. It has close affinities with both the Liliaceae and the Amaryllidaceae (Heywood 1978; Goldblatt 1991). The family is the fifth largest in the flora of southern Africa, with the southern African species comprising 55% of the family as a whole. The family comprises four major lineages, subfamilies Isophysidoideae, Nivenioideae (6 genera: 84 species), Iridoideae (ca. 40: 75) and Ixiodeae (28: 850). All except the Tasmanian monotype Isophysidoideae have radiated most extensively in Africa and may have originated there. Ixiodeae, the largest subfamily is almost exclusively African and relationships of the ca. 40 genera remain difficult to determine despite phylogenetic analysis of the family. The family is centred in the Cape Floristic Region with 620 species of the 900 southern African species occurring in this region and ca. 96% of the species and ca. 40 % of the genera endemic to southern Africa (Goldblatt 1991¹⁰).

Subfamily Nivenioideae is represented in the gorge by *Aristea*. The genus (50 species) is centred in Africa and Madagascar (Vincent 1985; Goldblatt 1995a, 1995b; Goldblatt & Manning 1997; Goldblatt & Le Thomas 1997). There are no endemic species in the gorges. The subfamily Iridoideae, tribe Irideae is represented by *Dietes* and *Moraëa* species in the gorges. The latter is centred in sub-Saharan Africa and species of the former are found in East and southern Africa (Goldblatt 1986). There are no endemic species from either genus. These genera are undercollected in OGNR, as no *Moraëa* specimens exist for the reserve and only one species *Dietes iridioides* (L.)

¹⁰ Goldblatt (1991) provides cladograms for Iridaceae – Irideae and Ixiodeae, including the position of the other tribes of the subfamilies.

in the mountains around Worcester & Caledon (16 species) and a secondary southern Cape centre with 11 species, four of which are endemic. The summer rainfall region is by no means depauperate with 21 species. Of the eight species which occur in the coastal sandstone areas of southern Natal and Pondoland, four are endemic or near endemic, namely *W. mtamvunae* Goldblatt, *W. pondoensis* Goldblatt, *W. inclinata* Goldblatt and *W. bachmannii* L. Bolus (Table 3.2.).

The pale pink *W. mtamvunae* is anomalous in section *Gladioloides* because of its low stature and slender habit. The species has a very limited distribution, occurring only on the plateaus and slopes surrounding the Umtamvuna River gorge, but it is fairly common at many of these sites. The endemic, which flowers in August to early October is probably related to the *W. densiflora* Baker complex and is similar to the coastal endemic *W. pondoensis*. (Goldblatt 1989).

W. pondoensis is a purple flowered member of section *Gladioloides* that is only found in marshy grassland at the type locality in UNR and near Port Grosvenor in northern Transkei. It flowers from September to October. It is most probably related to the somewhat larger flowered Pondoland endemic *W. inclinata* (Goldblatt 1989).

W. inclinata also flowers from September to October, but is more widespread within the Pondoland Centre, with specimens collected as far inland as Kokstad. The pink flowers are typical of section *Gladioloides* species and its affinity is with the stiffly erect stemmed *W. pondoensis*. The section *Gladioloides* appears to be a monophyletic line which is not centred in the south-western Cape.

W. bachmannii is a rare endemic that has only been collected from the Mkambati Nature Reserve, Port Grosvenor, near Lupatana in Transkei and UNR, where it grows in open grassland and sometimes marshy sites. The plants bloom from early July to mid October, and the orange flowers, herbaceous bracts and seeds with a wing-like ridge provisionally place the species in section *Watsonia*. Goldblatt (1989) states that its general appearance suggests an affinity with *W. pillansii* (Section *Watsonia*). This section seems to be centred in the south-western Cape.

Populations of all four of the endemics are found in UNR, as are the two other more widespread species mentioned as closest relatives namely *W. densiflora* and *W. pillansi*. No endemic *Watsonia* species occur in OGNR, but there are populations of *W. densiflora*.

Table 3.2. A comparison of the *Watsonia* species that are endemic to the Pondoland Centre (Goldblatt 1978).

	<i>W. mtamvunae</i>	<i>W. pondoensis</i>	<i>W. inclinata</i>	<i>W. bachmannii</i>
SECTION	<i>Gladiolooides</i>	<i>Gladiolooides</i>	<i>Gladiolooides</i>	<i>Watsonia</i>
FLOWERING TIME	August to early October	September to October	September to October	Early July to mid October
FLOWER COLOUR	Pink	Purple	Pink	Orange
ALLIES	<i>W. densiflora</i> complex (sympatric) and <i>W. pondoensis</i>	<i>W. inclinata</i> , <i>W. mtamvunae</i> and <i>W. densiflora</i> complex	<i>W. pondoensis</i> , <i>W. inclinata</i> and <i>W. densiflora</i> complex	<i>W. pillansi</i> tentative (Goldblatt 1989) a widespread species
HABITAT	Well-drained, grassy, stony slopes	Permanently marshy habitat	Permanently marshy habitat	In open grassland, although the type is from a marshy site.
DISTRIBUTION	Narrow endemic, only found in Umtamvuna River Gorge	Populations in UNR and at Port Grosvenor	More widespread within the Pondoland Centre - as far inland as Kokstad	Population only found in Mkambati Nature Reserve and UNR.

The tribe Ixiae (subfamily Ixiodeae) is represented by *Dierama*, *Tritonia*, *Crocospia*, *Anomatheca*, *Hesperantha*, *Schizostylis* and *Gladiolus* species. These genera are all tropical and southern Africa centred and it is interesting that there are no endemic species of this tribe in the gorges (Goldblatt 1986, 1989, 1991).

Orchidaceae

Most of the South African orchids are terrestrial. They may be found in marshes, on sand dunes, on forest floors and in a whole range of soil types. The majority have underground storage organs (swollen stems or tuberous roots). Many tubers are formed in the year prior to flowering (Schelpe 1966). The similarity index for the orchids in the two gorges is, at 20% not high, but I suspect that this is due to undercollection in OGNR and the paucity of specimens from the reserve. More collecting is needed in OGNR.

There are no terrestrial orchids strictly endemic to the Pondoland Centre but *Liparis remota* J. Stewart & Schelpe occurs on sandstones in OGNR, Kloof and Monteseel where it is a forest related litter species. It is most closely related to *L. bowkerii* Harv. which is much more widespread in South Africa.

The best represented terrestrial orchid genus in the gorges is the South African centred *Disa* with 10 species, and only one common to UNR and OGNR. Johnson, Linder and Steiner (1998) present a cladogram for 27 species in an attempt to understand adaptive radiation. Only two of the species on the gorges are covered in this cladogram, limiting its usefulness to this study. However the distribution of the *Disa* species that occur in the Pondoland Centre are interesting. *Disa similis* Summerh. (Section Aconitoideae) has a remarkably disjunct distribution, occurring along the River Zaire – Zambezi watershed and on the Transkei coast (UNR included). *Disa caffra* H. Bol. (Section Hircinornes) has three distinct distribution centres, Madagascar, Pondoland Centre and East Africa. Populations of both of these species occur in wet, swampy places. *Disa versicolor* Reichb. f. (Section Hircinornes) is much more widespread and the distribution is less patchy. The species occurs in secondary montane grasslands in southern Africa, from the Boschberg at Somerset East in the eastern Cape Province to the eastern Highlands of Zimbabwe, and to the highlands of Angola. *Disa sagittalis* (L.f.) Sw. (Section Coryphaea) occurs in the eastern part of the Cape Floral Region and extends into the southern extensions of the Afromontane region. There is a disjunction in the distribution, East London to Port St Johns. The species is often epilithic on sandstones. *Disa stachyoides* Reichb. f. (Section Emarginatae) occurs in the Afromontane grasslands south of the Limpopo River to Port St Johns and Engcobo in the Transkei and UNR. *Disa nervosa* Lindl., of the same Section occurs from Port St Johns in the south to Middelberg in the Eastern Transvaal. *Disa tripetaloides* (L.f.) N.E. Br. (Section *Disa*) occurs in perennially wet habitats on Sandstone between the Hottentots Holland Mountains in the western Cape and Port Shepstone, on the Natal south coast. *D. t.* subsp. *tripetaloides* exhibits the same gap in distribution as *D. sagittalis* (Linder 1981).

There are no epiphytic orchid species strictly endemic to the Pondoland Centre, but many of the species found in the two gorges exhibit interesting patchy distributions with forms that are more or less restricted to certain portions of the geographic range of the taxon. *Polystachya*¹¹ is an example of this pattern with *P. tesellata* Lindl. var. *tesellata* and var. *tricruris* (Section *Polystachya*) occurring at Pigg's Peak (Swaziland),

¹¹ *Polystachya* is large, mainly tropical and subtropical, widespread genus (Williamson 1977).

Nelspruit, Witrivier and Lydenberg Districts (Transvaal), Port St Johns District in northern Transkei and the Port Shepstone, Lower Tugela, Mtunzini and Hlabisa districts in Natal as well as in tropical Africa. The latter variety has larger lilac flowers than its yellow flowered counterpart and occurs in the coastal forested regions and cooler upland forested areas, growing in light to heavy shade (Harrison 1972). Populations of this species do not occur in UNR or OGNR.

A second example of this pattern is *Tridactyle bicaudata* (Lindl.) Schltr., a stately species that flowers from October to February. It is usually found in large clumps as an epiphyte of the cool moist forested regions and often occurs on tall trees in shaded conditions. A more robust form occurs in large colonies on rocky outcrops in fully exposed conditions (Harrison 1972). This form, *T. b.* subsp. *rupestris* is restricted to coastal sandstone outcrops, and potentially the area around OGNR / UNR. Populations of the near endemic occur in OGNR.

Populations of *Stenoglottis woodii* Schltr. occur in UNR and in OGNR. The species is restricted to sandstones around Durban but also occurs on Table Mountain. Populations of *Rangaeris muscicola* (Reichb. f.) Summerh. occur in both OGNR and UNR. The species is a widespread tropical African epiphyte with a patchy south eastern coastal distribution in South Africa. The epiphyte grows on fully exposed rock faces and sandstone outcrops with a southerly aspect (Harrison 1972; Williamson 1977).

Ypsilopus Summerh. is a small genus with a single representative in South Africa, namely *Y. erectus* (Cribb) Cribb & J. Stewart. Populations of the species occur in the forests of UNR, but none occur in OGNR.

Periplocaceae

The genus *Raphionacme* Harv. (Section *Raphionacme*) comprises thirty African endemics', of which ten are confined to southern Africa. *R. palustris* Venter & Verhoeven, is endemic to Natal, occurring in scattered populations from the coast to c. 1000 m above sea level. It inhabits swamps or wet grassland and is most closely related to the sympatric *R. hirsuta* (E. Mey.) R.A. Dyer. This suggests parapatric speciation for the endemic. The species does not follow the distribution pattern typical of the Pondoland endemics, as populations occur at Ngome, Inanda, Karkloof and Mt. Enon, as well as at UNR (Venter & Verhoeven 1986). No populations have been found at OGNR.

Lamiaceae

Lamiaceae, closely related to Verbenaceae, is characterised by a high number of morphologically isolated genera, some of which are widespread and large, while others

are small with limited distributions (Hedge 1992). *Plectranthus* L'Herit. follows the former pattern and is well represented, both in Africa south of the Sahara (Codd 1975; Hedge 1992), and in the Pondoland Region. The genus extends all the way through Asia into Papua New Guinea and Australia. The genus is very poorly represented in the Cape, but five of the 25 species recorded from southern Natal and northern Transkei are endemic (Van Jaarsveld & Edwards 1991). Codd (1975, 1985) states that the endemics are all clear-cut species, not related to one another, nor is there affinity with more widespread species.

All the Pondoland endemics except one, belong to the subgenus *Plectranthus*, Section *Plectranthus* (Table 3.3.). Members of the section occur from South Africa, where they are prevalent in the eastern high rainfall area, with a concentration of species in Natal, to tropical East and West Africa and India (Codd 1985).

P. oertendahlii Th. Fr. Jr. is a perennial, semi-succulent herb that has only been recorded from the Port Shepstone district, Natal (Codd 1985). It occurs in wooded river valleys near the coast and is found in OGNR and in UNR. The species is closest to *P. ciliatus* E. Mey. ex Benth., a soft straggling herb that occurs from Uniondale and Knysna along the eastern Cape semi-coastal areas to eastern Natal and the mountains of eastern Transvaal. Populations of the ally occur in OGNR and UNR.

P. ernstii Codd is only recorded from OGNR, where it is found in rock crevices and steep south-facing cliffs, in humus-rich pockets of soil. This species is also a perennial, semi-succulent herb. No specimens are housed in the various herbaria investigated but populations of the species do occur in UNR (Abbott 1996; Edwards 1997). In floral characteristics, it is similar to *P. praetermissus* Codd and to *P. oertendahlii*, but it exhibits swollen, moniliform stems (Codd 1985).

Table 3. 3. A comparison of the *Plectranthus* species that are endemic to the Pondoland Centre.

	<i>P. oertendahlii</i>	<i>P. hilliardiae</i>	<i>P. ernstii</i>	<i>P. oribiensis</i>	<i>P. saccatus</i> var. <i>pondoensis</i>	<i>P. aliciae</i>
SECTION	Plectranthus	Plectranthus	Plectranthus	Plectranthus	Plectranthus	Coleoides
HABIT	Perennial succulent-like herb.	Perennial, semi-succulent herb	Perennial, semi-succulent herb	Soft shrub or herb	Erect to spreading soft shrub	Perennial, often semi-succulent herb
FLOWER COLOUR	White	Light mauve			Mauve or white	White
	<i>P. oertendahlii</i>	<i>P. hilliardiae</i>	<i>P. ernstii</i>	<i>P. oribiensis</i>	<i>P. saccatus</i> var. <i>pondoensis</i>	<i>P. aliciae</i>
ALLIES	<i>P. ciliatus</i>	<i>P. ambiguus</i>	<i>P. praetermissus</i> & <i>P. oertendahlii</i>	<i>P. fruticosus</i>		
DISTRIB,¹²	Endemic to Pondoland Centre (Uvongo River, OGNR and UNR)	Endemic to area on either side of Umtamvuna River banks	Pondoland Endemic with population in OGNR	Endemic to OGNR	Restricted to Natal-Transkei border	The variety is endemic to the Pondoland Centre (UNR)

P. saccatus Benth. var. *longitubus* Codd is an erect to spreading soft shrub that is recorded from the Gwalaweni Forest at the southern end of the Lebombo Mountains, and from the Natal-Transkei border where populations occur in UNR (Codd 1985). This species displays distinctive trailing forms which appear to be unique to sandstone substrates and may deserve formal recognition (Edwards 1996b). The recognition of this subspecies is contentious as the corolla tube length is highly variable and appears

¹² DISTRIB. Is an abbreviation for distribution.

to form a continuum. A new subspecies was therefore described, *P. saccatus* Benth. subsp. *pondoensis* Van Jaarsv. & S. Milstein (Van Jaarsveld & Edwards 1997) endemic to the quartzitic sandstone cliff faces of the Msikaba River, distinguished by its distinctly succulent leaves and decumbent to procumbent habit.

P. hilliardiae Codd, is a semi-succulent, perennial herb; restricted to an area on each side of the Umtamvuna River, where it grows among rocks near and in the margins of scrub forest (Codd 1985). Populations of the endemic occur in the Msikaba Nature Reserve in very similar habitats. Its nearest affinity is with *P. ambiguus* (H. Bol.) Codd, which is less restricted in its distribution, occurring from the Albany and Bathurst Districts of the Cape, along the coast (including OGNR and UNR), to the Ngoye Forest in Natal (Codd 1975).

P. reflexus E.J. van Jaarsveld & T.J. Edwards is endemic to the Pondoland Centre (only recorded from Port St Johns), but has not yet been found in OGNR or in UNR. This semisucculent suffrutex is most closely allied to *P. praetermissus* and grows in densely shaded, humus-rich soils of tropical coastal forest (Van Jaarsveld & Edwards 1991). *P. praetermissus* Codd is a freely branched perennial herb that has been recorded only from forest glades in Port St. Johns in the Transkei (Van Jaarsveld 3812; Codd 1985). The third Pondoland endemic that occurs in neither OGNR nor UNR is *P. purpuratus* Harv. subspecies *tongaensis* Van Jaarsv. & T.J. Edwards.

P. oribiensis Codd, a herb or soft shrub, is known only from Oribi Gorge (OGNR), where it occurs at forest margins and in wooded kloofs. The corolla is similar in colour to *P. fruticosus* L'Herit, but lacks the purple spots on the upper lip. The endemic has a villous, gland-dotted corolla and cordate-based leaves, which are distinctly tomentose on the adaxial surface, with colourless gland dots (Codd 1985).

P. aliciae (Codd) E.J. Van Jaarsv. & T.J. Edwards is a newly described perennial, often semi-succulent herb, found only in the Transkei and southern Natal and has been collected from UNR. The endemic is a forest dweller. This taxon warrants specific status in view of its distinctive tuberous roots and the fact that it is sympatric with *P. madagascariensis* (Pers) Benth. (Van Jaarsveld & Edwards 1997).

P. malvinus E.J. Van Jaarsv. & T.J. Edwards is restricted to quartzitic sandstone in Natal and the north-eastern Cape. Populations are found at Mount Thesiger, Mount Sullivan and in the adjacent territory on forest margins. It is closely related to *P. ciliatus*.

Of the six *Syncolostemon* species that occur in UNR only one is endemic to the Pondoland Centre, namely *S. rotundifolius* E. Mey. ex Benth. Populations of the endemic occur in both UNR and in OGNR, although OGNR only has populations of three other *Syncolostemon* species including the endemics closest relative *S.*

densiflorus. One other species, namely *S. rhamulosus* E. Mey. ex Benth, which was reinstated recently only occurs on the banks of the Umtamvuna River. This species is also closely related to *S. densiflorus* and from the distribution of this ally and that of the closely related *Hemizygia* species, it appears as if the group has evolved in mountain refugia.

Fabaceae

Podalyria Lam. is a typically Cape genus, with one species, *P. velutina* Burch. ex Benth., a leguminous shrub, that is known only from Pondoland, where it is restricted to the Msikaba Group sandstone derived soils. The endemic lies towards the base of the genus, forming a section together with *P. burchellii* DC., *P. reticulata* Harv. and *P. orbicularis* E. Mey., with *P. burchellii* being its closest ally (Vlok 1996). Thus the species is palaeoendemic. Populations of the endemic occur in OGNR and in UNR. Populations of *P. burchellii* are found in UNR.

Eriosema is an interesting genus with no centre of species radiation in the Cape. Stirton (1986) split the *Eriosema squarrosus* complex (Papilionoideae) into eight species; retaining *E. squarrosus* (Thunb.) Walp.; reinstating *E. dregei* E. Mey.; raising *E. squarrosus* var. *latifolium* Benth. ex Harv. as well as *E. squarrosus* var. *acuminatum* Eckl. & Zeyh. to specific rank [*E. latifolium* (Benth. ex Harv.) C.H. Stirton and *E. acuminata* (Eckl. & Zeyh.) C.H. Stirton respectively]; and describing three new taxa. Two of the newly described taxa are endemic to the Pondoland Region.

The first of these is *Eriosema umtamvunense* C.H. Stirton which is endemic to the grassland plateaus on either side of the Umtamvuna River above 300 m. Although it is a locally abundant, erect, perennial shrub, with conspicuous red and yellow flowers, it has been collected only infrequently (Stirton 1986). Populations of the endemic are found in UNR and in OGNR (Table 3.4.).

The second is *E. luteopetalum* C.H. Stirton, which is endemic to southern Natal, where it is common along the coast and seems to grow best in sandy soils in frequently burnt grassland. No populations occur in UNR or in OGNR. The nearest allies of this suffrutex are *E. latifolium* (Benth. ex Harv.) C.H. Stirton and *E. dregei* E. Mey, with no populations of the former in either gorge and the latter only found in UNR. The former species is endemic to southern Natal and north-eastern Transkei (Pondoland Centre), whereas the latter species has only been found in the low-lying coastal dune and riverine grasslands below 200m, from Port Edward to Mkambati River Mouth (Table 3.4.).

Table 3.4. A comparison of the four *Eriosema* spp. from the *E. squarrosum* complex, that are endemic to the Pondoland Centre (Stirton 1986).

	<i>E. umtamvunense</i>	<i>E. luteopetalum</i>	<i>E. dregei</i>	<i>E. latifolium</i>
FLOWERING TIME	November - December	Spring (Sept. - ?)	August -October	October -November
HABIT	Erect, perennial shrub up to 500mm high- horizontal, branched rootstock	Suffrutex up to 600mm tall	Suffrutex up to 400mm tall	Erect suffrutex up to 1 m tall.
RACEME SIZE	Up to 125mm long, floriferous section 55mm long, 20-25-flowered	Axillary, 24-45-flowered, greatly exceeding leaves	Axillary, up to 67-flowered, exceeding leaves, 55-60mm long	Axillary, 30-45-flowered, 11-12mm long, held well above foliage, peduncles 30-75mm long.
FLOWER SIZE	13-14mm long; bracts 8mm long, caducous	12-15mm long with persistent 10-15mm long, 3mm wide boat-shaped bracts	14mm long, bracts 5x2mm boat-shaped	10-11mm long; bracts 6-7mm long, 2mm wide, boat-shaped
FLOWER COLOUR	Red and yellow	Greenish-yellow	Yellow	Yellow
ALLIES	<i>E. squarrosum</i>	<i>E. latifolium</i> & <i>E. dregei</i>	<i>E. squarrosum</i> & <i>E. luteopetalum</i>	<i>E. dregei</i> & <i>E. luteopetalum</i>
DISTRIBUTION	Endemic to the grassland plateaus on either side of the Umtamvuna River above 300m	Endemic to southern Natal (predominantly coastal)	Only found below 200m from Port Edward to Mkambati River Mouth	Endemic to southern Natal and north-eastern Transkei (Pondoland Centre)

Indigofera rubroglandulosa Germishuisen is a small erect to semi-erect herb which is found in grassland and is nearly endemic to the Pondoland Centre, with outlier populations at Nkandla, Melmoth and Camperdown (Germishuisen 1987). Populations are found in both UNR and OGNR. The distribution of the near endemic overlaps with

that of its closest ally, *I. hilaris* Eckl. & Zeyh. Populations of this ally also occur in both UNR and in OGNR.

Schrire (1985) states that southern Africa is a region of radiation for *Tephrosia*. A herbaceous species is found restricted to the Msikaba formation Sandstone derived soils of the Pondoland Centre, namely *T. bachmannii* Harms, a member of the subgenus *Barbistyla* which has a high degree of endemism in southern Africa.

Crassulaceae

The family is predominantly Cape and *Crassula* is no exception to this pattern as the genus is centred in the Cape. Toelken (1977) describes 2 subgenera, 20 sections, 13 subsections and 144 species with 126 subspecific taxa based on the morphology of the developing seedlings and the distribution of the hydathodes on the leaves. The gorges share 335 of their *Crassula* species. The perennial herb *Crassula streyi* Tölken (Subgenus *Dsiporocarpa*, Section *Anacampseroideae*, Subsection *Fasciculares*) occurs in Natal where it is endemic to the Pondoland Centre. The section is a heterogeneous, but natural group of species that is common in the eastern Cape and Natal, but also westwards to the south-western Cape. The species occurs in UNR, but not in OGNR. It is related to *C. multicava* but may be distinguished by the latter having obvious pits or hydathodes arranged in a row along the margin and scattered over the upper and lower surface of the leaves (Tölken 1985).

Asteraceae

Helichrysum Mill. comprises about 500 species, with representatives in southern Europe, south-west Asia, southern India, Ceylon and Australia with a high concentration in Africa including Madagascar (Hilliard 1977). *Helichrysum pannosum* De Candolle ranges from Camperdown, Pinetown and Inanda districts in Natal to Port St John's in the south, growing on Natal Group sandstone. The near endemic is a perennial herb with a creeping woodstock that grows in grassland up to 650 m above sea level. Populations are found on hillslopes, often near forest patches (Hilliard 1977) in UNR, but the species has not been collected from OGNR. The closest relative is *H. thapsus*, a montane grassland species (Hilliard 1977).

Cineraria (Senecioneae) is an African genus with a species concentration in southern Africa (Cron & Vincent 1994). Although there are no species endemic or nearly endemic to the Pondoland centre, the genus illustrates an interesting phenomenon, particularly with respect to *C. albicans* N.E. Br. This predominantly montane species (Natal Drakensberg, Transkei and eastern Cape) is usually found at the top of sandstone gorges. The species is very variable, particularly with respect to the following

characters: variable size and persistence of the petiolar auricles, the glabrescence of the involucre bracts and the indumentum of the cypselae. Hilliard (1977) suggested that the populations in OGNR and UNR may be a new species with close affinities to *C. albicans* as these populations more frequently have persistently tomentose involucre bracts and cypselae densely ciliate on faces and margins, larger leaves and longer petioles, but the characters are not sufficiently constant to enable the recognition of subspecies or even forms (Cron 1991).

Gesneriaceae

The family is taxonomically problematic with relations between Africa, Malagasy and Asiatic members of the Cyrtandroideae being poorly understood (Hilliard & Burtt 1971; Luegmayer 1993; Weigend & Edwards 1996). *Streptocarpus* is a genus with a wide morphological range with clusters of allied species. Natal contains a high number of endemic species, many of which are found only in the Pondoland Centre (Hilliard & Burtt 1971). The first of these is *S. porphyrostachys* Hilliard. The species is known only from the lower reaches of the Umtamvuna River and its tributaries, the Umzamba River Gorge and the Msikaba River Mouth (Mkambati Nature Reserve). Populations of the endemic are found on damp rock faces in forested gorges and under overhangs along the lips of the gorges along water seepages in UNR, but not in OGNR. The endemic is most similar to *S. cooperi* C.B. Clarke, a mainly Drakensberg and Biggarsberg species which is an element of the *S. grandis* complex and *S. wendlandii* Sprenger, which is endemic to the Ngoye forest in Zululand and has pollen that is aberrant to the rest of the species in this group (Hilliard & Burtt 1971; Weigend & Edwards 1996). Neither of these allies occurs in either of the gorges.

S. modestus L.L. Britten is known only from five collections in a small area in Pondoland, where it grows rooted in soil and wedged in rocky cliff crevices along the drier lips of forested gorges in the area. The populations are usually lightly shaded by other vegetation (Hilliard & Burtt 1971). Populations of the species are not found in OGNR or in UNR. The endemic is most closely related to the variable *S. rexii* (Hooker) Lindley, populations of which are found in the Cape Province eastward from George to southernmost Natal, including Port St Johns.

S. formosus (Hilliard & Burtt) T. Edwards is restricted in its distribution to Port St. Johns in the eastern Cape and Port Shepstone and Umzinto (?) districts in southern Natal. This species is recognisable by the yellow throat flecked with purplish-brown and the darker colour suffusion around the margins of the lobes and is related to the very variable *S. primulifolius* Gandoger (Edwards 1996a.). Populations of *S. primulifolius* do not occur in UNR or in OGNR.

S. haygarthii (N.E. Br. ex) C.B. Clarke is a widespread and variable species which, according to Hilliard and Burt (1971), has a distinct form that occurs only at Highflats, in Oribi Gorge, at Ngeli Mt., Tabankulu and Port St. Johns. The Natal populations of this form have almost pure white corollas, whereas the Cape populations are pale violet flowered. The affinity of this form is clearly with the remainder of the species, but the affinity of *S. haygarthii* is with *S. confusus* Hilliard. *S. confusus* is not found in OGNR or in UNR. One of the populations of the endemic in Oribi Gorge seems to exhibit a degree of hybridisation with *S. polyanthus* W. J. Hooker, with the influence of the gene exchange being visible in size and shape of the corolla limb.

S. traberculatus Hilliard, has a distributional range of about 120 km, stretching from Dumisa in southern Natal to the Umtentu River in Lusikisiki district of the Transkei. The populations are usually found hanging on cliff faces, but sometimes the plants grow under rock outcrops along escarpment edges. The endemic has been collected from OGNR, but not from UNR. The endemic exhibits floral characteristics that are similar to the widespread *S. polyanthus*. Populations of *S. polyanthus* subspecies *polyanthus* occur in both OGNR and in UNR, but *S. p.* subspecies *verecundus* is only found in OGNR. The pollen of the endemic emphasizes the species' isolation (Weigend & Edwards 1996).

Table 3.5. A comparison of the *Streptocarpus* species that are endemic to the Pondoland Centre.

	<i>S. porphyrostachys</i>	<i>S. formosus</i>	<i>S. haygarthii</i> (white form)	<i>S. traberculatus</i>
SECTION	Streptocarpus	-	Streptocarpus	-
FLOWERING TIME	Nov. – Jan.	-	Sept. – April	Oct. – Feb.
HABIT	Herb, sometimes solitary leaf	-	Monocarpic herb	Monocarpic herb
FLOWER COLOUR	Violet patterned floral lobes with white edges, median wedges with deep violet streaks.	Yellow throat flecked with purplish-brown and darker suffusion around lobe margins.	Endemic white form (otherwise pale violet flowers).	Pale to medium violet corolla with white streaks on the floor of the corolla tube. Base of lower lip white marked with deep violet streaks.
ALLIES	<i>S. cooperi</i> (<i>S. grandis</i> complex) and <i>S. wendlandii</i>	<i>S. primulifolius</i>	<i>S. haygarthii</i> and <i>S. confusus</i>	<i>S. polyanthus</i>
DISTRIBUTION	Lower reaches of Umtamvuna River (UNR), Umzamba River Gorge & Msikaba River Mouth	Pondoland endemic	White flowered form endemic to Oribi Gorge, Ngeli Mountain, Tabankulu and Port St. Johns	120 km from Dumisa in southern Natal to Umtentu River (Lusikisiki district) in Transkei

Thymelaeaceae

In South Africa, Thymelaeaceae is a predominantly Cape family. But *Gnidia* species extend into Madagascar and tropical Africa and *Passerina* species occur outside of the Cape. *Struthiola* is predominantly restricted to the Cape, with only one species, the woody shrub *S. pondoensis* Gilg ex C.H. Wr. extending north to Natal.

Populations of this palaeoendemic are found in the UNR, but not in OGNR (although populations of the endemic do occur at nearby Izotsha).

Vitaceae

Cyphostemma rubroglandulosum Retief & Van Wyk is the only member of the Vitaceae endemic to the Pondoland Centre. This perennial, climbing, succulent herb is found in forest and along forest margins and is closely related to *C. anatomicum* (C.A. Sm.) Wild & Drum. The two species are geographically separated, with the latter occurring in the northern Province and Mpumalanga (Transvaal; Retief & Van Wyk 1996).

3.4. DISCUSSION

Endemism may be due to historical, ecological or physiological reasons. The axes of variation on which this phenomenon are based relate to size and age of areas, extermination and re-invasion of the biota of glaciated (or otherwise denuded) areas, island isolation, age and degree of splitting up of land masses, presence of land bridges, ages of flora and habitats, latitudinal, altitudinal and humidity variation and differences in soil. The causes of endemism are complex and numerous, and include historical processes, contemporary ecological factors, inherent biological properties of taxa and their combinations. The endemic data presented is discussed in two parts. The first part deals with the palaeo- or neoendemic nature of the taxa and the second part deals with whether the endemics are habitat or edaphic endemics. Included in this latter section is a discussion on species displaying morphological differentiation that is significant, but not sufficiently so for taxonomic recognition.

A third focus of the discussion concerns the origin of the endemic species in the gorges (and Pondoland Centre), and the implications for past vegetation patterns in southern Africa. In other words, the phytogeographical significance of the Pondoland endemics as elucidators of palaeoenvironment and flora.

3.4.1. Palaeoendemic versus neoendemic nature

Habit reflects the divergence between palaeo- and neoendemic species, as does habitat. The palaeoendemics are almost entirely forest species, with a few exceptions, namely *Watsonia bachmannii* and *Podalyria burchellii*. The palaeoendemic portion is also predominantly perennial and woody, with habit ranging from shrubs to trees. It is thus apparent that historical factors may be more important than the current ecological

determinants for a large portion of the endemic component of the Pondoland Centre flora (Cowling & Samways 1995).

Palaeoendemism may result from environmental change, restricting a formerly widespread species to one or more isolated refugia (Kellman 1975), or be due to vicariance (that is geographical isolation caused by, for example continental drift, mountain building and sea level fluctuations; Stebbins & Major 1965; Richards 1986; Major 1988; Meffe & Carroll 1994). Thus regions with many endemic species may be refugia as a result of one or more major events that caused the ranges of many taxa to be fragmented at approximately the same place (Meffe & Carroll 1994). This is true for the Pondoland Centre and more specifically, for the UNR.

The argument for the palaeoendemic status of *Leucadendron pondoense* and *Pseudosalacia streyii* is enhanced by the fact that Upper Cretaceous/Tertiary fossilised pollen and or wood fragments have been found for the families to which these endemics belong. The affinity of these endemic species with the Cape Floral Region further supports this theory. Similarly the families of *Jubaeopsis caffra*, *Catha abbottii* Van Wyk & Prins, *Rinorea domatiosa*, *Pseudoscolopia polyantha*, *Eugenia erythrophylla*, *Memecylon bachmannii*, *Manilkara nicholsonii* and *Tricalysia africana*, which are allied to tropical species, are represented in the fossilised pollen and wood fragments. Thus an ancient tropical element exists in the Pondoland Centre.

The endemic *Plectranthus*, *Eriosema* and *Streptocarpus* species do not fit the palaeoendemic profile. The *Plectranthus* and *Streptocarpus* species are herbaceous. The *Eriosema* species are pyrophytic herbs.

Habit is important for a number of reasons. The first is that because trees are vulnerable to drought and fire, climatic oscillation led to the retreat of woody forest perennials into gorges as these provided more stable micro-environments, especially along the coast. This implies that the populations became relictual.

Catha abbottii, a large, endemic, forest tree which was discovered in 1986 is good example of this tendency. All known specimens of the species are confined to a 10 km radius, making it a tree with one of the most restricted geographical ranges in southern Africa (Van Wyk 1993). The species combines characters of the primarily tropical *C. transvaalensis* Codd and *C. edulis* (Vahl) Forssk. Van Wyk (1987) states that the endemic seems to be more closely allied with the former, although there are strong similarities in capsule morphology between it and *C. edulis*. This implies that the species may be ancestral and strengthens the argument for palaeoendemism. The species is bird dispersed and therefore theoretically vagile.

White (1955, 1962, 1983) believes that geographic or allopatric speciation is the predominant mode for the larger woody plants. He uses morphologically variable ecological and chorological transgressors (White 1979) to illustrate these points. Although it would thus be useful to identify and study ecological and chorological transgressors in the Pondoland Centre this is beyond the scope of this study.

The herbaceous habit implies fast growth rates and reproduction at an early age implying that there is a higher turnover of genes than that present in a taxon with a slower rate of maturation (Schwartz 1993). Potentially this allows an exponential increase in genetic combinations and a more rapid rate of accumulation of positive environmental adaptations within a population, as well as genetic drift. Thus a correlation between generation length and rate of speciation is implied. The shorter the generation length, the more likelihood there is of incorporating new genetic combinations. An accumulation of new genetic combinations in separate populations could possibly result in new species.

Thus the corollary to the fact that forest retreated into gorges is that new possibilities became available for herbaceous grassland taxa. The taxa were able to evolve seasonal cycles and or fire resilient structures (e.g. caudices and lignotubers). This implies that these species are often recently evolving, and may be neoendemic. This possibility is enhanced by the edaphic conditions present in the gorges. That the sandstone islands create a division of the initial populations, a prerequisite for allopatry is the primary critical fact in the development of neoendemics.

Goldblatt (1986) further emphasises the importance of habit in his explanation for the survival and speciation of many of the indigenous Iridaceae. The climate became increasingly dry and seasonal during the Oligocene and during the extremely arid periods of the late Pliocene and the Pleistocene, a mediterranean climate was established along the Cape west and south coasts. As this arid period eliminated forest and savanna, geophytic species were favoured as they were able to survive the hot dry summers by virtue of their habit. The palaeo- or neoendemic nature of the geophytic endemics is difficult to establish conclusively.

The explanation which best fits the austral distribution typical of the Iridaceae and many other Cape genera is that of a common southern origin at a time when the southern continents were in contact with one another. The theory of continental drift thus explains this type of distribution very well (Goldblatt 19XX). Goldblatt (19XX) proposes a central African origin of the irids in the Cape flora based on his evaluation of the distribution of African genera of the Iridaceae and the fact that the Cape taxa are more advanced and specialised. These genera are not represented by endemic species in the Pondoland Centre, whereas the tribe Watsoniae is.

Watsonia (Tribe Watsoniae, Subfamily Ixiodeae) sits more at the base of the generic cladogram developed by Goldblatt (1989) and its tribe is basal in a similar cladogram of the phylogenetic lineages of the Ixiodeae (Goldblatt 1991).

The three *Gladioloides* endemics are all related to each other and to the *W. densiflora* complex. *W. densiflora* extends along the coast of eastern southern Africa from Port St Johns in Transkei to St Lucia Bay in Zululand and is thus sympatric with the three aforementioned endemics but has a very different flowering time December to March, whereas the endemics flower from early spring to October (Goldblatt 1989; Goldblatt 1991). Oddly, the phenology of the endemics is more in line with Cape species. The close relationship between the endemics implies that the species may be neoendemic, evolving from a common ancestor as a result of allopatric speciation. It is unlikely that this ancestor is common to *W. densiflora* because the different flowering times separate the species genetically. The fourth endemic *W. bachmannii* belongs to section *Watsonia*, subsection *Grandibractea* which is centred in the south-western Cape. The species is thus an outlier, illustrating a form of disjunct distribution in the subsection and appears to be palaeoendemic.

Streptocarpus is a genus with a wide morphological range with clusters of allied species that represent more intense, and more recent, centres of evolutionary activity. Natal seems to be one such recent centre of evolution and speciation rather than the primary centre of subgenus *Streptocarpus*. It follows that the province contains a high number of endemic species, many of which are found only in the Pondoland Centre (Hilliard & Burt 1971; Weigend & Edwards 1996).

Streptocarpus has an interesting evolutionary pattern in which hybridisation and gene-flow, unassociated with polyploidy play an important part (Hilliard & Burt 1971). This makes the genus a good candidate for the evolution of neoendemics as opposed to palaeoendemics. However, this does little to explain the patterns of speciation observed in the Pondoland Centre which are more easily explained by allopatry and rapid evolution in isolation (Weigend & Edwards 1996).

Helichrysum pannosum is a near endemic that reaches as far north as Stanger. Populations are often found in grassland on hill slopes. The species seems to have a relict distribution as it is often associated with grassland marginal to forest. The distribution is restricted to high rainfall areas. *H. thapsus* is its closest relative but displays a montane distribution that seems to be restricted by orographic rainfall. Climatically limited species are usually relictual in their distribution (Hilliard 1977).

The data presented here fits the patterns identified by Cowling and Hilton-Taylor (1997). They showed that endemic forbs are relatively common in moist, summer-rainfall eastern centres; that endemic shrubs are common in all centres: that endemic

succulents are common in the semi-arid winter and non-seasonal rainfall zone; that endemic geophytes are common in the semi-arid southwest; and that endemic trees are rare everywhere except for a relatively low occurrence in the Maputaland, Pondoland and Koakoveld centres. Figure 2.1. illustrates that the endemics are predominantly phanerophytes¹³ (ca. 50%) and chamaephytes (ca. 30%), with ca. 26% cryptophytes.

3.4.2. Edaphic or habitat endemic?

Soil type has a great influence on the distribution of different species, as each species has evolved different environmental requirements, thus substrate availability may be a population limiting factor. Alternatively, edaphic endemism may be the result of competition rather than as a result of physicochemical requirements of the plants concerned (Major 1988). This may be the case with many of the Pondoland Centre endemics, but more experimental research into the ecology of the endemics is needed before conclusions about the causes of edaphic endemism for the Pondoland endemics can be made.

The actively evolving *Eriosema squarrosum* complex provides a good starting point for this investigation. The edaphic endemics within this complex seem to have evolved from species not limited to the sandstones. The endemic *E. dregei* is sympatric with *E. acuminatum*. It is allopatric with its closest ally, *E. luteopetalum*, with *E. umtamvunense* and *E. latifolium*. Allopatric speciation on sandstones is likely to lead to neoendemism. The endemic *E. latifolium* may be of hybrid origin because of size differences in its pollen (Stirton 1986).

That habitat plays an equally important role in the genesis of endemics is illustrated in the previous section. It is not the only important factor as is illustrated by the ferns. Ferns occupy the same habitat niche as many of the habitat restricted species, but they are not themselves restricted because of the high dispersal potential provided by the import and export of spores. Ferns have therefore been able to overcome the island effects of patchy habitats in both the present and the past. Habitat restricted herbs (for example forest associated) have short generation times, fragmentation of their habitat (forest dissection due to drought and decreased temperatures) may trigger allopatric speciation. These endemics are considered habitat endemics. Thus the same events may drive different processes in different taxa with forest restriction and isolation in fact increasing the species diversity of herbaceous

¹³ This category includes creepers and climbers, e.g. the endemic *Cyphostemma rubroglandulosa*.

forest taxa. This is evidenced in the high degree of divergence of herbaceous forest taxa including *Streptocarpus* and *Plectranthus* species.

Because of their lithophytic nature, the forest-dwelling *Streptocarpus* species may be endemic as a result of both edaphic and habitat constraints. But the fact that many, if not all of the endemics occur as epiphytes resolves the question of edaphic endemism. The *Streptocarpus* endemics are not primarily edaphic endemics if they grow happily on trees

Most of the *Plectranthus* endemics (*P. oertendahlii*, *P. hilliardiae*, *P. oribiensis* and *P. aliciae*) are, like the *Streptocarpus* endemics, forest associated species. However, *P. emstii* and *P. saccatus* var. *pondoensis* are endemic to the quartzitic sandstone cliff faces of the Msikaba River and are also habitat endemic. The endemics are currently evolving and are therefore neoendemics. That the endemics are primarily forest species growing on the forest floor suggests that the plants may be restricted as a result of the constraints of both edaphic conditions and habitat.

Liparis remota occurs on sandstones in OGNR, Kloof and Monteseel where it is a forest related litter species and is therefore a habitat endemic rather than an edaphic endemic, and is another example of allopatric speciation as a result of the fragmentation of the forest habitat. It is most closely related to *L. bowkerii*.

Watsonia pondoensis and *W. inclinata* (Section *Gladioloides*) are both habitat restricted as well as being geographically restricted to the Pondoland Centre. Both species only occur in permanently marshy habitats which may suggest that if this habitat were more widespread, then the species would be too.

Ecotypic differentiation, clinal variation and introgression are modes of speciation utilised regularly in the explanations forwarded for current speciation in floral taxa (White 1955; 1962; 1983).

A number of groups show early stages of morphological divergence from sister species. This variation is in many cases not sufficient to warrant taxonomic distinction but this fact potentially understates the genetic divergence of taxa on sandstone. Long distance dispersal with subsequent speciation may explain the patterns observed in *Cineraria albicans*. The apparent isolation of populations of *C. albicans* in the gorges, where they occur amongst the rocks and along the cliffs, has resulted in isolated pockets of gene flow, causing considerable inbreeding. The observation that certain variability is fixed in certain areas, has lead Cron (1991) to hypothesize that the *C. albicans* s.l. complex is in the process of speciating. It is species such as this that need to be investigated more thoroughly for evidence of current speciation and potential neoendemism.

There are no epiphytic orchid species strictly endemic to the Pondoland Centre, but many of the species found in the two gorges exhibit interesting patchy distributions with forms that are more or less restricted to certain portions of the geographic range of the taxon. *Polystachya*¹⁴ is a perfect example of this pattern with *P. tesellata* Lindl. var. *tesellata* and var. *tricuris* (Reichb. f.) Schelpe (Section *Polystachya*) occurring in the Pigg's Peak (Swaziland), Nelspruit, Witrivier and Lydenberg districts (Transvaal) as well as in tropical Africa, the Port St Johns District in northern Transkei and the Port Sheptone, Lower Tugela, Mtunzini and Hlabisa Districts in Natal, including UNR (Harrison 1972). It is likely that the morphs have arisen separately in two or three localities and therefore do not necessarily contribute to the phytogeographic argument presented here, but more ecological and taxonomic data is needed to conclude this contention.

3.4.3. Phytogeographical significance

One may speculate that if phylogenetic constraints are similar and past ecological constraints are similar then it is possible that the genesis of the observed pattern is similar. The section *Gladioloides* (containing three of the four Pondoland endemics) comprises primarily montane grassland species. This pattern of montane affiliations for the endemics is echoed in the endemic *Rhus* and *Apodytes* species and in the endemic *Helichrysum pannosum*'s closest ally, *H. thapsus*. This implies that the mountain ranges of southern Africa may have acted as conduits for species movements in the past. The climatic oscillations during the Quaternary forced the vegetation to migrate up and down the mountain slopes. However many populations became relictual and were pushed into habitats that were stable because they had lost the genetic plasticity to change to suit the new environments. The distribution of *Grewia pondoensis* is parapatric with *Apodytes abbottii* as is the distribution of the species closest allies adding weight to this argument.

The greater part of the OGNR could have been covered during the Tertiary Period by vegetation similar to that found in the Cape mountains (Wild 1964). An indication of this would be species endemic in Natal (and possibly the Transkei), but related to Cape species. A number of species of this kind are found in OGNR. *Chironia laxa* is an example of this pattern. Similarly the presence of *Raspalia trigyna*, *Watsonia* species and Proteaceae species in UNR, implies that the gorge supported a Tertiary

¹⁴ *Polystachya* is a large, mainly tropical and subtropical, widespread genus (Williamson 1977).

Cape mountainous flora. The presence of the palaeoendemic tree species listed earlier provide further support for this argument.

The current distribution patterns observed in *Polystachya*, *Ypsilopus* and *Rangaenis* may illustrate the former continuity of the forest habitat type in which they occur, but it is more likely that the current species distributions are a result of long distance dispersal. More data on the distance over which these species are able to disperse is vital but the assumption is that the light nature of the seeds, and their tiny size make them very good candidates for long distance dispersal. The fact that there is a very high overlap (ca. 70%) between the orchid flora at the species level on Madagascar and that of the mainland, coupled with the fact that this similarity is unlikely to date from the separation of the island from the mainland 100 mya, invokes long distance dispersal and gives some indication of the potential distance that orchid seeds can travel.

The distribution of the *Disa* species present in the gorges presents a complicated picture in terms of phytogeographical significance and will be discussed in more detail in the following chapter. Long distance dispersal is similarly invoked to explain the fact that the Pondoland Centre species display links with both tropical Africa (*D. caffra* and *D. nervosa*) and with the Cape (*D. tripetaloides* and *D. sagittata*).

In conclusion, the endemics are used to investigate correlation between phylogenetic patterns of monophyletic lineages and historical events and to elucidate the approximate timing and extent of transformation events affecting vegetation through space and time (Clayton 1983; Major 1988; Cowling & Samways 1995). The endemics are also used to establish whether the Pondoland Centre is a refugium or a centre of origin as well as to facilitate an investigation into the interrelatedness of the flora in the Centre (Wild 1964; Wild & Bradshaw 1977; Oliver, Linder & Rourke 1983; Hilliard & Burt 1987; Van Wyk 1993). The edaphic conditions, contemporary environment and fragmented nature of many of the habitats (vegetation types) provide an ample suite of explanatory variables for the observed levels of endemism in the gorges. The Pondoland Centre is both a refugium and a centre of neoendemism. The results and discussion presented here are synthesised with those of the following chapters and the resultant conclusions are presented in chapter 7.

CHAPTER 4: THE CAPE ELEMENT

4.1. INTRODUCTION

4.1.1. Nature, scope and objectives

There are strong links between the Cape Floristic Region and the Pondoland Centre (Moll & White 1978; Taylor 1978; White 1983; Acocks 1988; Van Wyk 1989a, 1989b, 1990b). The disjunctions illustrating these links are not restricted to the familial level as in *Bruniaceae* (*Raspalia trigyna*); or to the generic level as in *Leucadendron* (3 endemic taxa); but are also observed at the specific level as in *Helichrysum diffusum* DC. and *Pseudoscolopia polyantha* Gilg. This implies a temporally complex history for the origins of the Cape element in the Pondoland Centre (Section 3.4.). The hypothesis of temporal complexity is observed in the affiliations of the endemics.

The reasons for the investigation of the Cape element in the Pondoland Centre may be summarised as the aims of this chapter and are as follows:

- 1) Primarily to establish and quantify the difference in the flora of the two gorges (OGNR and UNR respectively), with respect to the Cape element.
- 2) Secondarily to utilise the data obtained from the analyses of the Cape floristic links to support the hypotheses regarding the origin of the Pondoland Centre flora developed as a result of the investigation of its endemics.

¹ An anomalous component of fynbos comprising woody taxa of a more tropical affinity than the current fynbos component, nor do these taxa belong to the Cape-Afromontane element, suggesting an origin in the tropical lowland forest prevailing in Gondwanaland in the Cretaceous-Tertiary period. This element is common to the Pondoland Centre as well and recognition of this fact provides some of the rationale for the investigation of the Cape element in the Pondoland Centre (Van Wyk 1989a, 1989b, 1990b).

