TAXONOMY OF THE GENUS *LYCIUM* L. (SOLANACEAE) IN AFRICA

by

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Submitted in fulfillment of the requirements
for the degree

PHILOSOPHIAE DOCTOR (BOTANY)

in the Faculty of Natural and Agricultural Sciences
(Department of Botany and Genetics)

University of the Orange Free State
Bloemfontein

June 2000

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L. afrum (Photograph by AM Venter)

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CHAPTER 1

INTRODUCTION

The Solanaceae, a cosmopolitan family, occurring mainly in tropical to temperate environment, consists of 96 genera and about 2 300 species (D'Arcy 1991). The centre of origin of this family was evidently western Gondwanaland, more specifically Argentina in South America (Symon 1991), and biogeographical evidence also suggests a pre-Gondwanaland origin (Chiang 1981). This region is the unquestioned centre of diversity of the Solanaceae as well (D'Arcy 1979, Hunziker 1979).

Only five genera of the Solanacious are indigenous to Africa. These are *Lycium* L. and *Solanum* L., both genera widespread and species rich; *Discopodium* Hochst., a monospecific genus with disjunct distribution on the high, tropical mountains; *Triguera* Cav., another monospecific genus restricted to the Pillars of Hercules (D'Arcy 1991) and *Nicotiana* L. with one species, *N. africana* Merxm., in Namibia (Symon 1991). The widespread and well known genera, *Datura* L. and *Physalis* L., are not indigenous but were introduced into "the Old World" from the Americas soon after the European discovery of that continent in the 1500's (Symon & Haegi 1991).

No paleobotanical evidence is available to help elucidate the origin of *Lycium* in particular. The Solanaceae's evident origin in western Gondwanaland prior to its breaking up into the present continents and the dispersal of the old genera from there (Chiang 1981, Symon 1991), must have included *Lycium*. The greatest number of *Lycium* species occur in Argentina and the closest relatives of the genus are also present in South America (Hitchcock 1932, Chiang 1981). Evidence also suggests that the origin of *Lycium* dates back to, at least, the late Cretaceous, since it currently occurs throughout the warm parts of the world on every continent (Chiang 1981). A global trend toward increasing aridity began during the Eocene and Oligocene times and this trend gave a selective advantage to plants adapted to semi-arid conditions and allowed them to spread geographically from the isolated xerophytic habitats they were restricted to previously. The Miocene epoch was even drier and it was probably at this time that the radiation and spread of *Lycium* was favoured (Chiang 1981).

The only two genera to occur on all the continents, are *Solanum* and *Lycium*. One possible explanation for this fact is the very early development and spread across the Gondwanan continent (Symon 1991). Another possibility is that these two, being the only Solanaceous genera with luring, fleshy berries, were long-distance dispersed by birds (Symon & Haegi 1991). The berries of most of the New World species of *Lycium* are red and therefore attractive to birds. Some *Lycium* species occur in muddy habitats and the seeds have a mucilaginous coating (Chiang 1981) that could help attach the seeds to the feathers and/or feet of birds in a similar manner to that proposed for the migration of *Larrea* Cav. from South America to North America (Wells & Hunziker 1976). It is, however, important to note that the southern continents may have these genera in common, but certainly no species (Symon 1991). Both explanations, probably, played a role in the world-wide dispersal of *Lycium* and *Solanum*. The initial distribution across the Gondwanan continents and later isolated diversification account for the presence of different species on the southern continents. Bird dispersal may have come into play, as well, for the northwards dispersal, explaining the occurrence of species common to both hemispheres. Hitchcock (1932) states that in most cases North American species find their closest relationships with South American species rather than with one another.

World wide *Lycium* comprises about 75 species (D'Arcy 1991), concentrated mainly in arid to desert environments of the New World. The centres of diversity are clearly South America, where the largest concentration of 35 species occurs (Hunziker 1979), North America (21 species, Chiang 1981) and southern Africa (where 22 of Africa's 25 indigenous species are concentrated). In Europe/Asia only 9 species are found (Pojarkova 1955). In Australia 4 species occur, 3 of which are definitely introduced from South Africa and the fourth is regarded as endemic (Haegi 1976), an assumption the author seriously doubts and intend to investigate cytogenetically in the near future.

The name *Lycium* refers to the region Lycia in south-western Turkey. The generic name was first used by the Greek herbalist Dioscorides in the first century AD (Ruellius 1543) to identify a thorny plant from Lycia. However, the plant for which Dioscorides coined the name *Lycium* does not correspond to the modern genus of the same name (Don 1838). The currently used generic name, *Lycium,* was established by Linnaeus (1753), but again there is no indication that Linnaeus adopted Dioscorides' name or recognised a taxon from Lycia.

Since the time that Linnaeus described the first three *Lycium* species, *L. afrum* L. from Africa being the type species, the genus received attention from a number of taxonomists, chronologically these being Dunal (1852) – world wide; Miers (1854) – world wide, in particular South America; Wright (1904) – Flora Capensis; Dammer (1913; 1915) – Flora of Africa; Hitchcock (1932) – western Hemisphere; Barkley (1953) – Argentina; Pojarkova (1955) – USSR; Feinbrun (1968) – Flora Orientalis region; Podlech & Roessler (1969) – Flora of Southwest Africa; Haegi (1976) – Australia; Chiang (1981) – North America; Bernardello (1986a) – South America; Dean (1974) – Africa.

In spite of all the above studies on, or including, *Lycium*, no comprehensive account was ever compiled for this genus in Africa. Its taxonomy in Africa proved to be a nightmare of confusion as to what constituted real species. No less than 101 species and 25 varieties were described for Africa, which compounded the confusion even more.

This prompted an investigation of *Lycium* in 1982 for an M.Sc. thesis on the South African lyciums. It was, however, apparent that the investigation would have to be broadened to include all of Africa, with additional techniques of genetical and molecular analyses employed, if ever the taxonomy of *Lycium* is to be solved. The aim of this investigation was to distinguish the different species occurring in Africa, to describe them, to correct their nomenclature and to study their phylogeny.

The study for this thesis thus commenced in 1993 with a study visit to all the major herbaria in Europe. Since then additional visits were made to European herbaria, in particular to K, BM, P and G. No less than 2800 specimens, including many from African herbaria, were examined during the course of this study. Many thousands of kilometers were travelled in southern Africa, as well as Egypt in northern Africa, to collect fresh material for morphological, cytogenetic and molecular analyses. Over a period of 8 years the “true” species slowly emerged, resulting in the final 25 species for Africa. Four of these are new species, two already published, and the other two in preparation.

CHAPTER 2

HISTORICAL REVIEW

2.1 Synoptic history of the Solanaceae

Members of the Solanaceae have been known and used since early times. Dioscorides mentioned the family Solanaceae in his *Codex* of 815 A.D., including illustrations of *Solanum nigrum* L. (annotated as *"Strygnos"*), *Physalis alkekengi* L. and *Mandragora* L., all plants of medicinal value in medieval times (D'Arcy 1979). *Atropa belladonna* L., or deadly nightshade, is another species used as medicine for a variety of ailments during those times. The generic name refers to the Greek god Atropos, one of the three fates, responsible for cutting life's thread – recognition of the extremely poisonous nature of *A. belladonna*, which was also used in many a murder (Simpson & Ogorzaly 1995). Today, *Solanum tuberosum* L. (potato) of the Solanaceae, provides one of the major staple foods of the world, together with the grains of the Poaceae, and constitutes a major food industry. The Solanaceae is also the source of tropane alkaloids used extensively in medicines.

Numerous botanists have studied and contributed in some way to the understanding of the family, added new genera, proposed classifications for the family and in general commented on various aspects of the family. D'Arcy (1979) comprehensively documented these contributions. For the present study, only the major and applicable treatments will be highlighted.

Casper Bauhin (1623), according to D'Arcy (1979), grouped the solanaceous taxa *Solanum, Atropa* L. and *Physalis* together in his *Pinax Theatri Botanica*, but also included the non solanaceous *Mirabilis* L. and *Paris* L. Subsequently, a number of genera, including *Lycopersicon* Mill., *Melongena* Mill. and *Cestrum* L., were added by Tournefort and Feuillee. Linnaeus used the generic concept of Bauhin's *Pinax* for both his *Species Plantarum* (1753) and *Genera Plantarum* (1754). He placed a number of genera, including *Lycium*, in his class Pentandra Monogyna, indicating that *Cestrum* and *Brunfelsia* L. were closely related to *Lycium*. The genera constituting the Pentandra Monogyna, today form the undisputed core-assembly of the Solanaceae (D'Arcy 1979).

Antoine Laurent de Jussieu (1789) compiled a classification of the genera in his *Genera Plantarum*, placing his order Solaneae in his eighth class Plantae Dicotyledones Monopetalae. Jussieu's grouping of genera forms the basis of the present day families and his Solaneae is regarded as the origin of the Solanaceae for nomenclatural purposes.

George Don from Great Britain, was next to propose a classification for the 43 genera comprising the Solanaceae of his time. He recognized seven tribes in his *Gardener's Guide* (1838).

John Miers, an engineer who worked in South America, was also an amateur botanist. He published a number of papers, principally dealing with the Solanaceae. Miers (1848) divided the traditional Solanaceae and created three additional families: the Sclerophylacaceae including the genus *Grabowskia* Schltdl. and the Nolanaceae including *Dichondra* J.R.Forst. & G.Forst. A year later he further split the Solanaceae, creating the Atropaceae (Miers 1849). This family, which he divided into ten tribes, included traditional solanaceous genera like *Nicotiana, Datura* and *Lycium.* The newly circumscribed Solanaceae consisted out of eight tribes (D'Arcy 1979). However, none of the other eminent botanists followed this redesigning of the Solanaceae.

Michel Félix Dunal, a botanist at the Institute de Botanique at Montpellier and a student of A. P. de Candolle, the then director of the Institute, made a considerable contribution towards understanding the Solanaceae. He published numerous works on various topics in the Solanaceae (D'Arcy 1979), the most comprehensive being his revision of all the species of the Solanaceae in the *Prodromus* of de Candolle (1852). For many groups this is still the latest revision available (D'Arcy 1979). D'Arcy (1979) notes that in the herbarium at Montpellier numerous fragments of Solanaceae are to be found, annotated by Dunal in the years around 1846. Either Dunal visited Genève and took them as he was preparing the manuscript for the *Prodromus*, or more likely, he received all the Genève material and retained fragments for his later study. In any event, this raises the question of which specimens should be used to typify the names of species of Solanaceae Dunal described. This may also explain the confusion, in a number of instances, encountered by the present author where *Lycium* specimens, collected by Drège and used as type material by Dunal, have corresponding collector's numbers in the herbaria of P and G but the specimens belong to different species.

George Bentham prepared a classification system for the Solanaceae in Bentham & Hooker's *Genera Plantarum* (1873, 1876) recognizing 67 genera for this family. His treatment was accepted and used throughout the British Empire. He divided the family into five tribes, placing *Lycium* in the tribe Atropeae.

Concurrently, Richard von Wettstein classified and characterized the Solanaceae, including 70 genera and 6 doubtful genera, in *Die natürlichen Pflanzenfamilien* of Engler & Prantl, published in 1891–1897 in Germany. He subdivided the tribe Solaneae into two subtribes, placing *Lycium* in the Lyciinae. This classification, except for the few major differences, agrees in general terms with that of Bentham, but had a much greater following world wide than the latter's work.

Charles Baehni (1946) from Genève was the first botanist of the twentieth century to arrange all 80 genera of the Solanaceae in a classification system. He recognized five tribes and a number of subtribes.

Pojarkova (1955) revised the Solanaceae for the Flora of the USSR. Following Baehni's system, she divided the family into five tribes, and subdivided each tribe into a number of subtribes. However, the classification system proposed by Baehni (1946) and adhered to by Pojarkova, has not drawn much attention (D'Arcy 1979).

Armando Hunziker (1979) did a synoptical survey in an attempt to appraise and summarize the data available on the Solanaceae in South America. He proposed the following classification for the family based on South American material:

Subfamily: SOLANOIDEAE

Subtribe: Solaneae

Subtribe: Datureae

Subtribe: Jaboroseae

Subtribe: Lycieae (consisting of *Lycium, Grabowskia* and *Phrodus* Miers)

Subtribe: Nicandreae

Subtribe: Solandreae

Subtribe: Juanulloeae

Subfamily: CESTROIDEAE

Subtribe: Cestreae

Subtribe: Nicotianeae

Subtribe: Salpiglossideae

Subtribe: Schwenckieae

Subtribe: Parabouchetieae

The distinctive characteristics generally used were those of the androecium and gynoecium. For instance, the subfamilies are differentiated according to the shape of the seeds and curvature of the embryos.

D'Arcy (1979) agreed with Hunziker's classification, but added a third subfamily, NOLANOIDEAE, to accommodate the genera *Nolana* L. and *Alona* Lindl.

2.2 Taxonomic history of *Lycium*

Lycium is a name first applied by Dioscorides to thorny shrubs from Lycia in Turkey (the then Asia Minor) in his comprehensive work on plants of medicinal value, *De materia Medica* (Ruellius 1543). A contemporary systematist/herbalist, Pliny the Second, used the same name, although he stated that: “the best lycium comes from a spiny plant called pyxacanthos chironia” (Hitchcock 1932). Don (1838) stated: "*Lycium* of Dioscorides, was renamed by Dr. Sibthorp as *Rhámnus infectorius*, but Mr. Royle was probably correct in identifying these plants as belonging to a species of *Berberis* L., which he called *Bérberis Lycium*. Linnaeus (1753) applied the name to a genus, which, to the author’s knowledge, does not grow in Lycia, but has thorny shrubs in common with the Dioscorides taxon".

Linnaeus (1737a) placed the genus *Lycium* in his Class V, Pentandria Monogynia. Prior to the Linnean treatment, the name *Jasminoides* was used by Nissole (1712), Micheli (1729) and Dilleneus (1732) for plants belonging to this taxon. In the first edition of *Species Plantarum* (1753), Linnaeus recognized three species, all from the Old World, namely *Lycium afrum* from the Cape of Good Hope, South Africa, *L. barbarum* originally from Asia but introduced into Europe and *L. europaeum* from southern Europe.

Though not a taxonomist in the true sense, Phillip Miller (1768), gardener at the Apothecaries herbal garden at Chelsea, studied the Solanaceae extensively (D’Arcy 1979). Miller also contributed some species names, and is therefore, included in this discussion. Most of the plants were grown from seed that he received from across the world over a period of 20 years. Miller adopted the Linnean classification system for his comprehensive, 8th edition *Gardeners' Dictionary*, and included some new species. Unfortunately, he cited no type specimens with his new species as his aim was to record information on growth and flowering of plants in the garden.

Medikus (1789) revived the generic name *Jasminoides* and "returned" *L. afrum* to *Jasminoides africanum jasmini aculeati foliis et facie* of Nissole (1712), however, the generic name given by Linnaeus in 1753 is the validly correct one. Necker (1790) split the Linnaean genus into *Lycium* and *Johnsonia,* but his Elementa Botanica is not regarded as having adopted Linnaean nomenclature and is listed under Opera Utique Oppressa in Appendix 5 of the Tokyo 1993 Code, and the name *Johnsonia* is therefore not validly published.

Kunth (1823) divided the genus *Lycium* into three sections, based mainly on characteristics of the calyx. However, he gave no names to these sections, which were characterized as follows:

1 Calyx urceolatus, irregulariter 3–6-fidus, rarius (in *Lycio Boerhaaviaefolio*) sinato-quinquedentatus et regualris. Corolla tubuloso-infundibuliformi; limbo quinquepartito, patente. Genitalia exserta. *L. barbarum* and *L. europaeum* were placed here.

2 Calyx urceolato-campanulatus, quinquedentatus, regularis. Corolla tubuloso-infundibuliformis; limbo quinquefido, erecto. Genitalia inclusa – Frutices spinosi. Folia fasiculata. Pedunculi subaxillares, solitarii. This section included *L. afrum.*

3 Calyx urceolatus, saepissirne irregulariter quinquefidus aut quinquedentatus. Corolla tubulosa; limboerecto, plicato, quinque-aut decemdentato, rarius quinquefido. Genitalia subinclusa. – Arbores aut frutices inermia. Folia spersa. Flores subaxillares aut termninales, fasciculato-umbellatii. No African species were included here.

The new species of *Lycium* described by Kunth (1823) have since been transferred to other genera (Chiang 1981).

Rafinesque (1838) segregated several new genera from *Lycium*, restricting his genus *Lycium,* to Kunth's first section. According to Rafinesque *L. afrum* was no longer part of the genus *Lycium* but belonged to his new genus *Oplukion* (Hitchcock 1932). Rafinesque's other new genera were *Pukanthus, Valteta, Diplukion, Ascleia, Teremis, Huanuca, Pederlea, Evoista* and *Plicula*. Of these, *Teremis, Oplukion* and *Evoista* are clearly synonymous with *Lycium*, *Ascleia* is congeneric with *Hydrolea* L. (Hydrophyllaceae), and the rest belong to several genera close to *Lycium* (Chiang 1981).

In his taxonomic treatment of Solanaceae, Don (1838) used Kunth's three sections, naming them **Eulycium, Isodontia** and **Anisodontia**. Thirty-four *Lycium* species were known at that time. The Asian, European and North African and some South American species were placed in the first section, the "true lyciums", while the rest of the African species were included in section Isodontia and the South American species in Anisodontia.

In his generic revision of the Solanaceae, Endlicher (1839) followed Kunth and Don by dividing the genus into three sections based on calyx characteristics and the degree of stamen exsertion, but he renamed them as **Eulycium**, **Lyciobatos** and **Lyciothainnos**. He listed no species under his sections.

Walpers (1844-45) reverted to Don's names for the three sections, and divided the then 39 *Lycium* species on the same bases as Don did.

Miers (1845) reshuffled the species that had been placed under *Lycium*, because, according to him, they represented a broad spectrum of characteristics in order to accommodate a number of existing genera. In order to solve this problem Miers created two new genera, namely *Lycioplesium* and *Chaenestes*. Imbricate aestivation being one of the distinctive characteristics for *Lycium*, all the spinescent species with valvate-plicate aestivation and acute corolla lobes were then placed in *Lycioplesium*. *Chaenestes* consisted of species of trees or large shrubs generally having long crimson or orange colored flowers (Hitchcock 1932). These two new genera were, however, synonymous with *Iochroma* Benth. (sometimes referred to as *Jochroma*) and *Acnistus* Schott respectively (Bentham & Hooker 1876).

Dunal (1852) placed *Lycium* in tribe Atropeae and divided the genus into four sections in his treatment of the Solanaceae:

1 **Schistocalyx**: Calyx glanduloso-puberulus, dimidiam corollam superans, profude 5-fidus sub-5-partitus......He placed two species with calyces divided to the base, that is having free sepals, in this section. However, neither of these two species, *L. ciliatum* Schlecht. and *L. serpilifolium* Dunal, belongs to *Lycium* (Miers 1854) and this section was therefore superfluous.

2 **Eulycium**: siting *Eulycium* of Endlicher: Calyx urceolatus, irregulariter 3-6-fidus, saepe primum 5-dentatus. Corolla infundibuliformis, fauce intus barbata ad basin staminurn partium liberarum, limbo 5-fido, patente. Stamina exserta. Folius sparxa, vel e gemmis axillaribus fasciculata. Flores in ramulis terminale 1–2–3–ni umbellatique. This section was further subdivided into two subgroups according to leaf characteristics, a

characteristic that is known to be extremely variable in *Lycium*. *L. barbarum,* most of the then known southern African species, plus Dunal's new species from southern Africa were placed in this section.

3 **Amblymeris**: Calyx poculiformis, subcampanulatus..... Corolla purpurea aut viridi-purpurea, campanulata vel infundibuliformi-campanulata..... Stamina inclusa vel exserta. The African species Dunal placed here were *L. hirsutum* Dunal, *L. afrum, L. camosum* Poir. and *L. rigidum* Thunb.

4 **Lyciobatos**: partly corresponding to Endlicher's section Lyciobatos: Calyx urceolato-campanulatus, subaequaliter 5-dentatus. Corolla infundibuliformis, limbo 5-fido, erecto. Stamina inclusa. Folia fasciculata; flores subsolitarii, terminales in ramulis axillaribus. In this section Dunal placed *L. mediterraneum,* a name he substituted for *L. europaeum* on account that the latter name misrepresented the distribution of the species. He also described 6 varieties under *L. mediterraneum* Dunal. This was the only African species Dunal acknowledged in sect. *Lyciobatos.*

Miers (1854) published a new assessment of *Lycium*, rejecting Dunal's treatment. The latter recognized only three South American species, whereas Miers added a further 30 species for South America. According to him Dunal's sections were inadequate to accommodate the new species. Dunal's sections also largely corresponded to those proposed by Kunth, Don and Endlicher, where the only distinctions were founded on the degree of stamen exsertion and calyx lobe regularity, the latter being extremely variable and, therefore, totally unreliable as a distinctive characteristic. Miers stated that the degree of stamen exsertion is dependent on the relative depth of corolla incision, according to him a much more reliable distinctive characteristic. He rejected all of the previous sections and proposed three new divisions, based on this corolla characteristic, expressed as the length of the corolla-lobes relative to the corolla-tube. These divisions were:

1 **Brachycope**: the corolla-lobes are one third or less of the entire length of the corolla.

2 **Mesocope**: the corolla-lobes are longer than one third of the corolla-tube but do not exceed the length of the tube.

3 **Macrocope**: the corolla-lobes are longer than the corolla tube. The stamens are inserted in the throat of the tube.

Miers (1849) disagreed with all the preceding botanists who placed *Lycium* in the Solanaceae. He rather positioned the genus in his new family Atropaceae, tribe Atropeae (D'Arcy 1979) (based on the tubular form of the calyx, five equal corolla lobes and imbricate aestivation of the corolla), and closely related to *Mandragora* and *Atropa.*

Bentham, in his revision of the Solanaceae (1873, 1876), did not divide the genus into sections.

Terracciano (1891) proposed a completely new system for the genus. His sections were **Lyciobatos, Amblymeris, Lycioplesioides** and **Acnistoides**. He listed no distinguishing characteristics for these sections and reduced several species to variety status. These varieties were grouped into subspecies which were represented by Greek letters, and these sub-specific categories were placed under a common specific name. In addition, some of his varieties were further subdivided into sub-varieties and forms. This system proved much to complicated for practical use.

Wettstein (1891–1897) followed Miers' classification for sectioning the genus, using the sections *Brachycope, Mesocope* and *Macrocope* but he moved *Lycium* to the tribe Solaneae-Lycineae.

Wright (1904) revised eight genera of the Solanaceae for the *Flora Capensis*. He made no mention of tribes, nor of sections in his treatment. A floral key was provided for each genus. For *Lycium* he included 18 species, of which two were new species, namely *L. pilifolium* and *L. schizocalyx*.

Dammer (1913, 1915) was the last to publish a comprehensive account of *Lycium*, as part of a taxonomic treatment of the Solanaceae for Africa, in Engler's *Botanische Jahrbücher*. He was a prolific splitter, recognizing only eight of the existing names and describing 29 (1913) and 10 (1915) new species. He made use of a grouping system (1913), depending firstly on the stamens being glabrous or pilose, subdividing these groups in terms of the internal hairiness of the corolla and the last subdivision concerns the hairiness of the calyx. None of the groups were named or described, and this can therefore, not be considered as a classification system, but merely a convenient grouping of related species. He discarded this grouping system in the 1915 publication.

Hitchcock (1932), in his monograph on *Lycium* and its species of North and South America, stated that the earlier sections proposed for this genus, had all been based on artificial and variable characters. Placing a given species in its correct section proved to be virtually impossible, and many of the species even keyed to more than one section. Using mainly characteristics of the ovary and stamens, Hitchcock divided the genus into three sections:

1 **Eulycium**, including in part Don's *Isodontia* and *Anisodontia*, Endlicher's *Lyciobatos*, partly Dunal's *Amblymeris* and nearly all of Miers' three sections. This section was characterized by 2–many-ovuled ovaries and 2–many seeded fruits, and thus included most of the world's *Lycium* species.

2 **Selidophora**, a new section to include only four South American species is characterized by enlarged and glandular filaments bordered with cilia.

3 **Sclerocarpellum**, a new section with only two species, was characterized by 1–ovuled carpels and 2–seeded fruits.

Barkley (1953) used the three sections of Hitchcock (1932) to classify the 30 *Lycium* species in Argentina. Section Sclerocarpellum is represented only by *L. ameghinoi* Speg., while the rest of the species are divided between the sections Eulycium and Selidophora, the latter containing the largest number of Argentinian species.

Pojarkova (1955) revised most of the Solanaceae genera, including *Lycium*, for the *Flora of the USSR*. She placed the genus *Lycium* in the tribe **Atropeae**, subtribe **Atropinae**, which comprised only three genera, namely *Atropa, Mandragora* and *Lycium.* She created four new series to classify the 6 *Lycium* species of the USSR region:

1 **Orientalia**: 'Corolla infundibuliform, tube cylindrical only at base; lobes 2/5–2/3 as long as the tube. Filaments glabrous. Berries red'. This series comprised only one east European species.

2 **Ruthenica**: 'Corolla tube cylindrical in lower part, gradually broadening above; lobes 2/5–2/3 as long as tube. Filaments puberulent at base, as is corolla tube. Berry black'. Only one east European species was placed in this series.

3 **Chinensia**: 'Length of corolla tube almost equaling limb, slightly broadened above. Filaments densely pubescent with tufts of hairs at base forming spherical or short cylindrical joint. Berry bright red'. *L. barbarum* was included here.

4 **Trucata**: 'Corolla tube narrow and cylindrical, abruptly broadening just below the limb; corolla lobes 2/5–1/2 as long as corolla tube. Stamens inserted in the upper half of the tube, filaments glabrous or puberulent at base. Berries red'. This series included only Asian species.

Feinbrun (1968) did a taxonomic revision of *Lycium* for the region covered by Boissier's *Flora Orientalis* (1879). Her study encompassed eleven species, of which one was new. The three North African species, *L. europaeum, L. schweinfurthii* Dammer and *L. shawii* Roem. & Schult. of the present thesis, also occur in the Flora Orientalis Region, and were included in her account. She disagreed with Pojarkova's division of the genus into series, claiming that the groupings are not natural and are insufficient to accommodate additional species, like *L. schweinfurthii* and *L. shawii,* species Pojarkova seemed to have forgotten about.

Podlech and Roessler (1969) were responsible for the six genera of the Solanaceae represented in the then German protectorate of South-west Africa, the present Namibia. They did not make use of, or propose any classification for the family or the genera. Floral keys were provided for the family and each genus, as well as a generic description but no species descriptions, relying for the latter on the very detailed keys. Ten *Lycium* species were included, placing a number of Dammer's species in synonymy.

Haegi (1976) discussed the four Australian species. *L. afrum* and *L. ferocissimum* Miers were introduced from South Africa, while *L. barbarum* was probably introduced from Europe. *L. australe* F.Muell. is regarded as the only indigenous representative of the genus.

In his revision of the Solanaceae in India, Deb (1979) classified the genera or species according to an existing or newly proposed system. Only three species, namely *L. barbarum, L. europaeum* and *L. ruthenicum* Murr. occur in India.

Chiang (1981) revised the North American species of *Lycium* for a Ph.D. thesis. Consequently, in 1983 he revised Hitchcock's delimitation of sections in *Lycium* for the New World. He agreed with this former treatment but redescribed and renamed the three sections in compliance with International Code of Nomenclature (Stafleu *et al.* 1978). These three sections are: Section **Lycium**, synonymous with Don's section Eulycium, section **Schistocalyx** using Dunal's (1852) name, synonymous with Macrocope of Miers (1854), Terracciano's (1891) Lycioplesioides and Hitchcock's (1932) Selidophora, and Section **Sclerocarpellum** as defined by Hitchcock (1932).

Bernardello (1986b) in his revision of the South American *Lycium* species used Chiang's (1983) sections but split section *Lycium* adding a fourth section, namely **Mesocope** (Miers 1854) for species with prominent red-coloured nectaries, grouping the species with inconspicuous green nectaries as part of section Lycium. The characteristics of the calyx, stamen bases (enlarged and ciliate or not) and the color and prominence of the nectary are the defining characteristics used for delimiting his four sections.

The most recent views on relationships within the Solanaceae are based on molecular studies by Olmstead and Palmer (1992). The phylogenetic analysis confirmed the division of the family into two subfamilies, the Solanoideae and Cestroideae (Hunziker 1979). The traditional views considered the Solanoideae as ancestral based on existing assumptions about trends in the evolution of characters from "primitive" to "specialized" (D'Arcy 1979, Armstrong 1986). Resolution of the tribes within the Cestroideae proved difficult, but results do not support the classification of Hunziker (1979). Both the tribes Salpiglossideae and Nicotianeae seem to be artificial groupings and should be redefined. For example, the characteristics uniting the Nicotianeae, being herbaceous habit, actinomorphic flowers, nonarticulate pedicels, capsular fruit and small seeds, all appear to be ancestral for the Cestroideae and also for the entire Solanaceae and are thus retained and not independently derived characteristics, typical to the Nicotianeae.

As far as the Solanoideae is concerned, the phylogenetic tree of Olmstead and Palmer (1992) indicates a monophyletic origin, derived from the Cestroideae.

They based this assumption on the many homogeneous attributes shared by members of the Solanoideae, like basic chromosome number n = 12. However, identifying relationships within this subfamily, proved to be difficult as well. They attributed these difficulties to inadequate taxonomic sampling for such a large, divergent taxon and proposed a more approximate analysis with a well-represented, extensive taxonomic sampling, which would probably yield more accurate results. Preliminary results suggest a relatively rapid diversification within this subfamily adding to the difficulties in resolving phylogenetic relationships. Based on their results they proposed the following characteristcs as derived or advanced for the Solanaceae: discoidal seeds, curved embryos and berry-like fruit. Olmstead and Palmer's view (1992) are directly opposed to that of D'Arcy (1979) and Armstrong (1986) who consider the cestroid morphological characteristics and floral anatomy to be more advanced than that of the Solanoideae, applying the criteria of Melchior (1964, quoted from Armstrong 1986).

2.3 Generic relationships of *Lycium*

Most of the taxonomists revising the Solanaceae, grouped the genera in various combinations in their classifications, based on the generic relationships. Don (1838) was the first to group related genera into tribes. Subsequently Endlicher (1839), Miers (1849), Dunal (1852), Bentham (1876), Wettstein (1891–1897), Baehni (1946) all proposed classification systems taking shared diagnostic characteristics into account.

From these treatments Chiang (1981) concluded that the genera considered to be closely related to *Lycium* are *Grabowskia*, *Acnistus* Schott, *Dunalia* Kunth, *Iochroma* and *Phrodus*. Other genera proposed by some of the 19th century investigators as related, are *Atropa, Mandragora, Dyssochroma* Miers and *Solandra* Sw. Modern taxonomic treatments indicate no close relationship of any of these four genera to *Lycium*.

Hunziker (1979) divided the Solanaceae into two subfamilies, and 11 subtribes. He placed *Lycium, Grabowskia*, and *Phrodus*, in tribe Lycieae, characterized by the following characters: woody plants, sometimes halophytic, flower-buds with overlapping corolla-lobes, filaments inserted on the back of the anthers, thecae free from each other for their lower third or even higher up, gynoecium 2-carpellary, fruit baccate or drupaceous. *Acnistus, Dunalia* and *Iochroma,* the other "closely related genera" were added to tribe Solaneae, diagnosed by aestivation never imbricate nor contorted, and filaments adhering to the base of the anther or near it. Hunziker's classification (1977, 1979) raised Wettstein's subtribe Lyciinae to tribal level, namely tribe Lycieae, in subfamily Solanoideae, placing only three closely related genera in that tribe: *Lycium* (world wide distribution, with centers of diversification in Argentina, South Africa and Arizona), *Grabowskia* (with disjunct distribution in Mexico (Puebla), Galápagos Islands, but mostly in South America), and *Phrodus* (with two species endemic to northern Chile). Bernardello (1987) concurred with this treatment.

Olmstead and Palmer (1992) concluded from their molecular analysis of representative members of the solanaceous tribes that the tribe Lycieae should include the maverick genus *Nolana*. This genus has been a problem for many taxonomists over the years and has been placed in a separate family, the Nolanaceae (Endlicher 1839, Miers 1848, Wettstein 1891–1897), or subfamily, the Nolanoideae (D'Arcy 1979) or tribe, the Nolaneae (Dunal 1852, Bentham 1876). Their results support Hunziker (1979) and Bernardello (1987) in indicating a close relationship between *Lycium* and *Grabowskia*. Unfortunately the genus *Phrodus,* indicated by Hunziker (1979) and Bernardello (1987) as the other related genus, was excluded from the Olmstead & Palmer (1992) analysis. Subsequent cladistical analyses (Olmstead & Sweene 1994) confirm the, as yet, novel assumption of a close association between *Nolana* and *Lycium.*

2.4 Typification of the genus *Lycium*

In 1929 Hitchcock and Green submitted a proposal to the IBC of 1930 that *Lycium afrum* should be the lectotype species of *Lycium.* However, during this congress no decision on the acceptance of the proposal was taken, but that name was published in 1935 as part 1 of a list, Supplement to the International Rules (Jones, 1960). At the Sixth International Congress (1936) this proposal was discussed again in the Nomenclature section. It was further proposed, and accepted, that the standard species of Linnaean generic names printed in the International Rules, 3rd ed., pp. 139-143, be adopted by botanists unless there was clear reason for the rejection of any species in favour of another (Chiang 1981). This list was again published as a supplement to the Rules after this congress, but acceptance of the list in these terms did not imply that it was to be binding since provision was made for changes (Jones 1960).

This list was not incorporated into the Rules of the Seventh International Congress (1950) nor those produced after the subsequent International Botanical Congresses, the last one being the Twelfth (1975) (Chiang 1981). However, article 8 of the ICBN (1930) states that "the author who first designates a lectotype or a neotype must be followed" and that "his choice [...] may [only] be superseded if it can be shown that the choice was based upon a misinterpretation of the protologue or was made arbitrarily" (Chiang 1981).

Feinbrun and Stearn (1963), having found no prior lectotype, agreed that *L. afrum* be the lectotype for this genus. These authors mentioned that it is represented in the Hortus Cliffortianus herbarium (BM) by a flowering specimen agreeing with Nissole's figure (as *Jasminoides*) cited by Linnaeus, clearly cited by Hitchcock and Green (1929). Chiang (1981) concurred with this decision having also found no prior lectotype designation, no misinterpretation of the protologue and no evidence that the choice was made arbitrarily. In his revision of the South American *Lycium* species Bernardello (1986a) also accepted *L. afrum* as the type species of the genus.

CHAPTER 3

MATERIAL AND METHODS

3.1 Cytogenetics

The material used for the chromosome analysis was collected in the field (Table 5.2). Care was taken to collect between 10:00 and 13:00 when meiosis of anther spore mother cells is at its peak. Voucher specimens are housed in the Geo Potts Herbarium (BLFU).

The material was fixed in Carnoy's fixative (Carnoy 1886). The fixative was replaced by 70% ethanol after 24–48 hours. Anthers were squashed in 2% aceto-carmine (Darlington & LaCour 1976). The slides were made permanent by freezing with liquid carbon dioxide (CO_2) (Bowen 1956), followed by dehydration in ethanol and mounting in Euparal. At least 20 cells per meiotic stage were studied for each specimen.

3.2 Sexuality

Detailed observations of fresh material of the African species were made in their natural environment. Photographs of the fresh flowers of these plants were taken in the field. Samples were collected for voucher herbarium specimens (BLFU).

Fresh flowers were fixed in 3% glutaraldehyde and the internal structure was studied and photographed with a Zeiss Photomicroscope.

The anthers of the functionally male and female flowers were removed, dehydrated in an alcohol series and embedded in Spurr's low viscosity resin. Sections of 2 µm were stained with 0.5% toluidine blue. For scanning electron microscopy (SEM) studies of stamens and pistils the dehydrated material was critical point dried, mounted on stubs, coated with gold and examined with a Jeol Winsem 6400 microscope at 10 kV.

3.3 Micromorphology of pollen, seed coat - and leaf epidermal surfaces

Pollen, seeds and leaf portions were obtained from herbarium specimens as indicated in Table 7.1.

SEM studies and SEM photographs were made using a Jeol Winsem 6400 microscope at 10 kV. Light microscopical investigations and photographs were made with a Zeiss Photomicroscope.

3.3.1 Pollen

The pollen samples were prepared according to the acetolysis method of Erdtman (1960). For SEM surface structure studies the acetolysed pollen was prepared according to the method of Reitsma (1969) by rinsing in acetic acid, washing twice with water, before being mounted on stubs, air-dried and coated with gold.

For light-microscopy the remainder of the acetolysed material was mounted in glycerine jelly and sealed with paraffin wax. Samples were examined with a Zeiss Photomicroscope. At least 30 pollen grains of each specimen were investigated and the polar axis (P) and equatorial diameter (E) in equatorial view were measured. Pollen grain measurements are given as average values for polar diameter (P) and equatorial diameter (E), followed by the standard deviation for each measurement. The polar-equatorial index (PE) was then calculated. The average measurements and standard deviation are summarised in Table 7.4 and the shape class was given for the majority of grains investigated, with that of the minority given in square brackets when applicable (Tables 7.4 & 7.5). The terminology used for describing the pollen is in accordance with Punt *et al.* (1994).

3.3.2 Seed coat surfaces

Dry seeds obtained from herbarium specimens were mounted on stubs, gold coated and investigated with the SEM. The terminology used is in accordance with Barthlott (1981) and Axelius (1992).

3.3.3 Leaf epidermal surfaces

Leaves from herbarium specimens were rehydrated for 48h or longer in 3% glutaraldehyde, dehydrated in an alcohol series, critical point dried, mounted on stubs and gold coated for SEM surface structure studies.

Strips of upper and lower leaf epidermisses were, furthermore, stained in Safranin, washed in ethanol and mounted on slides in Euparal for observation of cell structure and stomatal characteristics under the light microscope.

3.4 Taxonomic treatment of genus and species

Collecting of fresh material covered, as far as possible, the complete distribution ranges of the different species and necessitated travelling to remote corners of southern Africa, even visiting North Africa. Herbarium specimens were prepared from these collections. Furthermore, detailed observations were noted and colour slides as well as photographs were taken in the field of the habit, leaves, bark, flowers and fruit of each species. Being mostly succulent or semi-succulent, some of the important diagnostic characteristics get lost during the preparation and drying of herbarium specimens. Observation of fresh material was, therefore, of cardinal importance in solving the taxonomic confusion surrounding this genus and in delimiting the different species. Examination of herbarium specimens alone would not have provided adequate data for this purpose. An Olympus SX-PT stereo-photo-microscope was used for the floral investigations and photographs.

Herbarium specimens on loan from the major southern African herbaria as well as from most of the larger European herbaria supported this investigation. A number of visits were paid to these herbaria to examine all the specimens in their collections and to collect the relevant literature. More than 2500 specimens, representing the 25 indigenous African species, were examined and the collector's data, morphological measurements and observations recorded. All herbarium specimens mentioned in this thesis were seen by the author, unless stated otherwise.

All the existing type specimens, representing the 101 described species and 25 varieties described for Africa, were examined and photographed. Type literature was confirmed. The holotypes of names of 36 species described by Dammer (1913, 1915) were all lost during the bombing of Berlin (B) during the Second World War. Fortunately some isotypes were located in other herbaria and a number of lectotypes could be declared. In the absence of type material, synonymy of a number of names are based on Dammer's excellent type descriptions. Confusion, regarding collector's numbers and incorrect identification of some Drège type material, was solved during visits to Paris (P) where the original Drège collection is housed. In Genève (G) the holotypes used by Dunal for his species descriptions were examined.

Two new species, *L. gariepense* sp. nov. A. M. Venter and *L. strandveldense* sp. nov. A. M. Venter have not yet been formally published. In the rest of this thesis they will be referred to as *L. gariepense* and *L. strandveldense*.

Phillip Miller described 10 species of *Lycium* in his *Gardeners Dictionary* in 1768, from seeds collected all over the world and grown in the Chelsea Garden of the Company of Apothecaries where Miller was the Gardener. Five specimens were from the Cape of Good Hope, South Africa, and of these only *L. afrum* was described at that time. No type material of the species concerned is availble (R. Vickary, BM, pers. com.) and, although Miller's records and descriptions were meticulous, the species could not be recognised with certainty. Miller's names are, therefore, not used. However, because some of the names were well known and used in the literature at that time, they need to be taken into account. The names concerned are:

- *L. barbarum* Mill., an invalid name because the epithet was already used by Linnaeus (1753) for a species from China.
- *L. italicum* Mill., according to Mr Roy Vickery (Curator of Herbarium, British Museum, London, pers. com.), probably synomymous with *Rhamnus lycioides*.

♦*L. capense* Mill., probably refers to *L. tetrandrum* L.f. according to the vegetative description, but with no flowers or floral description, this is very uncertain and treated here as imperfectly known species (p 218).

♦*L. angustifolium* Mill. according to Miller related to *L. afrum*, but treated here as imperfectly known species (p 218).

♦*L. cordatum* Mill., definitely not a *Lycium*, probably *Carissa bispinosa* according Miller's descriptions of the heart shaped leaves, "paired" thorns and green bark.

Literature used in the description of species is the following:

Leaf shape descriptions follow Systematics Association Committee for Descriptive Biological Terminology (1962).

Terminology for vestiture adapted from Hitchcock (1932), Payne (1978) and Haegi (1991).

Spelling of author names follow Brummitt & Powell (1992).

Spelling and abbreviations of taxonomic literature as in Stafleu & Cowan (1976).

Nomenclature citation and designation of type material follow the *International Code of Botanical Nomenclature* (Greuter *et al.* 1988).

Herbaria acronyms in this thesis are as given in Holmgren *et al.* (1990).

Localities of most southern African specimens cited in this thesis were located in and are arranged according to the quarter-degree reference system of Edwards and Leistner (1971) and Leistner & Morris (1976). Some localities were found with the aid of Reader's Digest Atlas for Southern Africa (1984), and arranged according to the quarter degree reference system. Specimens from East African (Kenya, Tanzania and Uganda) localities were coded following Polhill (1988). North African localities are according to grid references in Gazetteers for Algeria, Tunisia, Liberia, Morocco, Egypt, Ethiopia and Sudan.

Some localities were grid referenced with the aid of The Times Atlas of the World (1985). Localities are indicated as N (north) or S (south) of the equator and E (east) or W (west) of the Greenwich line.

Specimens from the following herbaria were examined, mostly during personal visits but also on loan:

B Herbarium, Botanischer Garten und Botanisches Museum Berlin-Dahlem, Berlin, Germany.

BLFU Geo Potts Herbarium, Department of Botany and Genetics, University of the Orange Free Sate, Bloemfontein, South Africa.

BOL Bolus Herbarium, University of Cape Town, Rondebosch, South Africa.

BM Herbarium, Botany Department, The Natural History Museum London, England.

BR Herbarium, Nationale Plantentuin van België, Domein van Bouchout, Meise, Belgium.

CAI Herbarium, Botany Department, Faculty of Science, Cairo University, Cairo, Egypt.

COI Herbarium, Botanical Institute, University of Coimbra, Coimbra, Portugal.

E Herbarium, Royal Botanic Garden, Edinburgh, Scotland.

FT Erbario Tropicale di Firenze, Firenze, Italy.

G Herbarium Conservatoire et Jardin botaniques de la Ville de Genève, Chambésy/Genève, Switzerland. (G-DC).

GRA Herbarium, Botanical Research Institute, Grahamstown, South Africa.

HUJ Herbarium, Botany Department, Hebrew University, Jerusalem, Israel.

J Charles E. Moss Herbarium, Botany Department, University of the Witwatersrand, Johannesburg, South Africa.

K	Herbarium, Royal Botanic Gardens, Kew, Richmond, England.
KMG	Herbarium, McGregor Museum, Kimberley, South Africa.
KNP	Herbarium, Research and Information Department, National Parks Board, Skukuza, South Africa.
L	Rijksherbarium, Leiden, The Netherlands.
LINN	Herbarium, Linnean Society of London, Burlington House, Piccadilly, London, England.
LISC	Herbàrio, Centro de Botânica, Instituto de Investigaçâo Cientifica Tropical, Lisboa, Portugal.
LMU	Herbàrio, Departamento de Botânica, Universidade Eduardo Mondlane, Maputo, Mozambique.
M	Herbarium, Botanische Staatssammlung, München, Germany.
NBG	Compton Herbarium, National Botanic Gardens of South Afirca, Claremont, South Africa.
NH	Natal Herbarium, Botanical Research Unit, Durban, South Africa.
NMB	Herbarium, Botany Department, National Museum, Bloemfontein, South Africa.
NU	Herbarium, Botany Department, University of Natal, Pietermaritzburg, South Africa.
OXF	Fielding-Druce Herbarium, Plant Sciences Department, University of Oxford, Oxford, England.
P	Herbier, Laboratoire de Phanérogamie, Muséum National d'Histoire Naturelle Paris, France.
PRE	National Herbarium, Botanical Research Institute, Pretoria, South Africa.
PRU	H.G.W.J. Schweickerdt Herbarium, Botany Department, University of Pretoria, Pretoria, South Africa.

SAM South African Museum, Herbarium, incorporated in National Botanical Gardens (NBG), Claremont, South Africa.

SRGH National Herbarium and Botanic Garden, Harare, Zimbabwe.

STE Stellenbosch Herbarium, National Botanical Institute, Stellenbosch, South Africa (now incorporated into NBG).

STEU Herbarium, Botany Department, University of Stellenbosch, Stellenbosch, South Africa.

UNIN Herbarium, Botany Department, University of the North, Pietersburg, South Africa.

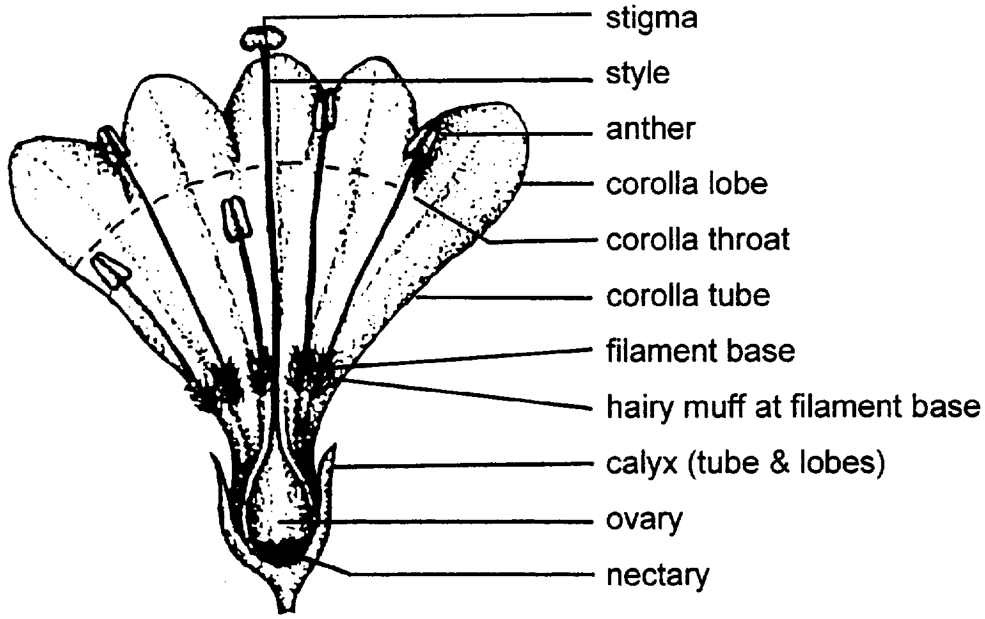
UPS Botanical Museum (Fytoteket), Uppsala University, Uppsala, Sweden.

W Herbarium, Department of Botany, Naturhistorisches Museum Wien, Wien, Austria.

WIND National Herbarium of Namibia, Windhoek, Namibia.

Z Herbarium, Institut für Systematische Botanik, Universität Zürich, Zürich, Switzerland.

3.5 Terminology of the flower



Voucher specimens listed with the descriptions of the species, represent the best specimens covering the ranges of the species' distribution. The distribution maps were drawn using the specimens listed in the Appendix: Specimen list.

3.6 Cladistics

Only morphological characteristics of vegetative parts, floral parts and fruit, as well as chromosome numbers, were used in the cladistical analysis. A number of characters initially included in the analysis were later excluded because of problems associated with coding the character states or because of high instances of polymorphism within the species. The characters were coded to be unordered, thus minimising weighting or polarity before analysis. Initially 30 morphological characters were included in the data matrix (Table 9.1). MacClade 3.04 (Maddison & Maddison 1992) was used to edit the data set by identifying and eliminating phylogenetically unimportant characters. The final matrix contained twenty-eight taxa, including two outgroups, and twenty-one characters. Two outgroups, namely *Nicotiana glauca* L. and *Datura stramonium* L. were chosen because they share a chromosome number of x = 12 with *Lycium*. *Datura* is a member of the Solanoideae and, traditionally, *Nicotiana* belongs to the Cestroideae. According to the molecular work of Olmstead & Palmer (1992) *Nicotiana* is actually very closely related to the Solanoideae and could, therefore, be regarded as an ideal "sister group" for *Lycium*. A further consideration in chosing these two species as outgroups was that fresh material was available.

The cladistic analysis was performed with the aid of PAUP 4.0 (Phylogenetic Analysis Using Parsimony) (Swofford 1998). Initial heuristic searches were conducted, excluding some of the data to assess the effects on the resultant cladograms. TBR (tree bisection-reconnection branch swapping) was then employed using maximum parsimony, with characters unordered and equally weighted. Strict consensus trees were computed together with tree length, consistency index (CI) and retention index (RI). Reliability of lineages was assessed by using bootstrapping.

Finally a hypothesized phylogenetic cladogram was constructed using MacClade 3.04 (Maddison & Maddison 1992). The well supported clades of the PAUP cladogram were incorporated and the principle of maximum parsimony was applied.

3.7 Format

The guidelines of the *South African Joumal of Botany* to authors of articles in particular instructions for taxonomic papers are followed in this thesis.

CHAPTER 4

DIAGNOSTICALLY IMPORTANT CHARACTERISTICS

4.1 Introduction

Since Linnaeus described the type species of the genus, *L. afrum*, in 1753, a total of 120 species and varieties have been described for Africa. *Lycium* has ever since proven to be a nightmare for taxonomists and in particular for South African ecologists. The considerable variability in characteristics, particularly vegetative, though florally as well, within each species is the main cause of confusion in delimiting and identifying the different species. After extensive observation, certain characteristics, mainly floral, have proven to be diagnostically important. In this genus, however, characteristics should never be considered individually for identification purposes but in combinations. The aim of this chapter is thus to explain the floral and vegetative diagnostic characteristics of the African lyciums used in the delimitation of the species and in the subsequent compilation of the keys.

4.2 Diagnostically important characteristics of *Lycium*

4.2.1 Growth form

The shrubs of most of the species are very thorny, with rigid, erect or spreading branches (Figures 4.1 & 4.6). Although habitat and climate may influence growth form, the general characteristics remain rather constant and a few species can be recognized by their very distinct habits:

- Long, pendulous, virtually thornless young branches occur in *L. arenicola* and *L. barbarum* (Figure 4.2), erect shrubs of 3–4 m high in *L. acutifolium*, a usually

Figure 4.1
Shrubs with rigidly erect stems. A: *L. hirsutum*; B: *L. pumilum*.

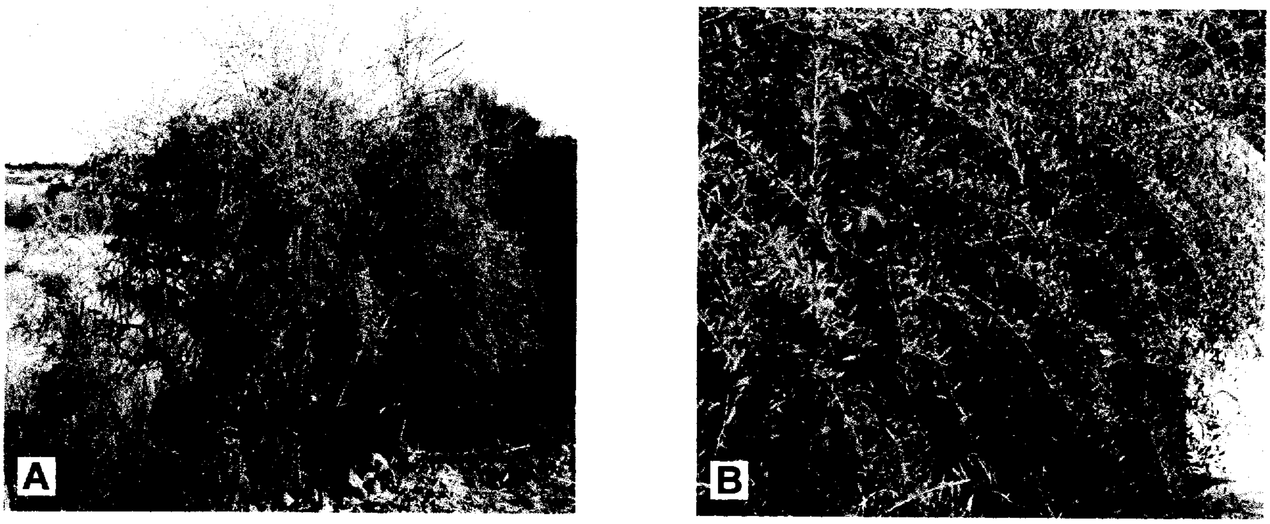


Figure 4.2
Shrubs with young stems pendulous and virtually thornless. A: *L. arenicola;* B: *L. barbarum.*

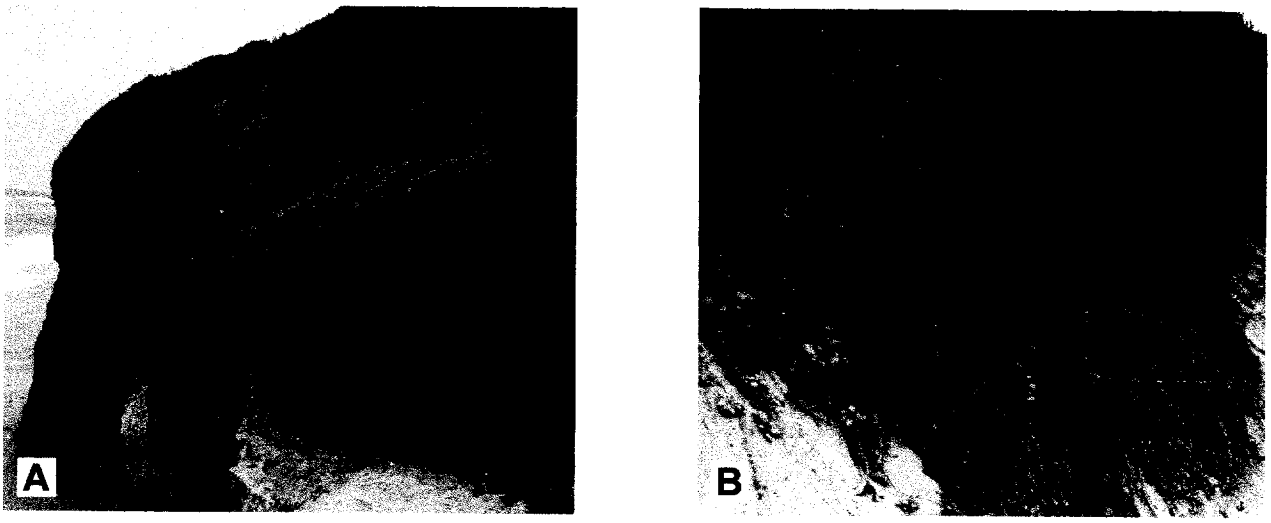


Figure 4.3
Pendulous, thornless young stems forming a "curtain" over sea-facing limestone rocks and dunes. A & B: *L. mascarenense*.

scandent shrub in thickets, and in *L. mascarenense*, a prostrate shrub restricted to sea-facing rocks and dunes (Figure 4.3).