4.1.2. A brief description of the Cape Floristic Region²

The Cape Region lies between 31°40'-34°30'S and 17°40'-25°45'E and its vegetation is heterogeneous with an anomalous south-western region in terms of both vegetation type and species composition (flora). This region is rich in floral species, but relatively poor in higher-level taxa (Goldblatt 1978; Moll & White 1978; Takhatjan 1978; Taylor 1978; White 1983; Acocks 1988; Major 1988; Myers 1990³; Pomeroy 1993;). Goldblatt (1978) defines the Cape Floristic Region as an area of approximately 89 x 10³ km² which includes all major fynbos⁴ areas and extends from Niewoudtville in the north, following the eastern slopes of the Cedarberg, and thence east from Karoopoort along the northern slopes of the Witteberg, Swartberg and Baviaanskloof, and Groot Winterhoek Mountains, ending at Port Elizabeth (Fig. 4.1.). This delimitation is used for the purposes of this study.

4.1.3. A brief description of the Cape Flora

The fynbos habit is superimposed on the floristic component (Van Wyk 1989a). The floristic component is biogeographically interesting primarily because approximately 73% of the species are endemic to the Cape Floristic Region (Goldblatt 1978; Takhatjan 1978; Major 1988). Both the fynbos habit and high specific endemism are evident in many of the prominent families of the Region, namely Ericaceae, Proteaceae (c. 8% endemic) and Restionaceae (Brown, Kirby & Botha 1996; Brown, Jamieson & Botha 1996).

² Good (1964) designates this Region as a separate Floral Kingdom.

³ Myers (1990) reviews Bond & Goldblatt (1984), Cowling & Roux (1982), Gibbs-Russell (1985; 1987), Goldblatt (1978), Hall (1987), Jarman (1986), Moll & Bossi (1984), Moll & Jarman (1984), Rutherford & Westfall (1986), Tansley (1988) and Werger (1987).

⁴ The term Fynbos was first used by Bews (1916) to describe the characteristic Cape vegetation. It implies both the fine-leaved form of many of the shrubs and the bushy structure of the vegetation, as well as delimiting a plant geographical unit - the distinctive temperate flora found within the Mediterranean-type climate of the south-western Cape. Fire-stimulated seed germination is common in this fire maintained vegetation type and the frequency of this natural phenomenon is once in five to forty years. The vegetation is subject to diverse landscapes and complex ecology (Linder 1996).

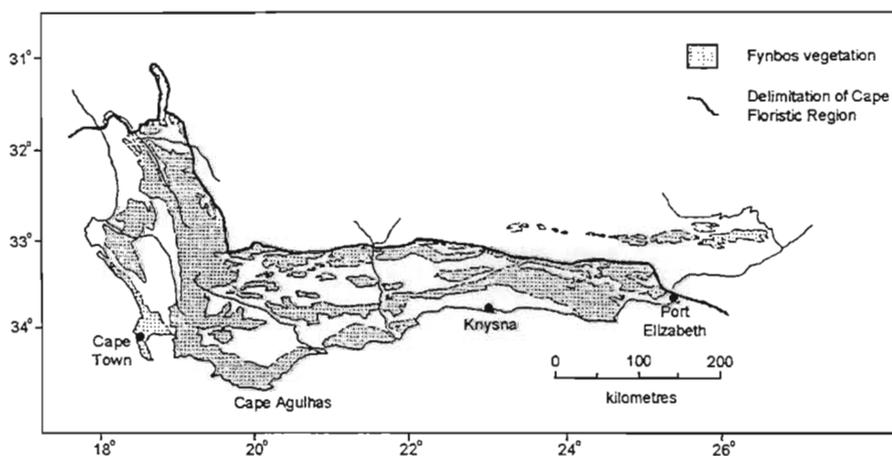


Fig.4.1. The limits of the Cape Floristic Region as defined by Goldblatt (1978). Areas of fynbos type vegetation [Acocks (1988) Macchia, False Macchia, Coastal Macchia and Coastal Rhenosterbosveld] shaded.

Restionaceae and Proteaceae illustrate a second biogeographically important phenomenon namely disjunct distributions. These disjunctions are both intercontinental (between Africa and Australia) and intracontinental (between the Cape and the Afromontane Region, and the Cape and the Pondoland Centre; Goldblatt 1978; Moll & White 1978; White 1983; Acocks 1988; Endrody-Younga 1988; Van Wyk 1989a, 1989b, 1990b). It is the latter that are of primary interest in this chapter.

4.1.4. Biogeographical hypothesis for the origins of the Cape element in the Pondoland Centre

The Cape element present in the Pondoland Centre has two components, an ancient and a more modern one, and is not the result of a single event. Van Wyk's (1989a) refugium hypothesis explains the ancient portion of this element. His hypothesis is summarised as follows:

The sandstone flora, of the mid-Cretaceous to late Tertiary, was primarily composed of lowland subtropical forest taxa but more temperate forest taxa occurred on the Cape Fold Mountains and an edaphic endemic component was extant in the lowland regions (Van Wyk 1989a, 1989b, 1990b).

With the break up of western Gondwanaland, the sandstones were separated, each acting as a trap for taxa unable to compete on the surrounding substrates (Van Wyk 1989a, 1989b, 1990b). The climate became cooler and drier, resulting in the extinction of many tropical lowland forest taxa, especially those trapped on the sandstones. However, a few of the edaphically dependent taxa managed to survive in small isolated populations, especially along the Natal/Pondoland coast because of the ameliorating influence of the ocean on the climate. In the Cape, the pre-fynbos flora underwent rapid expansion, filling the void left by the lowland forests, but pockets of temperate montane forests still remained in wet areas at lower altitudes.

The flora migrated in response to the climatic changes correlating with the glacial and interglacial periods that began in the Pliocene with the Cape flora extending north at times and the temperate forests south into areas now occupied by fynbos, at others (Martin 1968; Schalke 1973; Van Zinderen Bakker 1974, 1978⁵). The more modern Cape element may be a result of long distance dispersal up the east coast of Africa during more recent geological time i.e. post the Mid-Cretaceous. To verify this we need to 1. identify endemic taxa in the gorges with Cape affinities 2. Identify disjunctions at

⁵ Van Zinderen Bakker (1978) describes this period in detail.

different taxonomic levels and 3. establish the taxons' tentative potential for long distance dispersal. The word tentative is used because proving the long distance dispersal ability of species is beyond the scope of this thesis.

4.2. MATERIALS AND METHODS

The data was collected and is presented separately for OGNR and UNR to allow floristic comparison between the two gorges in terms of their Cape element, in order to comply with the primary aim of this study. Cape floristic data is from literature sources, using the geological record and present day distributions (Clayton 1983).

4.2.1. Evidence from the literature

Goldblatt (1978) identified a list of temperate forest taxa derived from and characteristic of the ancient and more extensive sandstone flora extant during the mid-Cretaceous to the Tertiary (Palaeocene). These families are no longer specifically Cape in their distributions, many of them are in fact primarily Natal or Tropical.

4.2.2. Evidence from the Geological Record

No fossils have been found in the Cape Supergroup or Msikaba Group sandstones so direct evidence from the geological record is almost nonexistent (Glen 1996; Anderson 1994). However the Mzamba fossilised wood fragments (Chapter 2; Muller-Stohl & Madel 1962) and south-western Cape fossil pollen (Coetzee 1981, 1983; Coetzee, Scholtz & Deacon 1983; Coetzee & Muller 1984) imply the presence of certain families during the Tertiary/Upper Cretaceous and some correlation occurs between the south-western Cape pollen fossil families and the Mzamba wood fragment fossil families.

Goldblatt (1978) identified thirteen relict woody species from the tropical lowland forest of the Cretaceous-Tertiary present in the Cape Floristic Region. The presence currently of this ancient element is discussed.

4.2.3. Evidence from floristic disjunctions

The way in which present day distributional data best provides evidence for past floras is through the recognition and analysis of floristic disjunctions. Floristic disjunctions between the Cape Floral Kingdom and the Pondoland Centre, are

illustrated by taxa that exhibit a species radiation in the Cape but have a few outliers in Natal, or by those taxa that exhibit disjunctions at the specific level. Thus the database is used to:

- 1) identify the taxa present in each of the gorges which exhibit floristic disjunctions with the Cape flora;
- 2) identify the number of taxa in each gorge which exhibit a Cape radiation of species, but with a few Natal representatives.

The total number of Cape taxa present in each gorge was obtained from the sum of the component sub-elements elucidated in the preceding paragraphs. The flora of OGNR and UNR was compared both in terms of the contribution of each of the sub-elements to the total Cape element, and in terms of the contribution of the total Cape element to the flora of each gorge.

4.3. RESULTS

When the list of Mzamba fossilised wood fragment families⁶ is correlated with the list compiled from fossilised pollen data it is evident that Euphorbiaceae, Celastraceae and Rubiaceae, were present in both the Pondoland Centre and the south-western Cape during the Cretaceous/Tertiary. These three families are currently diverse in both UNR and OGNR.

The species identified by Van Wyk (1989a, 1989b) as relicts of the Cretaceous-Tertiary tropical lowland forest belong to six of the ten fossilised pollen families. Three of the thirteen species (Table 4.1.) are found in OGNR and UNR. Only *Loxostylis alata* (Anacardiaceae) and *Pseudoscolopia polyantha* (Flacourtiaceae) occur in both gorges. *Hartogiella schinoides* (Celastraceae), is only found in OGNR.

The species identified by Van Wyk (1989a, 1989b) as displaying disjunct distributions between the Pondoland Centre and the Cape Floral Kingdom are listed as being present or absent in each of the gorges (Table 4.2.). Two of these species, *Loxostylis alata* and *Pseudoscolopia polyantha* are examples of relict woody species from the tropical lowland forest species presented in table 4.1. The data from table 4.2.

⁶ The following taxa are not represented in the south-western cape pollen fossils: Gymnospermae, Monimiaceae, Flacourtiaceae, Violaceae, Celastraceae, Apocynaceae, Rubiaceae and Burseraceae but are represented in the fossil wood fragments from the Upper Cretaceous forests in Mzamba.

illustrates that fewer of the taxa identified as having disjunctions with the Cape Floral Kingdom occur in OGNR, with a total of four of the eleven species present here. Eight of the eleven species have been collected from the UNR. Populations of *Pronium serratum*, *Leucadendron spissifolium* subsp. *natalense*, *Loxostylis alata* and *Pseudoscolopia polyantha* occur in both gorges.

Table 4.1. Relict woody species from the tropical lowland forests of the Cretaceous-Tertiary present in the Cape Floristic Region, with an indication of their presence (✓) or absence (-) in the OGNR and UNR.

Family	Species	OGNR	UNR
Proteaceae [★]	<i>Brabejum stellatifolium</i>	-	-
Lauraceae	<i>Cryptocarya angustifolia</i>	-	-
Euphorbiaceae [★]	<i>Hyaenanche globosa</i>	-	-
Anacardiaceae [★]	<i>Loxostylis alata</i>	✓	✓
	<i>Laurophyllus capensis</i>	-	-
	<i>Heeria argentea</i>	-	-
Celastraceae [★]	<i>Maurocena frangularia</i>	-	-
	<i>Hartogiella schinoides</i>	✓	-
Sapindaceae [★]	<i>Smelophyllum capense</i>	-	-
	<i>Atalaya capensis</i>	-	-
Sterculiaceae	<i>Sterculia alexandrii</i>	-	-
Flacourtiaceae	<i>Pseudoscolopia polyantha</i>	✓	✓
Myrtaceae [★]	<i>Metrosideros angustifolius</i>	-	-

★ These species represent families proposed as components of an Ancient tropical lowland forest flora identified from late Cretaceous-Paleocene fossilised pollen from the south-western Cape (Van Wyk 1989a).

Table 4.2. Table of species illustrating taxonomic disjunctions between the Pondoland Centre and the Cape Floral Kingdom, indicating presence (√) or absence (-) of the species in OGNR and UNR.

Family	Genus	Species	OGNR	UNR
Cyperaceae	<i>Macrochaetium</i>	<i>hexandrum</i>	-	-
Restionaceae	<i>Restio</i>	<i>triticeus</i>	-	√
Juncaceae	<i>Prionium</i>	<i>serratum</i>	√	√
Asphodelaceae	<i>Caesia</i>	<i>contorta</i>	-	√
Proteaceae [⊕]	<i>Leucadendron</i>	<i>pondoense</i>	-	-
		<i>spissifolium</i> subsp. <i>natalense</i>	√	√
Bruniaceae	<i>Raspalia</i>	<i>trigyna</i>	-	√
Rosaceae	<i>Cliffortia</i>	<i>odorata</i>	-	-
Anacardiaceae [⊕]	<i>Loxostylis</i>	<i>alata</i>	√	√
Flacourtiaceae [⊕]	<i>Pseudoscolopia</i>	<i>polyantha</i>	√	√
Asteraceae	<i>Helichrysum</i>	<i>diffusum</i>	-	√

Goldblatt (1978) incorporates a substantial temperate forest element related to Afromontane forest in the Pondoland Region, and identifies a group of temperate southern African genera, mostly centred in the Cape, but that extend outside southern Africa mainly in highland areas as a Cape-Afromontane group. Examples of this distribution pattern are *Watsonia* (Section *Gladioloides*)⁷, *Romulea* (Iridaceae) and *Osteospermum* (Asteraceae) (Goldblatt 1978). Populations of *O. fruticosum* occur in UNR, *O. grandidentatum* occur in OGNR and populations of *O. imbricatum* subspecies *imbricatum* occur in both. No *Romulea* species were found in the gorges but the checklist of each gorge was investigated for those taxa which exhibit a Cape radiation of species, but which include a few species in Natal. These are listed in table 4.3. with an indication of the number of species per genus in UNR and OGNR.

⁷ The *Watsonia* species have been introduced in the preceding chapter.

Table 4.3. The number of species per taxon with a centre of radiation in the Cape and a few species in the Pondoland Centre, present in each gorge.

FAMILY	GENUS	Species in OGNR	Species in UNR
Restionaceae	<i>Restio</i>	<i>distichus</i>	-
		-	<i>triticeus</i>
	<i>Ischyrolepis</i>	<i>setiger</i>	<i>setiger</i>
	<i>Calopsis</i>	-	<i>paniculata</i>
	<i>Rhodocoma</i>	<i>capensis</i>	-
Iridaceae	<i>Watsonia</i>	-	<i>bachmannia</i>
		<i>densiflora</i>	<i>densiflora</i>
		-	<i>inclinata</i>
		-	<i>mtumvunae</i>
		-	<i>pillansii</i>
	-	<i>pondoensis</i>	
	<i>Aristea</i> ⁸ *	2 species	7 species
Proteaceae	<i>Protea</i>	<i>caffra</i>	<i>caffra</i>
		<i>roupelliae</i>	<i>roupelliae</i>
		<i>simplex</i>	<i>simplex</i>
	<i>Leucadendron</i>	-	<i>salignum</i>
		<i>spissifolium</i>	<i>spissifolium</i>
Bruniaceae	<i>Raspalia</i>	-	<i>trigyna</i>
Rosaceae	<i>Cliffortia</i>	<i>linearifolia</i>	-
		<i>paucistaminea</i>	<i>paucistaminea</i>
		-	<i>serpyllifolia</i>
		<i>strobilifera</i>	<i>strobilifera</i>

⁸ This genus is described as a Cape Afromontane taxon (Goldblatt 1978), but all the species present in UNR and OGNR fall under Subgenus *Eucapsulares* which is predominantly tropical, Madagascan and eastern South African in distribution (Goldblatt & Le Thomas 1997).

FAMILY	GENUS	Species in OGNR	Species in UNR
Geraniaceae	<i>Geranium</i> <i>Monsonia</i> <i>Pelargonium</i>	- - - <i>natalensis</i> <i>alchemilloides</i> - <i>luridum</i> - <i>odoratissimum</i> <i>pulverulaentum</i>	<i>flanaganii</i> <i>angustifolia</i> <i>grandifolia</i> <i>natalensis</i> <i>alchemilloides</i> <i>capitatum</i> <i>luridum</i> <i>oblongatum</i> - -
Polygalaceae	<i>Muraltia</i> <i>Polygala</i>	- - - <i>confusa</i> - <i>fruticosa</i> - <i>hottentotta</i> - <i>ohlendorfiana</i> - - <i>serpentaria</i> - <i>virgata</i>	<i>lancifolia</i> <i>saxicola</i> <i>amatymbica</i> <i>confusa</i> <i>esterae</i> <i>fruticosa</i> <i>gerrardii</i> <i>hottentotta</i> <i>myrtifolia</i> <i>ohlendorfiana</i> <i>refracta</i> <i>rehmannii</i> <i>serpentaria</i> <i>uncinata</i> -
Rhamnaceae	<i>Phylica</i>	- <i>paniculata</i>	<i>natalensis</i> <i>paniculata</i>

FAMILY	GENUS	Species in OGNR	Species in UNR
Fabaceae – Papilionoidae	<i>Lotononis</i>	0 ¹⁰	7
	<i>Aspalathus</i>	- <i>gerrardii</i> <i>spinosa</i> - <i>pinnata</i>	<i>chortophila</i> <i>gerrardii</i> <i>spinosa</i> <i>uniflora</i> <i>pinnata</i>
Asteraceae	<i>Relhania</i>	<i>pungens</i>	<i>pungens</i>
	<i>Felicia</i>	<i>erigeroides</i> - <i>muricata</i>	<i>erigeroides</i> <i>filifolia</i> -
	<i>Stoebe</i>	<i>vulgaris</i>	<i>vulgaris</i>

The results from this table may best be divided up into the following observed patterns. The first group consists of those taxa for which each gorge has a different specific composition with no species common to both. This pattern is well illustrated by the *Restio* species, where each gorge contains a separate species. The Geraniaceae are interesting because although the same number of species occurs in each gorge, the species composition is completely different. *Pelargonium* species predominate in OGNR (4 species) and only one *Monsonia* species whereas the family is represented by *Geranium* (2 species), *Monsonia* (3 species) and *Pelargonium* (4 species) in UNR.

A second pattern is best illustrated by *Aristea* (Iridaceae), where the gorges share one or more species (in this case *A. woodii* and *A. cognata*), but these species are the only representatives of the genus in one of the gorges (in this case OGNR). These species are both widespread generalists. *Phyllica* (Rhamnaceae) follows this pattern with collections of *P. paniculata* from both OGNR and UNR, and *P. natalensis* from the latter gorge only. The former species is a widespread in South Africa, but the latter species is found only in Natal. This may be another example of the fact that the flora of OGNR is in dire need of collection to provide a comprehensive species list for the Reserve. *Aspalathus* is represented by *A. gerrardii* and *A. spinosa* subsp. *spinosa* in

¹⁰ The *Lotononis* species belong to three sections (*Lipozygis*, *Krebsia* and *Buchenroedera*) of the genus all of which are centred in the eastern part of South Africa, none of which extends to the Cape (Goldblatt & Le Thomas 1997).

OGNR, both of which are restricted to Natal and the Cape. Populations of *A. chortophila* and *A. uniflora* are found in UNR in addition to the OGNR *Aspalathus* species. The latter species is anomalous as it is not widespread in South Africa.

A third pattern is observed in *Watsonia* (Iridaceae) where only the widespread *Watsonia densiflora* is shared by both gorges, while the rest of the species in the two gorges are different. The UNR *Watsonia* species are particularly interesting because four of the six species are Pondoland endemics. *Cliffortia paucistaminea* occurs in both gorges whereas *C. linearifolia* occurs in OGNR only and *C. serpyllifolia* only in UNR. *Felicia* (Asteraceae) is represented in both UNR and OGNR by *F. erigeroides*, a widespread generalist, but *F. muricata* occurs in OGNR only, whereas *F. filifolia* is only found in UNR. Three *Erica* (Ericaceae) species are common to OGNR and UNR, however *E. caffrorum* var. *caffrorum* and *E. leucapelta* only occur in OGNR, whereas *E. abbottii*, *E. aspalathifolia* var. *aspalathifolia*, *E. caffra* var. *caffra*, *E. hispidula* var. *hispidula* and *E. oatesii* var. *oatesii* occur only in UNR. The *Gnidia* (Thymelaeaceae) species are similar with 50% of the species in OGNR widespread generalists, but only 30% of the species in UNR generalists.

A fourth pattern is observed in *Protea* (Proteaceae) found in the gorges. The genus is represented by the same three species, *P. caffra*, *P. roupelliae* and *P. simplex* in each of the gorges, all of which are widespread species. Similarly the widespread, *Leucadendron spissifolium* (Proteaceae), *Ischyrolepis setiger* (Restionaceae), *Psoralea pinnata* (Fabaceae), *Zanthoxylum capense*, *Calodendrum capense*, *Agathosma bisulca*, *A. ovata*, *Oricia bachmannii*, *Clausena anisata* (Rutaceae) and *Relhania pungens* (Asteraceae) occur in both UNR and OGNR. As these species are all widespread they provide little information about past vegetation patterns.

Raspalia (Bruniaceae) is another example of a common pattern observed in these data, namely that the genus is represented in one gorge (in this case by *R. trigyna* in UNR) and is absent from the other (OGNR). *Calopsis paniculata* (Restionaceae) only occurs in UNR. *Muraltia* (Polygalaceae) is represented by *M. lancifolia* Harv. and *M. saxicola* Chod. in UNR, but has no representatives in OGNR, although the family is well represented in both gorges. *Lotononis* (Fabaceae) is represented by *L. alpina* subspecies *multiflora* (Section Buchenroedera), *L. bachmanniana* (Section Krebsia), *L. camosa* (Section Krebsia), *L. corymbosa* (Section Lipozygis), *L. eriocarpa* (Section Krebsia), *L. meyeri* (Section Buchenroedera), *L. pulchra* (Section Lipozygis) and *L. viminea* (Section Buchenroedera) in UNR but has no representatives in OGNR. *L. corymbosa* and *L. pulchra* are both widespread in Natal at least (Ross 1972).

Aristea is interesting as all of the species present in the gorges belong to subgenus *Eucapsulares* (24 species). This genus, with 50 species (Weimarck 1940;

Vincent 1985; Goldblatt 1995a, 1995b; Goldblatt & Manning 1997; Goldblatt & Le Thomas 1997), is the largest genus in subfamily Nivenioideae (Iridaceae). Two subgenera in the genus (*Pseudaristea* and *Aristea*) are restricted to the Cape Floral Region. The third, like *Gladiolus* and *Crocasmia* (Sub-family Ixioidae) is widespread in sub-Saharan Africa and shares species with Madagascar. Goldblatt and Le Thomas (1997) used pollen characters combined with morphological and anatomical features to create cladograms revising infrageneric classification in the genus. The species relationships in *Eucapsulares* are poorly resolved. As a result four informal 'species-groups' are recognised. The gorge species belong to three of these groups: the *A. angolensis* group (*A. angolensis* Baker including *A. flexicaulis* Baker, *A. compressa* Buch. ex Baker, *A. gerrardii* Weim. – closely related to *A. compressa* and possibly not distinct, and *A. woodii* N.E. Br.), the *A. ecklonii* group (*A. ecklonii* Baker) and the *A. anceps* group (*A. abyssinica* Pax. – including *A. cognata* N.E. Br.).

The correlation between phylogeny and geographical distribution is high with subgenus *Eucapsulares* comprising widespread, temperate adapted species distributed throughout highland areas in sub-Saharan Africa and Madagascar. Eastern southern African and tropical African species show very discrete habitat preferences. Open grassland, short grassland, marshland and forest each harbour particular species (Goldblatt & Le Thomas 1997).

Lotononis is distributed throughout the African continent, including the adjoining extreme southern parts of the Mediterranean region and eleven centres of endemism have been defined. The geographical distributions of the various sections reveal definite patterns, one of which is highlighted by the species present in UNR. The three sections (Lipozygis, Krebsia and Buchenroedera – monophyletic units) have a very localized distribution and are restricted to the eastern part of southern Africa. One species, *L. bachmanniana* Duemmer is endemic to the north-eastern Transkei and south-eastern Natal. The endemic is closely related to the more widespread *L. carmosa* from which it can be distinguished by the former's suffrutescent habit, umbellate inflorescences and slightly larger flowers (Van Wyk 1991).

The orchid *Disa sagittalis* (L.f.) Sw. (Section Coryphaea) occurs in the eastern part of the Cape Floral Region and extends into the southern extensions of the Afromontane region. There is a disjunction in the distribution, East London to Port St Johns. The species is often epilithic on sandstones. *Disa tripetaloides* (L.f.) N.E. Br. (Section Disa) exhibits the same gap in distribution as *D. sagittalis* and occurs in perennially wet habitats on sandstone between the Hottentots Holland Mountains in the western Cape and Port Shepstone, on the Natal south coast. *D. t.* subsp. *tripetaloides*. This pattern is typical of Cape element species. Unfortunately the sectional divisions are

not based on cladograms and so do not necessarily reflect monophyletic groups. This limits the usefulness of biogeographic decisions based on the sectional divisions. Nevertheless, section *Coryphaea* is restricted to the Cape Floral region, with one species extending into the eastern Cape Province, and one species endemic to the island of Reunion. Section *Disa* is similarly concentrated in the Cape, with species widely distributed in the western, southern and eastern Cape province (Linder 1981).

The tribe *Anthospermae* (Rubiaceae) is centred in tropical, subtropical and temperate regions of the southern hemisphere. All African and Madagascan taxa belong to subtribe *Anthosperminae*. *Anthospermum streyi* Puff is a narrowly endemic dwarf shrub that is closely allied to the widespread (excluding the southwestern Cape) *A. pumilum* Sond. The species belong to the *Anthospermum galioides* group which is centred in the southwestern and western Cape.

Prionium serratum (L.f.) Drege ex Mey. is an aquatic or semi-aquatic that is common in the southern Cape, occurring in the southeastern Cape and then disjunct to the Pondoland Centre (Obermeyer 1985). Populations of *Helichrysum diffusum* DC., a south western Cape species, occur in the Drakensteen, Hottentots Holland and Wemmershoek Mountains. There is a disjunction to the Umtamvuna River and its tributaries in southern Natal. It is locally frequent in the grassland around the bases of the big weathered Table Mountain Sandstone (Natal Group Sandstone) outcrops in the area (Hilliard 1977).

The following Cape families are best represented in UNR; Iridaceae (26/10 species¹¹, excluding *Aristea*), Bruniaceae (1/0 species), Polygalaceae (14/6 species), Rhamnaceae (6/4 species), Thymelaeaceae (17/7 species), Ericaceae (8/4 species) and Fabaceae (101/82 species). Fabaceae is not solely a Cape family and many of the species have more tropical affinities so the overall representation may be inflated here, hence the concentration on the three predominantly Cape genera within the family (*Lotononis*, *Aspalathus* and *Psoralea*). Ideally the affinity of each species should be ascertained, but this requires a separate research effort.

4.4. DISCUSSION

As stated in the Materials and Methods (Section 3.2.), evidence for past floras comes from three main sources the first of which is the geological record. The lack of

¹¹ (x/y species) Where x is the number of species in UNR and y is the number of species in OGNR.

species level data for the Pondoland Centre is a serious shortfall as the fossil families are widespread and are not restricted to sandstone. Thus no generalisations concerning the origin of these families in the Pondoland Centre can be made.

Present day distributional disjunctions provide evidence in the following way. Attention is usually focussed on wide disjunctions involving taxa which have narrow geographical ranges, and, despite their relatively close relationship, are nevertheless sharply distinct. Such disjunctions are likely to have a long history behind them, and the longer the history is, the more difficult it is to interpret them. Disjunct distributions (White 1983) have been the subject of much controversy centred largely on the relative importance of long distance dispersal and direct migration over existing and earlier land masses, followed by extinction in parts of the former range, and vicariance of widespread populations. Dispersal mechanisms may support the former mode as illustrated by White (1983)¹².

Assuming the principal of biogeographic plausibility a disjunction in the distribution of a taxon at the species level suggests a more recent disruptive event than one resulting in a disjunct distribution at the familial level, for example Bruniaceae (*Raspalia trigyna*), or at the generic level as is the case with *Leucadendron*. Therefore species level disjunctions often indicate a more recent continuum of floristic elements than higher level taxon disjunctions. The majority of floristic disjunctions observed between the Cape and the Pondoland Centre taxa fall outside of this category, with generic and familial disjunctions of 600 km or more. This suggests vicariance at some time in the geological past. Identification of the seed dispersal mechanism of these species is necessary to establish the feasibility of long-distance dispersal potential of the species. *Disa sagittalis* and *D. tripetaloides* are examples of species level disjunctions, as are the species listed in table 4.2. Species level disjunctions, perhaps more so than generic or familial disjunctions, pose the question of vicariance or long distance dispersal. The *Disa* species produce copious amounts of seed that is then wind dispersed, which makes the argument for long distance dispersal feasible. Similarly the argument for long distance dispersal as an explanation of disjunction in *Loxostylis alata* is feasible as the trees produce fruit that is eaten by birds. However, the

¹² White (1983) presents an example of long distance dispersal between Africa and America in a number of genera with a specialised dispersal mechanism, namely highly bouyant seeds.

¹³ Adamson (1958) disputes this theory, maintaining that the Proteaceae, Rutaceae, Leguminosae and Restionaceae of Australia and the Cape Region have entirely different and independent origins.

long distance dispersal potential of *Helichrysum diffusum*, *Pseudosclopia polyantha* (with fruits that dehisce on ripening resulting in local dispersal) and *Caesia contorta* is less obvious. The paucity of information on *Raspalia trigyna* makes it impossible to establish the seed dispersal agent.

Twice as many of the species identified as displaying disjunctions with the Cape Floral Kingdom occur in UNR as in OGNR (Table 4.3.). There are two plausible explanations for this. Firstly that the former gorge has acted as a more stable refugium in the past due to its coastal proximity, lower elevation and resultant ecological factors than OGNR; and secondly that UNR is or was at some stage in closer proximity to the Cape Floral Kingdom than OGNR facilitating easier dispersal of taxa from the Cape Flora into the gorge. The explanations are complementary rather than mutually exclusive and so both are invoked here to explain the observed species patterns. The family disjunctions between the Cape Floral Kingdom and the Pondoland Centre is illustrated by Bruniaceae. *Leucadendron* illustrates generic disjunction between the Cape and the Pondoland.

The distinction between the two component sets of taxa comprising the Cape element is made because a predominance of the older Cretaceous-Tertiary tropical lowland forest relict taxa has different implications than a predominance of the more modern Cape element. In other words the magnitude and the nature of the links are both important to the explanation for the presence of the Cape element within the Pondoland Centre. Although the UNR may have a higher percentage of both groups of Cape element taxa, different processes may account for the presence of each subset of taxa present in the reserve. The number of species per taxon that display a centre of radiation in the Cape with a few species present in the Pondoland Centre give an indication of the potentially more modern links between the two floras. The UNR consistently has a higher number (75 species) of these species than the OGNR (46 species).

The fact that a variety of patterns are illustrated by Cape taxa in the gorges, implies a temporarily complex explanation for the origin of the Cape element in the Pondoland Centre flora (UNR and OGNR). That the Cape element identified in table 4.3. is almost consistently better represented in UNR than in OGNR, is a pattern well illustrated by the Iridaceae.

Watsonia (Ixioidae), with its cormous rootstock is a typical example of the predominant pattern of distribution presented by the mainly Cape Iridaceae namely, a concentration of genera in the Cape. A few genera are also found in Australia and the Americas, that is, exhibit a predominantly Austral distribution with a clear radiation of

genera in the Cape, South Africa and with these representatives illustrating polyploidy. The theory of continental drift explains this distribution very well, with the irids originating in central Africa (taxa with high polyploidy) and migrating very slowly, due to climate change and mountain erosion (Goldblatt 1978). The data presented in Appendix C show that the only *Watsonia* common to both gorges is *W. densiflora*. What is perhaps more relevant is that the Pondoland endemic species in the genus belong to two separate sections. Following Goldblatt and Le Thomas' (1997) logic, this implies that the genus has colonised the Pondoland Centre at least twice.

Although the Iridaceae is a predominantly Cape family, Goldblatt (1989) has postulated that the irids in the Cape have a central African origin, *Aristea* and *Gladiolus* fit this pattern. The species are simpler, less specialised and exhibit polyploidy in the Cape, implying that a general African origin is possible, with secondary origins in the Cape for some specialised genera. Species radiation in the subgenus *Eucapsulares* (*Aristea*) appears to be largely habitat-driven (Goldblatt & Le Thomas 1997). Goldblatt (1991) proposes a model of ecological and geographic speciation to explain the radiation and speciation in most genera of Iridaceae.

Van Wyk's (1991) revision of *Lotononis*, based on cladistic analysis of morphological, chemical and cytological characters, suggests an early pan-African distribution of the genus with subsequent speciation in localised areas, particularly in temperate southern Africa. Patterns of endemism within the genus agree with the concept of highland refugia. Subsequent speciation in and around current centres of species richness (Cape region, Namaqualand and eastern Cape and the Natal Drakensberg) would explain the localized distribution of the species and most of the sections, in particular the three represented by species present in UNR.

The data therefore support the hypothesis for the dichotomous nature of the endemics proposed in chapters one and three as well as the hypothesis of temporal complexity for the origin of the floristic elements in the Pondoland Centre flora.

CHAPTER 5: THE AFROMONTANE ELEMENT

5.1. INTRODUCTION

5.1.1. Nature, scope and objectives

The Afromontane flora is better represented in the Tongaland-Pondoland Regional Mosaic than in any lowland phytochorion (Goldblatt 1978; Moll & White 1978; White 1978, 1983; Takhatjan 1986; Acocks 1988; Van Wyk 1989a). A number of widespread woody Afromontane species occur in the Pondoland Region including a subset, referred to as the Cape Afromontane element (Table 5.1.) (Van Wyk 1989a).

These floristic links provide a tool for the investigation of historical vegetation patterns and for the establishment and validation of potential migratory routes for plant species in the recent and distant past. Evidence of past dispersal corridors becomes important when attempting to answer biogeographical questions about the origin of a flora (Geldenhuys 1989). The Afromontane components of the OGNR and the UNR flora provide an indication of degree of relation between these two floras.

This chapter aims to:

- 1) identify the Afromontane species present in the gorges;
- 2) assign these species to Van Wyk's (1989a, 1989b, 1990b) general or Cape Afromontane element;
- 3) establish whether there is a higher concentration of Afromontane species in OGNR or in UNR;
- 4) utilise this information to compare the flora of OGNR with that of UNR and to support the hypothesis for the nature of the endemics proposed in chapters one, three and four;
- 5) identify potential migratory routes for the element, both in the geological past, and in the present.

5.1.2. A brief description of the Afromontane Region

The Afromontane Region was first described as a series of isolated highland areas in Africa with its main centers in Ethiopia, East Africa and eastern South Africa (White 1978). It represents an archipelago-like regional centre of endemism and includes mountainous regions from Sierra Leone in the west, Somalia in the east, the Red Sea Hills in the north and the Cape Peninsula in the south (Meadows & Linder 1989). In South Africa, it is situated around the Drakensberg Mountains in Lesotho and western Natal, extending northward through the eastern Transvaal and southward to the Hogsback area of the eastern Cape Province (Fig. 1.3.). This temperate region shows some relation to Eurasia and has strong links with both Afromontane zones outside of the country and with the Cape¹ (Goldblatt 1978; White 1978; Hilliard & Burt 1987; Matthews, Van Wyk & Bredenkamp 1993). The Afromontane flora contains at least 4000 species, approximately 75% of which are endemic (White 1983).

5.1.3. A brief description of Afromontane vegetation

5.1.3.1. Forest

The vegetation of the Afromontane region is a mosaic of grassland or heathland with scattered patches of evergreen forest. The forest patches are floristically homogeneous, but with some floristic and structural changes along moisture and altitudinal gradients. The forest patches are comparatively poor floristically (Matthews, Van Wyk & Bredenkamp 1993). Few of the forest patches are large enough to contain the whole range of conditions (Meadows & Linder 1989)². White (1978, 1983) recognises two types of forest in the region namely, Afromontane Forest and Undifferentiated Afromontane Forest. The Afromontane forests share relatively few species with the south African coastal forests, except for the coastal forests at Umtamvuna and in the Transkei (Geldenhuys 1989).

¹ This is particularly true at the generic level (Hilliard & Burt 1987; Matthews, Van Wyk & Bredenkamp 1993).

² Meadows and Linder (1989) provide more detailed information regarding the floral and structural composition of the Afromontane forests in South Africa.

5.1.3.2. Heathland

The heathland component of Afromontane vegetation is mostly restricted to streamlines in the grassland, or dominates the vegetation on rocky slopes in the southern African portion of the region. The rocky slope heathlands are very similar to the Cape flora, dominated by Proteaceae with an Ericaceous component. Restionaceae frequently occur on these rocky slopes as do *Cliffortia*, *Anthospermum* and *Passerina* species.

5.1.3.3. Grassland

The southern African Afromontane Region flora is predominantly grassland, with a rich herbaceous component that often reflects edaphic conditions, and a resultant high endemic component (Hilliard & Burt 1987; Acocks 1988; Matthews, Van Wyk & Bredenkamp 1993). Clayton (1983)³ defines a South African element of Afromontane grasses as the northward extension of another montane flora of pooid grasses centred on the Drakensberg range. The herbaceous component usually flowers before the grasses and overwinters as rootstocks, tubers or rhizomes. Very little research has been carried out on this component of the vegetation (Meadows & Linder 1989) but it contains endemic species from widespread temperate genera that are absent from tropical lowlands. Hilliard and Burt's (1987) work in the southern Natal Drakensberg is a notable exception. The following taxa, *Eumorphia* (Asteraceae), *Rhodohypoxis* (Hypoxidaceae), *Bowkeria* and *Glumicalyx* (Scrophulariaceae) and the Greyiaceae, are characteristically Afromontane as they are endemic or strongly centred in the Region (Goldblatt 1978).

5.1.4. Biogeographical hypotheses for the origins of Afromontane Vegetation in the Pondoland Centre

A full discussion on the dissention about the age and the origin of the predominance of grassland in the Afromontane Flora is beyond the scope of this project. Suffice to say that its predominance has been variously ascribed to solely an anthropogenically induced secondary community (White 1983; Chapman & White 1970; Dowsett-Lemaire 1985; Acocks 1988 and others); to this and environmental factors

³ Clayton (1983) suggests that this element migrated to the older Miocene mountain blocks long ago enough for two separate indigenous floras to differentiate and due their great age, remarks that it would be misleading to think of them as Pan-temperate outliers.

unsuitable for tree growth; and finally to natural environmental effectors rather than anthropogenic factors (Meadows and Linder 1989)⁴.

Van Wyk (1989a, 1989b, 1990a) hypothesises that the ancient element taxa are descendants of the temperate forest present on the Cape Fold mountains at the break-up of Gondwanaland. The taxa presumably developed in response to the same geological factor(s) that led to the establishment of the Cape Floral Kingdom as indicated by the close proximity in age of the sandstones concerned.

The remainder of this element in the Pondoland Flora is more closely related to the taxa currently associated with the Afromontane Region. Van Wyk (1989a, 1989b, 1990a) suggests a more recent migration of these species into the Pondoland Centre due to taxa tracking the climatic shifts during the Quaternary. Two dispersal corridors from the Pondoland Centre to the Afromontane archipelago, or vice versa, have been proposed by Van Wyk (1989b) and Hilliard and Burt (1987). The first of these is northward from the Pondoland Centre via the remainder of the Natal Group Sandstone outcrops to the eastern Transvaal escarpment, including the Magaliesberg extension. The second is between the Natal Drakensberg and the Centre via the Ngeli range. The Clarens Formation sandstone present in the Drakensberg is younger than either the Table Mountain Sandstone or the Natal Group sandstones (SACS 1980).

The fact that Van Wyk (1989a, 1989b, 1990a) identifies both an ancient component and a modern Afromontane sub-element in the Pondoland Flora, begs a temporally complex hypothesis as an explanation for the presence of these taxa in the Pondoland Flora.

5.2. MATERIALS AND METHODS

Species characteristic of the Afromontane forests and grasslands were identified from the literature. The total number of Afromontane species present in each gorge is the sum of these species present in each of the three vegetational components of this flora, namely forest, heathland and grassland. The proportion of these species present in the flora of the gorges is calculated by establishing the Afromontane element as a percentage of the flora of each gorge respectively. A percentage value was used here

⁴ Meadows and Linder (1989) state that Afromontane forest may have expanded during the Holocene in response to more favourable climatic conditions and that grasses and sedges have been the dominant Afromontane vegetation type for at least the last 5 000 years.

primarily to allow for comparison between the two gorges, and to highlight the differences between the floras. The raw data provides an indication of actual events.

The Afromontane forest species comprise both herbaceous and woody taxa. The database was examined to establish the number of species of the following herbaceous taxa, *Eumorphia* (Asteraceae), *Rhodohypoxis* (Hypoxidaceae) and *Glumicalyx* (Scrophulariaceae) present in each of the gorges. The number of *Bowkeria* (Scrophulariaceae) and Greyiaceae species are also established from the database. The two categories of woody forest taxa (widespread and Cape Afromontane) (Van Wyk 1989a, 1989b, 1990b) are listed, and their presence or absence in each gorge is established from the database (Tables 5.1. and 5.2.). A measure of vagility (high, low, unknown) was allocated to each species, where vagility is a measure of the species long distance dispersal potential. This data is useful in so far that forest is, by its very nature, prone to disruption in the semi-arid climate of South Africa.

The heathland component of the Afromontane flora in each gorge is investigated by establishing the species of Proteaceae, Ericaceae and Restionaceae present in each of the gorges from the database (Taylor 1978). The *Cliffortia*, *Anthospermum* and *Passerina* species were also tallied for each gorge (Table 5.3.).

An estimate of the relative size of the forest versus the grassland habitat was calculated for each gorge respectively to facilitate comparison in an attempt to minimise the effects of different habitat sizes on species richness.

The potential dispersal corridors for both past Afromontane vegetation movement and for the potential movement of current Afromontane species are investigated in two ways. The first is by identifying Afromontane species reaching their southernmost limit for distribution in the gorges. The second is by identifying Afromontane species reaching the northernmost limit of their distribution in the gorges, or showing distribution patterns that link the gorges with the Drakensberg Mountains (the closest source or large "island" of Afromontane species). The Centre forms the southernmost limit for the distribution of *Ocotea kenyensis*, *Canthium suberosum* (OGNR and UNR), *Cephalanthus natalensis*, *Atalaya natalensis*, *Nectaropetalum zuluense*, *Pavetta galpinii* (UNR), *Alberta magna* (OGNR and UNR), *Mackaya bella* (UNR), *Trichocladus grandiflorus* (OGNR and UNR), *Maesa lanceolata* (OGNR and UNR) and the grassland species *Tinnea galpinii* (UNR).

5.3. RESULTS

The predominant vegetation type in OGNR is forest. UNR is also predominantly forest, with grassland only occupying 40% of the reserve.

No *Eumorphia* (Asteraceae), *Rhodohypoxis* (Hypoxidaceae), *Glumicalyx* or *Bowkeria* (Scrophulariaceae) species occur in OGNR or UNR. These taxa are endemic to or centred in the Afromontane region (Goldblatt 1978). However, seven of the thirteen species identified as general Afromontane forest species (Van Wyk 1989a, 1989b, 1990b) occur in both OGNR and UNR. *Prunus africana*, *Olinia radiata* and *Kiggelaria africana* only occur in UNR (Table 5.1.).

Table 5.1. The presence or absence of Van Wyk's (1989a, 1989b, 1990b) widespread Afromontane forest species present in OGNR and UNR

TAXON	HABIT	HABITAT	VAGILITY	OGNR	UNR
<i>Cyathea capensis</i>	Tree	Forest	Spores produced	-	-
<i>Apodytes dimidiata</i> ⁴	Tree	Forest / margins, bushveld, rock outcrops/ generalist	Black fruit with aril – bird dispersed	√	√
<i>Calodendrum capense</i>	Tree	Forest, scrub, wooded ravines, riverine bush/ generalist	Fruit is a 5-lobed woody capsule (3,5 cm diam.)	√	√
<i>Combretum kraussii</i>	Tree	Forest / margins/ generalist	Fruit is 4-winged – local	√	√
<i>Halleria lucida</i>	Tree	Forest / margins rock outcrops, stream banks, swamp forest/ generalist	Fleshy, edible fruit, turns black as it matures (1,2 cm in diam) – bird dispersed.	-	-
<i>Kiggelaria africana</i> ⁴	Tree	Forest / margins rock outcrops/ generalist	Rough warty fruit, 1,5 cm in diam. Containing black seeds that are coated in sticky red substance – bird dispersed.	-	√

TAXON	HABIT	HABITAT	VAGILITY	OGNR	UNR
<i>Maytenus acuminata</i>	Tree / shrub	Forest / margins, rock outcrops	Slightly fleshy, almost spherical fruits split on ripening exposing red to yellow arilled seeds — ? bird dispersed.	√	√
<i>Nuxia floribunda</i>	Tree	Forest / margins, seepage lines	Small oval capsule partly enclosed in calyx, splitting into four lobes - local.	√	√
<i>Olinia radiata</i>	Tree	Forest	Small fleshy fruit - ?bird dispersed	-	√
<i>Prunus africana</i>	Tree	Forest	Round purplish – brown fruit – bird dispersed.	-	√
<i>Rapanea melanophloeos</i>	Tree	Forest / margins, bush clumps, damp areas	Fleshy white fruits, 5mm in diam. blacken with age – eaten by birds.	√	√
<i>Schleffera umbellifera</i>	Tree	Forest	Dark red, small fruits eaten by birds.	-	-
<i>Xymalos monospora</i>	Tree	Forest	Oval, leathery, fleshy, red fruits – eaten by birds.	√	√

The Cape Afromontane species (Van Wyk 1989a, 1989b, 1990b) are similarly presented in table 5.2. The ancient Cape Afromontane species, *Brachylaena glabra* (L. f.) Druce, *Faurea macnaughtonii* Phill. and *Trichocladus crinitus* (Thunb.) Pers. occur in both gorges. Populations of *Cassine peragua* L., *Cunonia capensis* L., *Curtisia dentata* (Burm. f.) C.A. Sm., *Gonioma kamassi* E. Mey., *Pterocelastrus tricuspidatus* (Lam.) Sond. are found in UNR but not in OGNR.

Table 5.2. Number of Cape Afromontane element species (Van Wyk 1989a, 1989b, 1990b) present in OGNR and UNR

TAXON	HABIT	HABITAT	VAGILITY	OGNR	UNR
<i>Brachylaena glabra</i>	Tree	Forest	Fruit is a small thistle-like nutlet – wind dispersed	√	√
<i>Cassine peragua</i>	Tree	Forest	Fruits are 5 mm in diam. & ripen to dark purple – bird dispersed	-	-
<i>Cunonia capensis</i>	Tree	Forest	-	-	√
<i>Curtisia dentata</i>	Tree	Forest	White to red, bitter, fleshy fruit - bird dispersed	-	-
<i>Faurea macnaughtonii</i>	Tree	Forest	Small fruits split to produce hairy seeds - ? wind dispersed	√	√
<i>Gonioma kamassi</i>	Perennial shrub	Forest	2-carpelled fruit splitting to release flat, papery-winged seeds.	-	√
<i>Pterocelastrus tricuspidatus</i>	Tree	Forest margins	Yellow-orange, 3-lobed fruit – bird dispersed.	-	√
<i>Trichocladus crinitus*</i>	Tree	Forest	Small reddish brown capsules on cup-like calyx, splits in two.	√	√

The Afromontane heathland component of each gorge is presented in table 5.3. The Ericaceae, Restionaceae and Thymelaeaceae species are dealt with in the preceding chapter. *Cliffortia paucistaminea*, *C. serpyllifolia* and *C. strobilifera* occur in both gorges, but *C. linearifolia* is only found in OGNR. Both gorges contain populations of *Anthospermum galpinii*, *A. hispidulum* and *A. streyi*, but the widespread *A. herbaceum* has only been collected from UNR, although we are positive that

populations of the species occur in OGNR. *Passerina filiformis* occurs in both gorges, whereas *P. rigida* has been collected from UNR. Therefore, the total number of Afromontane Heathland species in OGNR is 15 species, as opposed to 27 in UNR.

Table 5.3. The Cape Afromontane Heathland (Taylor 1978) component present in each gorge .

FAMILY	GENUS	No. of species in OGNR	No. of species in UNR
Proteaceae	<i>Leucadendron</i>	1	2
	<i>Faurea</i>	1	1
	<i>Protea</i>	3	3
Ericaceae	<i>Erica</i>	4	8
Restionaceae	<i>Restio</i>	1	1
	<i>Ischyrolepis</i>	1	1
	<i>Calopsis</i>	-	1
	<i>Rhodocoma</i>	1	-
Rosaceae	<i>Cliffortia</i>	3	3
Rubiaceae	<i>Anthospermum</i>	3	4
Thymelaeaceae	<i>Passerina</i>	1	2
TOTAL		19	27

Disa versicolor Reichb. f. (Section Hircinornes) occurs in secondary montane grasslands in southern Africa, from the Boschberg at Somerset East in the eastern Cape Province to the eastern Highlands of Zimbabwe, and to the highlands of Angola. Although Linder (1981) does not base the sectional divisions of *Disa* on cladistic analyses limiting their usefulness for biogeographical application, it is interesting that the section Hircinornes is distributed in the montane grasslands of southern and central Africa, extending to Madagascar, with one species widespread in the montane grasslands south of the Sahara.