♦ Young branches in *L. bosciifolium, L. oxycarpum* and *L. schweinfurthii* are typically sturdy, curved structures giving a distinct appearance to these plants (Figure 4.4).

♦ In *L. decumbens* the branches grow vertically from the soil for a few centimeters and then curve at right angles to the ground surface and spread out over the soil, resulting in the typical decumbent appearance of this dwarf shrub (Figure 4.5).

4.2.2 Vestiture

The diagnostic value of vestiture in the taxonomy of this genus, has been recognized by Hitchcock (1932). Two main types of trichomes are found in the African species, namely glandular and eglandular. The vestiture is present on the leaves and epidermis of young stems in particular, but sometimes on the calyces as well.

♦ Short stalked glandular trichomes, with either elongated or spherical heads, are microscopically small and plants with these trichomes appear glabrous to the naked eye and are therefore described as glabrous, although, strictly speaking microscopical trichomes are present. These species are *L. afrum, L. acutifolium, L. amoenum, L. arenicola, L. barbarum, L. bosciifolium, L. cinereum, L. eenii, L. europaeum, L. gariepense, L. grandicalyx, L. horridum, L. ferocissimum, L. grandicalyx, L. mascarenense, L. oxycarpum, L. pumilum, L. schizocalyx, L. schweinfurthii, L. strandveldense, L. shawii, L. tenue* and *L. tetrandrum* (Figure 4.7).

♦ Glandular trichomes may be short or long stalked. Both long and short stalked glandular hairs occur in *L. pilifolium* (Figure 4.8).

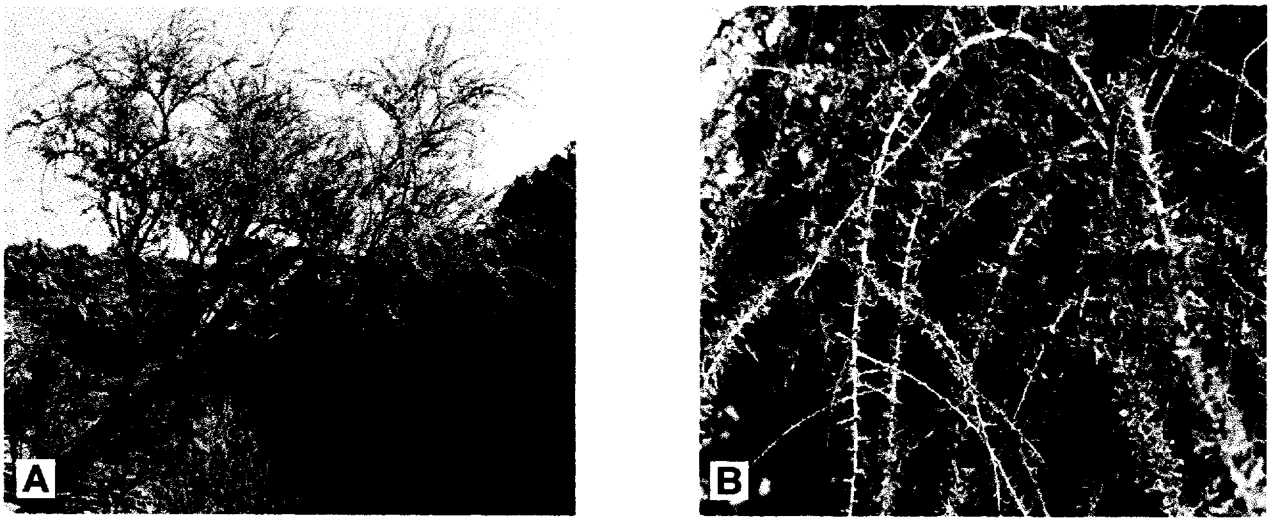


Figure 4.4
Shrubs with stems rigid but curved. A: *L. oxycarpum;* B: *L. schweinfurthii.*

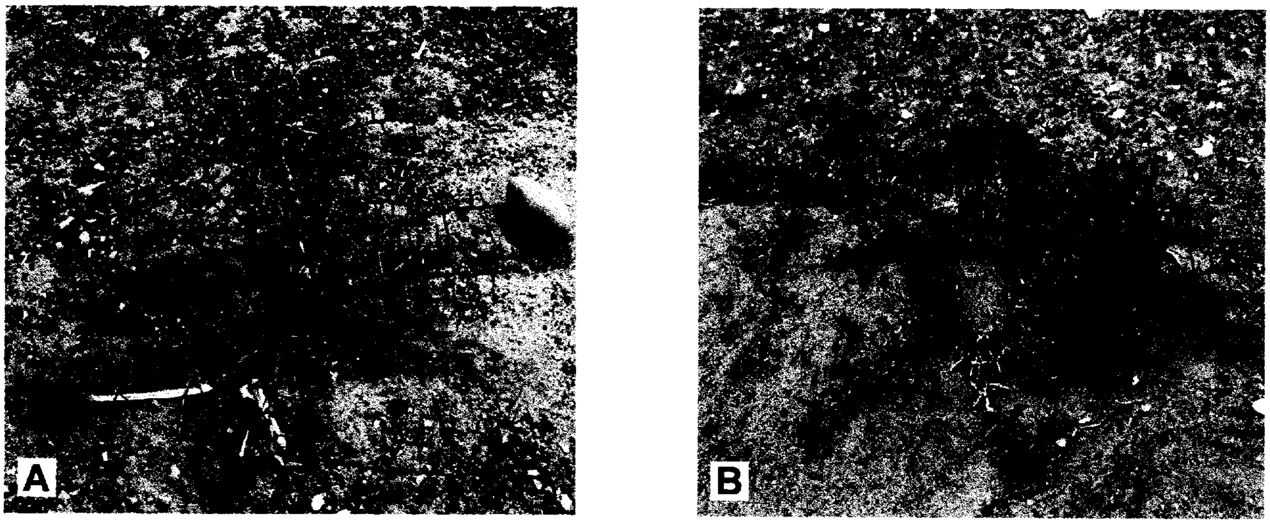


Figure 4.5
Shrubs decumbent. A & B: *L. decumbens.*

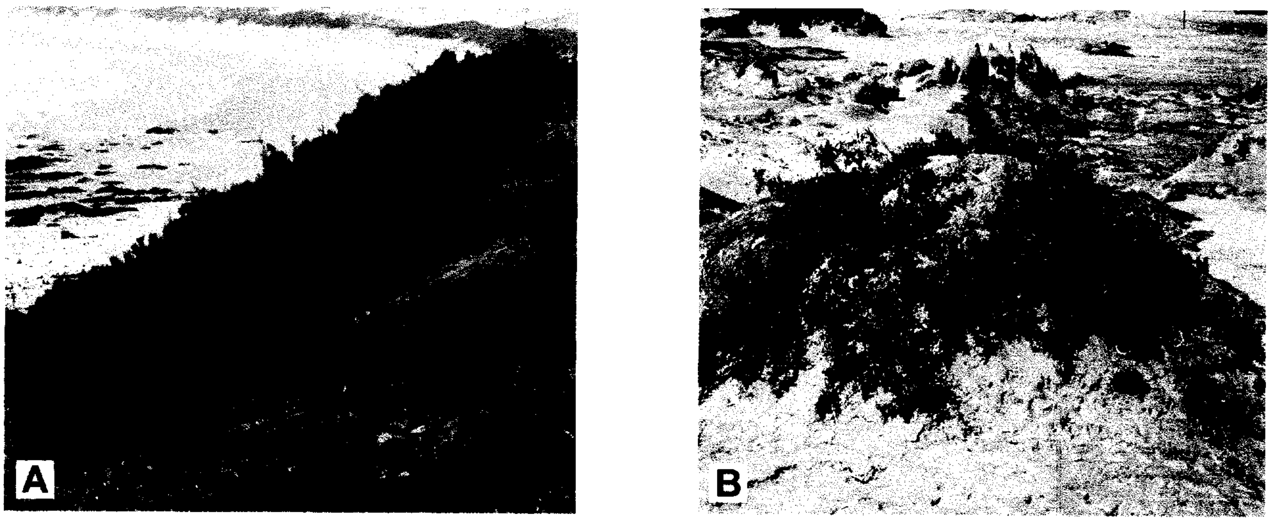


Figure 4.6
Dimorphic habit of *L. tetrandrum*. A: Bushy shrubs on a stabilized sea-facing dune;B: Shrub buried in a hump of windblown sand with only stem tips showing.

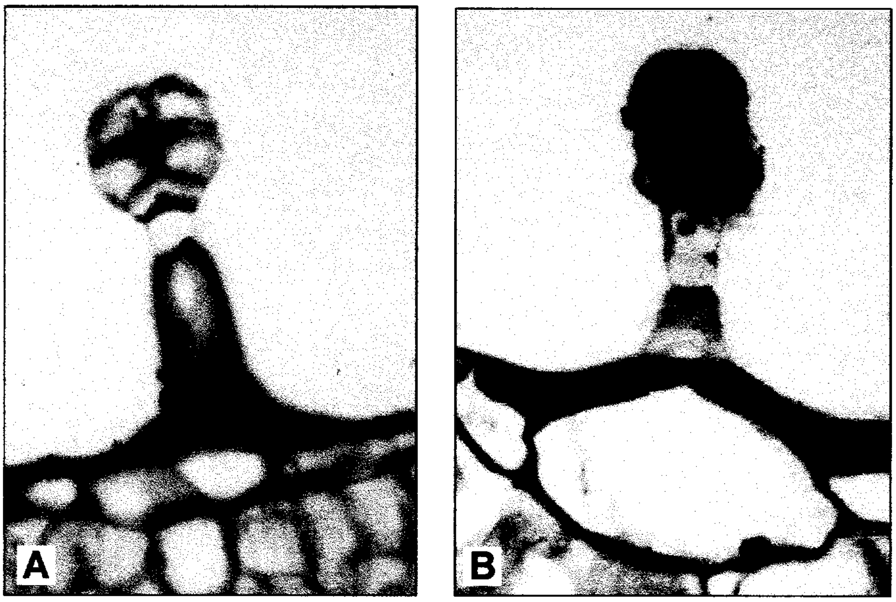


Figure 4.7
Short stalked glandular trichomes.A: Trichome with spherical head in *L. cinereum* ; B: Trichome with elongated head in *L. ferocissimum*.

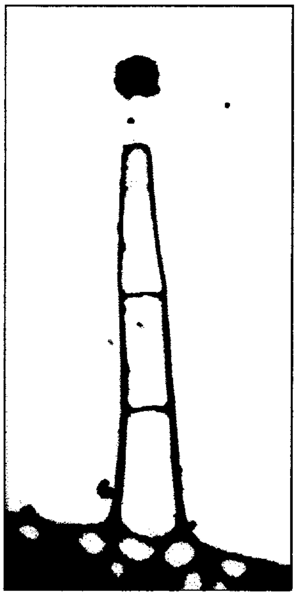


Figure 4.8
Long stalked glandular trichome of *L. pilifolium*.

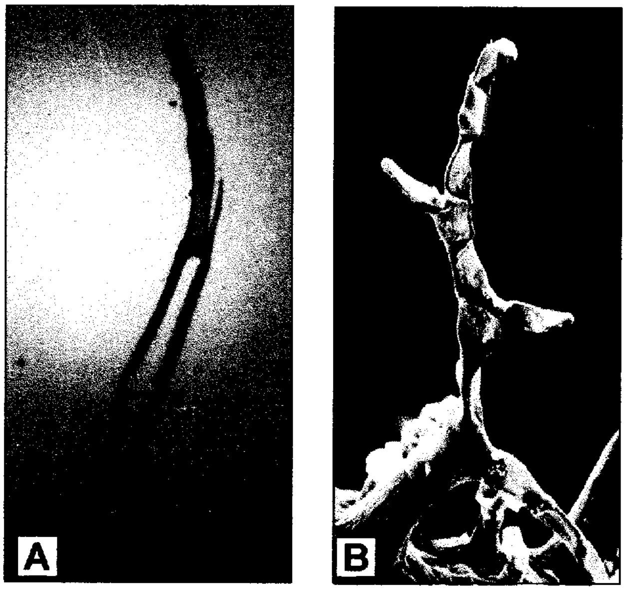


Figure 4.9
Eglandular trichomes.
A: Unbranched in *L. grandicalyx*;
B: Branched in *L. hirsutum*.

♦ The multicellular eglandular trichomes, which may be branched or unbranched, are found only in *L. grandicalyx, L. hirsutum* and *L. villosum* (Figure 4.9).

4.2.3 Thorns

All the species are thorny, even those where the young branches are virtually thornless, have thorns on older stems. In particular species, the nature and arrangement of the thorns are valuable diagnostic feature.

♦ In *L. gariepense* the thorns are slender and needle-like. Stout peg thorns are typical of *L. amoenum* and *L. ferocissimum* (Figures 4.10 & 4.11).

♦ In some species e.g. *L. hirsutum, L. horridum, L. tetrandrum* and *L. villosum* there is a gradual shortening of thorns from the older part of the stem upwards to the stem apex (Figure 4.12), giving a conical appearance. In *L. bosciifolium, L. oxycarpum, L. schweinfurthii* and *L. shawii* short thorns of about equal length, more or less 10–20 mm long, occur along the length of the stem (Figure 4.13). In the remainder of the species the thorns do not have a set pattern, but long and short thorns occur "mixed" or interspersed on all the stems (Figure 4.14).

4.2.4 Leaves

The leaf shape is mainly obovate, broadly or narrowly so, and sometimes elliptic. Both shapes can occur on the same plant. This characteristic has, therefore, no diagnostic value.

♦ The leaves are mostly succulent or semi-succulent. The habitat has a considerable influence on this characteristic. Exceptions are the herbaceous leaves of *L. acutifolium, L. amoenum, L. barbarum, L. hirsutum, L. shawii* and *L. villosum* (Figure 4.15).

Figure 4.10
Slender, needle-shaped thorns of *L. gariepense*.

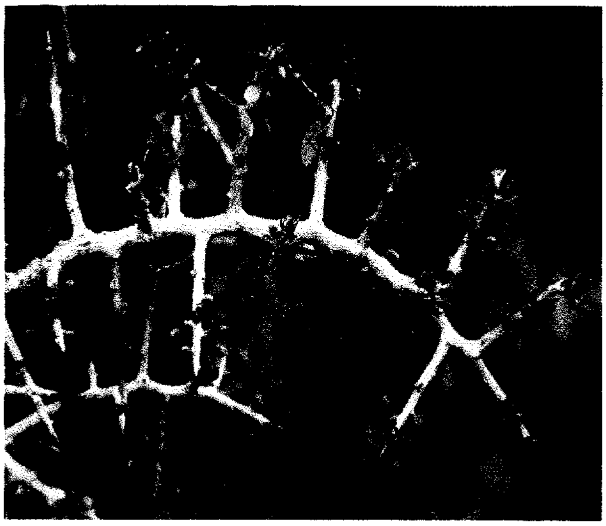


Figure 4.11
Stout peg-thorns of *L. ferocissimum*.

Figure 4.12
Thorns gradually shortening from older parts of the stem upwards towards the stem apex, resulting in a triangular outline, eg. *L. tetrandrum*.

Figure 4.13
Thorns of equal length on younger stems, as in *L. schweinfurthii*.

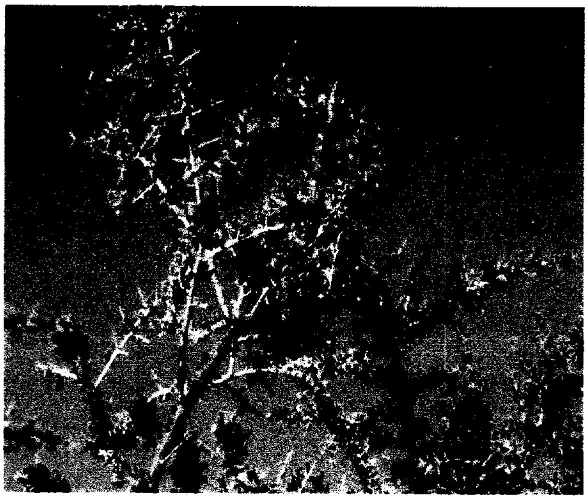


Figure 4.14
Long and short peg-thorns occurring unordered or "mixed" in *L. ferocissimum*.

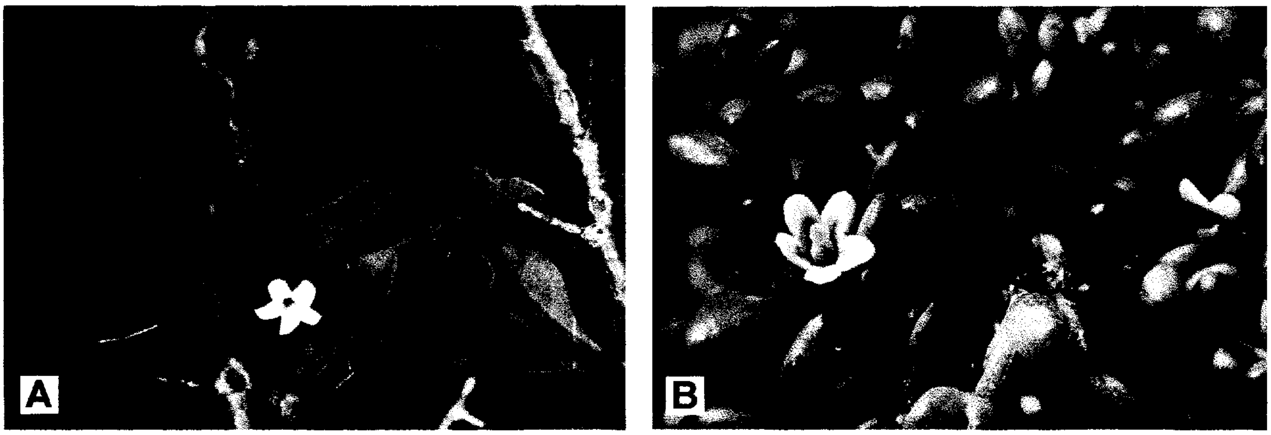


Figure 4.15
Leaf texture: A: Herbaceous leaves of *L. shawii;* B: Succulent leaves of *L. tetrandrum.*

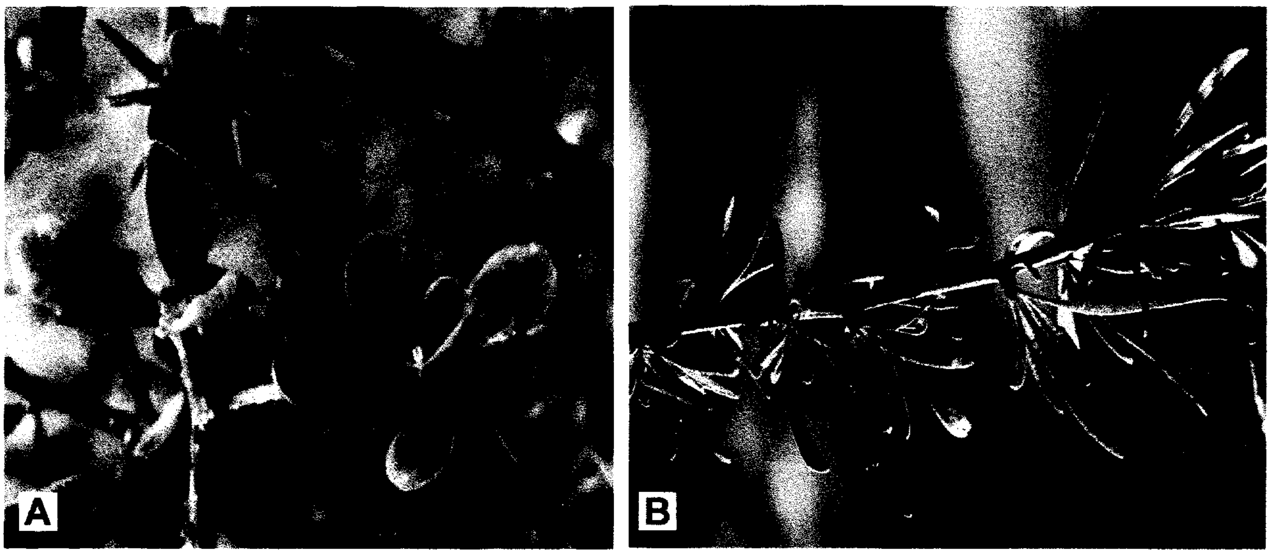


Figure 4.16
Leaf ratios, length:width ratio of A: 4:1 or less as in *L. ferocissimum*; B: 7:1 to 12:1 as in *L. schizocalyx.*

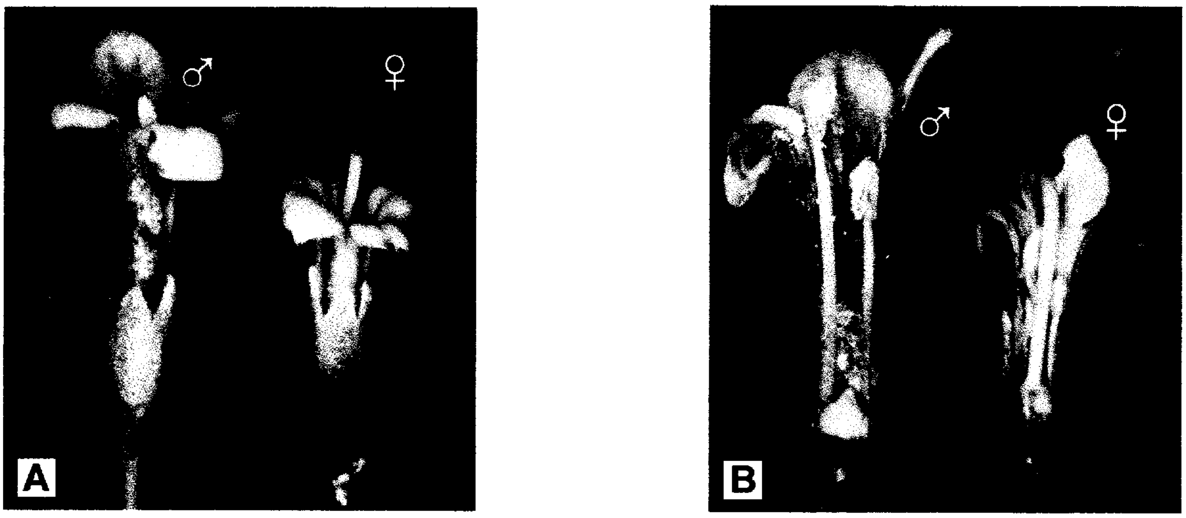


Figure 4.17
Cryptic dioecy in *L. arenicola*. A: Flowers externally: stamens just visible in male flower, style and stigma visible in smaller female flower; B: Flowers internally: style and stigma absent in male flower, pistil and stamens with infertile anthers in female flower.

♦ The ratio of length:width is, however, valuable in differentiating between a number of species. The ratios range from 3:1 to 4:1 in the broadly obovate and ellyptic leaves of *L. acutifolium, L. barbarum, L. eenii, L. ferocissimum, L. grandicalyx, L. shawii, L. hirsutum, L. pilifolium* and *L. villosum* to narrowly obovate leaves with a ratio of 7:1 to 12:1 in *L. afrum, L. bosciifolium, L. cinereum, L. decumbens, L. europaeum, L. gariepense, L. horridum, L. mascarenense, L. oxycarpum, L. pumilum, L. schizocalyx, L. schweinfurthii, L. strandveldense, L. tenue* and *L. tetrandrum* (Figure 4.16).

4.2.5 Sexuality

Most *Lycium*-species are bisexual but cryptic dioecy occurs in six species, *L. arenicola, L. horridum, L. gariepense, L. strandveldense, L. tetrandrum* and *L. villosum.*

♦ The flowers of the functionally male plants tend to have a funnel-shaped to narrowly funnel-shaped corolla, while 2 to 3 of the fertile stamens are slightly exserted from the corolla mouth and the undeveloped style and stigma are invisible externally (Figure 4.17).

♦ The flowers of the functionally female plants are tubular, slightly shorter than the male flowers of the particular species, the sterile stamens are completely included in the corolla tube and only the fully developed style and stigma are exserted from the corolla mouth. This difference in staminal and pistil characteristics were responsible for much of the species confusion in this genus (Figure 4.17).

4.2.6 Calyx

The shape of the calyx, the length of the calyx in comparison with the corolla tube length, as well as the degree of incision of the calyx, in other words, the length of

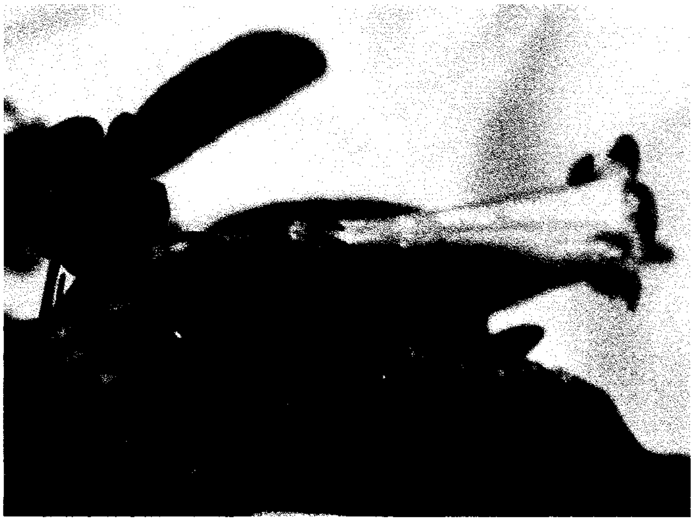


Figure 4.18
Pentamerous flowers of *L. oxycarpum*: calyx tubular, corolla long tubed and funnel-shaped, creamy white; corolla lobes small, semi-orbicular and mauve

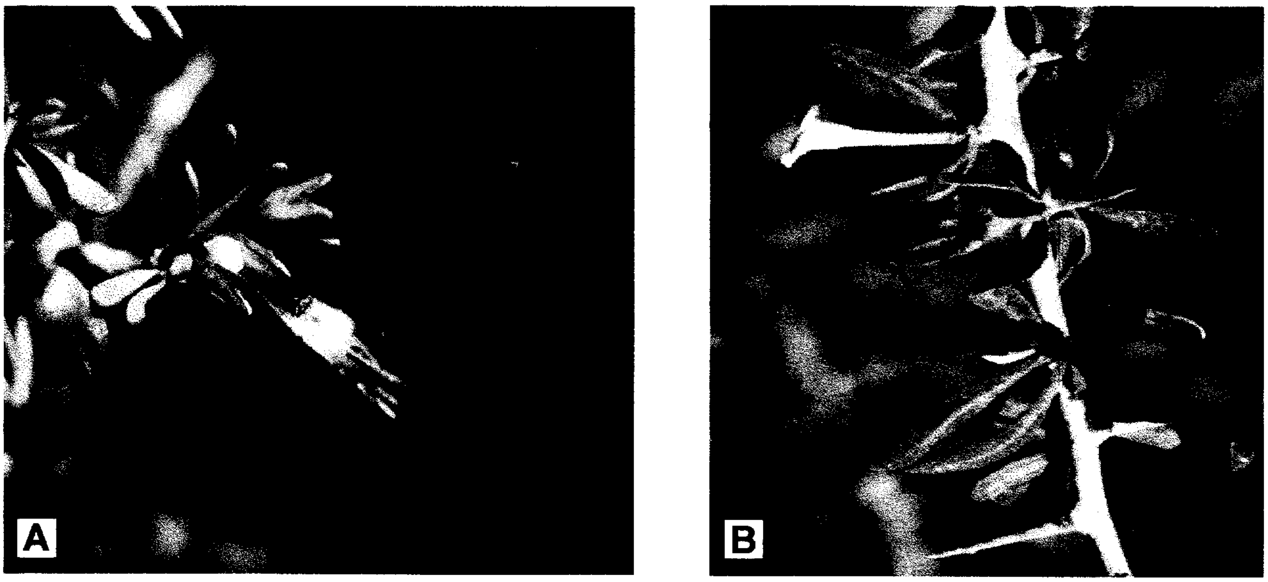


Figure 4.19
Calyx campanulate. Stamens included or slightly exserted from corolla mouth. A: *L. afrum* with tubular, claret colored corolla; B: *L. schweinfurthii* with funnel-shaped, white corolla.

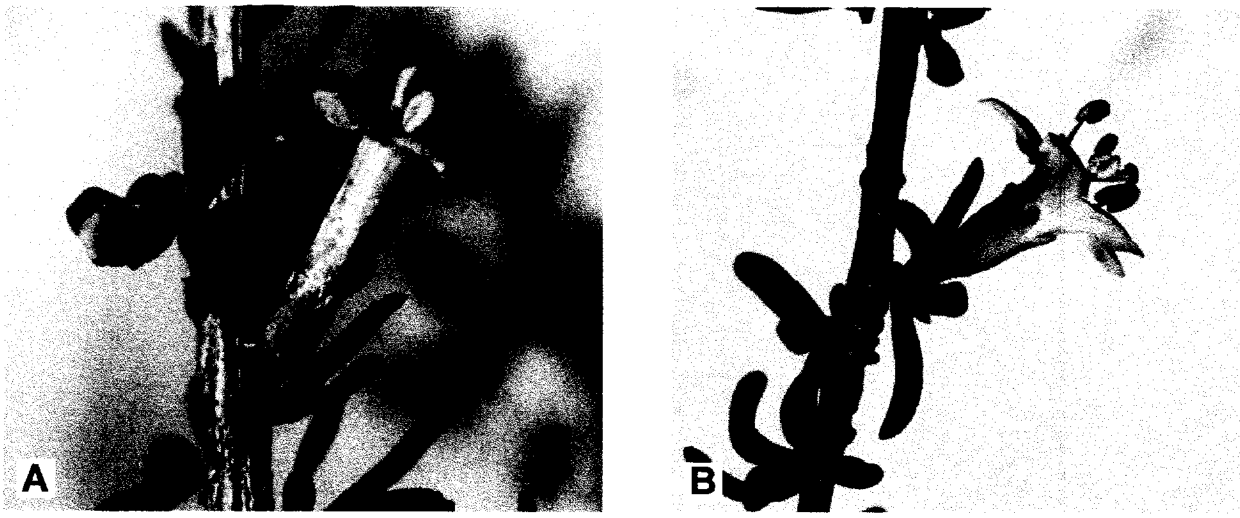


Figure 4.20
Calyx less than half as long as corolla tube with stamens slightly exserted from corolla mouth as in A: *L. horridum;* or calyx two-thirds and more as long as corolla tube with stamens clearly exserted from corolla mouth as in B: *L. pumilum.*

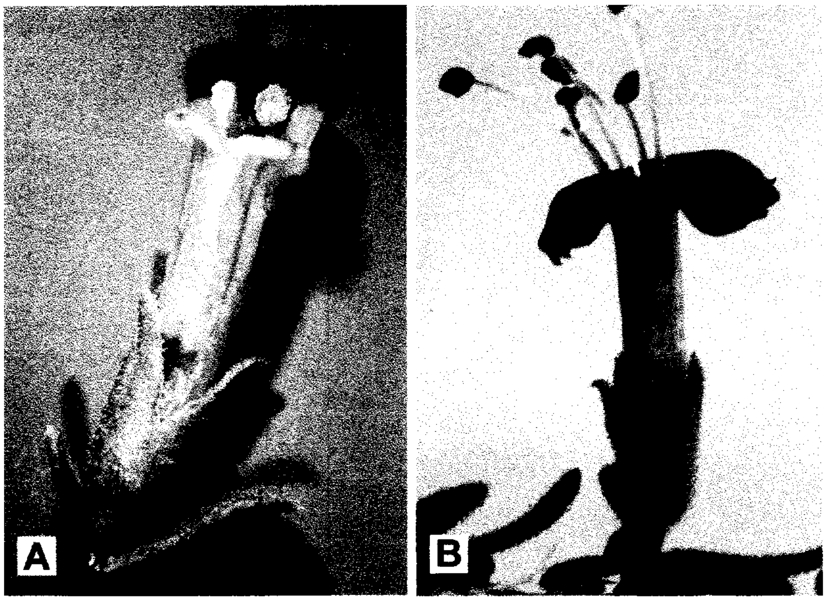


Figure 4.21
The incision of the calyx is at least halfway, resulting in calyx lobes and tube of about equal length.
A: *L. villosum*; B: *L. pilifolium.*

Figure 4.22
Enlarged and bladder-like calyx of *L. grandicalyx.*

Figure 4.23
Campanulate corolla of *L. amoenum*, with calyx also campanulate and tightly fitting around the corolla tube. The calyx lobes are small and less than the total calyx length.
The 6-merous corolla is abnormal.

the calyx lobes in comparison to the total calyx length, are of diagnostic value in some species.

♦ The calyx is distinctly tubular (that is about twice as long as wide) in *L decumbens, L. eenii, L. ferocissimum L. oxycarpum* and *L. shawii* or in other species, campanulate (length and width about equal) as in *L. afrum, L. amoenum, L. europaeum, L. schweinfurthii* (Figures 4.18 & 4.19). In the other species the distinction is not so conspicuous.

♦ The calyx is less than half the length of the corolla tube in the majority of species (Figure 4.20A), but in *L. decumbens, L. ferocissimum, L. grandicalyx, L.pilifolium, L. pumilum, L. schizocalyx* and *L. villosum* the calyx (tube and lobes) is at least 2/3 or more of the length of the corolla tube (Figure 4.20B).

♦ The calyx lobes are, normally, relatively small and less than 1/3 of the total calyx length (Figure 4.23), but in *L. hirsutum, L. pilifolium, L. schizocalyx* and *L. villosum* the incision of the calyx is halfway or more, and the lobes therefore, are as long as the calyx tube (Figure 4.21).

♦ In all the species, the calyx tube fits tightly around the base of the corolla (Figure 4.23), except in *L. grandicalyx* where the calyx is enlarged and bladder shaped (Figure 4.22).

4.2.7 Corolla characteristics

♦ The shape of the corolla can be regarded as tubular (Figure 4.19), funnel-shaped (infundibuliform) (Figure 4.19) or campanulate. Most of the African species have either tubular or funnel-shaped corollas, but in *L. amoenum* and *L. pumilum* a distinctly campanulate corolla tube is found (Figure 4.23).

♦ The corolla tube length varies considerably, but all species can be classified as having either long or short corolla tubes. For diagnostic purposes the length of the corolla tube is divided into long (10 mm and longer) and short (shorter than 10 mm). Species with a long tube are *L. afrum, L. bosciifolium, L. europaeum, L. hirsutum, L. oxycarpum, L. schweinfurthii* and *L. shawii*. All the other African species have short tubes.

♦The colour of the corolla tube is typically creamy-white, often with distinctive mauve to lilac lobes and purple venation in the majority of species (Figure 4.18). The corolla is completely white in some species, these being *L. acutifolium, L. eenii, L. hirsutum* and *L. shawii*. The dark maroon-purple corolla of *L. afrum* is very distinct (Figure 4.19), as is the dark purple lobes and greenish purple tube of *L. strandveldense*.

♦ The characteristics of the corolla lobes are of taxonomic value in a number of species. The corolla can be deeply divided resulting in large lobes, which may be as long as half of, but not shorter than one third, of the corolla tube and distinctly reflexed, as in *L. barbarum, L. cinereum, L. decumbens, L.grandicalyx, L. ferocissimum, L. pilifolium, L. pumilum, L. schizocalyx* and *L. tenue* (Figures 4.21B & 4.24). Shallow incision of the corolla results in lobes that are much shorter than the tube and that are spreading as in *L. afrum, L. acutifolium, L. amoenum, L. arenicola, L. bosciifolium, L. eenii, L. europaeum, L. gariepense, L. hirsutum, L. horridum, L. mascarenense, L. oxycarpum, L. schweinfurthii, L. strandveldense, L. shawii, L. tetrandrum* and *L. villosum* (Figures 4.18 & 4.19).

♦ Pentamerous flowers are characteristic of *Lycium* but *L. arenicola, L. gariepense, L. horridum* and *L. tetrandrum* (Figures 4.15 & 4.25) both tetra- and pentamerous flowers occur.

4.2.8 Stamen characteristics

The stamens are epipetalous and normally inserted about halfway in the corolla tube. The position of insertion varies and is of little diagnostic value.

♦ A very useful characteristic is the exsertion of the stamens from the corolla tube or their inclusion in the tube. The stamens are conspicuously exserted in all those species where the flowers have short corolla tubes with large reflexed corolla lobes (Figures 4.21B; 4.22 & 4.24), but are included or only slightly exserted in the species that have relatively long tubular and narrowly funnel-shaped corollas with small lobes (Figures 4.18; 4.19; 4.20A & 4.23). The exception here is *L. bosciifolium*, with narrowly funnel-shaped corollas, small, spreading lobes but with conspicuously exserted stamens (Figure 4.26). "Slightly exserted" stamens are defined as stamens reaching the mouth of the corolla and two or three of the anthers just protruding from the corolla tube mouth.

♦ The bases of the stamens are usefully glabrous in *L. europaeum, L. schweinfurthii* and *L. shawii* and sparsely to densely pilose in all the other species (Figure 4.27).

4.2.9 Nectaries

♦ The colour of the nectary has differentiating value. The nectaries occur in three colours, viz. red, golden-yellow and pale green. Four of the functionally dioecious species, namely *L. arenicola, L. horridum, L. tetrandrum and L. villosum*, as well as the *bisexual L. decumbens, L. ferocissimum, L. hirsutum, L. pumilum* and *L. schizocalyx* have red nectaries (Figure 4.28B). Honey-yellow nectaries occur in *L. acutifolium, L. amoenum, L. cinereum L. mascarenense, L. pilifolium, L. schizocalyx, L. tenue* and dioecious *L. strandveldense* (Figure 4.28C). The nectaries of *L. afrum, L. barbarum, L. bosciifolium, L. eenii, L. europaeum, L.*

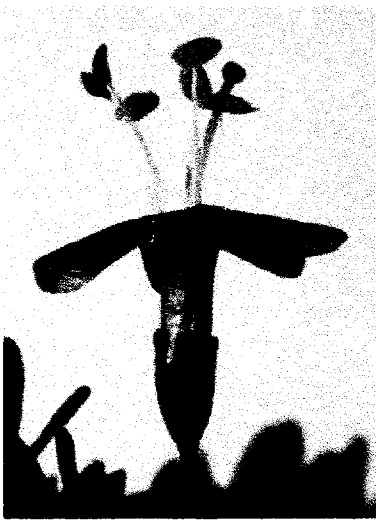


Figure 4.24
Corolla deeply incised with large, reflexed lobes in *L. cinereum*.

Figure 4.25
Tetramerous flowers of *L. tetrandrum.*

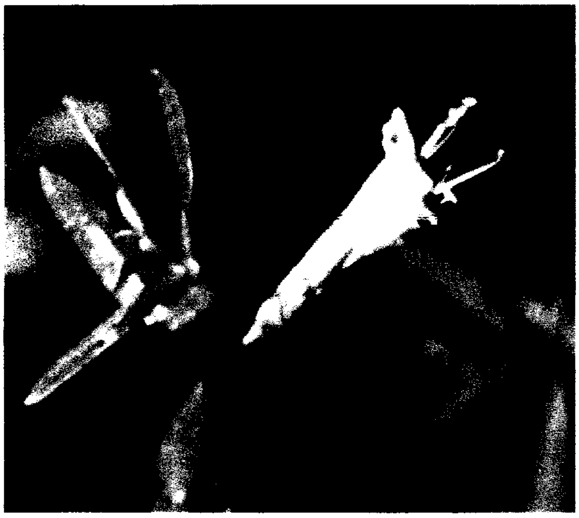


Figure 4.26
Narrowly funnel-shaped corolla of *L. bosciifolium* with stamens clearly exserted from the corolla mouth.

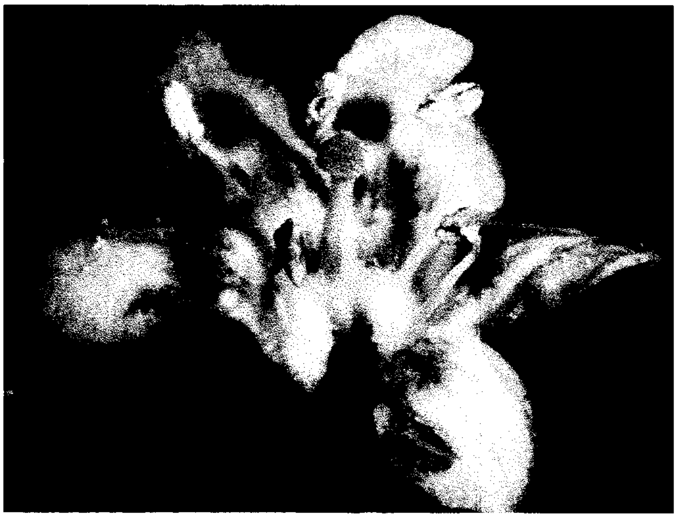


Figure 4.27
Stamens epipetalous with filament bases densely pilose as in *L. pumilum.*

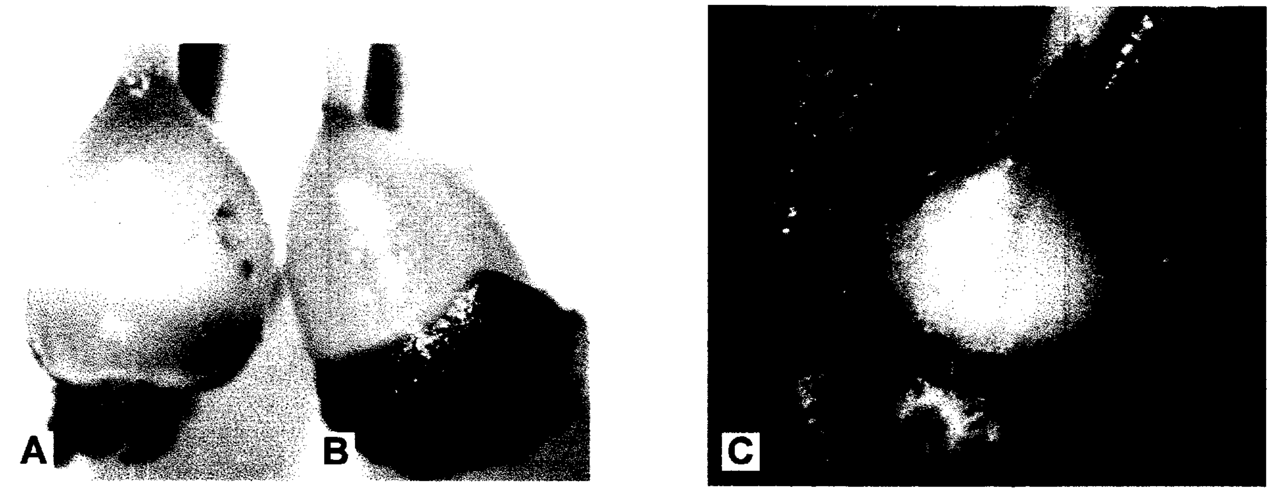


Figure 4.28
Nectaries can be A: inconspicuously greenish-white as in *L. oxycarpum*, or B: conspicuously red as in *L. hirsutum* or C: golden-yellow as in *L. pilifolium.*

grandicalyx, L. oxycarpum, L. schweinfurthii and *L. shawii* are pale greenish yellow and very inconspicuous (Figure 4.28A). The nectary colour in *L. gariepense* is, uncharacteristically, variable from golden-yellow to red. This could probably be the result of recent hybrid origin of the species.

♦ The annular nectary surrounding the ovary base can be well developed and conspicuously enlarged or morphologically indistinct from the ovary tissue, independent of the nectary's colour. The yellow nectaries of *L. amoenum* and *L. pilifolium*, and the red nectaries of *L. arenicola, L. hirsutum, L. tetrandrum* and *L. villosum* are well developed or "conspicuous" and form an enlarged ring around the base of the ovary, while the other species have undeveloped structures which are only discernable from the ovary tissue by their colour (Figure 4.29). This characteristic is visible only in fresh material because the colour of the nectary fades with drying. Therefore, although a very useful distinguishing field characteristic, it is of no use when identifying herbarium specimens.

4.2.10 Fruit colour

In most of the species the berries turn red when ripening (Figure 4.30), the exceptions being *L. afrum* and *L. schweinfurthii* with black berries and *L. pilifolium* with yellow berries (Figures 4.31 & 4.32).

On some plants of *L. arenicola* and *L. bosciifolium* black berries have been observed, sometimes together with the expected red berries on the same plant. However, the latter two species do not occur in the same distribution range as *L. afrum* and *L. schweinfurthii*.

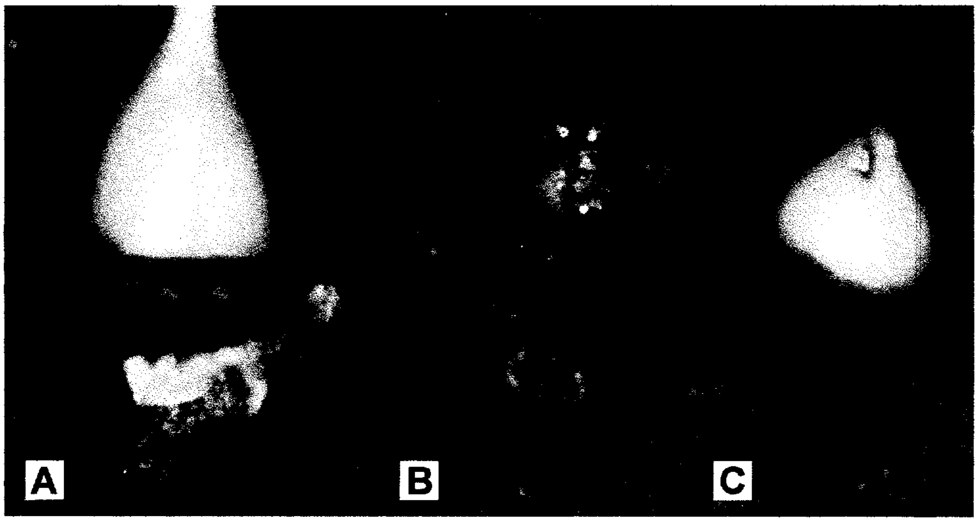


Figure 4.29
The nectary can be well developed as in A: *L. hirsutum* and B: *L. tetrandrum*, or C: undeveloped as in *L. horridum.*

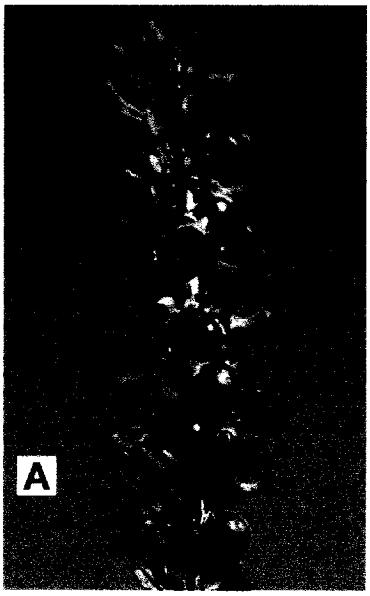


Figure 4.30
Red spherical or ovate berries of:A: *L. cinereum* and B: *L. strandveldense.*

Figure 4.31
Black berries of *L. schweinfurthii.*

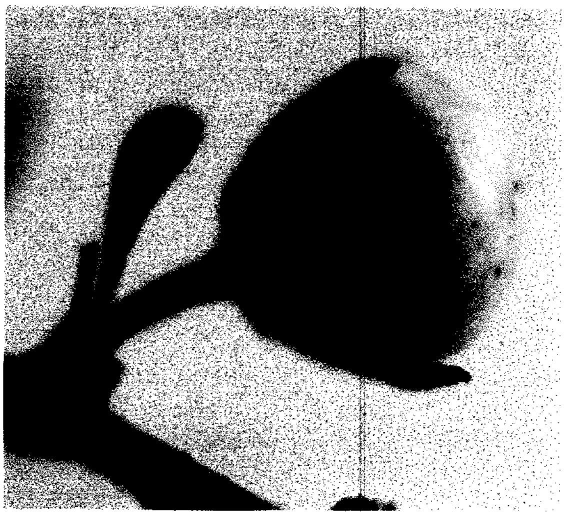


Figure 4.32
Yellow berries of *L. pilifolium.*

CHAPTER 5

CYTOGENETICS

5.1 Introduction

Chromosome numbers are known for a number of *Lycium* species from South America (Bernardello 1982), North America (Chiang 1981), Africa (Spies *et al.* 1993) Europe (Baquar 1967, Kiehn *et al.* 1991) and China (Gao & Zang 1984). *Lycium* accordingly, has a secondary basic chromosome number of n = x = 12 with polyploidy also present. Ploidy levels range from diploid (2n = 2x = 24) to hexaploid (2n = 6x = 72) (Spies *et al.* 1993), and octaploid (2n = 8x = 96) (Chiang 1981).

The aim of this cytogenetic study was fourfold:

1. To determine the chromosome numbers and ploidy levels of the African *Lycium* species.
2. To investigate the chromosomal behaviour and abnormalities of certain species and known hybrids to determine the possible hybrid status/origin of polyploid species.
3. To apply the chromosomal information obtained to taxonomic problems.
4. To analyse embryo sacs of representative *Lycium* species to determine their diagnostic value.

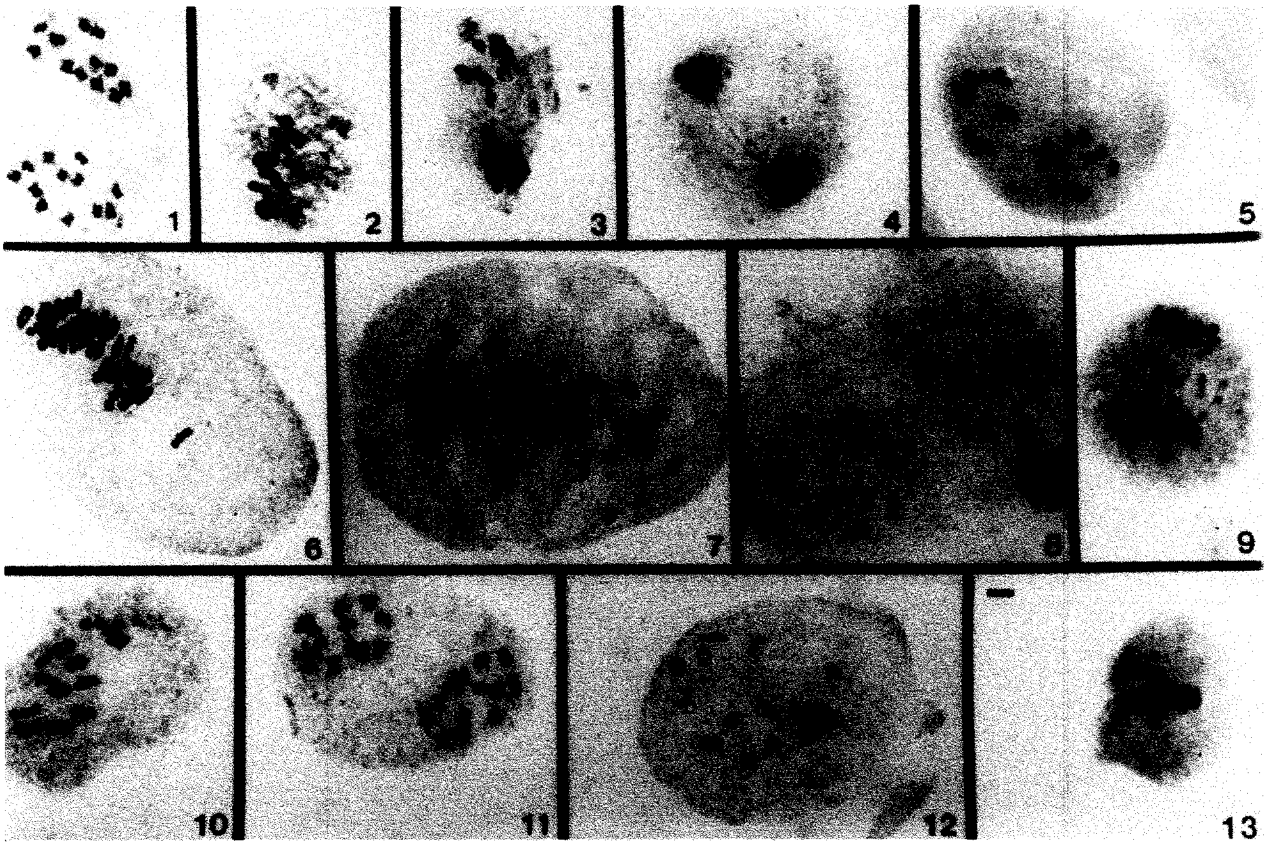
5.2 Results and discussion

Seventy-eight specimens, representing 24 of the 25 African *Lycium* species and three interspecific hybrids, have been analysed (Table 5.1, p 61). Eleven African species have been studied previously, i.e. *L. afrum* (Bernardello 1982, Castroviejo 1982, 1983, Spies *et al.* 1993). *L. arenicola* (Spies *et al.* 1993), *L. cinereum* (Minne 1992), *L. europaeum* (Bir *et al.* 1978, Bernardello 1982), *L. ferocissimum* (Minne 1992), *L. hirsutum* (Minne 1992). *L. horridum* (Spies *et al.* 1993), *L. oxycarpum* (Minne 1992), *L. schizocalyx* (Minne 1992), *L. tetrandrum* (Spies *et al.* 1993), *L. villosum* (Spies *et al.* 1993).

The basic chromosome number of all these species conforms to the published number of x = 12 (Bernardello 1982, Spies *et al.* 1993). The chromosome numbers observed are indicated in Table 5.2, p 65. The species are discussed in alphabetical order.

L. acutifolium

This South African bisexual species is diploid (2n = 2x = 24) (Figures 5.1 & 5.2). Meiosis is relatively normal, with the exception of a low percentage (less than 5%) chromatid bridges observed in anaphase I (Figure 5.3) and telophase I cells (Figure 5.4) of two specimens. All the specimens studied were collected in close proximity and do not represent the total geographical range of distribution of *L. acutifolium* which stretches from the Mozambique/Kwazulu-Natal border to the Eastern Cape. *L. acutifolium* is geographically isolated and, although the growth form varies from scandent to bushy or prostrate because of browsing, very little variation is found in the vegetative and floral characteristics. It would



Figures 5.1 - 5.13 Meiotic chromosomes in *Lycium*. 1-4. *L. acutifolium*. 1. *A. M. Venter 426*, anaphase I with 12 chromosomes in each cell. 2. *A. M. Venter 225*, metaphase I with 12_{II}. 3. *A. M. Venter 427*, anaphase I with a lagging chromatid. 4. *A. M. Venter 427*, telophase I with a chromatid bridge. 5. *L. afrum, A. M. Venter 511*, late anaphase I with a 12-12 segregation. 6-9. *L. arenicola*. 6. *A. M. Venter 361*, metaphase I. 7. *A. M. Venter 341*, late metaphase I with various univalents or early segregating chromosomes. 8. *A. M. Venter 361*, early metaphase II (polar view) with 36 chromosomes in each cell. 9. *A. M. Venter 330*, late anaphase I with various laggards. 10-11. *L. bosciifolium*. 10. *A. M. Venter 407*, diakinesis with 12_{II}. 11. *A. M. Venter 398*, anaphase I with 12 chromosomes in each cell. 12-13. *L. amoenum*, *A. M. Venter 563*. 12. Diakinesis with 12_{II} and a B-chromosome (indicated by an arrow). 13. Metaphase I with univalent (or B-chromosome) away from the equator. Scale bar = 6.4 µm.

therefore be surprising to find different ploidy levels in plants from the rest of the distribution range.

L. afrum

This bisexual species is diploid (2n = 2x = 24) (Figure 5.5), thus confirming previous reports (Bernardello 1982, Castroviejo 1982, 1983, Spies *et al.* 1993). The present study, together with the study of Spies *et al.* (1993), covered the total distribution area of *L. afrum* in the south-western and western coastal region of the Cape Province of South Africa and no other ploidy levels are expected. Although *L. afrum* occurs in the same environment as *L. amoenum, L. ferocissimum* and *L. tetrandrum,* and borders on the distribution ranges of *L. horridum, L. oxycarpum* and *L. cinereum,* hybridisation was found to occur with only *L. ferocissimum*, although *L. afrum* is most probably one parent of *L. strandveldense*.

L. amoenum

Both specimens of this bisexual species studied were diploid (2n = 2x = 24) (Figures 5.12 & 5.13). In most of the cells of *A. M. Venter 563* one small additional chromosome, which stained darker than the normal chromosomes, was present. These may have been B-chromosomes. The specimens studied were collected in the centre of the distribution range of this western Cape/Namaqualand species and more plants from the northern and southern limits should be studied to confirm the diploid condition of the species or reveal other ploidy levels.

L. arenicola

This dioecious species proved to be both tetraploid (2n = 4x = 48) and hexaploid (2n = 6x = 72) (Figures 5.6-9). The latter chromosome number conforms to that reported by Spies *et al.* (1993). Various univalents (Figure 5.7) were observed during metaphase I and chromosome laggards (Figure 5.9) were often observed during anaphase I. The tetraploid plant was encountered at the western extreme of the species' distribution range, however, hexaploid plants (Spies *et al.* 1993) were found in the same area. The present and previous investigations represent the total distribution range of *L. arenicola*.

A high frequency of chromosomal abnormalities, present during the metaphase and anaphase stages of meiosis, is usually the product of interspecific hybridisation (Spies *et al.* 1993). A considerable number of these abnormalities were identified in *L. arenicola*, these being univalents, laggards and anaphase bridges. This clearly suggests a hybrid origin for *L. arenicola,* with *L. horridum* probably one of the parents. Where such a high degree of cytogenetical abnormalities occur in a plant species, a decrease in fertility is to be expected (Spies *et al.* 1993). The 'hybrid' *L. arenicola*, however, is a very vigorous species and a most prolific reproducer (own observations substantiated by information on herbarium sheets).

L. barbarum

The chromosome number for this bisexual species is 2n = 2x = 24 (Gao & Zang 1984, Kiehn *et al.* 1991). This Asian species was introduced into Europe centuries ago, and from there it spread or was introduced to the extreme north of Algeria. As an introduced species, *L. barbarum* was excluded from the present cytogenetic study.

L. bosciifolium

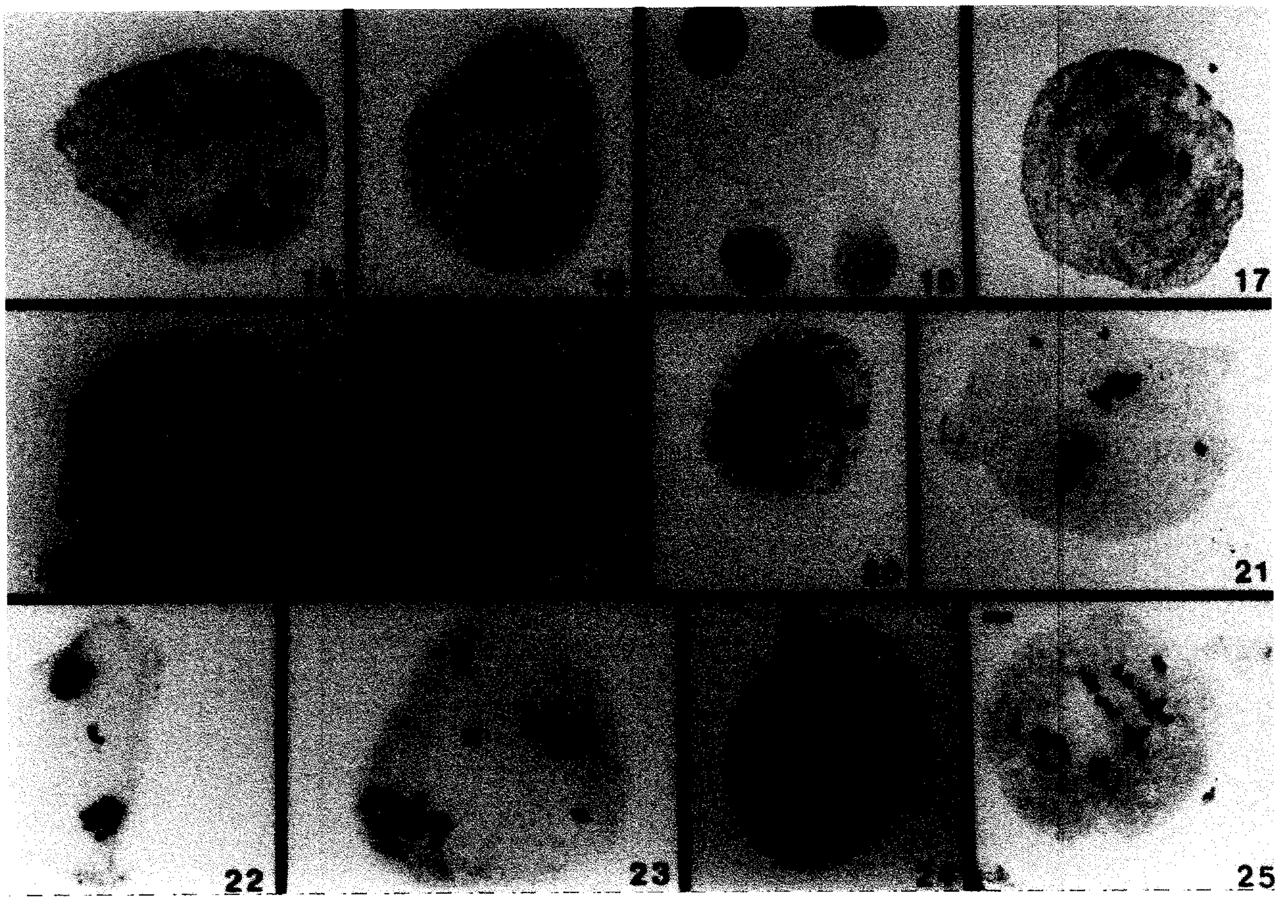
A bisexual diploid (2n = 2x = 24) species. The specimens examined (Figures 5.10 & 5.11) covered the southern part of this species' distribution range in the northern Cape and southern Namibia well. Vegetative and floral characteristics of *L. bosciifolium* show little variation over its distribution range and differing ploidy levels are thus not anticipated.

L. cinereum

A diploid chromosome number (2n = 2x = 24) was observed (Figures 5.14 & 5.15) and Minne (1992) in this bisexual species. Meiosis was normal in all the specimens which represented the total distribution range of this widely spread South African species. This cytogenetic study supports the present delimitation of *L. cinereum* that, previously, was regarded as a problem species aggregate (Dean 1974).

L. decumbens

Only one suitable specimen was found and collected of this rather rare Namibian/Angolan bisexual desert species. This specimen proved to be diploid (2n = 2x = 24) (Figure 5.16). Because of its limited distribution, habitat specificity and morphological uniformity, more ploidy levels are not expected, but more specimens should be studied to confirm this supposition.



Figures 5.14 - 5.25 Meiotic chromosomes in *Lycium*. 14-15. *L. cinereum*. 14. *A. M. Venter 450*, anaphase I with 12 chromosomes in each pole. 15. *A. M. Venter 336*, late anaphase I with 12 chromosomes in each pole. 16. *L. decumbens, A. M. Venter 621*, pollen mitosis indicating 12 chromosomes per cell. 17. *L. eenii, A. M. Venter 491*, metaphase I with 12_{II}. 18. *L. europaeum, A. M. Venter 577*, anaphase I with 12 chromosomes in each pole. 19-23. *L. ferocissimum*. 19. *A. M. Venter 345*, diakinesis with 12_{II} (two bivalents laying on top of two other ones on right side of photo visible as separate bivalents under the microscope). 20. *A. M. Venter 442*, anaphase I with 12 chromosomes in each cell. 21-23. *A. M. Venter 354*, meiocytes with univalents during metaphase I (21) and micronuclei during telophase I (22-23). 24. *L. gariepense, A. M. Venter 622*, anaphase I with a 12-12 segregation. 25. *L. grandicalyx, A. M. Venter 485*, early metaphase I with 11_{II} and 2_{I}. Scale bar = 6.4 µm.

L. eenii

The two specimens examined, were diploids (2n = 2x = 24) (Figure 5.17). Both specimens come from the Windhoek area and more specimens should be studied to determine whether polyploidy occurs in this widely spread Namibian species. Although widespread, this is a uniform, very distinct species, no hybridisation with other species has been noted, and following the pattern observed in the other bisexual species, a higher ploidy level is not anticipated.

L. europaeum

The diploid (2n = 2x = 24) chromosome number observed (Figure 5.18) in this bisexual taxon confirms previous reports by Bir *et al.* (1978) and Bernardello (1982). The specimen studied for this investigation, was collected in Spain as specimens from north Africa were not available. Considering the distribution pattern of *L. europaeum,* it is probably indigenous to the winter rainfall regions of North Africa and of the Mediterranean region of southern Europe.

A triploid specimen (2n = 3x = 36) reported by Bernardello (1982) does not fit the diploid chromosomal pattern of the bisexual species of Africa.

L. ferocissimum

A bisexual species with diploid (2n = 2x = 24) chromosome complement (Figures 5.19-23 and Minne 1992). Various metaphase I univalents (Figure 5.21), and anaphase I laggards (Figures 5.22 & 5.23) were observed. These abnormalities may be associated with the ability of this species to hybridise with other species. Two such interspecific hybrids were investigated in the present study, i.e. *L. afrum x L. ferocissimum* (2n = 2x = 24) and *L. ferocissimum x L.*

horridum (2n = 4x = 48) (Figures 5.42 & 5.43). The relatively normal meiosis observed in these hybrid plants suggests a close chromosomal relationship between the species concerned. The prevalence of *L. ferocissimum* as one of the hybrid parents, indicates that it may be a pivotal species in the origin of new species in *Lycium* in the Cape and Eastern Cape regions of South Africa.

L. gariepense

A dioecious species of the extreme south-western mountainous desert of Namibia. Diploid (2n = 2x = 24) and tetraploid (2n = 4x = 48) (Figure 5.24) chromosome numbers were found. Morphologically this Namib endemic seems to be of hybrid origin because some of its characteristics are rather variable. An example is the red nectary found in the flowers of some plants but a brownish yellow nectary in others. Two other species occur in the same region, namely, *L. bosciifolium* (a diploid, with a brownish yellow nectary) and *L. horridum* (a tetraploid, with a distinctly red nectary). Morphologically such a cross seems possible as *L. gariepense* exhibits characteristics found in both *L. horridum* and *L. bosciifolium.* Hybridization between these two 'parent' species may explain the presence of both diploid and tetraploid chromosome numbers in *L. gariepense.*

An interspecific hybrid of *L. bosciifolium* x *L. horridum* (2n = 2x = 24) was collected among its two 'parent' species in the northern Cape. Relative normal meiosis was observed in this hybrid suggesting a close chromosomal relationship between these two species. Morphologically there is no resemblance between this hybrid and *L. gariepense,* the latter species being, presumably, the product of hybridisation between *L. bosciifolium* x *L. horridum.*

L. grandicalyx

This rare, distinctive, bisexual endemic of the Namib Desert edge is diploid (2n = 2x = 24) (Figure 5.25). With the exception of one metaphase I cell containing two univalents, meiosis was normal in the specimen studied. *L. grandicalyx* is restricted to the black dolomitic limestone terraces in the far south-west of Namibia.

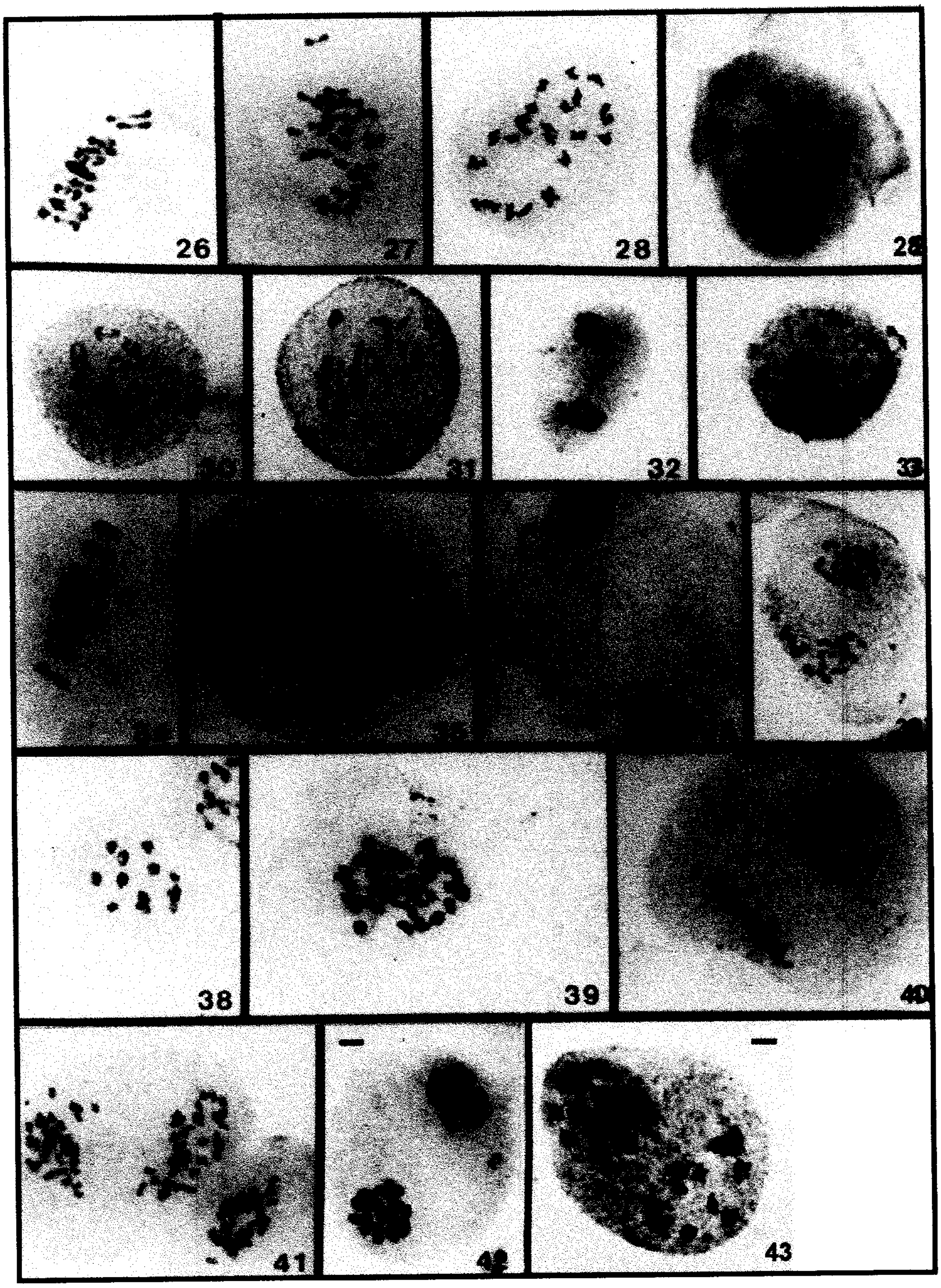
L. hirsutum

L. hirsutum is a diploid (2n = 2x = 24) (Figure 5.26 and Minne 1992), bisexual species covering an extensive range which extends from the Eastern and Western Cape, to the central Free State, Northern Cape, Northwest Province and Namibia. Although polyploidy is not expected in this taxon, more geographically representative specimens should be examined.

L. horridum

Spies *et al.* (1993) determined that this dioecious species is a tetraploid (2n = 4x = 48). Two more plants were examined in the present investigation and one proved to be diploid (2n = 2x = 24) (Figure 5.27) and the other tetraploid (2n = 4x = 48). The tetraploids were all collected in the Free State and Northern Cape, but the diploid plant was found in Namibia, on the northern edge of *L. horridum*'s range of distribution.

Considerable morphological variation occurs in *L. horridum*, often indicative of a hybrid origin. This supposition is supported by the meiotic abnormalities, including anaphase laggards and micronuclei, observed during chromosomal analyses (Spies *et al.* 1993). Meiosis, however, was found to be relatively



Figures 5.26 - 5.43 Meiotic chromosomes in *Lycium*. 26. *L. hirsutum, A. M. Venter 394*, metaphase I with 12_{II}. 27. *L. horridum, H. J. T. Venter 9232*, late metaphase I with 24 bivalents starting to segregate. 28. *L. mascarenense, A. M. Venter 457*, metaphase II (polar view) with 12 chromosomes per cell. 29. *L. oxycarpum, A. M. Venter 337*, diakinesis with 12_{II}. 30-31. *L. pilifolium, A. M. Venter 580*, diakinesis (30) with 12_{II} (note loosely paired bivalent) and metaphase I (31) with 11_{II} and 2_{I}. 32. *L. pumilum, A. M. Venter 367*, late anaphase I. 33. *L. schizocalyx, A. M. Venter 545*, early metaphase I with 12_{II}. 34-35. *L. schweinfurthii, A. M. Venter 576*, metaphase I (36) with one univalent and diakinesis (35) with 12_{II}. 36. *L. shawii, A. M. Venter 574*,late anaphase I with 12 chromosomes in each pole. 37. *L.* sp. nov. *'strandveldense', A. M. Venter 477*, late anaphase I with 24 chromosomes in each pole. 38. *L. tenue, A. M. Venter 438*, diakinesis with 12_{II}. 39-41. *L. tetrandrum*. 39. *A. M. Venter 395*, diakinesis with 36_{II}. 40-41. *A. M. Venter 500*, metaphase II. 42. *L. horridum* x *L. ferocissimum, Spies 5054*, anaphase I with 24 chromosomes per pole. 43. *L. afrum* x *L. ferocissimum A. M. Venter 445*, late anaphase I with 12 chromosomes per pole.
Scale bar = 6.4 µm.

normal. The uncharacteristic diploidy found in the one plant, may be a residual characteristic of one original diploid parent.

L. mascarenense

Three diploid (2n = 2x = 24) (Figure 5.28) and one tetraploid (2n = 4x = 48) specimens were observed for this, in Africa, rare species. It is a bisexual taxon and based on observations in the other bisexual species, the one specimen with tetraploid number is unexpected. The vegetative characteristics and habitat requirements of this species are rather distinct from that of the other African species. More material, covering the Mascarene Islands, Madagascar and Mozambique should be studied to determine the flow of ploidy in this species. It will be of great interest to know whether *L. mascarenense* is an African species that migrated to Madagascar and the Mascarene Islands, or vice versa, from Asia where a number of *Lycium* species occur.

L. oxycarpum

A bisexual diploid (2n = 2x = 24) (Figure 5.29 and Minne 1992). The specimens studied represent the distribution range of this South African karoo species well and no other ploidy levels are expected.

L. pilifolium

L. pilifolium, which occurs widespread from South Africa to Namibia, is bisexual and diploid (2n = 2x = 24) (Figures 5.30 & 5.31). Specimens from its central and western range of distribution were examined and more from the eastern and northern range should be studied, but, as this is a clearly delimited, uniform taxon, diploidy is probably typical.

L. pumilum

A diploid (2n = 2x = 24) (Figure 5.32) which is found widespread in the Karoo/namib scrub of South Africa and Namibia. Although its extensive range of distribution warrants analysis of more specimens, this well defined species will probably have no higher ploidy numbers.

L. schizocalyx

This bisexual species is diploid (2n = 2x = 24) (Figure 5.33 and Minne 1992). One specimen was examined in the present investigation, the other by Minne (1992) and additional material of this widely spread species from South Africa, Namibia and Botswana should be studied. Morphological delimitation from *L. cinereum* proved problematic, probably because of some shared genes.

L. schweinfurthii

One specimen, collected in Egypt and representing the eastern extreme of its distribution range in Africa, but also the type locality of *L. schweinfurthii*, was studied. This specimen proved to be diploid (2n = 2x = 24) (Figures 5.34 & 5.35). *L. schweinfurthii* inhabits the coastal areas of North Africa, the Mediterranean islands from Cyprus to Sicily and also Israel (Feinbrun 1968). More chromosomal studies, covering all of the above localities, are needed for this bisexual taxon. However, more polyploid levels are not expected.

L. shawii

With the exception of *L. shawii,* all the African species of *Lycium* exhibit distribution ranges in either southern or northern Africa. *L. shawii* has a continuous distribution pattern from northern Africa through eastern Africa to southern Africa. It also ranges from Palestine to Iraq and Iran (Feinbrun 1968). The eight specimens studied and collected in South Africa and Egypt, revealed that this bisexual species is a diploid (2n = 2x = 24) (Figure 5.36). No chromosomal differences were observed between the northern and southern specimens, suggesting that *L. shawii* is only diploid.

L. strandveldense

A rare species of the western coast belt of South Africa, from Lamberts Bay southwards to the Ceres region was found to be tetraploid (2n = 4x = 48) (Figure 5.37). According to its morphological characteristics, this dioecious species seems to be of hybrid origin. The flowers resemble those of the bisexual *L. afrum* in colour and shape, but they are functionally male and female. The dioecious *L. tetrandrum* is probably the other parent species, contributing the vegetative characteristics and dioecy, as well as the chromosome number. Both these parent species occur on the same western coast belt as *L. strandveldense*.

L. tenue

This bisexual species of the southern Cape is diploid (2n = 2x = 24) (Figure 5.38). Morphologically, it shows affinity with *L. ferocissimum*, but does not seem to be the product of hybridisation. Hybridisation, as observed in the African species of *Lycium*, seems to result in higher ploidy levels and distinctive chromosomal behaviour, both characteristics absent in *L. tenue*.

L. tetrandrum

A dioecious species with tetraploid (2n = 4x = 48) and hexaploid (2n = 6x = 72) chromosome numbers (Figures 5.39-41). The hexaploid number is confirmed by Spies *et al.* (1993). Only one tetraploid specimen was found and this was collected near the northern limit of the distribution range of *L. tetrandrum*. This species is widely spread along the coastal belt of south-western Africa from the Cape Peninsula in the south to Swakopmund, Namibia, in the north, and specimens representing this whole area have been examined. Spies *et al.* (1993) found meiotic abnormalities in only a few of the specimens, indicating that, if of hybrid origin, this species has stabilised over a long period of time to become a clearly defined taxon. The fact that the only tetraploid specimen was collected on the periphery of this species' distribution range is a common phenomenon found with regard to polyploid complexes (Grant 1981). The higher ploidy level hexaploid plants seem to be the better competitors and the less competitive lower ploidy level tetraploids are thus "pushed" out to the distribution extremities.

L. villosum

A dioecious species with tetraploid chromosome number (2n = 4x = 48) and regular meiosis in the majority of specimens examined (Spies *et al.* 1993). It occurs widespread on the Kalahari sands of the northern Cape, southern Namibia and Botswana. Vegetatively it is impossible to distinguish *L. villosum* from *L. hirsutum*, but its flowers are very distinct and unisexual, and thus a clearly defined species, probably of hybrid origin with *L. hirsutum* as one of the parents. The only other dioecious species in the distribution range of *L. villosum* and *L. hirsutum* are *L. horridum* and *L. arenicola*, and one of these may well be the other parent.

Interspecific hybrids

Three specimens, representative of three hybrids, were examined in the present study, i.e. *L. ferocissimum x L. horridum* (2n = 4x = 48) (Figure 5.42), *L. ferocissimum x L. afrum* (2n = 2x = 24) (Figure 5.43) and *L. bosciifolium x L. horridum* (2n = 2x = 24). Minne (1992) and Spies *et al.* (1993) also reported on *L. ferocissimum* x *L. afrum* and *L. ferocissimum* x *L. horridum,* corroborating the results found in the present study. Morphologically these hybrids were clearly distinguishable from the parent species amongst which they were found. The hybrids exhibited characteristics typical of both parents, but these parental characteristics were not expressed uniformly in all the individual hybrid plants. In some specimens more characteristics of one parent were expressed, in others more of the other parent. The relative normal meiosis observed in all these hybrid specimens suggests a close chromosomal relationship between the parent species concerned. Interestingly enough, the hybrid *L. bosciifolium* x *L. horridum* has not attained the higher tetraploid level of the dioecious *L. horridum* but retained the diploid level of the bisexual *L. bosciifolium.* The prevalence of *L. ferocissimum* as one of the hybrid parents, indicates that this species may be pivotal in the origin of new species. Additional cytogenetic studies of meiosis in artificial hybrids, complemented by DNA molecular studies should shed much light on the phylogenetic relationships in *Lycium*.

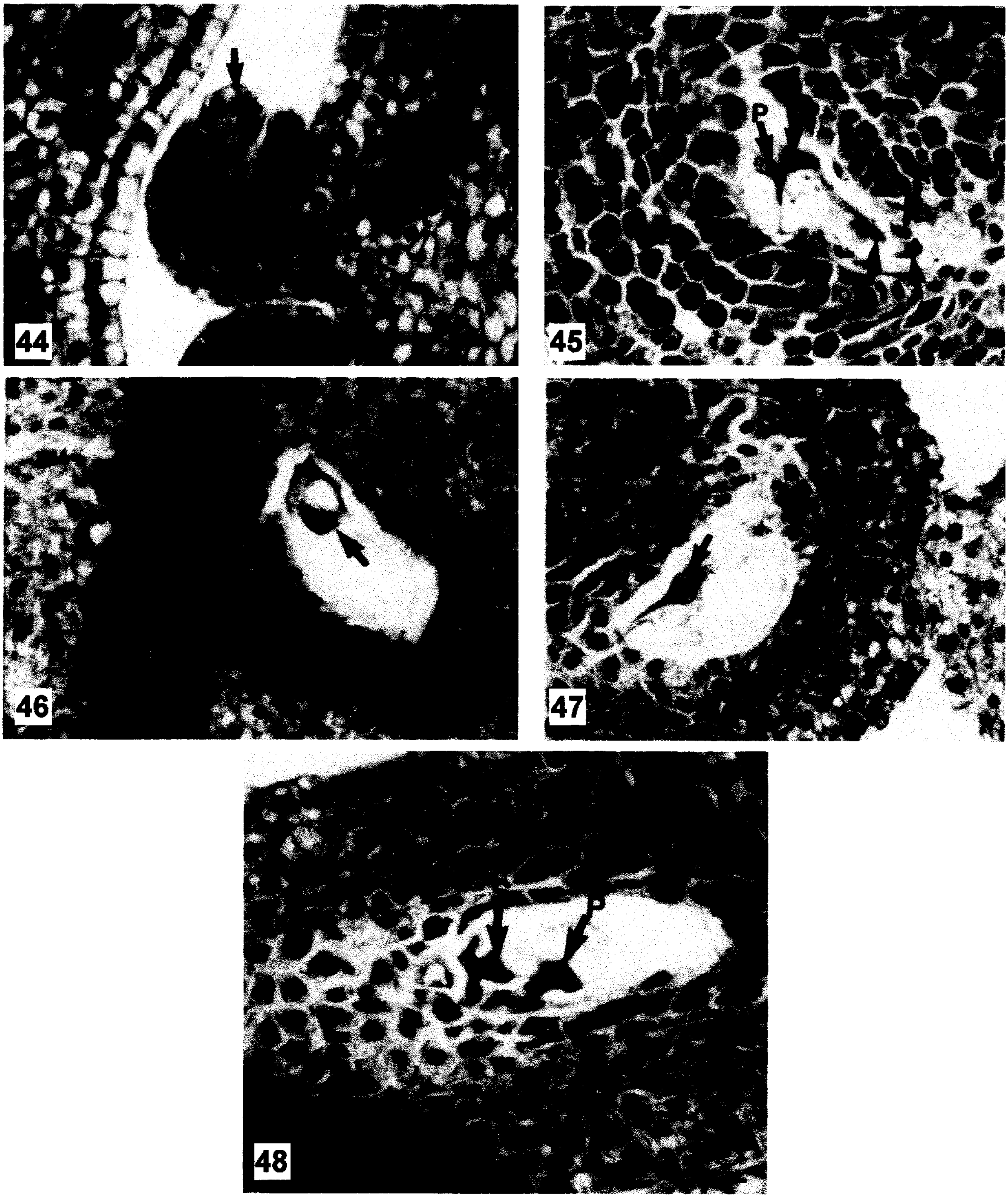
Polyploid *Lycium* species are not restricted to Africa. The following chromosome numbers were reported by Chiang (1981): n = 48 (*L. fremontii*

Gray var. *fremontii,* North America), n = 12 or 24 (*L. exertum* Gray, North America): n = 18 or 24 (*L. californicum* Nutt. ex Gray var. *californicum*, North America); Baquar (1967): n = 12 or 18 (*L. europaeum* L., Europe); Wiggins & Porter (1971): n = 24 (*L. minimum* Hitch., North America); Ratera (1944): n = 24 (*L. longiflorum* Phil., South America). It is unclear whether these polyploids are dioecious, *L. europaeum* is certainly bisexual.

5.3 Embryo sac

Minne (1992) and Minne *et al.* (1994) studied embryo sac development and characteristics in a number of South African *Lycium* species. According to these studies the ovules in the bisexual species, as well as in the functionally male and female flowers of the dioecious species, are unitegmic, tenuinucellate and anatropous (Figure 5.44) to hemi-campylotropous. An eight nucleate, *Polygonum*-type embryo sac was found in both bisexual and dioecious species (Figure 5. 45). In the bisexual *L. afrum* (Figure 5.46) all the nuclei, i.e. synergids, egg cell, polar and antipodal nuclei were of the same size. In the dioecious species examined, differences in the embryo sac nuclei were present. In the functionally male plants of *L. horridum* a fully developed embryo sac was present (Figure 5.47) and all the nuclei were of equal size, as observed in *L. afrum*. However, in the functionally female plants of *L. horridum* and in both sexes of *L. arenicola* and *L. tetrandrum* the polar nuclei were prominently larger than the other nuclei of the embryo sac (Figure 5.48).

Taxonomically the embryo sac does not seem to have much value as diagnostic tool in *Lycium*, particularly when the time expensive analysis of embryo sacs is considered.



Figures 5.44 - 5.48 44. *L. afrum, A. M. Venter 352*, macrospore mother cell (indicated by arrow) in anatropous ovule. 45. *L. tetrandrum* (♂), *Spies 5055, Polygonum*-type embryo sac showing polar nuclei (P) and antipodal cells (A). 46. *L. afrum, Reyneke 346,* embryo sac of bisexual flower with egg cell (indicated by arrow). 47. *L. horridum* (♂), *Reyneke 334*, normally developed embryo sac of functionally male flower, with egg cell (indicated by arrow). 48. *L. tetrandrum* (♀), *Spies 5055,* synergid (S) and one polar nucleus (P). Polar nucleus is prominently larger than the other nuclei in the embryo sac.
Scale bar = 3.4 μm. (Figures courtesy of Minne *et al.* 1994).

5.4 Conclusion

The African representatives of the genus *Lycium* have a basic chromosome number of 12 and agrees with that found for the rest of the genus outside Africa. Polyploidy is present in 25% of the African species, namely in *L. arenicola, L. gariepense, L. horridum, L. strandveldense, L. tetrandrum* and *L. villosum.* Polyploidy seems to be less frequent in *Lycium* outside the African continent (Chiang 1981, Bernardello 1986a).

Origin by hybridisation seems to be evident for the dioecious species *L. arenicola, L. gariepense, L. strandveldense, L. villosum* and *L. horridum,* but the sixth dioecious species, *L. tetrandrum,* probably evolved differently. All the diploid species are bisexual. Exactly where and when the unique functional unisexuality of the African lyciums originated, is unclear, but it could be assumed that one polyploid parent species contributed it to its offspring. The ploidy level for both male and female members of a dioecious species, is the same. Although very few microspore mother cells were found in the anthers of functionally female flowers and the frequency of meiocytes extremely low, chromosome numbers could be determined (Spies *et al.* 1993).

Without the discovery of dioecy in African *Lyciums* during the present study, the taxonomy of *Lycium* in Africa would never have been solved. Morphological characteristics, before our knowledge of dioecy, often proved totally confusing when endeavouring delimitation of species.

Dean (1974) lumped a number of species together as the *L. cinereum* complex. These included *L. cinereum, L. arenicola, L. horridum, L. pumilum, L. tenue, L.*

tetrandrum and various synomyms of these species, a total of 26 taxa. All these species have in common a relatively short corolla tube, as well as exsertion of the reproductive structures from the corolla mouth. Because of the extent of the variation of the floral characteristics, delimiting meaningful species seemed impossible. However, separating the bisexual, diploid species *L. cinereum, L. pumilum* and *L. tenue*, and realising that the polyploid *L. arenicola, L. horridum* and *L. tetrandrum* are dioecious with the stamens of the functionally male flowers only slightly exserted as is the pistil in the functionally female flowers, made possible the separation and eventual delimitation of the different species of Dean's complex.

A similar problem was encountered in differentiating between *L. hirsutum* and *L. villosum*. Vegetatively there is so much variation within each species and so much overlapping between the two species, with corolla tube lengths varying from 'long' to 'intermediate' to 'short'. Discovering the tetraploid, dioecious nature of *L. villosum* as opposed to the diploid, bisexual *L. hirsutum* solved the problem of delimitation of the two species.

Table 5.1. List of *Lycium* species and specimens studied cytologically.

(Voucher numbers and geographical localities are given).

L. acutifolium

SOUTH AFRICA: KWAZULU-NATAL. – **2832** (Nkandla): Umfolozi Game Reserve (-BC), *A. M. Venter 225, 423, 426, 427.*

L. afrum

SOUTH AFRICA: WESTERN CAPE. – **3218** (Clanwilliam): near Elands Bay (-AD), *A. M. Venter 511.*

L. amoenum

SOUTH AFRICA: WESTERN CAPE. – **3218** (Clanwilliam): 30 km east of Lamberts Bay (-BA), *A. M. Venter 563*; 1 km east of Graafwater (-BA), *A. M. Venter 379.*

L. arenicola

SOUTH AFRICA: NORTHERN CAPE. – **2922** (Prieska): Muishoek, banks of Brak River (-DB), *A. M. Venter 535.*

SOUTH AFRICA: WESTERN CAPE. – **3321** (Ladismith): East of bridge over Grootrivier on Barrydale-Ladismith road (-CA), *A. M. Venter 451.*

L. bosciifolium

NAMIBIA. – **2816** (Oranjemund): 5 km east of the Lorelei Mine (-BB), *H. J. T. Venter 9214.* 2817 (Vioolsdrif): Jan Haak Road (-AD), *A. M. Venter 484.*

SOUTH AFRICA: NORTHERN CAPE. – **2816** (Oranjemund): 3 km east of Alexander Bay (-CB), *A. M. Venter 393.* **2817** (Vioolsdrif): Kookrivier, west of Kubusberg (-AA), *A. M. Venter 407, 418, 419, 420.* **2820** (Kakamas): 1 km south of Augrabies National Park (-CB), *A. M. Venter 398.* **2922** (Prieska): 20 km east of Prieska (-DB), *A. M. Venter 493.*

L. cinereum

SOUTH AFRICA: NORTHERN PROVINCE. – **2329** (Pietersburg): At the Tropic of Capricorn along the Pietersburg-Louis Trichardt road (-BB), *A. M. Venter 344.*

SOUTH AFRICA: NORTHERN CAPE. – **2821** (Upington): 24 km from Upington to Olifantshoek (-AC), *A. M. Venter 558.* **3122** (Loxton): 56 km from Loxton to Fraserburg (-DB), *A. M. Venter 336.*

SOUTH AFRICA: WESTERN CAPE. – **3321** (Ladismith): East of bridge over Grootrivier on Barrydale-Ladismith road (-CA), *A. M. Venter 450.* **3322** (Oudtshoorn): 28 km south of Oudtshoorn (-CD), *A. M. Venter 603.*

L. decumbens

NAMIBIA. – **2113** (Cape Cross): Cape Cross (-DD), *A. M. Venter 621.*

L. eenii

NAMIBIA. – **2116** (Okahandja): 113 km north of Okahandja (-BB), *A. M. Venter 490*; 104 km north of Okahandja (-BB), *A. M. Venter 491.*

L. europaeum

SPAIN. – **3604** (Almeria): near Adra (-DC), *A. M. Venter 577.*

L. ferocissimum

SOUTH AFRICA: WESTERN CAPE. – **3118** (Vanrhynsdorp): 1 km east of Yzerfontein (-AC), *A. M. Venter 375.* **3318** (Cape Town): Near Melkbosstrand (-CD), *A. M. Venter 345, 354, 442, 443, 444.* **3420** (Bredasdorp): 2 km from Bredasdorp to Struisbaai (-CA), *Spies 5040.* **3421** (Riversdale): Stilbaai-East (-AD), *A. M. Venter 601.*

L. gariepense

NAMIBIA. – **2817** (Vioolsdrif): Western side of the Fish River (-AA), *A. M. Venter 590*; 21 km west of Fish River confluence with Orange River (-AB), *A. M. Venter 622.*

L. grandicalyx

NAMIBIA. – **2716** (Witputz): 13 km north of Witputz Police Station (-CD), *A. M. Venter 485.*

L. hirsutum

SOUTH AFRICA: NORTHERN CAPE. – **2816** (Oranjemund): 3 km east of Alexander Bay (-CB), *A. M. Venter 394.* **2824** (Kimberley): Along Windsorton-Barkly West road (-BC), *A. M. Venter 360*; along Kimberly-Barkly West road (-DA), *A. M. Venter 311.*

L. horridum

NAMIBIA. – **2817** (Otjosondu): Stormberg (-AD), *A. M. Venter 591, H. J. T. Venter 9232.*

L. mascarenense

SOUTH AFRICA: KWAZULU-NATAL. – **2632** (Belle Vista): Black Rock (-BB), *A. M. Venter 421, 422, 456, 457.*

L. oxycarpum

SOUTH AFRICA: NORTHERN CAPE. – **3222** (Beaufort West): 89 km from Matjiesfontein to Sutherland (-AB), *A. M. Venter 337.*

SOUTH AFRICA: WESTERN CAPE. – **3319** (Worcester): Along the Worcester-De Doorns road (-CB), *A. M. Venter 356.* – **3320** (Montagu): Tradeaux Pass (-DC), *A. M. Venter 447.*

L. pilifolium

NAMIBIA. – **2616** (Aus): 7 km from Aus to Rosh Pinah (-CB), *A. M. Venter 580.*

SOUTH AFRICA: NORTHERN CAPE. – **2824** (Kimberley): Weir Siding near Barkly West (-DA), *A. M. Venter 464.*

L. pumilum

SOUTH AFRICA: NORTHERN CAPE. – **3119** (Calvinia): 17 km from Calvinia to Williston (-DB), *A. M. Venter 383.* **3123** (Victoria West): 14 km north of Richmond (-BD), *A. M. Venter 367.*

L. schizocalyx

SOUTH AFRICA: NORTHERN PROVINCE. – **2229** (Waterpoort): 70 km from Swartwater to Alldays (-CA), *A. M. Venter 545.*

L. schweinfurthii

EGYPT. – **3029** (Alexandria): Burg-el-Arab (-DC), *A. M. Venter 576.*

L. shawii

EGYPT. – **2932** (Cairo): Wadi Hagul (-CD), *A. M. Venter 574, 575.*

SOUTH AFRICA: NORTHERN PROVINCE. – **2329** (Pietersburg): Bandolierskop crossing on N1 north of Pietersburg (-BD), *A. M. Venter 428, 429, 433, 434, 435, 436.*

L. strandveldense

SOUTH AFRICA: WESTERN CAPE. – **2318** (Clanwilliam): 5 km from Lamberts Bay to Clanwilliam (-AB), *A. M. Venter 477*; Malkop Bay (-AB), *A. M. Venter 507.*

L. tenue

SOUTH AFRICA: WESTERN CAPE. – **3419** (Caledon): 1 km from Riviersonderend to Swellendam (-BB), *A. M. Venter 446.* **3420** (Bredasdorp): 20 km from Swellendam to Bredasdorp (-AB), *A. M. Venter 519*; 7 km from Bredasdorp to Napier (-CA), *A. M. Venter 438*; 4 km from Bredasdorp to Waenhuiskrans (-CA), *A. M. Venter 439.*

L. tetrandrum

NAMIBIA. – **2214** (Swakopmund): Swakopmund (-DA), *A. M. Venter 569*. 2615 (Lüderitz): Lüderitz (-CA), *A. M. Venter 573*.

SOUTH AFRICA: NORTHERN CAPE. – **2816** (Oranjemund): Beauvillon (-CB), *A. M. Venter 395*.

SOUTH AFRICA: WESTERN CAPE. – **3218** (Clanwilliam): 22 km east of Lamberts Bay (-BA), *A. M. Venter 500, 501*.

Interspecific hybrids:

L. bosciifolium* x *L. horridum

SOUTH AFRICA: NORTHERN CAPE. – **2820** (Kakamas): 2 km from Friersdale to Kakamas (-DB), *A. M. Venter 399*.

L. ferocissimum* x *L. afrum

SOUTH AFRICA: WESTERN CAPE. – **3318** (Cape Town): Near Melkbosstrand (-CD), *A. M. Venter 445*.

L. ferocissimum x L. horridum

SOUTH AFRICA: EASTERN CAPE. – **3324** (Steytlerville): 20 km from Patensie to Willowmore (-DC), *Spies 5185*.

SOUTH AFRICA: WESTERN CAPE. – **3420** (Bredasdorp): 2 km from Waenhuiskrans to Bredasdorp (-CA), *Spies 5054*.

Table 5.2. Chromosome numbers of different *Lycium* species growing in Africa.

Results from the present study are asterixed (*), while results from previous articles are added for a comprehensive overview.

Voucher No.	*2n*	*Source*
L. acutifolium		
A. M. Venter 225, 423, 426, 427	24	*
L. afrum		
	24	*Bernardello 1982*
	24	*Castroviejo 1982*
	24	*Castroviejo 1983*
A. M. Venter 222, 223, 346, 347, 348, 353, 371, 373	24	*Spies et al. 1993*
A. M. Venter 511	24	
L. amoenum		
A. M. Venter 379, 563	24	*
L. arenicola		
A. M. Venter 535	48	*
A. M. Venter 151, 324, 325, 329, 330, 339, 340, 341, 342, 343, 361	72	*Spies et al. 1993*
A. M. Venter 451	72	*
L. bosciifolium		
A. M. Venter 393, 398, 407, 418, 419, 420, 484, 493, H. J. T. Venter 9214	24	*
L. cinereum		
A. M. Venter 336, 344, 450, 558, 603	24	*
L. decumbens		
A. M. Venter 621	24	*
L. eenii		
A. M. Venter 490, 491	24	*

L. europaeum		
	24	*Bir et al. 1978*
	24, 36	*Bernardello 1982*
A. M. Venter 577	*24*	*
L. ferocissimum		
Spies 5040, A. M. Venter 345, 354, 375, 442, 443, 444, 601	*24*	*
L. gariepense		
A. M. Venter 590	*24*	*
A. M. Venter 587	*48*	*
L. grandicalyx		
A. M. Venter 485	*24*	*
L. hirsutum		
A. M. Venter 311, 360, 394	*24*	*
L. horridum		
A. M. Venter 591	*24*	*
H. J. T. Venter 9215	*48*	
Spies 5234, A. M. Venter 333, 334, 338, 366, 368, 384,	*48*	*Spies et al. 1993*
H. J. T. Venter 9230, 9231, 9232		
L. mascarenense		
A. M. Venter 421, 422, 456	*24*	*
A. M. Venter 457	*48*	*
L. oxycarpum		
A. M. Venter 337, 356, 447	*24*	*
L. pilifolium		
A. M. Venter 464, 580	*24*	*
L. pumilum		
A. M. Venter 367, 383	*24*	*
L. schizocalyx		
A. M. Venter 545	*24*	*

L. schweinfurthii		
A. M. Venter 576	*24*	*
L. shawii		
A. M. Venter 428, 429, 433, 434, 435, 436, 574, 575	*24*	*
L. strandveldense		
A. M. Venter 477, 507	*48*	*
L. tenue		
A. M. Venter 438, 439, 446, 519	*24*	*
L. tetrandrum		
A. M. Venter 573	*48*	*
Spies 5001, 5002, 5055, A. M. Venter 347, 350, 351, 376, 377, H. J. T. Venter 9193	*72*	*Spies et al. 1993*
A. M. Venter 395, 500, 569	*72*	*
L. villosum		
A. M. Venter 312, 313, 357, 358, 362, 363, 388, 389	*48*	*
Interspecific hybrids		
L. afrum x L. ferocissimum		
A. M. Venter 445	*24*	*
A. M. Venter 352, 355, 372	*24*	*
L. bosciifolium x L. horridum		
A. M. Venter 399	*24*	*
L. horridum x L. ferocissimum		
Spies 5185, 5054	*48*	*

CHAPTER 6

SEXUALITY

6.1 Introduction

The considerable morphological variation within each of the African *Lycium* species and the high frequency of hybridisation, cause confusion in the delimitation of species. The large number of 101 species and 25 varieties described for Africa alone, confirms this statement. In the course of this investigation, only floral characteristics were found to be diagnostically reliable when delimiting species. However, in a number of species even these floral characteristics proved to be remarkably variable, until an abnormal condition in the staminal and pistillate whorls of their flowers was observed. Traditionally, *Lycium* has been regarded as a genus of bisexual species only (Dunal 1852, Miers 1854, Hitchcock 1932, Feinbrun 1968, Chiang 1981 and Bernardello 1986a), but in six *Lycium* species this phenomenon of "cryptic sexuality" / "cryptic dioecy" has, for the first time, been identified by the present author.

The occurrence and evolution of dioecy, with the different sexes borne on different plants, has been of interest to biologists since Darwin. Linnaeus even used this characteristic in his classification of plants (Knapp *et al.* 1998). Dioecy is a relatively rare condition in the angiosperms with approximately 4-5% of species being truly dioecious (Yampolsky & Yampolsky 1922, quoted from Grant 1975). Not only is dioecy rare but also occurs sporadic and scattered throughout numerous taxa. In the angiosperms the dioecious condition is usually characteristic of individual species or species groups and only rarely is it found as characteristic of a family or a genus (Westergaard 1958). Conclusions drawn from intensive research by a variety of researchers indicate that this condition has evolved many times and for presumably different reasons (Lloyd 1982).

Cryptic sex separation, as well as true dioecy, has only recently been discovered in *Solanum*, a sister genus of *Lycium* and, traditionally, also characterised by hermaphrodite flowers (Symon 1979, Anderson 1979, Anderson & Levine 1982, Levine & Anderson 1986, Anderson & Symon 1989, Knapp *et al.* 1998). In *Solanum* the flowers are usually borne in inflorescences. Andromonoecious species, with hermaphrodite and functionally male flowers borne together in the same inflorescence or on the same plant, is common in this genus (Symon 1979, 1981). Distal flowers of such inflorescences may become male by reduction of the ovary (slightly to vestigial), style (greatly to vestigial) and stigma (none to vestigial). The hermaphrodite flowers and male flowers may remain similar in size or the male flowers may become reduced in size. Androdioecy has been found in a few Australian species of *Solanum* (Symon 1979) where, in one species, separate male plants (ovaries of these flowers vestigial) occur together with plants having normal bisexual flowers. Sex expression in *Solanum* is cryptic in that functionally male and functionally female flowers are very similar. The anthers in both types are filled with pollen, but pollen from the functionally female plants is inaperturate. In the functionally male flowers the styles are short, never extending beyond the anther cone and their stigmatic surfaces are smaller, with smaller, dryer papillae (Anderson & Symon 1989, Knapp *et al.* 1998).

The aim of this study was to investigate and explain this "cryptic dioecious" condition found in the African species of *Lycium*.

6.2 Results

Examination of the African species of *Lycium* revealed that "cryptic dioecy" occurs in six species, namely in *L. arenicola*, *L. gariepense*, *L. horridum*, *L. strandveldense*, *L. tetrandrum* and *L. villosum*. All the other African species are bisexual with normal fertile stamens and pistils. A comparison of male and female plants of the species with cryptic dioecy is presented in Table 6.1 (p 78).

HABIT

No visible difference is discernible in the vegetative morphology of the two sexes of a species (Figure 6.1). Functionally male and female plants were observed to occur in a ratio of approximately 1:1 in nature. However, the two sexes are not always evenly dispersed, male and female plants are often found in separate clusters. This observed ratio of male and female plants corresponds to an extensive study of all the dioecious species of Israel (Rottenberg 1998).

FLOWERS EXTERNALLY

There is a recognisable difference in the flowers. The functionally female flowers have a somewhat shorter, tubular corolla tube and only the bright green stigmas protrude from these corollas. The corolla of the functionally male flowers, in contrast to the female flowers, is longer and more funnel-shaped, and only yellow stamens protrude from the corolla mouth (Figure 6.2).

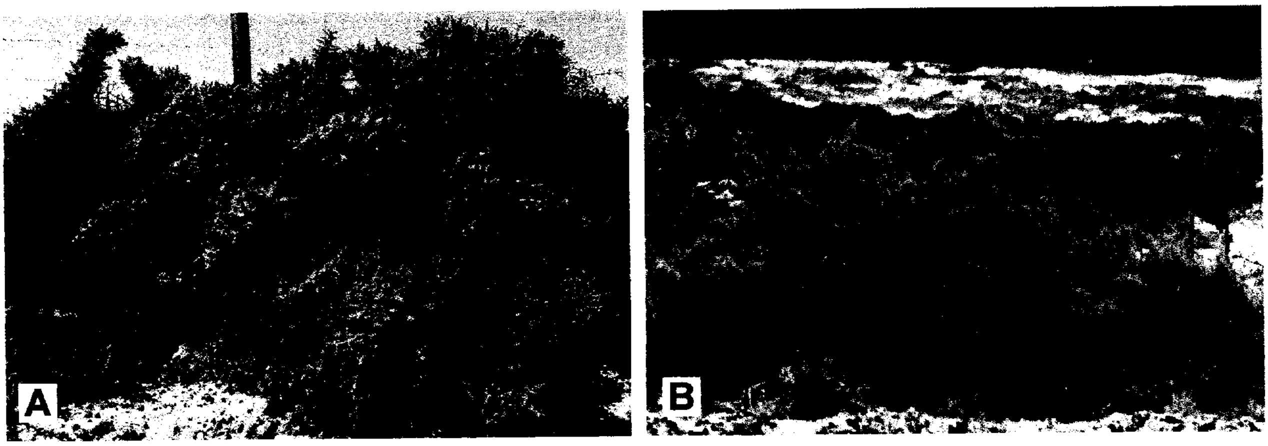


Figure 6.1
Similar looking A: female and B: male plants of *L. tetrandrum*.

Figure 6.2
Flowers of *L. villosum*:
Female flower smaller and tubular, only the style and stigma exserted from the corolla mouth. Male flower larger, funnel-shaped, only the stamens slightly exserted from the corolla mouth.

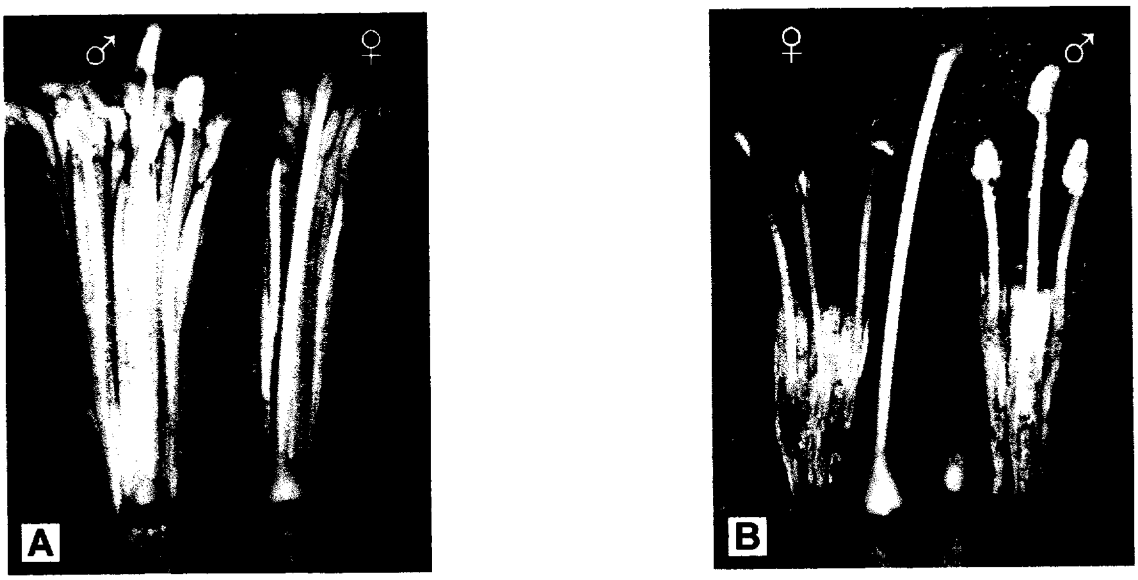


Figure 6.3
Male and female flowers of *L. villosum*: A: opened to expose the reproductive structures and conspicuous nectary; B: Corolla partially removed to show: female flowers with stamens and infertile anthers, normal pistil; ovary of male flowers without style or stigma and stamens with pollen containing anthers.

FLOWERS INTERNALLY

Certain plants of a particular species have flowers with normal, fully developed pistils, but their stamens are abnormal. No pollen develops in the anthers of these stamens and only a whitish, powdery dust is observable in the anthers. These are the 'functionally female' plants with 'functionally female or pistillate' flowers. Likewise, in other plants of the same species, the flowers have stamens with normal anthers, containing viable pollen. However, the pistils of these flowers are abnormal. Their ovaries are normal in structure and filled with normal looking ovules, but no stigmas occur on top of the stunted styles. Sometimes the style and stigma may be absent altogether. These plants are "functionally male" with "functionally male or staminate" flowers (Figures 6.3 – 6.6). This condition is considered to be "functionally dioecious". The terminology is in accordance with Diggle (1991, 1993), Knapp *et al.* (1998), Charlesworth (1984) and Rottenberg (1998).

OVULES

A number of bisexual species of *Lycium* were compared cytologically with the six functionally dioecious species by Minne (1992) and Minne *et al.* (1994). The ovules of both functionally male and female plants and of bisexual plants are unitegmic, tenuinucellate and anatropous to hemi-campylotropous, results corroborated by Chiang (1981) on *L. europaeum.* In both functionally male and female plants the ovule has a monosporic eight nucleate *Polygonum*-type embryo sac (Minne *et al.* 1994) (Figures 5.44–5.48).

As in the functionally female and bisexual plants, the ovules of the functionally male plants are fully developed (Figure 6.5), but fertilisation can obviously not take

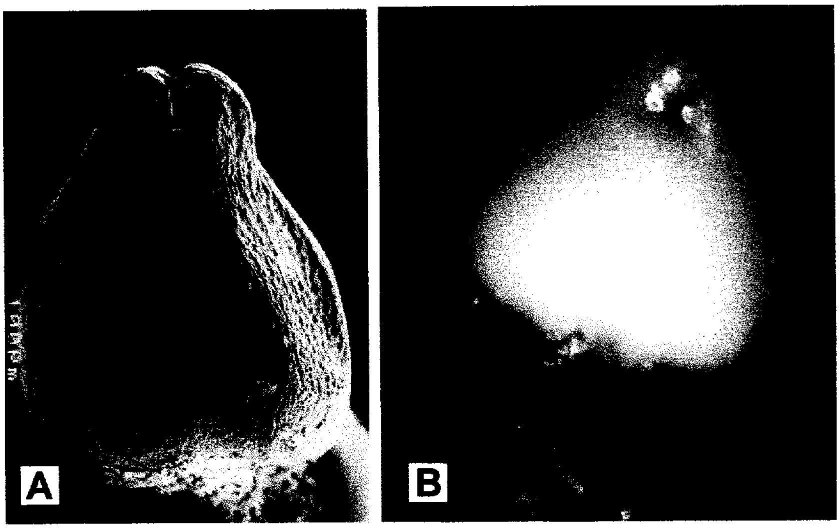


Figure 6.4
Ovary of male flower of *L. arenicola*. A: Micrograph and B: photograph showing the absence of style and stigma.