Disa stachyoides Reichb. f. (Section Emarginatae) occurs in the Afromontane grasslands south of the Limpopo River to Port St Johns and Engcobo in the Transkei and UNR. *Disa nervosa* Lindl., of the same Section occurs from Port St Johns in the south to Middelberg in the Eastern Transvaal. This section is widespread in the summer rainfall section of southern Africa, with one species reaching to Zimbabwe, and one endemic to Madagascar (Linder 1981).

From these tables it is clear that OGNR has a higher number of Afromontane species contributing to the overall vegetation than UNR. Many of the endemic species are most closely related to montane species, e.g. *Rhus acocksii* and *Apodytes abbottii*.

5.4. DISCUSSION

The OGNR lies in closer proximity to an Afromontane "island" source than UNR does. UNR is closer to the Ngeli Mountain range than OGNR. Therefore the patterns observed in the results may be explained by the gorge's proximity to the relevant Afromontane "island" sources in the form of one of the Afromontane islands identified by White (1978).

An alternative, but not mutually exclusive explanation for the presence of the Afromontane species in the two gorges is that a higher percentage of Afromontane species may indicate a more recent disjunctive event than a lower percentage of Afromontane species.

The validity of this statement relies on a number of assumptions. The first of these is that ecological differences between the two gorges are negligible, or almost so implying that the number and quality of niches provided by each gorge for the Afromontane species is similar. This is not strictly true for the gorges in question, as OGNR is hotter, drier and at a slightly higher altitude than its more coastal counterpart, UNR, ecological factors that are not favourable to Afromontane species.

The different proportions observed in the type of Afromontane species present in each gorge becomes more relevant here. The fact that there are more Afromontane species of Cape origin in UNR than in OGNR lends support to Van Wyk's (1989a, 1989b, 1990) proposal of the existence of a mutual floristic element existing during the Upper-Cretaceous/Tertiary when the Falkland Plateau formed a bridge between the Cape Supergroup and the Natal Group sandstones. Thus the coastal UNR was in closer proximity to Van Wyk's (1989a, 1989b, 1990b) proposed sandstone palaeoflora, explaining the higher number of these species present in the reserve. Alternatively long distance dispersal of the species could create this pattern of attrition northwards. This is supported by the fact that the majority of the species are bird dispersed. This means that their long distance dispersal potential is high and it is quite feasible that some of these species are in the gorges as a result of long distance dispersal.

The second argument supported by the patterns observed in the results relates to the origin and age of the Pondoland flora. Obviously a proportion of the Pondoland Centre flora has migrated more recently from the Afromontane Region. The fact that some of these species are of Cape origin implies that they are part of an older flora, as

opposed to the more general Afromontane species. This implies that there is a palaeo-component to the flora and a more modern component, with migratory routes that are potentially different lending support to the ideas developed about the origin of the endemic element in the Pondoland flora in chapter three. The high similarity observed in the species composition of this element in the two gorges is not unexpected because the majority of Afromontane species are widely distributed within the Afromontane Region⁵ (Matthews, Van Wyk & Bredenkamp 1993).

That the majority of the Afromontane element species occur in forest may be an artefact as the majority of research conducted on the Floristics of the Afromontane Archipelago has been limited to forest patches and species. The literature reveals that comparatively less research has been done on establishing the species composition of Afromontane grasslands, but Hilliard and Burt's (1987) research in the southern Drakensberg and Matthews, Van Wyk and Bredenkamp's (1993) work on the flora of the north-eastern Transvaal escarpment.

⁵ This generalisation does not apply to the mainly local endemic grassland component of the flora (Matthews, Van Wyk & Bredenkamp 1993).

CHAPTER 6: THE TROPICAL ELEMENT

6.1. INTRODUCTION

6.1.1. Nature, scope and objectives

Southern Africa shares few species with tropical Africa (Goldblatt 1978), but Van Wyk (1989a, 1989b, 1990b) identifies the heterogenous mixture of species comprising much of the Pondoland Flora as a mixed tropical element. This heterogenous mix of species has both a modern tropical Africa-linked component and an ancient tropical element component as has been noted for the endemic element, the Cape element and the Afromontane element of the Pondoland Flora in preceding chapters. Brenan (1978) estimates that the flora of tropical Africa comprises about 30 000 species in 2497 genera.

The aims of this chapter are a summary of the reasons for the investigation of the Mixed Tropical element in the Pondoland Flora and are as follows:

- 1) Primarily to establish and quantify the differences in the flora of the two gorges (OGNR and UNR respectively), with respect to the Mixed Tropical element.
- 2) Secondly to utilise the data obtained from the analyses of the Mixed Tropical floristic links to support the hypotheses regarding the origin of the Pondoland Flora developed as a result of the investigation of the endemics in the Centre.

6.1.2. A brief description of the Mixed Tropical element in the Pondoland Flora

The links with modern day tropical Africa are species that occur in the Pondoland Centre and are associated with the upland regions in tropical Africa (Moll & White 1978; Van Wyk 1989a, 1989b). Many of these species are the southern extensions of the Zambezian and Zanzibar-Inhambane elements (Van Wyk 1989a, 1989b, 1990b; Takhtajan 1986) (Table 6.1, Section 6.3.).

6.1.3. Biogeographical hypotheses for the origins of the mixed tropical element in the Pondoland flora

The presence of more widespread taxa affiliated with an Ancient tropical flora, together with the presence of the palaeoendemics derived from the same ancient tropical flora in both the Pondoland Centre and the Cape Floral Kingdom suggests vicariance (Van Wyk 1989a). This hypothesis is supported by the fact that the age of the Cape Supergroup sandstones (particularly the Table Mountain and the Witteberg Series) and that of the Natal Group sandstones (particularly the Msikaba Group) is similar.

Taxa of the more modern component of the Element have migrated south from the tropical African upland regions (Moll & White 1978; Van Wyk 1989a, 1989b, 1990b) where some taxa from the ancient sandstone flora managed to escape extinction by migrating north through the wet tropical zone as it retreated. The African grass flora is almost entirely Palaeo-tropical (Clayton 1983).

6.2. MATERIALS AND METHODS

The data is collected and presented separately for OGNR and UNR to allow for a floristic comparison to be made between the component Mixed Tropical element of the two gorges.

The links with modern day tropical Africa are identified by taxa common to the Pondoland Centre and the upland regions in tropical Africa (Moll & White 1978; Van Wyk 1989a, 1989b) (Table 6.1.) or by taxa exhibiting a radiation of species in Tropical Africa with endemic species in the Pondoland Centre.

One of the subsets within this group is an element endemic to the Tongaland-Pondoland Regional Mosaic but not confined to Natal Group Sandstone. The database was examined for the presence of these species in OGNR and UNR (Table 6.2.).

6.3. RESULTS

Species listed in table 6.1. illustrate the links between the Pondoland Centre and tropical Africa, as the species are associated with the upland regions in tropical Africa (Moll & White 1978; Van Wyk 1989a, 1989b). Six of these are common to both gorges. It is likely that populations of the widespread *Antidesma venosum* occur in UNR but there are no specimen records in the herbaria investigated. Populations of *Voacanga*

thouarsii occur in UNR. Many of these species are the southern extensions of the Zambezian and Zanzibar-Inhambane elements (Van Wyk 1989a, 1989b, 1990b). A slightly higher higher proportion of these species occurs in OGNR.

Table 6.1. Species of the mixed tropical element with links to modern tropical Africa present in the Pondoland Centre (Van Wyk 1989a, 1989b) with an indication of the presence or absence in OGNR and UNR.

FAMILY	SPECIES	OGNR	UNR
Ulmaceae	<i>Celtis gomphophylla</i> ¹	-	√
Annonaceae	<i>Uvaria caffra</i>	√	√
Meliaceae	<i>Turraea floribunda</i>	√	√
Euphorbiaceae	<i>Antidesma venosum</i>	√	-
	<i>Macaranga capensis</i>	-	-
Sapindaceae	<i>Allophyllus dregeanus</i>	√	√
Melanthaceae	<i>Bersama lucens</i>	√	√
Sapotaceae	<i>Chrysophyllum vindifolium</i>	√	√
	<i>Englerophyton natalense</i>	√	√
	<i>Manilkara concolor</i>	√	-
	<i>Vittelariopsis marginata</i>	-	√
	<i>Voacanga thouarsii</i>	-	√

Table 6.2. lists species endemic to the Tongaland-Pondoland Regional Mosaic but not confined to Natal Group Sandstone (Van Wyk 1989a, 1989b) together with an indication of the presence or absence of these taxa in OGNR and UNR. These species display similar links to the palaeoendemic sandstone species of ancient tropical origin discussed in chapter three but comprise a portion of the Mixed tropical element.

¹ This species does not feature in Arnold & De Wet (1993).

Populations of all four species occur in both gorges, but there is no specimen data for *Cola natalensis* from OGNR.

Table 6.2. Species present in the Pondoland flora with links to the ancient tropical Africa flora (Van Wyk 1989a, 1989b) with an indication of the presence or absence in OGNR and UNR.

FAMILY	SPECIES	OGNR	UNR
Capparaceae	<i>Bachmannia woodii</i>	√	√
Anacardiaceae	<i>Harpephyllum caffrum</i>	√	√
	<i>Protorhus longifolia</i>	√	√
Sterculiaceae	<i>Cola natalensis</i>	√	√

The Mixed tropical element, comprised of both of the above parts, is represented by 13 species in UNR and OGNR. When these figures are examined as a proportion of the flora of each gorge, the OGNR is better represented.

Rhynchochalyx lawsonioides is an example of an endemic species that is most closely related to tropical forest taxa. The genus *Maytenus* is concentrated in South America but contains a number species endemic to the Pondoland Centre (Chapter 3). The majority of the endemic species of *Plectranthus* belong to section *Plectranthus*. Section *Plectranthus* (Lamiaceae) species are concentrated in South Africa, occur in tropical East and West Africa and in India. In southern Africa they are concentrated in the eastern high rainfall areas of Natal and do not occur in the northern Cape and Namibia (1985).

The primarily tropical families Fabaceae, Lamiaceae, Acanthaceae and Scrophulariaceae are good indicators of vicariance as the species lack the potential for long distance dispersal. There are 126 Fabaceae species in UNR and OGNR, and 45% of these are shared by the gorges. Forty-eight percent of the 42 Lamiaceae species are shared by the gorges. Thirty-eight percent of the 32 species of Scrophulariaceae and 49% of the 47 species of Acanthaceae are common to the gorges. The tropical families are therefore represented by very similar species in the gorges.

Acanthaceae species dominate the forest understorey to a large extent but are also common in grassland (*Chaetacanthus* and *Thunbergia* species). The family is completely absent from the Cape but many species illustrate positive links with tropical

Africa. Three species of *Chaetacanthus*, and 6 species of *Thunbergia* occur in the gorges. *T. atriplicifolia*, *T. dregeana* and *T. purpurata* are shared. *Isoglossa* (7 species, 4 of which are shared) species are perennial herbs or subshrubs that exhibit local seed dispersal and are limited to forest.

Plectranthus is divided into a number of subgenera. *P. spicatus* from OGNR is the only species of subgenus *Bumatastrum*. Populations of this species are found in rocky places from the Humansdorp District along the coastal areas of the eastern Cape Province and Natal to eastern Swaziland and the eastern Transvaal Lowveld. The distribution of this species is very patchy (Codd 1985). The remaining species of *Plectranthus* in the gorges belong to subgenus *Plectranthus*.

P. aliciae (a Pondoland Centre endemic), *P. madagascariensis* and *P. hadiensis* belong to section *Coleoides*, but the remaining 14 species belong to section *Plectranthus*. Species in this section are distributed from South Africa to tropical East and West Africa and India. In southern Africa they occur in the eastern high rainfall part of the territory, with a concentration in Natal, being absent from the northern Cape and from Namibia. The majority of the gorge species in this section are forest limited or are associated with forest, or if not, then are associated with shaded rocky outcrops (85%). Only *P. emstii* is not forest limited, or forest associated (Codd 1975, 1985). The forest species in this section, excluding the endemic species discussed in chapter three are almost continuously distributed along the east coast of Natal as far south as Knysna and as far north and inland as eastern and northern Transvaal. Only *P. ambiguus* displays a small but distinct disjunction from East London to Port St Johns.

Tinnea galpinii (19 species mostly tropical; Lamiaceae) shows a disjunction to tropical Africa. The species is present in UNR.

Gesneriaceae is also primarily tropical and is well represented in the gorges (6 species) with populations of the Pondoland Centre endemic *S. porphyrostachys* in UNR and of *S. traberculatus* in OGNR.

6.4. DISCUSSION

The data presented illustrates the links between the flora of each gorge and that of modern day tropical Africa. The Tropical element is proportionally higher in OGNR. This is not unexpected as the species under examination are associated with the upland regions in tropical Africa (Moll & White 1978; Van Wyk 1989a, 1989b) and many of these species are the southern extensions of the Zambezian and Zanzibar-Inhambane elements (Van Wyk 1989a, 1989b).

Table 6.2. lists species endemic to the Tongaland-Pondoland Regional Mosaic (as introduced in Chapter 1) but not confined to Natal Group Sandstone (Van Wyk 1989a, 1989b) together with an indication of the presence or absence of these taxa in OGNR and UNR. These species display similar links to the palaeoendemic sandstone species of ancient tropical origin discussed in chapter three but comprise a portion of the Mixed tropical element therefore support the existence of a mutual sandstone flora during the Upper-Cretaceous/Tertiary. There is little difference between the representation of these species in UNR and OGNR. That *Cola natalensis* is the only exception may be explained by the species ecological requirements, but as populations of the species occur both north and south of the gorges this seems unlikely.

The mixed tropical element, comprised of both of the above parts, does not predominate in either of the gorges. The ancient versus the modern sub-elements are not significantly different for the flora of the two gorges either.

The presence of (palaeo?) endemic species related to species in tropical forest in the gorges implies that the Centre was formerly covered by a tropical forest. The endemic *Maytenus* species and *Rhynchochalyx lawsonoides* are examples of such species. Myrtaceae is very richly represented in Asia and America. There are only two nonendemic genera in tropical Africa (Brenan 1978). But the Pondoland Centre is rich in endemic *Eugenia* species. The Pondoland also houses populations of *Memecylon bachmannii* (Melastomataceae) and *Dahlgrenodendron natalense* (Lauraceae). Brenan (1978) states that these families are less well represented in the tropical African flora than is expected. Raven and Axelrod (1974) suggest that the paucity of species is due to past elimination of taxa by drought; major increases in altitude, particularly in the Miocene, accompanied by a cooler drier climate; the development of the cold Benguella Current, bringing a drier climate to the west coast of Africa and major fluctuations in the Quaternary climate, causing corresponding fluctuations in forest areas.

The *Plectranthus* endemics, bar *P. aliciae* (Section *Coleoides*) all belong to section *Plectranthus* and this section is almost continuously distributed along the east coast of southern Africa, in forest or forest associated habitats, into tropical Africa. The disjunction in the distribution of *P. ambiguus* seems to be an artefact of poor collecting. This pattern supports the hypothesis.

However, the endemic *Plectranthus* species (Section *Plectranthus*) are predominantly neoendemics and this implies that although the genus may have originally arrived in the Pondoland as a result of past vegetation movements during the Quaternary, subsequent fragmentation of forest habitat has resulted in a radiation of species.

CHAPTER 7: CONCLUSIONS, CONSERVATION AND RECOMMENDATIONS

7.1. CONCLUSIONS

7.1.1. A summary

The floristic data including habit, habitat, distribution and closest relative compiled for the OGNR and UNR endemics establishes the nature of the endemics in the Pondoland as dichotomous, namely that both neo and palaeoendemic processes exist. The data regarding the habit of the endemics show that there is a greater than average chance that a Pondoland endemic will be a cryptophyte or a phanerophyte, although chamaephytes are also well represented in the endemic flora.

The study is limited by the fact that current revisions do not exist for many of the of the taxa comprising the flora. The lack of potential phylogenetic trees and cladograms further limits the study, because cladograms can be used to characterise taxa (specifically endemics) in terms of hypotheses of relative age and propinquity of descent. An absolute estimate of the age of a taxon (specifically an endemic) can be given when congruent phylogenetic relationships correlate with identifiable historical events (Cowling & Samways 1995). The data implies that there may be many more discrete taxa masked by the lack of knowledge of distribution and taxonomic affiliations observed in many of the taxa under study.

A number of topics are introduced and the most relevant aspects discussed in brief in the introductory chapter in order to contextualise the research. However a full discussion on many of these topics is beyond the scope of the thesis. These topics are the contentions surrounding the definitions of biogeography; surrounding scientific hypothesis generation, biogeographical models and their accuracy, those surrounding the age of forest versus grasslands and the questions of measurement of biodiversity.

A tally of the species present in the reserves revealed that OGNR and UNR are primarily similar at the familial level, with the order of the first five families homologous for the two gorges. The presence of Orchidaceae in the top ten family table for UNR and its absence in the OGNR table was unexpected. However, investigation of the

distribution patterns of the orchid species collected from UNR but “absent” from OGNR revealed that many of the species also occur to the north of the gorge, suggesting that their absence in the reserve is an artefact due to undercollection.

The difference in the proportional contribution of the predominantly tropical Acanthaceae in the two gorges (UNR-2.8%; OGNR-3.5%) is perhaps more significant as the family is well collected in both of the gorges. Three of the OGNR families are predominantly tropical in their affiliation, whereas only two of the UNR families in this table are distinctly tropical. The predominant families are not primarily arborescent in either gorge with only Fabaceae and Rubiaceae containing arborescent species. The proportional contribution of the primarily grassland Liliaceae (*s.l.*), Poaceae and Cyperaceae species is similar in the gorges, although Poaceae contributes 6.5% of the OGNR species whereas the family only contributes 5.2% to UNR.

A similar comparison of the ten most important genera revealed similarity at the generic level between the two gorges, but highlighted two significant differences namely the contribution of *Cyperus* species (1.4%) and *Eragrostis* species (1%) to the OGNR flora, whereas neither genus contributes a significant number of species to UNR and secondly the almost 1% contribution of *Polygala* (Cape), *Euphorbia* (Tropical), *Eriosema*, *Gnidia* and *Vernonia* species to the flora of UNR.

Only 24% of the species collected from the two gorges occur in both. Cowling and Samways (1995) advocate the presentation of endemism as a percentage of all extant taxa present (excluding exotics) because it emphasizes the generality of endemism in a biota, regardless of the number of endemics. Cowling and Hilton-Taylor (1997) put the total number of vascular species in the Pondoland Centre at 1500, with 8% of the species endemic to the ca. 1880 km² Centre. This is clearly an underestimate. The total number of angiosperms, excluding ferns recorded from UNR and OGNR is 1514 species, higher than the previously stated figure for the whole centre, and this is obviously not a comprehensive count of the Pondoland Centre flora as not all of the endemics occur in the two gorges.

Four floristic elements are identified in the Pondoland Flora, Cape, Endemic, tropical and Afromontane. A summary of these results indicates the relative importance of each of the elemental components to the flora of each gorge. This summary is a synthesis of the data presented in chapters 2, 3, 4, 5 and 6.

Table 7.1. The proportional contribution of each of the four floristic elements to OGNR and UNR.

ELEMENT	SPECIES OVERLAP BETWEEN GORGES (x%)	PROPORTIONAL CONTRIBUTION OGNR (% species)	PROPORTIONAL CONTRIBUTION UNR (% species)
Endemic	41.3%	2.2% ¹	3.6%
Cape	39.2%	11.3%	16%
Afromontane	72%	2.8%	3.4%
Tropical	46.7% ²	19.1%	15.3%

The UNR flora is composed of a higher proportion (3.6%) of endemic species than the OGNR (2.2%). The gorges share 41.3% of the endemic species. The element is divided into palaeo and neoendemic sub-components. More taxa from both of these sub-components are present in the UNR (Appendix A & B). The low similarity index in the Cape element implies that the element's presence in the Pondoland Centre is ancient, allowing the subsequent extinction of many of the taxa from OGNR in response to climatic change. Alternatively this invasion was the most difficult, with fewer species finding refuge in OGNR. By the same token, the high similarity index in the tropical element indicates that the flora was more similar or that it was less prone to extinction and that the invasion was more recent than that of the Cape taxa. The high similarity index in the Afromontane species can be ascribed to both the success of the invasion and to the fact that the Pondoland Centre abuts the Afromontane Region, with Kokstad only 178km away from Port Edward (UNR). The element however, contributes only a small proportion of the species in the gorges.

¹ These figures do not sum to 100% as many of the species in the database have not been assigned to a particular element as the centre of radiation and origin of the species is unclear, or because the species in the gorges are widespread and therefore cannot be successfully assigned to one of the four categories listed in the table.

² The percentage similarity here is only calculated from two families, the Acanthaceae and the Poaceae.

The data also show that there is a positive correlation between non-woody habit and neoendemism and between palaeoendemism and woody habit. The neoendemics are of two kinds namely edaphic and habitat endemics but it is not possible to assign all of the species to one or the other group because of the paucity of phylogenetic and cladistic data on almost all of the endemics as well as the fact that these two categories are polarisations of a continuum. *Tephrosia bachmannii* and the *Eriosema squarrosum* complex are examples of current divergence, that is neoendemics. Both are grassland associated, are suffrutescent with a short generation time and are actively evolving on edaphic sandstone outcrops. *Dahlgrenodendron natalense* (Tribe Cryptocaryinaceae, subtribe Cryptocaryineae) is regarded as a surviving representative of the ancestral stock from which *Cryptocarya*, *Ravensara* and perhaps some of the Monimiaceae alliance have evolved. It is therefore a good example of a palaeoendemic (Van der Merwe, Van Wyk & Kok 1988).

Endemic *Watsonia* species are geophytic in grassland and are associated with a particular substrate, and three of the four endemics are closely related and are related to a sympatric widespread species complex, *W. densiflora*. The fourth endemic, *W. bachmannii* belongs to section *Watsonia* which is centred in the south-western Cape and seems to be of a different origin. Similarly, 5 of the *Plectranthus* endemics are in section *Plectranthus* (Subgenus *Plectranthus*), whereas *P. aliciae* is in section *Coleoides* of the same subgenus. Section *Coleoides* has evolved in drier habitats, often grasslands while section *Plectranthus* is forest associated.

The Cape species are clearly better represented in UNR than in OGNR, whereas the tropical species predominate in OGNR. This is interesting because the two families that comprise the largest portion of the tropical element, Acanthaceae and Poaceae exhibit a similarity of 46.7% in the two gorges. The vast majority of the grass species present in the gorges are tropical in origin.

7.1.2. Discussion and synthesis

The results provided by both of the methods highlight the similarities between the flora of the gorges at the generic and the familial level. The congruence, or near congruence in distribution patterns of the palaeoendemics strongly suggests a common explanation for their taxonomic disjunctions (between the Cape and the Pondoland Centres). The Natal Group sandstones of the Pondoland Centre are the nearest significant outcrops of rocks comparable to the Table Mountain Group.

The isolated taxonomic position and distantly occurring putative relatives of some of the taxa endemic or largely confined to the Pondoland Centre, have been taken as indicators of a very ancient vicariate event or events (Van Wyk 1989a, 1989b, 1990a, 1990b). These taxa include the taxonomically isolated *Rhynchochalyx lawsonoides*, with putative relatives including Alzateaceae from tropical South America and Penaeaeceae from the Cape (Graham 1984; Dahlgren & Van Wyk 1988), *Colubrina nicholsonii* with its nearest relatives on Madagascar (Van Wyk & Schrire 1986) and *Tricalysia africana* with its closest relatives in Central Africa (Robbrecht 1985).

Van Wyk (1990a) provides a detailed argument for the possible causes of disjunction in *Leucadendron* and this argument is summarised here. Drift onset between the African and South American continental blocks was initiated during the lower Cretaceous (c. 127Mya). Dates around 100 Mya have been suggested for the final separation of the Falkland Plateau from the southern tip of Africa (Maude 1968; Dingle, Siesser & Newton 1983 in Van Wyk 1990a)³. The great escarpment had receded 100km from the coastline by the mid-Cretaceous (Partridge & Maud 1987). Midgeley (1986a, 1987a, 1986b) argued that the disjunction of the genus is probably not Cretaceous in origin, but rather occurred 3 Mya when the Bredasdorp Formation was exposed by regression of the sea and that major climatic shifts best explain the generic disjunction.

The once continuous distribution of the Cape affiliated palaeoendemic taxa during wetter climatic phases was fragmented by the subsequent intervention of more arid conditions, probably during a Pleistocene glacial. These conditions led to range contractions and ultimate elimination of species from the intervening habitats. The complete or almost complete extermination by aridification of grassland and forest species seems likely. The Pondoland Centre appears to have served as a refuge for the fynbos elements, since it has been concluded that any substrate different from the regional one so weakens competitive dominance by the regional vegetation that endemics find their place (Gankin & Major 1964; Major 1988). Current evidence favours the climatic hypothesis for the disjunct distribution of *Leucadendron* and the Cape affiliated palaeoendemics.

³ Sedimentation data suggests a shallow water, anoxic marine environment over parts of the Falkland Plateau, prior to, and following, continental separation (Dingle *et al.* 1983 in Partridge & Maude 1987). This does not imply that there were no surface outcrops of similar sandstone adjacent to south-eastern Africa, a necessity for the validity of speculative hypotheses on Cape/Pondoland geological links.

The climate hypothesis is further supported by the evidence present for successive invasions of both the tropical and Cape elements⁴. The presence of the palaeoendemics with tropical affinities (for example *Rinorea domatiosa*, *Pseudoscolopia polyantha*, *Eugenia erythrophylla*, *Memecylon bachmannii* and *Manilkara nicholsonii*) in the Pondoland Centre suggests that climatic oscillation has fragmented a once more widespread tropical forest flora. The migration of plants and animals of aseasonal forests around the Indian Ocean between Africa and tropical Asia was essentially uninterrupted 20 Mya, but now involves huge gaps (Raven 1983). Hence the hypothesis of temporal complexity proposed in chapter 3 seems feasible. The fact that the *Watsonia* endemics are primarily grassland affiliated and the *Plectranthus* endemics are predominantly forest affiliated poses the question of whether the two vegetation types migrate in tandem. This seems unlikely as the majority of the grasses in the Pondoland Centre are, like the *Plectranthus* endemics, tropical in origin. Without the grasslands, the *Watsonia* endemics would have no habitat in which to grow. This implies that grasslands would have developed before the *Watsonia* endemics. Similarly the ancient Cape Afromontane forest element was present in the Pondoland Centre prior to the arrival of the predominantly tropical epiphytic orchids and *Streptocarpus* endemics. Although the *Streptocarpus* and *Watsonia* species must have migrated in tandem with favourable vegetation types *i.e.* *Streptocarpus* invaded with forest species (and forest habitat) from the north, whereas *Watsonia* species invaded with grassland or a functional ecological equivalent from the south.

The Malagasy and African members of *Streptocarpus*, with the only exception of one small group of rosulate species, represent anciently independent lines. Weigend and Edwards (1996) suggest that the African/Malagasy Gesneriads are likely to represent a monophyletic assemblage of taxa based on the palynological coherence of the group and that the generic ties previously assumed between Africa and Asia for this genus is inappropriate. The African Gesneriad pollen study suggests eastern South Africa and outliers up to southern Malawi as the primary focus of ancient evolution in the subgenus *Streptocarpus*. The South African *Streptocarpus* are therefore not recently derived, although disjunction in forest habitat in South Africa and ecological differentiation in the genus has led to extensive speciation, creating a pattern of many narrow endemics (Weigend & Edwards 1994).

⁴ The *Watsonia* and *Plectranthus* endemic data show that the genera have invaded the Pondoland Centre at least twice. This is indicated by the fact that the endemic species belong to two separate sections within the genera.

Goldblatt (1991) argues that most of the African continent had a fairly uniform topography and forested vegetation during the Paleogene and Eocene (65-38 Mya) so that open habitats for Iridaceae were few if any. Only in the south is there evidence for the existence of significant mountain belts as well as cooler climates⁵, allowing the development of locally open sites, despite a probable predominance of forest vegetation. Australia's separation from Antarctica during the Oligocene and the establishment of circum-Antarctic Ocean circulation with cold currents along the west coasts of Africa and South America caused the deterioration of the climates in the intertropical belts of the southern continents (Raven & Axelrod 1972; Axelrod & Raven 1978).

Uplift occurred almost concurrently and mountain building and rifting began in East Africa, fragmenting the once extensive tropical vegetation and in East Africa its restriction to locally wetter areas and mountain belts. The establishment of montane and plateau grasslands followed the creation of significant mountain belts with the climate and vegetation now providing for the development of an extensive herbaceous flora (Goldblatt 1991).

The presence of Iridaceae (an old southern hemisphere group) (Goldblatt 1991) in tropical Africa presumably only dates from this time (Oligocene or Miocene, 30-10 Mya). The strong seasonality and dry conditions further south created non-forested sites of very different conditions. Drought escaping adaptations such as underground perennating organs provided one way for plants to survive seasonality. Seasonality thus provided a strong adaptive advantage to plants with a deciduous habit and to geophytes. *Moraea* species (Irideae), strongly adapted to drought, radiated from a southern African centre along the west coast and interior. Migration along the eastern mountain belts was available to less drought tolerant species like *Gladiolus* and *Dierama* (both genera are well represented in tropical Africa) (Goldblatt 1991).

The geophytic habit also provides an adaptive advantage in frequently burnt grasslands, thus the Pondoland geophytes may be particularly important taxa for the processes of neoendemism to act on. This is particularly true if the taxa are simultaneously quick to reach reproductive maturity.

Van Wyk (1991) states that the diversity patterns observed in *Lotononis* species supports the concept of southern Africa as a survival centre for mesic and temperate

⁵ Africa was 10-12 degrees south of its present position during the Oligocene (38-26 Mya).

floristic elements that have subsequently evolved in relative isolation. Although many species are endemic to the Cape Region, the fynbos only accounts for part of the high species diversity in the genus in Africa. It is suggested that the evolutionary history of the genus reflects the dramatic climatic changes in the African continent during the Neogene and more particularly, the increased aridity during the Pliocene. The presence of a few species of the section *Leptis* in the Mediterranean region and in central Africa is considered relictual rather than a result of dispersal or migration. The diversity of habit in the genus indicates adaptations to regional climatic changes, so that the distinct biogeographic patterns in southern Africa are probably linked to the geomorphic evolution of the subcontinent.

The present phytogeographical patterns observed in the terrestrial orchids probably reflect the ecological requirements of the taxa, rather than their histories. This is due to the easy dispersal of orchid seed and the relatively stringent constraints of the plant's physical structures (Linder 1981). This somewhat limits the significance of orchids as phytogeographical elucidators.

7.2. CONSERVATION

7.2.1. Nature, scope and objectives

The current state of species loss is phenomenal with an estimated 60 000 plant species worldwide in danger of extinction or serious genetic erosion during the next three to four decades (Heywood 1989; Fuggle & Rabie 1983; Bond 1989; Daniels, Hegde, Joshi & Gadgil 1991; Cowling & Samways 1995). Extinction rates are higher than replacement rates by similar floral species through natural evolution in South Africa with 110 species on the brink of extinction, 223 severely threatened and 700 critically rare⁶ (Fuggle & Rabie 1983). It is therefore imperative to identify areas with high diversity and establish effective means of conserving the remaining biological diversity (Fuggle & Rabie 1983; Vane-Wright, Humphries & Williams 1991). Fuggle and Rabie (1983) provide an eloquent summary of the reasons for plant conservation.

Not only plants, but evolutionary processes, selective pressures and genetic diversity need to be conserved. The success of the first is dependent on the second, with evolutionary processes being conserved only in intact ecosystems where selective

⁶ Harper (1981) presents an excellent overview of the meanings of rarity.

pressures have reasonable continuity for directing evolutionary trends. These selective pressures can only function efficiently and successfully if there are an adequate number of individuals of a species offering a range of genetic combinations (Fuggle & Rabie 1983). Vegetation is a sensitive indicator of environment, not just of one habitat factor, but of them all (Taylor 1994). All ecosystems should be conserved, but this is not possible in a modern world, therefore choices have to be made.

7.2.2. The agony of choice

It is imperative to establish a list of global centres of biological diversity or "hot-spots" so that these centres may be afforded conservation priority (Myers 1990; Vane-Wright, Humphries & Williams 1991). The debate surrounding the question of how to measure diversity is beyond the scope of this research⁷ but one contention centres around the use of species richness as the sole measure of diversity. Species richness⁸ is a measure of the total number of species of a group reliably known to be indigenous to a place.

Knowledge of the biodiversity of a region forms the basis for understanding and managing its plant resources and environment. One of the main problems facing the conservationist is the lack of sound information on which to base conservation strategies. Taxonomists argue that taxonomic rank also needs to be taken into account when assessing the conservation priority of a taxon (Vane-Wright *et al.* 1991) and the rarer, more taxonomically unique, or more endangered the taxon, the more valuable it is to conserve it (Daniels, Hegde, Joshi & Gadgil 1991). Although only one manifestation of rarity, the narrow or local endemic is the one that best fits the colloquial notion of this concept (Kruckeberg & Rabinowitz 1985). The distribution of endemic taxa is often used to identify areas for protection (e.g. Terborgh & Winter 1983; Ackery & Vane-Wright

⁷ Meffe & Carroll (1994) provide a good introduction and overview of the various approaches to biodiversity conservation and Noss (1989) presents a discussion on the process of selecting biodiversity indicators.

⁸ Whittaker (1972) suggests that this is a limiting concept of diversity and stresses the need for the inclusion of various other parameters. He suggests at least three measures are required: alpha diversity (species richness of standard site samples): beta diversity (differentiation between communities along habitat gradients): and gamma diversity for a geographic area (the product of alpha diversity of its communities and the degree of beta differentiation amongst them).

1984; Collins & Morris 1985; Conservation International 1991; ICBP 1992; Saetersdal, Line & Birks 1993; Cowling & Samways 1995).

A strong case may be made for the conservation of the Pondoland Centre based on both high species richness and the presence of a number of endemics. The Centre fits the description of a "hot-spot", namely an area of endemism common to a number of different groups (Vane-Wright *et al.* 1991; Van Wyk 1995).

7.2.3. Endemism: the implications for conservation

If a taxon is restricted to a particular area (endemic), then it can only be conserved if populations of it are maintained in that area unless *ex situ* conservation is planned. But populations of rare or endemic taxa do not exist in isolation. They depend on a functioning ecosystem. Thus functional, representative portions of ecosystems need to be conserved. Conservation of endemic taxa can thus become an umbrella for the conservation of more common, widespread and eurytopic species. Endemic taxa may, as in the Pondoland Centre, indicate past Tertiary or Quaternary refugia. Conservation of refugia is important because these areas provide, among other things, tools for understanding past ecological processes (Cowling & Samways 1995). The fact of endemism increases genetic diversity which is vital for future breeding programmes (natural and artificial), leading to the maintenance of diversity necessary for life (Takhtajan 1986).

Where possible the endemic species identified in the database compiled for the OGNR and UNR flora were placed in one of two categories, namely adequately conserved, or inadequately conserved species. This decision was based on information obtained from the literature, expert opinion and personal observation of the populations of some of the species in question. More rigorous ecological information is required for nearly all of the endemics as the majority of them are barely understood in this context. Recommendations are made based on the conservation methods outlined by Fuggle and Rabie (1983), recommendations made by the Wildlife Society of South Africa (1977) and others (Cooper 1985; Van Wyk 1981).

This research recognises the importance of habitat, habit and nature of the endemics. As each of these factors has implications for conservation⁹. The prevention of habitat destruction is particularly relevant to endemic populations because, unlike

⁹ Harper (1979) presents some of the implications of rarity for the management of species.

more widespread species, these taxa are not replaceable from elsewhere (Cowling & Samways 1995). Different techniques are necessary for the conservation of palaeo versus neoendemic populations as well as for the maintenance of populations of woody perennials versus herbaceous shrubs and grasslands which require different conservation techniques to forests. However an in depth discussion of the specific techniques is beyond the scope of the thesis.

7.2.4. Status of the endemics

Cowling and Samways (1995) recognise the urgency of the need to categorize endemics more carefully in relation to their population abundance, since population size has important conservation implications and will be especially relevant when an endemic species is also a rare species.

7.2.4.1. Adequately conserved species

Canthium vanwykii and *Apodytes abbottii* are fairly common over most of the Pondoland Centre, with healthy populations in both OGNR and UNR. Healthy populations of *Rhus acocksii* occur in three nature reserves in the Pondoland Centre (OGNR, UNR and Mkambati Nature Reserve). Extinction does not seem to pose an immediate threat to these endemics. *Eriosema umtamvunense* is a very narrow endemic, but is abundant within the confines of its distribution and most of the populations are inside the UNR boundaries. *E. luteopetalum* is a common coastal resident and so is tentatively placed in this category. *Indigofera rubroglandulosa* appears to be under no immediate threat, with healthy populations in the Pondoland Centre reserves. The Natal endemic *Rhaphionacme palustris* is scattered throughout the coastland up to approximately 1 000m above sea level.

Populations of the clearly palaeoendemic *Colubrina nicholsonii* occur at Daza and Mtentu Rivers and are conserved in the Mkambati Nature Reserve. The populations along the Mpunzaana River are somewhat protected because of the inaccessibility of the terrain. However fruitset is poor despite prolific flowering (Van Wyk & Schrire 1986).

Cyphostemma rubroglandulosa is under no immediate threat as the species is fairly common although it is endemic to the Pondoland Centre (Retief & Van Wyk 1996). Similarly, the endemic climber *Putterlickia retrospina* is fairly common throughout the Pondoland Centre (Van Wyk & Mostert 1987). The same is true for *Plectranthus oertendahlii* which is locally common (Codd 1975) and *P. saccatus* subsp. *pondoensis*

(Van Jaarsveld & Edwards 1997). *Syzygium pondoense* populations are fairly abundant on river bed islands in the Umtamvuna and Mkwini Rivers (Van Wyk 1979b).

7.2.4.2. Inadequately conserved species

Rhus pondoensis occurs in four widely disjunct localities and only one of the populations is within the protective confines of a reserve. The implication is that further searches need to be carried out for populations of the endemic and more of the existing populations may need to be incorporated into new reserves.

Tricalysia africana has not been collected from either OGNR or UNR, although there are populations of the species along the Msikaba River in the Mkambati Reserve. A more thorough search of the river gorges between Umtamvuna and Msikaba Rivers may prove fruitful.

Dahlgrenodendron natalense is an extremely rare endemic with approximately 200 individuals in the Pondoland Centre. The populations are small and are widely scattered from the Msikaba River to just north of the Umtamvuna River. The species exhibits low seed set (Van der Merwe *et al.* 1988) and although the palaeoendemic nature of the tree has been suggested as a reason for this, further ecological and pollination studies are necessary to establish the validity of this theory.

Raspalia trigyna is a special case, as the species is on the brink of extinction. The only remaining wild plants occur in UNR. These plants were only discovered very recently after the species was thought to be extinct in the wild. An attempt to clone the plants is currently underway at the Botanical Gardens in Cape Town as the species is self-incompatible.

Manilkara nicholsonii is a rare species threatened by the large scale destruction of the few remaining patches of forest within its distribution range (Van Wyk & Lotter 1982). The same is true for *Maytenus abbottii*, a forest affiliated endemic which is known from three localities, two of which are rapidly being destroyed. Fortunately, the third population, the Umtamvuna population is fairly large (Van Wyk 1984). *M. oleosa* is a vulnerable species due to its very limited distribution although fair populations of the species occur between the Umtamvuna and the Mzamba Rivers (Van Wyk 1987). Van Wyk (1992) similarly classifies *M. vanwykii* as a vulnerable species in need of conservation. *Eugenia verdoorniae* occurs in a few scattered localities in the districts of Lusikisiki, Bizana and Port Shepstone. Although it is common in some localities it is a rare species in need of protection (Van Wyk 1979a). *E. umtamvunensis* is one of the rarest trees in South Africa, showing the most restricted distribution of the native tree

species of the genus (Van Wyk 1982). *Catha abbottii* is known from only four localities, only one of which is within a conservation area, the UNR (Van Wyk & Prins 1987). Although populations of *Rinorea domatiosa* occur in UNR and other conservation areas, the continued destruction of the extremely limited forest outside some of these areas calls for more rigorous protection (Van Wyk 1983).

7.2.4.3. Status unknown

There is little information on the conservation status of *Eriosema latifolium* and *E. dregei*. Very little is known about the conservation status of *Anthospermum streyi*. A similar situation exists for *Eugenia erythrophylla*.

7.2.4.4. Formalised conservation status of the vegetation types

Many of the Pondoland endemics examined in this thesis are restricted to grassland habitats, but this severely threatened vegetation type is one of the most poorly conserved in the country (Shackleton 1989; Le Roux 1995; Van Wyk 1995). An area of only c. 131 km², or 7% of the Pondoland Centre is currently formally conserved. The main reserves in the Centre are the Natal OGNR and UNR, and the Transkei Mkambati Nature Reserve (MNR). The latter reserve has a larger grassland component than the two Natal reserves. MNR is potentially under greater threat from increased utilization for natural resource harvesting and grazing (Shackleton 1989). Only 3.6% of the 8% of species endemic to the Pondoland Centre are conserved in UNR and 2.3% of the endemics are conserved in OGNR.

Contrary to the recommendations made by the Wildlife Society of Southern Africa (WLS, S.A.) in 1977, a casino was constructed in the endemic rich grassland on the southern bank of the Umtamvuna River. The indigenous grassland area has been further reduced subsequently as a result of large-scale sugar cane and maize cultivation and an increase in exotic tree plantations in the area. This means that the grassland component of the Pondoland Centre is under threat and it is perhaps not as well protected as it should be. Van Wyk (1981) has called for the enlargement of the UNR, a view supported by the data presented in this research.

7.2.5. Discussion

The data presented allows for more comprehensive and sensible long-term decisions concerning the conservation of the flora. These data also provide arguments

for the maintenance of both reserves as protected areas as there is sufficient diversity and similarity¹⁰ between them to warrant this.

We recognise the limitations of using floristic richness and endemism as indicators of conservation priority. The limitations are that the nature, relationships and values of the species and the ecological diversity of the area are not taken into account (WWF & IUCN 1994). However, there is insufficient data on the health and size of the majority of the endemic populations, let alone their role in the ecosystems of the Pondoland sandstone gorges, to make a sentient decision on the current conservation status of the majority of the endemics. So the high species and endemic richness are used as indicators for affording the Pondoland Centre high conservation priority. There are a number of formal options open to conservationists.

7.2.5.1. Formal options

The establishment of nature reserves under state or local authority is the most obvious approach for ensuring the long-term conservation of ecosystems through management. The degree of active conservation within these reserves differs, ranging from sanctuaries to leases. Sanctuaries require the most stringent controls in terms of access (usually only a selected few are allowed to enter such an area, often only the conservators) and where the aim is to maintain an ecosystem in a pristine state. Whereas leases and management agreements between conservation bodies and landowners often control access less strictly and focus on ecosystem conservation via management (Fuggle & Rabie 1983).

Wilderness areas, national parks and private nature reserves, are all similar in that they are under conservation and are open to the public to varying degrees. In both national parks and nature reserves, the aim of conservation via management of natural resources is combined with provision of amenities for public entry and use. Private reserves may be established by landowners who can afford to utilize areas of their property for conservation. Servitudes, or rights of conservation control over private land may be purchased by conservation authorities in some countries. Similarly leases provide an immediate and less costly way of exerting conservation control by an authority to privately owned land (Fuggle & Rabie 1983).

¹⁰ Similarity is important for reducing the danger of "putting all of ones eggs in one basket" ie of preserving only one of the populations of a particular species. This leaves the species vulnerable to extinction because if that population becomes extinct, so does the species (Cowling & Samways 1995).

However formal options are too limited and real conservation of ecosystems necessitates a simultaneous change in perception from a consumerist approach to one of sustainability.

7.2.5.2. Additional means

It is not sufficient to formally conserve fragmented samples of ecosystems; awareness of the need for conservation outside of designated conservation areas is imperative. This may be achieved through the establishment of environmental education or awareness centres established at sites of particular interest and with relatively easy access to the public. They can be used to supplement school and university courses with a biological focus. Botanic gardens can act as show places for increasing public awareness of the necessity of plant conservation, while at the same time providing stocks of rare or threatened species for future rehabilitation programs (Heywood 1989). Seed banks can similarly fulfill the latter function of preserving genetic material for the establishment of new populations of threatened or rare plants in rehabilitation schemes. Television, radio, the press, non-scientific publications and public lectures should be utilised to heighten public awareness of conservation issues.

Without research, monitoring and communication aimed at both the scientific community and the general public, efficient and successful conservation of the floral species diversity in South Africa and indeed, worldwide, is not possible (Hall 1993).

7.3. RECOMMENDATIONS

7.3.1. Conservation priorities

The recommendations of the 1977 WLS, S.A. report are supported, as is Van Wyk's (1981) call for a larger UNR. The data presented in this research support Cooper and Swart's (1992) proposal to incorporate all of the Pondoland Coastal Forests in a "large and consolidated conservation area or Biosphere Reserve".

7.3.2. Research

A concerted effort needs to be made to locate and, if necessary, translocate and establish *ex situ* populations of those individual endemic species, like *Raspalia trigyna*, that are almost extinct. Collecting trips to the Wild Coast grasslands are recommended as the research has highlighted the paucity of data regarding the distribution of many of

the endemic species. Data presented in this thesis highlights the fact that there is little or no ecological or population data for the endemic species. Research into the life history strategies, pollination, reproductive potential and vagility of the palaeo- and neoendemic species is vital. Research into the ecological factors limiting population growth and recruitment is needed. An intensive collecting exercise is vital for OGNR as many of the common species have not been collected from the reserve, let alone many of the endemics.

Many of the families comprising the flora of the Centre are in desperate need of taxonomic review and these data need to be published as papers and monographs. Genetic data needs to be obtained from the endemics to test the hypotheses of neoendemism presented in this thesis. The edaphic dependence of many of the endemics presented needs to be investigated. The question of whether these plants are dependent on the sandstone soils, or whether their success is due to reduced competition, or to competitive superiority, needs to be answered to facilitate effective conservation of the taxa, the ecosystems and the speciation potential and mechanisms present in the Pondoland Centre.

7.3.4. Call for a symposium

There is little or no knowledge about how limited or widespread floristically different grassland patches are. This study highlights some of the floristic diversity and uniqueness of the Pondoland Coastal Sourveld (the Pondoland Centre grasslands) and raises a number of questions surrounding the issues of determining the future survival of biota in this and other grasslands in South Africa. A recent (Geldenhuys 1989) symposium on the biogeography of indigenous forests dealt with many similar questions. We recommend a similar symposium with grasslands as the focus and recommend that a portion of the symposium be allocated to the discussion of the philosophical and practical implications for the conservation of endemic populations, and hence species.

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APPENDIX A

The occurrence of the (woody) endemic species in OGNR and UNR with an indication of their palaeo or neoendemic nature.

Family	Species	Dispersal	Palaeo / neoendemic	OGNR	UNR
Arecaceae	<i>Jubaeopsis caffra</i>	Plants sucker – local	-	-	-
Proteaceae	<i>Leucadendron pondoense</i>	-	Palaeoendemic	-	-
Lauraceae	<i>Dahlgrenodendron natalensis</i>	Bird	Palaeoendemic	√	√
Bruniaceae	<i>Raspalia trigyna</i>	-	Palaeoendemic	-	√
Anacardiaceae	<i>Rhus acocksii</i>	Bird	-	√	√
Celastraceae	<i>Maytenus abbottii</i>	Bird	-	√	√
	<i>M. bachmannii</i>	Bird	-	√	√
	<i>M. oleosa</i>	Bird	-	-	√
	<i>Pseudosalacia streyii</i>	Bird	Palaeoendemic	-	√
	<i>Catha abbottii</i>	Bird	Palaeoendemic	-	√
	<i>Putterlickia retrospina</i>	Bird	Palaeoendemic	√	√
Icacinaceae	<i>Apodytes abbottii</i>	Bird	Palaeoendemic	√	√
Rhamnaceae	<i>Colubrina nicholsonii</i>	?Bird (Low seed set)	-	-	√
Violaceae	<i>Rinorea domatiosa</i>	Explosive capsule	-	√	√
Tiliaceae	<i>Grewia pondoensis</i>	?Bird	-	√	√
Flacourtiaceae	<i>Pseudoscolopia polyantha</i>	Fruits dehisce on ripening	Palaeoendemic	√	√
Rhynchoalyc. ¹	<i>Rhynchoalycx lawsonioides</i>	Wind	Palaeoendemic	-	√
Myrtaceae	<i>Eugenia erythrophylla</i>	Bird	Palaeoendemic	√	√
	<i>E. simii</i>	Bird	-	√	√
	<i>E. umtamvunensis</i>	Bird	-	-	√
	<i>E. verdoorniae</i>	Bird	-	-	√
	<i>Syzygium pondoense</i>	Bird	Palaeoendemic	-	√
Melastomataceae	<i>Memecylon bachmanii</i>	Bird	-	√	√
Sapotaceae	<i>Manilkara nicholsonii</i>	Low fruiting ? Animal	Palaeoendemic	-	√
Rubiaceae	<i>Tricalysia africana</i>	?Bird	Palaeoendemic	-	-
	<i>Canthium vanwykii</i>	?Animal	-	√	√
	<i>Anthospermum² streyi</i>	Local	-	√	√
Fabaceae ³	<i>Tephrosia pondoensis</i>	Local	Palaeoendemic	√	√

¹Rhynchoalycaceae is abbreviated to Rhynchoalyc.