Figure 6.5
Micrograph of *L. villosum*'s male flower ovary showing well developed ovules.

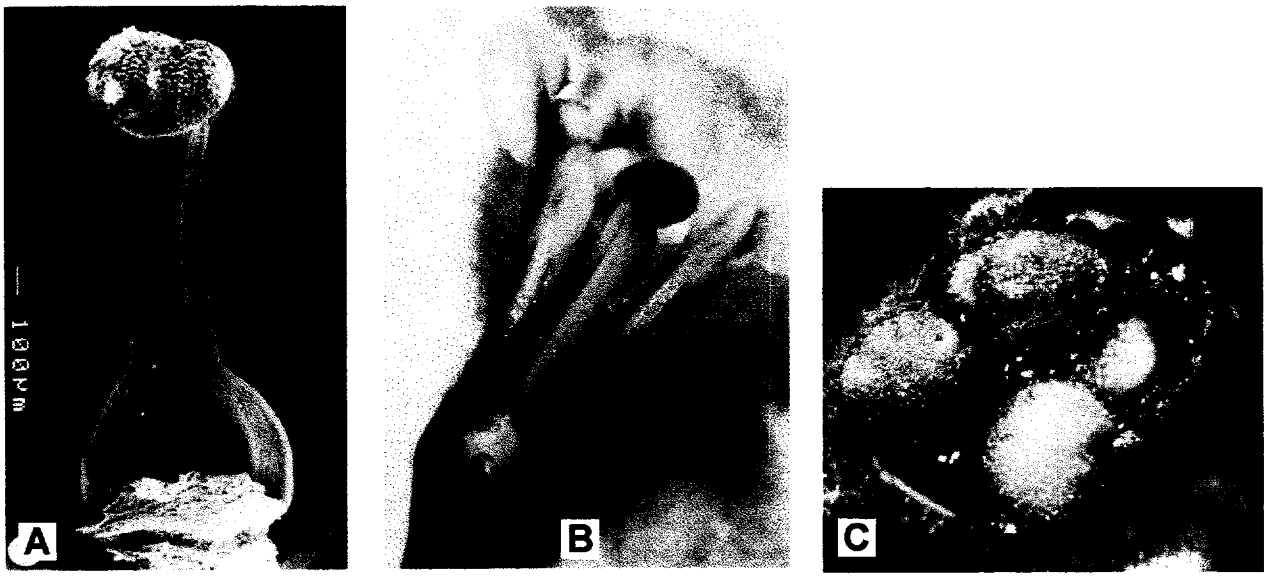


Figure 6.6
A & B: Micrograph and photograph of *L. arenicola*'s female flower with normal pistil showing stigmatic surface; C: Berry of *L. villosum* showing fully developed seeds.

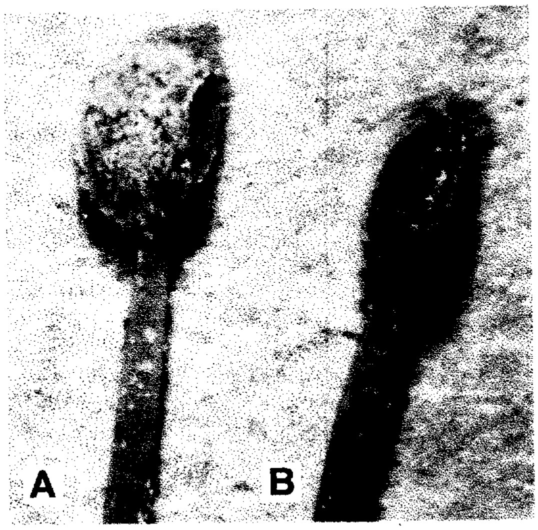


Figure 6.7
Stamens from: A: male flower of *L. villosum* where anthers contain fertile pollen and B: female flower of *L. villosum* with whitish powder visible in longitudinal slit.

Figure 6.8
Micrograph of a cross section of the theca of *L. arenicola.*

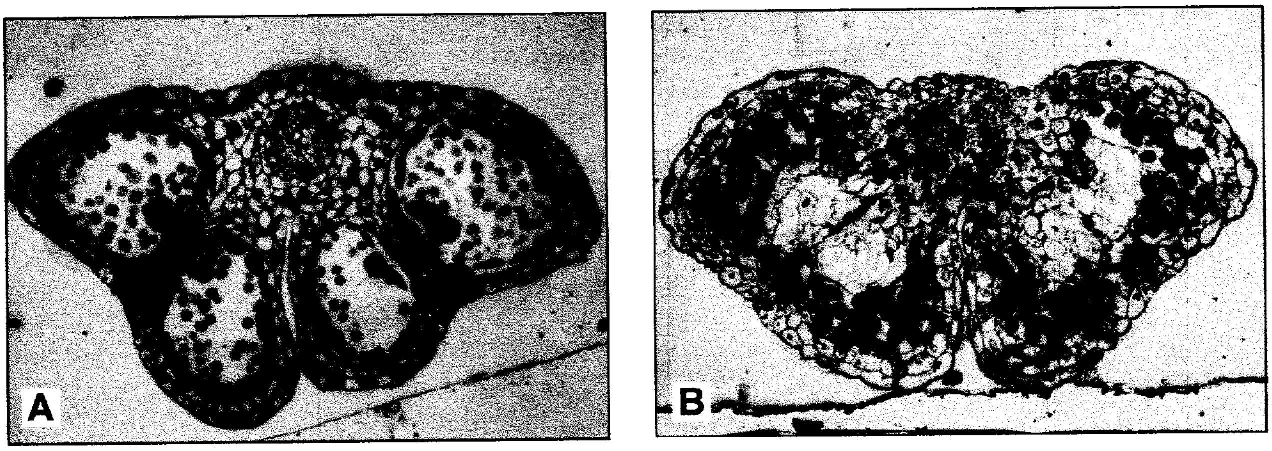


Figure 6.9
Micrographs of cross sections of the anther of a male flower in *L. arenicola*, showing A: developing pollen and B: mature pollen.

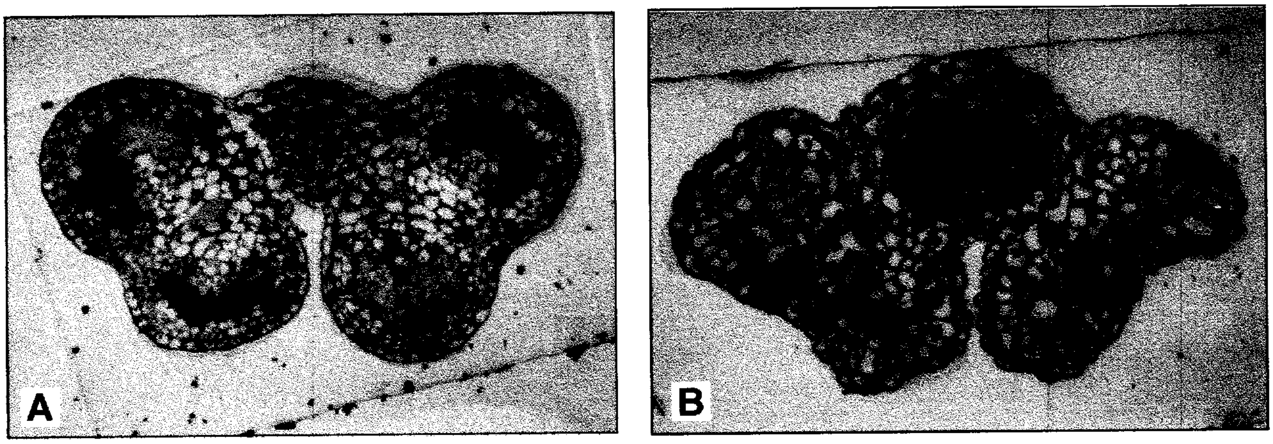


Figure 6.10
Micrograph of cross section of the anther of a female flower in *L. arenicola*, showing A: the absence of a tapetum layer and no development of pollen and B: disappearing microsporangia.

place in the absence of a stigma (Figure 6.4). The ovaries wither together with the flowers. In a few functionally male plants sparse "fruit setting" was observed in the field, but on dissection these structures turned out to be seedless insect or fungal galls. This same phenomenon was reported by Anderson & Levine (1982) in dioecious solanums. In all functionally female plants profuse fruit setting, similar to that found in the bisexual species, was observed since normal pollination can take place.

POLLEN

Copious, viable pollen grains develop in normal anthers of functionally male flowers, the same way as in the bisexual species (Figure 6.7). The anther wall consists of an epidermal layer, an endothecium, 2-3 middle layers and a glandular tapetum layer that is important for the development of pollen (Figures 6.8 & 6.9).

In the young anthers of female plants, an epidermis, endothecium and middle layers are present, but a tapetum is absent. As these anthers age, the microsporangia become depressed and eventually absorbed (Figure 6.10). In mature female flowers the anthers are only slightly smaller than normal, but the longitudinal slits of the thecae do not open wide as in normal anthers and they contain only a small amount of whitish powder, the residue of the microsporangia (Figure 6.7).

CHROMOSOMES

The chromosome number of the bisexual species were found to be diploid and $2n = 2x = 24$, polyploidy was very rarely observed. In the functionally dioecious species pollen was obtained from only male plants, although chromosome numbers could be verified in the microspore mother cells in some female specimens. The functionally dioecious species are polyploid and vary between tetraploid and hexaploid, *L. gariepense, L. horridum, L. strandveldense* and *L. villosum* are predominantly tetraploid, while hexaploidy prevailed in *L. arenicola* and *L. tetrandrum*.

6.3 Discussion

The vast majority of seed plants are bisexual, with only about 5% monoecious and more or less 5% dioecious. The other sex expressions, like gyno- and andromonoecy, and gyno- and androdioecy constitute a very small percentage of flowering plants (Charlesworth & Guttman 1999). Dioecious species occur in at least 7.1% of flowering plant genera (959 genera) but in 38% of families (Renner & Ricklefs 1995). The much lower frequency of dioecy in genera than in families implies origin within families. Many dioecious species are part of genera with predominantly hermaphrodite members, and in many species with hermaphrodite relatives there is evidence of opposite sex structures in flowers of plants of each sex: males may have substantial pistil rudiments and females staminodes. Observation and research suggests strongly that dioecy evolved quite recently, and this in turn implies that it has evolved repeatedly (Charlesworth & Guttman 1999).

In the majority of plants studied, males are heterozygous (XY) and females homozygous (XX), as in animals. Genetic research has established that dioecious plants carry the potential of femaleness and maleness in every individual. One of these potentials, however, is suppressed. The heterozygous males are thought to have a genotype containing a dominant suppressor of femaleness. In the homozygous females the recessive male-sterility factor is doubled and therefore causes male sterility, thereupon giving expression to the opposite sex form (Westergaard 1958).

There are a few models to explain the evolution of dioecy (Charlesworth & Guttman 1999). The two most likely of these are:

1: Out of a hermaphrodite population where a mutation causes female sterility, resulting in androdioecy (hermaphrodites and males). A subsequent mutation then causes male sterility resulting in a population with both males and females, therefore, dioecy.

2: Out of a hermaphrodite population where a mutation causes male sterility, resulting in gynodioecy (hermaphrodites and females). A second mutation then causes female sterility resulting in a population with both males and females, therefore, dioecy.

Of these two alternative pathways, there is both empirical and theoretical evidence that the pathway via gynodioecy is the more important, especially if the rarity of androdioecy is taken into account (Charlesworth & Guttman 1999). These two pathways possibly explain the dioecy found in *Solanum,* but does not satisfactorily explain the condition in *Lycium.*

Barrett (1992) suggested another possibility, which is evolution from distyly. Distyly is a cosexual system with two mutually interfertilising cosexual morphs. In a few taxa, there are clear indications that one morph has become specialised as male and the other as female (Muenchow & Gerbus 1987). This hypothesis presents a better explanation for the condition found in *Lycium*. However, the genetic details of this process are still not well understood, but some major factors may be necessary to accomplish this process and these factors need to be linked on a single chromosome. This prerequisite seems to pose practical problems and therefore distyly may not be a plausible pathway for the evolution of dioecy (Charlesworth & Guttman 1999).

It is very important to consider that all cases of the evolution of dioecy, even in a single genus, most probably have different causes (Knapp *et al.* 1998), like promotion of out-crossing in the absence of gametophytic self-sterility, adaptation to pollinators, resource allocation and sexual selection, with environmental conditions playing a negligible role (Rottenberg 1998).

Whatever mechanism is involved, one may postulate, and this seems to be the most obvious explanation, that the six functionally dioecious species of *Lycium* are in the process of evolving true male plants with staminate flowers (flowers with only stamens) and true female plants with pistillate flowers (flowers with only pistils) (Yun Sun *et al.* 1996). Functional dioecy may thus be regarded as the advanced condition in *Lycium*. This hypothesis is underscored by the fact that the dioecious condition in *Lycium* occurs in species with high chromosomal ploidy levels, accompanied by other, traditionally, advanced adaptations like hairiness, succulence, tubular corollas and red, prominent nectaries. Therefore, by implication, short corolla tubes, included stamens, red, conspicuous nectaries and red berries in African lyciums, can be considered advanced characteristics.

Another explanation for the retention of "complete" anthers in functionally female flowers, can be related to their role in pollination, and can be seen as visible pollinator lure. This seems most certainly to be the case in the nectarless *Solanum* flowers where anthers with inaperturate pollen, are retained in pistilate flowers as a reward / attraction for pollinators (Anderson & Symon 1989, Knapp *et al.* 1998). The same explanation may also relate to the condition found in *Lycium,* where the intact ovary, lacking style or stigma, in the functionally male flowers is retained. The nectary forms part of the ovary base and the nectar serves as added pollinator lure. A further possibility can be that the sex gene responsible for the development of the ovary also carries the code for development of the associated nectary, thus explaining retention of both structures in the functionally male flowers.

A preliminary investigation of American herbarium specimens of *Lycium* in Kew Herbarium, indicates the occurrence of functionally dioecious species on the American continent as well. The three dimorphic species in North American are *L. fremonti* A.Gray, *L. exsertum* A.Gray and *L. californicum* Nutt. ex A.Gray. Populations of these species consist of male-sterile (female) plants with reduced stamens and abortive anthers and morphologically hermaphrodite plants. The hermaphrodite plants, however, are strongly male in function and fruit setting is limited (Jill S. Miller, University of Arizona, Tuscon, USA, pers. com.). The reputedly endemic *L. australe* of Australia (Haegi 1976) is a functionally dioecious species as well, probably *L. horridum*, or a species very closely related to it.

6.4 Conclusion

The sexual condition found in the six *Lycium* species could not be regarded as true dioecy since, per definition, male or staminate flowers possess only stamens and female or pistilate flowers only carpels (Judd *et al.* 1999). In accordance with the teminology used for describing the sexual expression in *Solanum* by Diggle (1991, 1993), Knapp *et al.* (1998), Charlesworth (1984) and Rottenberg (1998), the condition in *Lycium* is called 'functional dioecy'. 'Functionally male' plants with 'functionally male' or staminate flowers and 'functionally female' plants with 'functionally female' or pistilate flowers occur.

According to Chiang (1981) the genus *Lycium* has to be very old, dating back to the Cretaceous and the existence of Gondwanaland. South America is presumably the centre of evolution and the genus must have spread from there to North America, southern Africa and Eurasia.

Although a broad range of sex expressions occur in *Solanum,* the only other widespread genus of the Solanaceae, the functional dioecy described for this genus differs from the functional dioecy found in *Lycium*. In *Solanum* inflorescences are involved whether the condition is andromonoecy or androdioecy, but in *Lycium* only solitary flowers occur and all the flowers of one plant are either male or female. This condition of *Lycium* seems to be unique to the Solanaceae and the sexuality types as found in this family, unique among the angiosperm families (Anderson & Symon 1989).

One may postulate that the six functionally dioecious species of African *Lycium* are in the process of evolving true male plants with staminate flowers and true female plants with pistilate flowers. Functional dioecy in species is correlated with a high ploidy level, which supports the hypothesis of dioecy in this genus being in an evolutionary process.

Evolution of dioecy, even in a single genus, most probably has different causes (Knapp *et al.* 1998). A number of the present day African *Lycium* species are of hybrid origin and most of the dioecious species are. In these cases the parent plants were diploid or tetraploid, and hybridisation led to a higher ploidy level. It is highly likely that this may be the mechanism by which functional dioecy developed in some of the *Lycium* species where the one dioecious parent contributed the dioecious character to the "new" species.

Table 6.1 Comparison of functionally male and female plants in functionally dioecious species of African *Lycium* species.

	Female plants	Male plants
Habit	similar	similar
Leaves	similar	similar
Number of flowers per plant	similar	similar
Calyx	similar	similar
Shape of corolla tube:		
L. arenicola	Tubular	Narrowly funnel-shaped
L. gariepense	Tubular	Narrowly funnel-shaped
L. horridum	Narrowly funnel-shaped	Narrowly funnel-shaped
L. strandveldense	Tubular	Narrowly funnel-shaped
L. tetrandrum	Tubular	Narrowly funnel-shaped
L. villosum	Tubular	Narrowly funnel-shaped

Corolla tube (in mm):		
L. arenicola	4.5–5 x 2.5	5–6 x 2–3
L. gariepense	7–9 x 2–3	7–9 x 2–3
L. horridum	6–8 x 2–2.5	7–9 x 2–3
L. strandveldense	10–11 x 2–2.5	11–13 x 3
L. tetrandrum	5–6 x 1.5–2.5	5–6 x 1.5–2.5
L. villosum	6–8 x 1–1.5	8–12 X 2–3
Stamen exsertion from corolla mouth:		
L. arenicola	Included	Slightly exserted
L. gariepense	Included	Slightly exserted
L. horridum	Two slightly exserted	Slightly exserted
L. strandveldense	Included	Slightly exserted
L. tetrandrum	Included	Slightly exserted
L. villosum	Included	Slightly exserted
Anther fertility	Infertile	Fertile
Pollen grains	Powdery dust	Normal
Ovary	Normal	Normal
Ovules	Normal	Normal
Style	Normal and slightly exserted from co. tube	Stunted/absent
Stigma	Present	Absent
Fruit	Present	Absent

CHAPTER 7

MICROMORPHOLOGY OF POLLEN, SEED COAT - AND LEAF EPIDERMAL SURFACES

7.1 POLLEN

7.1.1 Introduction

Considering the economic importance of the Solanaceae and its large size, surprisingly few pollen studies have been done, and then mostly on selected species as part of floristic or general morphological surveys (Persson *et al.* 1994; Bernardello & Luján 1997). The only comprehensive studies in the Solanaceae to date, are those of: Basak (1967) who studied the pollen of 93 species representing 28 genera of the Indian subcontinent; Gentry who examined pollen of the tribes Salpiglossideae (1979) and the Cestroideae (1986); Chiang (1981) who studied the pollen of the North American *Lycium* species and Persson *et al.* (1994) who investigated the tribe Juanulloeae. The most recent taxonomic treatment of the Solanaceae places *Lycium, Grabowskia* and *Phrodus* in the tribe Lycieae (Hunziker 1979). Bernardello and Luján (1997) investigated the pollen morphology of this tribe using material from 20 representative South American species, mainly of Argentina.

The sculpturing of the exine is distinct and often diagnostic in characterizing taxa. Palynology, although a relatively recent branch of plant morphology, has already provided a wealth of diagnostically and phylogenetically useful information. However, pollen characteristics proved to be, in most cases, of limited taxonomic importance at generic level or lower (Walker & Doyle 1975).

Pollen studies of some of the Solanaceae's other tribes, indicate considerable variation in pollen surface ornamentation, which can be useful in taxonomic studies. The variability of the vegetative characteristics in *Lycium* in particular, necessitated the search for diagnostic characteristics other than the normal macro-morphology. Some of the African *Lycium* species also occur in geographically separate areas, and isolation may thus have resulted in unique changes in the characteristics and/or morphology of the pollen and this aspect, furthermore, lead to the present pollen investigation. Pollen differences would then provide additional parameters which could be utilized, along with the gross morphological and other characteristics, in clarifying and improving the taxonomy of this genus.

The present study also makes possible a comparison of pollen studies on *Lycium* in South America and North America. Comparisons with pollen accounts of the other solanaceous genera in other tribes may eventually shed light on generic relationships and the phylogenetic position of *Lycium* in the Solanaceae.

7.1.2 Specimens examined

Table 7.1 Species and voucher specimens from which pollen was studied.

Taxon	Collector	Locality	Herbarium
Lycium acutifolium	Reyneke 225	South Africa	BLFU
	Reyneke 226	South Africa	BLFU
Lycium afrum	Venter A.M. 352	South Africa	BLFU
	Reyneke. 222	South Africa	BLFU
	Bayer 4456	South Africa	NBG
	Reyneke 224	South Africa	BLFU
	Venter A.M. 353	South Africa	BLFU
	Compton 16181	South Africa	NBG
	Venter A.M. 346	South Africa	BLFU
Lycium amoenum	Taylor 10944	South Africa	STE
	Hanekom 9067	South Africa	BLFU
	Hall 528	South Africa	NBG
	Müller 2716	Namibia	WIND
	Steyn 581	South Africa	NBG
Lycium arenicola	Reyneke 82	South Africa	BLFU
	Reyneke 120	South Africa	BLFU
	Geo Potts 1108	South Africa	BLFU
	Reyneke 284	South Africa	BLFU
	Smith 2533	Botswana	PRE
	Acocks 18837	Namibia	PRE
	Giess & Müller 12153	Namibia	WIND
	Giess 13515	Namibia	WIND
Lycium bosciifolium	Reyneke 211	South Africa	BLFU
	Reyneke 273	South Africa	BLFU
Lycium cinereum	Reyneke 78	South Africa	BLFU
	Reyneke 135	South Africa	BLFU
	Volk 12055	Namibia	WIND
	Skarpe S-373	Namibia	WIND
	Müller & Tilson 868	Namibia	WIND
	Merxmüller & Giess 28728	Namibia	WIND
Lycium decumbens	Venter A.M. 621	Namibia	BLFU
Lycium eenii	Hanekom 353	Namibia	PRE
	Müller & Loutit 1157	Namibia	WIND
	Hanekom 219	Namibia	WIND
	Müller 202	Namibia	WIND
	Pearson 9518	Namibia	K
	Pearson 9533	Namibia	BOL
Lycium europaeum	Garrigues 481	Algeria	P
	Feinbrun 148	Palestine	K
	Bourgeau 929	Tenerife	WAG
Lycium ferocissimum	Page 2856	South Africa	NBG
	Potts 679	South Africa	BLFU
	Reyneke 133	South Africa	BLFU
	Reyneke 134	South Africa	BLFU

Lycium gariepense	Venter A.M. 584	Namibia	BLFU
	Venter A.M. 587	Namibia	BFLU
Lycium grandicalyx	Meyer 47290	Namibia	WIND
	Giess & Müller	Namibia	WIND
Lycium hirsutum	Reyneke 311	South Africa	BLFU
	Goossens 2954	South Africa	BLFU
	Potts 1113	South Africa	BLFU
Lycium horridum	Reyneke 99	South Africa	BLFU
	Venter 8750	Namibia	BLFU
	Reyneke 174	Namibia	BLFU
Lycium mascarenense	Venter A.M. 421	South Africa	BLFU
	D'Arcy, Rakotozafy 15434	Madagascar	BLFU
	D'Arcy, Rakotozafy 15461	Madagascar	BLFU
	Gereau, Dumetz 3321	Madagascar	BLFU
	Phillipson 2895	Madagascar	BLFU
Lycium oxycarpum	Reyneke 132	South Africa	BLFU
	Hanekom 9065	South Africa	BLFU
	Linder 3223	South Africa	BOL
Lycium pilifolium	Reyneke 287	South Africa	BLFU
	Reyneke 285	South Africa	BLFU
	Reyneke 283	South Africa	BLFU
Lycium pumilum	Reyneke 331	South Africa	BLFU
	Venter 9227	South Africa	BLFU
Lycium schizocalyx	Reyneke 112	South Africa	BLFU
	Reyneke 163	South Africa	BLFU
	Volk 11448	Namibia	WIND
Lycium schweinfurthii	Balanza 959	Algeria	BM
	Keith 1127	Libya	K
	Chevallier 462	Algeria	P
	Dureyzicz 152/87	Libya	P
Lycium shawii	Drummond 15261	India	K
	Le Roux 214	Namibia	PRE
	Drummond 15260	India	K
Lycium strandveldense	Venter A.M. 504	South Africa	BLFU
	Venter A.M. 507	South Africa	BLFU
Lycium tenue	Venter A. M. 523	South Africa	BLFU
Lycium tetrandrum	Jankowitz 175	Namibia	WIND
	Lavranos & Barad 19227	Namibia	WIND
	Giess & Müller 22009	Namibia	WIND
Lycium villosum	Reyneke 302	South Africa	BLFU
	Reyneke 305	South Africa	BLFU
	Reyneke 310	South Africa	BLFU

7.1.3 Results

For the interpretation of pollen size and shape the classification systems in Table 7.2 and 7.3 were used:

Table 7.2 Pollen Size Classification (Walker & Doyle 1975).

Size class	Measurement
Minute grains	< 10 μm
Small grains	10 – 24 μm
Medium-size grains	25 – 49 μm
Large grains	50 – 99 μm
Very large grains	100 – 199 μm
Gigantic grains	≥ 200 μm

Table 7.3 Classificasion of globose pollen based on ratio of polar to equatorial axes (P/E) (Walker & Doyle 1975).

Designation – shape classes	P / E Ratio
Prolate	
Perprolate	≥ 2.00
Euprolate	1.34 – 1.99
Subprolate	1.15 – 1.33
Prolate spherical	1.01 – 1.14
Spherical	1.00
Oblate	
Oblate spherical	0.88 – 0.99
Suboblate	0.76 – 0. 87
Euoblate	0.51 – 0.75
Peroblate	< 0.50

The medium sized pollen grains (Table 7.4) of *Lycium* are typical monads, all being trizonocolporate (Figures 7.1.1 – 7.1.3). About half of the African species are euprolate (Figure 7.1.11), a quarter are subprolate (7.1.10), and the other quarter (more or less) are both euprolate and subprolate (Table 7.4). Their outline in polar view is mostly circular (Figures 7.1.2 & 7.1.3), sometimes triangularly obtuse convex (Figure 7.1.1), and in equatorial view mostly elliptic obtuse to, sometimes, broadly elliptic obtuse (Figures 7.1.10 & 7.1.11) (Table 7.5). The colpi are boat-shaped with acute ends (Figure 7.1.10) and stretch from proximal to distal polar region (Figures 7.1.5 & 7.1.11). In most of the species sculpturing of the exine is striate (Figures 7.1.5 & 7.1.9), in some it is striate-reticulate (Figures 7.1.1 – 7.1.2 & 7.1.4), and in *L. bosciifolium* and *L. gariepense* it is rugulate (Figures 7.1.7 & 7.1.8) (Table 7.5). In some grains the sculpturing become striate-rugulate along the colpi margins and at the polar region (Figure 7.1.3), but this feature does not seem to be constant.

In *L. ferocissimum, L. grandicalyx, L. gariepense, L. mascarenense, L. schizocalyx* and *L. strandveldense* the standard variation in pollen size measurements is small, but in the majority of species considerable variation in size was observed within each species. Striate to striate-reticulate sculpturing is typical for most of the species, but both striate and reticulate sculpturing was observed in some species. The sculpturing occurring in the majority of pollen grains was then taken as representative for the particular species.

Table 7.4 *Lycium* species and pollen grain measurements (μm).
(Average measurements are given in the table, but shape class is based on the majority of pollen grains measured for the investigation).

Taxon	Polar axis	Equatorial axis	P/E	Category
L. acutifolium	26.8 ± 1.8	17.8 ± 2.7	1.51	Euprolate
L. afrum	31.6 ± 2.3	20.1 ± 2.9	1.57	Euprolate
L. amoenum	33.3 ± 2.1	19.4 ± 3.8	1.72	Euprolate
L. arenicola	32.3 ± 2.2	22.0 ± 2.8	1.47	Euprolate
L. bosciifolium	26.7 ± 2.1	20.7 ± 3.7	1.26	Subprolate [Euprolate]
L. cinereum	30.6 ± 1.9	20.3 ± 3.2	1.51	Euprolate
L. decumbens	26.4 ± 4.7	21.15 ± 4.7	1.25	Subprolate
L. eenii	27.9 ± 1.7	19.5 ± 3.2	1.43	Euprolate [Subprolate]
L. europaeum	29.4± 2.1	19.7 ± 4.3	1.49	Euprolate
L. ferocissimum	32.4 ± 1.9	20.7 ± 2.0	1.57	Euprolate
L. gariepense	34.3 ± 2.3	24.7 ± 1.8	1.39	Euprolate
L. grandicalyx	34.9 ± 2.0	24.8 ± 2.3	1.41	Euprolate
L. hirsutum	31.3 ± 1.9	24.9 ± 3.8	1.26	Subprolate
L. horridum	32.0 ± 2.2	21.4 ± 3.1	1.50	Euprolate
L.mascarenense	31.3 ± 1.5	18.8 ± 1.7	1.66	Euprolate
L. oxycarpum	30.5 ± 2.0	24.2 ± 4.0	1.26	Subprolate
L. pilifolium	36.1 ± 2.6	27.4 ± 3.7	1.32	Subprolate
L. pumilum	28.0 ± 2.0	19.0 ± 3.4	1.47	Euprolate
L. schizocalyx	30.5 ± 1.6	23.0 ± 2.8	1.33	Euprolate [Subprolate]
L. schweinfurthii	28.2 ± 2.3	21.6 ± 3.4	1.31	Subprolate [Euprolate]
L. shawii	29.4 ± 2.3	22.0 ± 3.5	1.34	Euprolate [Subprolate]
L. strandveldense	38.5 ± 2.2	25.8 ± 1.5	1.49	Euprolate
L. tenue	33.4 ± 2.4	27.3 ± 1.8	1.22	Subprolate
L. tetrandrum	32.6 ± 2.1	22.7 ± 2.6	1.44	Euprolate
L. villosum	30.9 ± 2.4	24.0 ± 4.8	1.29	Subprolate [Euprolate]

Table 7.5 Shape, outline* [**Polar** and **Equatorial**] and sculpture* of pollen grains.

Taxon	Shape (P/E)	Outline (P)	Outline (E)	Sculpture
L. acutifolium	Euprolate	Circular to slightly triangular-obtuse-convex	Elliptic-obtuse	Striate
L. afrum	Euprolate	Circular	Elliptic-obtuse	Striate-reticulate
L. amoenum	Euprolate	Circular	Elliptic-obtuse	Striate-reticulate rarely reticulate
L. arenicola	Euprolate	Circular	Elliptic-obtuse	Striate-reticulate
L. bosciifolium	Subprolate [Euprolate]	Circular	Elliptic-obtuse	Rugulate,rarely striate-reticulate
L. cinereum	Euprolate	Circular	Elliptic-obtuse	Striate-reticulate
L. decumbens	Subprolate	Circular	Elliptic-obtuse	Striate
L. eenii	Euprolate [Subprolate]	Circular	Elliptic-obtuse	Striate
L. europaeum	Euprolate	Circular	Elliptic-obtuse	Striate
L. ferocissimum	Euprolate	Circular	Elliptic- obtuse	Striate
L. gariepense	Euprolate	Circular	Elliptic-obtuse	Rugulate
L. grandicalyx	Euprolate	Circular	Broadly elliptic-Obtuse	Striate to Striate-reticulate
L. hirsutum	Subprolate	Circular to slightly triangular-obtuse-convex	Elliptic-obtuse	Striate, rarely striate-reticulate
L. horridum	Euprolate	Circular	Broadly elliptic obtuse	Striate-reticulate
L .mascarenense	Euprolate	Circular	Elliptic-obtuse	Striate
L. oxycarpum	Subprolate	Slightly triangular-obtuse-convex	Elliptic- obtuse	Striate-reticulate
L. pilifolium	Subprolate	Circular	Elliptic-obtuse	Striate
L. pumilum	Euprolate	Circular	Elliptic-obtuse	Striate-reticulate
L. schizocalyx	Subprolate [Euprolate]	Circular	Broadly elliptic-obtuse	Striate
L. schweinfurthii	Subprolate [Euprolate]	Circular	Broadly elliptic-obtuse	Striate Striate-reticulate
L. shawii	Euprolate [Subprolate]	Circular	Broadly elliptic-obtuse	Striate to striate-reticulate
L. strandveldense	Euprolate	Circular	Elliptic-obtuse	Striate
L. tenue	Subprolate	Circular	Elliptic-obtuse-	Striate to striate-reticulate
L. tetrandrum	Euprolate	Circular	Elliptic-obtuse	Striate-reticulate
L. villosum	Subprolate [Euprolate]	Circular	Broadly elliptic-obtuse	Striate-reticulate

*Outline according to Moore & Webb (1978); sculpture after Punt *et al.* (1994) and Moore & Webb (1978).

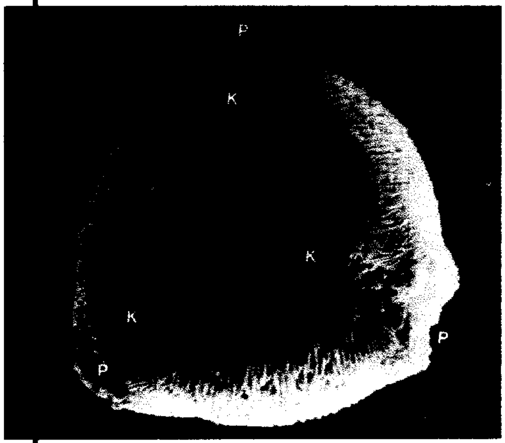


Figure 7.1.1
L. oxycarpum (A. M. Reyneke 132). Polar view showing triangular-obtuse-convex outline, striate-reticulate (mesocolpium) to striate-rugulate sculpturing (apocolpium). [K: colpus; P: pore]. Scale bar = 1μm.

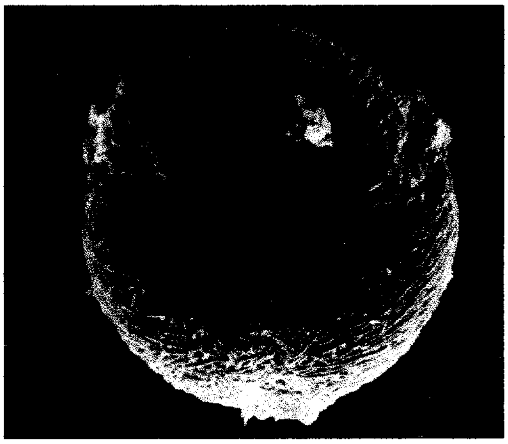


Figure 7.1.2
L. cinereum (A. M. Reyneke 78). Pollen grain showing striate-reticulate sculpturing and colpus margin and circular outline. Scale bar = 1μm.

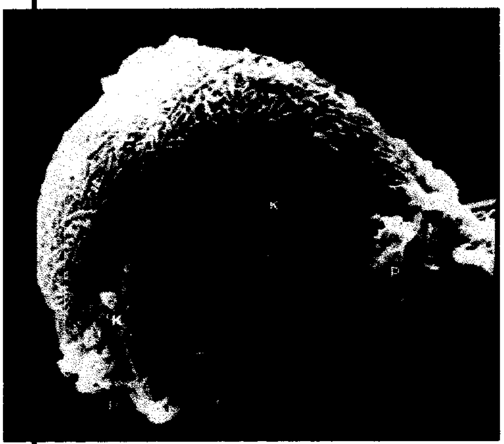


Figure 7.1.3
L. cinereum (A. M. Reyneke 135). Polar view showing rugulate sculpturing in apocolpium and colpus margin. [G: rugulate sculpturing; K: colpus; P: pore]. Scale bar = 1μm.

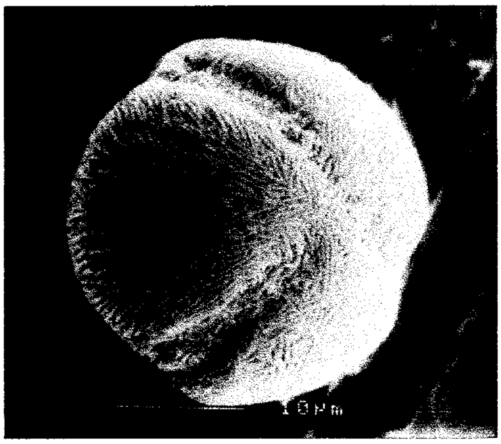


Figure 7.1.4
L. horridum (H. J. T. Venter 8750). Polar view showing striate-reticulate sculpturing. Scale bar = 10μm.

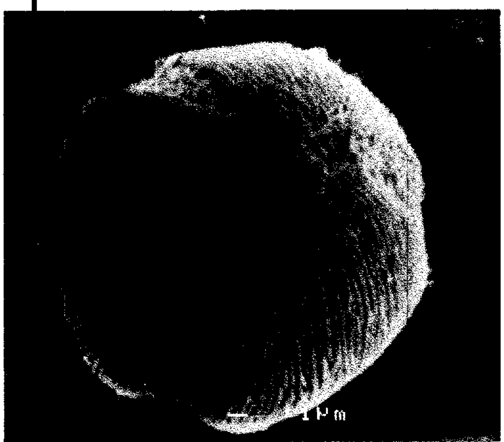


Figure 7.1.5
L. ferocissimum (A. M. Reyneke 134). Polar view showing circular outline and striate sculpturing. Scale bar = 1μm.

Figure 7.1.6
L. arenicola (A. M. Reyneke 120). Oblique polar view showing striate-reticulate sculpturing, becoming striate-rugulate in the polar region. Scale bar = 1μm.

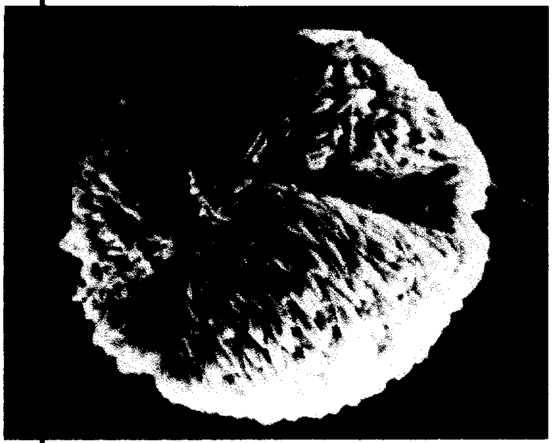


Figure 7.1.7
L. bosciifolium (A. M. Reyneke 273). Polar view showing rugulate sculpturing.
Scale bar = 1μm.

Figure 7.1.8
L. gariepense (A. M. Venter 587).
Equatorial view showing rugulate sculpturing in mesocolpium. Scale bar = 1μm.

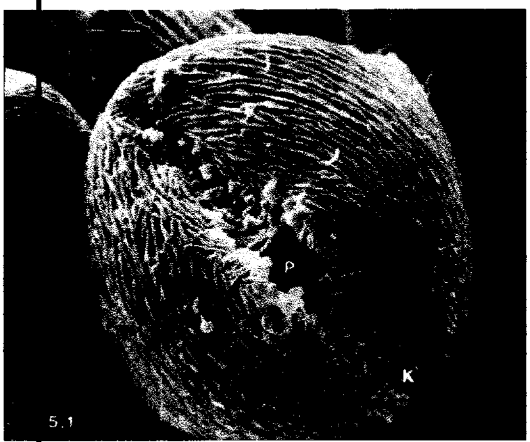


Figure 7.1.9
L. ferocissimum (A. M. Reyneke 133).
Equatorial view showing sculpturing becoming somewhat striate-reticulate along the colpus margin. [K: colpus; P: pore].
Scale bar = 1μm.

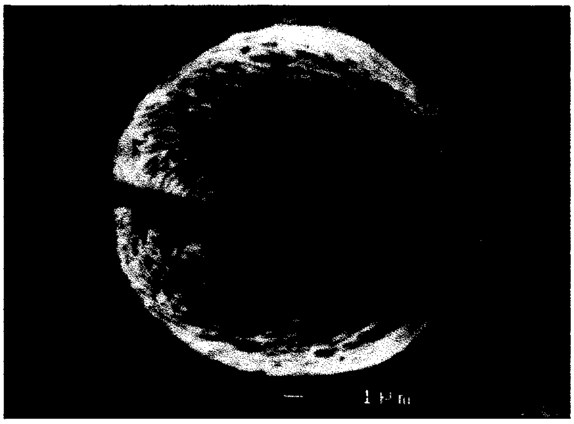


Figure 7.1.10
L. schweinfurthii (Balanza 959). Equatorial view showing elliptic-obtuse outline, subprolate shape and striate to striate-reticulate sculpturing.
Scale bar = 1μm.

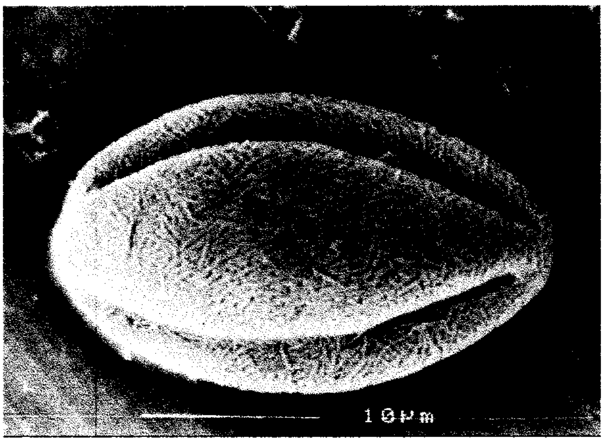


Figure 7.1.11
L. amoenum (Steyn 581). Equatorial view showing elliptic-obtuse outline, euprolate shape and reticulate sculpturing. Scale bar = 10μm.

7.1.4 Discussion

It is clear from the literature, as discussed in the introduction (7.1.1), that monad, trizonocolporate pollen characterizes the investigated members of the Solanaceae, a fact confirmed by this study of *Lycium*. It has also been found that most of the species comprising a genus or even a tribe exhibit reasonably uniform characteristics that can be useful, at most, in confirming relationships (Gentry 1979, Gbile & Sowunmi 1979, Bernardello & Luján 1997).

Chiang (1981) found little variation in the pollen characteristics of the North American *Lycium* species, as did Bernardello & Luján (1997) for the South American species and the present author for Africa. Even though some of the African species have distinctive, taxonomically informative characteristics regarding size (large grains in *L. grandicalyx, L. gariepense, L. pilifolium* and *L. strandveldense*), shape class and sculpturing of the exine (*L. bosciifolium* and *L. gariepense*), the pollen characteristics in a number of species were found to be so variable, that the differences between species are not necessarily meaningful. Pollen belonging to both shape class euprolate and subprolate were found in *L. bosciifolium, L. eenii, L. schizocalyx, L. schweinfurthii, L. shawii* and *L. villosum.* Sculpturing in some species varies between striate and striate-reticulate, and even rugulate to rarely reticulate in *L. bosciifolium.*

Bernardello & Luján (1997) found the difference in size among the *Lycium* species of South America to be small and, therefore, an uninformative characteristic. The present study of the African lyciums confirms this observation. The variation between the African *Lycium* species is not noticeably different from that found between individuals of one species. Bernardello & Luján (1997) reported that, size-wise, the pollen grains of the South American *Lycium* species fall within the upper limits of the SMALL category (Walker & Doyle 1975), but pollen grains sized by both Chiang (1981) for North America and by the present author for Africa fall under the MEDIUM size category (polar axis).

Chiang (1981) reported the ornamentation for the North American *Lycium* species to be striate-reticulate, except for *L. shockleyi,* which is echinate. Bernardello & Luján (1997) encountered mostly striately sculptured pollen, with a few species having rugulate and striate-reticulate patterning. Two species, *L. cestroides* and *L. elongatum* exhibit rugulose ornamentation. About half of the African *Lycium* species exhibit a striate exine sculpture, while the rest of the species exhibit a striate-reticulate sculpturing. However, distinguishing between striate and striate-reticulate ornamentation proved to be difficult because the degree of striate-reticulate sculpturing often varied within the same species, like *L. amoenum, L. grandicalyx, L. hirsutum, L. schweinfurthii, L. schawii* and *L. tenue*, some grains having a less striate and more reticulate sculpturing, and vice versa. In two species, *L. bosciifolium* and *L. gariepense,* the sculpturing was predominantly rugulate. *L. gariepense* is considered to be of hybrid origin (chapter 5) with *L. bosciifolium* probably one of its parents, an assumption supported by this shared, rare rugulate sculpturing of the exine.

Pollen grain shape, according to the P/E-ratio (Walker & Doyle 1975), of the North American *Lycium* species falls into three categories, these being euprolate (1.34 – 1.99), subprolate (1.15 – 1.33) and prolate spherical (1.01 – 1.14), in all species the ratio is thus bigger than 1 (Chiang 1981). The present investigation of the African *Lycium* species exhibited the same characteristic, where half of the species have euprolate, one quarter subprolate and the remaining quarter a mixture of euprolate and subprolate pollen grains. Bernardello & Luján (1997) found that most of the South American species have oblate spherical (0.88 – 0.99) and suboblate (0.76 – 0.87) pollen grains, another instance of the South American species of *Lycium* differing from the North American and African species.

Chiang (1981) included no polar or equatorial outline of the pollen grains in his report, but this was done by Bernardello & Luján (1997). In polar view the South American species of *Lycium* have pollen grains with circular to sometimes triangular convex outlines, as do the African species. In equatorial outline there is a difference, the pollen of the African species being elliptic-obtuse, and in a few instances, broadly elliptic-obtuse. Bernardello & Luján (1997) described the equatorial outline of the South American species as circular to elliptic. The pollen colpi, of all the species examined in the North American, South American and African investigations, are elongated (stretching more or less from pole to pole) and boat-shaped with acute ends.

The pollen characteristics found in *Lycium,* as reported for all three its centers of diversity, correspond to a certain extent with the results that Persson *et al.* (1994) found in the Juanulloideae of South America. The pollen grains of the Juanulloideae are mostly suboblate, rarely oblate, oblate spherical or spherical suboblate; the ornamentation is reticulate, rugate, scabrate, perforate or reticulate-baculate; the grains are medium sized; and there is considerable variation in the type of aperture, from colpate to apocolpate to colporate to inaperturate. The cladistical analysis by Persson *et al.* (1994), based only on the pollen of the Juanulloideae, resulted in a largely unresolved tree. This may imply that the contribution of palynological evidence to the resolution of phylogenetic relationships (in the Juanulloideae at least) is small. However, the poor resolution of Persson *et al.* (1994) may be the result of too few characters, only 12, being applied in their analysis of 44 terminal taxa.

The tribe Cestroideae is characterized by trizonocolporate, monad pollen grains with sculpture rugulate and reticulate, but also scabrate and echinate (Persson *et al.* 1994). There seems to be a distinct correlation between *Lycium* and the genera of the Cestroides considering the similarity in pollen characteristics.

Gentry (1979) studied the Salpiglossideae, comprising 12 genera and 130 species. This tribe is considered to be the most advanced in the Solanaceae, having advanced characteristics like zygomorphic corollas, reduction in the number of fertile stamens from 5 to 4 or 2. The pollen characteristics of this tribe differ considerably from that of the taxa discussed above. Triporate to penta- and heptacolporate pollen has been found, with rugulate to striate rugulate sculpturing, although the reticulate pattern also occurs. In addition to the typical monads, mature tetrahedral tetrads were noted for *Salpiglossis parviflora* Phil. This phenomenon was also reported for *S. sinuata* Ruiz & Pavon (Erdtman 1945). Pollen tetrads constitute an exceptional feature in the Solanaceae. Gentry (1979), furthermore, states that members of the Salpiglossideae reveal rather heterogeneous pollen morphology and that most of the genera and species can be differentiated on basis of their pollen characteristics.

According to Persson *et al.* (1994), the common occurrence of a particular pollen type in a range of taxa may be regarded as a single character and included as such in a phenetic or cladistic analysis. However, it is necessary to keep in mind that a pollen type is a morphological summary that includes, and refers to, a number of characteristics. The occurrence of these individual characteristics has much greater potential to reveal relationships between taxa. Palynological characteristics, although often regarded as less significant than other morphological characteristics, are no less powerful as indicators of relationship. Although pollen types represent unique morphological combinations of characteristics, they do not necessarily provide the most effective basis for making assessments of the relationships between taxa in which they occur. Where sufficiently detailed information is available, a more satisfying approach is to treat the establishment of pollen types as a starting point but then to undertake an analysis of the characteristics of the pollen grains (Blackmore & Barnes 1991).

7.2 SEED COAT SURFACE

7.2.1 Introduction

Brisson & Peterson (1976) state: "Seed characteristics are generally neglected in floras and general taxonomic studies in contrast to pollen morphology which has been used extensively. Seed coat scanning is a tool mainly applied in solving taxonomic problems, often at generic and species level. The degree of polymorphism of a species is perhaps an indication of the intraspecific variation related to geographical distribution, phenotypic plasticity and genotypic flexibility. Polymorphism could also indicate an interspecific variability since factors playing a role in maintaining a taxon may not interact in the same way throughout the entire range of a taxon's distribution.
Morphological variations associated with geographical locations have rarely been demonstrated since most authors, when included in a taxonomic treatment, investigate only one seed, or at most, one sample of a particular taxon. Preparation techniques can also have a marked influence on the morphology of the seed's epidermis. For example the drying effect is responsible for the foveolate seed type observed in the seed coats of *Vaccinium* spp.".

The arrangement of epidermal cells is usually of minor taxonomic importance (Barthlott 1981). However, Barthlott (1981) believes that cell shape is the most prominent feature of surface sculpturing, especially the outline of the cells, the superficially visible cell boundaries or anticlinal cell walls, and the presence of relief structures on cell boundaries. Structures of particular importance in the description of the seed coat characteristics are the relief of the anticlinal cell walls as well as the curvature of the outer periclinal wall. The cells may be flat, concave or convex, the latter characterised as conical, domed or papillate with fluent transition to unicellular trichomes. This curvature of the outer cell walls may serve as a good diagnostic characteristic at generic and even species level. The richest surface sculpturing is often found on seeds and pollen grains (Barthlott 1981).

To date, seed coat studies have been done primarily in the genera *Physalis* and *Solanum*. Axelius (1992) has investigated some genera in the tribe Solaneae in order to try and clarify the phylogenetic relationships of a group of genera centered around *Physalis*. He also observed that in some genera of the Solanaceae and in most species of *Solanum*, the outer periclinal wall of the testa epidermal cells, falls off by autolysis in mature seeds, thus leaving the inner walls to form a reticulate pattern. In the other genera where the outer cell wall remains, the seed coat looks smooth or is only slightly reticulate. These sculptured structures originate from the enlarged cells of the outer layer of the outer integument (Edmonds 1983).

To be able to compare the seed coat surfaces of the taxa he studied, Axelius (1992) needed to observe the inner walls and therefore treated all the seeds by removing the outer periclinal walls with enzyme etching, after which the seeds were dried and coated with platinum for SEM. In previous studies seeds were air-dried, a process which did not remove any intact outer periclinal cell walls and thus impeded comparison.

A literature search indicated that no seed surface studies have been done for the genus *Lycium*. The seed coat surface structure of the African *Lycium* species was examined by SEM to add to our taxonomic knowledge of *Lycium* and its species, and to determine whether this character has any value in species delimitation and interspecific relationships.

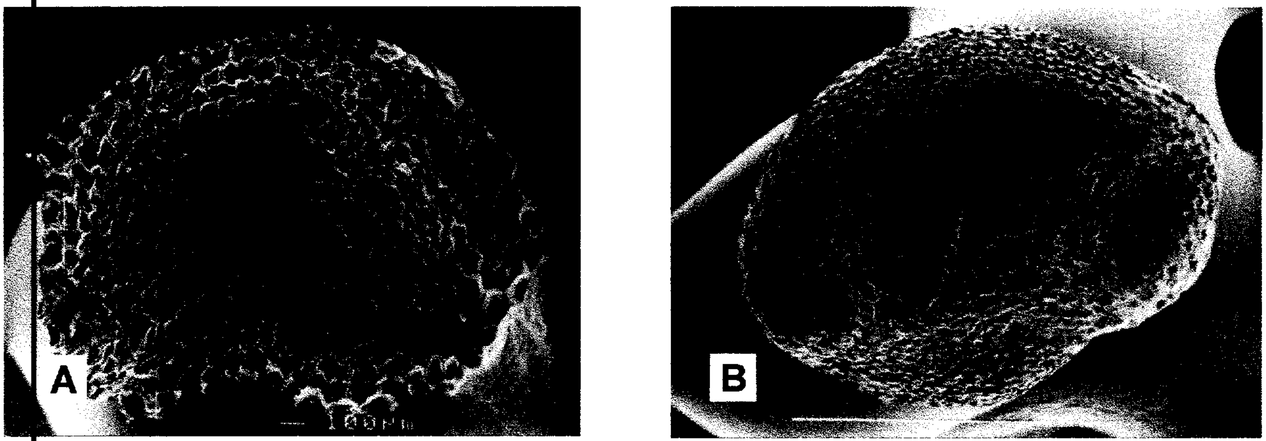
7.2.2 Results

There does not seem to be a comprehensive, operational classification for seed coat characteristics in general and the terminology used here, follows that of Barthlott (1981) for seed plants and Axelius (1992) for genera of the tribe Solaneae and species of the genus *Physalis* (Solanaceae).

The seeds of the African *Lycium* species are golden-yellow to light brown in colour, compressed and vary in shape from subdiscoid to ovate to reniform (Figures 7.2.1 A–C). No secondary sculpturing or micro-ornamentation, resulting from cuticle sculpturing or micro-papilliation was detected.

In most of the seeds investigated, a marked difference between the centre and marginal sculpturing was observed in that heavier patterning occurs towards the margins (Figures 7.2.1A & 7.2.3). The epidermal cells seem to be isodiametric to slightly elongated in outline. The anticlinal cell walls are slightly wavy to more or less regularly undulated, consisting of S–shaped to U-shaped curves (Figure 7.2.2 A–C).

Based on their coat sculpturing, the seeds of the African *Lycium* species can be divided into two groups:



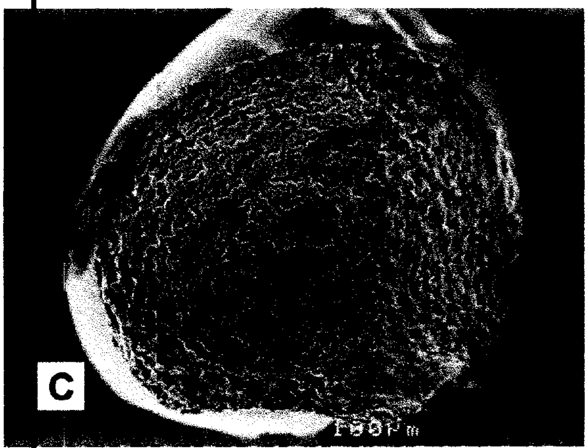
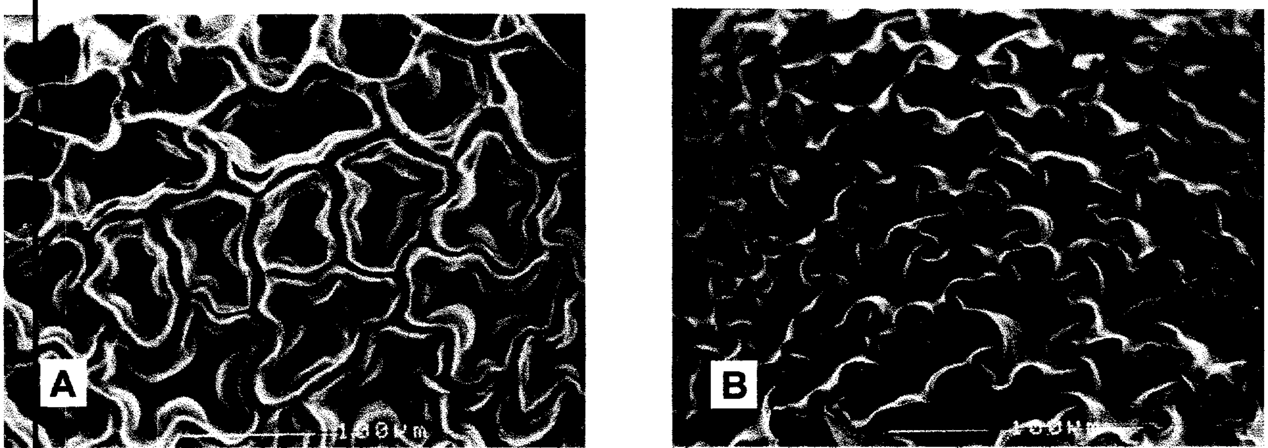


Figure 7.2.1
A: *L. arenicola* (P. J. du Preez 1484). Reniform seed showing heavier sculpturing towards the margin.
B: *L. ferocissimum* (A. M. Venter 516). Ovate seed.
C. *L. villosum* (A. M. Venter 543). Subdiscoid seed.
Scale bar = 100 µm.