² Puff (1986) suggests that *Anthospermum galpinii* Schltr. may be confined to Table Mountain Sandstone (Natal Group Sandstone), as it occurs on outcrops of the substrate from northern Natal to the eastern Cape.

³ The woody endemic, *Tephrosia pondoensis* (Codd) Schrire, has been included in this appendix; the other fabaceous Pondoland endemics are herbaceous.

APPENDIX B

The occurrence of the (non-woody) endemic species in OGNR and UNR with an indication of their palaeo or neoendemic nature. Some of the sandstone near endemics which have a wider distribution than the two gorges, have been included in the appendix.

Family	Species	Dispersal	Palaeo / neoendemic	OGNR	UNR
Iridaceae	<i>Watsonia bachmannii</i>	Local	Palaeoendemic	-	√
	<i>W. inclinata</i>	Local	Neoendemic	-	√
	<i>W. mtamvunae</i>	Local	Neoendemic	-	√
	<i>W. pondoensis</i>	Local	Neoendemic	-	√
	<i>Aristea platycaulis</i>	Local	-	-	-
Orchidaceae	<i>Tridactyle bicaudata</i> subsp. <i>rupestris</i>	Wind	-	√	-
Periplocaceae	<i>Raphionacme palustris</i>	Wind	-	-	-
Lamiaceae (Van Jaarsveld & Edwards 1997)	<i>Plectranthus ernstii</i>	Local	Neoendemic	√	√
	<i>P. hilliardiae</i>	Local	Neoendemic	-	√
	<i>P. aliciae</i>	Local	Neoendemic	-	√
	<i>P. oertendahlii</i>	Local	Neoendemic	√	√
	<i>P. oribiensis</i>	Local	Neoendemic	√	-
	<i>P. praetermissus</i>	Local	Neoendemic	-	-
	<i>P. purpuratus</i>	Local	Neoendemic	-	-
	<i>P. reflexus</i>	Local	Neoendemic	-	-
	<i>P. saccatus</i> subsp. <i>pondoensis</i>	Local	Neoendemic	-	√
<i>Syncolostemon rotundifolia</i>	Local	-	-	-	
Fabaceae	<i>Podalyria burchellii</i>	Local	Palaeoendemic	-	-
	<i>Eriosema dregei</i>	Local	?neoendemic ²	-	√
	<i>E. latifolium</i>	Local	?neoendemic	-	-
	<i>E. luteopetalum</i>	Local	?neoendemic	-	-
	<i>E. umtamvunense</i>	Local	?neoendemic	-	√
	<i>Tephrosia bachmannii</i> ¹	Local	neoendemic	√	√
Crassulaceae	<i>Crassula streyi</i>	Local	-	-	√
Asteraceae	<i>Helichrysum pannosum</i>	-	Palaeoendemic	-	√
Polygalaceae	<i>Polygala esterae</i>	Local	-	-	√
Gesneriaceae (Weigend & Edwards 1996)	<i>Streptocarpus formosus</i>	Wind	Neoendemic	√	√
	<i>S. johannis</i>	Wind	Neoendemic	-	-
	<i>S. modestus</i>	Wind	Neoendemic	-	-
	<i>S. porphyrostachys</i>	Wind	Neoendemic	-	√
	<i>S. trabeculatus</i>	Wind	Neoendemic	√	-
Thymelaeaceae	<i>Struthiola pondoensis</i>	Local	-	-	√
Vitaceae	<i>Cyphostemma rubroglandulosa</i>	Bird	-	-	-
Begoniaceae	<i>Begonia geranioides</i>	Local	-	-	-

¹ This species is included in the text and the table, although it is not found in Arnold and De Wet (1993).

² The *Eriosema* species are probably neoendemics, but the decision cannot be made until the phylogeny of the group has been finalised.

APPENDIX C

Section A : The species list for OGNR

PSILOTACEAE

Psilotum nudum (L.) Beauv.

K. Balkwill & O. Crankshaw s.n., J

LYCOPODIACEAE

Lycopodium cernuum L.

H.F. Glen 293, J

Lycopodium gnidioides L. f.

C.R. Scott-Shaw 2240, NPB

SELAGINACEAE

Selaginella dregei (Presl) Hieron.

Van Wyk 5508, PRE

Selaginella mittenii Bak.

Abbott 3478, UNR

EQUISETACEAE

Equisetum ramosissimum Desf.

Glen, HF 448, CPF

OSMUNDACEAE

Osmunda regalis L.

Davidson, VR 2570, CPF

Todea barbara (L.) T. Moore

L.E. Davidson 1244, J

SCHIZAEACEAE

Anemia dregeana Kunze

L.E. Davidson 2621, J

Mohria caffrorum (L.) Desv. var. *caffrorum*

A.T.D. Abbott s.n., UNR

Mohria caffrorum (L.) Desv. var. *ferruginea* J.E. & S.M. Burrows

Vassilatos & Mantell 2, J

Schizaea pectinata (L.) Swartz

A.E. van Wyk 5324, PRE

GLEICHENIACEAE

Gleichenia polypodioides (L.) J.E. Sm.

Henderson, Brokensha & Collins 137, J

Gleichenia umbraculifera (Kunze) T. Moore

Glen, HF 415, CPF

HYMENOPHYLLACEAE

Trichomanes borbonicum V.D. Bosch

Vassilatos & Mantell 959, J

Trichomanes melanotrichum Schlechtd.

Balkwill & Cron 85, J

Trichomanes reptans Swartz

Crouch 724, PRE

CYATHEACEAE

Cyathea dregei Kunze

R.G. Strey 6912, PRE

DENNSTAEDIACEAE

Histiopteris incisica (Thunb.) J. Sm.

L.L. Britten 6540, PRE

Hypolepis sparsisora (Schrad.) Kuhn

G. Hawke s.n., NU

Pteridium aquilinum (L.) Kuhn

H.F. Glen 303, J

VITTARIACEAE

Vittaria isoetifolia Bory

R.G. Strey 10626, PRE

ADIANTACEAE

Cheilanthes bergiana Schlechtd.

T. Edwards 870, NU

Cheilanthes deltoidea Kunze

Davidson, VR 1523, CPF

Cheilanthes hirta Swartz var. *hirta*

Vassilatos & Mantell 805, PRE

Cheilanthes inaequalis (Kunze) Mett. var. *buchananii* (Bak.) Schelpe

H.B. Nicholson 2137, PRE

Cheilanthes multifida (Swartz) Swartz subsp. *lacerata* N.C. Anthony & Schelpe

K. Balkwill & G.V. Cron 165, J

Cheilanthes viridis (Forssk.) Swartz var. *glauca* (Sim) Schelpe & N.C. Anthony

Vassilatos & Mantell 1081, J

Cheilanthes viridis (Forssk.) Swartz var. *macrophylla* (Kunze) Schelpe & N.C. Anthony

H.F. Glen 329, J

Anthony

Cheilanthes viridis (Forssk.) Swartz var. *viridis*

H.B. Nicholson 1736, PRE

Doryopteris concolor (Langsd. & Fisch.) Kuhn

Justine Bolton s.n., NU

Pellaea calomelanos (Swartz) Link var. *calomelanos*

H.B. Nicholson 1732, PRE

Pellaea dura (Willd.) Hook.

Crouch 726, PRE

Pityrogramma calomelanos (Swartz) Link var. *aureoflava* (Hook.) Weath ex

Glen, HF 412, CPF

Bailey*

Pteris buchananii Bak. ex Sim.

R.G. Strey 11137, PRE

Pteris catoptera Kunze

H.B. Nicholson 1572, PRE

Pteris dentata Forssk.

K. Balkwill, J.C. Manning, F. Getliffe Norris & A. Hutchings 80/130, J

POLYPODIACEAE

Microsorium punctatum (L.) Copel

T. Edwards & G. Hawke s.n., NU

Microgramma lycopodioides (L.) Copel.

A.P.D. Abbott s.n., UNR

Pleopeltis macrocarpa (Bory ex Willd.) Kaulf.

A.L. Pratt 18, NU

Pyrosia africana (Kunze) Ballard

A.E. van Wyk s.n., PRE

DAVALLIACEAE

Davallia chaerophylloides (Poir.) Steud.

A.E. van Wyk s.n., UNR

Oleandra distenta Kunze

A.T.D. Abbott s.n., UNR

ASPLENIACEAE

Asplenium aethiopicum (Burm. f.) Becherer

A.E. Van Wyk & Venter s.n., UNR

Asplenium erectum Bory ex Willd. var. *erectum*

H.B. Nicholson s.n., PRE

Asplenium gemmiferum Schrad.

Crouch 723, PRE

- Asplenium inaequilaterale* Willd.
Asplenium lunulatum Swartz
Asplenium rutifolium (Berg.) Kunze
Asplenium sandersonii Hook.
Asplenium splendens Kunze
Ceterach cordatum (Thunb.) Desv.
- THELYPTERIDACEAE**
Thelypteris dentata (Forssk.) E. St. John
Thelypteris gueinziana (Mett.) Schelpe
Macrothelypteris torresiana (Gaud.) Ching*
- LOMARIOPSIDACEAE**
Elaphoglossum macropodium (Fee) T. Moore
- ASPIDACEAE**
Rumohra adiantiformis (G. Forst.) Ching
- BLECHNACEAE**
Blechnum attenuatum (Swartz) Mett. Var. *giganteum* (Kaulf.) Bonap.
Blechnum punctulatum Swartz var. *krebsii* (Kunze) Sim
Stenochlaena tenuifolia (Desv.) T. Moore
- FISSIDENTACEAE**
Fissidens erulosus (C. Mull.) Par.
Fissidens submarginatus Bruch ex Krauss
- DICRANACEAE**
Campylopus atroluteus (C. Mull.) Par.
Campylopus introflexus (Hedw.) Brid.
Campylopus pilifer Brid.
Campylopus savannarum (C. Muell.) Mitt.
- CALYMPERACEAE**
Hypodontium dregei (Hornsch.) C. Mull.
Octoblepharum albidum Hedw.
- POTTIACEAE**
Trichostomum brachyodontium Bruch ex F. A. Muell.
- BRYACEAE**
Brachymerium acuminatum Harv. in Hook.
Bryum argenteum Hedw.
Bryum pycnophyllum (Dix.) Mohamed
- BARTRAMIACEAE**
Philonotis africana (C. Muell.) Par.
- ORTHOTRICHACEAE**
Macrocoma tenue (Hook. & Grev.) Vitt
Schlotheimia ferruginea (Hook. & Grev.) Brid.
- RACOPILACEAE**
Racopilum capense C. Mull.
- HEDWIGIACEAE**
Braunia secunda (Hook.) B. S. G.
- METEORACEAE**
Aerobryopsis capensis (C. Mull.) Fleisch.
Papillaria africana (C. Mull.) Jaeg.
- THUIDIACEAE**
Haplohymenium pseudo-triste (C. Mull.) Broth.
- STANGERIACEAE**
Stangeria eriopus (Kunze) Baill.
- ZAMIACEAE**
Encephalartos caffer (Thunb.) Lehm.
Encephalartos ghellinckii Lem.
Encephalartos natalensis R.A. Dyer & Verdoorn
Encephalartos villosus Lem.
- PODOCARPACEAE**
Podocarpus falcatus (Thunb.) R. Br. ex Mirb.
Podocarpus latifolius (Thunb.) R. Br. ex Mirb.
- POTAMOGETONACEAE**
Potamogeton schweinfurthii A.W. Benn.
Potamogeton thunbergii Cham. & Schlechtd.
- JUNCAGINACEAE**
Triglochin bulbosa L.
- CYPERACEAE**
Cyperus sp.
Cyperus sp.
Cyperus sp.
Cyperus sp.
Cyperus albostriatus Schrad.
- H.B. Nicholson s.n., J
Vassilatos & Mantell 964, J
R. Stamp 19, NU
Van Jaarsveld & Campher s.n., PRE
Mantell & Vassilatos 43, J
Vassilatos & Mantell 200, J
- Vassilatos & Mantell 1052, J
Vassilatos & Mantell 818, J
J.P. Roux s.n., PRE
- K. Balkwill & G.V. Cron 74, J
- H.F. Glen 465, J
- Balkwill & Cron 64, J
Balkwill & Cron 7, J
Davidson, VR 1245, CPF
- Van Roy J. 961, PRE
Oliver 7348, PRE
- Smook 1640, PRE
Smook 1640, PRE
Smook 1440, PRE
Oliver 7343, PRE
- Glen 3850, PRE
Smook 1776, PRE
- Smook 1776, PRE
- Smook 1778, PRE
Oliver 7351, PRE
Risse -2, PRE
- BJ Cholnoky 133, PRE
- Oliver 7350, PRE
Smook 1782, PRE
- Glen 3847, PRE
- Oliver 7346, PRE
- Cholnoky 77, PRE
Mantell & Vassilatos 815, PRE
- Cholnoky 143, PRE
- L.E. Davidson 1614, J
- Neetling 1, PRE
Strey 5878, PRE
K. Balkwill & G.V. Cron 11, J
Glen, HF 539, CPF
- Scott-Shaw, CR 5914, CPF
H.F. Glen 463, J
- H.B. Nicholson 1001, PRE
Musil 120, PRE
- Nicholson 1871, PRE
- Balkwill & Cron 167, J
L.E. Davidson 1544, J
Balkwill & Cron 167, J
L.E. Davidson 1544, J
K. Balkwill & G.V. Cron 1, J

- Cyperus difformis* L.
Cyperus distans L. f.
Cyperus dives Del. (used to be *C. immensus* C.B. Clarke)
Cyperus leptocladus Kunth
Cyperus obtusiflorus Vahl var. *obtusiflorus*
Cyperus prolifer Lam.
Cyperus rubicundus Vahl
Cyperus rupestris Kunth var. *amnicola* (Kunth) Kuekenth.
Cyperus rupestris Kunth var. *rupestris*
Cyperus sexangularis Nees
Cyperus sphaerospermus Schrad.
Cyperus textilis Thunb.
Pycneus polystachyos (Rottb.) Beauv. var. *polystachyos*
Mariscus congestus (Vahl) C.B. Cl.
Mariscus dregeanus Kunth
Mariscus dubius (Rottb.) Kuekenth. Ex G.E.C. Fischer
Mariscus grantii C.B. Cl.
Mariscus macer Kunth subsp. *macer*
Mariscus pseudo-vestitus C.B. Cl.
Mariscus sumatrensis (Retz.) J. Raynal *
Mariscus uitenhaensis Steud.
Kyllinga elatior Kunth
Fuirena hirsuta (Berg.) P.L. Forbes
Isolepis cernua (Vahl) Roem. & Schult.
Isolepis prolifera R. Br.
Fimbristylis complanata (Retz.) Link
Fimbristylis dichotoma (L.) Vahl
Bulbostylis boeckeleriana (Schweinf.) Beetle
Bulbostylis hispidula (Vahl) R. Haines subsp. *pyriformis* (Lye) R.W. Haines
Abildgaardia ovata (Burm. f.) Kral
Abildgaardia variegata (Gordon-Gray) K. Lye
Rhynchospora barrosiana Guaglianone
Rhynchospora brownii Roem. & Schult.
Tetraria capillaceae (Thunb.) C.B. Cl.
Scleria melanomphala Kunth
Scleria woodii C.B. Cl.
Schoenoxiphium sp. c.f. *S. lehmannii* (Nees) Steud.
Schoenoxiphium sp.
Schoenoxiphium lehmannii (Nees) Steud.
- ARECACEAE**
- Phoenix reclinata* Jacq.
- FLAGELLARIACEAE**
- Flagellaria guineensis* Schumach.
- RESTIONACEAE**
- Ischyrolepis setiger* (Kunth) Linder
Restio distichus Rottb.
Rhodocoma capensis Nees ex Steud.
- XYRIDACEAE**
- Xyris anceps* Lam.
- ERIOCAULACEAE**
- Eriocaulon abyssinicum* Hochst.
- COMMELINACEAE**
- Commelina africana* L. var. ?
Commelina africana L. var. *krebsiana* (Kunth) C.B. Cl.
Commelina africana L. var. *lancispatha* C.B. Cl.
Commelina benghalensis L.
Commelina diffusa Burm. f. subsp. ?
Commelina eckloniana Kunth
Aneilema aequinoctiale (Beauv.) Loudon
Aneilema dregeanum Kunth
Aneilema hockii De Wild.
Cyanotis speciosa (L.f.) Hassk.
- JUNCACEAE**
- Prionium serratum* (L.f.) Drege ex E. Mey.
Juncus dregeanus Kunth
Juncus effusus L.
Juncus exsertus Buchen. subsp. *exsertus*
Juncus kraussii Hochst.
- COLCHICACEAE**
- Sandersonia aurantiaca* Hook.
- H.B. Nicholson s.n., PRE
C. Reid 919, PRE
Forbes & Munday 483, J
Mantell & Vassilatos 75, J
Vassilatos & Mantell 1115, J
M. Du Toit s.n., PRE
Reid, C. s.n., PRE
Wits 10, J
Mantell & Vassilatos 80, PRE
Vassilatos & Mantell 13, J
H.F. Glen 210, J
Forbes & Munday s.n., J
Vassilatos & Mantell 1085, J
K. Balkwill & O. Crankshaw 80/35, J
Vassilatos & Mantell 104, J
O. Kerfoot K7726, UNR
O. Kerfoot K7386, UNR
Vassilatos & Mantell 650, J
R.G. Uys 5, NU
H.B. Nicholson s.n., PRE
R.G. Uys 6, NU
Forbes & Munday 494, J
O.M. Hilliard 2564, J
Forbes & Munday 488, J
C. Reid s.n., PRE
R.A. Lubke 1689, PRE
H.F. Glen 409, J
R.G. Uys 7, NU
Munday, J. s.n., J
L.E. Davidson s.n., PRE
Vassilatos & Mantell 61, J
H.B. Nicholson s.n., PRE
H.F. Glen 517, J
R.A. Lubke 1677, J
A.P.D. McCleans n., PRE
Balkwill & Cron 345, J
L.E. Davidson 2649, J
L.E. Davidson 2648, J
Balkwill & Cron 354, J
- Glen, HF 338, CPF
- T.H. Arnold 1345, PRE
- L.E. Davidson s.n., CPF
Mantell & Vassilatos s.n., PRE
L.E. Davidson 2035, J
- H.F. Glen 513, J
- L.E. Davidson s.n., CPF
- Balkwill & Cron s.n., J
Mantell & Vassilatos s.n., PRE
H.F. Glen 389, PRE
L. Smook s.n., PRE
Forbes & Munday s.n., J
H.F. Glen 297, J
Munday, J s.n., CPF
C. Reid 894, CPF
H.F. Glen 223, CPF
Vassilatos & Mantell 79, J
- L.E. Davidson 2536, CPF
H.B. Nicholson 1676, PRE
R.G. Strey s.n., PRE
C. Reid s.n., PRE
Vassilatos & Mantell 1114, J
- H.G.W.J. Schweickerdt s.n., PRE

ASPHODELACEAE

Bulbine abyssinica A. Rich.
Bulbine frutescens (L.) Willd.
Trachyandra capillata (V. Poelln.) Oberm.
Trachyandra saltii (Bak.) Oberm. var. *saltii*
Chlorophytum sp.
Chlorophytum comosum (Thunb.) Jacq.
Chlorophytum krookianum Zahlbr.
Chlorophytum modestum Bak.
Kniphofia sp. probably *S. parviflora* Kunth
Kniphofia coddiana Cufod.
Aloe arborescens Mill.
Aloe barberaei T.-Dyer
Aloe candelabrum Berger
Aloe ferox Mill.
Aloe linearifolia Berger
Aloe pluridens Haw.
Gasteria croucheri (Hook. f.) Bak.

HYACINTHACEAE

Albuca nelsonii N. E. Br.
Albuca setosa Jacq.
Urginea modesta Bak.
Dipcadi sp.
Dipcadi viride (L.) Moench
Scilla nervosa (Burch.) Jessop

Ornithogalum juncifolium Jacq.
Ornithogalum longibracteatum Jacq.
Ornithogalum tenuifolium Delaroché subsp. *tenuifolium*
Drimiopsis burkei Bak.
Drimiopsis lachenalioides (Bak.) Jessop
Drimiopsis maxima Bak.
Ledebouria revoluta (L.f.) Jessop

ERIOSPERMACEAE

Eriosperrum sp.
Eriosperrum mackenii (Hook. f.) Bak.

ALLIACEAE

Agapanthus campanulatus Leighton subsp. *campanulatus*
Agapanthus caulescens Spreng. Subsp. *angustifolius* Leighton
Agapanthus praecox Willd. subsp. *orientalis* (Leighton) Leighton

DRACAENACEAE

Dracaena hookeriana K. Koch.
Sansevieria hyacinthoides (L.) Druce

ASPARGACEAE

Protasparagus densiflorus (Kunth) Oberm.
Protasparagus falcatus (L.) Oberm.
Protasparagus macowanii (Bak.) Oberm.
Protasparagus natalensis (Bak.) Oberm.
Protasparagus racemosus (Willd.) Oberm.
Protasparagus setaceus (Kunth) Oberm.
Protasparagus subulatus (Thunb.) Oberm.
Protasparagus virgatus (Bak.) Oberm.

LUZURIAGACEAE

Behnia reticulata (Thunb.) Didr.

SMILACACEAE

Smilax anceps Willd.

AMARYLLIDACEAE

Haemanthus sp. cf. *H. albiflos* Jacq.
Haemanthus montanus Bak.
Scadoxus sp. cf. *S. membranaceus* (Bak.) Friis & Nordal
Scadoxus multiflorus (Martyn) Raf. Subsp. *katharinae* (Bak.) Friis & Nordal
Scadoxus puniceus (L.) Friis & Nordal
Clivia gardenii Hook.
Clivia miniata (Lindl.) Regel var. *miniata*
Crinum moorei Hook. f.
Cyrtanthus sanguineus (Lindl.) Walp.

HYPOXIDACEAE

Hypoxis angustifolia Lam. var. *angustifolia*
Hypoxis angustifolia Lam. var. *buchananii* Bak.
Hypoxis angustifolia Lam. var. *buchananii* x *H. membranacea* Bak.

L.N. Prosser 1449, J
H.F. Glen 384, CPF
H.B. Nicholson s.n., PRE
L.E. Davidson 1280, J
Davidson 1996, PRE
Balkwill & G.V. Cron 135, J
R.G. Strey s.n., PRE
C. Reid s.n., PRE
K. Balkwill & O. Crankshaw 80/146, J
Strey 1021, CPF
H.F. Glen 436, CPF
Balkwill & Cron 360, J
R.G. Strey s.n., PRE
Balkwill & Cron 389, J
L.E. Davidson 2590, CPF
Scott-Shaw, CR 1448, CPF
D.C.H. Plowes 2677, PRE

R.G. Strey s.n., PRE
L.E. Davidson 2514, J
L.E. Davidson 1995, J
Vassilatos & Mantell 761, J
K. Balkwill & O. Crankshaw 80/205, J
Henderson, Brokenshaw & Collins 115, PRE

L. E. Davidson 2000, J
O. Kerfoot s.n., J
Balkwill & Cron 180, PRE
Vassilatos & Mantell 731, J
K. Balkwill & G.V. Cron 188, J
Van Wyk 5090, PRE
K. Balkwill & G.V. Cron 187, J

Balkwill & Cron 362, J
L.E. Davidson s.n., J

Davidson, L.E. 1896, CPF
Balkwill & Cron 145, PRE
H.F. Glen 264, CPF

L.E. Davidson 1562, CPF
Crankshaw 1110, J

Forbes & Munday 491, J
L.E. Davidson 1071, J
Balkwill & Cron 124, J
Smith & Sender 27, J
Vassilatos & Mantell 814, J
Forbes & Munday 490, J
Balkwill & Cron 29, J
Forbes & Munday 455, J

Balkwill & Cron 160, J

T.H. Arnold 1346, PRE

H.F. Glen 489, J
Balkwill & Cron 195, J
Balkwill & Cron 194, J
L.E. Davidson 2587, CPF
Vassilatos & Mantell 711, J
H.F. Glen 483, CPF
J. Munday 814, J
O. Crankshaw s.n., CPF
Vassilatos & Mantell 586, J

Henderson, Brokenshaw & Collins 175, J
O. Kerfoot K7694, CPF
Kerfoot 7225, CPF

- Hypoxis filiformis* Bak.
Hypoxis longifolia Bak.
Hypoxis membranacea Bak.
Hypoxis rigidula Bak. var. *rigidula*
- DIOSCOREACEAE**
Dioscorea cotonifolia Kunth
Dioscorea dregeana (Kunth) Dur. & Schinz
Dioscorea sylvatica (Kunth) Eckl. var. ?
- IRIDACEAE**
Dietes indioides (L.) Sweet ex Klatt
Aristea cognata N.E. Br. ex Weim.
Aristea woodii N.E. Br.
Hesperantha lactea Bak.
Dierama argyreum L. Bol.
Dierama igneum Klatt
Tritonia sp.
Tritonia sp.
Tritonia sp.
Tritonia disticha (Klatt) Bak. subsp. *rubrolucens* (R. C. Fost.) De Vos
Tritonea lineata (Salisb.) Ker-Gawl. Var. *lineata*
Crocasmia aurea (Pappe ex Hook.) Planch. var. *aurea*
Gladiolus sp. cf. *G. dalenii* Van Geel
Gladiolus permeabilis Delaroché subsp. *wilsonii* (Bak.) G. J. Lewis
Watsonia densiflora Bak.
Anomatheca laxa (Thunb.) Goldbl.
- STRELITZIACEAE**
Strelitzia nicolai Regel & Koern.
- ORCHIDACEAE**
Stenoglottis fimbriata Lindl.
Stenoglottis woodii Schltr.
Habenaria dives Reichb. f.
Habenaria falcicomis (Burch. ex Lindl.) H. Bol. subsp. *caffra* (Schltr.) J. C. Manning
Bonatea speciosa (L.f.) Willd. var. ?
Satyrium longicauda Lindl. var. ?
Satyrium longicauda Lindl. var. *longicauda*
Disa polygonoides Lindl.
Liparis bowkeri Harv.
Eulophia ensata Lindl.
Angraecum sp. cf. *A. pusillum* Lindl.
Tndactyle bicaudata (Lindl.) Schltr. subsp. *rupestris* Linder
Tndactyle tridentata (Harv.) Schltr.
Diaphananthe xanthopollinia (Reichb. f.) Summerh.
Aerangis mystacidii (Reichb. f.) Schltr.
Rangaeris muscicola (Reichb. f.) Summerh.
Cyrtorchis arcuata (Lindl.) Schltr.
Mystacidium sp.
Mystacidium alicaeae H. Bol.
- PIPERACEAE**
Peperomia retusa (L.f.) A. Dietr. var. *retusa*
Peperomia rotundifolia (L.) H.B.K.
Peperomia tetraphylla (G. Forst.) Hook. & Am.
- SALICACEAE**
Salix mucronata Thunb. subsp. *capensis* (Thunb.) Immelman
- MYRICACEAE**
Myrica serrata Lam.
- ULMACEAE**
Celtis africana Burm. f.
Trema orientalis (L.) Blume
Chaetachme aristata Planch.
- MORACEAE**
Ficus sp.
Ficus bizanae Hutch. & Burtt Davy
Ficus burtt-davyi Hutch.
Ficus craterostoma Warb. ex Midbr. & Burret
Ficus glumosa (Miq.) Del.
Ficus ingens (Miq.) Miq. var. *ingens*
Ficus natalensis Hochst. subsp. *natalensis*
Ficus sur Forssk.
Ficus thonningii Blume
- Davidson 2007, 2450, J
O. Kerfoot s.n., CPF
K. Balkwill & Crankshaw s.n., J
K. Balkwill & G.V. Cron 191, J
- Mantell & Vassilatos 697, J
Pienaar 121, J
H.F. Glen s.n., CPF
- H. F. Glen 285, CPF
H.F. Glen 352, CPF
Vassilatos & Mantell 94, J
Nicholson 1673, PRE
Balkwill & Cadman 2114, E & NU
Prosser 1387, PRE
L.N. Prosser 1388, J
L.E. Davidson s.n., PRE
O. Kerfoot K5794, CPF
K. Balkwill & O. Crankshaw 80/196, J
Vassilatos & Mantell 73, PRE
Balkwill & Cron 79, PRE
Vassilatos & Mantell 750, J
Van Wyk 5016, PRE
L.E. Davidson 2388, J
Balkwill & Cron 48, J
- H.F. Glen 482, CPF
- O. Kerfoot 6383, CPF
O. Crankshaw s.n., J
L.E. Davidson s.n., CPF
McClellan 371, PRE
- H.F. Glen 273, CPF
Balkwill & Crankshaw 80/128, J
Vassilatos & Mantell 19, PRE
H.F. Glen 271, CPF
Vassilatos & Mantell 127, J
H.F. Glen 232, J
Balkwill & Crankshaw 80/2, J
O. Crankshaw s.n., J
L.E. Davidson s.n., CPF
Vassilatos & Mantell 965, J
Vassilatos & Mantell 709, J
K. Balkwill & G.V. Cron 370, J
Vassilatos & Mantell 82,
Balkwill & Cron 147, J
K. Balkwill & O. Crankshaw 80/1, J
- Mantell & Vassilatos 175, J
A.E. Van Wyk 4198, PRE
Crankshaw s.n., J
- Van Wyk A.E. & Kok P.D.F. 5781, J
- Vassilatos & Mantell 971, J
- L.E. Davidson 1540, CPF
C. Reid 895, PRE
H.B. Nicholson 1131, PRE
- L.E. Davidson 2575, J
Balkwill & Cron 210, J
O. Crankshaw 1961, J
L.E. Davidson 2431, CPF
J. Munday 816, J
H.F. Glen 45, CPF
Balkwill & Cron 206, J
L.E. Davidson 1193, J
Scott-Shaw, CR 5905, CPF

URTICACEAE*Ureia trinervis* (Hochst. Apud Krauss) Friis & Immelman*Obetia tenax* (N.E. Br.) Friis*Laportea grossa* (Wedd.) Chew**PROTEACEAE***Faurea macnaughtonii* Phill.*Protea caffra* Meisn. subsp. *caffra**Protea roupelliae* Meisn. subsp. *roupelliae**Protea simplex* Phill.*Leucadendron spissifolium* (Salisb. ex Knight) I. Williams subsp. *natalense*

(Thode & Gilg) I. Williams

Leucadendron spissifolium (Salisb. ex Knight) I. Williams subsp. *phillipsii*

(Hutch.) I. Williams

LORANTHACEAE*Tapinanthus kraussianus* (Meisn.) V. Tieghem subsp. *transvaalensis*

(Sprague) Wiens

Tapinanthus natalitius (Meisn.) Danser subsp. *natalitius**Tapinanthus natalitius* (Meisn.) Danser subsp. *zeyheri* (Harv.) Wiens*Helixanthera subcylindrica* (Sprague) Danser**VISCACEAE***Viscum anceps* E. Mey. ex Sprague*Viscum combreticola* Engl.*Viscum obovatum* Harv.*Viscum obscurum* Thunb.**SANTALACEAE***Colpoon compressum* Berg.*Osyridocarpus schimperianus* (Hocht. ex. A. Rich.) A. DC.*Thesium* sp.*Thesium acutissimum* A. DC.*Thesium asterias* A.W. Hill*Thesium squarrosus* L.f.*Thesium triflorum* Thunb.**OLACACEAE***Olax dissitiflora* Oliv.*Ximenia caffra* Sond. var. *natalensis* Sond.**POLYGONACEAE***Rumex sagittatus* Thunb.*Persicaria lapathifolia* (L.) S.F. Gray **Persicaria serrulata* (Lag.) Webb & Moq.**AMARANTHACEAE***Celosia trigyna* L.*Cyathula cylindrica* Moq.*Pupalia lappacea* (L.) A. Juss. var. *lappacea**Achyranthes aspera* L. var. *aspera* **Achyranthes aspera* L. var. *sicula* **Alternanthera pungens* H.B.K. ***PHYTOLACCACEAE***Phytolacca dodecandra* L'Herit.*Phytolacca octandra* L.**MESEMBRYANTHEMACEAE***Aptenia cordifolia* (L.f.) Schwant. var. *cordifolia**Delosperma* sp.*Delosperma galpinii* L. Bol. var. ?*Delosperma herbeum* (N.E. Br.) N.E. Br.*Lampranthus blandus* (Haw.) Schwant.*Lampranthus spectabilis* (Haw.) N.E. Br. subsp. *fugitans* (L. Bol.) Glen**PORTULACACEAE***Anacampseros rufescens* (Harv.) Sweet**CARYOPHYLLACEAE***Drymaria cordata* (L.) Willd. subsp. *diandra* (Blume) J. Duke**ILLECEBRACEAE***Pollichia* sp.*Silene burchellii* Otth. var. ?*Dianthus mooiensis* F.N. Williams subsp. *mooiensis* var. *mooiensis***NYMFAEACEAE***Nymphaea nouchali* Burm. f. var. *caerulea* (Sav.) Verdc.**RANUNCULACEAE***Knowltonia brevistylis* Szyszyl.*Clematis brachiata* Thunb.*J. Munday s.n.*, JDavidson, VR 1904, CPFMcLean 465, PREScott-Shaw, CR 5927, CPFH.F. Glen 242, CPFMcLean 577, PREHenderson, Brokensha & Collins 116, JScott-Shaw, CR & Meter, E 5965, CPFH.F. Glen 350, PREVan Wyk 5118, PREBalkwill & G.V. Cron 47, PREHenderson, Brokensha, S. & Collins 197,PREMantell, D. & Vassilatos, A. 55, PREMantell, D. & Vassilatos, A. 679, PREL.E. Davidson 1094, CPFL.E. Davidson 2028, CPFMantell & Vassilatos 62, PREBalkwill & Cron 171, PREJ. Munday 794, JH.F. Glen 383, CPFO. Kerfoot K7605, JKerfoot K 7589, JWard, C.J. 6645, PREManning, J.C. 1001, PREL.E. Davidson 2434, JV.R. Davidson 1607, CPFA.P.D. McClean 449, PREVassilatos & Mantell 589, JBalkwill & Crankshaw 80/179, JVassilatos & Mantell 785, JMcLean 454, PREMantell & Vassilatos 556, PREBalkwill & Cron, G.V. 133, PREA.P.D. McClean 453, PREBalkwill & Cron 133, JVassilatos & Mantell 928, JK. Balkwill & O. Crankshaw 80/113, UNRHVassilatos & Mantell 536, JDavidson 2409, JBalkwill & Crankshaw 80/193, JGlen 262, JV.R. Davidson s.n., CPFMantell & Vassilatos 59, JBalkwill & Cron 141, JVassilatos & Mantell 582JPotgieter & Meter 102, NUH.F. Glen 328, CPFBalkwill & Crankshaw 80/187, JL.E. Davidson 1915, JV.R. Davidson 1159, CPFPotgieter & Meter 100, NU

Ranunculus multifidus Forssk.

MENISPERMACEAE

Cissampelos mucronata A. Rich.

Cissampelos torulosa E. Mey. ex Harv.

ANNONACEAE

Uvaria caffra E. Mey. ex Sond.

Uvaria lucida Benth. subsp. *virens* (N.E. Br.) Verdc.

Monanthes caffra (Sond.) Verdc.

TRIMENIACEAE

Xymalos monospora (Harv.) Baill.

LAURACEAE

Cryptocarya latifolia Sond.

Cryptocarya woodii Engl.

Cryptocarya wyliei Stapf

Dahlgrenodendron natalense (J.H. Ross) J.J.M. v.d. Merwe & Van Wyk

Cassytha filiformis L. *

BRASSICACEAE

Heliophila elongata (Thunb.) DC.

Heliophila rigidiuscula Sond.

Lepidium bonariense L. *

Cardamine africana L.

CAPPARACEAE

Bachmannia woodii (Oliv.) Gilg

Capparis brassii DC.

Capparis fascicularis DC. var. *zeyheri* (Turcz.) Toelken

Capparis sepiana L. var. *citriifolia* (Lam.) Toelken

Capparis tomentosa Lam.

Maerua juncea Pax subsp. *crustata* (Wild) Wild

Maerua racemulosa (A. DC.) Gilg. & Ben.

DROSERACEAE

Drosera sp.

Drosera sp. c.f. *D. collinsiae* N.E. Br. ex Burt Davy

Drosera sp. c.f. *D. burkeana* Planch.

Drosera cuneifolia L.f.

CRASSULACEAE

Cotyledon orbiculata L. var. ?

Kalanchoe rotundifolia (Haw.) Haw.

Kalanchoe crenata (Andr.) Haw.

Crassula alba Forssk. var. *parvisepala* (Schonl.) Toelken

Crassula capitella Thunb. subsp. *meyeri* (Harv.) Toelken

Crassula flanaganii Schonl. & Bak. f.

Crassula obovata Haw. var. *dregeana* (Harv.) Toelken

Crassula obovata Haw. var. *obovata*

Crassula orbicularis L.

Crassula ovata (Mill.) Druce

Crassula pellucida L. subsp. *brachypetala* (Drege ex Harv.) Toelken

Crassula pellucida L. subsp. *marginalis* (Dryand. in Ait.) Toelken

Crassula perfoliata L. var. *heterotricha* (Schinz) Toelken

Crassula perforata Thunb.

Crassula sarmentosa Harv. var. *integrifolia* Toelken

Crassula sarmentosa Harv. var. *sarmentosa*

Crassula sediflora (Eckl. & Zeyh.) Endl. & Walp. var. *sediflora*

Crassula setulosa Harv. var. ?

Crassula setulosa Harv. var. *setulosa* x *C. natalensis* Schonl.

Crassula southii Schonl. subsp. *sphaerocephala* Toelken

Crassula tetragona L. subsp. *acutifolia* (Lam.) Toelken

Crassula vaginata Eckl. & Zeyh.

PITTOSPORACEAE

Pittosporum viridiflorum Sims

HAMAMELIDACEAE

Trichocladus crinitus (Thunb.) Pers.

Trichocladus grandiflorus Oliv.

ROSACEAE

Cliffortia linearifolia Eckl. & Zeyh.

Cliffortia paucistaminea Weim.

Cliffortia strobilifera Murray

CONNARACEAE

Cnestis natalensis (Hochst.) Planch. & Sond.

FABACEAE

Albizia adianthifolia (Schumach.) W.F. Wight

L.E. Davidson 2194, J

Vassilatos & Mantell 677, J

Vassilatos & Mantell 280, J

Vassilatos & Mantell 456, J

L.E. Davidson 1631, CPF

R.A. Lubke 1505, CPF

K. Balkwill s.n., J

O.M. Hilliard s.n., J

A.E. Van Wyk 4194, J

Henderson, Brokensha & Collins 124, J

L.E. Davidson 2434, J

L.E. Davidson 1843, CPF

Balkwill & Crankshaw 80/149, J

Mantell & Vassilatos 30, J

H.F. Glen 215, CPF

V.R. Davidson s.n., CPF

L.E. Davidson 1548, UNRH

Balkwill & Cron 304, J

L.E. Davidson 1165, UNRH

O. Kerfoot K7249, J

L.E. Davidson 2527, J

V.R. Davidson 1692, CPF

C.R. Scott-Shaw 1452, CPF

Prosser s.n., J

Balkwill & Cron s.n., J

H.F. Glen 356, CPF

H.F. Glen 356, CPF

H.F. Glen 406, CPF

McLean 532, PRE

Nicholson 1981, PRE

Mantell & Vassilatos 916, PRE

Vassilatos & Mantell 908, J

H.F. Glen 458, UNRH

H.F. Glen 368, CPF

K. Kerfoot 6394, J

L.E. Davidson 2024, J

DuToit M. 150, PRE

L.E. Davidson 2438, J

L.E. Davidson 1999, CPF

H.F. Glen 411, J

L.E. Davidson 1143, J

Vassilatos & Mantell 515, J

Mantell & Vassilatos 893, PRE

Vassilatos & Mantell 208, J

L.E. Davidson 2019, CPF

Nicholson 1963, PRE

Vassilatos & Mantell 246, J

H.F. Glen 355, CPF

H.B. Nicholson 2115, PRE

L.E. Davidson 2577, J

K. Balkwill & O. Crankshaw 80/87, J

L.E. Davidson 1108, J

H. F. Glen 380, J

Brokensha & Collins 181, J

R.G. Strey 11061, PRE

Balkwill & Cron 44, J

L.E. Davidson s.n., UNRH

- Acacia ataxacantha* DC.
Acacia caffra (Thunb.) Willd.
Acacia karroo Hayne
Acacia meamsii De Wild. *
Dichrostachys cinerea (L.) Wight & Arn. subsp. *nyassana* (Taub.) Brenan
Adenopodia spicata (E. Mey.) Presl.
Schotia sp. nov.
Schotia brachypetala Sond.
Schotia capitata Bolle
Schotia latifolia Jacq.
Bauhinia natalensis Oliv. ex Hook.
Chamaecrista mimosoides (L.) Greene
Chamaecrista plumosa E. Mey. var. *plumosa*
Chamaecrista stricta E. Mey.
Senna septemtrionalis (Viv.) Irwin & Barmeby *
Caesalpinia sp. c.f. *C. bonduc* (L.) Roxb.
Caesalpinia decapetala (Roth) Alston *
Calpurnia aurea (Ait.) Benth. subsp. *sylvatica* (Burch.) Brummitt
Baphia racemosa (Hochst.) Bak.
Podalyria velutina Burch. ex Benth.
Rafnia elliptica Thunb.
Aspalathus gerrardii H. Bol.
Aspalathus spinosa L. subsp. ?
Aspalathus spinosa L. subsp. *spinosa*
Crotalaria sp.
Crotalaria capensis Jacq.
Crotalaria globifera E. Mey.
Crotalaria lanceolata E. Mey. subsp. *lanceolata*
Crotalaria macrocarpa E. Mey. subsp. *macrocarpa*
Crotalaria natalensis Bak. f.
Crotalaria natalitia Meisn. var. *natalitia*
Argyrobolium sp. c.f. *A. rupestre* (Eckl. & Zeyh.) Walp.
Argyrobolium harveyanum Oliv.
Argyrobolium rupestre (Eckl. & Zeyh.) Walp.
Argyrobolium tomentosum (Andr.) Druce
Indigofera sp. c.f. *I. velutina* E. Mey.
Indigofera dregeana E. Mey.
Indigofera eriocarpa E. Mey.
Indigofera filipes Benth. ex Harv.
Indigofera hedyantha Eckl. & Zeyh.
Indigofera hilaris Eckl. & Zeyh.
Indigofera micrantha E. Mey.
Indigofera rubroglandulosa Germishuizen
Indigofera sordida Benth. ex Harv.
Indigofera tristis E. Mey.
Indigofera williamsonii (Harv.) N.E. Br.
Indigofera woodii H. Bol.
Psoralea pinnata L.
Tephrosia sp.
Tephrosia sp. c.f. *T. bachmannii* Harms
Tephrosia bachmannii Harms
Tephrosia glomeruliflora Meisn. subsp. *glomeruliflora*
Tephrosia grandiflora (Ait.) Pers.
Tephrosia kraussiana Meisn.
Tephrosia macropoda (E. Mey.) Harv. var. *diffusa* (E. Mey.) B.D. Schrire
Tephrosia multijuga R.G.N. Young
Tephrosia polystachya E. Mey. var. *hirta* Harv.
Tephrosia pondoensis (Codd) Schrire
Tephrosia purpurea (L.) Pers. subsp. *canescens* (E. Mey.) Brummitt
Tephrosia shilwanensis Schinz
Ophrestia oblongifolia (E. Mey.) H.M. Forbes var. *oblongifolia*
Millettia grandis (E. Mey.) Skeels
Aeschynomene micrantha DC.
Zomia c.f. *Z. milneana* Mohlenbr.
Zomia capensis Pers.
Zomia linearis E. Mey.
Desmodium dregeanum Benth.
Desmodium incanum DC.
Desmodium setigerum (E. Mey.) Benth. ex Harv.
Pseudarthria hookeri Wight & Arn. var. *hookeri*
Balkwill & Cron 13, J
E.J. Moll 5035, PRE
Mantell & Vassilatos 90, PRE
DuToit M. 148, PRE
L.E. Davidson 2267, J
CL s.n., CPF
Balkwill & Cron 266, J
D.C.H. Plowes 2780, PRE
Nicholson PRE61799, PRE
Balkwill & Cron 15, J
Coetzer, L.A. 78, PRE
T.H. Arnold 1336, PRE
Henderson, Brokensha & Collins 148, PRE
Mantell & Vassilatos 8, PRE
H.F. Glen 205, CPF
L.E. Davidson 2478, J
H.F. Glen 425, CPF
Pienaar J.N. 128, PRE
V.R. Davidson 1760, CPF
C.R. Scott-Shaw 4180, CPF
Mantell & Vassilatos 46, J
Vassilatos & Mantell 897, J
H.F. Glen 370, CPF
Balkwill & Cron 101, J
O. Kerfoot K7246, J
Nicholson 1403, PRE
C.R. Scott-Shaw s.n., CPF
Forbes & Munday 468, J
Balkwill & Cron 164, J
Mantell & Vassilatos 578, PRE
K. Kerfoot 6382, CPF
K. Balkwill & O. Crankshaw 80/177, J
C.R. Scott-Shaw 0, CPF
Vassilatos & Mantell 949, J
Potgieter & Meter 104, NU
Balkwill & Cron 225, J
Henderson, Brokensha & Collins 76, J
Vassilatos & Mantell 895, J
L.E. Davidson s.n., CPF
L.E. Davidson s.n., J
Vassilatos & Mantell 895,
McLean 480, PRE
J. Munday 801, J
H.F. Glen 361, J
Nicholson 1709, PRE
O. Kerfoot K7244, J
O. Kerfoot K7229, J
L.E. Davidson s.n., CPF
L.E. Davidson 2015, J
L.E. Davidson 1209, J
T.J. Edwards 1248, NU
Schrire B.D. 2287, PRE
R. Cripps 7, NU
C.R. Scott-Shaws.n., CPF
Mantell & Vassilatos 128, PRE
Mantell & Vassilatos 564, PRE
Balkwill & Cron 94, J
A. Abbott 962, UNRH
O. Kerfoot K.7345, J
J. Munday 822, J
Mantell & Vassilatos 129, PRE
H.F. Glen 292, CPF
Vassilatos & Mantell 11, J
Balkwill & Cron 127, J
Mantell & Vassilatos 84, PRE
C.R. Scott-Shaw s.n., CPF
C.R. Scott-Shaw s.n., CPF
C.R. Scott-Shaw s.n., CPF
C.R. Scott-Shaw s.n., CPF
Vassilatos & Mantell 701, J

- Dalbergia* sp.
Dalbergia armata E. Mey.
Dalbergia multijuga E. Mey.
Dalbergia obovata E. Mey.
Abrus laevigatus E. Mey.
Abrus precatorius L. subsp. *africanus* Verdc.
Erythrina x dyeri Hennesy
Erythrina humeana Spreng.
Erythrina latissima E. Mey.
Erythrina lysistemon Hutch.
Canavalia maritima (Aubl.) Thouars
Rhynchosia sp. c.f. *R. hirsuta* Eckl. & Zeyh.
Rhynchosia caribaea (Jacq.) DC.
Rhynchosia minima (L.) DC. var. *prostrata* (Harv.) Meikle
Rhynchosia pentheri Schltr. ex Zahlbr. var. *pentheri*
Rhynchosia totta (Thunb.) DC. var. *totta*
Eriosema burkei Benth.
Eriosema cordatum E. Mey.
Eriosema kraussianum Meisn.
Eriosema salignum E. Mey.
Eriosema simulans C.H. Stirton
Sphenostylis marginata E. Mey. subsp. *marginata*
Dolichos falciformis E. Mey.
Dolichos sericeus E. Mey. subsp. *sericeus*
Macrotyloma axillare (E. Mey.) Verdc. var. ?
- GERANIACEAE**
- Monsonia natalensis* Knuth
Pelargonium alchemilloides (L.) L'Herit
Pelargonium luridum (Andr.) Sweet
Pelargonium odoratissimum (L.) L'Herit.
Pelargonium pulverulentum Colv. ex Sweet
- OXALIDACEAE**
- Oxalis semiloba* Sond.
- LINACEAE**
- Linum thunbergii* Eckl. & Zeyh.
- ERYTHROXYLACEAE**
- Erythroxylum emarginatum* Thonn.
Erythroxylum pictum E. Mey. ex Sond.
Nectaropetalum capense (H. Bol.) Stapf & Boodle
Nectaropetalum zuluense (Schonl.) Corbishley
- RUTACEAE**
- Zanthoxylum capense* (Thunb.) Harv.
Zanthoxylum davyi (Verdoorn) Waterm.
Calodendrum capense (L.f.) Thunb.
Agathosma bisulca (Thunb.) Bartl. & Wendl.
Agathosma ovata (Thunb.) Pillans
Oricia bachmannii (Engl.) Verdoorn
Vepris lanceolata (Lam.) G. Don.
Teclea gerrardii Verdoorn
Teclea natalensis (Sond.) Engl.
Clausena anisata (Willd.) Hook. f. ex Benth.
- BURSERACEAE**
- Commiphora harveyi* (Engl.) Engl.
Commiphora neglecta Verdoorn
Commiphora woodii Engl.
- PTAEROXYLACEAE**
- Ptaeroxylon obliquum* (Thunb.) Radlk.
Turraea floribunda Hochst.
Ekebergia capensis Sparm.
Ekebergia pterophylla (C. DC.) Hofmeyr
Trichilia dregeana Sond.
- MALPIGHIACEAE**
- Sphedamnocarpus pruriens* (Juss.) Szyszyl. subsp. *pruriens*
Acridocarpus natalitius Juss. var. *natalitius*
- POLYGALACEAE**
- Polygala* sp.
Polygala confusa MacOwan
Polygala fruticosa Berg.
Polygala hottentotta Presl.
Polygala serpentaria Eckl. & Zeyh.
- L.E. Davidson 1241, J
 L.E. Davidson 2545, J
 B. Neumann 15, PRE
 McLean 361, PRE
 Mantell & Vassilatos 196, PRE
 K. Balkwill & O. Crankshaw 80/172, J
 Dyer & Dohse 5417, PRE
 H.F. Glen 268, CPF
 C.R. Scott-Shaw s.n., CPF
 H.F. Glen 446, CPF
 O. Kerfoot s.n., CPF
 Vassilatos & Mantell 174, J
 R.A. Lubke 1474, J
 L.E. Davidson s.n., J
 McClean 571, PRE
 Balkwill & Cron 42, PRE
 J. Munday 802, J
 C.R. Scott-Shaw s.n., CPF
 Van Wyk 5063, PRE
 C.R. Scott-Shaw s.n., CPF
 Vassilatos & Mantell 364, J
 J. Munday 825, PRE
 Coetzer C. 81, PRE
 Strey 10039, PRE
 Vassilatos & Mantell 672 A, J
- Vassilatos & Mantell 142, J
 Glen 424, J
 L.E. Davidson 1866, J
 A.P.D. McClean 363, PRE
 Van Wyk, A.E. 4220, PRE
- Vassilatos & Mantell 938, J
- Vassilatos & Mantell 506, J
- Van Wyk 5019, PRE
 R.A. Lubke 1507, J
 O. Kerfoot K7626, J
 L.E. Davidson 1907, J
- Vassilatos & Mantell 368, J
 O. Kerfoot K7289, J
 L.E. Davidson 2566,
 J. Munday 810, J
 Mantell & Vassilatos 45, PRE
 C.R. Scott-Shaw 5915, CPF
 L.E. Davidson 1825, CPF
 L.E. Davidson 1822, J
 Strey 11059, PRE
 L.E. Davidson 1900, CPF
- H.B. Nicholson 2223, PRE
 Vassilatos & Mantell 442A, J
 Vassilatos & Mantell 442A, J
- J.V. Van Greuning 473, PRE
 K. Balkwill & O. Crankshaw 80/101, J
 J.N. Pienaar 117, PRE
 A.E. Van Wyk & S. Venter 1294, PRE
 Balkwill & Cron 485 (Q18 17), J
- Henderson, Brokensha & Collins 110, J
 Mantell & Vassilatos 446, PRE
- C.R. Scott-Shaw 5908, CPF
 C. Reid 903, PRE
 K. Balkwill & O. Crankshaw 80/148, J
 Mantell & Vassilatos 92, J
 Vassilatos & Mantell 260, PRE

Polygala ohlendorfiana Eckl. & Zeyh.