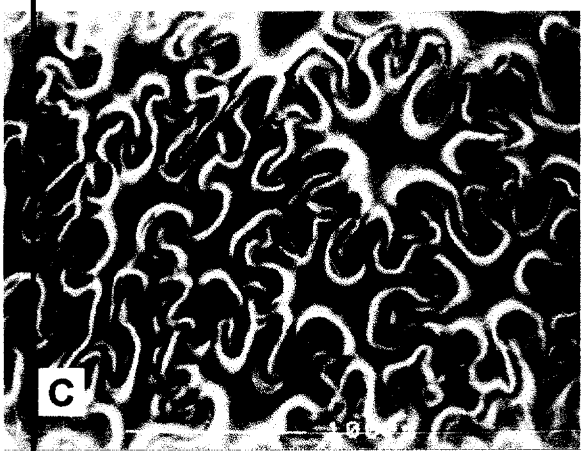


Figure 7.2.2
SEM micrographs of seed coat sculpturing with raised anticlinal cell walls.
A: *L. arenicola* (P. J. du Preez 1484). Slightly wavy cell walls.
B: *L. mascarenense* (A. M. Venter 421).S-shaped undulations.
C: *L. tetrandrum* (H. J. T. Venter 7910). U-shaped undulations.
Scale bar = 100 µm.

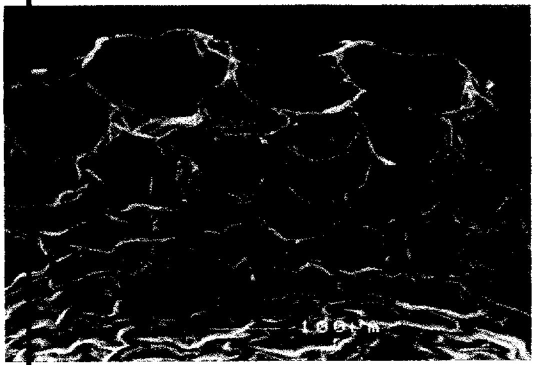


Figure 7.2.3
L. arenicola (P. J. du Preez 1484).
Raised anticlinal cell walls with deep cavities (cell lumens) in between. Heavier scuplturing occurs toward the margin of the seed.
Scale bar = 100 µm.

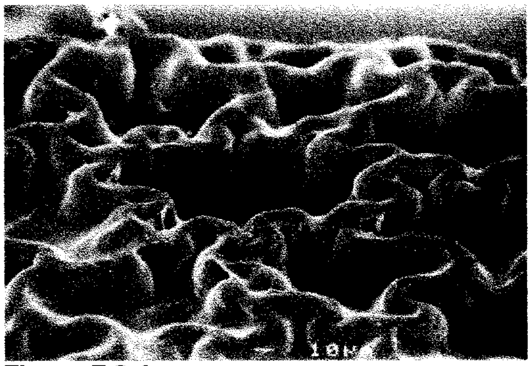


Figure 7.2.4
L. villosum (A. M. Venter 543).
Raised, thickened anticlinal cell walls with deep cavities (cell lumens) in between.
Scale bar = 10 µm.

Figure 7.2.5
L. shawii (Le Chedaville 2663).
Ridged cell boundaries.
Scale bar =100 µm.

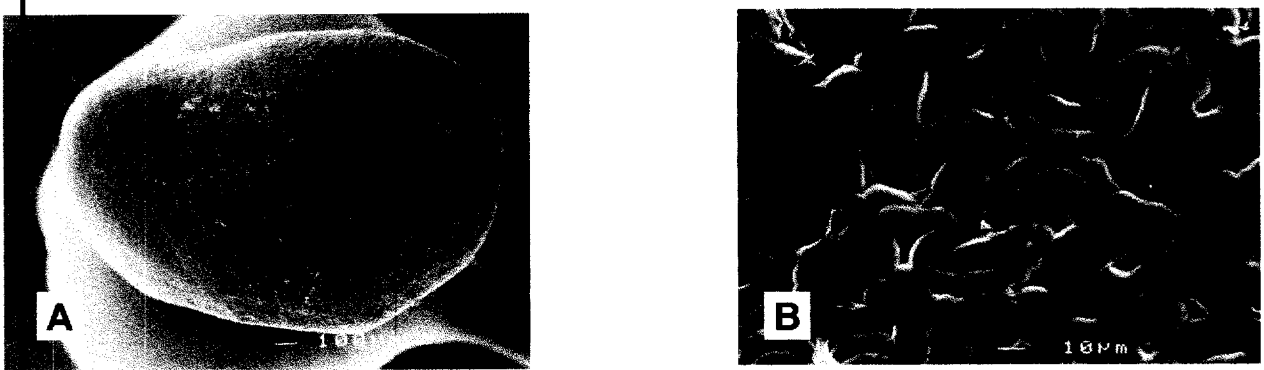


Figure 7.2.6
A & B: *L. pilifolium* (A. M. Reyneke 173).
A: Ovate seed with worm-like surface sculpturing. B: Thickened cell walls fill the cell lumen resulting in the characteristically worm-like pattern.
Scale bar A = 100 µm; B = 10 µm.

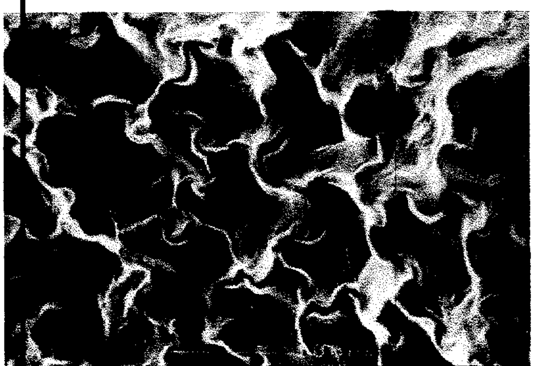


Figure 7.2.7
L. gariepense (A. M. Venter 183).
Inner periclinal epidermal cell walls showing round holes.
Scale bar = 100 µm.

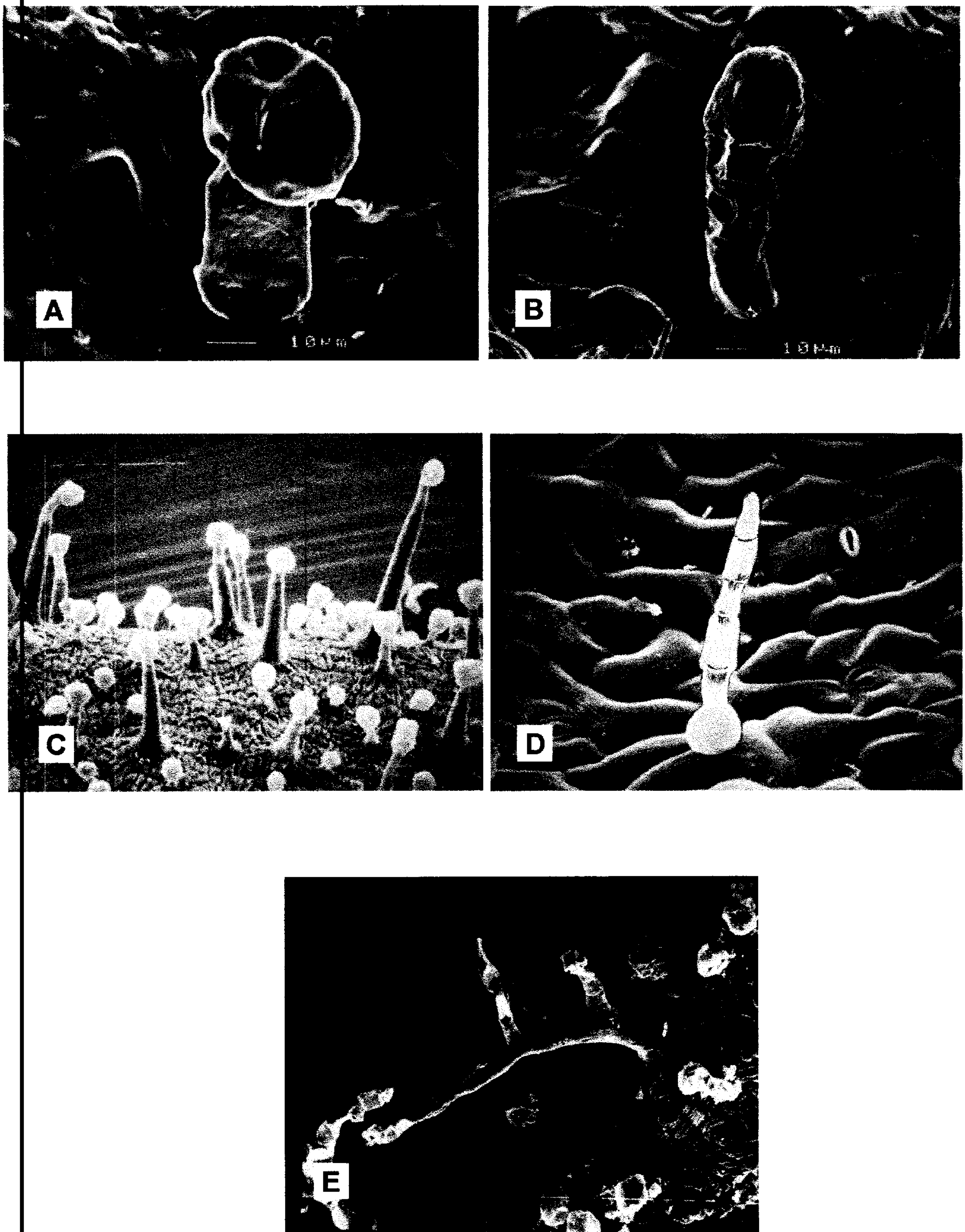


Figure 7.3.1
SEM of leaf surface showing different trichomes.
A: Short stalked glandular trichome with spherical head in *L. grandicalyx*.
B: Short stalked glandular trichome with elongated head in *L. eenii*.
C: Long and short stalked glandular trichome in *L. pilifolium*.
D: Uniseriate eglandular trichome in *L. grandicalyx*.
E: Dendritic eglandular, short and long stalked glandular trichomes in *L. hirsutum*.

Scale bar A, B, D = 10 µm; C & E = 100 µm.

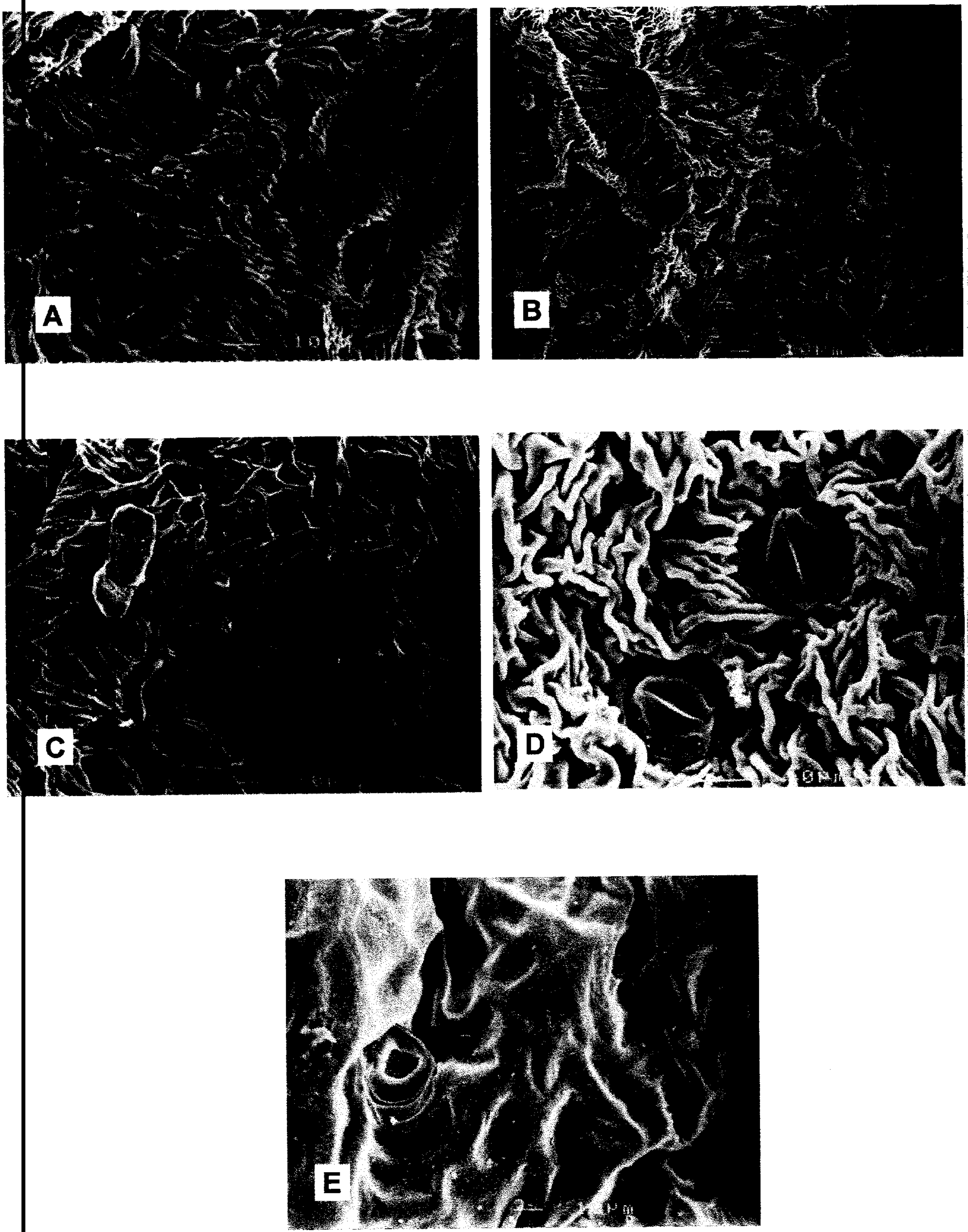


Figure 7.3.2
SEM of leaf surface.
A: Epidermis of *L. eenii* showing parallel cuticular striations.
B & C: Epidermal surfaces of *L. acutifolium* and *L. strandveldense* respectively, showing the striations becoming more reticulate in the interstomatal region.
D: The epidermis sculpture of *L. villosum* showing reticulate cuticle.
E: Leaf surface of *L. afrum* showing smooth cuticle.

Scale bar = 10 µm.

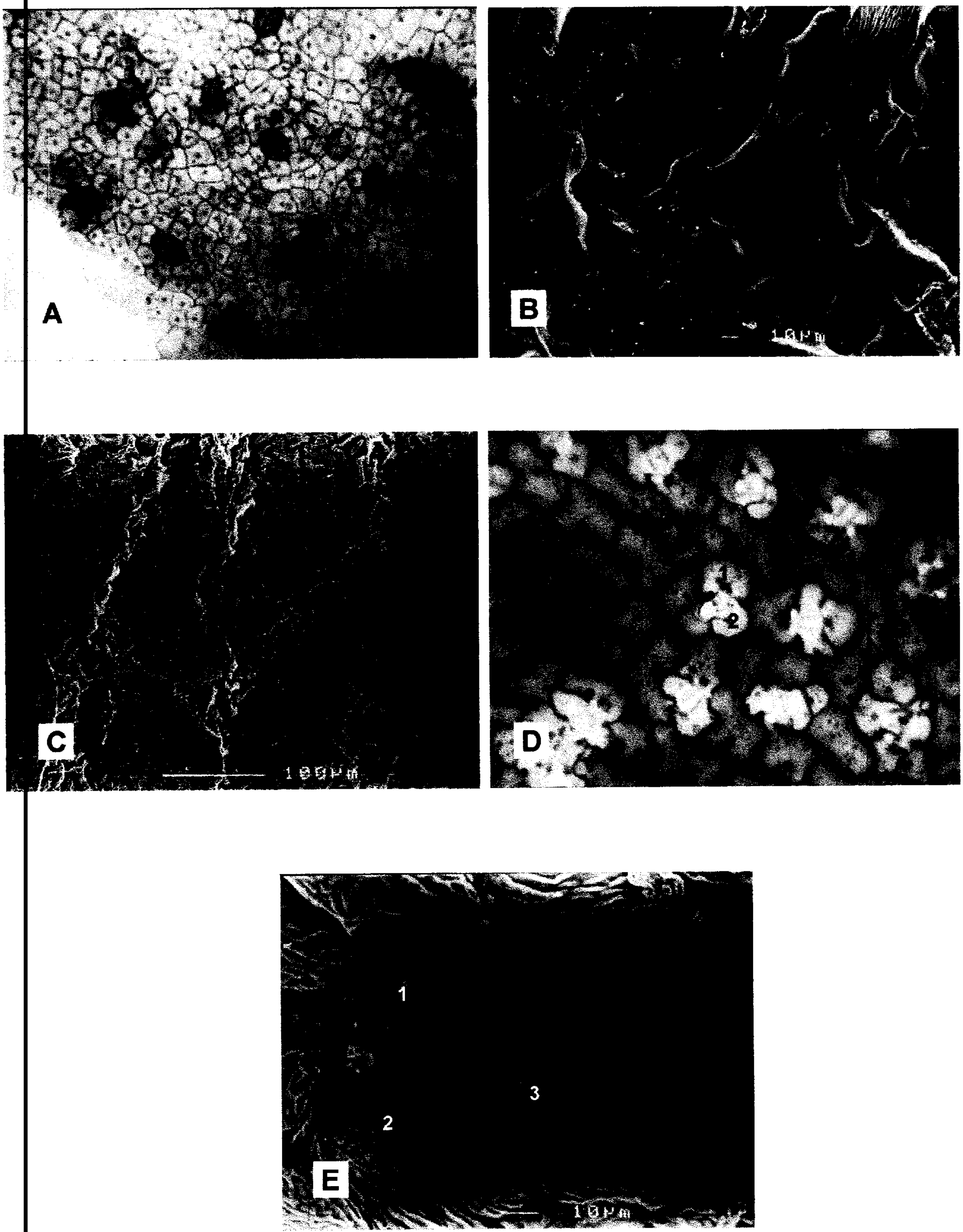


Figure 7.3.3
LM and SEM of leaf surface.
A: Epidermis of *L. oxycarpum* showing anomocytic stomata and straight walled epidermis cells.
B: Epidermis of *L. gariepense* showing anomocytic stomata and pronounced undulating anticlinal cell walls, covered by cuticle with little to no striations.
C: Epidermis of *L. oxycarpum* showing anomocytic stomata and parallel striations.
D: Epidermis of *L. pilifolium* showing anisocytic stoma (1,2 & 3: subsidiary cells)
E: Epidermis of *L. schweinfurthii* showing anisocytic stoma, shallowly undulating anticlinal cell walls and more or less parallel cuticular striations.

Scale bar B & E = 10 µm; A, C & D = 100 µm.

1. Seed coat surface reticulate with shallow to deep cavities (cell lumens) between the anticlinal cell walls. Varying degrees of thickening are found on the anticlinal walls (Figures 7.2.1A–C, 7.2.3 & 7.2.4).
   Sometimes the cell boundaries are not level with the thickenings. They may be channeled into the wall thickening or raised above the thickened anticlinal cell wall to form an additional ridge on top as was found in *L. shawii* (Figure 7.2.5).
2. Seed coat surface with a worm-like pattern, caused by the undulating, extremely thickened anticlinal cell walls that fill the cell lumen and compact together. This pattern was observed in four species, *L. afrum, L. amoenum, L. grandicalyx* and *L pilifolium* (Figure 7.2.6A & B). This phenomenon was also described by Axelius (1992) for *Physalis* and other solanaceous species.

In only three species, *L. arenicola, L. gariepense* and *L. villosum*, holes were observed in the inner periclinal cell walls (Figure 7.2.7).

The visibility of the seed coat sculpturing of species in group 1 indicates spontaneous autolysis of the outer periclinal cell wall in most of the African *Lycium* species, a phenomenon found in most species of *Solanum* and some other solanaceous species (Edmonds 1983).

7.2.3 Discussion

The Solanaceae is divided into two subfamilies the Cestroideae and the Solanoideae (Hunziker 1979). It is of importance to note that seed structure and chemistry play an important role in this division. The Cestroideae have non-compressed, often prismatic seeds with tropane alkaloids, while the Solanoideae have compressed seeds with steroidal alkaloids. The Solanoideae include the majority of taxa of the family, also *Solanum* and *Lycium* (Persson *et al.* 1994).

Axelius (1992) determined the shape of the seeds of the solanaceous genera he examined, excluding *Lycium,* as discoidal or reniform. The open and empty cells on the testa surface displayed more or less pronounced undulated anticlinal walls. He also found that in some cases the shape of cells differed, depending on the position of the cell on the seed. The thickenings of the anticlinal walls are composed of lignin and pectin, and can range from non-existent to varying degrees of thickness. The testa cell walls in some species are both undulated and very thick, resulting in the worm-like pattern common in the Solanaceae. The upper ends of the thickenings can be even or, rarely, somewhat irregular or have pillar-like outgrowths in *Athenaea*. A ridge occurred in some examples on the upper surface of the thickened anticlinal wall, which he interpreted as the edge of the original anticlinal wall, which exhibited many forms, such as a simple ridge, or be submerged between the thickenings to form a channel or have fringes or hair-like structures as in *Solanum nigrum* L. [= *S. luteum* Mill.] Axelius (1992) observed channeling and raised ridges in *Physalis peruviana* L. and *Chamaesaracha coronopus* A.Gray respectively. He furthermore, reported holes or pores of varying shape in the thickenings of the inner periclinal cell wall for species of *Chamaesaracha* (A.Gray) Benth., *Physalis* and *Withania* Pauquy, all genera of the Solanaceae.

The seed coats of the African *Lycium* species exhibit the typical solanaceous reticulate sculpturing resulting from the spontaneous autolysis of the outer periclinal epidermal cell wall and the slight to pronounced undulating nature of the thickened anticlinal cell walls. The seed shape varies, being subdiscoid, ovate or reniform. Although some differences in seed coat sculpturing and seed shape have been observed between species, the value as taxonomic tool does not seem significant when the variability of seed characteristics within the different species is considered. However, since a number of the characteristics observed by Axelius (1992) in his investigation of *Physalis, Margaranthus* Schldhtl. and *Achnitus* Schott were observed in the African *Lycium* species during the present investigation and, given the diagnostic and phylogenetic value of the surface sculpturing (Barthlott 1981, Axelius 1992), this may indicate some relationship between *Lycium* and the genera mentioned above.

When any part of the plant is exposed to direct sunlight, the temperature experienced by the exposed surface can by far exceed that tolerated by living cells. The temperature of the surrounding air, however, hardly exceeds 35°C. Surface temperatures under isolation are controlled by evaporation of water, resulting in water loss. Seeds cannot control temperature by transpiration. In xerophytes there is evidence of an additional surface temperature control mechanism, namely heavy leaf surface sculpturing. This observation lead to a hypothesis (Barthlott 1981) explaining the advantage of surface sculpturing in seed coats, and also in other epidermal cells, namely the surface temperature control mechanism that is created. The sculpturally increased surface area could also increase the energy exchange with the surrounding cooler air and additional surface "roughness" may cause turbulency in laminar air flow and therefore increase the thermodynamic exchange. The same mechanism can explain the heavier surface sculpturing found on the marginal parts of the seed surfaces in the African *Lycium* species, all of which occur in the more arid regions of the continent. In four species, namely *L. afrum, L. amoenum, L. grandicalyx* and *L. mascarenense*, the anticlinal cell walls are extremely thickened, reducing the cavities between the cell walls and thus reducing the 'roughness' of the seed coat. There does not seem to be any ecological advantage or common habitat feature linking these species that would explain this difference in sculpturing compared to the other species. The species often associated with water, namely *L. arenicola, L. hirsutum* and *L. oxycarpum* exhibit no marked differences compared to the seeds of the other species. These three species are, however, not dependent on a water associated habitat.

It would seem that the much neglected study of seed coat characteristics, including a more comprehensive study, over a taxon's distribution range, and across the boundaries of taxa, may be very rewarding in contributing valuable solutions to taxonomic headaches. Micromorphological and ultrastructural data have already contributed invaluable information to our understanding of the evolution and classification of seed plants (Barthlott 1981).

7.3 LEAF EPIDERMAL SURFACE

7.3.1 Introduction

Plant surface characteristics may be grouped into four categories, these being (i) cellular arrangement, (ii) shape of epidermal cells or primary sculpture, (iii) relief of surface or secondary sculpture caused mainly by cuticular striations and (iv) epicuticular secretions or tertiary sculpture caused by waxes and related substances (Barthlott 1981). Structurally epidermis cells are usually rather thick walled and stable even in vacuum. This feature resists structural deformation during preparation and facilitates easy preparation for SEM examinations (Barthlott 1981).

However, many surface features are of minor taxonomic importance and can only be used to characterize taxonomic categories up to family level. Bessis & Guyot (1979) studied the ontogeny of stomata and proposed an evolution of stomatal apparatus from the primitive perigenous anomocytic type, to the meso-perigenous anisocytic type, which diverge into two branches resulting in either paracytic and diacytic or tetracytic stomata, depending on the arrangement of the surrounding epidermal cells. An investigation of the Solanaceae revealed that most of the stomatal types, including anomocytic -, anisocytic -, tetracytic - and bicytic stomata are present and occur in all the tribes of the family (Bessis & Guyot 1979).

Bessis & Guyot (1979) selected 56 species representing 45 genera of 10 tribes of the Solanaceae to try and establish whether the stomata are of systematic and phylogenetic value. They confirmed the presence of all of the stomatal types in the family. In a number of genera different types of stomata coexist.

Perigynous anomocytic stomata, the primitive and initial type found in most flowering species, were found in all the species studied. *L. chinense* represented the genus *Lycium* in their investigation and in addition to the anomocytic stomata, all the transitional forms of anisocytic stomata were also observed in this taxon.

The taxonomic and diagnostic value of vestiture in the Solanaceae has been recognized by various authors (Roe 1971, Seithe 1979, Freire de Carvalho & Machado 1991), but mainly for the genus *Solanum*. Hitchcock (1932) studied the vestiture of *Lycium* species in the Americas and subsequent investigators used his terminology in their taxonomic treatments.

7.3.2 Results

The results obtained from light microscopical and SEM observations of vestiture, secondary or cuticular sculpture and stomatal types of leaves are summarized in Table 7.6.

Table 7.6 Epidermal characteristics of the African *Lycium* species.

Taxon	Vestiture	Cuticular sculpture	Stoma type
L. acutifolium	Short, glandular, elongated head	Parallel striations	Anomocytic and anisocytic
L. afrum	None	Smooth coating	Anomocytic
L. amoenum	Short, glandular, elongated head	Parallel striations	Anomocytic
L. arenicola	Short, glandular elongated head	Parallel striations	Anomocytic and anisocytic
L. boscifolium	Short, glandular, spherical head	Parallel striations	Anomocytic and anisocytic
L. cinereum	Short, glandular, spherical head	Parallel striations	Anomocytic and anisocytic

L. decumbens	None	Smooth coating	Anomocytic
L. eenii	Short, glandular, elongated head	Parallel striations	Anomocytic
L. europaeum	Short, glandular, spherical head	Parallel striations	Anomocytic and anisocytic
L. ferocissimum	Short, glandular, elongated head	Parallel striations	Anomocytic
L. gariepense	None	Smooth coating	Anomocytic and anisocytic
L. grandicalyx	Short, glandular, spherical head, unbranced eglandular	Smooth coating	Anomocytic and anisocytic
L. hirsutum	Branched eglandular, short and long glandular, spherical head	Parallel striations	Anomocytic
L. horridum	Short, glandular, elongated head	Parallel striations	Anomocytic
L. mascarenense	None	Parallel striations	Anomocytic
L. oxycarpum	Short, glandular, elongated head	Parallel striations	Anomocytic and anisocytic
L. pilifolium	Short and long glandular, spherical head	Parallel striations	Anomocytic
L. pumilum	Short, glandular, spherical head	Parallel striations	Anomocytic and anisocytic
L. schizocalyx	Short, glandular, spherical head	Parallel striations	Anisocytic
L. schweinfurthii	None	Parallel striations	Anomocytic and anisocytic
L. shawii	None	Parallel striations	Anomocytic and anisocytic
L. strandveldense	Short, glandular, elongated head	Parallel striations	Anomocytic and anisocytic
L. tenue	Short, glandular, spherical head	Parallel striations	Anomocytic
L. tetrandrum	Short, glandular, spherical head	Parallel striations	Anomocytic and anisocytic
L. villosum	Branched eglandular, short and long glandular, spherical head	Parallel striations	Anomocytic and anisocytic

The majority of species possess short stalked glandular trichomes, either with spherical or elongated heads. In addition to these trichomes *L. pilifolium* has long stalked glandular trichomes, *L. grandicalyx* has unbranched, uniseriate, multicellular, eglandular hairs, and in both *L. hirsutum* and *L. villosum* long stalked glandular trichomes and dendritic eglandular hairs occur (Figure 7.3.1: A–E). Trichomes are absent in *L. afrum, L. decumbens, L. gariepense, L. mascarenense, L. schweinfurthii* and *L. shawii.*

The characterisically striated cuticle is absent in *L. afrum, L. decumbens, L. gariepense* and *L. grandicalyx*, and is replaced by a smooth layer of cuticle. The striations are mostly parallel, becoming striate-reticulate in certain regions of some leaves (Figure 7.3.2: A–E).

Anomocytic stomata occurr in all the species and in some the more advanced anisocytic stomata were also observed.

The shape of the cells in surface view are isodiametrical to somewhat elongated, with anticlinal walls straight to slightly undulate. In *L. gariepense* and *L. villosum* the cell walls are more prominently undulated (Figure 7.3.3: A–E).

7.3.3 Discussion

The types of trichomes found in this investigation agree with the types observed by Hitchcock (1932) in the Western Hemisphere. Neither Chiang (1981) in North America or Bernardello (1986a) in South America seem to have attached any diagnostic value to the trichomes found in the species of *Lycium*. In the genus *Solanum,* though, this characteristic is of tremendous importance and is even used to confirm the sections in *Solanum* (Freire de Carvalho & Machado 1991) and phylogenetic relationships (Seithe 1979). The evolutionary trends in hair types in *Solanum* according to Seithe (1979) are from:

- short to long stalked glandular trichomes
- one or few gland cells to trichomes with multi-celled glandular heads
- gland-tipped to glandless trichomes
- unbranched to branched eglandular trichomes.

Seithe's (1979) conception of evolutionary trends in trichomes is confirmed by the observation in the African *Lycium* species. In the majority of species only short stalked gland-tipped trichomes are found. In one species, *L. pilifolium*, both long and short stalked glandular trichomes were observed. Two species considered as advanced, namely *L. hirsutum* and *L. villosum*, have long and short stalked glandular trichomes as well as uniseriate, multicellular and dendritic, eglandular trichomes.

The different trichome types are definitely of taxonomic value in the African lyciums, especially to identify those species with macroscopical vestiture, namely *L. hirsutum, L. grandicalyx, L. pilifolium* and *L. villosum.*

The presence of the same type of vestiture in species, could also be an indication of close relationships between particular species. As discussed in chapter 6, the dioecious *L. villosum* is of hybrid origin, and the fact that *L. hirsutum* is the only other species to have the same types of trichomes, is rather conclusive evidence of the latter being one of the parent species of *L. villosum.*

The secondary or cuticular sculpturing does not seem to be of any taxonomic value. The typical glaucous leaf colour of *L. afrum* and *L. pumilum* is not associated with the smooth cuticles observed in some of the species. Although *L. afrum's* cuticle is smooth, *L. pumilum* has striate cuticular sculpturing and short stalked glandular trichomes. However, this thickened, smooth cuticle seems to be one of the adaptations to extremely arid conditions of semi-desert or beach vegetation in *L. afrum, L. decumbens, L. gariepense* and *L. grandicalyx*.

Both anomocytic and anisocytic stomata were found in 14 of the African *Lycium* species and only anisocytic in the remainder of the species. This confirms the findings of Bessis & Guyot (1979) in *L. chinense* as well as for the subfamily Solanoideae. Except for the vestiture in some species, the cuticular, stomatal and vestiture characteristics of the species investigated do not seem to be of any distinguishing value.

Bessis & Guyot (1979) found that the tribes of the Solanaceae show great stomatal heterogeneity, but it appears as if the two series of Wettstein's classification (1891–1897), corresponding to Hunziker's two subfamilies (1979), are well supported. The first subfamily, the Solanoideae, including the Nicandreae, Solaneae and Datureae, is characterized by curved embryos and the species are relatively homogenous with mainly anisocytic stomata. However, species with very diversified stomata from anomocytic, anisocytic and bicytic, can be found in the second subfamily, the Cestroideae, consisting of the Cestreae and Salpiglossideae and are also characterized by straight embryos.

From these observations Bessis & Guyot (1979) concluded that the Solanaceae clearly appears polyphyletic and it is remarkable that they comprise both genera with primitive stomata and genera with evolved stomata. This evolution would have occurred parallel to one another, at the level of embryogeny and epidermis development, since the subfamily with curved embryos corresponds to an evolution in the anisocytic direction and the other subfamily with straight embryos in the bicytic direction. They also suggest that those species with diversified stomata show intermediate stages in the stomatal evolution and species with the homogeneous type of stomata can be considered as the ends of a phylum. This reasoning implies that the tribe Salpiglossideae with diverse stomata types should be considered as more primitive in comparison to, for instance, Solaneae with the homogeneous stomatal type. This is a contradiction of the fact that pollen and floral characteristics put the Salpiglossideae at the top of the phylogenetic development in the family, as discussed in 7.1.4. These same considerations also indicate that the Solaneae is one of the more primitive tribes, again an opposite view to the conclusions of Bessis & Guyot (1979) based on stomatal characteristics.

It is abundantly clear that no single characteristic should be considered in determining relationships between taxa in this family. Solving the phylogeny of a complex and diverse family like the Solanaceae and determining the evolutionary line of the different characteristics would seem virtually impossible.

CHAPTER 8

TAXONOMIC TREATMENT

8.1. GENERIC DESCRIPTION of *LYCIUM* in Africa

Lycium L., Genera plantarum: 57 (1737a); Gen. pl.: 88 (1754).

Kunth: 179 (1823); G. Don: 457 (1838); Raf.: 52 (1838); Endl.: 667 (1839); Walp.: 106 (1844); Dunal: 508 (1852); Miers: 7 (1854); Benth.: 885 (1876); Gray: 237 (1886), Wettst.: 13 (1891–1897); C. H. Wright: 109 (1904); Hitchc.: 199–200 (1932); Barkley:177 (1953); Podl. & Roessl. :124, 2 (1969); Haegi: 670 (1976); Hunziker: 7 (1977); Chiang: 87–88 (1981); Bernardello: 180 (1986a).

Type species: *L. afrum* L.

= ***Jasminoides*** Medik., Phil. Bot. 1: 134 (1789).

= ***Johnsonia*** Neck., Elem. Bot., 2: 49 (1808).

= ***Oplukion*** Raf., Syl. Tell. 53 (1838).

= ***Lycioplesium*** Miers, J. Bot (Hooker) 4: 330 (1845).

= ***Acnistus*** Miers, J. Bot. (Hooker) 4: 335 (1845).

DESCRIPTION

Species bisexual or dioecious. **Plants** densely branched, thorny, tangled, erect, decumbent or scandent bushy sub-shrubs, shrubs or rarely trees. **Stems** terete to sometimes angular, stout to pendulous, nodes on stems and thorns mostly swollen with brachyblasts; whitish to grey to brown to purplish, glabrous or hairy, glossy to dull, uniform to striated to rugose and cracked or flaking off in corky segments; vestiture of microscopic or macroscopic, multicellular and uniseriate, simple or branched, glandular or eglandular trichomes; thorns slender or stout. **Leaves** solitary and alternate or clustered on brachyblasts, vestiture as on stems; *petiole* present or absent; *lamina* narrowly to broadly ovate, obovate, or elliptic, succulent to semi-succulent or herbaceous, bright green to glaucous, apex acute or obtuse, base cuneate, margin entire. **Flowers** 1 or 2 from a brachyblast, bisexual or functionally unisexual, actinomorphic, 5-merous, sometimes 4-merous; pedicel slender, filiform, thickened distally, erect to rarely pendulous, glabrous, rarely hairy with indumentum as on calyx. **Calyx**: *tube* trumpet-shaped, campanulate or tubular; *lobes* triangular to oblong to triangular-ovate, aestivation valvate, indumentum as on stems, margins minutely or conspicuously ciliate; apices acute to obtuse, erect to spreading. **Corolla** white to off-white to greenish-white, often with purple markings and lobes usually lilac, or corolla maroon/purple, turning pale dirty-yellow with age; *tube* tubular, trumpet-shaped or campanulate, somewhat constricted above ovary, hypogenous, outside usually glabrous, sometimes hirsute, inside mostly pilose at stamen insertion; *lobes* shorter than tube, semi-ovate to semi-oblong ovate, spreading or reflexed, aestivation imbricate, apices rounded, margins ciliate, often recurved. **Stamens** epipetalous, equalling number of petals, 2 mostly long, 2 medium long and 1 short, included to conspicuously exserted from corolla-tube; *filament* bases with a pilose muff, rarely glabrous; *anthers* ovate-oblong to ovate, 0.5–1 mm long, all fertile in bisexual and functionally male flowers, sterile in functionally female flowers, glabrous, free, dorsifix, thecae equal, basally divergent, dehiscing by longitudinal slits; pollen trizonocolporate with exine striate, striate-reticulate, rarely rugulate. **Pistil** glabrous; *ovary* orbicular to ovoid, bicarpellate, bilocular, placentation axile, ovules anatropous to hemi-campylotropous, numerous; annular *nectary* from base of ovary prominent or inconspicuous, red, golden-ochre or pale yellowish-green; *style* erect, filiform in bisexual and functionally female flowers; *stigma* dilated, obtuse and bilobed, pale green, included or exserted from corolla tube in bisexual and functionally female flowers, style stunted and stigma absent in functionally male flowers. **Berry** globose to ovoid, apex obtuse to rarely acute, glabrous. **Seeds** usually numerous, subdiscoid or ovate to reniform; *testa* straw-coloured, leathery or crustaceous, reticulate-foveolate, glabrous; *embryo* curved with radicle terete and cotyledons semi-terete, endosperm usually abundant.

DIAGNOSTIC CHARACTERISTICS

Bisexual or dioecious plants. Densely branched, thorny shrubs; leaves clustered on brachyblasts. Flowers 1 or 2 per leaf cluster, 5-(4)-merous, bisexual or functionally unisexual. Corolla campanulate, tubular, funnel-, or trumpet-shaped, mostly white with violet markings. Stamens epipetalous, filament bases with a muff of hairs, anthers in bisexual and male flowers with viable pollen, in female flowers sterile. Ovary with basal annular, red, golden brown or pale green to pale yellow nectary. Style in bisexual and female flowers normal, style in male flowers rudimentary and stigma absent. Berries mandarin red to black.

DISTRIBUTION AND ECOLOGY

Lycium is widely spread over southern, eastern and northern Africa. However, the largest concentration of species is found in southern Africa where 23 of the 25 African species occur (Figure 8.1). The genus is found in a variety of habitats that range from arid plains to drainage lines, hill slopes or depressions on a variety of soils from sand to clay. The African lyciums are often associated with halophytic soil conditions. As far as vegetation types are concerned, *Lycium* occurs, and may even be dominant, in arid karoo/namib scrub, arid and moister savanna, and stream-bank scrub or forest.

Flowering takes place during the rainy seasons, therefore during winter and early spring in the winter rainfall areas and in spring and summer in the summer rainfall areas.

HYBRIDS AND SPECIES OF HYBRID ORIGIN

Field observations indicate that species of *Lycium* hybridize quite easily. These hybrids are recognisable by the presence of typical characteristics from both parent plants, found in the vicinity of the hybrid plant. Hybrids in the same vicinity exhibit a range of parental characteristics.

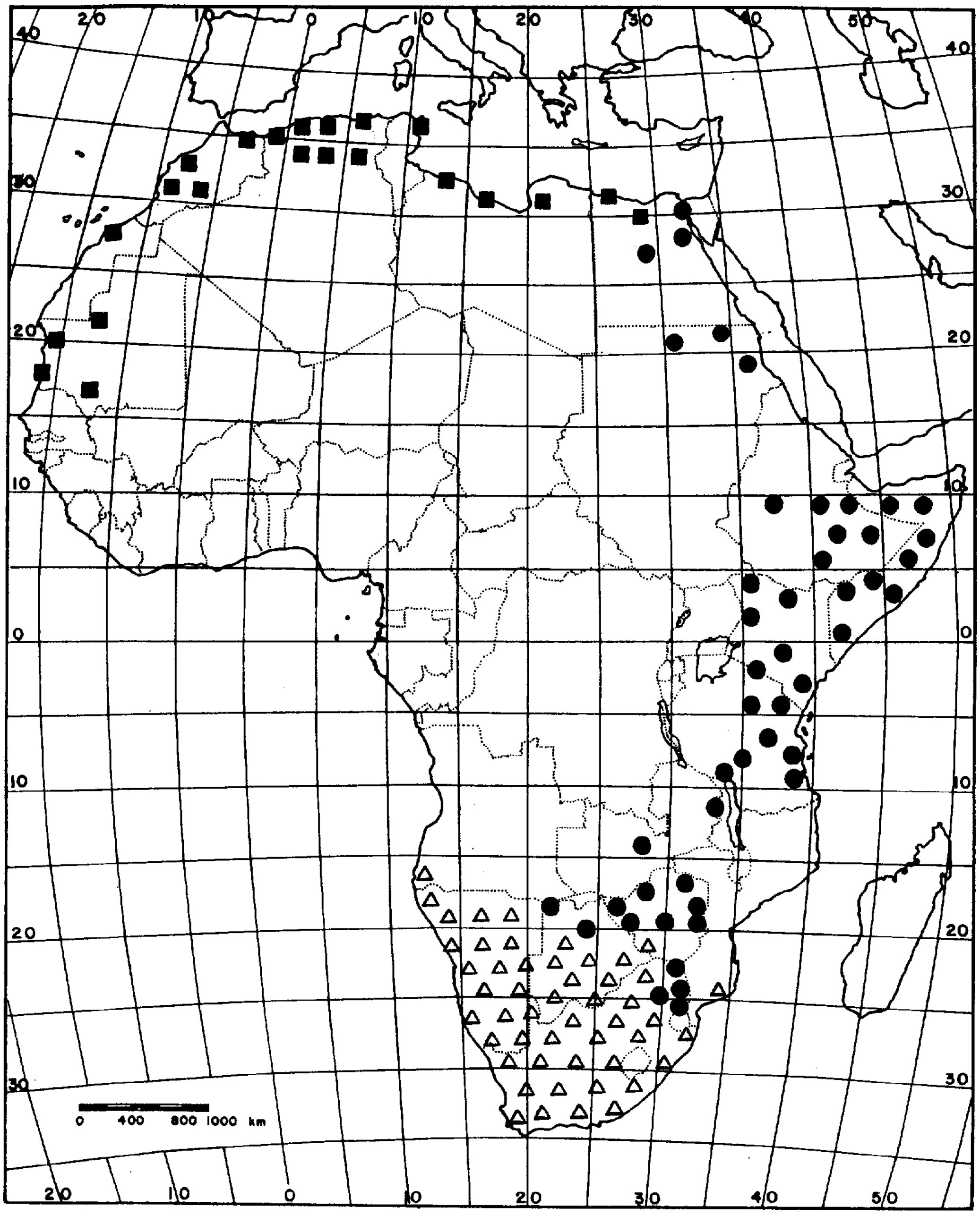


Figure 8.1 Distribution of *Lycium* species in Africa.

- △ Southern African species.
- ● *L. shawii* in southern, eastern and northern Africa.
- ■ North African species, *L. europaeum* and *L. schweinfurthii*.

A number of hybrids became established as individual species. Plants of these "hybrid" species are fully viable, share the same characteristics and have colonised a considerable area. These species are *L. arenicola, L. gariepense, L. horridum, L. strandveldense* and *L. villosum.*

NOTES

Pollination has not been observed, although butterflies have been noted around the plants. Ants are often found on these plants, even inside the flowers, but it is doubtful whether they are pollinators. In those species with longer, purplish corollas, birds may well be pollinators.

The lyciums of Africa, Asia and America are conspicuously similar in vegetative and floral structure. In a few American species the fruit deviates from the normal berry in being a sclerocarpous fruit with only 1 or 2 ovules per locule. A form of cryptic dioecy, different from that found in the African species, occurs in three American lyciums, namely *L. fremontii* , *L. exsertum* and *L. californicum*. The Asian and European lyciums all seem to be bisexual, and there is no report of any form of dioecy in the South American species.

UTILIZATION OF *LYCIUM* SPECIES

The Old World Solanaceae comprise many highly poisonous plants, some valuable medicinal plants and several food plant species. Although from the pre-historic period a few of its species were used by different ethnic groups in their folk-lore and therapeutic practices, no systematic ethnobotanical investigation has so far been undertaken. However, useful information on certain ethnobotanical aspects of many species has been indirectly recorded by specialists such as archaeologists, anthropologists, historians, travellers and field botanists (Mehra 1979).

Fruit and bark of *Lycium* species have been used for therapeutic purposes in Japan, China and Indochina (Vietnam) (Weitz 1921, quoted from Chiang 1981).

The young leaves and shoots of *L. barbarum* are used as a salad in the Orient, Spain and Provence, France (Weitz 1921, quoted from Chiang 1981). In the Iberian Peninsula a decoction of the leaves is used as a remedy for measles. In Yugoslavia infants with diarrhoea are treated with this decoction. In the Mediterranean region of Europe leaves of this species are used as substitute for Chinese tee (Standley 1924, quoted from Chiang 1981). *L. barbarum* is cultivated in China, especially for its berries. These are dried and used as food flavouring or as edible decoration in salads (Prof. Zhang Zhi-Yun, The Chinese Academy of Science, Beijing, pers. com.).

The young vegetative parts of *L.europaeum* are prepared as a vegetable in Spain and Italy (Standley 1924, quoted from Chiang 1981).

Very little of the utilisation of the African *Lycium* species has been formally recorded. Collectors' notes supply most of the available information. *L. shawii* seems to be the most widely and extensively used in eastern and northern Africa. In Kenya the young vegetative parts serve as a green vegetable, or extracts of various parts of the plants are used as medicine for stomach ache, coughing, skin rash or urinary problems. In the arid regions of Africa the plants are also heavily browsed by domestic animals, especially goats, camels, sheep and even browsing game like giraffe.

In South Africa Marloth (1932) recorded cases of serious poisoning in children after eating berries of *L. horridum.* Most of the other species were also found to be poisonous when eaten in quantity, especially the large, slightly sweet berries of *L. ferocissimum* (Watt & Breyer-Brandwijk 1962). The symptoms are those of narcotic poisoning. Some of the indigenous people, for instance the Sesotho people, smoke dried leaves of *Lycium* plants to relieve headaches. Instances of narcotic poisoning caused by this practice have also been recorded (Watt & Breyer-Brandwijk 1962).

Young foliage and ripe berries of most species are eaten by goats with no recorded ill effects (Marloth 1932, Watt & Breyer-Brandwijk 1962). When plants are of sufficient size they are much esteemed for supplying fencing poles or thorny branches are used as protective fencing (Marloth 1932, present author's observations).

L. ferocissimum has been extensively used as a hedge plant, especially in the 1800's and as such it has been spread to various locations outside its natural distribution range, like North Africa and Australia (Haegi 1976).

8.1.1 KEY TO THE AFRICAN *LYCIUM* SPECIES

1. Flowers with stamens and style conspicuously exserted from the corolla mouth 2

1. Flowers with stamens and style included in or very slightly exserted from the corolla mouth 12

2. Calyx shorter than ½ of the corolla tube 3

2. Calyx longer than ½ of the corolla tube 5

3. Corolla tube 10 mm or longer . . . . ***L. bosciifolium***

3. Corolla tube shorter than 10 mm 4

4. Leaves large, 30–45 x 7–12 mm. Plants introduced from Europe and restricted to North Africa . . . . ***L. barbarum***

4. Leaves small and narrow, 7–17 x 1–2 mm. Indigenous and restricted to southern Africa . . . . ***L. cinereum***

5. Calyx bladder-like, enclosing the corolla tube. Restricted to the black limestone ridges of southern Namibia . . . . ***L. grandicalyx***

5. Calyx tubular or campanulate and fitting tightly around the corolla tube . . . 6

6. Flowers large, corolla tube broadly funnel-shaped to campanulate, longer that 10 mm and corolla mouth wider than 6 mm . . . . ***L. amoenum***

6. Flowers small, corolla tube narrowly funnel-shaped or tubular, shorter than 10 mm and corolla mouth narrower than 5 mm 7

7. Calyx lobes about as long as the calyx tube, oblong with acute apices to narrowly triangular 8

7. Calyx lobes shorter than the calyx tube, triangular 9

8. Leaves and young stems pilose with long stalked glandular trichomes. Berries yellow . . . . ***L. pilifolium***

8. Leaves and young stems appear glabrous. Berries red . . . ***L. schizocalyx***

9. Corolla tube up to 5 mm long. Stamens inserted in corolla mouth, pilose filament bases visible in corolla mouth. Leaves glaucous. Stems prominently zig-zag, bark dark purplish brown and shining . . . . ***L. pumilum***

9. Corolla tube longer than 5 mm. Stamens inserted at or below the middle of the corolla tube. Leaves bright to pale green. Stems straight. Bark not dark purplish brown 10

10. Plants up to 0.2m high, branches decumbent. Nectary golden brown. Restricted to the arid coastal belt of northern Namibia and southern Angola . . . . ***L. decumbens***

10. Plants 1– 3 m high, erect branches. Nectary red. Plants indigenous to southern South Africa 11

11. Leaves large, obovate to elliptic, 12–35 x 4–10 mm, bright green and shiny. Calyx at least 2/3 the length of the corolla tube . . . . ***L. ferocissimum***

11. Leaves narrowly obovate, 8–16 x 1–3 mm, pale green. Calyx not more than ½ the length of the corolla tube . . . . ***L. tenue***

12. Leaves, young stems and calyces conspicuously hirsute 13

12. Leaves, stems and calyces apparently glabrous 14

13. Corolla 14–28 mm long, flowers bisexual . . . . ***L. hirsutum***

13. Corolla 8–12 mm in length, flowers unisexual . . . . ***L. villosum***

14. Corolla tube 10 mm or longer. Nectaries creamy to pale yellowish green, if golden yellow, then corolla dark purple 15

14. Corolla tube shorter than 10 mm. Nectaries red or golden yellow. 21

15. Corolla tubular. Calyx campanulate, 4 mm or longer. Leaves 3 mm wide or narrower. Plants restricted to south-western region of South Africa 16

15. Corolla funnel-shaped. Calyx tubular, or if campanulate then shorter than 4 mm. Leaves broader than 3 mm 17

16. Leaves linear to narrowly obovate, longer than 14 mm, narrower than 2mm, glaucous. Flowers bisexual, corolla wine red or maroon. Berries black . . . . ***L. afrum***

16. Leaves ovate to obovate, shorter than 14 mm, 2–3 mm broad, bright green. Flowers unisexual, corolla deep purple. Berries red . . . . ***L. strandveldense***

17. Calyx 1–1.5 mm long. Corolla lobes very small, hemi-orbicular and less than 0.8 mm long. Berries black . . . . ***L. schweinfurthii***

17. Calyx longer than 2 mm. Corolla lobes hemi-orbicular to ovate to oblong, 1.5–4 mm long. Berries red 18

18. Corolla tube 20 mm or longer . . . . ***L. oxycarpum***

18. Corolla tube shorter than 20 mm 19

19. Leaves coriacious, dull green, apices cuspidate. Ratio length:width ≡ 2:1–3:1. Stamens inserted on lower third of corolla tube . . . . ***L. eenii***

19. Leaves herbaceous to succulent, bright green, rarely glaucous, apices acute to rounded.. Ratio length:width ≡ 5:1–8:1. Stamens inserted at middle or in upper half of corolla tube 20

20. Calyx campanulate to broadly tubular. Corolla tube funnel-shaped and corolla lobes semi-orbicular, 1.5–2 x 1.5–2 mm. Corolla tube tinged greenish purple on outside with dark purple lobes . . . . ***L. europaeum***

20. Calyx distinctly and narrowly tubular. Corolla tubular and corolla lobes ovate to oblong, 3–4 x 2–3 mm. Corolla creamly white, lobes sometimes pale lilac with purple venation . . . . ***L. shawii***

21. Leaves with ratio length:width about 3:1. Flowers bisexual 22

21. Leaves with ratio length:width 4:1 – 10:1. Flowers unisexual 23

22. Leaves herbaceous, flat, elliptic to narrowly obovate. Scandent or erect shrub. Occurs on coastal flates and in interior of KwaZulu-Natal and Transkei . . . . ***L. acutifolium***

22. Leaves succulent and cylindrical, obovate. Shrub spreading carpet- or curtain-like over rock faces and dunes along beach of northern KwaZulu-Natal and southern Mazambique . . . . ***L. mascarenense***

23. A shrub, young branches pendulous and with a few short thorns or thornless. Leaves glaucous, lanceolate, linear or narrowly obovate, ratio length:width about 10:1 . . . . ***L. arenicola***

23. Shrubs with rigidly erect branches, young branches conspicuously thorny. Leaves obovate, green to pale green, ratio length:width ≡ 4:1–8:1 24

24. Thorns needle thin, branched even in young parts. Stems slender, densely branched and entangled, giving the plants an untidy appearance. Restricted to the arid regions of southern parts of Namibia . . . . ***L. gariepense***

24. Thorns stout, unbranched in younger parts. Thorns lengthening gradually from apex downwards, giving terminal branches a deltoid appearance . . . 25

25. Flowers creamy white, sometimes with pale lilac lobes or purple veins. Corolla tube usually shorter than 6 mm. Leaves succulent and cylindrical, clustered on prominent brachyblasts. Restricted to the coastal belt of southern and western South Africa and Namibia . . . . ***L. tetrandrum***

25. Flowers white with dark purple patch at base of lilac corolla lobes. Corolla tube usually longer than 6 mm. Leaves succulent but flattened. Leaves clustered on inconspicuous brachyblasts. Wide spread in the interior of South Africa and Namibia . . . . ***L. horridum***

8.2 DESCRIPTION OF SPECIES

8.2.1 ***LYCIUM ACUTIFOLIUM*** E. Mey. ex Dunal in *DC, Prodromus* 13(1): 518-519 (1852); E. Mey. ex Drège: 145 (1843), (nomen); Miers: 16 (1854); t. 66 fig. B (1857); C. H. Wright: 112 (1904); Dean: 2 (1974).