Polygala virgata Thunb. var. *virgata*

EUPHORBIACEAE

Heywoodia lucens Sim

Phyllanthus nummulariifolius Poir.

Phyllanthus reticulatus Poir.

Margaritana discoidea (Baill.) Webster var. *discoidea*

Margaritana discoidea (Baill.) Webster var. *nitida* (Pax) Radcliffe-Sm.

Drypetes arguta (Muell. Arg.) Hutch.

Drypetes gerrardii Hutch.

Antidesma venosum E. Mey. ex Tul.

Croton sylvaticus Hochst.

Micrococca capensis (Baill.) Prain

Erythrococca berberidea Prain

Macaranga capensis (Baill.) Benth. ex Sim

Acalypha ecklonii Baill.

Acalypha glabrata Thunb. var. *glabrata*

Acalypha glabrata Thunb. var. *pilosior* (Kuntze) Prain

Acalypha glabrata Thunb. var. *pilosior* (Kuntze) Prain

Acalypha glandulifolia Buchinger ex Meisn.

Acalypha peduncularis E. Mey. ex Meisn.

Acalypha schinzii Pax.

Acalypha wilmsii Pax.

Tragia glabrata (Muell. Arg.) Pax & K. Hoffm. var. *glabrata*

Ctenomeria capensis (Thunb.) Harv. ex Sond.

Dalechampia capensis Spreng. f.

Dalechampia volubilis E. Mey. ex Baill.

Jatropha varifolia Pax*

Clutia sp. cf. *C. abyssinica* Jaub. & Spach

Clutia abyssinica Jaub. & Spach var. *abyssinica*

Clutia hirsuta E. Mey. ex Sond. var. *hirsuta*

Clutia natalensis Bernh. ex Krauss

Clutia pulchella L. var. ?

Clutia virgata Pax & K. Hoffm.

Suregada africana (Sond.) Kuntze

Excoecaria simii (Kuntze) Pax

Sapium integerrimum (Hochst.) J. Leonard

Euphorbia sp. c.f. *E. grandidens*

Euphorbia sp. c.f. *E. kraussiana*

Euphorbia bupleurifolia Jacq.

Euphorbia ericoides Lam.

Euphorbia franksiae N.E. Br. var. ?

Euphorbia grandidens Haw.

Euphorbia gueinzii Boiss. var. ?

Euphorbia kraussiana Bernh. var. *kraussiana*

Euphorbia natalensis Bernh.

Euphorbia tirucalli L.

Euphorbia triangularis Desf.

BUXACEAE

Buxus natalensis (Oliv.) Hutch.

ANACARDIACEAE

Sclerocarya birrea (A. Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro

Harpephyllum caffrum Bernh. ex Krauss

Protorhus longifolia (Bernh.) Engl.

Loxostylis alata Spreng. f. ex Reichb.

Rhus sp. nov. c.f. *R. rigida* Mill.

Rhus acocksii Moffett

Rhus camosula Schonl.

Rhus chirindensis Bak. f.

Rhus crenata Thunb.

Rhus dentata Thunb.

Rhus discolor E. Mey. ex Sond.

Rhus gueinzii Sond.

Rhus lucida L.

Rhus natalensis Bernh. ex Krauss

Rhus nebulosa Schonl.

L.E. Davidson s.n., CPF

H.F. Glen 283, CPF

Glen 487, J

Vassilatos & Mantell 432, J

Vassilatos & Mantell 380, J

L.E. Davidson 1833, CPF

K. Balkwill & O. Crankshaw 80/ 102, J

A.E. Van Wyk 3270, PRE

Balkwill & Cron 311, PRE

L.E. Davidson 1060, CPF

B.J. Pienaar 580, PRE

C.R. Scott-Shaw 5919, CPF

O. Kerfoot s.n., CPF

H.F. Glen 340, J

C.R. Scott-Shaw 5931, CPF

Balkwill & Cron 139, J

Henderson, Brokensha & Collins 154, J

Moll 5017, PRE

J. Munday 826, J

Vassilatos & Mantell 257, PRE

C.R. Scott-Shaw 638, NU

Scott-Shaw 636 holotype, NU

V.R. Davidson 1844, CPF

Arnold 1349, PRE

Mantell & Vassilatos 14, PRE

Henderson, Brokensha & Collins 66, J

Balkwill & Cron 229, PRE

V.R. Davidson 2025, CPF

L.E. Davidson 2025, J

Arnold 1337, PRE

D. McMurtry 6071, J

H.F. Glen 442, J

Vassilatos & Mantell 1045, J

V.R. Davidson 1882, CPF

L.E. Davidson s.n., CPF

L.E. Davidson 1626, CPF

L.E. Davidson 1145, J

Balkwill & Crankshaw 80/132, J

L.E. Davidson 1873, CPF

H.F. Glen 284, PRE

Balkwill & Cron 55, PRE

Vassilatos & Mantell 580, PRE

L.E. Davidson 1947, J

B.J. Pienaar 582, PRE

L.E. Davidson 2023, CPF

A.E. Van Wyk 5076, PRE

Vassilatos & Mantell 194, PRE

Mantell & Vassilatos 72, J

Mantell & Vassilatos 7, J

H.F. Glen 343, J

L.E. Davidson 2530, J

C.R. Scott-Shaw 4200, PRE

Vassilatos & Mantell 601, J

R.A. Lubke 1506, J

M. Du Toit 155, PRE

Henderson, Brokensha, S. & Collins 131, J

Balkwill & Cron 284, J

B.K. Adie s.n., NU

C.R. Scott-Shaw s.n., CPF

J.N. Pienaar 119, PRE

R.A. Lubke 1460, CPF

Mantell & Vassilatos 24, PRE

C.R. Scott-Shaw s.n., CPF

H.B. Nicholson 1938, PRE

L.E. Davidson 2386, J

C.R. Scott-Shaw s.n., CPF

Forbes & Munday s.n., J

- Rhus pallens* Eckl. & Zeyh.
Rhus pentheri Zahlbr.
Rhus pyroides Burch. var. ?
Rhus pyroides Burch. var. *pyroides*
Rhus rehmanniana Engl.
- CELASTRACEAE**
Maytenus abbotii Van Wyk
Maytenus acuminata (L. f.) Loes. var. *acuminata*
Maytenus bachmannii (Loes.) Marais
Maytenus cordata (E. Mey. ex Sond.) Loes.
Maytenus heterophylla (Eckl. & Zeyh.) N.K.B. Robson
Maytenus mossambicensis (Klotzsch) Blakelock var. *mossambicensis*
Maytenus mossambicensis (Klotzsch) Blakelock var. *rubra* (Harv.) Blakelock
Maytenus nemorosa (Eckl. & Zeyh.) Marais
Maytenus peduncularis (Sond.) Loes.
Maytenus tenuispina (Sond.) Marais
Maytenus undata (Thunb.) Blakelock
Putterlickia retrospinosa Van Wyk & Mostert
Putterlickia verrucosa (E. Mey. ex Sond.) Szyszyl.
Pterocelastrus echinatus N.E. Br.
Cassine aethiopica Thunb.
Cassine crocea (Thunb.) Kuntze
Cassine eucleiformis (Eckl. & Zeyh.) Kuntze
Cassine papillosa (Hochst.) Kuntze
Cassine peragua L.
Cassine tetragona (L.f.) Loes.
Pleurostyliia capensis (Turcz.) Loes.
Salacia gerrardii Harv.
- ICACINACEAE**
Cassinopsis ilicifolia (Hochst.) Kuntze
Cassinopsis tinifolia Harv.
Apodytes abbotii A.E. Van Wyk
Apodytes dimidiata E. Mey. ex Arn. subsp. *dimidiata*
- SAPINDACEAE**
Allophylus dregeanus (Sond.) De Winter
Allophylus melanocarpus (Sond.) Radlk.
Allophylus natalensis (Sond.) De Winter
Dodonaea angustifolia L.f.
Hippobromus pauciflorus (L.f.) Radlk.
- MELIANTHACEAE**
Bersama sp. c.f. *B. tysoniana* Oliv.
Bersama lucens (Hochst.) Szyszyl.
Bersama stayneri Phill.
Bersama swinyi Phillips
Bersama tysoniana Oliv.
- BALSAMINACEAE**
Impatiens hochstetteri Warb. subsp. *hochstetteri*
- RHAMNACEAE**
Ziziphus mucronata Willd. subsp. ?
Scutia myrtina (Burm. f.) Kurz
Phylica paniculata Willd.
Helinus integrifolius (Lam.) Kuntze
- VITACEAE**
Rhoicissus digitata (L.f.) Gilg. & Brandt
Rhoicissus rhomboidea (E. Mey. ex Harv.) Planch.
Rhoicissus tomentosa (Lam.) Wild & Drum.
Rhoicissus tridentata (L. f.) Wild & Drum. subsp. ?
Rhoicissus tridentata (L. f.) Wild & Drum. subsp. *tridentata*
Cissus fragilis E. Mey. ex Kunth
Cyphostemma cirrhosum (Thunb.) Descoings ex Wild & Drum. subsp. ?
Cyphostemma hypoleucum (Harv.) Descoings ex Wild & Drum.
Cyphostemma woodii (Gilg & Brandt) Descoings
- TILIACEAE**
Grewia caffra Meisn.
Grewia lasiocarpa E. Mey. ex Harv.
Grewia occidentalis L.
Grewia pondoensis Burnet
Triumfetta pilosa Roth var. *tomentosa* Szyszyl. ex Sprague & Hutch.
- MALVACEAE**
Abutilon sonneratianum (Cav.) Sweet
- C.R. Scott-Shaw 5909, CPF
Vassilatos & Mantell 896, J
C.R. Scott-Shaw s.n., CPF
McClellan 574, PRE
K. Kerfoot 6381, J
- L.E. Davidson 2513, J
Mantell & Vassilatos 48, PRE
Strey 11060, PRE
C.R. Scott-Shaw & E. Meter 5920, CPF
Vassilatos & Mantell 298, J
L.E. Davidson 1555, J
Nicholson 1332, PRE
K. Balkwill & G.V. Cron 186, J
R. Cripps 32, NU
L.E. Davidson 1117, J
K. Balkwill & O. Crankshaw 80/95, J
C.R. Scott-Shaw 5924, CPF
L.E. Davidson 2413, J
Balkwill & Cron 115, PRE
A. Abbott 2672, UNRH
L.E. Davidson 1832, J
E.J. Moll 5014, PRE
Balkwill & Cron 302, PRE
C.R. Scott-Shaw & E. Meter 5962, CPF
L.E. Davidson 2472, J
Balkwill 330, J
K. Balkwill & O. Crankshaw 80/89, J
- V.R. Davidson s.n., CPF
H.B. Nicholson 1273, PRE
B.K. Adie s.n., NU
Mantell & Vassilatos 49, PRE
- L.E. Davidson 1081, CPF
Vassilatos & Mantell 583, PRE
R.A. Lubke 1462, CPF
V.R. Davidson 1070, CPF
V.R. Davidson 1744, CPF
- Balkwill & Cron 190, PRE
L.E. Davidson s.n., CPF
Balkwill & Cron 88, PRE
Balkwill & Cron 157, PRE
L.E. Davidson s.n., CPF
- Vassilatos & Mantell 712, PRE
- R.A. Lubke 1151, CPF
L.E. Davidson 1212, CPF
L.E. Davidson 2541, CPF
Henderson, Brokensha S. & Collins 189, J
- L.E. Davidson 1297, CPF
L.E. Davidson s.n., J
C.R. Scott-Shaw s.n., CPF
Balkwill & Cron 57, PRE
Pienaar, J.N. 122, PRE
H.B. Nicholson 2140, J
O. Kerfoot K7335, J
L.E. Davidson 2499, J
Venter, H.J.T. 9097, PRE
- K. Balkwill & O. Crankshaw 80/108, J
Mantell & Vassilatos 401, PRE
A.E. Van Wyk & S. Venter 1300, PRE
C.R. Scott-Shaw 1412, CPF
McClellan 482, PRE
- Balkwill & Cron 441, J

- Sida dregei* Burt Davy
Sida rhombifolia L.
Pavonia burchellii (DC.) R.A. Dyer
Pavonia columella Cav.
Hibiscus aethiopicus L. var. *ovatus* Harv.
Hibiscus calyphyllus Cav.
Hibiscus fuscus Garcke
Hibiscus ludwigii Eckl. & Zeyh.
Hibiscus meyeri Harv. subsp. *meyeri*
Hibiscus pedunculatus L.f.
Hibiscus trionum L.
- STERCULIACEAE**
- Melhania didyma* Eckl. & Zeyh.
Dombeya burgessiae Gerr. ex Harv.
Dombeya cymosa Harv.
Dombeya tiliacea (Endl.) Planch.
Hermannia grandistipula (Buchinger ex Hochst.) K. Schum.
- OCHNACEAE**
- Ochna* sp.
Ochna arborea Burch. ex DC. var. *arborea*
Ochna arborea Burch. ex DC. var. *oconnorii* (Phill.) Du Toit
Ochna gamostigmata Du Toit
Ochna natalitia (Meisn.) Walp.
Ochna serrulata (Hochst.) Walp.
- CLUSIACEAE**
- Hypericum aethiopicum* Thunb. subsp. ?
Hypericum landii Choisy
Hypericum natalense Wood & Evans
Garcinia gerrardii Harv. ex Sim.
- VIOLACEAE**
- Rinorea angustifolia* (Thouars) Baill.
Hybanthus enneaspermus (L.) F. Muell. *
- FLACOURTIACEAE**
- Rawsonia lucida* Harv. & Sond.
Xylothea kraussiana Hochst.
Scolopia sp.
Scolopia zeyheri (Nees) Harv.
Pseudoscolopia polyantha Gilg.
Gerrardina foliosa Oliv.
Homalium dentatum (Harv.) Warb.
Homalium rufescens Benth.
Trimeria grandifolia (Hochst.) Warb.
Dovyalis caffra (Hook. f. & Harv.) Hook. f.
Dovyalis longispina (Harv.) Warb.
Dovyalis rhamnoides (Burch. ex DC.) Harv.
- PASSIFLORACEAE**
- Adenia gummifera* (Harv.) Harms var. *gummifera*
- ACHARIACEAE**
- Ceratosicyos laevis* (Thunb.) A. Meeuse
- BEGONIACEAE**
- Begonia dregei* Otto & Dietr.
Begonia sutherlandii Hook. f.
- CACTACEAE**
- Rhipsalis baccifera* (J. Mill.) Stearn
- THYMELAEACEAE**
- Peddiea africana* Harv.
Gnidia anthylloides (L.f.) Gilg.
Gnidia kraussiana Meisn. var. *kraussiana*
Gnidia macropetala Meisn.
Gnidia myrtifolia C. H. Wr.
Gnidia nodiflora Meisn.
Passerina filiformis L.
- LYTHRACEAE**
- Nesaea radicans* Guill. & Perr. var. *floribunda* (Sond.) A. Fernandes
- RHYNCHOCALYCEAE**
- Rhynchocalyx lawsonioides* Oliv.
- RHIZOPHORACEAE**
- Cassipourea gerrardii* (Schinz) Alston
Cassipourea gummiflua Tul. var. *verticillata* (N.E. Br.) J. Lewis
- Vassilatos & Mantell 134, PRE
Vassilatos & Mantell 800, J
Vassilatos & Mantell 953, J
A.P.D. McClean 562, PRE
Vassilatos & Mantell 230, J
Mantell & Vassilatos 570, PRE
Vassilatos & Mantell 729, J
Vassilatos & Mantell 792, J
H.B. Nicholson 1139, PRE
Mantell & Vassilatos 58, PRE
Mantell & Vassilatos 1281, PRE
- Vassilatos & Mantell 525, J
Vassilatos & Mantell 402A, J
H.F. Glen 472, PRE
E.J. Van Jaarsveld 2202, PRE
Vassilatos & Mantell 148, PRE
- P.C.V. Du Toit 945, PRE
H.F. Glen 490, PRE
K. Balkwill & O. Crankshaw s.n., J
L.E. Davidson 1088, CPF
J. Munday 823, J
C.R. Scott-Shaw 5911, J
- H.F. Glen 305, PRE
H.B. Nicholson 2189, PRE
L.E. Davidson 2549, CPF
L.E. Davidson 1857, CPF
- K. Balkwill & O. Crankshaw 80/110, J
Vassilatos & Mantell 969, J
- A.E. Van Wyk 5018, PRE
J. Munday 820, J
C.R. Scott-Shaw 5917, CPF
K. Cooper 35, PRE
B.K. Adie s.n., NU
Henderson, Brokensha & Collins 21, J
C.R. Scott-Shaw & E. Meter 5926, CPF
L.E. Davidson 2511, J
L.E. Davidson 1872, J
L.E. Davidson 1573, J
Vassilatos & Mantell 483, J
L.E. Davidson 2403, J
- T.H. Arnold 1350, PRE
- Nichols, G.R. 736, PRE
- H.F. Glen 276, J
K. Balkwill & G.V. Cron 6, J
- A.E. Van Wyk 5073, PRE
- K. Balkwill & G.V. Cron 72, J
R.A. Lubke 1486, CPF
J. Munday 804, J
K. Balkwill & O. Crankshaw 80/164, J
O. Kerfoot 7653, J
Vassilatos & Mantell 880, J
Mantell & Vassilatos 32, PRE
- Balkwill & Cron, G.V. 250, PRE
- B.K. Adie s.n., NU
- A.E. Van Wyk 5021, PRE
McLean 468, PRE

COMBRETACEAE

Combretum sp. cf. *C. erythrophyllum* (Burch.) Sond.
Combretum kraussii Hochst.

MYRTACEAE

Psidium cattleianum Sabine *
Psidium guajava L. *
Eugenia sp. nova
Eugenia capensis (Eckl. & Zeyh.) Harv. ex Sond.
Eugenia erythrophylla Strey
Eugenia guienzii Sond.
Eugenia natalitia Sond.
Eugenia simii Duemmer
Eugenia woodii Duemmer
Eugenia zeyheri Harv.
Syzygium cordatum Hochst.
Syzygium gerrardii (Harv. ex Hook. f.) Burt Davy
Syzygium guineense (Willd.) DC.
Heteropyxis natalensis Harv.

MELASTOMATACEAE

Antherotoma naudinii Hook. f.
Dissotis canescens (E. Mey. ex R.A. Grah.) Hook. f.
Memecylon bachmannii Engl.
Memecylon natalense Markg.

ONAGRACEAE

Ludwigia octovalvis (Jacq.) Raven subsp. *sessiliflora* (Mich.) Raven
Oenothera indecora Cambess. subsp. *indecora* *
Oenothera rosea L'Herit. ex Ait. *

ARALIACEAE

Schefflera umbellifera (Sond.) Baill.
Cussonia nicholsonii Strey
Cussonia sphaerocephala Strey
Cussonia spicata Thunb.
Seemannaralia gerrardii (Seemann) Harms

APIACEAE

Centella coriacea Nannfd.
Centella glabrata L. var. *natalensis* Adamson
Alepidea longifolia E. Mey. var. *longifolia*
Heteromorpha arborescens (Spreng.) Cham. & Schlecht.
Heteromorpha trifoliata (Wendl.) Eckl. & Zeyh.
Pimpinella caffra (Eckl. & Zeyh.) D. Dietr.
Foeniculum vulgare Mill. *
Peucedanum sp.
Peucedanum sp.
Peucedanum sp.
Peucedanum caffrum (Meisn.) Phill.

ERICACEAE

Erica caffrorum H. Bol. var. *caffrorum*
Erica cerinthoides L. var. ?
Erica cubica L. var. *cubica*
Erica cubica L. var. *natalensis* H. Bol.
Erica leucapelta Tausch. var. ?

MYRSINACEAE

Maesa lanceolata Forssk.
Rapanea melanophloes (L.) Mez

PRIMULACEAE

Anagallis huttonii Harv.

PLUMBAGINACEAE

Plumbago auriculata Lam.

SAPOTACEAE

Sideroxylon inerme L. subsp. *inerme*
Bequaertiodendron natalense (Sond.) Heine & J.H. Hemsl.
Mimusops obovata Sond.
Vitellariopsis marginata (N.E. Br.) Aubrev.

EBENACEAE

Euclea sp. cf. *E. schimperi* (A. DC.) Dandy var. *schimperi*
Euclea crispa (Thunb.) Guerke var. *crispa*
Euclea natalensis A. DC. subsp. ?
Euclea undulata Thunb. var. *myrtina* (Burch.) Hiern
Euclea undulata Thunb. var. *undulata*

L.E. Davidson 1066, PRE
Mantell & Vassilatos 69, J

L.E. Davidson 1114, J
H.F. Glen 327, J
C.R. Scott-Shaw 5933, CPF
L.E. Davidson 1846, J
Mantell & Vassilatos 308, PRE
O. Kerfoot s.n., CPF
E.J. Moll 5027, PRE
B.K. Adie s.n., NU
C.R. Scott-Shaw 5916, CPF
R.G. Strey 11058, PRE
M. Du Toit 154, PRE
H.B. Nicholson 1274, PRE
L.E. Davidson 1834, PRE
Vassilatos & Mantell 31, PRE

L. Smook 1773, PRE
A.O.D. Mogg 38003, PRE
C.R. Scott-Shaw 1344, CPF
H.B. Nicholson 1878, PRE

Retief, E. 1634, PRE
Vassilatos & Mantell 10, PRE
Vassilatos & Mantell 586, PRE

L.E. Davidson 2547, CPF
C.R. Scott-Shaw 1451, CPF
R.G. Strey 6928, PRE
L.E. Davidson 1894, CPF
Balkwill & Cron 86, J

Vassilatos & Mantell 1117, J
A.E. Van Wyk 5025, PRE
Mantell & Vassilatos 421, PRE
L.E. Davidson s.n., CPF
H.B. Nicholson 1922, CPF
Vassilatos & Mantell 1040, J
Mantell & Vassilatos 28, J
Balkwill & Cron 106, PRE
Balkwill & Cron 328, J
L.E. Davidson 2487, J
K. Balkwill & O. Crankshaw 80/148, J

H.B. Nicholson 1189, PRE
B.K. Adie s.n., NU
J. Munday 819, J
L.E. Davidson 1991, J
V.R. Davidson s.n., CPF

A.P.D. McClean 269, PRE
H.F. Glen 476, CPF

A.P.D. McClean 121, PRE

Balkwill & Cron 291, J

Vassilatos & Mantell 482, PRE
L.E. Davidson 1889, J
Henderson, Brokensha & Collins 185, J
Van Wyk 5017, PRE

Balkwill & Cron 169, J
Brokensha & Collins 83, J
L.E. Davidson 1152, CPF
H.B. Nicholson 1198, PRE
Balkwill & Cron 172, J

Diospyros sp. c.f. *D. lycioides* Desf. subsp. *sericea* (Bernh.) De Winter
Diospyros dichrophylla (Gand.) De Winter
Diospyros lycioides Desf. subsp. *lycioides*
Diospyros natalensis (Harv.) Brenan subsp. ?
Diospyros scabrida (Harv. ex Hiern) De Winter var. *cordata* (E. Mey. ex A. DC.) De Winter
Diospyros simii (Kuntze) De Winter
Diospyros villosa (L.) De Winter var. *villosa*
Diospyros whyteana (Hiern) F. White

OLEACEAE

Chionanthus peglerae (C.H. Wr.) Stearn
Olea capensis L. subsp. *enervis* (Harv. ex C.H. Wr.) Verdoorn
Olea capensis L. subsp. *macrocarpa* (C.H. Wr.) Verdoorn
Olea woodiana Knobl.
Jasminum multipartitum Hochst.

SALVADORACEAE

Azima tetracantha Lam.

LOGANIACEAE

Strychnos decussata (Pappe) Gilg
Strychnos henningsii Gilg
Strychnos madagascariensis Poir.
Strychnos spinosa Lam.
Strychnos usambarensis Gilg
Nuxia congesta R. Br. ex Fresen.
Nuxia floribunda Benth.
Buddleja saligna Willd.

GENTIANACEAE

Sebaea bojeri Griseb.
Chironia laxa Gilg

APOCYNACEAE

Acokanthera oppositifolia (Lam.) Codd
Carissa bispinosa (L.) Desf. ex Brenan subsp. *bispinosa*
Strophanthus speciosus (Ward & Harv.) Reber

PERIPLOCAEAE

Petopentia natalensis (Schltr.) Bullock
Cryptolepis capensis Schltr.
Cryptolepis oblongifolia (Meisn.) Schltr.
Raphionacme galpinii Schltr.

ASCLEPIADACEAE

Xysmalobium confusum Scott Elliot
Schizoglossum sp.
Pachycarpus asperifolius Meisn.
Asclepias affinis (Schltr.) Schltr.
Asclepias physocarpa (E. Mey.) Schltr.
Asclepias praemorsa Schltr.
Cynanchum ellipticum (Harv.) R.A. Dyer
Cynanchum gerrardii (Harv.) Liede
Cynanchum natalitium Schltr.
Sarcostemma viminale (L.) R. Br.
Secamone sp. c.f. *S. gerrardii* Harv. Ex Benth.
Secamone alpini Schultes
Secamone filiformis (L.f.) J.H. Ross
Brachystelma australe R.A. Dyer
Brachystelma vahmeijeri R. A. Dyer
Ceropegia sp.
Ceropegia distincta N.E. Br. subsp. *haygarthii* (Schltr.) Huber
Huemia hystrix (Hook. f.) N.E. Br. var. *parvula* Leach
Tylophora sp.
Tylophora sp.
Tylophora cordata (Thunb.) Druce
Tylophora flanaganii Schltr.
Dregea floribunda E. Mey.
Telosma africana (N.E. Br.) N.E. Br.
Tenaris rubella E. Mey.
Fockea tugelensis N.E. Br.

CONVOLVULACEAE

Cuscuta campestris Yunck. *
Evolvulus alsinoides (L.) L. var. *linifolius* (L.) Bak.
Convolvulus fannosus L.
Ipomoea cairica (L.) Sweet

Balkwill & Cron 184, J
Vassilatos & Mantell 618, J
Van Wyk & Kok 5782, PRE
L.E. Davidson 1569, CPF
H.B. Nicholson 1675, PRE

L.E. Davidson 1570, J
L.E. Davidson 1892, CPF
Van Wyk & Kok 5763, PRE

K. Balkwill & O. Crankshaw 80/97, J
L.M. Prosser 1446, J
K. Balkwill & O. Crankshaw 80/103, J
K. Balkwill & G.V. Cron 272, J
Balkwill & Crankshaw 80/9, J

O. Kerfoot 6375, CPF

C.R. Scott-Shaw 5909, CPF
Balkwill & Cron, G.V. 218, J
K. Balkwill & O. Crankshaw 80/86, J
Vassilatos & Mantell 435B, J
A.E. Van Wyk 5022, PRE
H.F. Glen 342, CPF
A.P.D. McLean 488, PRE
Mantell & Vassilatos 182, PRE

McCLean 566, PRE
O. Kerfoot 6372, CPF

L.E. Davidson 1628, J
H.B. Nicholson 1866, PRE
V.R. Davidson 2561, CPF

R.A. Lubke 1451, J
O. Crankshaw s.n., J
L.E. Davidson 2522, CPF
A.E. Van Wyk 5067, PRE

L.E. Davidson 1258, J
Vassilatos & Mantell 703, J
A.E. Van Wyk & S. Venter 1278, PRE
Nicholas A 988, PRE
J. McLaren s.n., NU
A.E. Van Wyk 5123, PRE
Balkwill & Cron 209, J
Moll 5031, PRE
R.A. Lubke s.n., CPF
H.F. Glen 456, CPF
Balkwill & Cron 298, J
L.E. Davidson 1847, CPF
O. Kerfoot K.7327, J
Strey 6973, J
Strey 10050, PRE
Balkwill & Cron 325, J
K. Balkwill s.n., J
Balkwill & Cron 193, J
L.E. Davidson 2396, J
Vassilatos & Mantell 409, J
Vassilatos & Mantell 821, J
K. Balkwill 7, O. Crankshaw 80/192, J
O. Crankshaw s.n., J
K. Balkwill & O. Crankshaw 80/119, J
Mantell & Vassilatos 54, J
K. Balkwill s.n., J

H.B. Nicholson 1921, PRE
Balkwill & Crankshaw 80/161, J
H.B. Nicholson 2129, PRE
R.A. Lubke 1453, CPF

- Ipomoea ficifolia* Lindl.
Ipomoea magnusiana Schinz var. *magnusiana*
Ipomoea obscura (L.) Ker-Gawl. var. *fragilis* (Choisy) A. Meeuse
Ipomoea pellita Hallier f.
Ipomoea pes-caprae (L.) R. Br. subsp. *brasiliensis* (L.) Van Ooststr.
Ipomoea plebeia R. Br. subsp. *africana* A. Meeuse
Ipomoea wightii (Wall.) Choisy
- BORAGINACEAE**
Cordia caffra Sond.
- VERBENACEAE**
Lantana rugosa Thunb.
Clerodendrum glabrum E. Mey. var. *glabrum*
- LAMIACEAE**
Teucrium kraussii Codd
Leonotis ocymifolia (Burm. f.) Iwarsson var. *raineriana* (Visiani) Iwarsson
Stachys aethiopica L.
Tetradenia riparia (Hochst.) Codd
Aeollanthus buchnerianus Briq.
- Aeollanthus parvifolius* Benth.
Endostemon obtusifolius (E. Mey. ex Benth.) N.E. Br.
Pycnostachys reticulata (E. Mey.) Benth.
Plectranthus sp.
Plectranthus ambiguus (H. Bol.) Codd
Plectranthus ciliatus E. Mey. ex Benth.
Plectranthus ecklonii Benth.
Plectranthus emstii Codd
Plectranthus fruticosus L'Herit.
Plectranthus grallatus Briq.
Plectranthus hadiensis (Forssk.) Schweinf. ex Spreng. var. *tomentosus* (Benth.) Codd
Plectranthus hadiensis (Forssk.) Schweinf. ex Spreng. var. *woodii* (Guerke) Codd
Plectranthus aliciae (Codd) Van Jaarsv. & T.J. Edwards
Plectranthus madagascariensis (Pers.) Benth. var. *madagascariensis*
Plectranthus oertendahlia Th. Fr. Jr.
Plectranthus onbiensis Codd
Plectranthus petiolaris E. Mey. ex Benth.
Plectranthus saccatus Benth. var. ?
Plectranthus saccatus Benth. var. *saccatus*
Plectranthus spicatus E. Mey. ex Benth.
Plectranthus verticillatus (L.f.) Druce
Plectranthus zuluensis T. Cooke
Rabdosiella calycina (Benth.) Codd
Syncolostemon macranthus (Guerke) M. Ashby
Syncolostemon rotundifolius E. Mey. ex Benth.
Orthosiphon suffrutescens (Thonn.) J. K. Morton
- SOLANACEAE**
Lycium acutifolium E. Mey. ex Dun.
Physalis angulata L. *
Solanum duplo-sinuatum Klotzsch.
Solanum giganteum Jacq.
Solanum incanum L.
Solanum mauritianum Scop. *
Solanum retroflexum Dun.
Solanum rigescens Jacq.
Solanum seafortianum Andr. *
Solanum tomentosum L.
- SCROPHULARIACEAE**
Halleria lucida L.
Anastrabe integerrima E. Mey. ex Benth.
Manulea parviflora Benth. var. *parviflora*
Sutera floribunda (Benth.) Kuntze
Sutera kraussiana (Bernh. ex Krauss) Hiern.
Sutera platysepala Hiern.
Sutera polelensis Hiern. subsp. ?
Zaluzianskya angustifolia Hilliard & Burt
Zaluzianskya capensis (L.) Walp.
Zaluzianskya elongata Hilliard & Burt
Ilysanthes dubia (L.) Bernh.
- A.P.D. McClean 475, PRE
K. Balkwill & O Crankshaw 80/166, J
H.B. Nicholson 1002, PRE
V.R. Davidson 2528, CPF
R.A. Lubke 1489, PRE
Nicholson 1235, PRE
Vassilatos & Mantell 1121, J
- Balkwill & Cron 182, J
- H.B. Nicholson 746, PRE
O. Kerfoot s.n., CPF
- H.F. Glen 263, J
Mantell & Vassilatos 81, J
Mantell & Vassilatos 179, J
Brokenshaw, Collins & Henderson 92, PRE
Henderson, Brokensha, S. & Collins 142, PRE
H.B. Nicholson 1045, PRE
Mantell & Vassilatos 501, PRE
A.P.D. McClean 391, PRE
L.E. Davidson 1601, PRE
Nicholson, H.B. 1041, PRE
Van Jaarsveld E.J. 2192, PRE
H.B. Nicholson 1059, PRE
K. Balkwill s.n., J
Codd, L.E. 9344B, PRE
Mantell & Vassilatos 666, J
O. Kerfoot K.7629, J
- Balkwill & Cron 49, J
- E.J. van Jaarsveld 3883, PRE
H.B. Nicholson 1011, PRE
H.B. Nicholson 1191, PRE
Van Jaarsveld 3875, CPF
Vassilatos & Mantell 733, J
Balkwill & Crankshaw s.n., J
H.B. Nicholson 1056, PRE
Vassilatos & Mantell 742, J
V.R. Davidson 2022, CPF
H.B. Nicholson 1010, PRE
Vassilatos & Mantell 913, J
L.E. Davidson 1224, CPF
B.K. Adie s.n., NU
Goldblatt, P. & Manning, J.C. 953, PRE
- L.E. Davidson 2550, J
Forbes & Munday 442, J
O. Kerfoot K7245, J
L.E. Davidson 1257, J
L.E. Davidson s.n., CPF
H.F. Glen 443, CPF
McClellan 28270, PRE
Balkwill & Cron, G.V. 215, J
Mantell & Vassilatos 581, PRE
L.E. Davidson 2268, CPF
- L.E. Davidson 1880, CPF
Balkwill & Cron 140, CPF
Mantell & Vassilatos 9, PRE
Balkwill & Cron 64, PRE
Mantell & Vassilatos 21, J
K. Balkwill & G. V. Cron 64, J
Vassilatos & Mantell 243, J
Vassilatos & Mantell 968, J
L.E. Davidson 1600, J
L.E. Davidson 2031, J
Smook L. 1783, PRE

- Alectra sessiliflora* (Vahl.) Kuntze var. *sessiliflora*
Sopubia simplex (Hochst.) Hochst.
Buchnera dura Benth.
Cycnium racemosum Benth.
Cycnium tubulosum (L.f.) Engl. subsp. *tubulosum*
Striga asiatica (L.) Kuntze
Striga bilabiata (Thunb.) Kuntze
Harveya speciosa Bernh. ex Krauss
- SELAGINACEAE**
Selago elongata Hilliard
Selago lepidioides Rolfe
- BIGNONIACEAE**
Tecomaria capensis (Thunb.) Spach subsp. *capensis*
- PEDALIACEAE**
Ceratotheca triloba (Bernh.) Hook. f.
Streptocarpus haygarthii N.E. Br. ex C.B. Cl. x *S. polyanthus* Hook. putative hybrid
- GESNERIACEAE**
Streptocarpus formosus (Hilliard & Burt) T. Edwards
Streptocarpus haygarthii N.E. Br. ex C.B. Cl.
Streptocarpus polyanthus Hook. subsp. *polyanthus*
Streptocarpus polyanthus Hook. subsp. *verecundus* Hilliard
Streptocarpus rexii (Hook.) Lindl.
Streptocarpus trabeculatus Hilliard
- LENTIBULARIACEAE**
Utricularia livida E. Mey.
Utricularia prehensilis E. Mey.
Utricularia sandersonii Oliv.
Utricularia subulata L.
- ACANTHACEAE**
Thunbergia alata Sims
Thunbergia atriplicifolia E. Mey. ex Nees
Thunbergia dregeana Nees
Thunbergia neglecta Sond.
Thunbergia purpurata Harv. ex C.B. Cl.
Chaetacanthus burchellii Nees
Chaetacanthus setiger (Pers.) Lindl.
Ruellia cordata Thunb.
Barleria gueinzii Sond.
Barleria meyeriana Nees
Barleria obtusa Nees
Barleria ovata E. Mey. ex Nees
Sclerochiton harveyanus Nees
Blepharis integrifolia (L.f.) E. Mey. ex Schinz var. *integrifolia*
Blepharis obtusisepala Oberm.
Asystasia gangetica (L.) T. Anders.
Penistrophe cernua Nees
Penistrophe natalensis T. Anders.
Dicliptera clinopodia Nees
Dicliptera heterostegia Presl ex Nees
Dicliptera zeylanica Nees
Hypoestes aristata (Vahl.) Soland. ex Roem. & Schult. var. *aristata*
Siphonoglossa leptantha (Nees) Immelman subsp. *leptantha*
Rhinacanthus gracilis Klotzsch
Duvernoia adhatodoides E. Mey. ex Nees
Ruttya ovata Harv.
Isoglossa ciliata (Nees) Lindau
Isoglossa cooperi C.B. Cl.
Isoglossa hypoestiflora Lindau
Isoglossa ovata (Nees) Lindau
Justicia betonica L.
Justicia campylostemon (Nees) T. Anders.
Justicia flava (Vahl) Vahl
Justicia petiolaris (Nees) T. Anders. subsp. *bowiei* (C.B. Cl.) Immelman
Justicia protracta (Nees) T. Anders. subsp. *protracta*
Justicia protracta (Nees) T. Anders. subsp. *rhodesiana* (S. Moore) Immelman
- PLANTAGINACEAE**
Plantago major L.
- RUBIACEAE**
Kohautia amatymbica Eckl. & Zeyh.
- Vassilatos & Mantell 979, J
Balkwill & Cron 211, J
L.E. Davidson 2009, J
L.E. Davidson s.n., J
L.E. Davidson 2206, J
O. Kerfoot K7704, J
Mantell & Vassilatos 41, J
H. F. Glen 267, J
- K. Balkwill & O. Crankshaw 80/168, J
H.F. Glen 252, PRE
- A.P.D. Abbott 487, PRE
- Vassilatos & Mantell 751, J
Hilliard 2134, NU
- Hilliard 2791, NU
Hilliard 997, NU
Hilliard 925, NU
Balkwill & Crankshaw 80/151, J
L.E. Davidson 1970, J
Hilliard 917, NU
- H.F. Glen 272, CPF
L.E. Davidson s.n., CPF
A.P.D. McClean 367, PRE
L.E. Davidson s.n., CPF
- Retief, E. 1631, PRE
L.E. Davidson 2526, CPF
H.B. Nicholson 1790, PRE
Pienaar, B.J. 576, PRE
Mantell & Vassilatos 678, PRE
Van Wyk 5065, PRE
L.E. Davidson 2013, CPF
T.J. Edwards & M-J. Cadman 124, J
Potgieter & Meter 106, NU
H.B. Nicholson 1197, PRE
H.B. Nicholson 1417, PRE
Mantell & Vassilatos 132, PRE
H.B. Nicholson 2211, PRE
L.E. Davidson 2020, J
Steyn OP155/52, PRE
Van Wyk 2626, PRE
K. Balkwill 335, J
L.E. Davidson 1162, CPF
O. Kerfoot 6400, CPF
K. Balkwill 322, J
K. Balkwill 338, J
Balkwill K. Hyp8, PRE
Vassilatos & Mantell 720, PRE
K. Balkwill 331, J
G.V. Van Greuning 470, PRE
Vassilatos & Mantell 424, J
L.E. Davidson s.n., CPF
C. Reid 898, PRE
Mantell & Vassilatos 655, PRE
Nicholson 1174, PRE
McClean 557, NH
Henderson, Brokensha & Collins 183, PRE
MacLean 412, NH
L.E. Davidson 1617, CPF
K. Balkwill & O. Crankshaw 80/143, J
P.J. Forbes & J. Munday 462, J
- C. Reid 920, PRE
- J. Munday 806, J

- Conostomium natalense* (Hochst.) Brem. var. *glabrum* Brem.
Conostomium natalense (Hochst.) Brem. var. *natalense*
Oldenlandia affinis (Roem. & Schult.) DC. subsp. *fugax* (Vatke) Verdc.
Oldenlandia herbacea (L.) Roxb. var. ?
Burchellia bubalina (L.f.) Sims
Catunaregam spinosa (Thunb.) Tirvengadam subsp. *spinosa*
Coddia rudis (E. Mey. ex Harv.) Verdc.
Gardenia thunbergia Thunb.
Rothmannia globosa (Hochst.) Keay
Hyperacanthus amoenus (Sims) Bridson
Oxyanthus speciosus DC. subsp. *gerrardii* (Sond.) Bridson
Tricalysia capensis (Meisn. ex Hochst.) Sim var. *capensis*
Tricalysia lanceolata (Sond.) Burt Davy
Tricalysia sonderiana Hiern
Alberta magna E. Mey.
Pentanisia angustifolia (Hochst.) Hochst.
Pentanisia prunelloides (Klotzsch ex Eckl. & Zeyh.) Walp. subsp. ?
Vangueria infausta Burch. subsp. *infausta*
Vangueria randii S. Moore subsp. *chartacea* (Robyns) Verdc.
Eriosemopsis subanisophylla Robyns
Canthium sp.
Canthium ciliatum (Klotzsch) Kuntze
Canthium inerme (L.f.) Kuntze
Canthium spinosum (Klotzsch) Kuntze
Canthium suberosum Codd.
Canthium vanwykii Tilney & Kok
Psydrax locuples (K. Schum.) Bridson
Psydrax obovata (Eckl. & Zeyh.) Bridson subsp. *obovata*
Keetia gueinzii (Sond.) Bridson
Pachystigma macrocalyx (Sond.) Robyns
Pavetta bowkeri Harv. T
Pavetta capensis (Houtt.) Brem. subsp. *komghensis* (Brem.) Kok
Pavetta gracilifolia Brem.
Pavetta inandensis Brem.
Pavetta lanceolata Eckl.
Psychotria capensis (Eckl.) Vatke subsp. *capensis* var.
Psychotria capensis (Eckl.) Vatke subsp. *capensis* var. *capensis*
Galopina circaeoides Thunb.
Galopina tomentosa Hochst.
Anthospermum sp.
Anthospermum galpinii Schltr.
Anthospermum hispidulum E. Mey. ex Sond.
Anthospermum streyi Puff
Richardia brasiliensis Gomes *
Spermacoce natalensis Hochst.
- DIPSICACEAE**
- Cephalaria decurrens* (Thunb.) Roem. & Schult.
Scabiosa columbaria L.
- CUCURBITACEAE**
- Gerrardanthus macrorhizus* Harv. ex Benth. & Hook. f.
Zehneria parvifolia (Cogn.) J.H. Ross
Zehneria scabra (L.f.) Sond. subsp. *scabra*
Kedrostis foetidissima (Jacq.) Cogn.
Kedrostis hirtella (Naud.) Cogn.
Momordica foetida Schumach.
Peponium mackenii (Naud.) Engl.
Coccinia palmata (Sond.) Cogn.
- CAMPANULACEAE**
- Wahlenbergia capillacea* (L.f.) A. DC. subsp. *capillacea*
Wahlenbergia huttonii (Sond.) Thulin
Wahlenbergia madagascariensis A. DC.
Wahlenbergia pinnata Compton
- LOBELIACEAE**
- Cyphia elata* Harv. var. ?
Lobelia sp.
Lobelia chamaedryfolia (Presl) A. DC.
Lobelia erinus L.
Lobelia malowensis E. Wimm.
Lobelia preslii A. DC.
Lobelia pteropoda (Presl) A. DC.
- L.E. Davidson 1251, J
 A.P.D. McClean 315, PRE
 A.P.D. McLean 569, PRE
 L.E. Davidson 2552, CPF
 R.G. Uys 12, NU
 Smith & Sender 2, PRE
 Henderson, L. 74, PRE
 Mantel I & Vassilatos 471, J
 Henderson, Brokensha, S. & Collins 198, J
 H.F. Glen 294, CPF
 R.A. Lubke 1501, CPF
 Van Greuning, J.V. 481, PRE
 Mantell & Vassilatos 410, PRE
 O. Kerfoot K7666, PRE
 L.E. Davidson 1615, CPF
 L.E. Davidson 1592, CPF
 H.F. Glen 253, CPF
 Henderson, Brokensha & Collins 56, J
 O. Kerfoot K7620, J
 K. Balkwill & G.V. Cron 122, J
 L.E. Davidson 1990, CPF
 O. Kerfoot K7235, J
 H.B. Nicholson 1926, PRE
 L.E. Davidson 1990, CPF
 C.R. Scott-Shaw & E. Meter 5880, CPF
 Van Wyk, A.E. 4189, PRE
 O. Kerfoot K72323, PRE
 Vassilatos & Mantell 51, PRE
 Tilney, P. 162, PRE
 O. Kerfoot s.n., J
 Mantell & Vassilatos 60, PRE
 Balkwill & Cron, G.V. 292, J
 Henderson, Brokensha & Collins 39, J
 Balkwill & Cron 326, J
 Grobbelaar, N. 1456, PRE
 R.G. Uys 18, NU
 Pienaar 115, PRE
 C. Puff 790426 - 2/1, PRE
 H.B. Nicholson 2192, PRE
 L.E. Davidson 1618, CPF
 H.F. Glen 371, J
 Balkwill & Cron 116, J
 H.B. Nicholson 1145, PRE
 Vassilatos & Mantell 718, PRE
 Van Wyk, A.E. 5066, PRE
- H.F. Glen 278, J
 Mantell & Vassilatos 507, PRE
- Onderstall D. 66, PRE
 Henderson, Brokensha & Collins 1844, J
 Vassilatos & Mantell 825, J
 Nicholson 1708, PRE
 Retief, E. 1627, PRE
 H.F. Glen 307, J
 Onderstall, D. 77, PRE
 Van Wyk 4245, PRE
- McClean 297, PRE
 Mantell & Vassilatos 875, PRE
 C. Reid 922, PRE
 Vassilatos & Mantell 875, J
- L.E. Davidson s.n., CPF
 J. Munday 812, J
 O. Kerfoot s.n., CPF
 H.B. Nicholson 1874, PRE
 Balkwill & Cron 81, PRE
 V.R. Davidson 2540, CPF
 Mantell & Vassilatos 267, PRE

- Lobelia vanreenensis* (Kuntze) K. Schum.
Monopsis unidentata (Dryand.) E. Wimm. subsp. *laevicaulis*
Monopsis decipiens (Sond.) Thulin
Monopsis scabra (Thunb.) Urb.
Grammatotheca bergiana (Cham.) Presl var. *bergiana*
- ASTERACEAE**
- Vernonia angulifolia* DC.
Vernonia anisochaetoides Sond.
Vernonia capensis (Houtt.) Druce
Vernonia galpinii Klatt
Vernonia natalensis Sch. Bip. ex Walp.
Vernonia oligocephala (DC.) Sch. Bip. ex Walp.
Ageratum sp.
Ageratum conyzoides L. *
Chromolaena odorata (L.) R.M. King & H. Robinson
Aster harveyanus Kuntze
Felicia erigeroides DC.
Felicia muricata (Thunb.) Nees subsp. ?
Microglossa mespilifolia (Less.) B.L. Robinson
Conyza albida Spreng. *
Conyza scabrida DC.
Chrysocoma ciliata L.
Brachylaena discolor DC. var. ?
Brachylaena elliptica (Thunb.) DC.
Brachylaena glabra (L.f.) Druce
Brachylaena uniflora Harv.
Tarchonanthus camphoratus L.
Tarchonanthus trilobus DC. var. *trilobus*
Pseudognaphalium undulatum (L.) Hilliard & Burt
Tenrynea phyllicifolia (DC.) Hilliard & Burt
Helichrysum acutatum DC.
Helichrysum adenocarpum DC. subsp. *adenocarpum*
Helichrysum appendiculatum (L.f.) Less.
Helichrysum auriceps Hilliard
Helichrysum cephaloideum DC.
Helichrysum chionosphaerum DC.
Helichrysum cymosum (L.) D. Don subsp. ? c.f. *H. cymosum* subsp. *cymosum*
Helichrysum cymosum (L.) D. Don subsp. *cymosum*
Helichrysum felinum Less.
Helichrysum griseum Sond.
Helichrysum herbaceum (Andr.) Sweet
Helichrysum krebsianum Less.
Helichrysum lepidissimum S. Moore
Helichrysum mixtum (Kuntze) Moeser var. ?
Helichrysum nudifolium (L.) Less.
Helichrysum oxyphyllum DC.
Helichrysum pallidum DC.
Helichrysum panduratum O. Hoffm. var. *panduratum*
Helichrysum platypterum DC.
Helichrysum populifolium DC.
Helichrysum simillimum DC.
Helichrysum spiralepis Hilliard & Burt
Helichrysum umbraculigerum Less.
Stoebe vulgaris Levyns
Disparago ericoides (Berg.) Gaertn.
Disparago tortilis (DC.) Sch. Bip.
Relhania pungens L'Herit. subsp. *angustifolia* (DC.) Bremer
Relhania pungens L'Herit. subsp. *pungens*
Relhania pungens L'Herit. subsp. *trinervis* (Thunb.) Bremer
Athrixia phyllicoides DC.
Pulicaria scabra (Thunb.) Druce
Callilepis laureola DC.
Callilepis leptophylla Harv.
Acanthospermum australe (Loefl.) Kuntze *
Bidens bipinnata L. *
Bidens pilosa L. *
Tagetes minuta L. *
Oedera squarrosa (L.) Anderb. & Bremer
Inulanthera dregeana (DC.) Kallersjo
Phymaspemum acerosum (DC.) Kallersjo
- E. Retief 1629, PRE
Balkwill & Cron 237, J
Nicholson 1875, PRE
Nicholson 2113, PRE
Smook, L. 1764, PRE
- Britten 6542, PRE
Van Wyk 4518, PRE
Henderson, Brokensha & Collins 51, J
Van Wyk 5131, PRE
L.E. Davidson 2562, CPF
Balkwill & Cron 243, J
O. Kerfoot 6400, CPF
Mantell & Vassilatos 739, J
H.F. Glen 452, J
Van Wyk 5061, PRE
McClellan 471, PRE
WITS s.n., J
H.B. Nicholson 1133, PRE
Vassilatos & Mantell 1079, J
E.Retief 1633, PRE
Mantell & Vassilatos 156, J
O. Kerfoot 6374, CPF
Moll 5039, PRE
C.R. Scott-Shaw 5912, CPF
Thode, H.J. 2936, PRE
McClellan 265, PRE
Van Wyk 5026, PRE
H.F. Glen 224, J
Nicholson 1994, PRE
Nicholson 1869, PRE
McClellan 304, PRE
Mantell & Vassilatos 159, J
Vassilatos & Mantell 157, J
Balkwill & Cron 198, J
Nicholson 1877, PRE
L.E. Davidson 1192, CPF
Mantell & Vassilatos 724, PRE
Nicholson 1868, PRE
L.A. Coetzer 83, PRE
McClellan 28208, PRE
Henderson, Brokensha & Collins 34, J
H.F. Glen 316, J
V.R. Davidson 1865, CPF
Mantell & Vassilatos 29, J
C.R. Scott-Shaw 5912, CPF
Mantell & Vassilatos 140, J
Mantell & Vassilatos 591, J
Mantell & Vassilatos 1048, J
L.E. Davidson 2542, J
Mantell & Vassilatos 20, J
Nicholson 1151, J
Vassilatos & Mantell 1046, J
Mogg 38017, PRE
M. Koekemoer 264, PRE
Van Wyk 5415, PRE
Balkwill & Cron 112, J
McClellan 303, PRE
L.E. Davidson 1205, CPF
J. Munday 807, J
Nicholson 1285, PRE
Van Wyk 5121, J
Hilliard & Burt 6066, NU
H.F. Glen 255, J
Hilliard 2790, J
O. Kerfoot K7318, J
Vassilatos & Mantell 947, J
Mantell & Vassilatos 124, PRE
Nicholson 1241, PRE
Balkwill & Crankshaw 80/175, J

- Matricaria nigellifolia* DC. var. ?
Cotula hispida (DC.) Harv.
Schistostephium sp.
Schistostephium crataegifolium (DC.) Fenzl ex Harv.
Schistostephium flabelliforme Less.
Schistostephium heptalobum (DC.) Oliv. & Hiern
Schistostephium rotundifolium (DC.) Fenzl. ex Harv.
Artemisia afra Jacq. ex Willd.
Crassocephalum crepidioides (Benth.) S. Moore
Cineraria sp. A. c.f. *C. albicans* N.E. Br.
Cineraria sp.
Cineraria albicans N.E. Br.
Cineraria decipiens Harv.
Cineraria lobata L' Herit.
Senecio sp. c.f. *S. macroglossus* DC.
Senecio sp.
Senecio albanopsis Hilliard
Senecio arenarius Thunb.
Senecio brachypodus DC.
Senecio bryoniifolius Harv.
Senecio bupleuroides DC.
Senecio chrysocoma Meerb.
Senecio deltoideus Less.
Senecio erubescens Ait. var. ?
Senecio erubescens Ait. var. *incisus* DC.
Senecio helminthioides (Sch. Bip.) Hilliard
Senecio latifolius DC.
Senecio linifolius L.
Senecio lygodes Hiern.
Senecio medley-woodii Hutch.
Senecio oxyodontus DC.
Senecio pellucidus DC.
Senecio pterophorus DC.
Senecio quinquelobus (Thunb.) DC.
Senecio retrorsus DC.
Senecio ryncholaenus DC.
Senecio serratuloides DC. var. *serratuloides*
Senecio tamoides DC.
Senecio variabilis Sch. Bip.
Kleinia fulgens Hook. f.
Euryops brevipapposus M.D. Henderson
Euryops chrysanthemoides (DC.) B. Nord.
Euryops leiocarpus (DC.) B. Nord.
Euryops pedunculatus N.E. Br.
Osteospermum grandidentatum DC.
Osteospermum imbricatum L. subsp. *nervatum* (DC.) Nord. var. *nervatum*
Chrysanthemoides monilifera (L.) T. Norl. subsp. *rotundata* (DC.) T. Norl.
Ursinia tenuiloba DC.
Berkheya bipinnatifida (Harv.) Roessl. subsp. *bipinnatifida*
Berkheya erysithales (DC.) Roessl.
Berkheya maritima Wood & Evans
Berkheya speciosa (DC.) O. Hoffm. subsp. *speciosa*
Berkheya sphaerocephala (DC.) Roessl.
Gerbera ambigua (Cass.) Sch. Bip.
Gerbera piloselloides (L.) Cass.
Gerbera viridifolia (DC.) Sch. Bip. subsp. ?
Sonchus wilmsii R.E. Fr.
- POACEAE**
- Ischaemum fasciculatum* Brongn.
Miscanthus capensis (Nees) Anderss.
Bothriochloa bladhii (Retz.) S.T. Blake
Schizachyrium sanguineum (Retz.) Aist.
Andropogon eucomus Nees
Cymbopogon excavatus (Hochst.) Stapf ex Burt Davy
Cymbopogon plurinodis (Stapf) Stapf ex Burt Davy
Cymbopogon validus (Stapf) Stapf ex Burt Davy
Hyparrhenia sp. c.f. *H. hirta* (L.) Stapf
Hyparrhenia anamesa Clayton
Hyparrhenia filipendula (Hochst.) Stapf var. *pilosa* (Hochst.) Stapf
Monocymbium ceresiiforme (Nees) Stapf
- L.E. Davidson 2203, J
 Vassilatos & Mantell 150, J
 L.E. Davidson 2033, CPF
 McClean 318, PRE
 L.E. Davidson 2033, CPF
 Mantell & Vassilatos 57, PRE
 Vassilatos & Mantell 1100, J
 Vassilatos & Mantell 503, J
 Nicholson 1925, PRE
 G.V. Cron & Brummer 6, J
 V.R. Davidson 2012, CPF
 Mantell & Vassilatos 88, J
 G.V. Cron & B. Brummer 5a & 5b, J
 Nicholson 786, PRE
 Vassilatos & Mantell 683, PRE
 O. Kerfoot K7696, J
 H.F. Glen 477, J
 Nicholson 1471, PRE
 Nicholson 1986, PRE
 K. Balkwill & O. Crankshaw 80/107, PRE
 Smith & Sender 7, J
 Balkwill & Cron 220, J
 H.F. Glen 428, J
 Vassilatos & Mantell 1017, J
 Mogg 13192, PRE
 Nicholson 1003, PRE
 K. Balkwill & O. Crankshaw 80/107, J
 O. Kerfoot K7257, J
 Mantell & Vassilatos 83, PRE
 C.R. Scott-Shaw 5903, J
 Vassilatos & Mantell 743, J
 H.F. Glen 259, J
 Mantell & Vassilatos 791, PRE
 H.F. Glen 432, J
 Nicholson 1873, PRE
 Mantell & Vassilatos 77, PRE
 Steyn D.G. PRE44665, PRE
 Forbes & Munday 440, J
 Koekemoer M. 267, PRE
 L.E. Davidson 1623, J
 Mantell & Vassilatos 70, PRE
 Hilliard & Burt 6070, J
 L.E. Davidson 2078, J
 Vassilatos & Mantell 1132, J
 Mantell & Vassilatos 1331, PRE
 McClean 288, PRE
 C. Puff & Botany III s.n., J
 H.J. Thode 2869, PRE
 L. Henderson 73, J
 Strey 9638, PRE
 Mantell & Vassilatos 513, J
 Vassilatos & Mantell 44, PRE
 Vassilatos & Mantell 137, PRE
 L.E. Davidson 2457, J
 Nicholson 1870, PRE
 L.E. Davidson s.n., J
 O. Kerfoot K7256, J
- A.P.D. McLean 464, PRE
 Davidson 1997, J
 McClean 572, PRE
 McClean 339, PRE
 L.E. Davidson 2656, J
 Vassilatos & Mantell 102, J
 Mantell & Vassilatos 91, PRE
 WITS 86, J
 R.A. Lubke 1493, J
 Mantell & Vassilatos 115, PRE
 R.A. Lubke 1493, CPF
 A.P.D. McLean 301, PRE

<i>Trachypogon spicatus</i> (L.f.) Kuntze	<u>K. Balkwill & O. Crankshaw 80/73, J</u>
<i>Heteropogon contortus</i> (L.) Roem. & Schult.	<u>Koekemoer M. 265, PRE</u>
<i>Diheteropogon amplexans</i> (Nees) Clayton	<u>A.P.D. McLean 528, PRE</u>
<i>Themeda triandra</i> Forssk.	<u>Vassilatos & Mantell 1056, PRE</u>
<i>Digitaria longiflora</i> (Retz) Pers.	<u>L.E. Davidson 1103, J</u>
<i>Digitaria natalensis</i> Stent	<u>H.F. Glen 387, J</u>
<i>Alloteropsis semialata</i> (R. Br.) Hitchc. subsp. <i>eckloniana</i> (Nees) Gibbs Russell	<u>V.R. Davidson 1194, CPF</u>
<i>Paspalum scrobiculatum</i> L.	<u>H.F. Glen 384, J</u>
<i>Paspalum urvillei</i> Steud. *	<u>H.F. Glen 205, J</u>
<i>Stenotaphrum secundatum</i> (Walt.) Kuntze	<u>R.A. Lubke s.n., CPF</u>
<i>Echinochloa colona</i> (L.) Link	<u>Smook 1766, PRE</u>
<i>Echinochloa pyramidalis</i> (Lam.) Hitchc. & Chase	<u>Smook 1784, PRE</u>
<i>Oplismenus hirtellus</i> (L.) Beauv.	<u>H.B. Nicholson 1061, PRE</u>
<i>Panicum aequinerve</i> Nees	<u>R.A. Lubke 147, CPF</u>
<i>Panicum deustum</i> Thunb.	<u>J. Munday 798, J</u>
<i>Panicum dregeanum</i> Nees	<u>McClellan 389, PRE</u>
<i>Panicum fluviicola</i> Steud.	<u>Balkwill & Cron 348, J</u>
<i>Panicum laticomum</i> Nees	<u>Nicholson 1007, PRE</u>
<i>Panicum maximum</i> Jacq.	<u>Mantell & Vassilatos 648, PRE</u>
<i>Panicum natalense</i> Hochst.	<u>K. Balkwill & O. Crankshaw 80/74, J</u>
<i>Setaria</i> sp. cf. <i>S. lindenbergiana</i> (Nees) Stapf	<u>R.A. Lubke 1495, CPF</u>
<i>Setaria incrassata</i> (Hochst.) Hack.	<u>McClellan 372, PRE</u>
<i>Setaria megaphylla</i> (Steud.) Dur. & Schinz.	<u>A.P.D. McLean 533, PRE</u>
<i>Setaria sphacelata</i> (Schumach.) Moss var. <i>sphacelata</i>	<u>L. Smook 1774, PRE</u>
<i>Melinis repens</i> (Willd.) Zizka subsp. <i>repens</i>	<u>Vassilatos & Mantell 925, J</u>
<i>Prospyrtochloa prehensilis</i> (Nees) Schweick.	<u>L.E. Davidson 1532, J</u>
<i>Phalaris arundinacea</i> L. *	<u>Nicholson 1899, PRE</u>
<i>Arundinella nepalensis</i> Trin.	<u>H.B. Nicholson 1004, PRE</u>
<i>Tristachya leucothrix</i> Nees	<u>H. F. Glen 376, J</u>
<i>Loudetia simplex</i> (Nees) C.E. Hubb.	<u>Mantell & Vassilatos 89, J</u>
<i>Phragmites mauritianus</i> Kunth	<u>H.F. Glen 534, J</u>
<i>Aristida junciformis</i> Trin. & Rupr. subsp. <i>junciformis</i>	<u>Vassilatos & Mantell 857, J</u>
<i>Sporobolus</i> sp. cf. <i>S. fimbriatus</i> (Trin.) Nees	<u>Forbes & Munday s.n., J</u>
<i>Sporobolus africanus</i> (Poir.) Robyns & Toumay	<u>Vassilatos & Mantell 1020, J</u>
<i>Sporobolus centrifugus</i> (Trin.) Nees	<u>L.E. Davidson s.n., CPF</u>
<i>Sporobolus natalensis</i> (Steud.) Dur. & Schinz	<u>Smook 1771, PRE</u>
<i>Sporobolus pyramidalis</i> Beauv.	<u>H.F. Glen 388, J</u>
<i>Eragrostis acraeae</i> De Winter	<u>L.E. Davidson 1126, J</u>
<i>Eragrostis capensis</i> (Thunb.) Trin.	<u>R. Cripps 8, NU</u>
<i>Eragrostis ciliaris</i> (L.) R. Br.	<u>Munday s.n., J</u>
<i>Eragrostis curvula</i> (Schrad.) Nees	<u>H.F. Glen 207, J</u>
<i>Eragrostis inamoena</i> K. Schum.	<u>McClellan 390, PRE</u>
<i>Eragrostis pilosa</i> (L.) Beauv.	<u>Smook 1765, PRE</u>
<i>Eragrostis plana</i> Nees	<u>Vassilatos & Mantell 1087, J</u>
<i>Eragrostis racemosa</i> (Thunb.) Steud.	<u>K. Balkwill & G.V. Cron 344, J</u>
<i>Eragrostis rigidior</i> Pilg.	<u>L.E. Davidson 1126, CPF</u>
<i>Microchloa caffra</i> Nees	<u>Nicholson 1137, PRE</u>
<i>Cynodon dactylon</i> (L.) Pers.	<u>H.F. Glen 447, J</u>
<i>Harporchloa falx</i> (L. f.) Kuntze	<u>R.G. Uys 4, NU</u>
<i>Ctenium concinnum</i> Nees	<u>Vassilatos & Mantell 853, J</u>
<i>Chloris gayana</i> Kunth	<u>H.F. Glen 449, CPF</u>
<i>Chloris pycnothrix</i> Trin.	<u>Munday s.n., J</u>
<i>Chloris virgata</i> Swartz	<u>Vassilatos & Mantell 945, J</u>
<i>Dactyloctenium aegypticum</i> (L.) Willd.	<u>Vassilatos & Mantell 105, J</u>
<i>Dactyloctenium australe</i> Steud.	<u>Retief 1632, PRE</u>
<i>Koeleria capensis</i> (Steud.) Nees	<u>Vassilatos & Mantell 1039, PRE</u>
<i>Bromus catharticus</i> Vahl *	<u>A.L. Pratt 11, NU</u>

Section B : The species list for UNR

HYMENOPHYLLACEAE

Trichomanes borbonicum V.D. Bosch

Ward 7148, PRE

Trichomanes reptans Swartz

Crouch 724, NH

CYATHEACEAE

Cyathea dregei Kunze

R.G. Strey 6912, PRE

DENNSTAEDTIACEAE

Hypolepis sparsisora (Schrad.) Kuhn

H.B. Nicholson 1569, PRE

VITTARIACEAE

Vittaria isoetifolia Bory

R.G. Strey 10626, PRE

ADIANTACEAE

Cheilanthes inaequalis (Kunze) Mett. var. *buchananii* (Bak.) Schelpe
Cheilanthes viridis (Forssk.) Swartz var. *viridis*
Doryopteris concolor (Langsd. & Fisch.) Kuhn
Pteris dentata Forssk.

H.B. Nicholson 2137, PRE
R.G. Strey 8718, PRE
H.B. Nicholson 1527, PRE
H.B. Nicholson 1573, PRE

POLYPODIACEAE

Microgramma lycopodioides (L.) Copel.

A.P.D. Abbott s.n., PRE

ASPLENIACEAE

Asplenium aethiopicum (Burm. f.) Becherer
Asplenium gemmiferum Schrad.
Asplenium inaequilaterale Willd.
Asplenium lunulatum Swartz
Asplenium rutifolium (Berg.) Kunze
Asplenium sandersonii Hook.
Asplenium splendens Kunze
Asplenium dregeanum Kunze x *Asplenium sandersonii* Hook.

A.E. van Wyk & Venter s.n., PRE
Crouch 723, NH
H.B. Nicholson s.n., PRE
R.G. Strey s.n., PRE
R.G. Strey s.n., PRE
Van Jaarsveld & Campher s.n., PRE
R.G. Strey s.n., PRE
Crouch 725, NH

THELYPTERIDACEAE

Thelypteris dentata (Forssk.) E. St. John
Thelypteris gueinziana (Mett.) Schelpe
Macrothelypteris torresiana (Gaud.) Ching*

R.G. Strey s.n., PRE
R.G. Strey s.n., PRE
H.B. Nicholson s.n., PRE

LOMARIOPSIDACEAE

Elaphoglossum macropodium (Fee) T. Moore

R.G. Strey s.n., PRE

ASPIDIACEAE

Rumorha adiantiformis (G. Forst.) Ching

H.B. Nicholson s.n., PRE

BLECHNACEAE

Blechnum capense Burm. f.
Blechnum punctulatum Swartz var. *krebsii* (Kunze) Sim

R.G. Strey s.n., PRE
R.G. Strey s.n., PRE

FISSIDENTACEAE

Fissidens glaucescens Hornsch.

Hilliard & Burt 10270, PRE

DICRANACEAE

Campylopus pilifer Brid.
Campylopus pyriformis (Schutz) Brid.
Campylopus savannarum (C. Muell.) Mitt.
Campylopus stenopelma (C. Muell.) Par.
Holomitrium cylindraceum Beauv. var. *cucullatum* (Besch.) Wijk & Marg.
Leucobryum acutifolium (Mitt.) Card.

Van Roy J. 959, PRE
Abbott 2289, PRE
Van Roy 962, PRE
Van Roy 10276, PRE
Nicholson CH13469, PRE
Abbott 1771, PRE

CALYMPERACEAE

Hypodontium dregei (Hornsch.) C. Mull.

Abbott 1869, PRE

POTTIACEAE

Trichostomum brachydontium Bruch ex F. A. Muell.

Van Roy 960, PRE

BRYACEAE

Bryum pycnophyllum (Dix.) Mohamed
Bryum viridescens Welw. & Dub.
Rhodobryum keniae (C. Mull.) Broth.

Abbott 1769, PRE
Abbott 760, PRE
Abbott 1399, PRE

ORTHOTRICHACEAE

Schlotheimia ferruginea (Hook. & Grev.) Brid.

Abbott 1830, PRE

LEUCODONTACEAE

Leucodon assimilis (C. Mull.) Jaeg.

Abbott 1865, PRE

METEORACEAE

Aerobryopsis capensis (C. Muell.) Fleisch.
Papillaria africana (C. Muell.) Jaeg.
Pilotrichella panduraefolia (C. Muell.) Jaeg.

Abbott s.n., PRE
Abbott 2287, PRE
Nicholson 2243, PRE

THAMNOBRYACEAE

Porothamnium stipitatum (Mitt.) Touw ex De Sloover
Porotrichum madagassum Kiaer ex Besch.

Abbott 1957, PRE
Abbott 1958, PRE

STANGERIACEAE

Stangeria eriopus (Kunze) Baill.

A. Abbott 2963, PRE

ZAMIACEAE

Encephalartos altensteinii Lehm.
Encephalartos laevifolius Stapf & Burt Davy
Encephalartos natalensis R.A. Dyer & Verdoorn
Encephalartos villosus Lem.

Strey 6953, PRE
Rob Scott Shaw s.n., CPF
A. Abbott 2965, UNRH
A. Abbott 2962, UNRH

PODOCARPACEAE

Podocarpus falcatus (Thunb.) R. Br. ex Mirb.
Podocarpus latifolius (Thunb.) R. Br. ex Mirb.

A. Abbott 3348, UNRH
A. Abbott 1714, UNRH

TYPHACEAE

Typha capensis (Rohrb.) N.E. Br.

A. Abbott 2261, UNRH

POTAMOGETONACEAE

Potamogeton crispus L.
Potamogeton schweinfurthii A.W. Benn.

A. Abbott 2200, UNRH
A. Abbott 2197, UNRH

TRIGLOCHINACEAE*Triglochin striata* Ruiz. & Pav.**ALISMATACEAE***Alisma plantago-aquatica* L. ***CYPERACEAE***Ascolepis capensis* (Kunth) Ridley*Carpha glomerata* (Thunb.) Nees*Cyperus albostriatus* Schrad.*Cyperus dives* Del.*Cyperus obtusiflorus* Vahl var. *obtusiflorus**Cyperus sphaerospermus* Schrad.*Cyperus textilis* Thunb.*Pycneus macranthus* (Boeck.) C.B. Cl.*Pycneus oakfortensis* C.B. Cl.*Pycneus polystachyos* (Rottb.) Beauv. var. *polystachyos**Mariscus grantii* C.B. Cl.*Kyllinga odorata* Vahl.*Ficinia* sp.*Ficinia* sp.*Ficinia* sp.*Ficinia tenuifolia* Kunth*Fuirena pubescens* (Poir.) Kunth*Schoenoplectus litoralis* (Schrad.) Palla*Isolepis fluitans* (L.) R. Br.*Eleocharis dregeana* Steud.*Fimbristylis complanata* (Retz.) Link*Fimbristylis obtusifolia* (Lam.) Kunth*Bulbostylis* sp.*Bulbostylis boeckleriana* (Schweinf.) Beetle*Bulbostylis contexta* (Nees) Bodard*Bulbostylis hispidula* (Vahl) R. Haines*Bulbostylis onitrephe* (Ridley) C.B. Cl.*Abildgaardia hygrophila* (Gordon-Gray) K. Lye*Schoenus nigricans* L.*Rhynchospora brownii* Roem. & Schult.*Rhynchospora corymbosa* (L.) Britton*Tetralia compressa* Turrill*Tetralia cuspidata* (Rottb.) C.B. Cl.*Tetralia macowaniana* B.L. Burt*Scleria angusta* Nees ex Kunth*Scleria aterrima* (Ridley) Napper*Scleria bulbifera* Hochst. ex A. Rich.*Scleria greigiifolia* (Ridley) C. B. Cl.*Scleria melanomphala* Kunth*Scleria natalensis* C.B. Cl.*Scleria nutans* Willd. ex Kunth*Schoenoxiphium lanceum* (Thunb.) Kuekenth*Schoenoxiphium lehmannii* (Nees) Steud.*Schoenoxiphium sparteum* (Wahlenb.) C.B. Cl.*Carex zuluensis* C.B. Cl.**ARECACEAE***Phoenix reclinata* Jacq.**FLAGELLARIACEAE***Flagellaria guineensis* Schumach.**RESTIONACEAE***Ischyrolepis setiger* (Kunth) Linder*Restio* sp.*Restio* sp.*Restio triticeus* Rottb.*Calopsis paniculata* (Rottb.) Desv.**XYRIDACEAE***Xyris anceps* Lam.**ERIOCAULACEAE***Eriocaulon dregei* Hochst. var. *dregei**Eriocaulon ruhlandii* Schinz**COMMELINACEAE***Commelina africana* L. var. ?*Commelina africana* L. var. *lancispatha* C.B. Cl.*Commelina erecta* L.*Aneilema aequinoctiale* (Beauv.) LoudonWard 6754, PREA. Abbott 2967, UNRHA. Abbott 2138, UNRHA. Abbott 4411, UNRHA. Abbott 2899, UNRHA. Abbott 2203, UNRHA. Abbott 1648, UNRHA. Abbott 2749, PREA. Abbott 2083, UNRHA. Abbott 322, UNRHA.T.D. Abbott s.n., PREH.B. Nicholson s.n., PREA. Abbott 1784, UNRHWits 19, UNRHA. Abbott 173, UNRHA. Abbott 2134, UNRHA. Abbott 292, UNRHC.J. Ward s.n., PREA. Abbott 2720, UNRHA. Abbott 2205, UNRHA. Abbott 4410, UNRHA. Abbott 2163, UNRHA. Abbott 2930, UNRHR. Crawford s.n., PREA. Abbott 3456, UNRHA. Abbott 2110, UNRHWits 9, UNRHA. Abbott 2520, UNRHC.J. Ward s.n., PREH.B. Nicholson s.n., PREA.O.D. Mogg s.n., PREWITS 1, UNRHA. Abbott 2151, UNRHA.E. van Wyk s.n., PREH.B. Nicholson s.n., PREA. Abbott 2299, UNRHR.G. Strey s.n., PREA. Abbott 2156, UNRHA. Abbott 2157, PREH.B. Nicholson s.n., PREA. Abbott 3007, UNRHWits 11, UNRHA. Abbott 2774, UNRHA. Abbott 452, UNRHA. Abbott 2165, UNRHH.B. Nicholson s.n. M PREA.T.D. Abbott s.n., PREA. Abbott 1914, UNRHA. Abbott 2, UNRHA. Abbott 1933, UNRHA. Abbott 1122, UNRHA. Abbott 1632, UNRHA. Abbott 50, PREA. Abbott 1104, UNRHA. Abbott 2162, UNRHA. Abbott 2164, UNRHH.B. Nicholson s.n., PREA. Abbott 1899, UNRHA. Abbott 592, UNRHR.G. Strey s.n., PREA. Abbott 1504, PRE

Aneilema dregeanum Kunth
Coleotrype natalensis C.B. Cl.
Cyanotis speciosa (L.f.) Hassk.

JUNCACEAE

Prionium serratum (L.f.) Drege ex E. Mey.
Juncus kraussii Hochst.
Juncus lomatophyllus Spreng.

COLCHICACEAE

Gloriosa superba L.
Wurmbea kraussii Bak.

ASPHODELACEAE

Bulbine frutescens (L.) Willd.
Bulbine latifolia (L. f.) Roem. & Schult.
Trachyandra asperata Kunth var. *nataglencoensis* (O. Kuntze) Oberm.
Trachyandra asperata Kunth var. *stenophylla* (Bak.) Oberm.
Trachyandra capillata (V. Poelln.) Oberm.
Trachyandra saltii (Bak.) Oberm. var. *saltii*
Anthericum cooperi Bak.
Anthericum galpinii Bak. var. *galpinii*
Chlorophytum comosum (Thunb.) Jacq.
Caesia contorta (L.f.) Dur. & Schinz.
Kniphofia coddiana Cufod.
Kniphofia laxiflora Kunth
Kniphofia littoralis Codd
Kniphofia parviflora Kunth
Kniphofia rooperi (Moore) Lem.
Aloe sp. c.f. *A. linearifolia* Berger
Aloe arborescens Mill.
Aloe candelabrum Berger
Aloe ferox Mill.
Aloe linearifolia Berger
Aloe maculata All.
Aloe myriacantha (Haw.) Schult. & J.H. Schult.
Gasteria acinacifolia (Jacq.) Haw.
Gasteria croucheri (Hook. f.) Bak.

HYACINTHACEAE

Albuca setosa Jacq.
Urginea sp.
Urginea delagoensis Bak.
Urginea modesta Bak.
Urginea rubella Bak.
Dipcadi marlothii Engl.
Dipcadi viride (L.) Moench
Litanthus pusillus Harv.
Scilla natalensis Planch.
Scilla nervosa (Burch.) Jessop
Eucomis autumnalis (Mill.) Chitt. ssp. ?
Eucomis comosa (Houtt.) Wehrh. var. *striata* (Don) Willd.
Omithogalum graminifolium Thunb.
Omithogalum juncifolium Jacq.
Omithogalum omithogaloides (Kunth) Oberm.
Omithogalum paludosum Bak.
Drimiopsis maculata Lindl.
Drimiopsis maxima Bak.
Ledebouria cooperi (Hook. f.) Jessop
Ledebouria floribunda (Bak.) Jessop
Ledebouria revoluta (L.f.) Jessop

ERIOSPERMACEAE

Eriospermum sp. c.f. *E. cooperi*
Eriospermum abyssinicum Bak.
Eriospermum cooperi Bak.
Eriospermum luteo-rubrum Bak.
Eriospermum mackenii (Hook. f.) Bak.
Eriospermum natalense Bak.

ALLIACEAE

Agapanthus campanulatus Leighton ssp. *patens* (Leighton) Leighton
Agapanthus praecox Willd. ssp. *orientalis* (Leighton) Leighton
Tulbaghia acutiloba Harv.
Tulbaghia cernua Ave-Lall.
Tulbaghia ludwigiana Harv.

A. Abbott 2877, UNRH
A. Abbott 2878, UNRH
A. Abbott 912, UNRH

A. Abbott 1407, NH
A. Abbott 1287, UNRH
A. Abbott 2161, PRE

R. Crawford s.n., PRE
C.J. Ward s.n., PRE

A. Abbott 1621, UNRH
C.R. Scott-Shaw 881, CPF

A. Abbott 407, UNRH
A. Abbott 1807, UNRH
A. Abbott 1007, UNRH
A. Abbott 680, UNRH
A. Abbott 2063, UNRH
A. Abbott 3295, UNRH
A. Abbott 2130, UNRH
Nicholson 2455, NH
H.B. Nicholson s.n., PRE
A. Abbott 1212, UNRH
A. Abbott 2743, UNRH
A. Abbott 1816, UNRH
A.E. Van Wyk s.n., PRE
A. Abbott 977, UNRH
A. Abbott 1093, UNRH
R.G. Strey s.n., PRE
A. Abbott 3947, UNRH
A. Abbott 1747, UNRH
A. Abbott 3969, UNRH
A. Abbott 966, UNRH
A. Abbott 1675, NH
A. Abbott 1675, UNRH

A. Abbott s.n., UNRH
A. Abbott 2698, UNRH
A. Abbott 1313, UNRH
H.B. Nicholson s.n., PRE
A.T.D. Abbott 247, PRE
A. Abbott 1531, UNRH
A. Abbott 2703, UNRH
A. Abbott 2300, UNRH
C.R. Scott-Shaw 1647, CPF
A. Abbott 2304, PRE
A. Abbott 1513, UNRH
A. Abbott 2858, UNRH
A. Abbott 3986, UNRH
A. Abbott 713, UNRH
A. Abbott 708, UNRH
A.E. van Wyk 5002, PRE
A. Abbott 2105, UNRH
A. Abbott 1291, UNRH
A. Abbott 3939, UNRH
A. Abbott 2148, UNRH
A. Abbott 2131, UNRH

A. Abbott 2710, UNRH
A. Abbott 4181, UNRH
A.T.D. Abbott s.n., PRE
A. Abbott 1280, UNRH
A. Abbott 2694, UNRH
A. Abbott 3283, UNRH

A. Abbott 3051, UNRH
A. Abbott 1559, UNRH
A. Abbott 1211, UNRH
H.B. Nicholson s.n., PRE
C.J. Ward s.n., PRE

Tulbaghia violacea Harv.

DRACAENACEAE

Dracaena hookeriana K. Koch.

Sansevieria hyacinthoides (L.) Druce

ASPARGACEAE

Protasparagus sp.

Protasparagus sp.

Protasparagus sp.

Protasparagus africanus (Lam.) Oberm.

Protasparagus plumosus (Bak.) Oberm.

Protasparagus racemosa (Willd.) Oberm.

Protasparagus virgatus (Bak.) Oberm.

LUZURIAGACEAE

Behnia reticulata (Thunb.) Didr.

SMILACEAE

Smilax anceps Willd.

AMARYLLIDACEAE

Haemanthus albiflos Jacq.

Scadoxus membranaceus (Bak.) Friis & Nordal

Scadoxus puniceus (L.) Friis & Nordal

Boophane disticha (L. f.) Herb.

Clivia gardenii Hook.

Clivia miniata (Lindl.) Regel var. ?

Cyrtanthus brachyscyphus Bak.

Cyrtanthus breviflorus Harv.

Cyrtanthus mackenii Hook. f. var. *cooperi* R.A. Dyer

Cyrtanthus mackenii Hook. f. var. *mackenii*

HYPOXIDACEAE

Empodium elongatum (Nel.) B.L. Burtt

Hypoxis angustifolia Lam. var. *angustifolia*

Hypoxis angustifolia Lam. var. *buchananii* Bak.

Hypoxis angustifolia Lam. var. *buchananii* x *H. membranacea* Bak.

Hypoxis argentea Harv. ex Bak. var. *argentea*

Hypoxis colchicifolia Bak.

Hypoxis filiformis Bak.

Hypoxis flanaganii Bak.

Hypoxis gerrardii Bak.

Hypoxis hemerocallidea Fisch. & C.A. Mey.

Hypoxis membranacea Bak.

Hypoxis rigidula Bak. var. *rigidula*

DIOSCOREACEAE

Dioscorea cotonifolia Kunth

Dioscorea dregeana (Kunth) Dur. & Schinz

Dioscorea sylvatica (Kunth) Eckl. var. *sylvatica*

IRIDACEAE

Moraea elliotii Bak.

Moraea inclinata Goldbl.

Moraea spathulata (L.f.) Klatt

Moraea thomsonii Bak.

Dietes bicolor (Steud.) Sweet ex Klatt

Dietes butcheriana Gerstn.

Dietes grandiflora N.E. Br.

Aristea angolensis Bak. ssp. *angolensis*

Aristea cognata N.E. Br. ex Weim.

Aristea compressa Buchinger ex Bak.

Aristea ecklonii Bak.

Aristea flexicaulis Bak.

Aristea gerrardii Weim.

Aristea woodii N.E. Br.

Schizostylis coccinea Backh. & Harv.

Hesperantha bauni Bak. ssp. *baunii*

Hesperantha hygrophila Hilliard & Burtt

Hesperantha lactea Bak.

Dierama igneum Klatt

Dierama robustum N.E. Br.

Tritonia sp. nov.

Tritonia disticha (Klatt) Bak. ssp. *rubrolucens* (R.C. Fost.) De Vos

Tritonia lineata (Salisb.) Ker-Gawl. var. *lineata*

Crocasmia aurea (Pappe ex Hook.) Planch. var. *aurea*

Gladiolus dalenii Van Geel

G. Germishuizen s.n., PRE

A. Abbott 3315, UNRH

A. Abbott 3336, UNRH

A. Abbott 4425, UNRH

A. Abbott 4427, UNRH

A. Abbott 443, UNRH

A. Abbott 1160, UNRH

Strey 9843, PRE

Codd 10699, PRE

A. Abbott 1145, UNRH

A. Abbott 1271, UNRH

A. Abbott 23, UNRH

C.R. Scott-Shaw 1640, CPF

A. Abbott 1778, UNRH

A. Abbott 1550, UNRH

A. Abbott 2087, UNRH

A. Abbott 1945, UNRH

A. Abbott 1330, UNRH

C. Groenewald 222, CPF

Victor 1391, PRE

A. Abbott 2017, UNRH

Victor 1381, PRE

A. Abbott 4498, UNRH

A. Abbott 3323, UNRH

A. Abbott 2863, UNRH

A. Abbott 2266, UNRH

A. Abbott 152, UNRH

Abbott 308A, PRE

A. Abbott 2089, UNRH

Nicholson 1693, PRE

A. Abbott 263, UNRH

A. Abbott 344, UNRH

Nicholson 713, PRE

A. Abbott 3249, UNRH

A. Abbott 1496, UNRH

A. Abbott 1480, UNRH

A. Abbott 2961, UNRH

Abbott 151, PRE

A. Abbott 2794, UNRH

A. Abbott 4104, UNRH

C. Groenewald 216, CPF

A. Abbott 2184, UNRH

A. Abbott 3316b, UNRH

A. Abbott 1424, UNRH

A. Abbott 3310, UNRH

A. Abbott 754, UNRH

A. Abbott 2778, UNRH

Abbott 2287, PRE

Nicholson 1905, PRE

A. Abbott 2932, UNRH

A. Abbott 2923, UNRH

C.R. Scott-Shaw 1726, CPF

A. Abbott 900, UNRH

A. Abbott 1582, UNRH

Nicholson 2135, PRE

Strey 9153, PRE

A. Abbott 1083, UNRH

A. Abbott 1549, UNRH

A. Abbott 206, UNRH

A. Abbott 202, UNRH

A. Abbott 3479, UNRH

A. Abbott 1581, UNRH

- Gladiolus ecklonii* Lehm. ssp. *ecklonii*
Gladiolus longicollis Bak. var. *longicollis*
Gladiolus longicollis Bak. var. *platypetalus* (Bak.) Oberm.
Gladiolus permeabilis Delaroché ssp. *wilsonii* (Bak.) G. J. Lewis
Watsonia sp. c.f. *W. confusa* Goldbl.
Watsonia bachmanii L. Bol.
Watsonia densiflora Bak.
Watsonia inclinata Goldbl.
Watsonia mtamvunae Goldbl.
Watsonia pillansii L. Bol.
Watsonia pondoensis Goldbl.
Anomatheca laxa (Thunb.) Goldbl.
- STRELITZIACEAE**
Strelitzia nicolai Regel & Koern.
- ORCHIDACEAE**
Stenoglottis sp. c.f. *S. woodii* Schltr.
Stenoglottis woodii Schltr.
Holothrix orthoceras (Harv.) Reichb. f.
Habenaria chlorotica Reichb. f.
Habenaria dives Reichb. f.
Habenaria falcicornis (Burch. ex Lindl.) H. Bol. ssp. *falcicornis*
Habenaria lithophila Schltr.
Habenaria woodii Schltr.
Brachycorythis inhambenensis (Schltr.) Schltr.
Brachycorythis ovata Lindl.
Satyrium sp. c.f. *S. longicauda* Lindl.
Satyrium longicauda Lindl. var. *longicauda*
Satyrium sphaerocarpaceum Lindl.
Satyrium trinerve Lindl.
Schizochilus zeyheri Sond.
Brownleea coerulea Harv. ex Lindl.
Disa caffra H. Bol.
Disa nervosa Lindl.
Disa polygonoides Lindl.
Disa sagittalis (L. f.) Swartz
Disa similis Summerh.
Disa stachyoides Reichb. f.
Disa tripetaloides (L.f.) N.E. Br. ssp. *tripetaloides*
Disa versicolor Reichb.
Disa woodii Schltr.
Herschelianthe baurii (H. Bol.) Rauschert
Disperis anthoceros Reichb. f.
Corymborkis corymbis Thouars
Liparis bowkeri Harv.
Liparis remota J. Stewart & Schelpe
Polystachya pubescens Reichb. f.
Polystachya sandersonii Harv.
Eulophia angolensis (Reichb. f.) Summerh.
Eulophia clavicornis Lindl. var. *clavicornis*
Eulophia ensata Lindl.
Eulophia odontoglossa Reichb. f.
Eulophia parviflora (Lindl.) A.V. Hall
Eulophia tenella Reichb. f.
Bulbophyllum scaberulum (Rolfe) H. Bol.
Angraecum pusillum Lindl.
Tridactyle tridentata (Harv.) Schltr.
Rangaeris muscicola (Reichb. f.) Summerh.
Ypsilopus erectus (Cribb) Cribb & J. Stewart
Cyrtorchis arcuata (Lindl.) Schltr.
Mystacidium venosum Harv. ex Rolfe
- PIPERACEAE**
Peperomia blanda (Jacq.) H.B.K. var. *leptostachya* (Hook. & Arn.) Duell
Peperomia retusa (L.f.) A. Dietr. var. *retusa*
Peperomia tetraphylla (Forst.) Hook & Arn.
- SALICACEAE**
Salix sp.
- MYRICACEAE**
Myrica brevifolia E. Mey. ex C. DC.
Myrica pilulifera Rendle
Myrica serrata Lam.
- A. Abbott 1002, UNRH
C.F. Scott-Shaw 1650, CPF
A. Abbott 1063, UNRH
A. Abbott 1159a, UNRH
A. Abbott 3952, UNRH
Goldblatt 8522, PRE
A. Abbott 1061, NH
A. Abbott 1268, NH
A. Abbott 2061, PRU
A. Abbott 3936, PRE
A. Abbott 2760, PRU
A. Abbott 1289, UNRH
- A. Abbott 3013, UNRH
- A. Abbott 1505, UNRH
A. Abbott 2325, UNRH
A. Abbott 114, UNRH
A. Abbott 4079, UNRH
A. Abbott 1617, UNRH
Nicholson 1530, PRE
A. Abbott 1655, UNRH
A. Abbott 878, UNRH
A. Abbott 2971, UNRH
A. Abbott 2767, UNRH
A. Abbott 1436, UNRH
A. Abbott 439, UNRH
Pienaar 774, PRE
A. Abbott 1500, UNRH
Nicholson 1357, PRE
A. Abbott 1039, UNRH
A. Abbott 3332, UNRH
A. Abbott 1828, UNRH
A. Abbott 1114, UNRH
A. Abbott 4497, UNRH
A. Abbott 3290, UNRH
A. Abbott 1329, UNRH
A. Abbott 258, UNRH
A. Abbott 2147, UNRH
A. Abbott 2172, UNRH
A. Abbott 1206, UNRH
A. Abbott 3457, UNRH
A. Abbott 3, PRE
A. Abbott 1573, UNRH
A. Abbott 2949, UNRH
A. Abbott 1293, UNRH
A. Abbott 4097, UNRH
A. Abbott 4197, UNRH
A. Abbott 266, UNRH
A. Abbott 2903, UNRH
A. Abbott 4198, UNRH
Abbott 126, PRE
A. Abbott 2913, UNRH
A. Abbott 1574, UNRH
A. Abbott 3159, UNRH
A. Abbott 1507, UNRH
A. Abbott 1745, UNRH
A. Abbott 1909, NH
A. Abbott 2132, UNRH
A. Abbott 1143, UNRH
- A. Abbott 613, UNRH
A. Abbott 3019, UNRH
A. Abbott 5268, UNRH
- A. Abbott 2696, UNRH
- K. Balkwill 7892, J
A. Abbott 2673, UNRH
A. Abbott 2016, UNRH

ULMACEAE

Celtis africana Burm. f.
Celtis durandii Engl.
Trema orientalis (L.) Blume
Chaetachme aristata Planch.

MORACEAE

Ficus bizanae Hutch. & Burt Davy
Ficus burt-davyi Hutch.
Ficus craterostoma Warb. ex Midbr. & Burret
Ficus ingens (Miq.) Miq. var. *ingens*
Ficus natalensis Hochst. ssp. *natalensis*
Ficus sur Forssk.
Ficus thonningii Blume

URTICACEAE

Urtica dioica L. *
Urera trinervis (Hochst. Apud Krauss) Friis & Immelman
Obetia tenax (N.E. Br.) Friis
Laportea grossa (Wedd.) Chew
Laportea peduncularis (Wedd.) Chew. ssp. ?
Drougetia iners (Forssk.) Schweinf. ssp. *iners*

PROTEACEAE

Faurea macnaughtonii Phill.
Faurea saligna Harv.
Protea caffra Meisn. ssp. *caffra*
Protea roupelliae Meisn. ssp. *roupelliae*
Protea simplex Phill.
Leucadendron salignum Berg.
Leucadendron spissifolium (Salisb. ex Knight) I. Williams ssp. *natalense*
 (Thode & Gilg) I. Williams
Leucadendron spissifolium (Salisb. ex Knight) I. Williams ssp. *oribinum* I. Williams
Leucadendron spissifolium (Salisb. ex Knight) I. Williams ssp. *spissifolium*

LORANTHACEAE

Tapinanthus kraussianus (Meisn.) V. Tieghem ssp. *kraussianus*
Erianthemum dregei (Eckl. & Zeyh.) V. Tieghem
Helixanthera woodii (Schltr. ex Krause) Danser

VISCACEAE

Viscum obscurum Thunb.
Viscum rotundifolium L.f.

SANTALACEAE

Colpoon compressum Berg.
Osyris lanceolata Hochst. & Steud.
Osyridicarpus schimperianus (Hochst. ex A. Rich.) A. DC.
Thesium sp. c.f. *T. funale* L.
Thesium sp. c.f. *T. acutissimum* A. DC.
Thesium acutissimum A. DC.
Thesium angulosum A. DC.
Thesium cupressoides A.W. Hill
Thesium funale L.
Thesium impeditum A.W. Hill
Thesium natalense Sond.
Thesium pallidum A. DC.

POLYGONACEAE

Rumex sp. (intermediate between *R. woodii* & *R. cordatus*)
Rumex dregeanus Meisn. ssp. *dregeanus*
Rumex sagittatus Thunb.
Persicaria hydropiper (L.) Spach *
Persicaria lapathifolia (L.) S.F. Gray *
Persicaria semulata (Lag.) Webb & Moq.
Oxygonum dregeanum Meisn. ssp. *streyi* Germishuizen

CHENOPODIACEAE

Chenopodium ambrosioides L. *

AMARANTHACEAE

Celosia trigyna L.
Cyathula cylindrica Moq.
Pupalia sp.
Pupalia lappacea (L.) A. Juss. var. *lappacea*
Achyranthes aspera L. var. ? *
Achyranthes aspera L. var. *aspera* *
Achyropsis leptostachya (E. Mey. ex Meisn.) Bak. & C.B. Cl.