Type: South Africa, Umtata, *Drège 4874a* (G-DC!, holotype; K!, P!, MO!, isotypes).

≡ ***L. acutifolium*** *var.* ***latifolium*** Dunal: 519 (1852), (nom. invalid.).

Type: homotypic with *L. acutifoium*

= ***L. acutifolium*** *var.* ***angustifolium*** Dunal: 519 (1852), **syn. nov.**

Type: South Africa, Gekau, *Drège 4874b* (G-DC!, holotype; P!, isotype).

= ***L. pendulinum*** Miers: 20 (1854); Dean: 10 (1974), **syn. nov.**

Type: South Africa, Cape, *no collector* (K!, holotype).

DESCRIPTION

A bisexual, erect, much branched, sometimes scandent or prostrate **shrub** of 0.5–3 m high. **Stems** slender; young branches often pendulous, internodes often conspicuously long, young stems greenish–creamy white, older stems pale grey to pale brown, glabrous; thorns awl-shaped, (10–)30–50 mm long, often

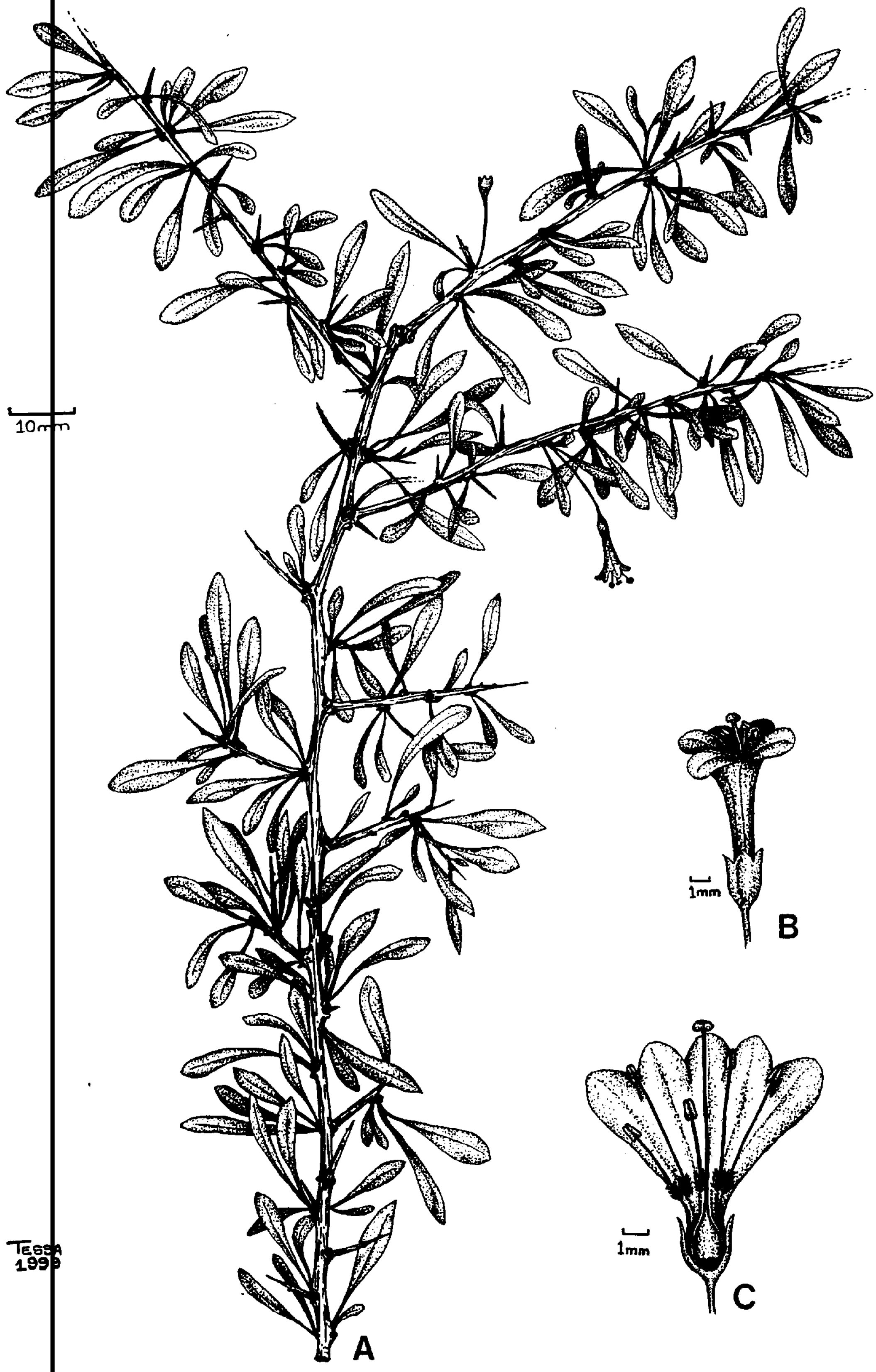


Figure 8.2.1 *Lycium acutifolium.*
A: Stem with thorns, leaves and flowers; B: External view of flower;
C: Flower internally showing pistil and stamens.
[A, B & C: *A. M. Reyneke 225* (BLFU)].

absent on young branches. **Leaves** often solitary, mostly fascicled with 2–5 leaves per cluster; *petiole* 1–5 mm long; *lamina* elliptic to obovate or narrowly obovate, 10–23 x 3–7 mm, herbaceous, bright green, macroscopically glabrous, apices acute or obtuse, seldom mucronate. **Flowers** 5-merous, sub-erect to slightly pendulous; pedicel (5–)8–14(–16) mm long. **Calyx** campanulate, 2–3 x 2–3 mm, glabrous; *lobes* triangular, 0.5–0.8 mm long, equal, erect, apices acute. **Corolla** creamy white, with violet venation; *tube* funnel-shaped, (5–)7–8(–9) x 3–4(–5) mm, glabrous outside; pilose on inside at filament bases; *lobes* 2.5–3 x 2–3.5 mm, semi-ovate or semi-orbicular, spreading. **Stamens** arise at or just below middle of corolla tube, 1 or 2 included, others slightly exserted from corolla mouth; *filaments* 4–5 mm long, bases pilose. **Pistil:** *ovary* ovoid, 2.5 x 2 mm; *style* 9–10(–11) mm long, exserted past stamens; *nectary* orange-red, inconspicuous. **Berry** ovoid or ovoid-oblong, 6–8 x 4–5 mm, apex slightly apiculate, red. **Seed** subdiscoid to ovate, 2 x 1.5 mm. (Figure 8.2.1). 2n = 2x = 24.

VERNACULAR NAMES

"Soft leafed box thorn", "sagteblaarkriedoring"

NOTES

Dunal (1852) included two varieties with his description of the species, viz. *L. acutifolium* var. *latifolium* (Drège 4874a) and *L. acutifolium* var. *angustifolium* (Drège 4874b) because of a difference in leaf shape and size. However, these differences are commonly found on the same plant and therefore the varieties are considered as synonyms of the species.

DISTRIBUTION AND ECOLOGY

L. acutifolium is restricted to the moister, subtropical eastern parts of southern Africa from the Mozambique/Kwazulu-Natal border to the Eastern Cape Province (Figure 8.2.2). This species occurs in grassland and savannah on flood plains, sandy soils and occasionally rocky, particularly dolorite, soils.

L. acutifolium flowers throughout the year, peaking during spring in August and September and early summer during November.

VOUCHER SPECIMENS

South Africa:

–28S31E: Umfolozi Game Reserve, Mbuzana area (–BD), *Fakude E. N. 99* (NH, NU).

–28S31E: Umfolozi Game Reserve, Tobothi turn-off (–CD), *Reyneke A. M. 225* (BLFU).

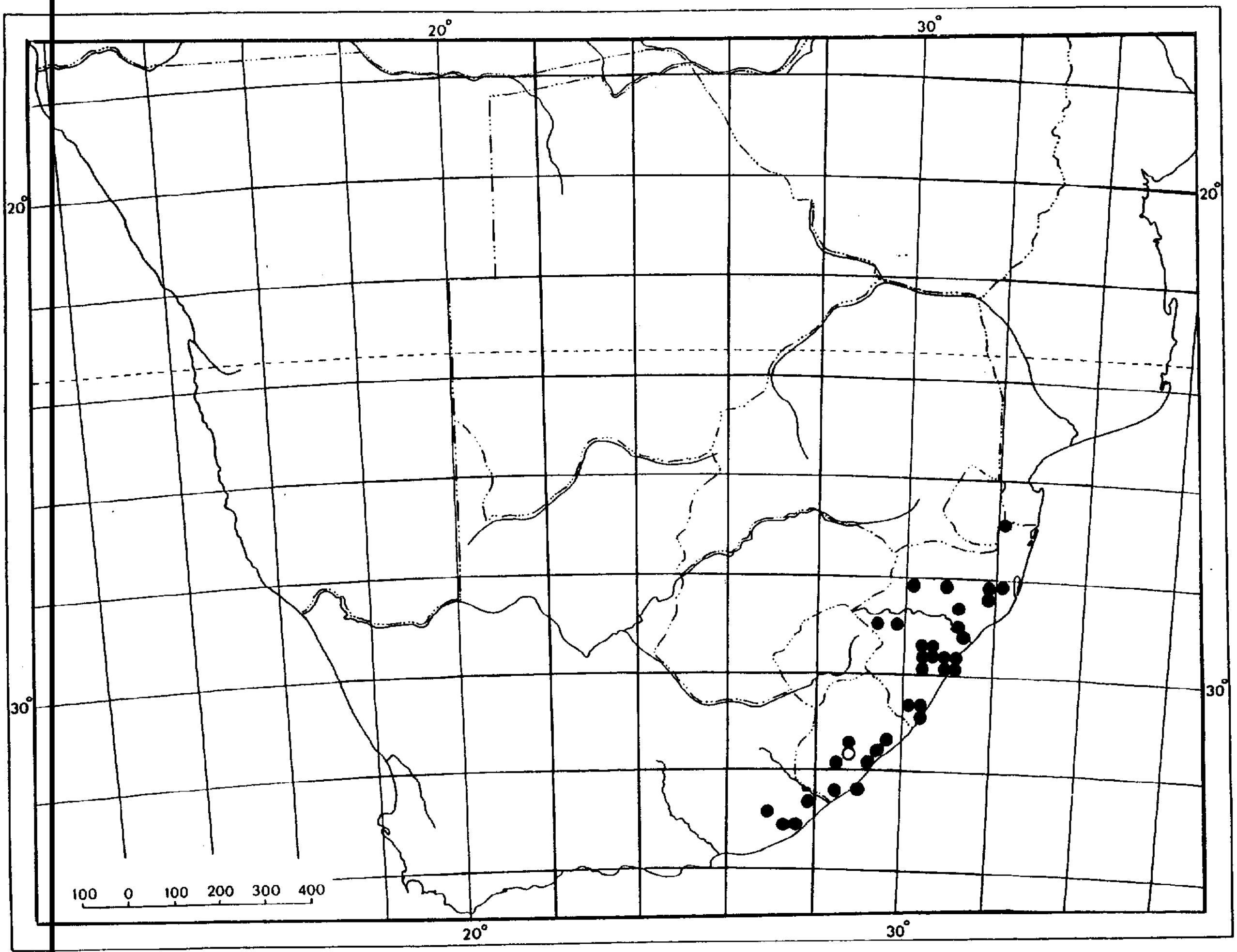
–29S30E: Nagle Dam, Camperdown district (–DA), *Wells M. J. 1391* (K, NH).

–29S31E: Umgeni (–AA), *Wood M. J. 12574* (PRE, NU).

–30S30E: Horseshoe farm near Umzimkulu, Port Shepstone (–CB), *Strey R. G. 5864* (PRE, NU, NH).

–32S28E: Transkei at confluence of Qora and Ngqageni Rivers (–AD), *Ward C. J 5778* (PRE, NH).

–33S28E: Dwesa Forest, Willowvale (–BD), *Acocks J. H. P. 13602* (PRE, K).



F|gure 8.2.2 Known geographical distribution of *Lycium acutifolium*.

[o : Type locality]

8.2.2 ***LYCIUM AFRUM*** L., Species plantarum 1: 191 (1753), 57 (1737b); L.f.: 691 (1819)f 700 (1825); Nissole: 324, t 12 (1712); Micheli: 224, t 105, fig 2 (1729); Thunb.: 153 (1808); Willd.: 245 (1809); Roem. & Schult.: 690 (1819); Dunal: 512 (1852); Miers: 16 (1854), t 66, fig c (1857); C.H.Wright: 111 (1904); Dammer: 234 (1913); Feinbrun & Stearn: 118 (1963); Dean: 3 (1974); Haegi: 672 (1976).

Type: *Lycium foliis linearibus* in Hortus Cliffortianus (BM!, holotype).

= ***Jasminoides africanum, jasmini aculeati foliis et facie,*** Nissole: 318, t.12 (1712), (synonymy declared by Feinbrun & Stearn (1963)).

= ***L. rigidum*** Thunb.: 37 (1794), **syn. nov.**; 153 (1808); Willd.: 245 (1809); L. (1819); 700 (1825); Roem. & Schult.: 691 (1819); Dunal: 512 (1852); Miers: 186 (1854); C.H.Wright: 111 (1904); Dean: 3 (1974).

Type: South Africa, Cape Town and elsewhere, *Thunberg s.n.* (UPS no 5311!, holotype).

= ***L. crassifolium*** Salisb.: 135 (1796), **syn. nov.**

Type: Plant collected from the Cape by *F. Masson*, no herbarium specimen found (synonymy after description of Salisbury).

= ***L. carnosum*** Poir.: 427 (1814), **syn. nov.**; Miers: 17 (1854); Dean: 4 (1974).

Type: Plant grown in Paris from seed from the Cape (P-LAM, holotype) (synonymy after description of Poiret).

= *L. **propinquum*** G. Don: 459 (1838), **syn. nov.**

Type: South Africa, Cape, *Thunberg 5299* (UPS!, holotype).

= *L. **afrum*** var. ***breviflorum*** Dunal: 522 (1852), **syn. nov.**

Type: South Africa, Cape, Table Bay near Cape Town, *Drège 7868* (G-DC!, holotype).

= *L. **afrum*** var. ***longifolium*** Dunal: 522 (1852), **syn. nov.**

Type: From a plant grown in the garden of Palais Francaville at Naples (G-DC!, holotype).

= *L. **afrum var. sublatum*** Dunal: 522 (1852), **syn. nov.**

Type: Cap Lambert (perhaps Lamberts Bay), *anon* (G-DC!, holotype).

≡ *L. **bachmanni*** Dammer: 232 (1913); Dean: 4 (1974).

Type: South Africa, Cape, Hopefield in Malmesbury district, *Bachmann 1893* (B†, holotype), (Synonymy after Dammer's description).

DESCRIPTION

A bisexual, erect, rigid, profusely branched, thorny **shrub** of 0.6–2 m high. **Stems** stout, young stems pale yellowish brown to pale grey, older stems grey to

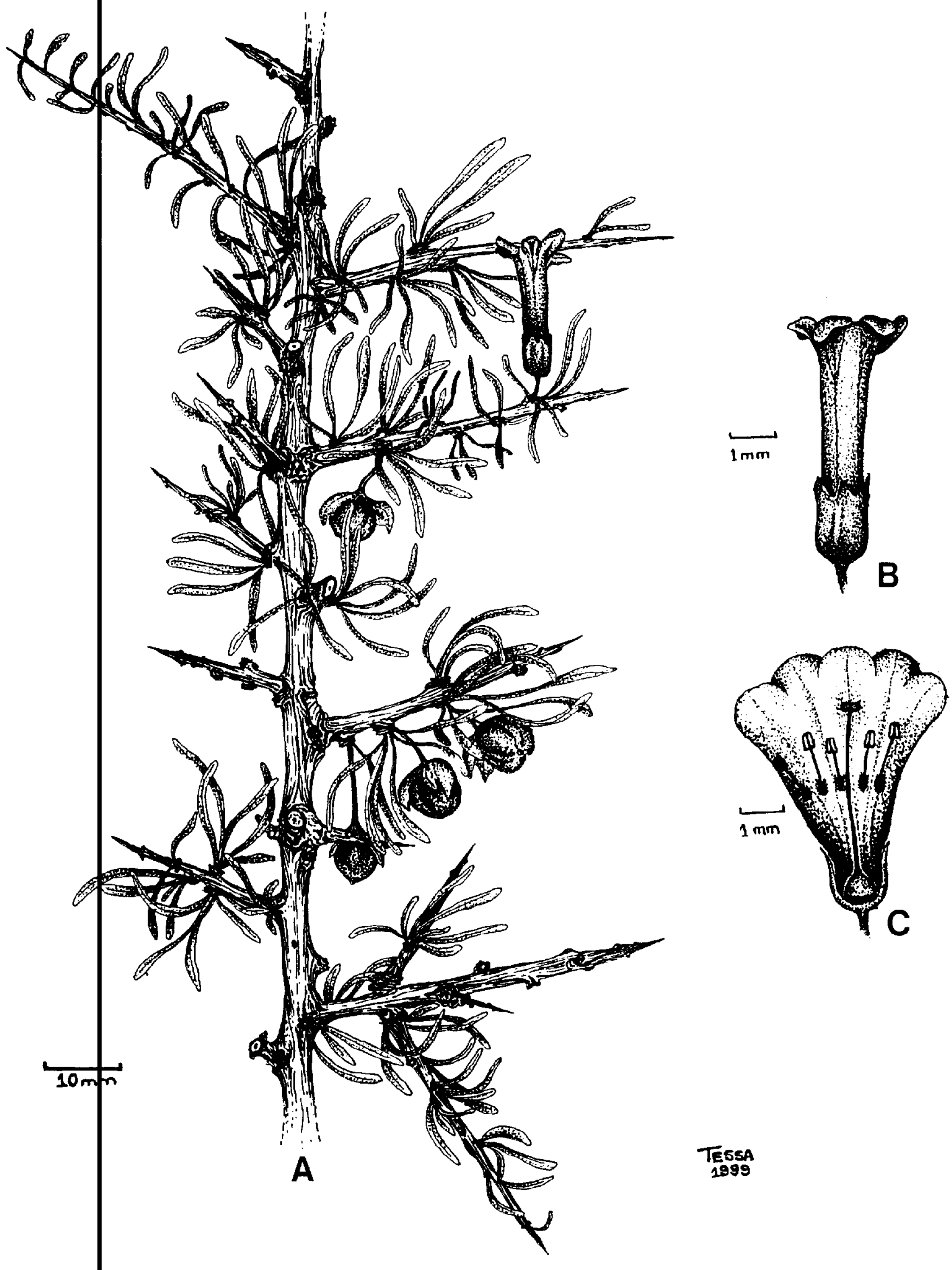


Figure 8.2.3 *Lycium afrum.*
A: Stem with thorns, leaves, flowers and fruit; B: External view of flower;
C: Flower internally showing pistil and stamens.
[A, B & C: *A. M. Reyneke 223* (BLFU)].

brownish grey, glabrous; thorns stout, 20–30 mm long on young stems, 30–100 mm long on older stems. **Leaves** fascicled on stems and thorns, 5–12 per fascicle, glabrous; *petiole* 0–1 mm long; *lamina* linear to sometimes narrowly oblong, (11–)14–18(–24) x 0.8–2 mm, succulent, glaucous, apices acute to somewhat obtuse. **Flowers** 5-merous; pedicel 5–10 (–13) mm long. **Calyx** campanulate to slightly tubular in larger flowers, 4–6(–8) x 4–5 mm; *lobes* triangular, 1.5 mm long, about equal, erect; apices acute. **Corolla** deep maroon (wine/claret red); *tube* narrowly trumpet-shaped to tubular, (13–)15–20 x 5–6(–8) mm, glabrous outside, inside sparsely pilose at and below insertion of stamens; *lobes* semi-orbicular or sometimes semi-ovate, 2–3 mm long, spreading. **Stamens** about equal in length and reach corolla throat; filaments inserted 7–10 mm above corolla base at about middle of tube; *filaments* 7–8 mm long, bases pilose. **Pistil:** *ovary* broadly ovoid, 1.5–2 x 1.5–2 mm, *style* 12–18 mm long, reaching into corolla throat but not exserted; *nectary* greenish-white, inconspicuous. **Berry** spherical to slightly ellipsoid, 8–13 x 8–10 mm, black. **Seed** subdiscoid to ovate, 1.5–2 mm. (Figure 8.2.3). $2n = 2x = 24$.

VERNACULAR NAMES

"Bokdoring" (Adamson & Salter 1950), "kraaldoring" or "slangbessieboom" (Palmer & Pitman 1972).

NOTES

The pigmentation of the berry is a very dark red and therefore appears to be black. A species worth cultivating for its beautiful flowers.

DISTRIBUTION AND ECOLOGY

This species occurs in the winter rainfall region of the Western Cape Province, from Clanwilliam in the north through the Cape Peninsula to the Caledon District in the east (Figure 8.2.4). The usual habitat is sandy flats and dunes of the low lying areas along the coast, but plants are also found on mountain slopes. Flowering begins in June at the onset of the rainy season, peaking in spring during September and October.

VOUCHER SPECIMENS

South Africa:

–31S18E: Van Rhynsdorp near Olifants River (–DA), *Drège s.n.* (K).

–32S18E: Lamberts Bay, at Nortier Farm (–AB), *Boucher C. 2578* (K, NBG).

–32S18E: Observatory near Cape Town (–CD), *Wilms F. 3451* (BM).

–33S18E: Bokbaai, along the west coast (–CB), *Reyneke A. M. 223* (K, BLFU).

–33S18E: Just north of Melkbosstrand (–CB), *Venter A. M. 353* (BLFU).

–33S18E: Mamre Hills near Malmesbury (–DA), *Compton R. H. 11603* (NBG).

–34S18E: Cape Penninsula, Noordhoek (–AB), *Compton R. H. 14517* (NBG).

–34S18E: Van der Stel at Stellenbosch (–BB), *Smith C. A. 4213* (PRE).

–34S19E: Baviaansfontein Hills at Uiteskraalbos near Caledon (–CB), *Taylor H. C. 1588* (PRE, NBG).

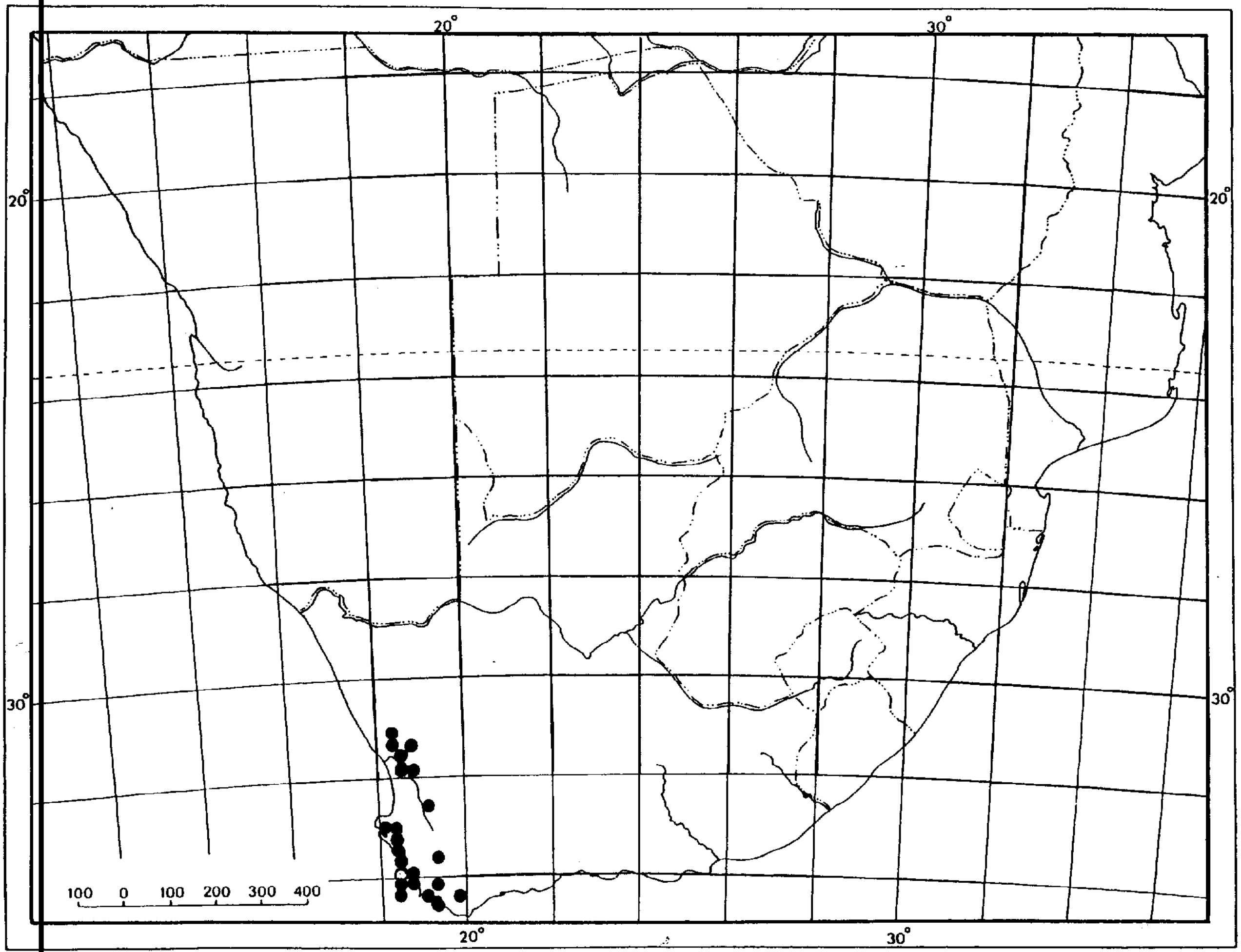


Figure 8.2.4 Known geographical distribution of *Lycium afrum*.

[o : Type locality]

8.2.3 *LYCIUM AMOENUM* Dammer: 228 (1913).

Type: South Africa, SW Cape, Malmesbury region, Uitkomst at Hopefield. *Bachmann 1878* (BΨ, holotype).

South Africa, SW Cape, 30 km east of Lamberts Bay, *A. M. Venter 563* (BLFU!, neotype, here declared; BM!, K!, NBG!, PRE!, isotypes).

= ***L. campanulatum*** E. Mey ex C.H.Wright in Dyer, Flora Capensis 4(2): 111 (1904) (nom. illegit.); Dean: 11 (1974).

Types: South Africa, Cape Province, Clanwilliam region between Langevallei and Heerelogement, *Drège s.n.* (K!, lectotype, here declared);

Cape Province, Port Elizabeth near lead mine, *Burchell 4490* (K!, syntype);

Cape Province, Uitenhage, *Zeyher 105* (K!, syntype, but holotype of *L. ferocissimum*).

= ***L. rigidum*** var. ***angustifolium*** Dunal: 523 (1852), **syn. nov.**

Type: South Africa, Olifants River, *Drège 3060b*, [*L. rigidum b*], (G-BOISS!, holotype; P!, isotype).

= ***L. rigidum*** var. ***latifolium-grandiflorum*** Dunal: 522 (1852), **syn. nov.**; C.H. Wright: 111 (1904); Dean: 11 (1974).

Type: South Africa, between Jakkals River and Langevales, *Drège s. n.* (G-DC!, holotype; P!, isotype).

= *L. rigidum* var. ***latifolium-parviflorum*** Dunal: 523 (1852), **syn. nov.**

Type: South Afica, near Ebenezar, *Drège 3069a* [*L. rigidum a*], (G-BOISS!, holotype; P!, K!, isotypes).

DESCRIPTION

A bisexual, thorny **shrub** of 1–2(–3) m high. **Stems** long, stout, young stems dull green to creamy brown, older stems pale-grey to ash-brown, glabrous; thorns at right angles to stem, peg-like, 15–30 mm long in younger parts, 50–80 mm long on older stems. **Leaves** densely clustered on stems and thorns, 3–8 leaves per fascicle, young stems sometimes with solitary, spirally arranged leaves; *petiole* 0–1 mm long; *lamina* obovate, sometimes elliptic or oblong, 12–24 x (2–)4–7 mm, semi-succulent, dull green, sometimes dark green, macroscopically glabrous, apices acute to obtuse. **Flowers** 5-merous; pedicel 5–10(–15) mm long. **Calyx** campanulate or sometimes broadly tubular, 6–8(–10) x 5–8(–9) mm; *lobes* triangular, 2–3 mm long, unequal, apices acute. **Corolla** off-white with purple markings and violet lobes, *tube* campanulate to broadly funnel-shaped, 10–14(–17) x 7–10 mm., sparsely pilose at insertion of stamens; *lobes* suborbicular, 3–4 x 4–5 mm, margin often recurved, reflexed. **Stamens** inserted 4–6 mm above the base of corolla, just below middle of tube, conspicuously exserted from corolla mouth; *filaments* 8–10(–14) mm long, bases pilose. **Pistil:** *ovary* broadly ovoid to spherical, 2–3 x 2–3 mm, *style* 15–20 mm long, exserted as far as stamens; *nectary* golden-yellow and conspicuous. **Berry** broadly ovoid or spherical, 8–10(–12) x 8–10(–12) mm, red. **Seed** subdiscoid, 2–3 x 3 mm (Figure 8.2.5). $2n = 2x = 24$.

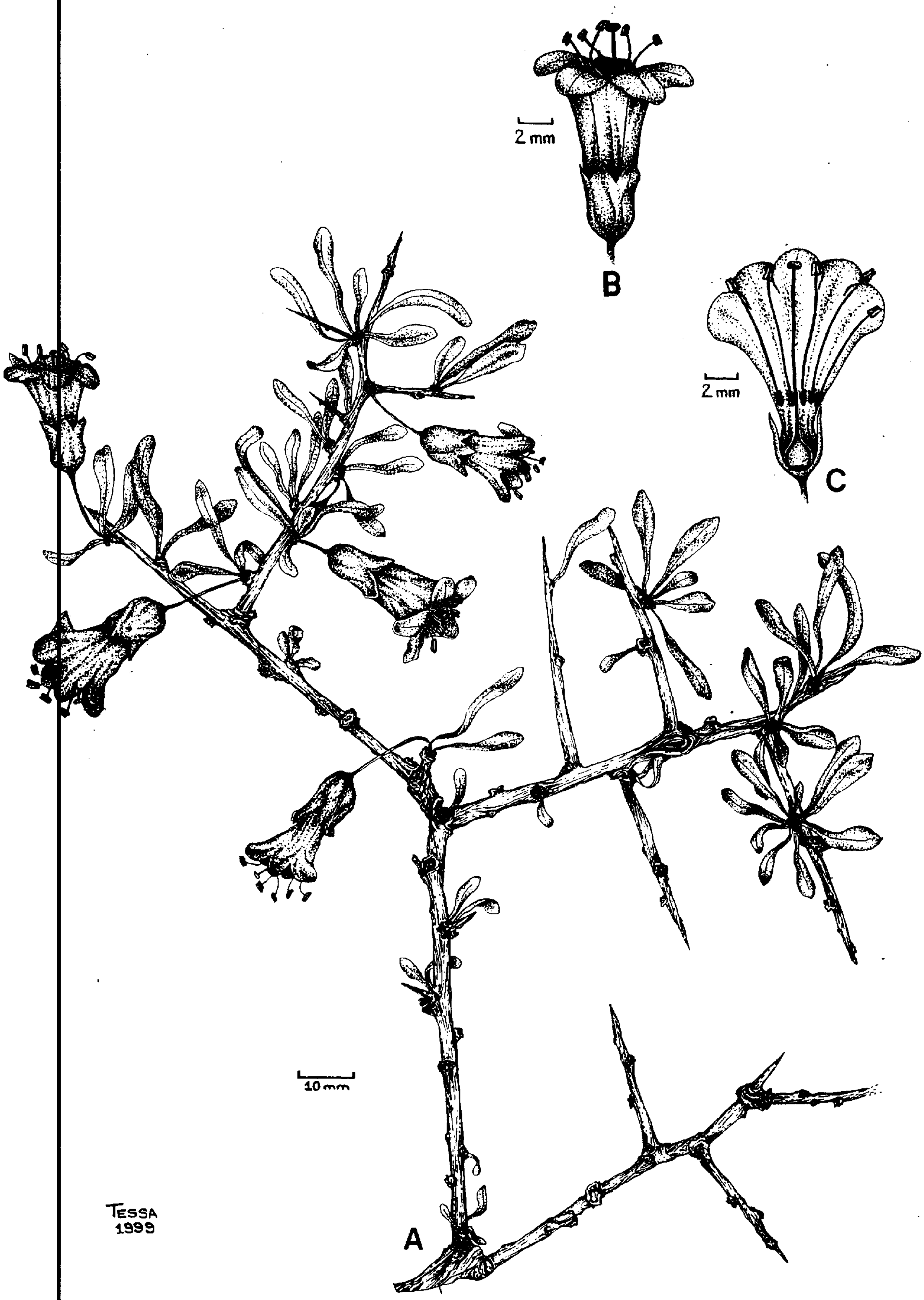


Figure 8.2.5 *Lycium amoenum*.
A: Stem with thorns, leaves and flowers; B: External view of flower;
C: Flower internally showing pistil and stamens.
[A, B & C: *L. van Rooyen & M. Ramsey 640* (PRE)].

NOTES

Drège's two specimens on the same type sheet caused much confusion and *L. amoenum* was thus regarded as a form of *L. ferocissimum* for long.

L. amoenum is well worth cultivating for its beautifull large flowers.

VERNACULAR NAME

"Slangbessie" (Smith 1966).

DISTRIBUTION AND ECOLOGY

Found from the Cape Peninsula along the west coast to Namaqualand and the Orange River (Figure 8.2.6). Only one collection is known from Namibia at the Schakal Mountains to the northeast of Oranjemund.

This species is found in sandy soil of dry riverbeds or along stream banks, or on dry, rocky hillsides in sandy or loamy soils. The vegetation ranges from Fynbos in the southwest, to Namaqualand broken veld and succulent karoo towards the northwest. Being distributed in the winter rainfall region, flowering starts in winter from June to July and peaks just after the seasonal rains in early spring from August to September.

VOUCHER SPECIMENS

Namibia:

–28S16E: Schakal Mountains near Oranjemund (–BC), *Müller M. 770* (PRE, WIND).

South Africa:

–28S17E: Richtersveld, 25 km north of Eksteensfontein (–CA), *Venter A. M. 405* (BLFU).

–29S17E: 15 km east of Port Nolloth (–AC), *Paterson J. C. & Jones 771* (NBG).

–29S17E: Northern slope of Rooiberg, above the Buffels River (–DC), *Hilton-Taylor C. 2133* (NBG).

–31S18E: East of Yzerfontein (–AC), *Venter A. M. 374* (BLFU).

–32S18E: Clanwilliam (–BB), *Schlechter 8009* (BM, G, K, GRA).

–32S18E: Roscher Nature Reserve, Velddrift (–CB), *Van Rooyen & Ramsey 640* (PRE, STE).

–33S18E: 9 km from Darling to Hopefield, Malmesbury District (–AA), *Davis D K s.n.* (NBG).

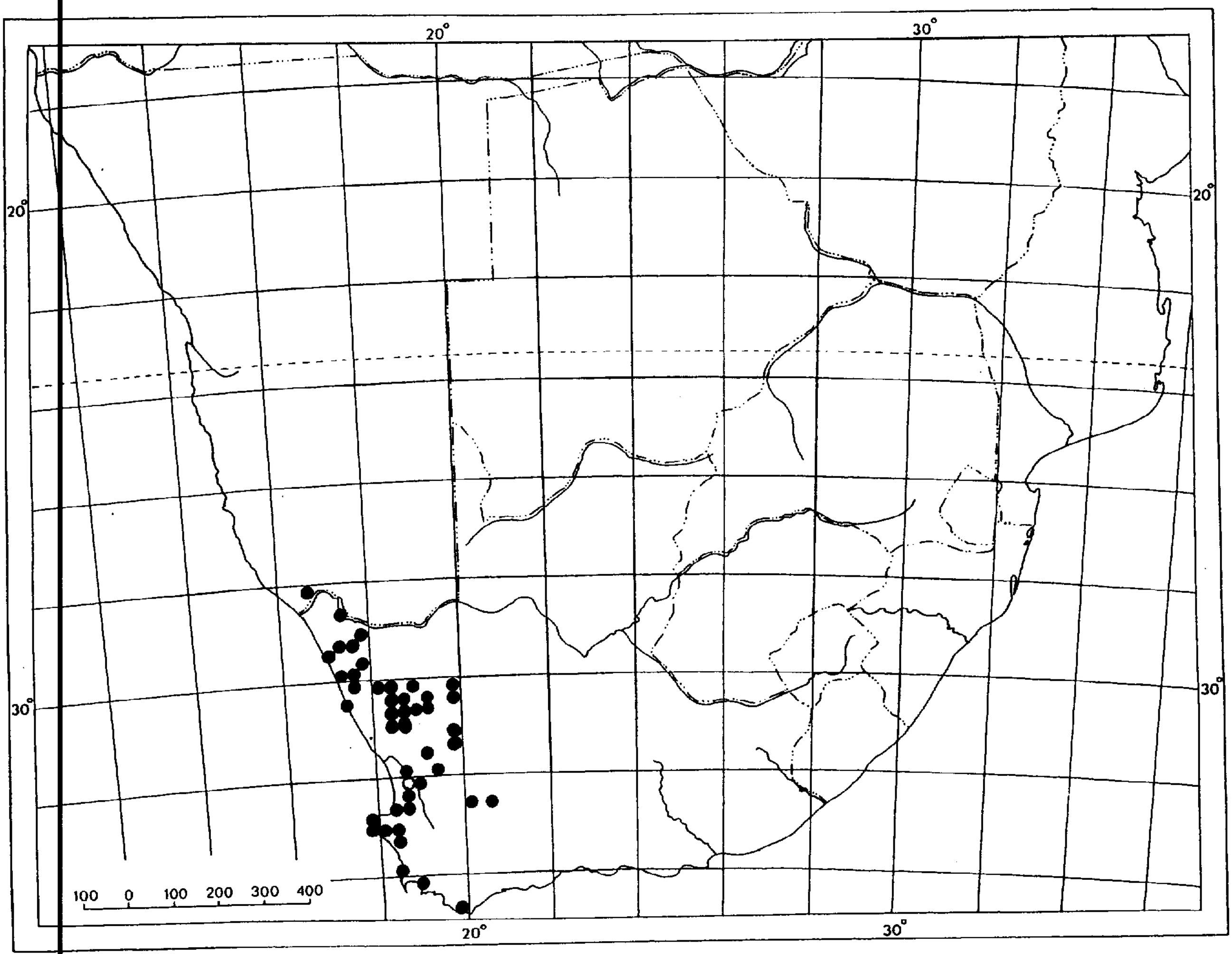


Figure 8.2.6 Known geographical distribution of *Lycium amoenum*.

[o : Type locality]

8.2.4 ***LYCIUM ARENICOLA*** Miers in The Annals and Magazine of Natural History ser. II, 14: 20 (1854); Miers: plate 65, fig. E (1857); C.H.Wright: 114 (1904); Dean: 10 (1974).

Type: South Africa, Orange River at Sanddrift, *Burke s.n.* (K!, holotype; PRE!, isotype).

DESCRIPTION

A dioecious, much branched **shrub** of 3–4 m high. **Stems**: young stems long, slender and pendulous, older stems rigid, young stems creamy white, often striated, older stems reddish- to greyish brown, glabrous; thorns absent on young stems or rarely with a few short, awl-shaped thorns of 10–15 mm long, older stems with stout thorns, 30–50 mm long. **Leaves** densely clustered on stems and thorns, 6–15 leaves per cluster; sub-sessile; *lamina* oblong to narrowly obovate, (9–)14–25 x 1–2(–3) mm, elliptic to narrowly elliptic on suckers and 25–35 x 4–5 mm, semi-succulent, pale to bright green; macroscopically glabrous, apices acute to sometimes obtuse. **Flowers** functionally unisexual, 4- or 5-merous; pedicel 2–5 mm long. **Male flowers: calyx** campanulate to somewhat tubular, 2.5–3(–3.5) x (1–)1.5—2.5 mm; *lobes* triangular, sometimes unequal, 0.5–0.8 mm long, apices acute. **Corolla** trumpet-shaped, white with violet veins; *tube* 5–6 x 2–3 mm, glabrous outside, inside pilose at stamen insertion; *lobes* semi-ovate, 1.5–2 x 1.5–2 mm, spreading. **Stamens** inserted 3–4 mm above corolla base just above middle of tube, 2 stamens reach corolla mouth, 2–3 are slightly longer than corolla tube and slightly exerted; *anthers* fertile; *filaments* 2–3 mm long, bases pilose. **Pistil:** *ovary* ovoid, 1 x 0.2 mm; *style* 1 mm long or absent; *stigma* absent; *nectary* red, conspicuous. **Female flowers**: **Calyx** as in male flower. **Corolla** as in male

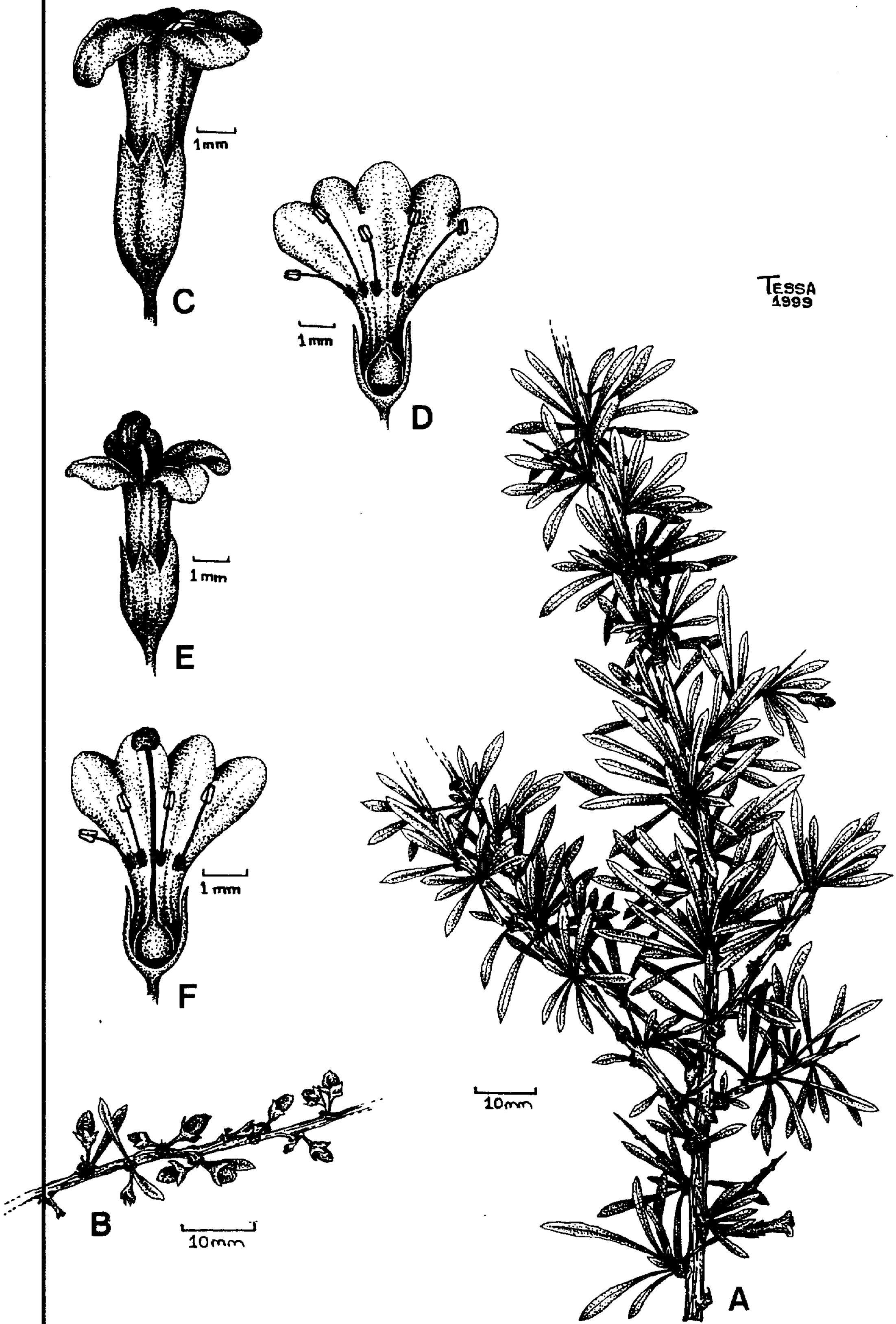


Figure 8.2.7 *Lycium arenicola.*
A: Stem with thorns, leaves and flowers; B: branch with fruit; C: External view of male flower; D: Male flower internally showing ovary with stunted style and fertile stamens; E: External view of female flower; F: Female flower internally showing complete pistil and infertile stamens.
[A, C & D: *A. M. Reyneke 82* (BLFU); B: *A. M. Reyneke 110* (BLFU); E & F: *A. M. Reyneke 110* (BLFU)].

flower, except tube tubular, sometimes narrowly trumpet-shaped, 4.5–5 x 2.5 mm. **Stamens** reach corolla throat, all included; *anthers* sterile; *filament* bases pilose. **Pistil:** *ovary* as in male flower; *style* 6-7 mm long, exserted from corolla mouth; *stigma* present; *nectary* as in male flower. **Berry**: *male plants*: none; *female plants*: berries ovoid, 4–5 x 3–4 mm, red, sometimes black. **Seed** reniform, 1.5 x 1 mm. (Figure 8.2.7). 2n = 6x = 72, rarely 2n = 4x = 48.

VERNACULAR NAMES

"Kareebos", "rivierkareedoring" or "kriedoring" (Smith 1966).

NOTES ON SYNONYMY

Although the floral characteristics of this species resemble those of *L. tetrandrum* and *L. horridum* closely, its willow-like habit and oblong leaves differ to such an extent that *L. arenicola* could not be confused with either of the two species. When comparing the chromosome numbers of these three species *L. horridum* is found to be a tetraploid while both *L. arenicola* and *L. tetrandrum* are usually hexaploid. A high frequency of univalents suggests that *L. arenicola* is of hybrid origin, probably with one of the closely related species, *L. horridum* or *L. tetrandrum*, as one of the parent species (Spies *et al.* 1993).

NOTES ON HABIT AND HABITAT

Although *L. arenicola* is normally found in the vicinity of water, it is by no means restricted to moist habitats. Plants of moist and drier habitat reveal the typically long willow-like lateral branches giving a soft appearance to this shrub. Somewhat more thorny, less willowy plants are also found, but this species, together with *L. mascarenense*, are the least thorny of the African lyciums. A conspicuous characteristic of *L. arenicola* is its ability to spread by subterranean tillering. It is, furthermore, important to note that, in contrast to other *Lycium* species, leaf shape always remains constant, irrespective of length caused by changes in moisture availability.

DISTRIBUTION AND ECOLOGY

This species is concentrated in the Eastern Cape Province, Free State and Northern Cape Province, but is also found in the northern and western parts of Lesotho (Figure 8.2.8). The distribution reaches westwards along the Orange River up to about Prieska. A colony of plants seems to have established in the region of Oudtshoorn and the Swartberg Mountain. This species has also been collected in Botswana's moister eastern parts.

This distribution of *L. arenicola* is definitely water correlated. Its habitat is most commonly near water, e.g. along stream- and riverbanks, dongas and dams. Plants are also found in open grassland, along cooler slopes of hills and mountains, but here they are normally associated with depressions of pans or marshes. Plants were found in soils varying from deep sand, sand on calcrete to loam and even clay.

Flowering in South Africa and Lesotho occurs during the summer months from November to April, peaking in December and January. In Botswana flowering normally occurs during late summer from February to April.

VOUCHER SPECIMENS

Botswana:

–21S24E: Xhumo area near saline pan (–BB), *Smith P. A. 2533* (PRE).

–24S25E: Mone Valley near Letlhakeng, south-eastern Botswana (–BB), *Wild H. 4961* (PRE).

Lesotho:

–29S27E: Maseru (–AD), *Williamson C. 278* (K).

–30S27E: Mohales Hoek (–AB), *Dieterlen A. 1215* (P).

South Africa:

–27S27E: 5 km east of Kroonstad (–DC), *Reyneke A. M. 82* (BLFU).

–28S17E: Riet River at Jacobsdal (–AA), *Venter H. J. T. 7260* (BLFU).

–28S24E: Modder River, near Kimberley (–DC), *Flanagan H. G. 1408* (PRE, BOL).

–29S26E: 27 km from Reddersburg to Edenburg (–CA), *Reyneke A. M. 110* (BLFU).

–28S28E: Broomland, near Bervue homestead (–AB), *Scheepers J. C.1789* (K, PRE).

–31S25E: Schoombee Station (–BC), *Reyneke A. M. 146* (BLFU).

–32S24E: Near Graaff Reinet (–BC), *Bolus H. 776* (K, GRA).

–33S22E: Northern entrance to Swartberg Pass (–AD), *Venter A. M. 455* (BLFU).

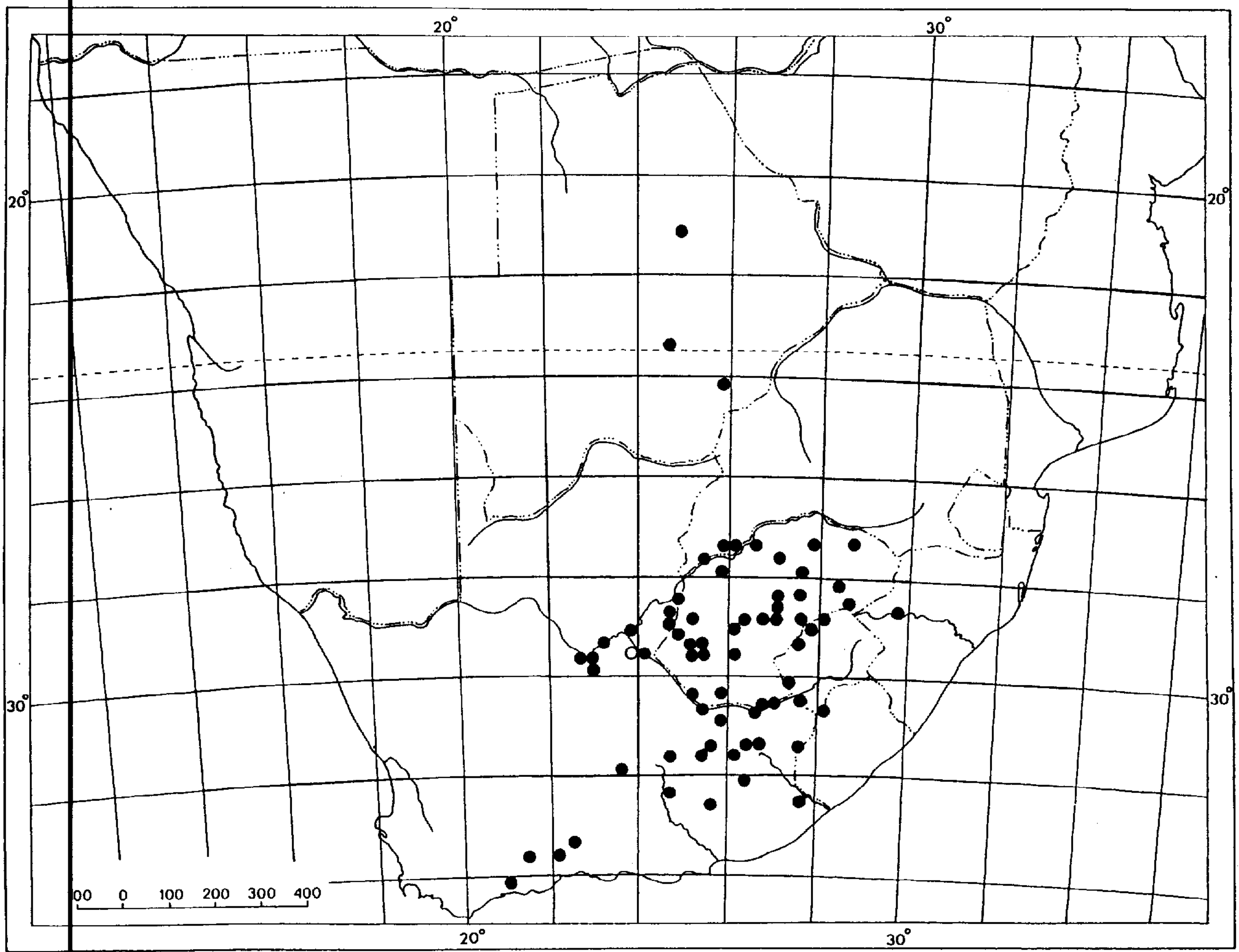


Figure 8.2.8 Known geographical distribution of *Lycium arenicola*.

[o : Type locality]

8.2.5 *LYCIUM BARBARUM* L., Species plantarum 1: 191 (1753); 700 (1825); Thunb.: 152 (1808); Dunal: 511 (1852); Miers: 182 (1854); Feinbrun & Stearn: 114 (1963); Dean: 4 (1974).

Type: *LINN no 259.6.* (LINN!, lectotype, declared by Feinbrun (1968)).

= ***Jasminoides Sinense Halimifolio*** Duhamel: 306, Tab. 121, fig 4 (1755). (synonymy after Feinbrun (1968)).

Iconotype: Duhamel, Traite Arb. 1: 306 Tab. 121, fig 4 (1755). (designated by Feinbrun & Stearn (1963)).

= ***L. halimifolium*** Mill.: *Lycium* no 6 (1768), (synonymy after Feinbrun & Stearn (1963)).

Type: Plants grown in the Chelsea Garden from seed collected in the Royal Garden of Paris, from seed collected in China.

= ***L. lanceolatum*** Veill: 119 Tab. 32 (1802), (synonymy after Feinbrun & Stearn (1963)).

Iconotype: Duhamel, Traite Arb. ed 2 (Augm) 1: 119 Tab. 32 (1802).

= ***L. thunbergii*** G.Don: 459 (1838), **syn. nov.**

Type: South Africa, Karoo between Roggeveld and Bokkeveld, *Thunberg s. n.* (UPS no 5300! & 5301!, holotype).

= *L. turbinatum* Veill: 119 Tab. 31 (1802), (synonymy and nom. illegit. after Feinbrun & Stearn (1963)).

Iconotype: Duhamel, Traite Arb. ed 2 (Augm) 1: 119 Tab. 31 (1802).

= *L. vulgare* Dunal: 509 (1852), (nom. illegit.), (synonymy by Feinbrun (1963)); Feinbrun: 115 (1963); Dunal: 509 (1852); Miers: 185(1854).

Type: Plant collected in the Garden at Leyden, part of Daniel de la Roche Herbarium, now housed in Genève (G-DC!, holotype).