A. Abbott 2803, UNRH
A. Abbott 1425, UNRH
A. Abbott 1423, UNRH
A. Abbott 1919, UNRH

A. Abbott 2190, UNRH
A. Abbott 2294, UNRH
A. Abbott 2776, UNRH
C.R. Scott-Shaw 1892, CPF
C.R. Scott-Shaw 1881, CPF
A. Abbott 2031, UNRH
A. Abbott 3983, UNRH

H.B. Nicholson 895, PRE
A. Abbott 1432, CPF
A. Abbott 2048, UNRH
A. Abbott 1723, UNRH
A. Abbott 1801, UNRH
A. Abbott 2251, CPF

A. Abbott 798, UNRH
A.E. Van Wyk 5322, PRE
A. Abbott 2223, UNRH
A. Abbott 1613, UNRH
A. Abbott 4053, UNRH
A.E. Van Wyk 6109, PRE
A. Abbott 1260, UNRH

A. Abbott 275, UNRH

R.G. Strey 9151, PRE

A. Abbott 1509, UNRH
A. Abbott 33, PRE
A. Abbott 1596, UNRH

A. Abbott 981, UNRH
A.E. Van Wyk 1567, PRE

A. Abbott 2066, UNRH
Nicholson 1523, PRE
A. Abbott 2049, UNRH
A. Abbott 2310, UNRH
A. Abbott 280, UNRH
A. Abbott 332, PRE
A. Abbott 2861, UNRH
A. Abbott 2314, UNRH
A. Abbott 745, UNRH
A. Abbott 2972, UNRH
Nicholson 1688, PRE
A. Abbott 2869, UNRH

A. Abbott 601, UNRH
Rycroft, H.B. 3457, PRE
Van Wyk A.E. 1677, UNRH
A. Abbott 2208a, CPF
A. Abbott 3096, CPF
A. Abbott 133, CPF
H.B. Nicholson 1712, PRE

A. Abbott 2993, UNRH

A. Abbott 2996, UNRH
A. Abbott 1898, UNRH
A. Abbott 4224, UNRH
A. Abbott 3504, UNRH
A. Abbott 4096, UNRH
H.B. Nicholson 1534, PRE
A. Abbott 1072, UNRH

Gomphraena celosoides Mart. *

PHYTOLACCACEAE

Phytolacca dodecandra L'Herit.

Phytolacca octandra L.

AIZOACEAE

Psammotropha mucronata (Thunb.) Fenzl var. *mucronata*

Psammotropha myriantha Sond.

MESEMBRYANTHEMACEAE

Delosperma sp.

Delosperma caespitosum L. Bol.

Delosperma concavum L. Bol.

Delosperma tradescantioides (Berger) L. Bol.

Delosperma velutinum L. Bol.

Lampranthus stipulaceus (L.) N.E. Br.

PORTULACCACEAE

Portulacaria afra Jacq.

CARYOPHYLLACEAE

Drymaria cordata (L.) Willd. ssp. *diandra* (Blume) J. Duke

Silene burchellii Otth. var. *burchellii*

Silene burchellii Otth. var. *latifolia* Sond.

Silene gallica L. *

Dianthus crenatus Thunb.

Dianthus mooiensis F.N. Williams ssp. *mooiensis* var. *dentatus* Burt Davy

Dianthus zeyheri Sond. ssp. *natalensis* Hooper

ILLECEBRACEAE

Pollichia campestris Ait.

NYMphaeACEAE

Nymphaea nouchali Burm. f. var. *caerulea*

RANUNCULACEAE

Anemone fanninii Harv. ex Mast.

Knowltonia bracteata Harv. ex Zahlbr.

Clematis brachiata Thunb.

Ranunculus multifidus Forssk.

MENISPERMACEAE

Cissampelos torulosa E. Mey. ex Harv.

ANNONACEAE

Uvaria caffra E. Mey. ex Sond

Monanthes caffra (Sond.) Verdc.

TRIMENIACEAE

Xymalos monospora (Harv.) Baill.

LAURACEAE

Cryptocarya latifolia Sond.

Cryptocarya liebertiana Engl.

Cryptocarya myrtifolia Stapf.

Cryptocarya woodii Engl.

Cryptocarya wyliei Stapf

Dahlgrenodendron natalense (J.H. Ross) J.J.M. v.d. Merwe & Van Wyk

Cassytha filiformis L. *

Cassytha pondoensis Engl.

PAPAVERACEAE

Argemone ochroleuca Sweet ssp. *ochroleuca* *

BRASSICACEAE

Heliophila elongata (Thunb.) DC.

Heliophila ngidiuscula Sond.

Cardamine africana L.

CAPPARACEAE

Bachmannia woodii (Oliv.) Gilg

Capparis brassii DC.

Capparis fascicularis DC. var. *zeyheri* (Turcz.) Toelken

Capparis tomentosa Lam.

Maerua cafra (DC.) Pax

DROSERACEAE

Drosera madagascariensis DC.

Drosera natalensis Diels

CRASSULACEAE

Cotyledon orbiculata L. var. *oblonga* (Harv.) DC.

Cotyledon orbiculata L. var. *orbiculata*

Kalanchoe rotundifolia (Haw.) Haw.

Crassula sp.

Crassula alba Forssk. var. *alba*

A. Abbott 3495, UNRH

A. Abbott 3981, UNRH

A. Abbott 1090, UNRH

A. Abbott 442, UNRH

A. Abbott 1534, UNRH

A. Abbott 954, UNRH

A. Abbott 1707, UNRH

A. Abbott 1471, UNRH

Van Jaarsveld, E.J. 17247, UNRH

A. Abbott 1217, UNRH

A. Abbott 3476, UNRH

A. Abbott s.n., CPF

A. Abbott 1896, UNRH

A. Abbott s.n., UNRH

A. Abbott 875, UNRH

A. Abbott 1490, UNRH

A. Abbott 1273, UNRH

A. Abbott 565, UNRH

A. Abbott 123, UNRH

A. Abbott 4408, UNRH

A. Abbott 2748, UNRH

A. Abbott 2713, UNRH

A. Abbott 637, UNRH

A. Abbott 3528, UNRH

A. Abbott 2209, UNRH

A. Abbott 3485, UNRH

A. Abbott 1443, UNRH

A. Abbott 692, UNRH

A. Abbott 1190, UNRH

A. Abbott 1316, UNRH

Venter, S. 1002, PRE

A. Abbott 3288, UNRH

A. Abbott 3263, UNRH

A. Abbott 32, UNRH

A. Abbott 631, UNRH

Strey, R.G. 9859, PRE

A. Abbott 856, UNRH

A. Abbott 2112, UNRH

F. Getliffe-Norris s.n., J

A. Abbott 1512, UNRH

A. Abbott 4095, CPF

C.R. Scott-Shaw 1594, CPF

A. Abbott 1246, UNRH

A. Abbott 1998, UNRH

A. Abbott 1317, UNRH

A. Abbott 2125, UNRH

A. Abbott 2221, UNRH

A. Abbott 207, UNRH

A. Abbott 1199, UNRH

A. Abbott s.n., CPF

A. Abbott 1077, UNRH

A. Abbott 4423, UNRH

A. Abbott s.n., CPF

- Crassula cultrata* L.
Crassula ericoides Haw. ssp. *ericoides*
Crassula flanaganii Schonl. & Bak. f.
- Crassula multicava* Lem. ssp. *floribunda* Friedr. ex Tolken
Crassula multicava Lem. var. *multicava*
Crassula natalensis Schonl.
Crassula nudicaulis L. var. *nudicaulis*
Crassula obovata Haw. var. *obovata*
Crassula ovata (Mill.) Druce
Crassula pellucida L. ssp. *alsinoides* (Hook. f.) Toelken
Crassula pellucida L. ssp. *brachypetala* (Drege ex Harv.) Toelken
Crassula perforata Thunb.
Crassula sarmentosa Harv. var. *integrifolia* Toelken
Crassula spathulata Thunb.
Crassula streyi Tolken
Crassula vaginata Eckl. & Zeyh. ssp. *vaginata*
- PITTOSPORACEAE**
Pittosporum viridiflorum Sims
- CUNONIACEAE**
Cunonia capensis L.
- BRUNIACEAE**
Raspalia trigyna (Schltr.) Dummer
- HAMAMELIDACEAE**
Trichocladus crinitus (Thunb.) Pers.
Trichocladus ellipticus Eckl. & Zeyh. ex Walp. ssp. *ellipticus*
Trichocladus grandiflorus Oliv.
- ROSACEAE**
Rubus immixtus C.E. Gust.
Rubus pinnatus Willd.
Rubus rosifolius J. E. Sm. *
Cliffortia paucistaminea Weim.
Cliffortia serpyllifolia Cham. & Schlechtd.
Cliffortia strobilifera Murray
Prunus africana (Hook. f.) Kalkm.
- CONNARACEAE**
Cnestis natalensis (Hochst.) Planch. & Sond.
- FABACEAE**
Albizia adianthifolia (Schumach.) W.F. Wight
Acacia ataxacantha DC.
Acacia caffra (Thunb.) Willd.
Acacia karroo Hayne
Acacia longifolia (Andr.) Willd.*
Dichrostachys cinerea (L.) Wight & Arn. ssp. *nyassana* (Taub.) Brenan
Adenopodia spicata (E. Mey.) Presl.
Schotia brachypetala Sond.
Chamaecrista capensis (Thunb.) E. Mey. var. *flavescens* (Thunb.) E. Mey.
Chamaecrista comosa E. Mey. var. *comosa*
Chamaecrista mimosoides (L.) Greene
Chamaecrista plumosa E. Mey. var. *erecta* (Schorn & Gordon-Gray) Lock
Senna septemtrionalis (Viv.) Irwin & Barneby *
Caesalpinia decapetala (Roth) Alston *
Podalyria velutina Burch. ex Benth.
Rafnia elliptica Thunb.
Lotononis alpina (Eckl. & Zeyh.) B-E. van Wyk ssp. *multiflora* (Eckl. & Zeyh.) B-E. van Wyk
Lotononis bachmanniana Dummer
Lotononis camosa (Eckl. & Zeyh.) Benth. ssp. ?
Lotononis corymbosa (E. Mey.) Benth.
Lotononis eriocarpa (E. Mey.) B-E. van Wyk
Lotononis meyeri (Presl.) B-E. van Wyk
Lotononis pulchra Dummer
Lotononis viminea (E. Mey.) B-E. van Wyk
Aspalathus sp.
Aspalathus chortophila Eckl. & Zeyh.
Aspalathus gerrardii H. Bol.
Aspalathus spinosa L. ssp. *spinosa*
Aspalathus uniflora L.
Dichilus reflexus (N.E. Br.) A.L. Schutte
Crotalaria capensis Jacq.
- A. Abbott 1265, UNRH*
A. Abbott 1624, UNRH
Britz, Van der Walt & Van Jaarsveld 143, PRE
Van Wyk 6104, PRE
A. Abbott s.n., CPF
Strey 8331, PRE
A. Abbott 1193, UNRH
Bot. III (Puff) 2, J
A. Abbott 1178, UNRH
A. Abbott 652, UNRH
A. Abbott 4083, UNRH
A. Abbott 758, UNRH
A. Abbott s.n., UNRH
Van Jaarsveld 17249, PRE
A. Abbott 1586, UNRH
A. Abbott 868, UNRH
- A. Abbott 1169, UNRH*
- A. Abbott 1682, UNRH*
- Meter s.n., NU*
- A. Abbott 615, UNRH*
A. Abbott 1372, UNRH
A. Abbott 961, UNRH
- A. Abbott 1118, UNRH*
Van Wyk 5377, PRE
A. Abbott 1717, UNRH
A. Abbott 177, UNRH
A. Abbott 1740, UNRH
A. Abbott 2516, UNRH
A. Abbott 2035, UNRH
- A. Abbott 1375, UNRH*
- A. Abbott 2783b, UNRH*
A. Abbott 1040, UNRH
A. Abbott 1040, UNRH
A. Abbott 281, UNRH
A. Abbott 2015, UNRH
A. Abbott 3660, UNRH
A. Abbott 724, CPF
A. Abbott 1457, UNRH
A. Abbott 1709, CPF
A. Abbott 1335, PRE
A. Abbott 2929, CPF
A. Abbott 1460, CPF
A. Abbott s.n., CPF
A. Abbott 1146, UNRH
A. Abbott 2726, UNRH
A. Abbott 612, UNRH
C.R. Scott-Shaw 1625, CPF
- A. Abbott 4336, UNRH*
C.R. Scott-Shaw 1644, CPF
A. Abbott 2096, UNRH
A. Abbott 1470, CPF
Van Wyk 5150, PRE
C.R. Scott-Shaw 1731, CPF
A. Abbott s.n., CPF
A. Abbott 4125, UNRH
C.R. Scott-Shaw 1665, CPF
A.E. van Wyk & T. Lowrey 6825, J
A. Abbott 618, UNRH
A. Abbott 730, PRE
A. Abbott 4223, UNRH
A. Abbott 1352, CPF

- Crotalaria globifera* E. Mey.
Crotalaria lanceolata E. Mey. ssp. *lanceolata*
Crotalaria natalitia Meisn. var. *natalitia*
Crotalaria virgulata Klotzsch ssp. *grantiana* (Harv.) Polhill
Argyrobolium harveyanum Oliv.
Argyrobolium marginatum H. Bol.
Argyrobolium pilosum Harv.
Argyrobolium rotundifolium T. J. Edwards (Not in Arnold & De Wet 1993)
Argyrobolium rupestre (Eckl. & Zeyh.) Walp.
Argyrobolium tomentosum (Andr.) Druce
Argyrobolium woodii Dummer
Indigofera sp. c.f. *I. eriocarpa* E. Mey.
Indigofera sp. c.f. *I. torulosa* E. Mey.
Indigofera fastigiata E. Mey.
Indigofera frutescens L.f.
Indigofera grata E. Mey.
Indigofera hedyantha Eckl. & Zeyh.
Indigofera hilaris Eckl. & Zeyh.
Indigofera micrantha E. Mey.
Indigofera natalensis H. Bol.
Indigofera rubroglandulosa Germishuizen
Indigofera spicata Forssk.
Indigofera swaziensis H. Bol. var. *swaziensis*
Indigofera tenuissima E. Mey.
Indigofera tristis E. Mey.
Indigofera velutina E. Mey.
Indigofera woodii H. Bol. var. ?
Psoralea pinnata L.
Otholobium caffrum (Eckl. & Zeyh.) C.H. Stirton
Otholobium polyphyllum (Eckl. & Zeyh.) C. H. Stirton
Tephrosia bachmannii Hams.
Tephrosia grandiflora (Ait.) Pers.
Tephrosia kraussiana Meisn.
Tephrosia macropoda (E. Mey.) Harv. var. *diffusa* (E. Mey.) B.D. Schrire
Tephrosia polystachya E. Mey. var. *hirta* Haw.
Tephrosia polystachya E. Mey. var. *polystachya*
Tephrosia pondoensis (Codd) Schrire
Tephrosia purpurea (L.) Pers. ssp. *purpurea* *
Tephrosia shiluanensis Schinz.
Ophrestia oblongifolia (E. Mey.) H.M. Forbes var. *oblongifolia*
Millettia grandis (E. Mey.) Skeels
Aeschynomene micrantha DC.
Zomia capensis Pers.
Zomia linearis E. Mey.
Desmodium dregeanum Benth.
Desmodium incanum DC.
Desmodium setigerum (E. Mey.) Benth. ex Harv.
Pseudarthria hookeri Wight & Arn. var. *hookeri*
Alysicarpus rugosus (Willd.) DC. ssp. *perenirufus* J. Leonard
Dalbergia sp. c.f. *D. multijuga* E. Mey.
Dalbergia armata E. Mey.
Dalbergia multijuga E. Mey.
Dalbergia obovata E. Mey.
Abrus laevigatus E. Mey.
Neonotonia wightii (Arn.) Lackey
Erythrina latissima E. Mey.
Erythrina lysistemon Hutch.
Canavalia bonariensis Lindl.
Rhynchosia caribaea (Jacq.) DC.
Rhynchosia confusa Burt Davy
Rhynchosia pentheri Schltr. ex Zahlbr. var. *pentheri*
Rhynchosia sordida (E. Mey.) Schinz
Rhynchosia totta (Thunb.) DC. var. *totta*
Rhynchosia villosa (Meisn.) Druce
Eriosema acuminatum (Eckl. & Zeyh.) C. H. Stirton
Eriosema cordatum E. Mey.
Eriosema dregei E. Mey.
Eriosema kraussianum Meisn.
Eriosema parviflorum E. Mey.
Eriosema preptum C. H. Stirton
A. Abbott 894, UNRH
A. Abbott 1843, UNRH
A. Abbott s.n., UNRH
A. Abbott 3053, CPF
A. Abbott 1845, UNRH
A. Abbott 1811, UNRH
A. Abbott s.n., UNRH
Edwards, T.J. 610, PRE
A. Abbott 1458, UNRH
A. Abbott 1069, UNRH
A. Abbott 2170, UNRH
A. Abbott 3335, UNRH
A. Abbott 3535, UNRH
A. Abbott 842, UNRH
A. Abbott 694, PRE
A. Abbott 5159, UNRH
A. Abbott s.n., CPF
A. Abbott 2790, UNRH
A. Abbott 648, UNRH
A. Abbott 2881, UNRH
A. Abbott 2091, UNRH
A. Abbott 3959, UNRH
Van Wyk 2604, PRE
A. Abbott 2298, CPF
A. Abbott 3502, UNRH
A. Abbott 2809, UNRH
A. Abbott s.n., CPF
A. Abbott 134, PRE
A. Abbott 825, UNRH
C.J. Ward 7161, PRE
A. Abbott 755, UNRH
C.R. Scott-Shaw 862, CPF
A. Abbott 3011, UNRH
A. Abbott 742, PRE
A. Abbott 3074, UNRH
Nicholson 994, PRE
A. Abbott 1544, UNRH
A. Abbott s.n., CPF
A. Abbott 776, UNRH
A. Abbott 597, UNRH
A. Abbott 695, UNRH
A. Abbott 2978, PRE
Edwards, T.J. 95, PRE
A. Abbott 707, UNRH
A. Abbott 1657, UNRH
A. Abbott 1097, UNRH
A. Abbott 1812, UNRH
A. Abbott 1779, UNRH
A. Abbott 2264, UNRH
A. Abbott 4143, UNRH
A. Abbott 2317, UNRH
A. Abbott 4143, UNRH
A. Abbott 1487, UNRH
A. Abbott 757, UNRH
A. Abbott 3055, UNRH
A. Abbott 1577, UNRH
A. Abbott 1615, UNRH
A. Abbott 4221, UNRH
A. Abbott 3067, UNRH
A. Abbott 3024, UNRH
A. Abbott 927, UNRH
A. Abbott 3005, UNRH
A. Abbott 919, UNRH
A. Abbott 2171, UNRH
A. Abbott s.n., CPF
A. Abbott 433, UNRH
Germishuizen 1740, PRE
A. Abbott 356, UNRH
A. Abbott 4087, PRE
A. Abbott 4043, PRE

- Eriosema rossi* C.H. Stirton
Eriosema salignum E. Mey.
Eriosema squarrosum (Thunb.) Walp.
Eriosema umtamvunense C.H. Stirton
Vigna nervosa Markotter
Vigna unguiculata (L.) Walp. ssp. *unguiculata*
Vigna vexillata (L.) A. Rich. var. *vexillata*
Sphenostylis marginata E. Mey. ssp. *marginata*
Lablab purpureus (L.) Sweet ssp. *uncinatus* Verdc.
- GERANIACEAE**
Geranium flanaganii Knuth
Geranium omithopodum Eckl. & Zeyh.
Monsonia angustifolia E. Mey. ex A. Rich.
Monsonia grandifolia Knuth.
Monsonia natalensis Knuth
Pelargonium alchemilloides (L.) L'Herit
Pelargonium capitatum (L.) L'Herit.
Pelargonium luridum (Andr.) Sweet
- OXALIDACEAE**
Oxalis sp. c.f. *O. semiloba* Sond.
Oxalis comiculata L. *
Oxalis tysonii Phill.
- LINACEAE**
Linum thunbergii Eckl. & Zeyh.
- ERYTHROXYLACEAE**
Erythroxylum delagoense Schinz
Erythroxylum emarginatum Thonn.
Erythroxylum pictum E. Mey. ex Sond.
Nectaropetalum capense (H. Bol.) Stapf & Boodle
Nectaropetalum zuluense (Schonl.) Corbishley
- RUTACEAE**
Zanthoxylum capense (Thunb.) Harv.
Zanthoxylum davyi (Verdoorn) Waterm.
Calodendrum capense (L.f.) Thunb.
Agathosma ovata (Thunb.) Pillans
Oricia bachmannii (Engl.) Verdoorn
Vepris lanceolata (Lam.) G. Don
Teclea gerrardii Verdoorn
Clausena anisata (Willd.) Hook. f. ex Benth.
- BURSERACEAE**
Commiphora harveyi (Engl.) Engl.
Commiphora woodii Engl.
- MELIACEAE**
Turraea floribunda Hochst.
Melia azedarach L. *
Ekebergia capensis Sparm.
Ekebergia pterophylla (C. DC.) Hofmeyr
Trichilia dregeana Sond.
- PTAEROXYLACEAE**
Ptaeroxylon obliquum (Thunb.) Radlk.
- MALPIGHIACEAE**
Acridocarpus natalitius Juss. var. *natalitius*
- POLYGALACEAE**
Polygala amatymbica Eckl. & Zeyh.
Polygala confusa Macowan
Polygala esterae Chod.
Polygala fruticosa Berg.
Polygala gerrardii Chod.
Polygala hottentotta Presl.
Polygala myrtifolia L.
Polygala ohlendoriana Eckl. & Zeyh.
Polygala refracta DC.
Polygala rehmannii Chod.
Polygala serpentaria Eckl. & Zeyh.
Polygala uncinata E. Mey. ex Meisn.
Muraltia lancifolia Harv.
Muraltia saxicola Chod.
- EUPHORBIACEAE**
Heywoodia lucens Sim
Phyllanthus sp.
- A. Abbott 2195, UNRH
A. Abbott 1763, PRE
Germishuizen 1745, PRE
Stirton 10974, PRE
A. Abbott 960, UNRH
Pienaar B.J. 789, PRE
A. Abbott 939, UNRH
A. Abbott 1028, UNRH
A. Abbott 4336, UNRH
- Nicholson 1490, PRE
A. Abbott 1385, UNRH
H.B. Nicholson 989, PRE
A. Abbott 790, PRE
A. Abbott 1876, UNRH
A. Abbott 1598, UNRH
A. Abbott 1889, UNRH
A. Abbott 323, UNRH
- A. Abbott 4108, UNRH
A. Abbott 2754, UNRH
A.T.D. Abbott 4109, PRE
- A. Abbott 1693, UNRH
- A.T.D. Abbott 172, PRE
A. Abbott 3957, UNRH
A. Abbott 12, UNRH
A. Abbott 172, PRE
A. Abbott 1237, UNRH
- A. Abbott 685, UNRH
A. Abbott 684, UNRH
A. Abbott 1543, UNRH
A. Abbott 105, UNRH
A. Abbott 746, UNRH
A. Abbott 1780, UNRH
A. Abbott 3021, UNRH
A. Abbott 1290, UNRH
- A. Abbott 1446, UNRH
A. Abbott 1467, UNRH
- A. Abbott 1420, UNRH
A. Abbott 1318, UNRH
A. Abbott 1421, UNRH
A. Abbott 1339, UNRH
A. Abbott 2213, UNRH
- A. Abbott 1454, UNRH
- A. Abbott 1519, UNRH
- A. Abbott 2732, UNRH
A. Abbott 1392, UNRH
A. Abbott 1027, UNRH
A. Abbott 3542, UNRH
A. Abbott 3530, UNRH
A. Abbott 1616, UNRH
A. Abbott 2665, UNRH
A. Abbott 374, PRE
A. Abbott 1932, UNRH
A. Abbott 2897, UNRH
A. Abbott 1453, UNRH
A. Abbott 398, UNRH
A. Abbott 3321, UNRH
A. Abbott 253, UNRH
- A. Abbott 1286, UNRH
A. Abbott 1749, UNRH

- Phyllanthus glaucophyllus* Sond.
Phyllanthus meyerianus Mull. Arg.
Phyllanthus myrtaceus Sond.
Margaritana discoidea (Baill.) Webster var. *discoidea*
Margaritana discoidea (Baill.) Webster var. *nitida* (Pax) Radcliffe-Sm.
Drypetes arguta (Muell. Arg.) Hutch.
Drypetes gerrardii Hutch.
Drypetes natalensis (Harv.) Hutch.
Antidesma rufescens Tul.
Bridelia cathartica Bertol. f.
Bridelia micrantha (Hochst.) Baill.
Croton sylvaticus Hochst.
Micrococca capensis (Baill.) Prain.
Erythrococca sp. nov. (=Moll 4937)
Erythrococca berberidea Prain
Erythrococca menyharthii (Pax) Prain
Erythrococca natalensis Prain
Adenocline pauciflora Turcz.
Macaranga capensis (Baill.) Benth. ex Sim.
Acalypha glabrata Thunb. var. *glabrata*
Acalypha glandulifolia Buchinger ex Meisn.
Acalypha peduncularis E. Mey. ex Meisn.
Acalypha punctata Meisn. var. *punctata*
Acalypha schinzii Pax.
Tragia sp.
Tragia glabrata (Muell. Arg.) Pax & K. Hoffm. var. *glabrata*
Ctenomeria capensis (Thunb.) Harv. ex Sond.
Tragiella natalensis (Sond.) Pax & K. Hoffm.
Dalechampia capensis Spreng. f.
Clutia sp. (=Hitchins 775)
Clutia abyssinica Jaub. & Spach var. *abyssinica*
Clutia disceptata Prain.
Clutia laxa Eckl. & Sond.
Clutia pulchella L. var. *pulchella*
Clutia pulchella L. var. *obtusata* Sond.
Clutia virgata Pax & K. Hoffm.
Suregada africana (Sond.) Kuntze
Suregada procera (Prain) Croizat
Excoecaria simii (Kuntze) Pax
Sapium ellipticum (Krauss) Pax
Euphorbia sp.
Euphorbia bupleurifolia Jacq.
Euphorbia ericoides Lam.
Euphorbia frankisiae N.E. Br. var. ?
Euphorbia grandidens Haw.
Euphorbia gueinzii Boiss. var. *albovillosa* (Pax) N.E. Br.
Euphorbia guienzii Boiss. var. *guienzii*
Euphorbia kraussiana Bernh. var. *erubescens* N. E. Br.
Euphorbia kraussiana Bernh. var. *kraussiana*
Euphorbia natalensis Bernh.
Euphorbia striata Thunb. var. *striata*
Euphorbia tirucalli L.
Euphorbia triangularis Desf.
Euphorbia woodii N.E. Br.
- BUXACEAE**
- Buxus macowanii* Oliv.
Buxus natalensis (Oliv.) Hutch.
- ANACARDIACEAE**
- Harpephyllum caffrum* Bernh. ex Krauss
Protorhus longifolia (Bernh.) Engl.
Loxostylis alata Spreng. f. ex Reichb.
Rhus acocksii Moffett
Rhus camosula Schonl.
Rhus chinindensis Bak. f.
Rhus dentata Thunb.
Rhus discolor E. Mey. ex Sond.
Rhus fastigiata Eckl. & Zeyh.
Rhus guienzii Sond.
Rhus lucida L.
Rhus natalensis Bernh. ex Krauss
- A. Abbott 4496, UNRH
A. Abbott 700, UNRH
A. Abbott 2245, UNRH
A. Abbott 1478, UNRH
A. Abbott 41, UNRH
A. Abbott 376, UNRH
A. Abbott 2792, UNRH
Van Wyk 5390, PRE
C.R. Scott-Shaw 2726, CPF
Van Wyk 2954, PRE
A. Abbott 582, UNRH
A. Abbott s.n., CPF
A. Abbott 2907, UNRH
A. Abbott 704, UNRH
A. Abbott 19, UNRH
Van Wyk 4996, PRE
A. Abbott 154, PRE
A. Abbott 2167, UNRH
A. Abbott 51, UNRH
A. Abbott 2114, UNRH
Scott-Shaw 1498, CPF
Scott-Shaw 1665, CPF
Scott-Shaw 2729, CPF
Scott-Shaw 2720, CPF
A. Abbott 1777, UNRH
A. Abbott 4240, UNRH
A. Abbott 2515, UNRH
Nicholson 1374, PRE
A. Abbott 2327, UNRH
A. Abbott 4084, UNRH
A. Abbott 40, UNRH
C.R. Scott-Shaw 1661, CPF
A. Abbott 983, UNRH
Abbott 371, PRE
A. Abbott 4234, UNRH
A. Abbott 2136, PRE
A. Abbott 3265, CPF
C.R. Scott-Shaw 2741, CPF
A. Abbott 2296, UNRH
A. Abbott 2276, UNRH
A. Abbott 2320, UNRH
A. Abbott s.n., CPF
A. Abbott 153, UNRH
A. Abbott 1927, UNRH
A. Abbott 1219, UNRH
A. Abbott 1419, UNRH
A. Abbott 2183, UNRH
A. Abbott 1670, UNRH
A. Abbott 1921, UNRH
C.R. Scott-Shaw 2244, CPF
A. Abbott 1711, UNRH
A. Abbott 2249, UNRH
A. Abbott 1133, UNRH
A. Abbott 2690, UNRH
- A. Abbott 87, PRE
A. Abbott 214, PRE
- A. Abbott 1167, UNRH
A. Abbott 1294, UNRH
A. Abbott 738, UNRH
A. Abbott 1491, NH
A. Abbott 1638, PRE
A. Abbott 451, UNRH
A. Abbott 137, UNRH
A. Abbott 607, CPF
A. Abbott 1078, UNRH
A. Abbott 4237, UNRH
A. Abbott 1641, UNRH
A. Abbott 1332, UNRH

- Rhus nebulosa* Schoml.
Rhus pentheri Zahlbr.
Rhus pondoensis Schoml.
Rhus rehmanniana Engl.
- AQUIFOLIACEAE**
Ilex mitis (L.) Radlk. var. *mitis*
- CELASTRACEAE**
Maytenus abbottii Van Wyk
Maytenus acuminata (L. f.) Loes. var. *acuminata*
Maytenus bachmannii (Loes.) Marais
Maytenus cordata (E. Mey. ex Sond.) Loes.
Maytenus heterophylla (Eckl. & Zeyh.) N.K.B. Robson
Maytenus mossambicensis (Klotzsch) Blakelock var. *mossambicensis*
Maytenus mossambicensis (Klotzsch) Blakelock var. *rubra* (Harv.) Blakelock
Maytenus nemorosa (Eckl. & Zeyh.) Marais
Maytenus oleosa Van Wyk & Archer
Maytenus peduncularis (Sond.) Loes.
Maytenus procumbens (L.f.) Loes.
Maytenus pubescens N.K.B. Robson
Maytenus tenuispina (Sond.) Marais
Maytenus undata (Thunb.) Blakelock
Putterlickia sp. nov.
Putterlickia pyracantha (L.) Szyszyl.
Putterlickia retrospinosa Van Wyk & Mostert
Catha abbottii Van Wyk & Prins
Pterocelastrus echinatus N.E. Br.
Pterocelastrus rostratus Walp.
Pterocelastrus tricuspidatus (Lam.) Sond.
Cassine aethiopica Thunb.
Cassine eucleiformis (Eckl. & Zeyh.) Kuntze
Cassine papillosa (Hochst.) Kuntze
Cassine peragua L.
Cassine tetragona (L.f.) Loes
Allocassine laurifolia (Harv.) N.K.B. Robson
Pleurostyliya capensis (Turcz.) Loes.
Hippocratea delagoensis Loes.
Hippocratea schlechteri Loes. var. *peglerae* Loes.
Salacia gerrardii Harv.
Pseudosalacia streyi Codd
- ICACINACEAE**
Cassinopsis tinifolia Harv.
Apodytes abbottii A.E. Van Wyk
Apodytes dimidiata E. Mey. ex Arn. ssp. *dimidiata*
- SAPINDACEAE**
Allophylus dregeanus (Sond.) De Winter
Allophylus melanocarpus (Sond.) Radkl.
Atalaya natalensis R.A. Dyer
Deinbollia oblongifolia (E. Mey. ex Arn.) Radkl.
Dodonaea angustifolia L.f.
Hippobromus pauciflorus (L.f.) Radkl.
- MELIANTHACEAE**
Bersama lucens (Hochst.) Szyszyl.
Bersama swinnyi Phillips
Bersama tysoniana Oliv.
- RHAMNACEAE**
Ziziphus mucronata Willd. ssp. *mucronata*
Scutia myrtina (Burm. f.) Kurz
Colubrina nicholsonii Van Wyk & Schrire
Phylica natalensis Pillans
Phylica paniculata Willd.
Helinus integrifolius (Lam.) Kuntze
- VITACEAE**
Rhoicissus digitata (L.f.) Gilg. & Brandt
Rhoicissus rhomboidea (E. Mey. ex Harv.) Planch.
Rhoicissus tomentosa (Lam.) Wild & Drum.
Rhoicissus tridentata (L. f.) Wild & Drum. ssp. *cuneifolia* (Eckl. & Zeyh.) Urton
Rhoicissus tridentata (L. f.) Wild & Drum. ssp. *tridentata*
Cissus fragilis E. Mey. ex Kunth
Cyphostemma sp. nov.
Cyphostemma hypoleucum (Harv.) Descoings ex Wild & Drum.
- A. Abbott 4091, PRE
A. Abbott 1021, UNRH
A.T.D. Abbott 30, PRE
A. Abbott 985, UNRH
- A. Abbott 420, UNRH
- A. Abbott 2326, PRU
A. Abbott 763, UNRH
A. Abbott 651, UNRH
A. Abbott 3020, UNRH
A. Abbott 1628, CPF
A. Abbott 90, UNRH
A. Abbott 11, UNRH
A. Abbott 2693, UNRH
A. Abbott 2081, NH
A. Abbott 340, UNRH
A. Abbott 3948, UNRH
Biggs, D.C. 188, PRE
C.R. Scott-Shaw 1528, CPF
A. Abbott 3995, UNRH
A. Abbott 1518, UNRH
A. Abbott 1416, UNRH
A. Abbott 2359, CPF
A. Abbott 2332, UNRH
A. Abbott 1546, UNRH
A. Abbott 4086, UNRH
A. Abbott 1030, UNRH
A. Abbott 584, CPF
A. Abbott 61, UNRH
A. Abbott 1418, UNRH
A. Abbott 178, UNRH
A. Abbott 982, PRE
Nicholson 1042, PRE
A. Abbott 3555, CPF
A. Abbott 238, CPF
A. Abbott 2043, UNRH
A. Abbott 2879, UNRH
C.R. Scott-Shaw 1613, CPF
- A. Abbott 28, UNRH
C.R. Scott-Shaw 1477, CPF
A. Abbott 851, UNRH
- A. Abbott 215, UNRH
A. Abbott 723, UNRH
Nicholson 2395, NH
A. Abbott s.n., CPF
A. Abbott 1376, UNRH
A. Abbott 562, UNRH
- A. Abbott 2051, UNRH
C.R. Scott-Shaw 1902, UNRH
Van Wyk, P. BSA1678, PRE
- A. Abbott 892, UNRH
A. Abbott 2247, UNRH
Van Wyk 7244, PRE
A. Abbott 3162, UNRH
A. Abbott 1643, UNRH
A. Abbott 1608, UNRH
- A. Abbott 1996, UNRH
A. Abbott 3487, UNRH
A. Abbott 718, UNRH
Edwards, T.J. 92, PRE
C.J. Ward 7135, PRE
A. Abbott 1567, UNRH
A. Abbott 1557, UNRH
A. Abbott 1521, PRE

Cyphostemma natalitium (Szyszyl.) J. V.D.Merwe

TILIACEAE

Grewia sp. c.f. *G. hispida* Harv.

Grewia hispida Harv.

Grewia lasiocarpa E. Mey. ex Harv.

Grewia occidentalis L.

Grewia pondoensis Burnet

Triumfetta pilosa Roth var. *effusa* (E. Mey. ex Harv.) Wild

Triumfetta pilosa Roth var. *tomentosa* Szyszyl. ex Sprague & Hutch.

Triumfetta rhomboidea Jacq.

MALVACEAE

Abutilon sonneratianum (Cav.) Sweet.

Anisodonteia scabrosa (L.) Bates

Sida dregei Burt Davy

Sida rhombifolia L.

Hibiscus sp. nov. (=Strey 4513)

Hibiscus aethiopicus L. var. *aethiopicus*

Hibiscus calyphyllus Cav.

Hibiscus pedunculatus L.f.

Hibiscus tiliaceus L.

Hibiscus trionum L.

Hibiscus vitifolius L. ssp. *vitifolius*

STERCULIACEAE

Dombeya cymosa Harv.

Dombeya tiliacea (Endl.) Planch.

Cola natalensis Oliv.

OCHNACEAE

Ochna arborea Burch. ex DC. var. *arborea*

Ochna natalitia (Meisn.) Walp.

Ochna serrulata (Hochst.) Walp.

CLUSIACEAE

Hypericum sp. (=Strey 7443)

Hypericum aethiopicum Thunb. ssp. *sonderi* (Bredell) Robson

Hypericum lalandii Choisy

Garcinia gerrardii Harv. ex Sim.

VIOLACEAE

Rinorea angustifolia (Thouars) Baill.

Rinorea domatiosa Van Wyk

Hybanthus enneaspermus (L.) F. Muell. *

FLACOURTIACEAE

Rawsonia lucida Harv. & Sond.

Kiggelaria africana L.

Scolopia flanaganii (H. Bol.) Sim.

Scolopia mundii (Eckl. & Zeyh.) Warb.

Scolopia zeyheri (Nees) Harv.

Pseudoscolopia polyantha Gilg.

Gerrardina foliosa Oliv.

Homalium dentatum (Harv.) Warb.

Homalium rufescens Benth.

Trimeria grandifolia (Hochst.) Warb.

Dovyalis lucida Sim.

Dovyalis rhamnoides (Burch. ex DC.) Harv.

Casearia gladiiformis Mast.

PASSIFLORACEAE

Adenia gummifera (Harv.) Harms var. *gummifera*

Passiflora coerulea L. *

ACHARIACEAE

Ceratosicyos laevis (Thunb.) A. Meuse

BEGONIACEAE

Begonia dregei Otto & Dietr.

Begonia homonyma Steud.

Begonia sutherlandii Hook. f.

CACTACEAE

Rhipsalis baccifera (J. Mill.) Stearn

Opuntia vulgaris Mill. *

OLINIACEAE

Olinia radiata J. Hoffm.

Olinia ventosa (L.) Cufod.

THYMELAEACEAE

Peddiea africana Harv.

A. Abbott 2902, UNRH

A. Abbott 3050, UNRH

A. Abbott 3557, UNRH

A. Abbott 1686, UNRH

A. Abbott 1427, UNRH

A. Abbott 421, UNRH

A. Abbott 2568, UNRH

Van Wyk A.E. 5336, PRE

A. Abbott 2569, UNRH

A. Abbott 3529, UNRH

A. Abbott 212, UNRH

A. Abbott 1847, UNRH

A. Abbott 1569, UNRH

A. Abbott 1738, UNRH

A. Abbott 2920, UNRH

A. Abbott 1563, UNRH

A. Abbott 1003, UNRH

A. Abbott 3960, UNRH

A. Abbott 1908, UNRH

A. Abbott 2876, UNRH

R.G. Strey 8693, PRE

A. Abbott 993, UNRH

A. Abbott 88, UNRH

A. Abbott 2113, UNRH

A. Abbott 283, UNRH

A. Abbott 2135, UNRH

A. Abbott 3025, UNRH

A. Abbott 386, UNRH

A. Abbott 2827, UNRH

A. Abbott 387, UNRH

A. Abbott 1520, UNRH

A.E. van Wyk 5004, PRE

A. Abbott 360, PRE

A. Abbott 2267, UNRH

F. White 10561, PRE

Van Wyk, A.E. 5386, PRE

A. Abbott 2290, UNRH

A. Abbott 1087, UNRH

A. Abbott 73, UNRH

C.R. Scott-Shaw 1442, CPF

A. Abbott 557, UNRH

A. Abbott 441, UNRH

A. Abbott s.n., UNRH

A. Abbott 2124, UNRH

A. Abbott 2143, UNRH

A. Abbott 2224, CPF

A. Abbott 2725, UNRH

A. Abbott 2220, UNRH

A. Abbott 3536, UNRH

A. Abbott 3546, UNRH

A. Abbott 2989, UNRH

A. Abbott 623, UNRH

A. Abbott 846, UNRH

A. Abbott 1892, CPF

A. Abbott 1494, UNRH

A. Abbott 413, UNRH

A. Abbott 1224, UNRH

- Gnidia* sp.
Gnidia anthylloides (L.f.) Gilg
Gnidia caffra Meisn.
Gnidia calocephala (C.A. Mey.) Gilg.
Gnidia coriacea Meisn.
Gnidia kraussiana Meisn. var. *kraussiana*
Gnidia nodiflora Meisn.
Gnidia polyantha Gilg.
Gnidia pulchella Meisn.
Gnidia triplinervis Meisn.
Gnidia woodii C.H. Wr.
Struthiola congesta C.H. Wr.
Struthiola pondoensis Gilg.
Englerodaphne ovalifolia (Meisn.) Phill.
Passerina filiformis L.
Passerina rigida Wikstr.
Dais cotonifolia L.
- LYTHRACEAE**
Nesaea sp.
Heimia myrtifolia Cham. & Schlechtd. *
- RHYNCHOCALYCEAE**
Rhynchocalyx lawsonioides Oliv.
- RHIZOPHORACEAE**
Cassipourea flanagani (Schinz) Alston
Cassipourea gerrardii (Schinz) Alston
Cassipourea gummiflua Tul. var. *verticillata* (N.E. Br.) J. Lewis
- COMBRETACEAE**
Combretum caffrum (Eckl. & Zeyh.) Kuntze
Combretum edwardsii Exell.
Combretum erythrophyllum (Burch.) Sond.
Combretum kraussii Hochst.
Combretum woodii Dummer
Quisqualis parviflora Gerr. ex Harv.
- MYRTACEAE**
Psidium cattleianum Sabine *
Eugenia albanensis Sond.
Eugenia capensis (Eckl. & Zeyh.) Harv. ex Sond.
Eugenia erythrophylla Strey
Eugenia natalitia Sond.
Eugenia simii Duemmer
Eugenia umtamvunensis Van Wyk
Eugenia verdoorniae Van Wyk
Syzygium cordatum Hochst. x *S. guineense* (Willd.) DC.
Syzygium cordatum Hochst.
Syzygium gerrardii (Harv. ex Hook. f.) Burt Davy
Syzygium guineense (Willd.) DC.
Syzygium pondoense Engl.
- MELASTOMATACEAE**
Dissotis canescens (E. Mey. ex R.A. Grah.) Hook. f.
Memecylon bachmannii Engl.
Memecylon natalense Markg.
- ONAGRACEAE**
Ludwigia octovalvis (Jacq.) Raven ssp. *sessiliflora* (Mich.) Raven
Oenothera affinis Cambess. *
Oenothera parodiana Munz. ssp. *parodiana* *
Oenothera rosea L'Herit. ex Ait. *
Oenothera villosa Thunb. *
- HALORAGACEAE**
Laurembergia repens Berg. ssp. *brachypoda*
- ARALIACEAE**
Schefflera umbellifera (Sond.) Baill.
Cussonia arenicola Strey.
Cussonia nicholsonii Strey
Cussonia sphaerocephala Strey.
Cussonia spicata Thunb.
- APIACEAE**
Centella asiatica (L.) Urb.
Centella glabrata L. var. *glabrata*
Centella glabrata L. var. *natalensis* Adamson
Alepidea longifolia E. Mey. var. *longifolia*
- A. Abbott 4429, UNRH
A. Abbott 2069, UNRH
A. Abbott 77, PRE
Victor, J.E. 1375, PRE
A. Abbott 672, UNRH
A. Abbott 2158, UNRH
A. Abbott 1538, UNRH
A. Abbott 120, UNRH
A. Abbott 1922, UNRH
A. Abbott 2068, UNRH
A. Abbott 1020, UNRH
Van Wyk 4495, PRE
A. Abbott 45, PRE
A. Abbott 1684, UNRH
A. Abbott 308, UNRH
Crawford R. 384, PRE
Venter S. 1005, PRE
- A. Abbott 3534, UNRH
A. Abbott 2834, UNRH
- A. Abbott 80, UNRH
- A. Abbott 375, UNRH
A. Abbott 1387, CPF
A. Abbott 941, UNRH
- H.B. Nicholson 1314, PRE
A. Abbott 82, UNRH
A. Abbott 277, UNRH
A. Abbott 1552, UNRH
Van Wyk A.E. 5012, PRE
A. Abbott 91, PRE
- Van Wyk A.E. 5285, PRE
A. Abbott 335, UNRH
A. Abbott 3493, UNRH
A. Abbott 1462, UNRH
A. Abbott 1515, UNRH
A. Abbott 422, UNRH
A. Abbott 1611, UNRH
A. Abbott 1016, UNRH
A. Abbott 1209, UNRH
A. Abbott 2770, UNRH
A. Abbott 338, UNRH
H.B. Nicholson 11304, PRE
A. Abbott 37, UNRH
- A. Abbott 116, UNRH
A. Abbott 1947, UNRH
A. Abbott 2175, UNRH
- A. Abbott 169, UNRH
H.B. Nicholson 1949, PRE
A. Abbott 1465, UNRH
A. Abbott 2746, UNRH
A. Abbott 1721, UNRH
- A. Abbott 2606, UNRH
- A. Abbott 1697, UNRH
R.G. Strey 9886, PRE
A. Abbott 1492, UNRH
R.G. Strey 10406, CPF
A. Abbott 1185, UNRH
- A. Abbott 4188, UNRH
A. Abbott 2159, UNRH
A. Abbott 570, UNRH
A. Abbott 1672, UNRH

- Lichtensteinia interrupta* (Thunb.) E. Mey.
Lichtensteinia kolbeana Bol.
Heteromorpha arborescens (Thunb.) Cham. & Schlecht.
Heteromorpha trifoliata (Wendl.) Eckl. & Zeyh.
Apium graveolens L. *
Ciclospermum leptophyllum (Pers.) Eichler *
Pimpinella caffra (Eckl. & Zeyh.) D. Dietr.
Foeniculum vulgare Mill. *
Stenosemis angustifolia E. Mey. ex Sond.
Peucedanum caffrum (Meisn.) Phill.
Peucedanum capense (Thunb.) Sond. var. *capense*
Peucedanum natalense (Sond.) Engl.
Peucedanum platycarpum E. Mey. ex Sond.
- ERICACEAE**
Erica abbottii Oliver
Erica aspalathifolia H. Bol. var. *aspalathifolia*
Erica caffra L. var. *caffra*
Erica cerinthoides L. var. *barbertona* (Galpin) H. Bol.
Erica cerinthoides L. var. *cerinthoides*
Erica cubica L. var. *cubica*
Erica hispidula L. var. *hispidula*
Erica natalitia H. Bol. var. *natalitia*
Erica oatesii Rolfe var. *oatesii*
- MYRSINACEAE**
Maesa alnifolia Harv.
Maesa lanceolata Forssk.
Embelia ruminata (E. Mey. ex A. DC.) Mez
Myrsine africana L.
Rapanea melanophloes (L.) Mez
- PLUMBAGINACEAE**
Plumbago auriculata Lam.
- SAPOTACEAE**
Sideroxylon inerme L. ssp. *inerme*
Chrysophyllum viridifolium J.M. Wood & Franks
Bequaertiodendron natalense (Sond.) Heine & J.H. Hemsl.
Mimusops obovata Sond.
Manilkara nicholsonii Van Wyk
Vitellariopsis marginata (N.E. Br.) Aubrev.
- EBENACEAE**
Euclea crispa (Thunb.) Guerke ssp. *crispa*
Euclea natalensis A. DC. ssp. *natalensis*
Euclea polyandra (L.f.) E. Mey. ex Hiern.
Euclea undulata Thunb. var. *myrtina* (Burch.) Hiern
Diospyros dichrophylla (Gand.) De Winter
Diospyros galpinii (Hiern.) De Winter
Diospyros lycioides Desf. ssp. *guerkei* (Kuntze) De Winter
Diospyros lycioides Desf. ssp. *sericea* (Bernh.) De Winter
Diospyros natalensis (Harv.) Brenan ssp. *natalensis*
Diospyros scabrida (Harv. ex Hiern) De Winter var. *cordata* (E. Mey. ex A. DC.) De Winter
Diospyros scabrida (Harv. ex Hiern.) De Winter var. *scabrida*
Diospyros simii (Kuntze) De Winter
Diospyros villosa (L.) De Winter var. *villosa*
- OLEACEAE**
Schrebera alata (Hochst.) Welw.
Chionanthus foveolatus (E. Mey.) Stearn ssp. *foveolatus*
Chionanthus foveolatus (E. Mey.) Stearn ssp. *tomentellus* (Verdoorn) Stearn
Chionanthus peglerae (C.H. Wr.) Stearn
Olea capensis L. ssp. *capensis*
Olea capensis L. ssp. *enervis* (Harv. ex C.H. Wr.) Verdoorn
Olea capensis L. ssp. *macrocarpa* (C.H. Wr.) Verdoorn
Olea woodiana Knobl.
Jasminum multipartitum Hochst.
Jasminum streptopus E. Mey. var. *transvaalensis* (S. Moore) Verdoorn
- SALVADORACEAE**
Azima tetraacantha Lam.
- LOGANIACEAE**
Strychnos decussata (Pappe) Gilg
Strychnos henningsii Gilg.
Strychnos madagascariensis Poir.
- A. Abbott 2194, CPF
A. Abbott 1542, CPF
A. Abbott 3451, UNRH
A. Abbott 3451, CPF
A. Abbott 1154, UNRH
A. Abbott 2724, UNRH
A. Abbott 1931, UNRH
A. Abbott 4056, UNRH
A. Abbott 4048, UNRH
R.G. Strey 10329, PRE
R.G. Strey 7447, PRE
A. Abbott 1120, UNRH
A. Abbott 1495, UNRH
- A. Abbott 2273, UNRH
A. Abbott 1887, UNRH
A. Abbott 3726, PRE
A. Abbott 1200, UNRH
A. Abbott 1015, UNRH
A. Abbott 2011, UNRH
R.G. Strey 5856, PRE
A. Abbott 428, PRE
R.G. Strey 9848, PRE
- A. Abbott 1080, UNRH
A. Abbott 25, UNRH
A. Abbott 1924, UNRH
A. Abbott 1314, UNRH
A. Abbott 187, UNRH
- A. Abbott 1463, UNRH
- A. Abbott 1019, UNRH
A. Abbott 2262, UNRH
A. Abbott 307, UNRH
A. Abbott 72, UNRH
A. Abbott 2122, UNRH
A. Abbott 380, UNRH
- A. Abbott 1417, UNRH
A. Abbott 1231, UNRH
Biggs D.C. 185, PRE
A. Abbott 192, UNRH
A. Abbott 1210, UNRH
Van Wyk 3279, PRE
Pienaar, B.J. 794, PRE
A. Abbott 2115, UNRH
A. Abbott 1142, UNRH
A.T.D. Abbott 1884, PRE
- A. Abbott 1303, UNRH
A. Abbott 1946, UNRH
A. Abbott 31, UNRH
- A. Abbott 89, UNRH
A. Abbott 3075, UNRH
A. Abbott 964, UNRH
A. Abbott 2893, UNRH
Van Wyk 6126, PRE
A. Abbott 628, UNRH
A. Abbott 3508, UNRH
A. Abbott 1481, UNRH
A. Abbott 2067, UNRH
A. Abbott 1522, UNRH
- A. Abbott 1674, UNRH
- A. Abbott 2837, UNRH
A. Abbott 1440, UNRH
A. Abbott 1136, UNRH

Strychnos mitis S. Moore
Strychnos spinosa Lam.
Strychnos usambarensis Gilg
Nuxia congesta R. Br. ex Fresen
Nuxia floribunda Benth.
Buddleja dysophylla (Benth.) Radlk.
Buddleja saligna Willd.