DESCRIPTION

A bisexual **shrub** of 2–3 m high. **Stems** long and slender, young stems pendulous and creamy to greenish white, older stems light brown to brown, glabrous; young stems without thorns; older stems with thorns of 30–50 mm long. **Leaves** alternate on young stems, clustered on older stems and thorns, 4–6 leaves per cluster; macroscopically glabrous; *petiole* 5–6 mm long; *lamina* narrowly elliptic to elliptic, (30–)35–45 x (7–)8–12 mm, herbaceous, pale to bright green, apices acute. **Flowers** 5-merous, bisexual; pedicel 7–8(–12) mm long. **Calyx** campanulate, 3–3.5 x 2.5–3 mm; *lobes* triangular, 1.5–2 mm long, $\frac{2}{3}$–$\frac{1}{2}$ of total calyx length, apices acute. **Corolla** white with violet veins; *tube* funnel-shaped, 6–7 x 4–6 mm; *lobes* semi-ovate, 5–6 x 4 mm, reflexed. **Stamens** inserted 1–3 mm above base of corolla tube below middle of tube, conspicuously exserted from corolla mouth; *filaments* 6–8 mm long, bases pilose. **Pistil:** *ovary* ovoid, *style* 7–9 mm long, exserted from corolla mouth as far as longest stamens; *nectary* creamy white and inconspicuous. **Berry**

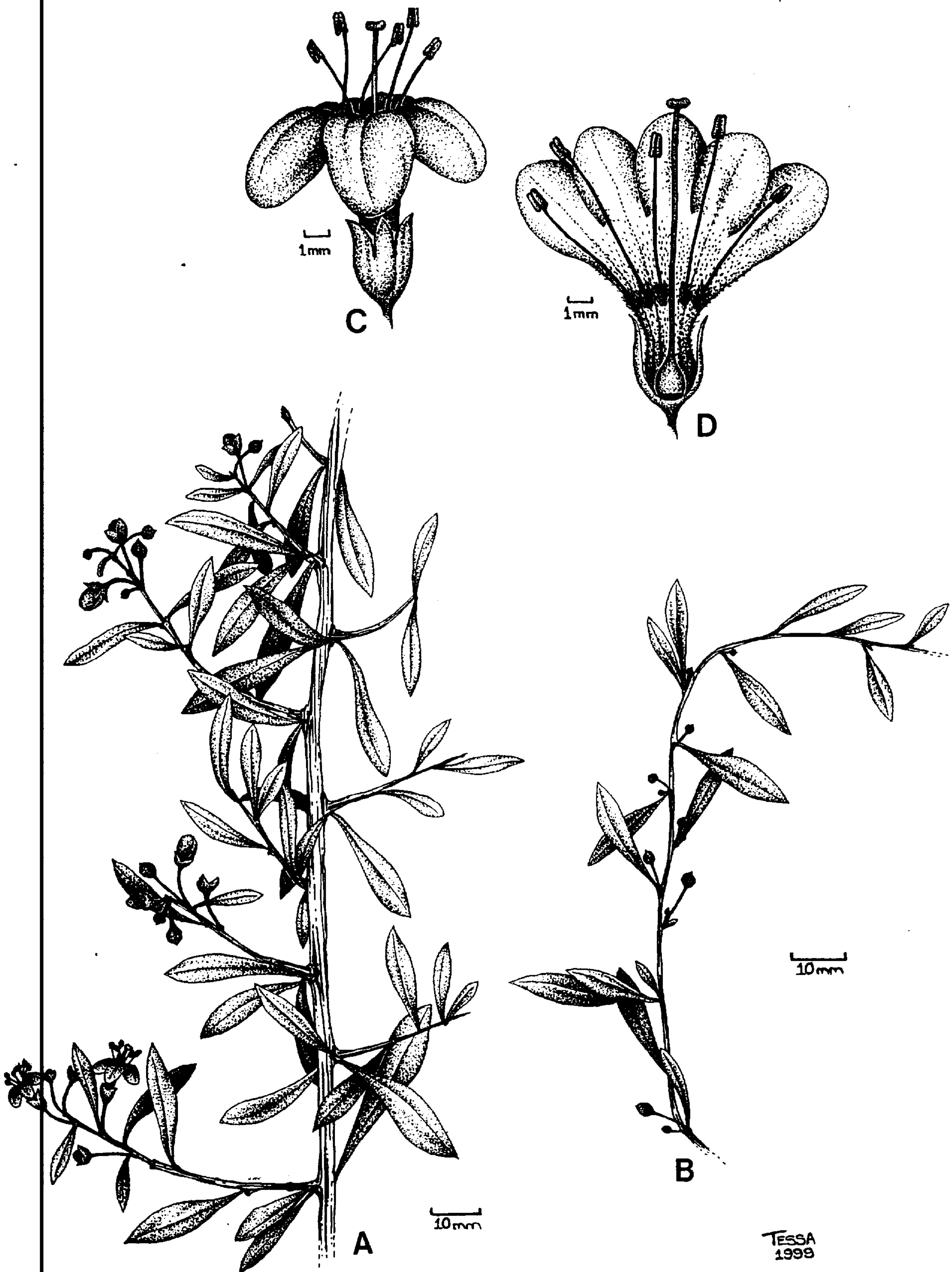


Figure 8.2.9 *Lycium barbarum*.
A: Stem with thorns, sparsely clustered leaves, flowers and fruit; B: Young stem with alternate leaves; C: External view of flower; D: Flower internally showing pistil and stamens.
[A, B, C & D: *A. M. Venter 471* (BLFU)].

spherical to ovoid, 3–4 x 4 mm, red. **Seed** subdiscoid to ovate to somewhat triangular, 1.5 x 1 mm. (Figure 8.2.9). 2n = 2x = 24 (Gao & Zang 1984, Kiehn *et al.* 1991).

VERNACULAR NAME

Chinese bastard jasmine (Miller 1768).

UTILIZATION

Introduced into Europe from China where it has been cultivated in gardens, often as hedges. Records show that this was customary even in the times of the Greeks, Romans and Persians (Miers 1854).

NOTES

Feinbrun & Stearn (1963) discussed the typification of *L. barbarum* as well as its synonyms as follows: "Dunal's name *L. vulgare* is illegitemate because he cites an older name as synonym. Dunal distinguishes between the *L. barbarum* of the first edition of Linnaeus' *Species plantarum* in 1753 and the second edition in 1762. He identifies the latter with his new species *L. vulgare*. Dunal's new name is, however, illegitimate since he cited *L. halimifolium* Miller (1768). In Miller's description of *L. halimifolium* he cites a drawing by Duhamel, the same drawing to which Linnaeus, in a later edition of his *Systema Naturae,* refers as representative of his *L. barbarum.* Therefore *L. halimifolium* is considered as equivalent to *L. barbarum*".

In his description Dunal (1852) assumed that this species was introduced into Africa, which does not form part of its normal distribution pattern.

DISTRIBUTION AND ECOLOGY

This species occurs naturally in China and East Asia. It was introduced into Europe some centuries ago (Miers 1854) and eventually into the United Kingdom and the north of Africa in Algeria (Figure 8.2.10).

In North Africa *L. barbarum* flowers during the end of the rainy season in August and September.

VOUCHER SPECIMENS

Algeria:

–36N06E: 90 km from Constantine to Setif (–BC), *Davis 52073* (BM, E).

–36N03E: Algiers, El-Biar (–CC), *Luizet D. s.n.* (P).

England:

–51N00W: London, Kew Bridge (–AB), *Venter A. M. 471* (BLFU).

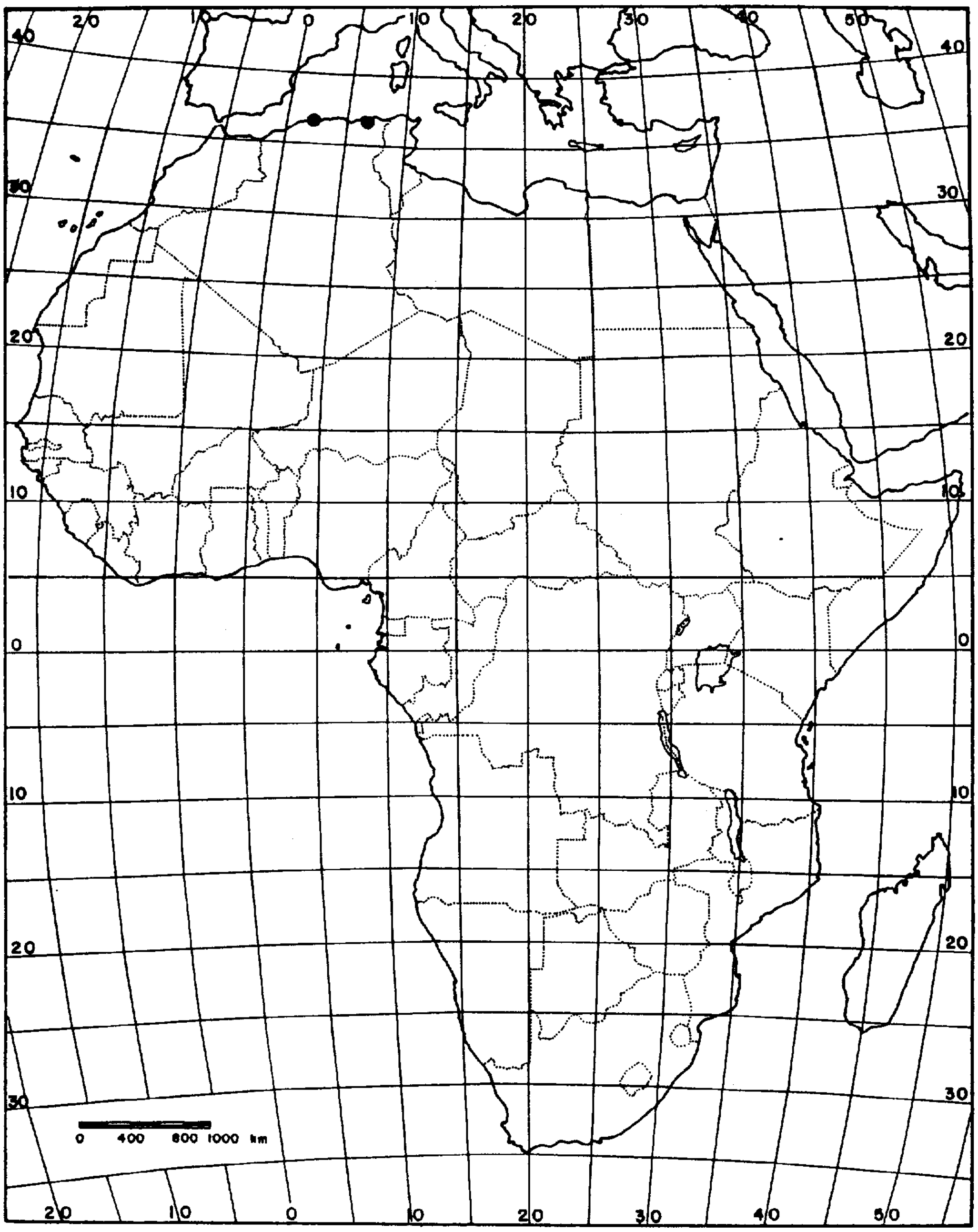


Figure 8.2.10 Known geographical distribution of *Lycium barbarum* in Africa.

8.2.6 ***LYCIUM BOSCIIFOLIUM*** Schinz in Vierteljahrsschrift der Naturforschenden Gesellschaft in Zürich 56: 263 (1911); Dean: 5 (1974).

Type: Namibia, Kaigamtes in Great Namaqualand, *Fleck 891* (not Schinz) (Z!, holotype).

= ***L. aciculare*** Dammer: 231 (1913), **syn. nov.**; Dean: 10 (1974).

Type: Namibia, Orange River, *Range 611* (BΨ, holotype; SAM!, lectotype, here declared; BOL!, isotype).

= ***L. emarginatum*** Dammer: 226 (1913), **syn. nov.**; Dean: 5 (1974).

Type: Namibia, Damaraland, Brakwater, *Dinter 1550* (BΨ, holotype), (synonymy after description of Dammer).

= ***L. glossophyllum*** Dammer: 235 (1913), **syn. nov.**; Dean: 11 (1974).

Type: Botswana, Massaringani Vlei, *Seiner II. 267* (BΨ, holotype), (synonymy after Dammer's description).

= ***L. namaquense*** Dammer: 234 (1913), **syn. nov.**; Dean: 5 (1974).

Type: Namibia, Witmanshaar, *Range 489* (BΨ, holotype; SAM! lectotype, here declared).

= *L. rangei* Dammer: 230 (1913), **syn. nov.**; Dean:10 (1974).

Type: Namibia, Kuibis, *Range 623* (BΨ, holotype; BOL!, lectotype, here declared; SAM!, isotype).

= ***L. squarrosum*** Dammer: 227 (1913) **syn. nov.**; Dean: 5 (1974).

Type: Namibia, *Dinter II 259* (BΨ, holotype; SAM!, lectotype, here declared).

= ***L. dunaloides*** Dammer: 356 (1915), **syn. nov.**; Dean: 5 (1974).

Type: Namibia, Kalkveld, *Engler 6453* (BΨ, holotype; K!, lectotype, here declared).

= ***L. pauciflorum*** Dammer: 354 (1915), **syn. nov.**; Dean: 5 (1974).

Type: Namibia, Damaraland, Sphinx, *Engler 6097* (BΨ, holotype), (synonymy after Dammer's description).

= ***L. schaeferi*** Dammer: 354 (1915), **syn. nov.**; Dean: 5 (1974).

Type: Namibia, Klein Karas, *Shäffer 196* (BΨ, holotype), (synonymy after Dammer's description).

DESCRIPTION

A bisexual, erect, tangled **shrub** of 1,5 to 3 m high, very rarely a small tree of up to 4 m high. **Stems** arched, young stems pale grey or creamy white, older stems reddish brown and glossy, glabrous; thorns on young stems smooth and slender,

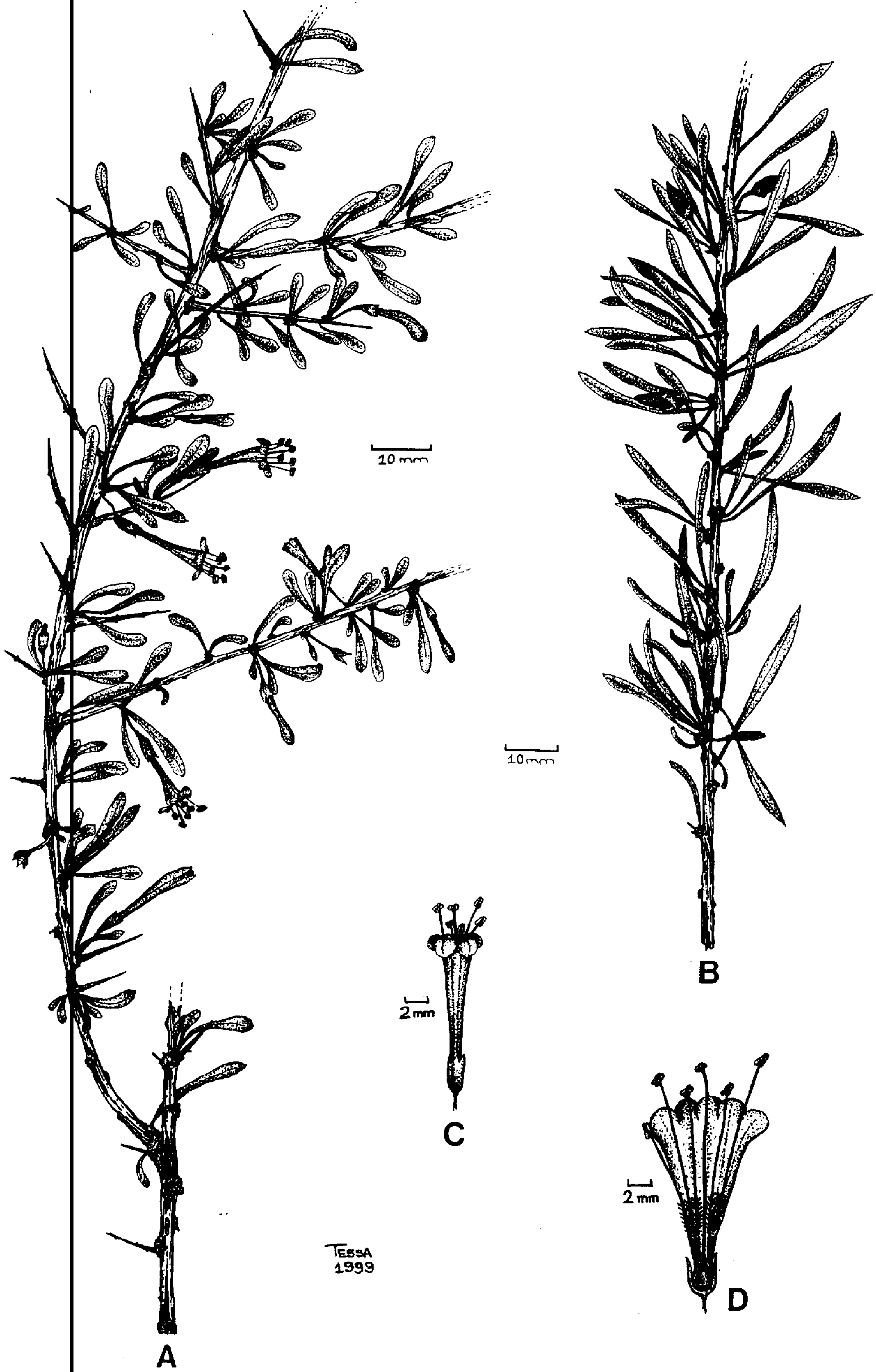


Figure 8.2.11 *Lycium bosciifolium.*
A: Stem with thorns, leaves and flowers; B: Stem with fruit; C: External view of f.lower; D: Flower internally showing pistil and stamens.
[A, C & D: *M. Müller 1406* (WIND); B: *H. J. T. Venter 8830* (BLFU)].

5–10 mm long, leafless, 10 to 40 mm long on older stems. **Leaves** solitary and alternate on young stems, fascicled on older stems and thorns in clusters of 3–9, *petiole* 0–5(–8) mm long; *lamina* obovate to oblong-elliptic to narrowly obovate, 10–30(–50) x 3–8(–11) mm, semi-succulent to succulent, bright-green to yellowish green, slightly paler below, macroscopically glabrous, apices acute to rounded. **Flowers** 5(rarely 4)-merous, slightly pendulous; pedicel 5–11 mm long. **Calyx** tubular to campanulate, 3–5 x 1.5–2 mm; *lobes* triangular, 0.8–1 mm long, erect; apices acute. **Corolla** dirty white to greenish-cream with dark violet lobes; *tube* narrowly infundibuliform to tubular, 10–16 x 3–3.5 mm, occasionally slightly curved, glabrous outside, sparsely pilose inside at base to above stamen insertion; *lobes* semi-ovate, 2–3 mm long, spreading. **Stamens** inserted 4– 6 mm above corolla base, from a third above to middle of corolla-tube, all stamens conspicuously exserted from corolla mouth; *filaments* 12–14 mm long, bases sparsely pilose. **Pistil:** *ovary* obconical, 1.5–2 x 1.5 mm, *style* 13–22 mm long, exserted; *nectary* green and inconspicuous. **Berry** oblong-elliptic, seldom ovoid, apiculate, 5–6(–10) x 3–5 mm, red, seldom black, glossy. **Seed** reniform, 2x1.5 mm. (Figure 8.2.11). 2n = 2x = 24.

VERNACULAR NAME

"Slapkriedoring"

NOTES

According to its description, *L. glossophyllum* Dammer, collected in Botswana at, probably, Masarwanyane Pan, is regarded as a synonym of *L. bosciifolium*. Vegetatively the plant undoubtedly belongs to *L. bosciifolium*, but its floral characteristics are atypical and seem to agree more with those of *L. cinereum*. This specimen may have been a hybrid of the two species, both occurring in the region where the collection was made. The present author has never detected any hybridisation between these two species in the field, but hybridisation in the genus is quite common.

DISTRIBUTION AND ECOLOGY

This species is distributed throughout Namibia, mostly in arid and sub-arid habitats (Figure 8.2.12). This species has been collected in southern Angola around Mozamedes but this area does not seem to be part of the species' natural distribution range. In South Africa *L. bosciifolium* is found in the arid Northern Cape Province, more or less as far south as the summer rains reach. The species also occurs in the arid southwestern part of Botswana.

Its habitat is typically karoo/namib scrub or savanna (mainly *Acacia* species) on kalahari sand, limestone outcrops with black loam, sandy riverbanks in the shade of trees and on flood plains. Plants in the latter habitat grow much more luxuriant with much denser foliage than those plants occurring under drier conditions.

Plants have been observed to flower abundantly a few weeks after good rains at any time of the year, however, the normal flowering season is from January to August with a peak during autumn from March to May.

VOUCHER SPECIMENS

Angola:

–15S12E: Mozamedes, Caraculo (–AA), *De Menezes 235* (K, SRGH).

Botswana:

–25S20E: Ooi Kolle KGNP, 5 km east of Nosop (–BC), *Blair Rains A. & Yalala A. 30* (K, SRGH).

–26S22E: 15 km south-west of Tsabong (–AB), *Cole D. T. 335* (PRE).

Namibia:

–22S15E: Karibib district, Namibrand, at Glasberg (–BA), *Giess 13515* (K, WIND, PRE, WAG).

–23S17E: Rehobot district, farm Tsumis (–CA) *Müller M. 1406* (WIND).

–25S18E: 7 miles north of Tses Station, Keetmanshoop district (–CC), *Giess, Volk & Bleissner 6817* (K, WIND).

–26S19E: 24 miles WNW of Aroab (–DC), *Acocks J. H. P. 18065* (K).

–27S18E: Farm Genadendal (–DD), *Giess & Müller 12089* (WIND).

–28S19E: 2 km south of Karasburg (–BA), *Reyneke A. M. 209* (BLFU).

South Africa:

–28S17E: Richtersveld, Kook River west of Kubusberg (–AA), *Venter A. M. 406* (BLFU).

–29S17E: Aribes River near Steinkop (–BB), *Venter H.J. T. 8830* BLFU)

–29S19E: Gannapoort, 40 km south-east of Pofadder (–BC), *Leistner O. A. 2458* (K, PRE).

–30S23E: 31 km from Britstown en route to Prieska (–AD), *Herman P 1181* (PRE).

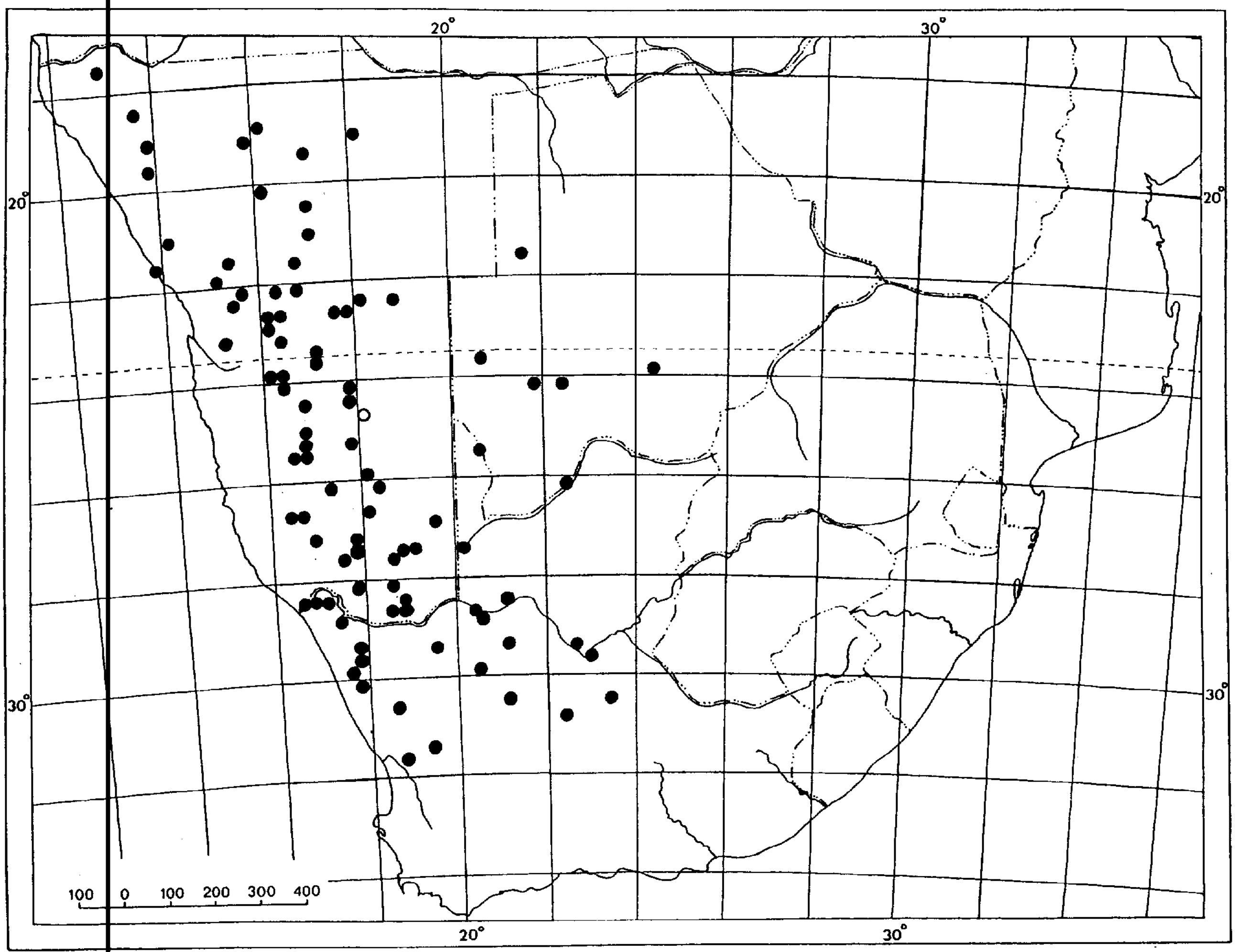


Figure 8.2.12 Known geographical distribution of *Lycium bosciifolium*.

[o : Type locality]

8.2.7 ***LYCIUM CINEREUM*** Thunb., *Prodromus Plantarum Capensis* 1: 37 (1794);

154 (1808); Willd.: 245 (1809); Poir.: 430 (1814); Roem. & Schult.: 694 (1819); L.: 701 (1825); Walpers: 110 (1844); Dunal: 516 (1852); Miers: 20 (1854); C. H. Wright: 116 (1904); Dean: 2, 9 (1974).

Type: South Africa, Cape *Thunberg* (UPS nr 5306!, holotype).

= *L. prunus-spinosa* Dunal: 515 (1852), **syn. nov.**; Miers 187 (1854); C. H. Wright: 117 (1904); Podl. & Roessl.: 4, 6 (1969); Dean: 10, 12 (1974).

Type: South Africa, Cape Peninsula, *Drège 7871* (G-DC!, holotype; P!, isotype).

= *L. horridum* Miers: 15 (1854), **syn. nov.**; Pl.2, t. 66, fig. A (1857); C. H. Wright: 118 (1904); Dean: 10 (1974).

Type: South Africa, Bedford area, Smaldeel, *Burke s. n.* (K!, holotype).

= *L. seineri* Dammer: 230 (1913), **syn. nov.**; Dean: 10 (1974).

Type: Namibia, north of Rietfontein *Seiner 411* (BΨ, holotype), (synonymy after Dammer's description).

= *L. woodii* Dammer: 229 (1913), **syn. nov.**; Dean:13 (1974).

Type: South Africa, Natal, Colenso, *Wood J. M. s.n. anno 1891* (BΨ, holotype), (synonymy after Dammer's description).

= ***L. caespitosum*** Dinter & Dammer: 253 (1915), **syn. nov.**; Dean: 11 (1974).

Type: Namibia, Hoachanas, *Dinter 1964*, (BΨ, holotype; SAM!, lectotype, here declared).

= ***L. engleri*** Dammer: 353 (1915), **syn. nov.**; Dean: 11 (1974).

Type: Namibia, Salzbrunn, *Engler 6567*, (BΨ, holotype; K!, lectotype, here declared).

DESCRIPTION

A bisexual, rigid, erect, much branched, very thorny **shrub** of 0.3–2 m high. **Stems** rigid, erect-spreading, intricately branched, young stems dirty white to greyish-white and striated, older stems brown to purplish-brown, smooth and shiny to rugose, glabrous; thorns 20–30 mm on younger stems, gradually lengthening to 50–60 mm on older stems, often densely branched into short awls of 5–10mm long. **Leaves** 6–12 per cluster on branchlets and thorns, macroscopically glabrous; *petiole* of 0.5 mm or leaves sub-sessile; *lamina* 7–17 x 1–2 mm., oblong to narrowly oblong or spathulate, apex rounded to slightly acute. **Flowers** 5-merous, pedicel 2–5(8) mm long, glabrous. **Calyx** campanulate to broadly tubular, 2.5–3 x (1.5)2–2.5 mm; *lobes* equal or sometimes sub-equal, 0.6–0.9 mm long, triangular and acute, erect. **Corolla** creamy white with lobes violet to dark purple, *tube* 5–7 x 1.5–2 mm, tubular, glabrous outside; pilose at stamen insertion; *lobes* 2–3.5 mm long, semi-orbicular to broadly ovate, reflexed. **Stamens** subequal, conspicuously exserted from corolla-mouth; attached at the middle or slightly above middle of corolla-tube; *filaments* 5–8 mm long, densely pilose at the base.

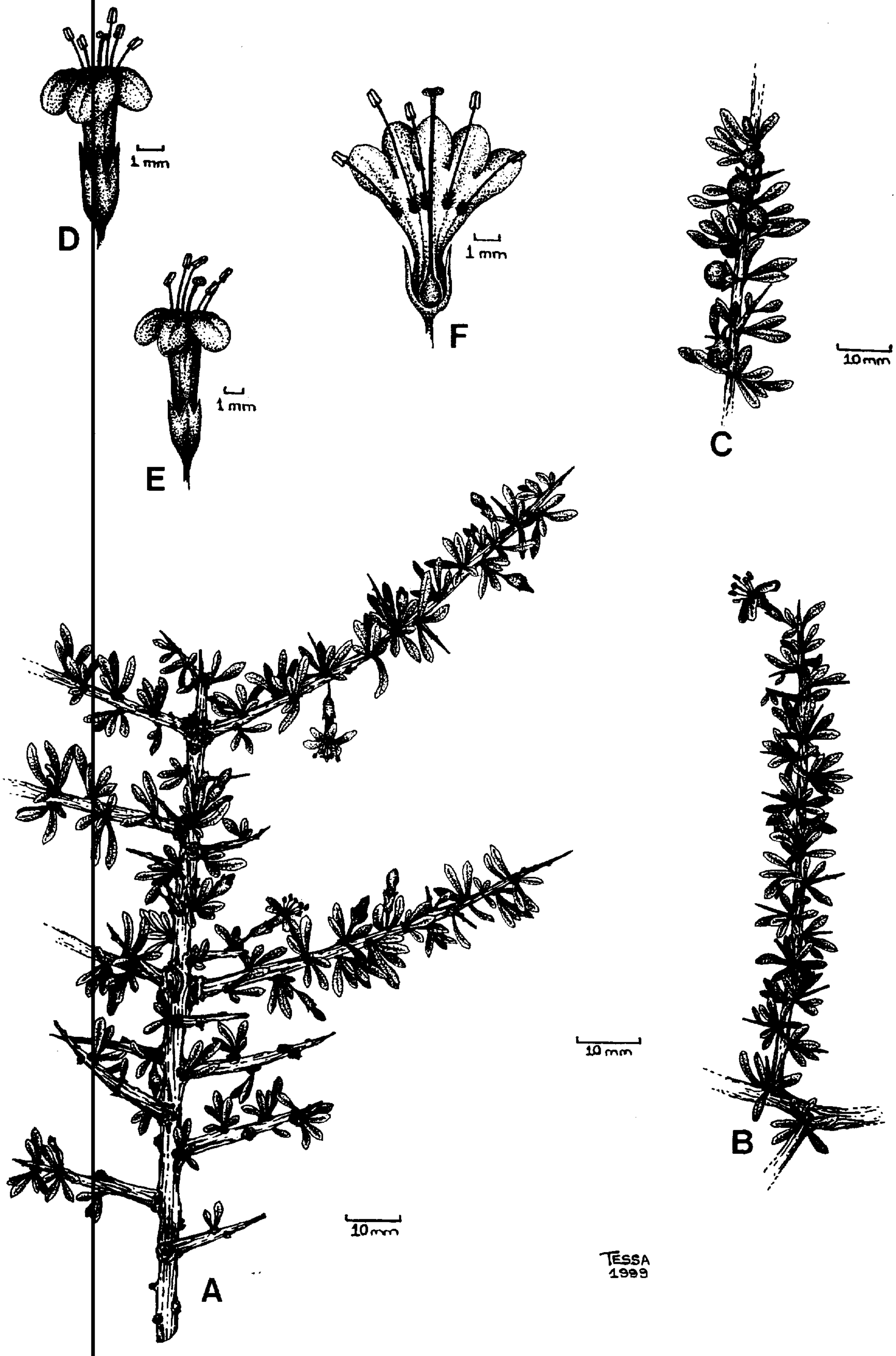


Figure 8.2.13 *Lycium cinereum.*
A & B: Stem with thorns, leaves, flowers and fruit; C: Stem with fruit;
D: External view of flower with atypically larger calyx;
E: External view of typical flower
F: Flower internally showing pistil and stamens.
[A & D: A. M. Reyneke 216 (BLFU); B: A. M. Reyneke 213 (BLFU); C: D. M. Gemmell 6154 (BLFU); E & F: A. M. Reyneke 229 (BLFU)].

Pistil: *ovary* ovoid; 1.5 x 1 mm, *style* 8–10 mm long, conspicuously exserted from corolla-mouth; *nectary* yellow-brown, inconspicuous. **Berry** ovoid to globose, 3–4(5) x 3–4 mm, red. **Seed** subdiscoid to ovate, 1.5 x 1.0 mm. (Figure 8.2.13). 2n = 2x = 24.

VERNACULAR NAMES

"Bloukareedoring", "douvatkareedoring", "kareedoring", "kriedoring" (Smith 1966).

DISTRIBUTION AND ECOLOGY

Common and widespread in South Africa, from the south-western parts of the Western Cape Province through the Karoo to the Northern Cape Province, the Free State, the Northern Province and just into southern Zimbabwe, as well as eastwards to the Eastern Cape Province and southern Kwazulu-Natal Province (Figure 8.2.14). It also occurs in south and central Botswana, and in Namibia where it is concentrated in the southern and central parts, occurring sparsely in the north. Next to *L. shawii* this species has the widest distribution of the African lyciums.

This species' habitat includes dry, sandy, calcareous gravel plains and hills; dry ravines and valleys; alluvial floodplains, flat drainage areas on fine dark grey soils; sands overlying calcrete and quartzite, Kalahari sand, limestone slopes, stony basalt ridges and granite-gneiss inselbergs. Plants are often found on disturbed soil, as along roadsides. The species inhabits fynbos, karoo scrub, grassland, savanna, open *Acacia*-parkland, riverine scrub of *Acacia detinens,* *Boscia* and *Grewia* and dry riverine forest with *Sclerocarya caffra, Capassa violacea, Acacia nilotica* and *A. tortilis.*

In Botswana and Namibia the normal rainfall in the arid south and central regions starts in March and peak flowering occurs from April to June, but flowering can also take place during the summer months, depending on rain showers. In South Africa its flowering time differs somewhat, occurring throughout the summer till autumn, from August to April, peaking in January to February and April, which corresponds with the seasonal rainfall pattern of the central, arid regions.

VOUCHER SPECIMENS

Botswana:

–21S23E: Deception Pan, South-western District (–DB), *Smith 4174* (BR, PRE).

–23S24E: Kuku Pan 121 km northwest of Molepoldo (–AD), *Storey R. 4897*, (K, PRE, LISC).

–24S25E: Content farm, Gaborone District. (–DB), *Hansen O. J. 3436* (K, PRE, BM, SRGH).

Namibia:

–18S15E: Between Ondangwa and Adamax (–DD), *Le Roux 593* (PRE, WIND).

–24S16E: Farm Uitkoms (–CA), *Müller M. 1341* (WIND).

–24S17E: Mariental (–DA), *Volk O. H. 12248* (WIND).

–27S16E: Zebrafontein (–DD), *Reyneke A. M. 168* (BLFU).

South Africa:

–25S30E: Greenlands farm at foot of Luki Mountains, Sekukuniland (–AB), *Bamard & Mogg 597* (K, BM, PRE).

–28S21E: 28 km from Upington to Groblershoop (–BD), *Reyneke A. M. 213* (BLFU).

–28S23E: 5 km west of Campbell, North Cape (–DD), *Reyneke A. M. 216* (BLFU).

–28S24E: Near Kimberley (–DB), *Lewis G. J. 532* (NBG, SAM).

–28S30E: Farm Zingela in Tugela River Valley (–CA), *Balkwill K. 5093* (BLFU, J).

–29S24E: Valschfontein, Hopetown area (–BA), *Acocks J. P. H. 2595* (K).

–29S25E: 10 km from Fauresmith to Koffiefontein (–CB), *Reyneke A. M. 229* (BLFU).

–29S26E: Bloemfontein area (–AA), *Gemmell D. M. 6154* (BLFU).

–31S21E: Just east of Frazerburg (–CD), *Coetzer L. A. 56* (STE).

–31S27E: Farm Swempoort, in Waschbankspruit catchment area (–AA), *Müller D. B. 746* (GRA).

–33S21E: Gamka Mountain Reserve, south of Keurkloof (–DB), *Allardice R. 1702* (NBG).

–24S20E: De Hoop–Potberg Nature Reserve, Potberg House (–BC), *Scott A. 483* (PRE).

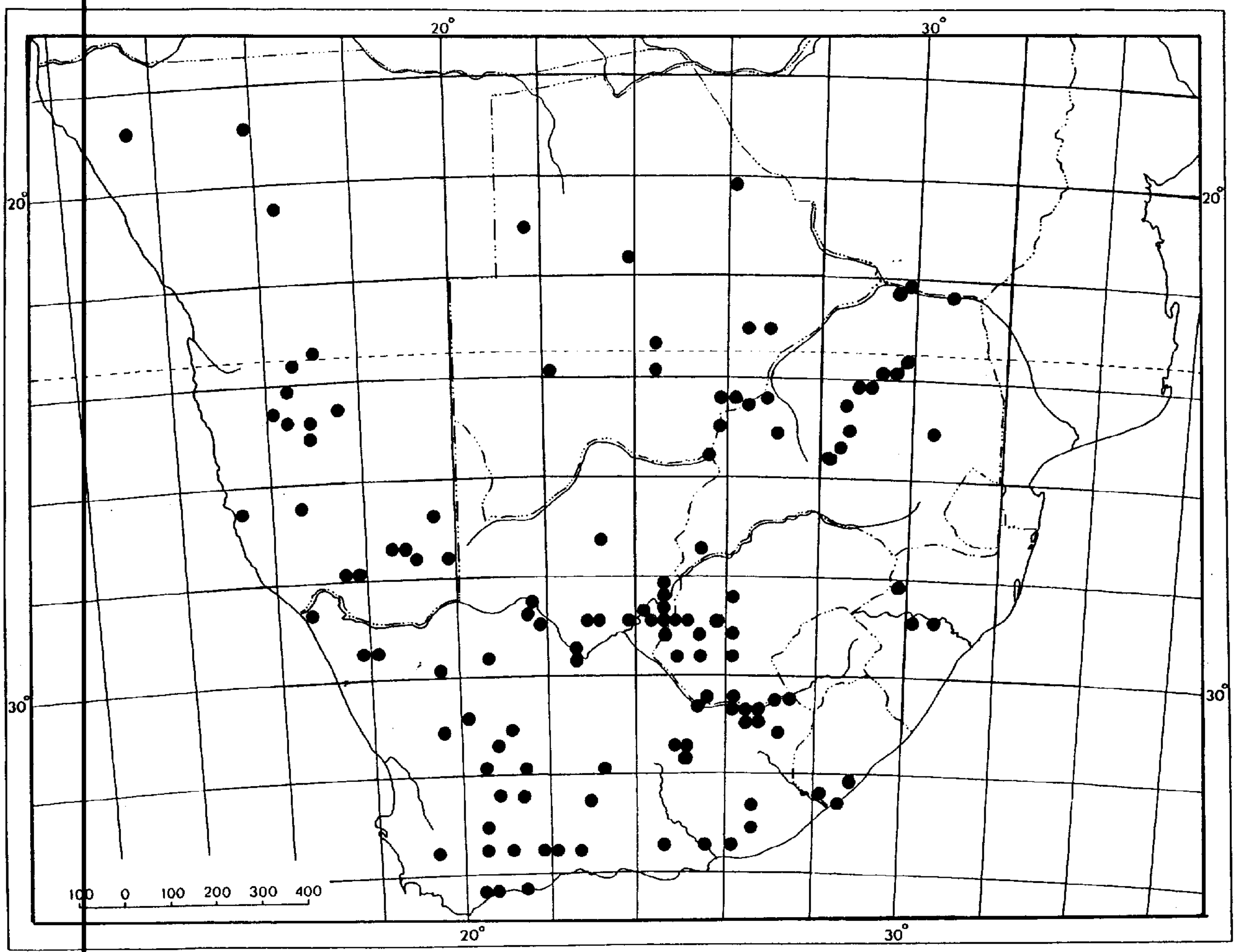


Figure 8.2.14 Known geographical distribution of *Lycium cinereum*.

8.2.8. ***LYCIUM DECUMBENS*** Welw. ex Hiern, Catalogue of the African plants 3: 752 (1898); Podl. & Roessl.: 124:5 (1969).

Type: Angola, Mossamedes, Cabo Negro, *Welwitsch 6024* (BM!, holotype).

= ***Rhigosum angolense*** Bamps: 150 (1975), **syn. nov.**

Type: Angola, District of Mossamedes, Cabo Negro, *Bamps, Martins & Matos 4518* (BR! holotype; K, LISC, LUA, WAG isotypes).

DESCRIPTION

A small, bisexual, very thorny prostrate dwarf **shrub** of up to 0.2 m high and 0.5–0.75 m in diameter. **Stems** rigid and characteristically decumbent, young branches unbranched, some branching in older plants, brachyblasts prominent, pale yellow-brown to dull grey, glabrous; thorns stout, peg-like, 15–50 mm long, perpendicular on branches or sometimes recurved. **Leaves** fascicled with 2–4 leaves per cluster on prominent brachyblasts of stems and thorns; *petiole* short, 1–3 mm long; *lamina* obovate to narrowly obovate, 15–20 x 3–5 mm, succulent, bright green, glabrous, apices rounded to slightly acute. **Flowers** 5-merous, rarely 4-merous; pedicel 2–3(–5) mm long. **Calyx** tubular, 4–5 x 2–3 mm; *lobes* triangular, 1–1.5 mm long, apices acute, erect. **Corolla** creamy white with lilac lobes and dark purple veins; *tube* broadly funnel-shaped, (5–)6–8 x 3 mm, pilose in region of stamen insertion; *lobes* sub-orbicular to ovate, 3 x 3 mm, spreading. **Stamens** inserted 3–4 mm above corolla base just below or sometimes in middle of corolla tube, clearly exserted from corolla mouth but not further than closed corolla lobes, *filaments* 6–7 mm long, bases densely pilose. **Pistil:** *ovary* ovoid to broadly ovoid, 1–1.5 x 1–1.5 mm, *style* (10–)12–13 mm long, slightly

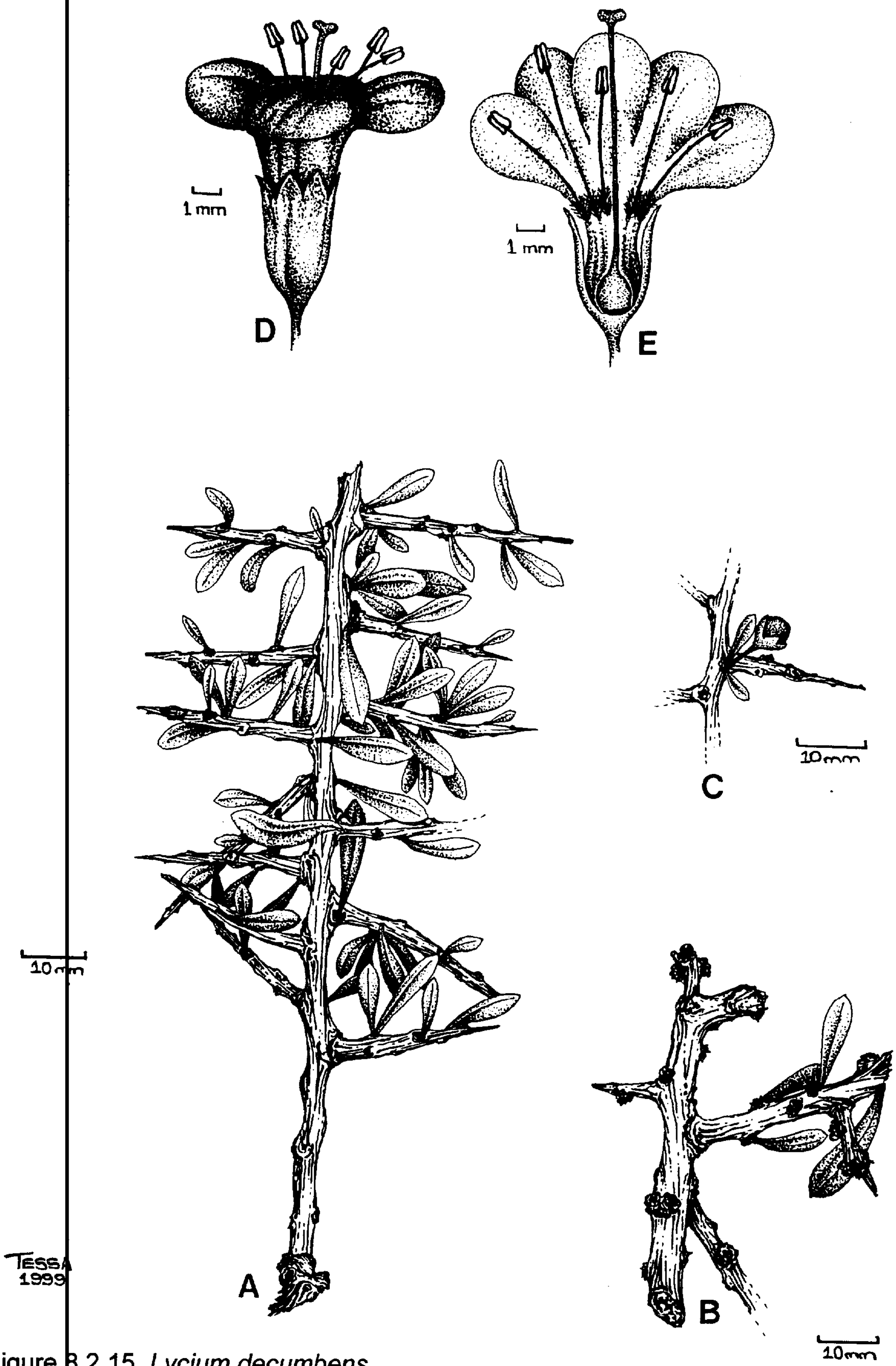


Figure 3.2.15 *Lycium decumbens*.
A: Stem, somewhat flexuous, with thorns and leaves;
B: Deleafed stem showing the pronounced brachiblasts; C: Stem with fruit;
D: External view of flower: E: Flower internally showing pistil and stamens.
[A, B, C, D & E: W. Giess 10470 (WIND); D & E: *A. M. Venter 627*(BLFU)].

more exserted than the longest stamen; *nectary* golden-brown, inconspicuous. **Berry** globose, 4 x 4 mm, orange-red. **Seed** ovate, 2.5 x 2 mm. (Figure 8.2.15). $2n = 2x = 24$.

VERNACULAR NAMES

"Platkriedoring", "platwolwedoring"

NOTES

Specimens collected from dry gullies seem less densely thorny than plants growing in the open desert.

DISTRIBUTION AND ECOLOGY

This species occurs in the desert coastal belt of northern Namibia and across the Kunene River in southern Angola (Figure 8.2.16). This species is often associated with gravel of pink Damara granite, concentrated in gullies where runoff rain-water accumulates. Plants also grow in deep sand along riverbeds and banks, or beach dunes. *L. decumbens* seems to be "deciduous" through most of the year as plants with leaves are seldom encountered.

Flowering is not restricted to any season but occurs shortly after rain showers that occur only rarely in the coastal desert. The coastal fog, upon which many desert animal and plant species depend for water, may be critical in the survival of *L. decumbens* as well.

VOUCHER SPECIMENS

Angola:

–15S11E: Cabo Negro (–DB), *Martinos & Martos 4518* (K).

–17S11E: Cunene River, at Mossamedes (renamed as Namibe) (–CC), *Menezes A. 3789*, (K, BM, P, SRGH).

–17S11E: Angola, Mossamedes (renamed as Namibe), at National Park Jana (–BB), *Ward C. J. & J. C. 23* (K, WIND).

Namibia:

–20S14E: 8 km south of Ugab River Settlement (–DD), *Müller M. & Loutit B. 1060* (WIND).

–21S14E: Cape Cross, mountain at lagune (–DD), *Giess 10470* (WIND).

–21S14E: Cape Cross, 1 km north of Memorial Cross (–DD), *Venter A. M. 627* (BLFU).

–22S14E: Swakop River mouth (–DA), *Seydel 904* (WIND).

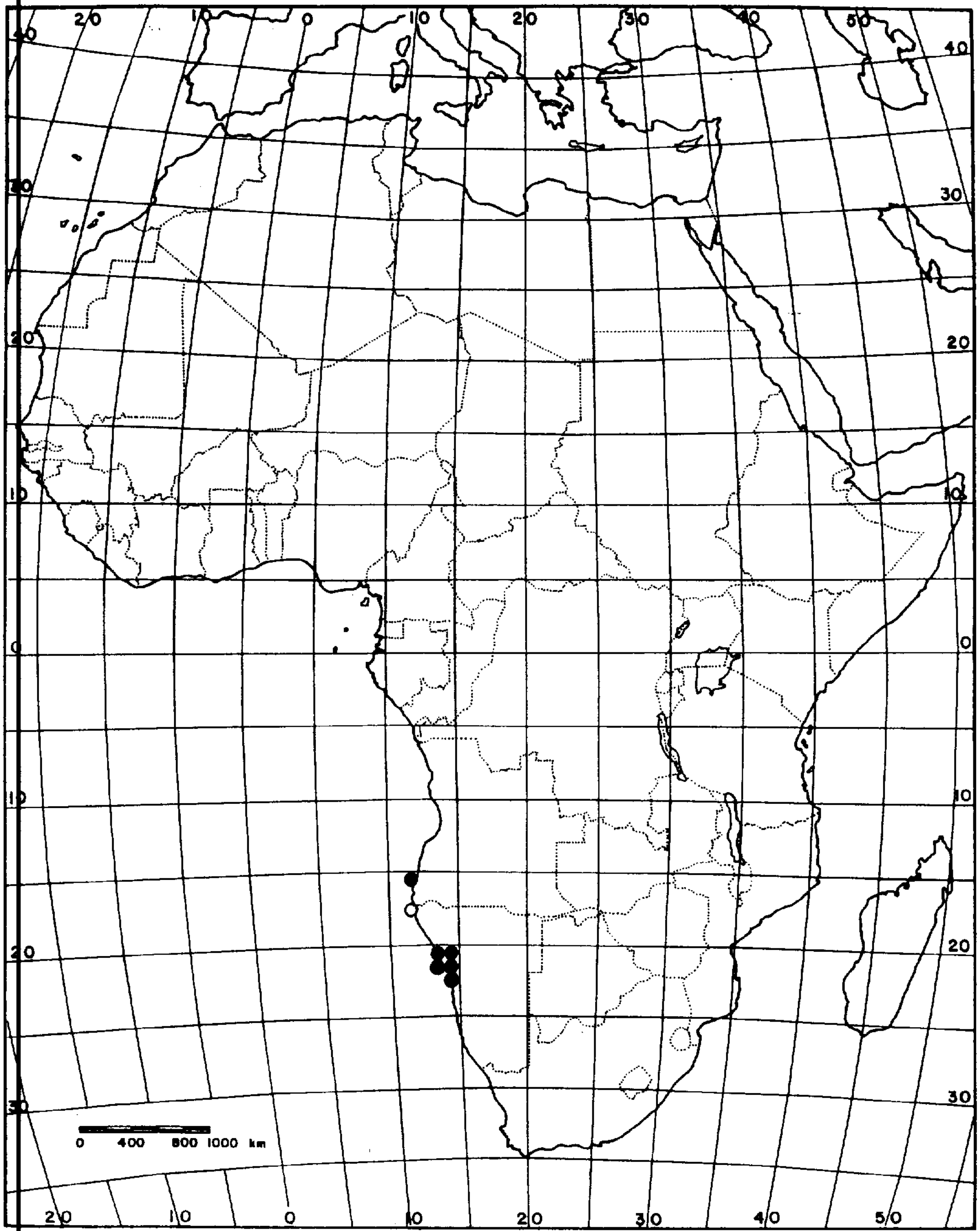


Figure 8.2.16 Known geographical distribution of *Lycium decumbens*.

[o : Type locality]

8.2.9 ***LYCIUM EENII*** S. Moore in Journal of Botany 46: 71 (1908); Dean: 8 (1974).

Type: Namibia, Damaraland, *T.G.Een*, anno 1879 (BM!, holotype).

= ***L. trothae*** Dammer: 231 (1913), **syn. nov.**; Dean: 8.(1974).

Type: Namibia, Damaraland, Vorberge north of Windhoek, *Von Trotha 100*, (BΨ, holotype), (synonymy after Dammer's description).

= ***L. lancifolium*** Dammer: 255 (1915), **syn. nov.**; Dean: 8 (1974).

Type: Namibia, Northern Hereroland, Omaheke at Epata, *Seiner F. ser III 370*, (BM!, holotype).