GENTIANACEAE

Sebaea bojeri Griseb.
Sebaea grandis (E. Mey.) Steud
Sebaea rehmannii Schinz.
Chironia krebssii Griseb.
Chironia laxa Gilg

MENYANTHACEAE

Nymphoides indica (L.) Kuntze ssp. *occidentalis*

APOCYNACEAE

Acokanthera oblongifolia (Hochst.) Codd
Acokanthera oppositifolia (Lam.) Codd
Carissa bispinosa (L.) Desf. ex Brenan ssp. *bispinosa*
Carissa bispinosa (L.) Desf. ex Brenan ssp. *zambesiensis* Kupicha
Carissa wyliei N.E. Br.
Gonioma kamassi E. Mey.
Tabernaemontana ventricosa Hochst. ex A. DC.
Voacanga thouarsii Roem. & Schult.
Rauvolfia caffra Sond.
Oncinotis tenuiloba Stapf.
Strophanthus speciosus (Ward & Harv.) Reber

PERIPLOCAEAE

Tacazzea apiculata Oliv.
Petopentia natalensis (Schltr.) Bullock
Cryptolepis capensis Schltr.
Raphionacme sp. (=Wood 1849 NU; Hilliard & Burt 10142 NU)
Raphionacme galpinii Schltr.
Raphionacme palustris Venter & Verhoeven

ASCLEPIADACEAE

Xysmalobium involucreatum (E. Mey.) Decne
Xysmalobium orbiculare (E. Mey.) D. Dietr.
Schizoglossum atropurpureum E. Mey. ssp. *virens* (E. Mey.) Kupicha
Schizoglossum bidens E. Mey. ssp. *pachyglossum* (Schltr.) Kupicha
Aspidoglossum woodii (Schltr.) Kupicha
Pachycarpus asperifolius Meisn.
Pachycarpus concolor E. Mey.
Pachycarpus coronarius E. Mey.
Pachycarpus grandiflorus (L.f.) E. Mey. var. *grandiflorus*
Asclepias affinis (Schltr.) Schltr.
Asclepias albens (E. Mey.) Schltr.
Asclepias diploglossa (Turcz.) Druce
Asclepias dregeana Schltr. var. ?
Asclepias physocarpa (E. Mey.) Schltr.
Asclepias praemorsa Schltr.
Sarcostemma viminale (L.) R. Br.
Secamone alpini Schultes
Secamone filiformis (L.f.) J.H. Ross
Sisyranthus barbatus (Turcz.) N.E. Br.
Sisyranthus imberbis Harv.
Sisyranthus saundersiae N.E. Br.
Sisyranthus virgatus E. Mey.
Brachystelma australe R.A. Dyer
Brachystelma blepharathera Huber
Ceropegia camosa E. Mey.
Ceropegia racemosa N.E. Br. ssp. *setifera* (Schltr.) Huber
Riocreuxia torulosa Decne.
Orbea speciosa Leach
Tylophora anomala N.E. Br.
Tylophora flanagani Schltr.
Tylophora umbellata Schltr.
Telosma africana (N.E. Br.) N.E. Br.
Tenaris rubella E. Mey.

CONVOLVULACEAE

Cuscuta campestris Yunck. *

A. Abbott 1288, UNRH
A. Abbott 279, UNRH
A. Abbott 633, UNRH
A. Abbott 984, UNRH
A. Abbott 131/17, UNRH
A. Abbott 2044, UNRH
A. Abbott 1456, UNRH

A. Abbott 1713, UNRH
H.B. Nicholson 2248, PRE
A. Abbott 3458, UNRH
A. Abbott 4149, UNRH
A. Abbott 2248, UNRH

A. Abbott 2866, UNRH

A. Abbott 2508, UNRH
A. Abbott 2048, UNRH
A. Abbott 1379, UNRH
A. Abbott 4113, CPF
L.E.W. Codd 10711, PRE
A. Abbott 3949, CPF
Strey, R.G. 9885, PRE
A. Abbott 934, CPF
A. Abbott 3158, CPF
Edwards 1324, NU
A. Abbott 441, CPF

H.B. Nicholson 1786, PRE
A. Abbott 1241, UNRH
A. Abbott 1497, UNRH
A. Abbott 888, UNRH
A. Abbott 1623, UNRH
A. Abbott 2150, UNRH

A. Abbott 406, UNRH
A. Abbott 3556, UNRH
Nicholson 1846, PRE
A. Abbott 2548, UNRH
A. Abbott 2979, UNRH
A. Abbott 2242, UNRH
A. Abbott 1477, UNRH
A. Abbott 4049, UNRH
A. Abbott 673, UNRH
A. Abbott 2756, UNRH
Mantell & Vassilatos 131, PRE
A. Abbott 2868, UNRH
A. Abbott 3297, UNRH
A. Abbott 1276, UNRH
A. Abbott 748, PRE
A. Abbott 980, UNRH
A. Abbott 415, UNRH
A. Abbott s.n., CPF
A. Abbott 1011, UNRH
A. Abbott 2870, UNRH
A. Abbott 658, UNRH
A. Abbott 1692a, UNRH
A. Abbott 3454, UNRH
Strey 6973, PRE
A. Abbott 4195, UNRH
A. Abbott 3506, UNRH
A. Abbott s.n., CPF
R. Scott-shaw s.n., PRE
Van Jaarsveld, E.J. 3919, PRE
Strey 11130, PRE
A. Abbott 1409, UNRH
A. Abbott 857, UNRH
A. Abbott 2883, UNRH

H.B. Nicholson 1646, PRE

- Convolvulus natalensis* Bernh. ex Krauss. var. *natalensis*
Hewittia sublobata (L.f.) Kuntze
Ipomoea congesta R. Br. *
Ipomoea crassipes Hook.
Ipomoea mauritiana Jacq.
Ipomoea obscura (L.) Ker-Gawl. var. *fragilis* (Choisy) A. Meeuse
Ipomoea ommaneyi Rendle
Ipomoea purpurea (L.) Roth *
Ipomoea simplex Thunb.
Ipomoea wightii (Wall.) Choisy
- BORAGINACEAE**
Cordia caffra Sond.
Ehretia rigida (Thunb.) Druce
- VERBENACEAE**
Verbena bonariensis L. *
Verbena tenuisecta Briq. *
Verbena venosa Gill & Hook. *
Lantana camara L. *
Lantana rugosa Thunb.
Lippia javanica (Burm. f.) Spreng.
Priva meyeri Jaub. & Spach var. *meyeri*
Clerodendrum glabrum E. Mey. var. *glabrum*
Clerodendrum myricoides (Hochst.) Vatke
Clerodendrum triphyllum (Harv.) H. Pearson var. *triphyllum*
- LAMIACEAE**
Ajuga ophrydis Burch. ex Benth.
Teucrium kraussii Codd
Tinnea galpinii Briq.
Leonotis leonurus (L.) R. Br.
Leonotis ocymifolia (Burm. f.) Iwarsson var. *raineriana* (Visiani) Iwarsson
Stachys aethiopica L.
Stachys erectiuscula Guerke
Stachys gracilliflora Presl.
Hyptis pectinata (L.) Poit.
Aeollanthus parvifolius Benth.
Endostemon obtusifolius (E. Mey. ex Benth.) N.E. Br.
Pycnostachys reticulata (E. Mey.) Benth.
Plectranthus ambiguus (H. Bol.) Codd
Plectranthus ciliatus E. Mey. ex Benth.
Plectranthus ecklonii Benth.
Plectranthus emstii Codd
Plectranthus hadiensis (Forssk.) Schweinf. ex Spreng. var. *hadiensis*
Plectranthus hadiensis (Forssk.) Schweinf. ex Spreng. var. *woodii* (Guerke) Codd
Plectranthus hilliardiae Codd
Plectranthus aliciae (Codd) Van Jaarsv. & T.J. Edwards
Plectranthus oertendahlii Th. Fr. Jr.
Plectranthus petiolaris E. Mey. ex Benth.
Plectranthus saccatus Benth. var. *longitubus* Codd
Plectranthus saccatus Benth. var. *saccatus*
Plectranthus strigosus Benth.
Plectranthus verticillatus (L.f.) Druce
- Plectranthus zuluensis* T. Cooke
Rabdosiella calycina (Benth.) Codd
Syncolostemon argenteus N.E. Br.
Syncolostemon densiflorus Benth.
Syncolostemon eriocephalus Verdoorn
Syncolostemon parviflorus E. Mey. ex Benth. var. *lanceolatus* (Guerke) Codd
Syncolostemon parviflorus E. Mey. ex Benth. var. *parviflorus*
Syncolostemon ramulosus E. Mey. ex Benth.
Syncolostemon rotundifolius E. Mey. ex Benth.
Becium grandiflorum (Lam.) Pichi-Serm. var. *obovatum* (E. Mey. ex Benth.) Sebald
- SOLANACEAE**
Nicandra physaloides Gaertn. *
Physalis peruviana L. *
Solanum sp. c.f. R.G. Strey 10899
Solanum didyanthum Dun. var. *pluriflorum* Dun.
Solanum giganteum Jacq.
- A. Abbott 2173*, UNRH
A. Abbott 1720, UNRH
A. Abbott 1730, UNRH
A. Abbott 1724, UNRH
R.G. Strey 11122, PRE
A. Abbott 3498, UNRH
Crawford R. 375, PRE
A. Abbott 3540, UNRH
A. Abbott 2243, UNRH
A. Abbott 1191, UNRH
- A. Abbott 1319*, CPF
A. Abbott 1024, UNRH
- A. Abbott 918*, UNRH
A. Abbott 2772, UNRH
A. Abbott 1373, UNRH
A. Abbott 1893, UNRH
A. Abbott 3350, UNRH
A. Abbott 1071, UNRH
A. Abbott 3501, UNRH
A. Abbott 1565, UNRH
A. Abbott 3296, UNRH
A. Abbott 389, UNRH
- A. Abbott 194*, PRE
A. Abbott 768, UNRH
A.E. Van Wyk 3333, PRE
A. Abbott s.n., CPF
A. Abbott 1823, UNRH
A. Abbott 793, UNRH
A. Abbott 2154, UNRH
A. Abbott 1155, UNRH
A. Abbott 2747, UNRH
A. Abbott 10, UNRH
A. Abbott 2528, UNRH
A. Abbott 3071, UNRH
A. Abbott 1860, UNRH
A. Abbott 1794, UNRH
A. Abbott 1799, UNRH
A. Abbott 3553, UNRH
A. Abbott s.n., CPF
A. Abbott 1853, UNRH
- H.B. Nicholson 7350, PRE
A. Abbott 4372, UNRH
A. Abbott 1791, NH
A. Abbott 3537, UNRH
A. Abbott 1802, UNRH
A. Abbott 859, UNRH
A. Abbott 1014, UNRH
Van Jaarsveld, E.J. & Nichols, G. 3893, PRE
A. Abbott 1796, UNRH
A. Abbott 1102, UNRH
A. Abbott 1007, UNRH
A. Abbott s.n., CPF
Puff & Ill years WITS 57, J
A. Abbott 1703, UNRH
A. Abbott 920, UNRH
A. Abbott 3102, UNRH
A. Abbott 1585, UNRH
A. Abbott 121, UNRH
- A. Abbott 3945*, CPF
A. Abbott 2236, CPF
A. Abbott 4225, UNRH
A. Abbott 5493, UNRH
A. Abbott 3156, UNRH

- Solanum nodiflorum* Jacq.
Solanum retroflexum Dun.
Solanum terminale Forssk. var. *terminale*
Solanum tomentosum L.
Cestrum laevigatum Schlechtd.
- SCROPHULARIACEAE**
- Nemesia caerulea* Hiern.
Nemesia cynanchifolia Benth.
Dermatobotrys saundersii H. Bol.
Halleria lucida L.
Teedia lucida Rudolphi
Anastrabe integerrima E. Mey. ex Benth.
Sutera kraussiana (Bernh. ex Krauss) Hiern
Sutera pallescens Hiern.
Sutera polelensis Hiern. ssp. ?
Zaluzianskya sp. nov. (=Hilliard & Burt 12405)
Zaluzianskya angustifolia Hilliard & Burt
Zaluzianskya capensis (L.) Walp.
Zaluzianskya pachyrrhiza Hilliard & Burt
Craterostigma nanum (E. Mey. ex Benth.) Wettst. var. *nanum*
- SELAGINACEAE**
- Hebenstreitia comosa* Hochst.
Hebenstreitia dura Choisy
Selago elongata Hilliard
Selago lepidioides Rolfe
Selago woodii Rolfe
Melasma scabrum Berg.
Alectra orobanchoides Benth.
Alectra sessiliflora (Vahl.) Kuntze var. *sessiliflora*
Graderia scabra (L.f.) Benth.
Sopubia mannii Skan var. ?
Sopubia mannii Skan var. *nov.*
Sopubia simplex (Hochst.) Hochst.
Buchnera dura Benth.
Cycnium adonense E. Mey. ex Benth. ssp. *adonense*
Cycnium racemosum Benth.
Cycnium tubulosum (L.f.) Engl. ssp. *tubulosum*
Striga asiatica (L.) Kuntze
Striga bilabiata (Thunb.) Kuntze
Striga elegans Benth.
Harveya coccinea Schltr.
Harveya silvatica Hilliard & Burt
- BIGNONIACEAE**
- Tecomaria capensis* (Thunb.) Spach ssp. *capensis*
- PEDALIACEAE**
- Ceratotheca triloba* (Bernh.) Hook. f.
- GESNERIACEAE**
- Streptocarpus formosus* (Hilliard & Burt) T. Edwards
Streptocarpus haygarthii N.E. Br. ex C.B. Cl.
Streptocarpus polyanthus Hook. ssp. *polyanthus*
Streptocarpus porphyrostachys Hilliard
Streptocarpus prolixus C.B. Cl.
- LENTIBULARIACEAE**
- Genlisea hispidula* Stapf
Utricularia arenaria A. DC
Utricularia firmula Oliv.
Utricularia livida E. Mey.
Utricularia prehensilis E. Mey.
Utricularia sandersonii Oliv.
- ACANTHACEAE**
- Thunbergia atriplicifolia* E. Mey. ex Nees
Thunbergia dregeana Nees
Thunbergia natalensis Hook.
Thunbergia purpurata Harv. ex C.B. Cl.
Phaulopsis imbricata (Forssk.) Sweet
Chaetacanthus burchellii Nees
Chaetacanthus costatus Nees
Chaetacanthus setiger (Pers.) Lindl.
Ruellia malacophylla C.B. Cl.
Crabbea hirsuta Harv.
- A. Abbott 803, UNRH
A. Abbott 854, UNRH
A. Abbott 2258, UNRH
A. Abbott 1073, UNRH
A. Abbott 1728, UNRH
- A. Abbott 2740, UNRH
A. Abbott 1413, UNRH
Van Wyk & Venter 1695, PRE
A. Abbott 1149, UNRH
A. Abbott 4414, NH
A. Abbott 22, UNRH
Edwards 1323, NU
A. Abbott 1580, UNRH
A. Abbott 3320, UNRH
A. Abbott 908, UNRH
A. Abbott 3475, UNRH
A. Abbott 150, UNRH
A. Abbott 1597, UNRH
A. Abbott 3477, UNRH
- A.T.D. Abbott 221, PRE
A. Abbott 2153, UNRH
A. Abbott 2291, UNRH
A. Abbott 2104, UNRH
A. Abbott 243, UNRH
A. Abbott 1824, UNRH
A. Abbott 951, UNRH
A. Abbott 3472, UNRH
A. Abbott 3994, UNRH
A. Abbott s.n., CPF
A. Abbott 3455, UNRH
C.R. Scott-Shaw 1641, CPF
A. Abbott 2999, UNRH
A. Abbott 2768, UNRH
A. Abbott 1502, UNRH
A. Abbott 2784, UNRH
A. Abbott 3057, UNRH
A. Abbott 604, UNRH
A. Abbott 1006, UNRH
A. Abbott 2772, UNRH
A. Abbott 2192, UNRH
- A. Abbott 1100, UNRH
- A. Abbott 2253, UNRH
- Hilliard 1133, NU
A. Abbott 2329, UNRH
A. Abbott 663, UNRH
Hilliard 3052 Holotype, NU
A. Abbott 2227, CPF
- A. Abbott 1668, UNRH
A. Abbott 1636, UNRH
A. Abbott 1659, UNRH
A. Abbott 1667, UNRH
A. Abbott 1741, UNRH
A. Abbott 1666, UNRH
- A. Abbott 361, UNRH
A. Abbott 2226, UNRH
Germishuizen 1711, UNRH
A. Abbott 1602, PRE
Germishuizen 8045, PRE
A. Abbott 667, UNRH
Edwards, T.J. 90, PRE
Codd, L.E.W. 10698, PRE
A. Abbott 351, UNRH
A. Abbott 3500, UNRH

- Crabbea nana* Nees
Barleria gueinzii Sond.
Barleria meyeriana Nees
Barleria obtusa Nees
Sclerochiton harveyanus Nees
Asystasia gangetica (L.) T. Anders.
Asystasia varia N.E. Br.
Peristrophe cernua Nees
Hypoestes aristata (Vahl.) Soland. ex Roem. & Schult. var. *aristata*
Hypoestes forskalii (Vahl) R. Br.
Mackaya bella Harv.
Siphonoglossa leptantha (Nees) Immelman ssp. *leptantha*
Rhinacanthus gracilis Klotzsch
Duvermoia adhatodoides E. Mey. ex Nees
Ruttya ovata Harv.
Isoglossa ciliata (Nees) Lindau
Isoglossa cooperi C.B. Cl.
Isoglossa delicatula C. B. Cl.
Isoglossa hypoestiflora Lindau
Isoglossa ovata (Nees) Lindau
Isoglossa stipitata C.B. Cl.
Isoglossa woodii C.B. Cl.
Justicia campylostemon (Nees) T. Anders.
Justicia petiolaris (Nees) T. Anders. ssp. *petiolaris*
Justicia protracta (Nees) T. Anders. ssp. *protracta*
PLANTAGINACEAE
Plantago lanceolata L. *
Plantago longissima Decne.
RUBIACEAE
Kohautia amatymbica Eckl. & Zeyh.
Conostomium natalense (Hochst.) Brem. var. *glabrum* Brem.
Conostomium natalense (Hochst.) Brem. var. *natalense*
Agathisanthemum chlorophyllum (Hochst.) Brem. var. *chlorophyllum*
Oldenlandia affinis (Roem. & Schult.) DC. ssp. ?
Oldenlandia cephalotes (Hochst.) Kuntze
Oldenlandia corymbosa L. var. *caespitosa* (Benth.) Verdc.
Oldenlandia herbacea (L.) Roxb. var. ?
Oldenlandia rosulata K. Schum. var. *rosulata*
Oldenlandia tenella (Hochst.) Kuntze
Tarrena pavettoides (Harv.) Sim ssp. *pavettoides*
Burchellia bubalina (L.f.) Sims
Mitrostigma axillare Hochst.
Catunaregam spinosa (Thunb.) Tirvengadam ssp. *spinosa*
Coddia rudis (E. Mey. ex Harv.) Verdc.
Gardenia thunbergia Thunb.
Rothmannia capensis Thunb.
Rothmannia globosa (Hochst.) Keay
Hyperacanthus amoenus (Sims) Bridson
Oxyanthus speciosus DC. ssp. *gerrardii* (Sond.) Bridson
Tricalysia capensis (Meisn. ex Hochst.) Sim var. *capensis*
Tricalysia lanceolata (Sond.) Burt Davy
Alberta magna E. Mey.
Pentanisia angustifolia (Hochst.) Hochst.
Pentanisia prunelloides (Klotzsch ex Eckl. & Zeyh.) Walp. ssp. *latifolia* (Hochst.) Verdc.
Vangueria infausta Burch. ssp. *infausta*
Vangueria randii S. Moore ssp. *chartacea* (Robyns) Verdc.
Eriosemopsis subanisophylla Robyns
Canthium sp. nov. (=Cooper 100)
Canthium sp. (=Acocks 13262)
Canthium sp. c.f. *C. ciliatum* (Klotzsch) Kuntze
Canthium ciliatum (Klotzsch) Kuntze
Canthium inerme (L.f.) Kuntze
Canthium mundianum Cham. & Schlechtd.
Canthium spinosum (Klotzsch) Kuntze
Canthium suberosum Codd.
Canthium vanwykii Tilney & Kok
Psydrax obovata (Eckl. & Zeyh.) Bridson ssp. *obovata*
Keetia gueinzii (Sond.) Bridson
Pachystigma sp. c.f. *P. bowkeri*
A. Abbott 926, UNRH
A. Abbott 1840, UNRH
A. Abbott 1955, UNRH
A. Abbott 1951, UNRH
A. Abbott 774, UNRH
A. Abbott 1716, UNRH
A. Abbott 2330, UNRH
A. Abbott 1144, UNRH
A. Abbott 1841, UNRH
Germishuizen 8078, PRE
A. Abbott 1391, UNRH
Nicholson 2173, PRE
A. Abbott 1140, UNRH
A. Abbott 6, UNRH
A. Abbott 2324, UNRH
A. Abbott 914, UNRH
A. Abbott 2959, UNRH
A. Abbott 1008, UNRH
K. Balkwill 344, UNRH
A. Abbott 2984, UNRH
A. Abbott 1856, UNRH
A. Abbott 4196, UNRH
A. Abbott 20, UNRH
Acocks 10894, PRE
Nicholson 1088, PRE
A. Abbott 2256, UNRH
A. Abbott 2293, UNRH
A.T.D. Abbott 309, UNRH
A.T.D. Abbott 884, UNRH
Puff, C. 84082122, PRE
A.T.D. Abbott 2833, UNRH
A.T.D. Abbott s.n., CPF
A.T.D. Abbott 879, UNRH
A.T.D. Abbott 2980, UNRH
A.T.D. Abbott 1803, UNRH
A.T.D. Abbott 899, UNRH
A.T.D. Abbott 643, UNRH
C.R. Scott-Shaw 1545, CPF
A.T.D. Abbott 1614, UNRH
A.T.D. Abbott 229, PRE
A.T.D. Abbott 579, UNRH
A.T.D. Abbott 303, UNRH
Venter, S. 1006, PRE
A.T.D. Abbott 1607, UNRH
A.T.D. Abbott 1095, UNRH
K. Balkwill 5408, CPF
A.T.D. Abbott 1545, UNRH
A.T.D. Abbott 1270, UNRH
A.T.D. Abbott 2785, UNRH
A.T.D. Abbott 27, UNRH
A.T.D. Abbott 2305, UNRH
A.T.D. Abbott 1139, UNRH
A.T.D. Abbott 620, UNRH
A.T.D. Abbott s.n., CPF
A.T.D. Abbott 2517, UNRH
A.T.D. Abbott 1301, UNRH
A.T.D. Abbott 1308, UNRH
A.T.D. Abbott 1371, UNRH
A.T.D. Abbott 775, UNRH
A.T.D. Abbott 1461, UNRH
A.T.D. Abbott 3352, UNRH
A.T.D. Abbott 1321, UNRH
A.T.D. Abbott 1182, PRU
Tilney, P. 180, PRE
Tilney, P. 179, PRE
A.T.D. Abbott 70, PRE
A.T.D. Abbott 2763, UNRH

- Pachystigma* sp. (=Moll 4989)
Pachystigma cymosum Robyns
Pachystigma macrocalyx (Sond.) Robyns
Pavetta bowkeri Harv.
Pavetta capensis (Houtt.) Brem. ssp. *komghensis* (Brem.) Kok
Pavetta galpinii Brem.
Pavetta inandensis Brem.
Pavetta lanceolata Eckl.
Pavetta natalensis Sond.
Pavetta revoluta Hochst.
Psychotria capensis (Eckl.) Vatke ssp. *capensis* var. *capensis*
Galopina circaeoides Thunb.
Galopina tomentosa Hochst.
Anthospermum galpinii Schltr.
Anthospermum galpinii Schltr.
Anthospermum herbaceum L.f.
Anthospermum hispidulum E. Mey. ex Sond.
Anthospermum streyi Puff
Richardia brasiliensis Gomes *
Spermaceoce natalensis Hochst.
Rubia cordifolia L. ssp. *conotricha* (Gand.) Verdc.
DIPSACACEAE
Cephalaria sp. (=Strey 8366)
Cephalaria oblongifolia (Kuntze) Szabo.
Scabiosa columbaria L.
CUCURBITACEAE
Gerrardanthus tomentosus Hook. f.
Zehneria parvifolia (Cogn.) J.H. Ross
Zehneria scabra (L.f.) Sond. ssp. *scabra*
Momordica foetida Schumach.
Cucumis hirsutus Sond.
Cucumis zeyheri Sond.
Lagenaria sphaerica (Sond.) Naud.
Coccinia palmata (Sond.) Cogn.
CAMPANULACEAE
Roella glomerata A. DC.
Wahlenbergia huttonii (Sond.) Thulin
Wahlenbergia madagascariensis A. DC.
Wahlenbergia undulata (Thunb.) A. DC.
LOBELIACEAE
Cyphia elata Harv. var. ?
Lobelia anceps L.f.
Lobelia chinensis Lour. *
Lobelia coronopifolia L.
Lobelia erinus L.
Lobelia flaccida (Presl.) A. DC. ssp. *flaccida*
Lobelia malowensis E. Wimm.
Lobelia pteropoda (Presl) A. DC.
Lobelia tomentosa L.f.
Monopsis scabra (Thunb.) Urb.
Monopsis stellaroides (Presl.) Urb. ssp. *stellaroides*
Grammatotheca bergiana (Cham.) Presl var. *bergiana*
ASTERACEAE
Vernonia sp. c.f. *V. capensis* (Houtt.) Druce
Vernonia angulifolia DC.
Vernonia anisochaetoides Sond.
Vernonia capensis (Houtt.) Druce
Vernonia crataegifolia Hutch.
Vernonia dregeana Sch. Bip.
Vernonia galpinii Klatt
Vernonia hirsuta (DC.) Sch. Bip.
Vernonia natalensis Sch. Bip. ex Walp.
Vernonia neocorymbosa Hilliard
Vernonia oligocephala (DC.) Sch. Bip. ex Walp.
Adenostemma viscosum J.R. Forst. & G. Forst.
Ageratum conyzoides L. *
Ageratum houstonianum Mill. *
Chromolaena odorata (L.) R.M. King & H. Robinson *
Mikania capensis DC.
Mikania natalensis DC.
A.T.D. Abbott 630, UNRH
A.T.D. Abbott 1584, UNRH
A.T.D. Abbott 372, UNRH
A.T.D. Abbott 622, UNRH
A.T.D. Abbott 1488, UNRH
A.T.D. Abbott 610, UNRH
H.B. Nicholson 1955, PRE
A.T.D. Abbott 1032, UNRH
A.T.D. Abbott 855, UNRH
Crawford 377, PRE
A.T.D. Abbott 14, PRE
A.T.D. Abbott 885, UNRH
Puff, C. 84082322, PRE
A.T.D. Abbott 237, PRE
E.J. MOLL 5497, PRE
A.T.D. Abbott 792, UNRH
H.B. Nicholson 988, UNRH
A.T.D. Abbott 2316, UNRH
A.T.D. Abbott 2995, UNRH
A.T.D. Abbott 201, UNRH
A.T.D. Abbott 2118, UNRH
A. Abbott 2946, UNRH
A. Abbott 1671, UNRH
A. Abbott 1056, UNRH
A. Abbott 3554, UNRH
A. Abbott s.n., UNRH
A. Abbott 4226, UNRH
A. Abbott s.n. CPF
A. Abbott 3269, UNRH
A. Abbott 876, UNRH
A. Abbott 1562, UNRH
A. Abbott 1758, UNRH
A. Abbott 1650, PRE
A. Abbott 1928, PRE
A. Abbott 2981, UNRH
A. Abbott 2319, CPF
A. Abbott 809, UNRH
Nicholson 2060, PRE
A. Abbott 662, UNRH
A. Abbott 109, PRE
A. Abbott 1903, UNRH
Nicholson 998, PRE
Edwards, T.J. 848, PRE
B.D. Schrire 1432, PRE
G. Germishuizen 8046, PRE
A. Abbott 2193, UNRH
A. Abbott 901, UNRH
A. Abbott 2603, UNRH
A. Abbott 2951, PRE
A. Abbott 1096, UNRH
A. Abbott 2692, UNRH
A. Abbott 1450, UNRH
H.B. Nicholson 1475, PRE
A. Abbott 1092, UNRH
A. Abbott 261, PRE
A. Abbott 311, UNRH
A. Abbott 365, UNRH
A. Abbott 1620, UNRH
A. Abbott 310, UNRH
Edwards, T.J. 873, PRE
Van Wyk 1678, PRE
A. Abbott 1718, UNRH
Van Wyk 1679, PRE
Germishuizen 1841, PRE
A. Abbott 1247, UNRH

- Aster bakeranus* Burt Davy ex C.A. Smith
Aster harveyanus Kuntze
Aster squamatus (Spreng.) Hieron. *
Felicia erigeroides DC.
Felicia filifolia (Vent.) Burt Davy ssp. *filifolia*
Nidorella auriculata DC.
Conyza attenuata DC.
Conyza obscura DC.
Conyza scabrata DC.
Brachylaena discolor DC. var. *discolor*
Brachylaena glabra (L.f.) Druce
Brachylaena uniflora Harv.
Tarchonanthus camphoratus L.
Tarchonanthus trilobus DC. var. *trilobus*
Blumea cafra (DC.) O. Hoffm.
Blumea mollis (D. Don.) Merrill
Plecostachys polifolia (Thunb.) Hilliard & Burt
Plecostachys serpyllifolia (Berg.) Hilliard & Burt
Pseudognaphalium luteo-album (L.) Hilliard & Burt
Tenryhnea phyllicifolia (DC.) Hilliard & Burt
Helichrysum sp. c.f. *H. odoratissimum* (L.) Sweet
Helichrysum sp.
Helichrysum acutatatum DC.
Helichrysum adenocarpum DC. ssp. *adenocarpum*
Helichrysum allioides Less.
Helichrysum appendiculatum (L.f.) Less.
Helichrysum asperum (Thunb.) Hilliard & Burt var. ?
Helichrysum aureum (Houtt.) Merr. var. ?
Helichrysum aureum (Houtt.) Merr. var. *aureum*
Helichrysum aureum (Houtt.) Merr. var. *monocephalum* (DC.) Hilliard
Helichrysum auriceps Hilliard
Helichrysum chionosphaerum DC.
Helichrysum cymosum (L.) D. Don ssp. *cymosum*
Helichrysum decorum DC.
Helichrysum diffusum DC.
Helichrysum ecklonis Sond.
Helichrysum felinum Less.
Helichrysum griseum Sond.
Helichrysum herbaceum (Andr.) Sweet
Helichrysum infaustum Wood & Evans
Helichrysum krebsianum Less.
Helichrysum lepidissimum S. Moore
Helichrysum longifolium DC.
Helichrysum mimetes S. Moore
Helichrysum mixtum (Kuntze) Moeser var. *mixtum*
Helichrysum natalitium DC.
Helichrysum nudifolium (L.) Less.
Helichrysum oxyphyllum DC.
Helichrysum pallidum DC.
Helichrysum panduratum O. Hoffm. var. *panduratum*
Helichrysum pannosum DC.
Helichrysum pilosellum (L. f.) Less.
Helichrysum platypterum DC.
Helichrysum populifolium DC.
Helichrysum ruderale Hilliard & Burt
Helichrysum simillimum DC.
Helichrysum spiralepis Hilliard & Burt
Helichrysum subglomeratum Less.
Stoebe vulgaris Levyns
Disparago ericoides (Berg.) Gaertn.
Relhania pungens L'Herit. ssp. *angustifolia* (DC.) Bremer
Athrixia phyllicoides DC.
Anisochaeta mikanioides DC.
Callilepis laureola DC.
Acanthospermum glabratum (DC) Wild *
Acanthospermum hispidum DC. *
Ambrosia artemisiifolia L. *
Xanthium strumarium L. *
Sigesbeckia orientalis L. *
Spilanthes mauritiana (Pers.) DC.
- A. Abbott 240, UNRH
 A. Abbott 1240, UNRH
 A. Abbott 3512, UNRH
 A. Abbott 1917, UNRH
 A. Abbott 1368, UNRH
 A. Abbott 1918, UNRH
 A. Abbott 3965/2, PRE
 A. Abbott 1849, PRE
 A. Abbott 1111, PRE
 Biggs, D.C. 184, PRE
 A. Abbott 1192, UNRH
 A. Abbott 3958, UNRH
 A. Abbott 2307, UNRH
 A. Abbott 1645, UNRH
 A. Abbott 2816, UNRH
 A. Abbott 2715, CPF
 A. Abbott 4170, UNRH
 A. Abbott 390, UNRH
 A. Abbott 112, CPF
 A. Abbott s.n., CPF
 A. Abbott 405, UNRH
 A. Abbott 4348, UNRH
 A. Abbott 1474, UNRH
 A. Abbott 862, UNRH
 A. Abbott 140, PRE
 A. Abbott 991, UNRH
 A. Abbott 3351, UNRH
 Abbott 106, UNRH
 Strey 9846, PRE
 A. Abbott 1184, UNRH
 A. Abbott 110, UNRH
 A. Abbott 2121, UNRH
 A. Abbott 594, UNRH
 A. Abbott 4089, UNRH
 A. Abbott 4146, UNRH
 A. Abbott 224, UNRH
 H.B. Nicholson 11302, UNRH
 A. Abbott 318, UNRH
 A. Abbott 9216, UNRH
 A. Abbott 932, UNRH
 A. Abbott 2831, UNRH
 A. Abbott 2010, UNRH
 A. Abbott 554, UNRH
 A. Abbott 236, UNRH
 Nicholson 1903, PRE
 A. Abbott 1708, UNRH
 A. Abbott 1134, UNRH
 A. Abbott 1510, UNRH
 A. Abbott 198, UNRH
 A. Abbott 2835, UNRH
 A. Abbott 3068, PRE
 A. Abbott 233, PRE
 A. Abbott 989, UNRH
 A. Abbott 48, UNRH
 A. Abbott 193, UNRH
 A. Abbott 1103, UNRH
 A. Abbott 1495, UNRH
 A. Abbott 1081, UNRH
 Van Wyk 6114, PRE
 A. Abbott 1929, UNRH
 A. Abbott 184, UNRH
 A. Abbott 113, UNRH
 A. Abbott s.n., UNRH
 A. Abbott 3267, UNRH
 A. Abbott 2997, UNRH
 A. Abbott 2602, UNRH
 A. Abbott 1098, UNRH
 A. Abbott 1894, UNRH
 A. Abbott 1905, UNRH
 A. Abbott 3058, CPF

- Tagetes minuta* L. *
Inulanthera calva (Hutch.) Kallersjö
Inulanthera leucoclada (DC.) Kallersjö
Phymaspermum acerosum (DC.) Kallersjö
Phymaspermum villosum (Hilliard) Kallersjö
Matricaria nigellifolia DC. var. *nigellifolia*
Hilliardia zuurbergensis (Oliv.) B. Nord.
Schistostephium crataegifolium (DC.) Fenzl ex Harv.
Schistostephium heptalobum (DC.) Oliv. & Hiern.
Artemisia afra Jacq. ex Willd.
Pentzia incana (Thunb.) Kuntze
Lopholaena dregeana DC.
Crassocephalum crepidioides (Benth.) S. Moore
Crassocephalum x picridifolium (DC.) S. Moore
Cineraria sp. c.f. *C. albicans* N.E. Br.
Cineraria sp.
Cineraria albicans N.E. Br.
Cineraria geraniifolia DC.
Senecio sp.
Senecio albanopsis Hilliard
Senecio brevidentatus M. D. Henderson
Senecio bryoniifolius Harv.
Senecio bupleuroides DC.
Senecio caudatus DC.
Senecio chrysocoma Meerb.
Senecio citriceps Hilliard & Burt
Senecio coronatus (Thunb.) Harv.
Senecio decurrens DC.
Senecio deltoideus Less.
Senecio discodregeanus Hilliard & Burt
Senecio erubescens Ait. var. *incisus* DC.
Senecio glaberrimus DC.
Senecio glanduloso-lanosus Thell.
Senecio helminthioides (Sch. Bip.) Hilliard
Senecio latifolius DC.
Senecio macrocephalus DC.
Senecio madagascariensis Poir.
Senecio medley-woodii Hutch.
Senecio natalicola Hilliard
Senecio oxyodontus DC.
Senecio oxyriifolius DC.
Senecio polyanthemoides Sch. Bip.
Senecio ryncholaenus DC.
Senecio serratuloides DC.
Senecio speciosus Willd.
Senecio variabilis Sch. Bip.
Euryops brevipapposus M.D. Henderson
Euryops leiocarpus (DC.) B. Nord.
Othonna natalensis Sch. Bip.
Osteospermum sp. (= Strey 8891 & 5908)
Osteospermum fruticosum (L.) Nord.
Osteospermum imbricatum L. ssp. *nervatum* (DC.) Nord. var. *helichrysoides* (DC.) Nord
Osteospermum imbricatum L. ssp. *nervatum* (DC.) Nord. var. *nervatum*
Chrysanthemoides monilifera (L.) T. Norl. ssp. *rotundata* (DC.) T. Norl.
Ursinia tenuiloba DC.
Gazania krebsiana Less.
Gazania linearis (Thunb.) Druce var. *linearis*
Berkheya bergiana Soederb.
Berkheya bipinnatifida (Harv.) Roessl. ssp. *bipinnatifida*
Berkheya erysithales (DC.) Roessl.
Berkheya insignis (Harv.) Thell.
Berkheya rhapontica (DC.) Hutch. & Burt Davy ssp. *rhapontica*
Berkheya setifera DC.
Berkheya speciosa (DC.) O. Hoffm. ssp. *speciosa*
Berkheya umbellata DC.
Gerbera ambigua (Cass.) Sch. Bip.
Gerbera piloselloides (L.) Cass.
Gerbera viridifolia (DC.) Sch. Bip. ssp. *natalensis* (Sch. Bip.) Hansen
Tolpis capensis (L.) Sch. Bip.
- A. Abbott 1855, CPF
 A. Abbott 5265a, UNRH
 A. Abbott s.n., CPF
 Nicholson 1014, PRE
 A. Abbott 2894, UNRH
 A. Abbott 2814, UNRH
 R.G. Strey 8720, PRE
 Germishuizen 8071, PRE
 A. Abbott 1837, UNRH
 A. Abbott 1025, CPF
 Nicholson 1473, PRE
 C.R. Scott-Shaw 1560, CPF
 Nicholson 1556, PRE
 A. Abbott 1691, UNRH
 A. Abbott 1854, UNRH
 A. Abbott 1885, UNRH
 K. Balkwill 5409, J
 C.R. Scott-Shaw 1437, CPF
 A. Abbott 4413, UNRH
 A. Abbott 3545, UNRH
 A. Abbott 308c, UNRH
 A. Abbott 2572, UNRH
 A. Abbott 197, UNRH
 A. Abbott 4409, UNRH
 A. Abbott 200, UNRH
 A. Abbott 1194, UNRH
 A. Abbott 2169, UNRH
 A. Abbott 2821, UNRH
 A. Abbott 3931, UNRH
 A. Abbott 955, UNRH
 A. Abbott 924, UNRH
 A. Abbott 196, PRE
 A. Abbott s.n., UNRH
 A. Abbott 1920, UNRH
 A. Abbott 341, CPF
 A. Abbott 1328, UNRH
 A. Abbott 111, UNRH
 A. Abbott 1086, UNRH
 Strey 6899, PRE
 Germishuizen 1849, PRE
 A. Abbott 2093, UNRH
 A. Abbott 1112, UNRH
 A. Abbott 216, UNRH
 A. Abbott 1075, UNRH
 Nicholson 1346, PRE
 A. Abbott 2174, UNRH
 A. Abbott 182, UNRH
 A. Abbott 687, UNRH
 A. Abbott 146, PRE
 A. Abbott 2088, UNRH
 Hilliard 1671, NU
 Hilliard & Burt 6757, PRE
 Germishuizen 8084, PRE
 A. Abbott 3751, UNRH
 A. Abbott 1210, UNRH
 A. Abbott 4050, UNRH
 A. Abbott 1447, UNRH
 A. Abbott 3665, UNRH
 A. Abbott 1068, UNRH
 A. Abbott 1915, UNRH
 A. Abbott 343, UNRH
 Nicholson 1195, PRE
 A. Abbott 2733, UNRH
 A. Abbott 115, PRE
 A. Abbott 2176, UNRH
 A. Abbott 181, UNRH
 A. Abbott 366, UNRH
 A. Abbott 2040, UNRH
 A. Abbott 2168, CPF

- Hypochoeris radicata* L. *
- Sonchus oleraceus* L. *
- Lactuca capensis* Thunb.
- POACEAE**
- Ischaemum fasciculatum* Brongn.
- Urelytrum agropyroides* (Hack.) Hack.
- Phacelurus franksiae* (J.M. Wood) Clayton
- Elionurus muticus* (Spreng.) Kunth
- Miscanthus capensis* (Nees) Anderss.
- Miscanthus junceus* (Stapf.) Gilg.
- Eriochrysis pallida* Munro
- Eulalia villosa* (Thunb.) Nees
- Schizachyrium sanguineum* (Retz.) Alst.
- Andropogon appendiculatus* Nees.
- Andropogon eucomus* Nees.
- Andropogon festuciformis* Randle
- Cymbopogon* sp.
- Cymbopogon excavatus* (Hochst.) Stapf ex Burt Davy
- Cymbopogon validus* (Stapf) Stapf ex Burt Davy
- Hyparrhenia cymbaria* (L.) Stapf.
- Hyparrhenia filipendula* (Hochst.) Stapf var. *pilosa* (Hochst.) Stapf
- Hyparrhenia schimperii* (Hochst. ex A. Rich.) Anderss. ex Stapf.
- Monocymbium ceresiiforme* (Nees) Stapf
- Trachypogon spicatus* (L.f.) Kuntze
- Diheteropogon amplexens* (Nees) Clayton
- Diheteropogon filifolius* (Nees) Clayton
- Themeda triandra* Forssk.
- Digitaria diagonalis* (Nees) Stapf var. *diagonalis*
- Digitaria natalensis* Stent
- Digitaria setifolia* Stapf.
- Alloteropsis semialata* (R. Br.) Hitch. ssp. *eckloniana* (Nees) Gibbs Russel
- Pseudechinolaena polystachya* (Kunth) Stapf
- Eriochloa meyeriana* (Nees) Pilg. ssp. *meyeriana*
- Paspalum dilatatum* Poir. *
- Paspalum scrobiculatum* L.
- Paspalum urvillei* Steud. *
- Echinochloa pyramidalis* (Lam.) Hitchc. & Chase
- Opismenus hirtellus* (L.) Beauv.
- Panicum deustum* Thunb.
- Panicum dregeanum* Nees
- Panicum ecklonii* Nees
- Panicum hymenochilum* Nees
- Setaria lindenbergiana* (Nees) Stapf.
- Setaria sphacelata* (Schumach.) Moss var. *sericea* (Stapf) Clayton
- Setaria sphacelata* (Schumach.) Moss var. *sphacelata*
- Melinis nerviglumis* (Franch.) Zizka
- Prosphytochloa prehensilis* (Nees) Schweick.
- Leersia tisserantii* (A. Chev.) Launert
- Phalaris aquatica* L. *
- Olyra latifolia* L. *
- Arundinella nepalensis* Trin.
- Tristachya leucothrix* Nees
- Trichopteryx dregeana* Nees
- Loudetia simplex* (Nees) C.E. Hubb.
- Phragmites australis* (Cav.) Steud.
- Phragmites mauritianus* Kunth
- Agrostis lachnantha* Nees. var. *lachnantha*
- Aristida adscensionis* L.
- Aristida canescens* Henr. ssp. *ramosa* De Winter
- Aristida junciformis* Trin. & Rupr. ssp. *junciformis*
- Sporobolus* sp.
- Sporobolus centrifugus* (Trin.) Nees
- Sporobolus subtilis* Kunth
- Eragrostis acraea* De Winter
- Eragrostis capensis* (Thunb.) Trin.
- Eragrostis curvula* (Schrad.) Nees
- Eragrostis inamoena* K. Schum.
- Eragrostis plana* Nees
- Eragrostis racemosa* (Thunb.) Steud.
- Eragrostis tenuifolia* (A. Rich.) Steud.
- A. Abbott 2217, CPF
- A. Abbott 1091, CPF
- A. Abbott 1848, UNRH
- A. Abbott 3003, UNRH
- Wits 31, UNRH
- A. Abbott 2782, UNRH
- Van Wyk 1504, PRE
- A. Abbott 2510, UNRH
- A. Abbott 2860, UNRH
- A. Abbott 2766, UNRH
- PCV DuToit 2364, PRE
- A. Abbott 2957, UNRH
- Van Wyk 5406, PRE
- A. Abbott 1626, UNRH
- A. Abbott 2737, UNRH
- A. Abbott 735, UNRH
- A. Abbott 4107, PRE
- A. Abbott 752, UNRH
- Du Toit 928, PRE
- A. Abbott 2960, UNRH
- A. Abbott 2750, UNRH
- A. Abbott 921a, UNRH
- A. Abbott 2315, UNRH
- WITS 4, UNRH
- A. Abbott 316, UNRH
- A. Abbott 289, UNRH
- WITS 16, UNRH
- A. Abbott 736, UNRH
- A. Abbott 396, UNRH
- A. Abbott 315, UNRH
- Ellis 379, PRE
- Ellis 3784, PRE
- Wits 8, UNRH
- Wits 7, UNRH
- A. Abbott 734, UNRH
- A. Abbott 4093, UNRH
- A. Abbott 1786, UNRH
- A. Abbott 2752, UNRH
- Du Toit 2363, PRE
- A. Abbott 2818, UNRH
- A. Abbott 4222, UNRH
- A. Abbott 2900, UNRH
- A. Abbott 2939, UNRH
- A. Abbott 436, UNRH
- A. Abbott 2819, UNRH
- A. Abbott 34, UNRH
- No collector's name or number, PRE
- Ellis 3782, PRE
- Nicholson 1398, PRE
- A. Abbott 3069, UNRH
- A. Abbott 285, UNRH
- A. Abbott 1105, UNRH
- A. Abbott s.n., UNRH
- A. Abbott 1904, UNRH
- A. Abbott 132, UNRH
- A. Abbott 2723, UNRH
- H.B. Stephens 109, PRE
- s.n., PRE
- A. Abbott 3064, UNRH
- A. Abbott 358, UNRH
- A. Abbott 319, UNRH
- A. Abbott 2735, UNRH
- WITS 3, UNRH
- A. Abbott 288, UNRH
- WITS 20, UNRH
- A. Abbott 2762, UNRH
- A. Abbott 734, UNRH
- A. Abbott 750, UNRH
- Du Toit 926, PRE

Rendlia altera (Rendle) Chiov.
Ctenium concinnum Nees
Chloris gayana Kunth
Dactyloctenium australe Steud.
Stiburus alopeuroides (Hack.) Stapf.
Festuca costata Nees

A. Abbott 317, UNRH
WITS 30, UNRH
A. Abbott 2751, UNRH
A. Abbott 808, UNRH
A. Abbott 1058, UNRH
Nicholson 1581, PRE