DESCRIPTION

A bisexual, rigid, bushy, sometimes scandent, **shrub** of 1–2 m high, rarely to 4 m high. **Stems** thorny, younger stems creamy to greyish white, older stems silver-grey to dark grey, glabrous; thorns 10–30 mm long and unbranched on young stems, 30–50 mm long and branched on older stems. **Leaves** solitary on young stems, clustered on older stems and thorns with 4–6 leaves per cluster; *petiole* 1–4 mm long; *lamina* obovate to ovate to elliptic, (15–)20–30(–45) x (5–) 8–12(–28) mm, coriaceous, pale to dull green, sometimes yellowish green, macroscopically glabrous, often shiny, apex cuspidate, rarely obtuse. **Flowers** 5-merous; pedicels (1–)2–4(–5) mm long. **Calyx** tubular, (4–)6–7 x 2 mm; *lobes* narrowly triangular, 1–2 mm long, about equal in size, apices acuminate, slightly spreading. **Corolla** greenish-white with purple veins and lobes; *tube* tubular to

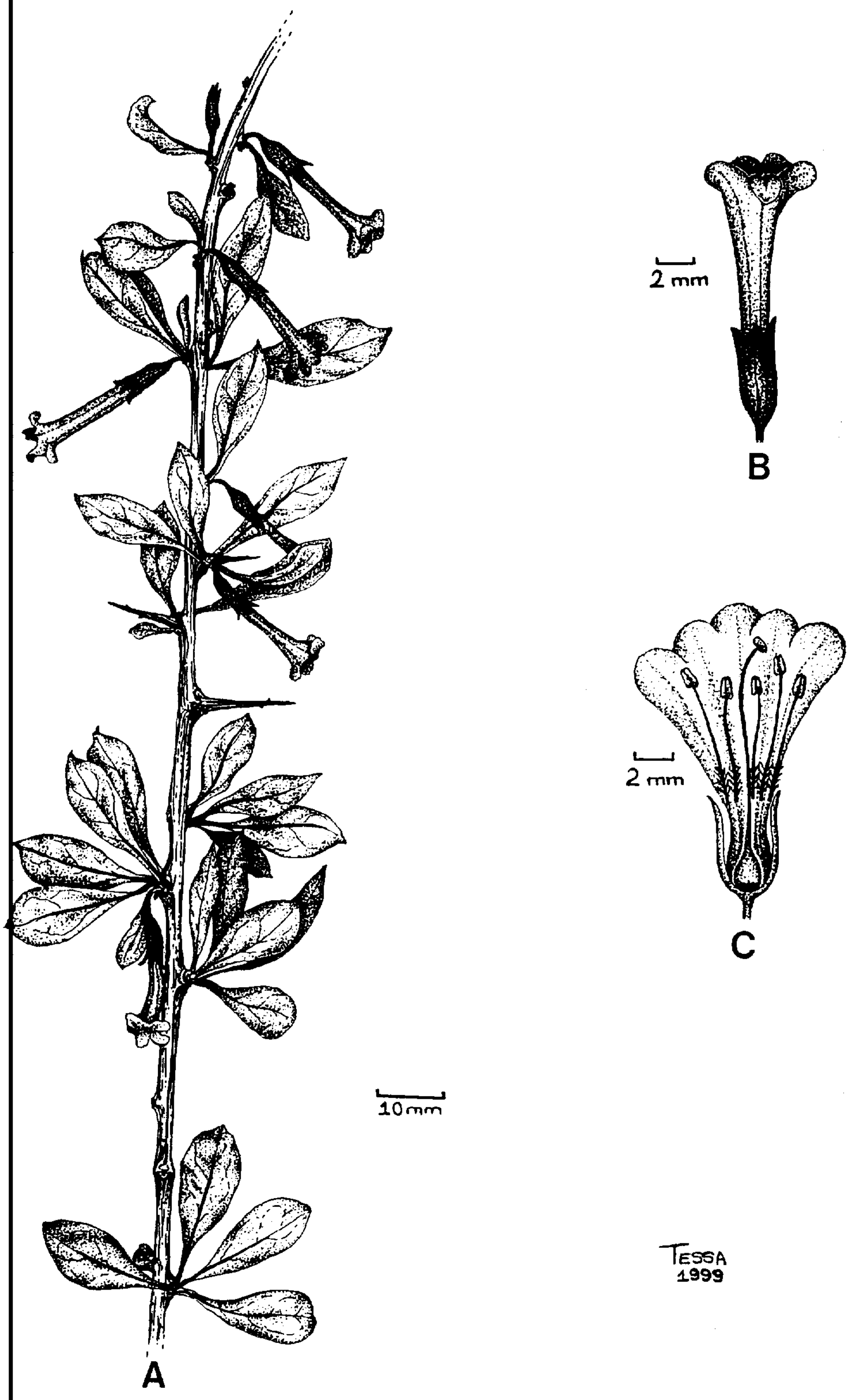


Figure 8.2.17 *Lycium eenii.*
A: Stem with thorns, leaves and flowers; B: External view of flower;
C: Flower internally showing pistil and stamens.
[A, B & C: *R Seydel 1243* (BLFU)].

narrowly funnel-shaped, (10–)12–15(–18) x 2–3 mm long, exterior glabrous, glabrous or sparsely pilose in region of stamen insertion; *lobes* sub-orbicular, 3–2.5 x 3 mm, spreading. **Stamens** inserted 5–6 mm above base of corolla tube, about $\frac{1}{3}$ from the base, reaching into corolla throat; *filaments* (7–)8–10 mm long, lower $\frac{1}{4}$ of filament sparcely pilose. **Pistil:** *ovary* ovoid, 2 x 1–1.5 mm, *style* 10–13 mm long, included; *nectary* pale greenish-yellow and inconspicuous. **Berry** ovate 7–8 x 4–5 mm, red. **Seed** discoid-ovoid, 2.5—2 mm. (Figure 8.2.17). 2n = 2x = 24.

VERNACULAR NAME

"Breëblaarkriedoring"

DISTRIBUTION AND ECOLOGY

Distributed throughout Namibia, from north of the Orange River, through the central regions and northwest into Damaraland and northeast into Hereroland to about 20°S (Figure 8.2.18). Plants are found on sandy soil, often of doleritic origin, in semi-desert scrub, moister savanna and stream bank scrub.

VOUCHER SPECIMENS

Namibia:

–20S13E: 34 km west of Wêreldsend en route to Torra Bay (–BC), *Giess, W. 7981* (WIND).

–20S14E: Damaraland, farm Nickberg (–CA), *Craven, P. 1006* (WIND).

–20S14E: Brandberg West at Ugab crossing to Gai-as (–CC), *Craven, P. 1511* (WIND).

–20S15E: 64 km west of Outjo (–DD), *Esterhuyse, C. J. 446* (WIND).

–20S16E: Otjiwarongo, Omatjenne experimental farm (–AD), *Giess, W. 8186* (WIND).

–20S16E: Otjiwarongo to Waterberg, farm Okosongomingo (–CA), *Wanntorp, H. 606* (PRE).

–21S15E: Okomitundu, Karabib (–DD), *Seydel 1243* (PRE).

–21S15E: Karabib, Okomitundu (–DD), *Seydel, R. 1243* (BLFU, PRE).

–21S15E: Erongo Mountains on farm Daheim, Karabib (–DD), *Kinges, H. 3233a* (PRE).

–21S16E: Farm Sukses 113 km north of Okahandja (–BB), *Venter A. M. 490* (BLFU).

–21S16E: Okahandja, Waterberg District (–DD), *Bradfield 209* (K, PRE).

–22S17E: Windhoek, southern outskirts of town (–CA), *Venter A. M. 553* (BLFU).

–24S17E: Hardap Wild Reserve, Mariental (–DB), *Le Roux 1226* (WIND).

–25S16E: Kleinfontein-south, 80 km north of Helmeringhauzen (–BD), *Reyneke A. M. 189* (BLFU).

–28S17E: 2 km south of Karasburg to Warmbad (–BB), *Reyneke A. M. 209* (BLFU).

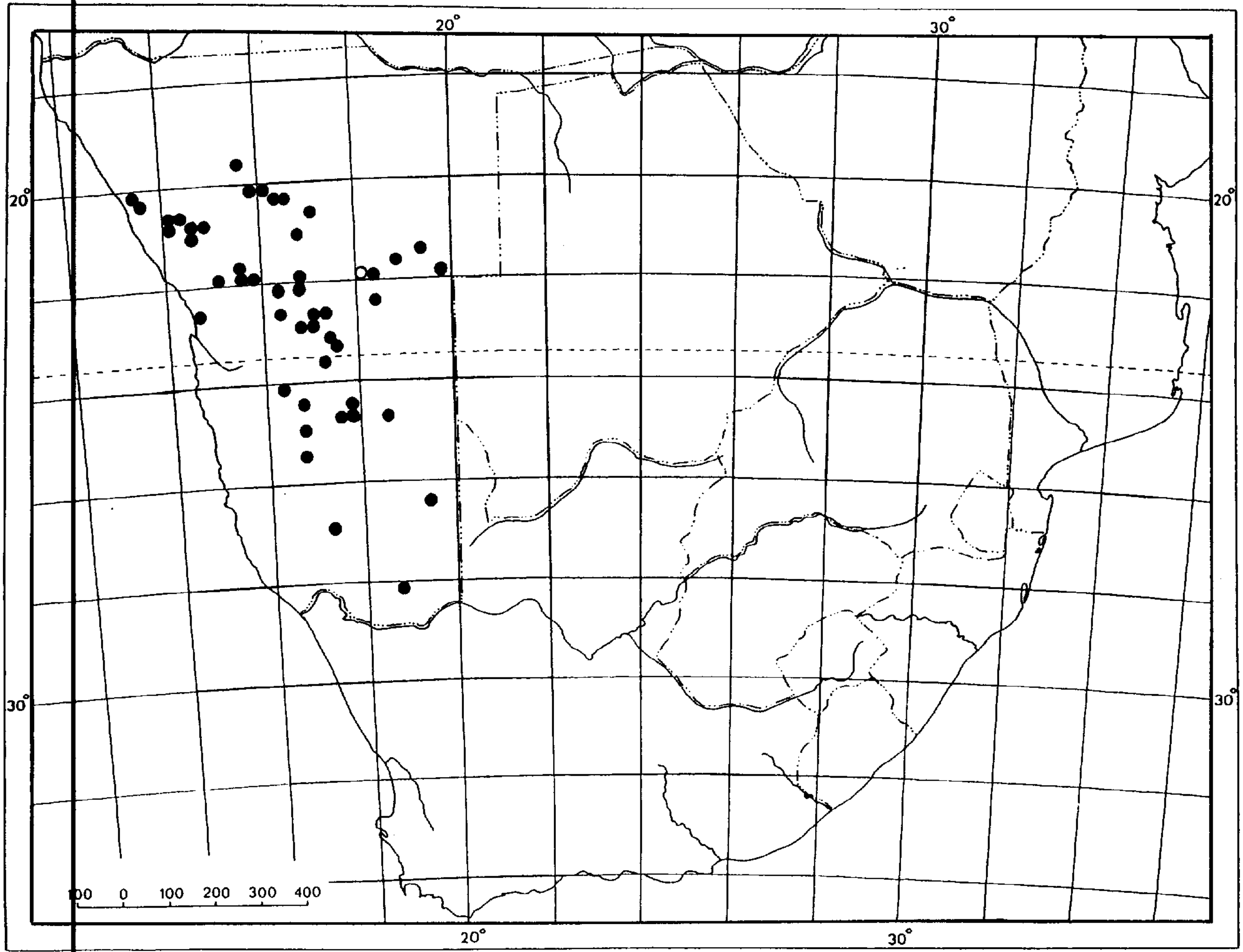


Figure 8.2.18 Known geographical distribution of *Lycium eenii*.

[o : Type locality]

8.2.10 ***LYCIUM EUROPAEUM*** L., Species plantarum 1:191 (1753); 57 (1737b).

Type: Linnean Herbarium, London, *LINN no 257.7.* (LINN!, lectotype, designated by Feinbrun (1968)).

= ***Jasminoides aculeatum***, *Salicis folio, flore parvo ex albo pupurascente* Micheli: 224, t 105, f. 1 (1729) (synonymy after Feinbrun & Stearn (1963)).

Type: Micheli, Nova pl. Gen.: 24, t. 105, f.l (1729) (lecto-iconotype, after Feinbrun & Stearn (1963)).

≡ ***L. mediterraneum*** Dunal: 523 (1852) (synonymy by Feinbrun & Stearn (1963)), nom. illegit.

Type: no type indicated by Dunal for the species, only for the varieties.

= ***L. mediterraneum*** var. ***glabrum*** Dunal: 523 (1852), **syn. nov.**

Type: *Gufsoner s.n.* (G-DC!).

(Dunal did not indicate any type specimen in his description. *Gufsoner s.n.* is indicated as type in G-DC.).

= ***L. mediterraneum*** var. ***leptophyllum*** Dunal: 523 (1852), **syn nov.**

Type: Syria (G-DC!).

(Dunal indicated a type specimen from Syria, without collector, in his description. Above mentioned specimen is indicated as type specimen in G-DC.).

8.2.10 ***LYCIUM EUROPAEUM*** L., Species plantarum 1:191 (1753); 57 (1737b).

Type: Linnean Herbarium, London, *LINN no 257.7.* (LINN!, lectotype, designated by Feinbrun (1968)).

= ***Jasminoides aculeatum***, *Salicis folio, flore parvo ex albo pupurascente* Micheli: 224, t 105, f. 1 (1729) (synonymy after Feinbrun & Stearn (1963)).

Type: Micheli, Nova pl. Gen.: 24, t. 105, f.l (1729) (lecto-iconotype, after Feinbrun & Stearn (1963)).

≡ ***L. mediterraneum*** Dunal: 523 (1852) (synonymy by Feinbrun & Stearn (1963)), nom. illegit.

Type: no type indicated by Dunal for the species, only for the varieties.

= ***L. mediterraneum*** var. ***glabrum*** Dunal: 523 (1852), **syn. nov.**

Type: *Gufsoner s.n.* (G-DC!).

(Dunal did not indicate any type specimen in his description. *Gufsoner s.n.* is indicated as type in G-DC.).

= ***L. mediterraneum*** var. ***leptophyllum*** Dunal: 523 (1852), **syn nov.**

Type: Syria (G-DC!).

(Dunal indicated a type specimen from Syria, without collector, in his description. Above mentioned specimen is indicated as type specimen in G-DC.).

= ***L. orientale*** Miers:12 (1854), (synonymy after Feinbrun & Stearn (1963)); Miers: 99, tab. 65: fig. A (1857).

Type: Arabia Petraea, Smyrna, *Boissier E. s.n.* (K, holotype).

= ***L. barbarum*** var. ***brevilobum*** Post: 569 (1896), (synonymy after Feinbrun (1968)).

Type: none indicated by Feinbrun.

= ***L. somalense*** Dammer: 225 (1913), **syn nov.**;

Type: Somaliland, Anlayra, *Edith Cole s.n.* (BΨ, holotype), (synonymy after Dammer's description).

DESCRIPTION:

A bisexual, rigidly erect **shrub** of 1–2 m high. **Stems** stout and very thorny, young stems dull white to pale brown, older stems pale grey and brown, glabrous; thorns stiff, peg-like, 5–10(–15) mm long on young stems, 30–50 mm on older stems. **Leaves** solitary and alternate on young stems, clusters of 3–9 leaves on older stems and thorns; *petiole* 0.5 mm long or absent; *lamina* narrowly obovate to obovate, elliptic on suckers, (10–)15–25(–35) x (3–)5–8 mm, semi-succulent, macroscopically glabrous, bright green to sometimes glaucous, apex acute to rounded. **Flowers** 5-merous; pedicel (2–)3–5(–8) mm long. **Calyx** campanulate to broadly tubular, 2(–3) x 2–2.5 mm; *lobes* triangular, 0.5 mm long, erect, apices acute. **Corolla** purple tinged green on outside, with dark purple lobes; *tube*

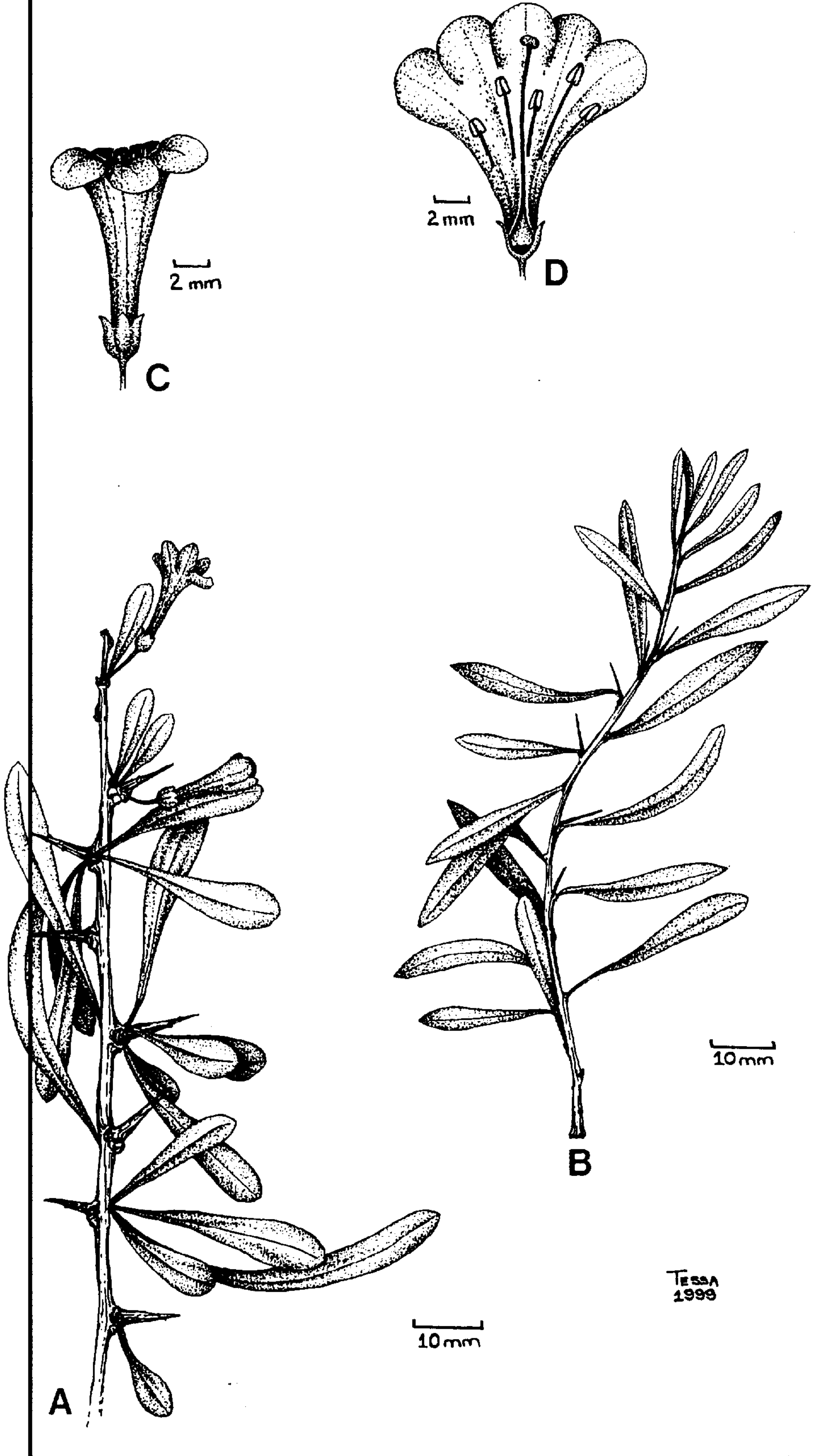


Figure 8.2.19 *Lycium europaeum.*
A: Stem with thorns, leaves and flowers; B: Young stem with short thorns and alternate leaves; C: External view of flower; D: Flower internally showing pistil and stamens.
[A & B: *J. A. Porter s.n.* (K); C & D: *P. Jarmin 944* (P)].

trumpet-shaped, (10–)11–13(–14) x 3–3.5 mm, glabrous outside and inside, rarely sparsely pilose below point of stamen insertion; *lobes* suborbicular, 2.5–3 x 2.5–3 mm, spreading. **Stamens** inserted 7–8 mm above base of corolla just above middle of tube, included in corolla tube; *filaments* 4–5 mm long, bases glabrous or very sparsely pilose. **Pistil:** *ovary* ovoid, 1.5–2 x 1.5 mm; *style* 7–9 mm long, as long as stamens, included; *nectary* greenish-white, inconspicuous. **Berry** ovoid, 5–6 x 4–5 mm, red. **Seed** ovate, 2–1.5 mm. (Figure 8.2.19). 2n = 2x = 24 (36).

VERNACULAR NAME

"Spanish boxthorn" (Miller 1768).

DISTRIBUTION AND ECOLOGY:

In Africa this species is restricted to the winter rainfall region south of the Mediterranean Ocean in Algeria, Mauritania, Morocco and Tunisia (Figure 8.2.20). Outside Africa this species occurs in the southern parts of Europe, as well as in the Middle East and Mediterranean Islands (Dunal 1852, Feinbrun 1968). *L. europaeum* grows on calcrete outcrops and the rocky slopes of igneous valleys.

VOUCHER SPECIMENS:

Algeria:

–35N00W: Oran (–DA), *Wolfe s.n.* (P, K).

–36N06E: Constantine (–BC), *Garriques 481* (P).

–36N30E: Lake St Eugene (=Bologuine Ibnou Zin) (–AC), *Jarmin 944* (P).

Mauritania:

–20N17W: Port Ettienne (=Nouadhibou) (–AC), *Chudeau M. 23* (P).

–22N12W: Adrar Region, Zoukar (=Zouerate) (–CB), *Chevalier L. s.n.* (P).

Morocco:

–29N09W: 12 km east of Tiznit (–AA), *Miller, Russell, & Sutton 595* (K, BM).

–33N02W: Fedhala (–CA), *Trettewy A. W. 109* (K).

Tunisia:

–36N10E: 30 km north-east of Grombalia (–DC), *Jansen 287* (WAG).

Spain:

36N04W: Malaga region (–CB) *Porter s.n.* (K).

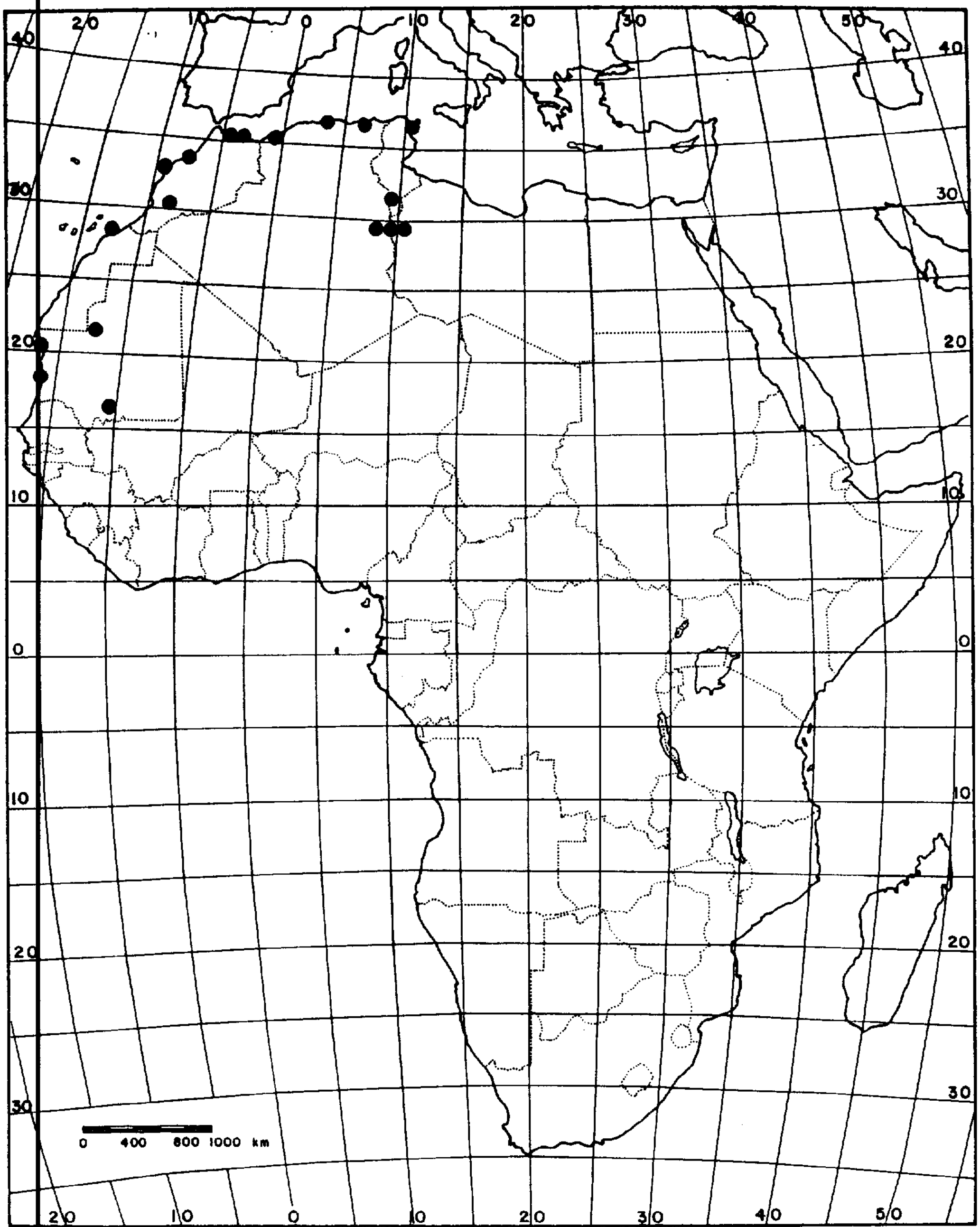


Figure 8.2.20 Known geographical distribution of *Lycium europaeum* in Africa.

8.2.11 ***LYCIUM FEROCISSIMUM*** Miers in Annals of the Magazine of Natural History ser. 2, 14(79): 187 (1854);

Miers: plate 70 (1857); C. H. Wright: 111 (1904); Dean: 11–12 (1974); Haegi: 671 (1976).

Type: South Africa, Uitenhage, *Zeyher 105* (not Harvey as indicated in the description, but housed in the Harvey collection) (K!, holotype; PRE!, BOL!, isotypes).

= *L. bachmannii* Schinz: 558 (November 1912), **syn. nov.**; Dean: 10 (1974).

Type: South Africa, Cape, Hopefield, *Bachmann 1792* (BΨ, holotype; Z!, lectotype, here declared).

= *L. macrocalyx* Dammer: 232 (1913), **syn nov.**; Dean: 10 (1974).

Type: homotypical with *L. bachmannii* Schinz.

DESCRIPTION

A bisexual, rigid, thorny **shrub** of 2–3 m high. **Stems** rigid, young stems dull green, older stems pale-grey to pale pinkish brown, glabrous; thorns stout, peg-like, 30–80 mm long, of mixed length on young and older stems. **Leaves** clustered on stems and thorns, 3–6 leaves per fascicle, sometimes solitary on young stems; sub-sessile or *petiole* short, up to 1 mm long; *blade* obovate to elliptic, 12–24(–35) x 4–7(–10) mm, succulent, bright green, often shiny; macroscopically glabrous, apex usually obtuse to sometimes acute. **Flowers** 5-merous; pedicel (5–)7–10(–

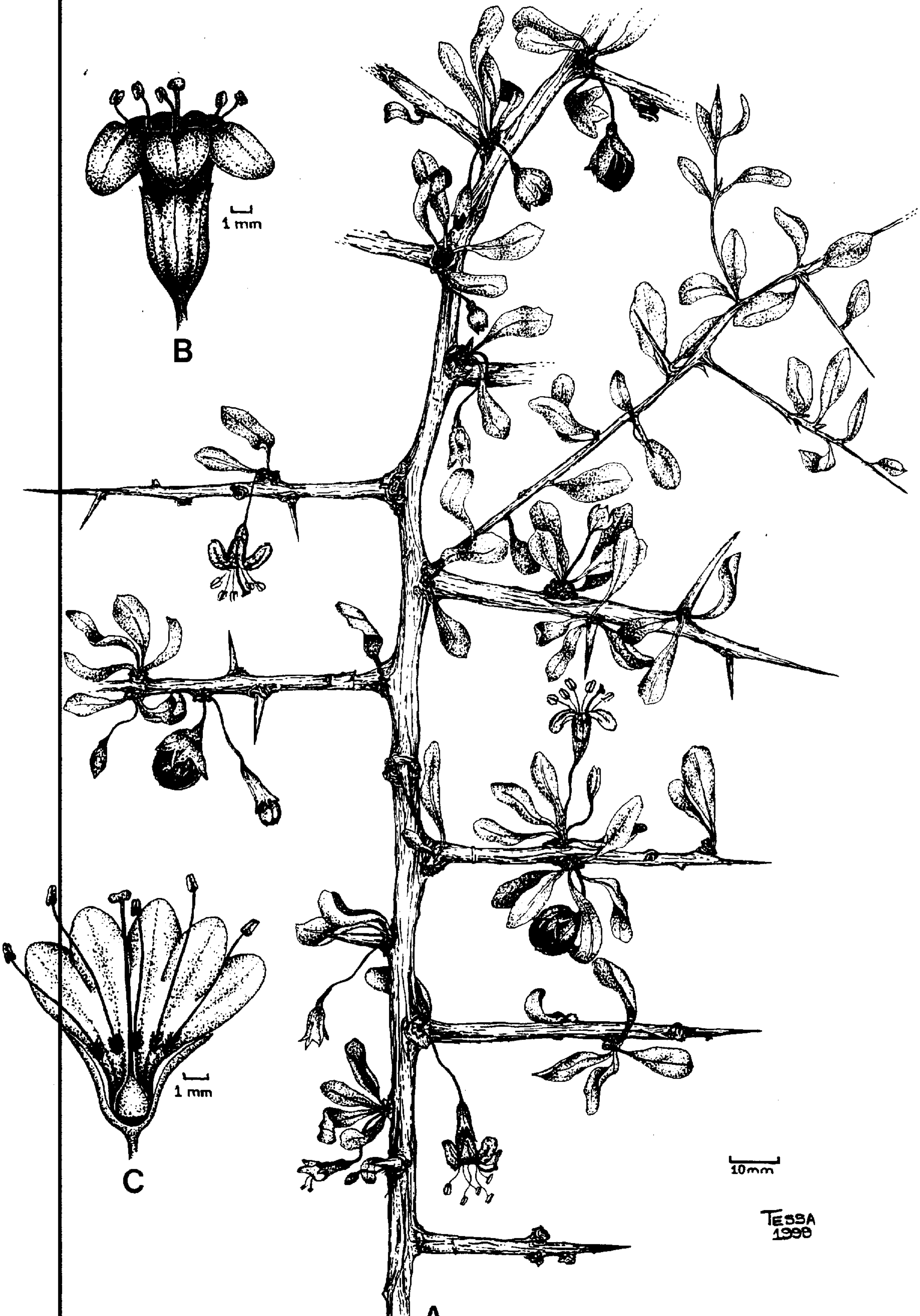


Figure 8.2.21 *Lycium ferocissimum.*
A: Stem with thorns, leaves and flowers; B: External view of flower;
C: Flower internally showing pistil and stamens.
[A, B & C: *H. C. Taylor 7770* (PRE)].

15) mm long. **Calyx** tubular; 5–7 x 2.5–4 mm; *lobes* triangular, 1–1.5 mm long, unequal, erect, apices acute. **Corolla** white with violet venation and lobes pale lilac with basal purple spot; *tube* funnel-shaped, 6–8 x 3–4(–5) mm, glabrous outside, pilose inside at stamen insertion; *lobes* obovate, 3–4 mm long, recurved. **Stamens** inserted 3–5 mm above corolla base near middle of tube, conspicuously exserted from corolla mouth; *filaments* 8–11 mm long, bases densely pilose. **Pistil**: *ovary* broadly ovoid to spherical, 1.5 x 1.5 mm, *style* 10–15 mm long, exserted as far as, or further than stamens; *nectary* red, inconspicuous. **Berry** broadly ovoid or spherical, 8–10 x (7–)8–10 mm, red. **Seed** ovate, 2–3 x 3 mm. (Figure 8.2.21). 2n = 2x = 24.

NOTES

The type *Zeyher 105* used by Miers (1854) for the description of *L. ferocissimum* is one of the syntypes cited by Wright (1904) for *L. campanulatum*, making the latter name illegitimate.

Much confusion was caused by the fact that *L. ferocissimum* and *L. afrum* hybridise readily, resulting in plants with intermediate characteristics.

VERNACULAR NAME

"Slangbessie" (Smith 1966).

UTILIZATION

The plants of this species are quite attractive with their large glossy bright green, densely clustered leaves. It thus became a popular and effective hedge plant because of its thorny nature. *L. ferocissimum*, therefore, has become established in the eastern Free State, Lesotho and North Africa, outside its natural distribution range. Plants of this species were also introduced into Australia and this species has since been declared a weed in that country (Haegi 1976).

The large red, slightly sweet berries are considered edible, but cases of serious poisoning in humans have been traced to intake of these berries (Watt & Breyer-Brandwijk 1962).

DISTRIBUTION AND ECOLOGY

A native species of the Eastern and Western Cape Provinces, chiefly along the sea coast (Figure 8.2.22). Plants have also been collected in Lesotho, and the Provinces of the Free State, Kwazulu-Natal and Mpumalanga. A few accounts of this species occurring in North Africa, in Morocco and Tunisia, have been recorded. This is not part of the normal distribution of the species and plants have definitely been introduced into these areas (see UTILIZATION).

Along the coastal areas *L. ferocissimum* occurs on sand dunes and sand flats, more inland it is found on sandy soils of the arid grassy plains and karoo areas.

In the south-western Cape, where winter rainfall prevails, flowering occurs during winter and early spring, from April to September. Along the south-western coast, from Grahamstown to Port Elizabeth, flowering is mainly in summer, from October to November and also in January. In the central regions of South Africa, where the species has been introduced, flowering occurs during the summer months of November to January. The plants introduced into North Africa flower from May to July and also in September to November.

VOUCHER SPECIMENS:

Morocco:

–31N09W: Essaouira, Morocco (–DB), *Jury, Rejdali & Watson 9121* (BM).

South Africa:

–29S27E: Modderpoort, Ladybrand (–AB), *Reyneke A. M. 133* (BLFU, K).

–31S28E: Umtata Commonage (–DB), *Miller O. B. B/690* (PRE).

–33S18E: Darling, slope of Slangkop (–AD), *Rycroft H. B. 1777* (NBG).

–33S25E: Swartkops River at Port Elizabeth (–DC), *Theron G. 661* (PRE).

–33S26E: Grahamstown (–CA), *Bokelmann s.n.* (NBG).

–34S18E: Cape of Good Hope Reserwe (–AB), *Taylor H. C. 7770* (PRE).

–34S18E: Cape of Good Hope Reserwe (–AD), *Taylor H. C.10323* (STE).

–34S18E: Eerste River Forest Station, Cape flats (–BA), *Britton 6* (NBG).

–34S20E: 4 km east of Struisbaai (–CC), *Venter A. M. 516* (BLFU).

Tunisia:

–35N09E: Makthar (–CC), *Davis 69869* (E).

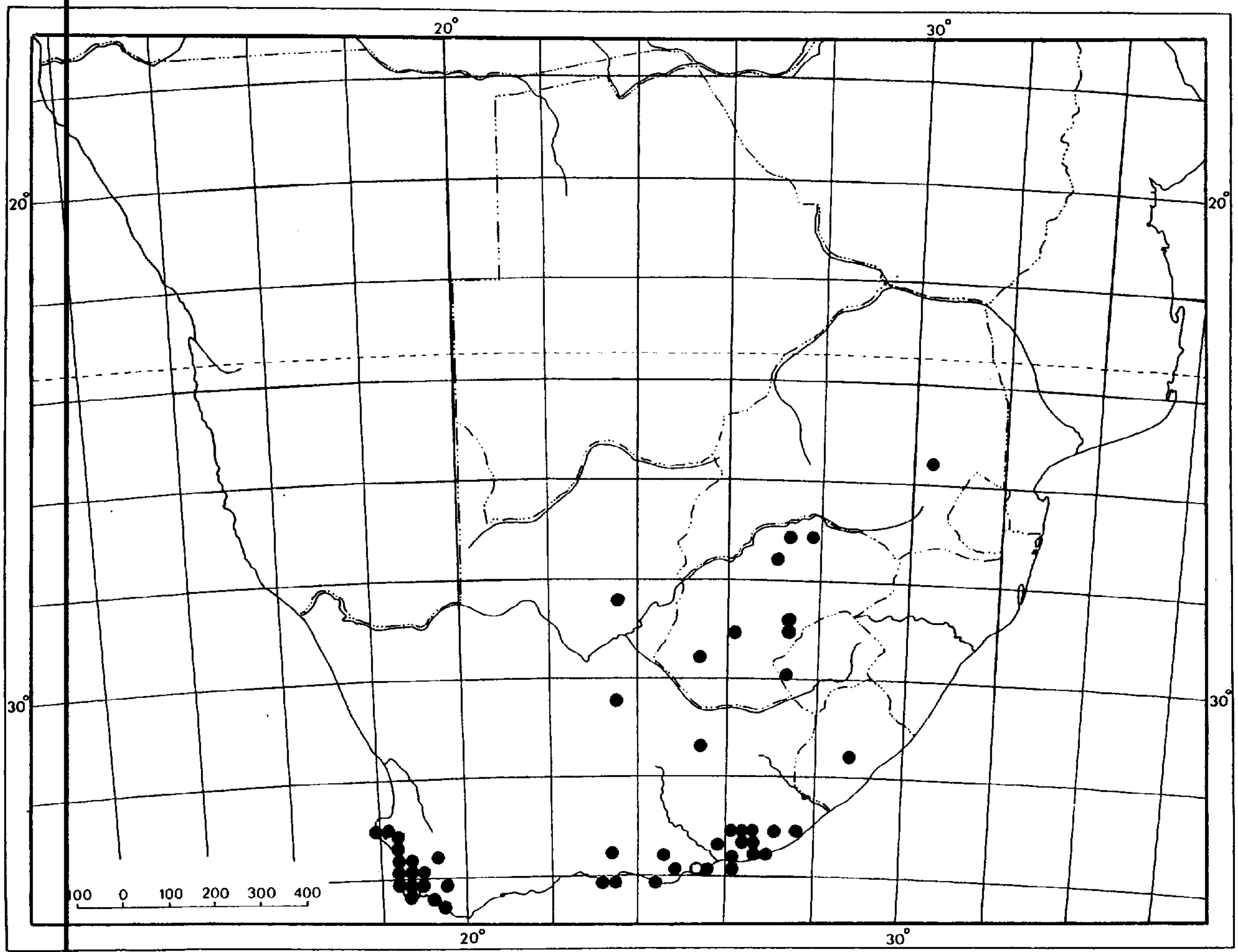


Figure 8.2.22 Known geographical distribution of *Lycium ferocissimum* in southern Africa. The four specimens from Morocco and two from Tunisia are not mapped.

[o : Type locality]

8.2.12 ***LYCIUM GARIEPENSE*** A. M. Venter, **sp. nov.** (to be published in the South African Journal of Botany).

Type: 28S17E: 21 km west of Fish River-Orange River confluence (–AB), *A. M. Venter 622* (BLFU!, holotype; K!, PRE!, WIND!, isotypes)

DESCRIPTION

A dioecious, extremely thorny **shrub** of 0.6–1.2 m high. **Stems** spreading, intricately branched, young stems light brown with dirty white striations, older stems brown to greyish brown, glabrous; thorns branched and needle-like, (10–)20–60 mm long, perpendicular to stems, much branched. **Leaves** alternate on young stems, clustered in fascicles of 2–4 leaves on conspicuous brachyblasts of older stems and thorns, glabrous, sessile; *lamina* obovate to narrowly obovate, sometimes narrowly elliptic, (5–)10–15(–20) x (1–)2–3 mm, succulent, glossy, pale green, glabrous, apices obtuse to somewhat acute. **Flowers** functionally unisexual, 5-merous; pedicel 3–6 mm long. **Male flowers**: **calyx** tubular, 2.5–3.5 x 1.5–2.5 mm; *lobes* about equal, 0.5–0.8 mm long, triangular, apices acute. **Corolla** creamy white with purple veins and pale lilac lobes, *tube* narrowly funnel-shaped, 7–9 x 2–3 mm, sparsely pilose just below stamen insertion; *lobes* sub-orbicular, 2–3 x 2–2.5 mm, spreading. **Stamens** inserted 3–4 mm above corolla base just below middle of tube, unequal in length, *anthers* just protruding from corolla tube; *filaments* 5–7 mm long, bases glabrous or sparsely pilose above insertion. **Pistil:** *ovary* ovoid, 1 x 1 mm, *style* 0–3 mm long, stigma absent; *nectary* pale green to yellow to orangy red, inconspicuous. **Female flowers: calyx** and **corolla** as in male flowers, except corolla tube distinctly tubular. **Stamens** as in male flowers, except anthers infertile, not protruding from corolla tube. **Pistil:** *ovary* ovoid, 1 x 1 mm.; *style* 7–9 mm long,

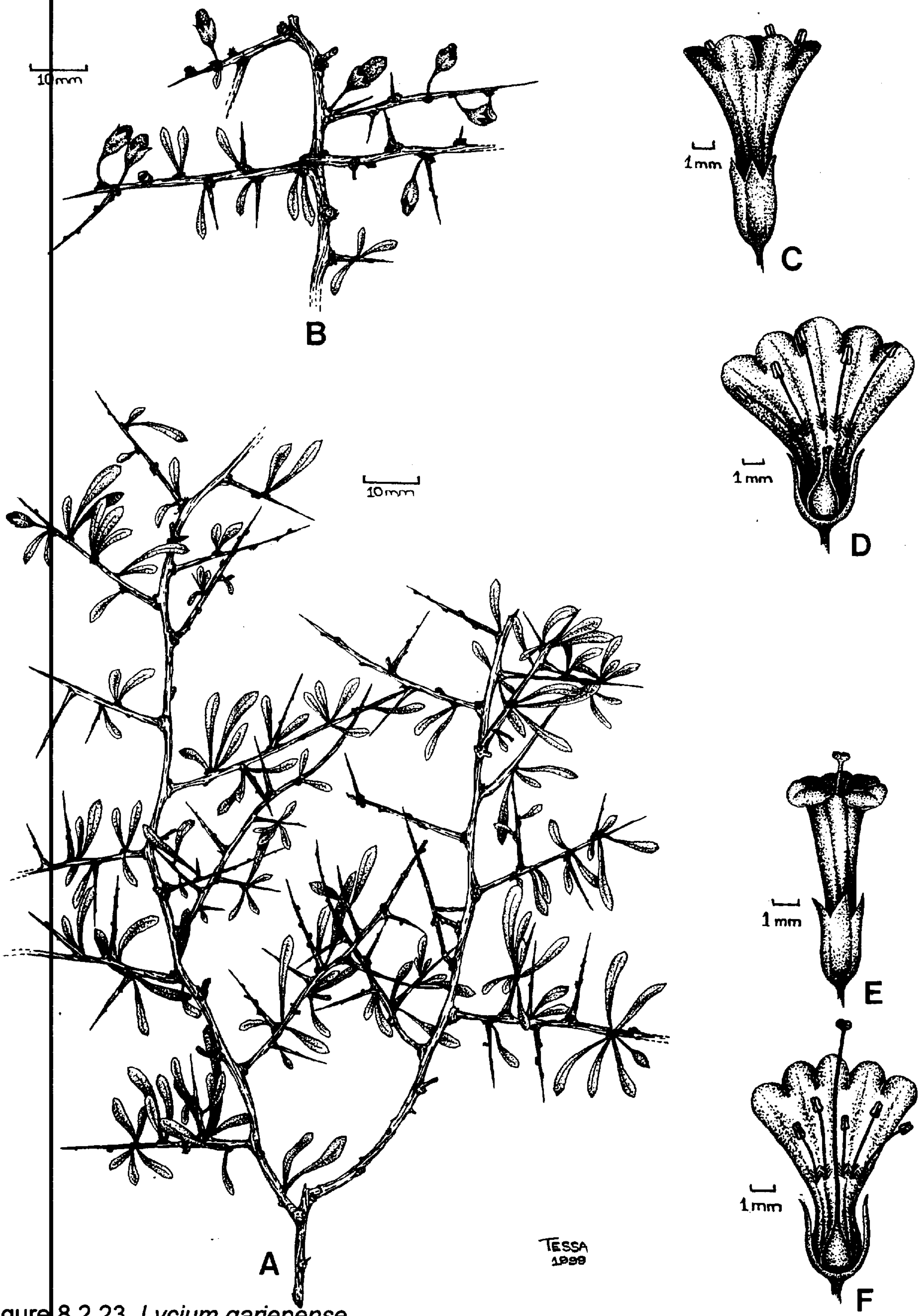


Figure 8.2.23 *Lycium gariepense.*
A: Stem with slender, awl-like thorns and leaves; B. Stem with fruit;
C: External view of male flower; D: Male flower internally showing ovary and stunted style and fertile stamens; E: External view of female flower;
F: Female flower internally showing complete pistil and infertile stamens.
[A, E & F: *A. M. Venter 585* (BLFU)*; B: A. M .Reyneke 183* (BLFU); C & D: *A. M. Venter 587* (BLFU)].

stigma green and obtuse; *nectary* as in male flower. **Berry**: *male plants*: none; *female plants*: berries ovoid, 5–6 x 3 mm, red. **Seed** ovate, 2–2.5 x 2 mm. (Figure 8 2.23). 2n = 4x = 48, rarely 2n = 2x = 24.

NOTES

According to the cytogenetic studies (chapter 5) this species is probably of hybrid origin, the most likely parent species being *L. bosciifolium* and *L. horridum*. Both these species are present in the same area as *L. gariepense.*

Because of the heterozygotic nature of this species, some of its characteristics are not constant, like the fruit and nectary colours. Nectary colour in all of the African lyciums has diagnostic value, but in *L. gariepense* the nectary colour varies form green, as in *L. bosciifolium,* to orange red, as in *L. horridum*, and sometimes the nectary may be an intermediary yellow. This variation has been found to occur on the same plant.

VERNACULAR NAME

"Gariepkriedoring", "gariep box thorn"

DISTRIBUTION AND ECOLOGY:

L. gariepense is found in southern Namibia for about 25 km west of the Fish River along the more or less vertical cliffs bordering the Orange River and as far north as

Witputz on rocky ridges (Figure 8.2.24). The environment is very dry, with more or less full exposure to the summer sun.

The region where *L. gariepense* occurs is very inhospitable and with only a few private roads, which may explain this new species' hitherto unnoticed status. According to the National Herbarium of Namibia (WIND), the region to the north of the localities where *L. gariepense* was collected, is seriously under collected, and this species may well have a wider distribution than that presently known.

VOUCHER SPECIMENS

Namibia:

–24S16E: Bullsport (–AB), *Dinter 2476* (NBG).

–27S16E: Hill on farm Zebrafontein (–DD), *Reyneke A. M. 183* (BLFU).

–27S16E: Rocky ridge on farm Witputz (–DD), *Venter A. M. 628* (BLFU)

–28S16E: Obib Mountains (–BA), *Merxmüller & Giess 28638* (WIND).

–28S17E: 21 km west of Fish /Orange River confluence (–AB), *Venter A. M. 585* (BLFU).

–28S17E: 21 km west of Fish /Orange River confluence (–AB), *Venter A. M. 587* (BLFU).

–28S17E: 21 km west of Fish /Orange River confluence (–AB), *Venter A. M. 622* (BLFU, K, PRE, WIND).

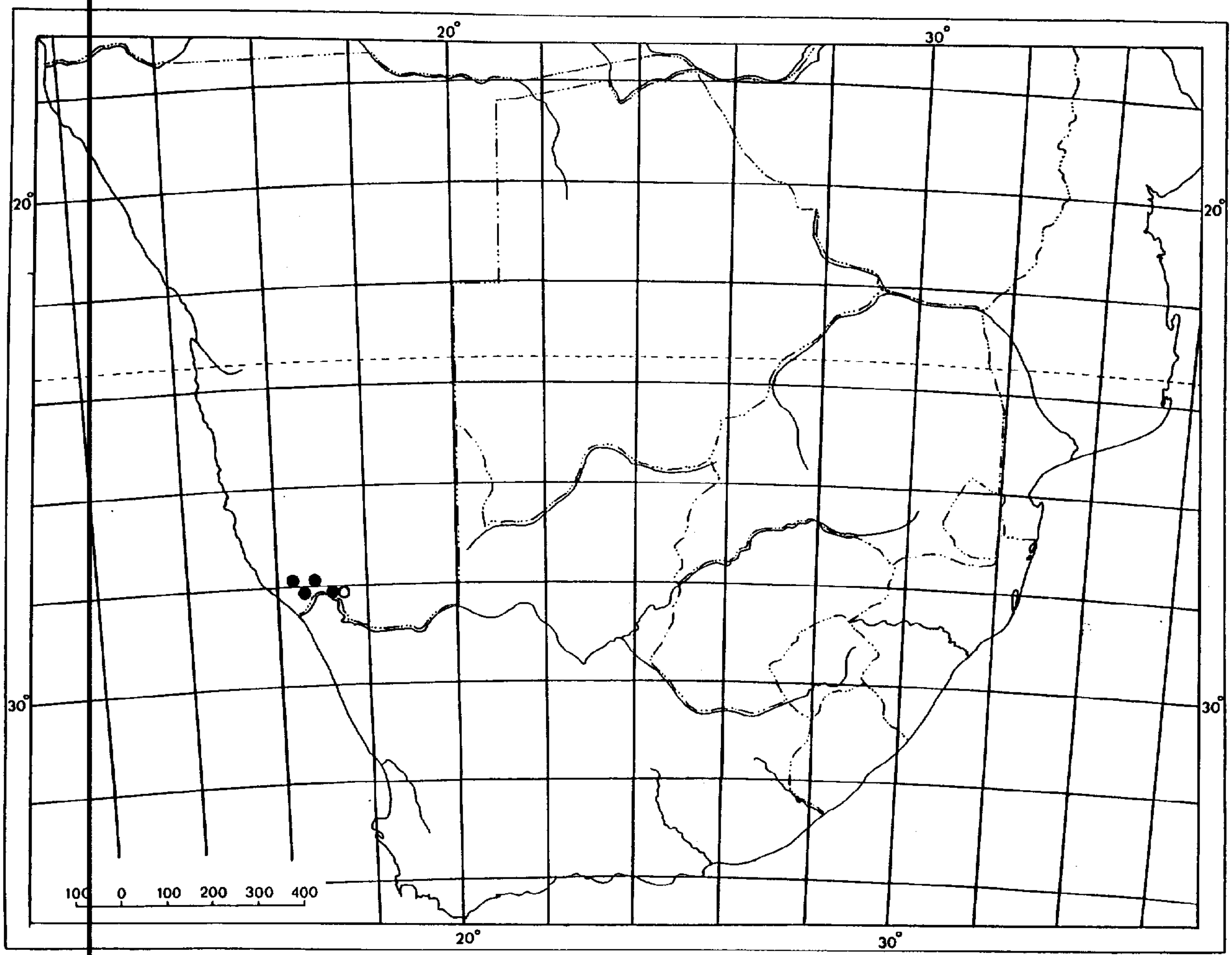


Figure 8.2.24 Known geographical distribution of *Lycium gariepense*.

[○ : Type locality]

8.2.13 ***LYCIUM GRANDICALYX*** Joubert & Venter in South African Journal of Botany 55: 516–519 (1989); Podl. & Roessl.: 124:8 (1969).

Type: Namibia: Witputz, Schwarzkalkrand, 9.6 km north of Police Station, 02/09/1963, Merxmüller 34 / Giess 3447 (WIND!, holotype; BLFN!, M!, isotypes).

DESCRIPTION

A bisexual, erect, thorny **shrub** of 0.5–1 m high. **Stems** erect or somewhat spreading, young stems brittle, whitish, older stems greyish and striated, glabrous; thorns of 15–30 mm long on younger stems, 20–50 mm long on older stem, mixed. **Leaves** fascicled on stems and thorns in clusters of 5–10 leaves, often solitary and alternate on young stems, sub-sessile or *petiole* up to 5 mm long; *lamina* obovate, ovate or elliptic, 20–40 x 8–15 mm, young leaves sparsely hirsute with multicellular glandular hairs, semi-succulent, bright green, apex obtuse to acute. **Flowers** 5-merous; pedicels 2–10 mm long. **Calyx** enlarged and broadly urceolate, 9–12 x 7–10 mm, vestiture as in leaves, succulent; *lobes* deltate, 3–4 x 4 mm, unequal, erect, apices acute. **Corolla** creamy white tube with lilac lobes; *tube* trumpet-shaped, 10–13 x 6–8 mm, glabrous outside, inside pilose between stamen bases; *lobes* broadly semi-ovate, 3–5 x 3–5 mm, reflexed. **Stamens** inserted 4–5 mm above corolla base, just below middle of tube, clearly exserted from corolla mouth; *filaments* 10–13 mm long, bases pilose. **Pistil**: *ovary* very broadly ovoid, 2 x 2 mm, *style* 17–18 mm long, exceed stamens from corolla mouth. **Berry** ovoid to orbicular, 7–8 mm in diameter, red, enclosed by inflated calyx. **Seed** subdiscoid, 2–3 x 3 mm. (Figure 8.2.25). $2n = 2x = 24$.

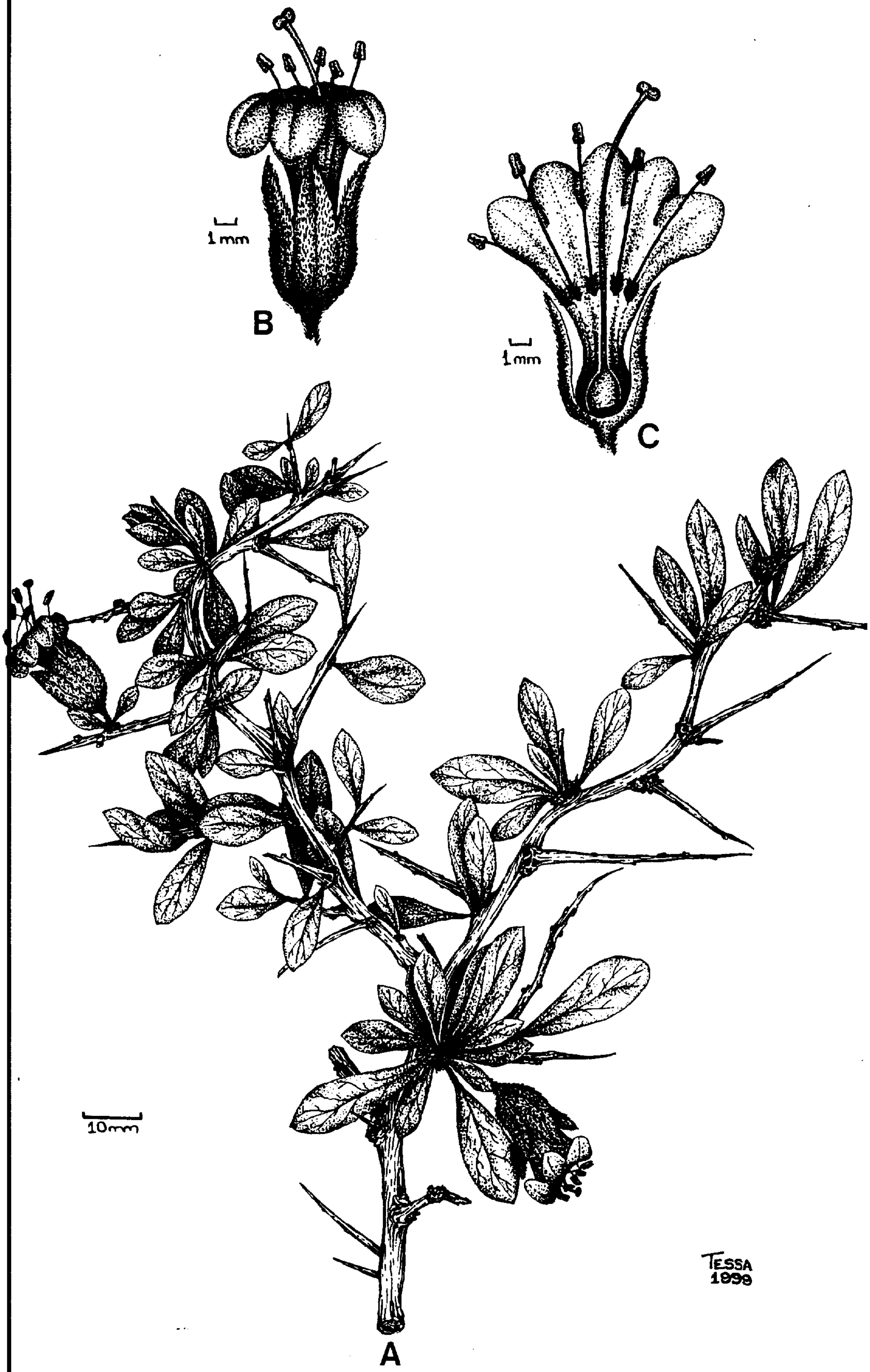


Figure 8.2.25 *Lycium grandicalyx.*
A: Stem with thorns, leaves and flowers; B: External view of flower;
C: Flower internally showing pistil and stamens.
[A: *A. M. Reyneke 178* (BLFU); B & C: *A. M. Venter 583* (BLFU)].

VERNACULAR NAME

"Blaaskelkkriedoring"

DISTRIBUTION AND ECOLOGY:

The known distribution in southern Namibia stretches from the Witputz area to the Fish River Canyon (Figure 8.2.26). This region is undercollected, being extremely arid and inhospitable, and the distribution could therefore be wider than is known at present.

L. grandicalyx is a component of open xerophytic scrub communities in the desert and succulent steppe. Plants seem to be restricted to black lime terraces (a dark grey to blueish grey dolomitic limestone (G. J. Beukes, Department of Geology, University of the Orange Free State, pers. com.), that is common in the southern Namib and eastwards to the Fish River Canyon. The species is usually found in rock crevices of the terrace slopes but may also occur in dry streambeds that drain these terraces. Very high summer temperatures occur and the little rain received, falls in winter.

Flowering occurs during the rainy season from May to August, but is not an annual event, being totally dependent on the eratic precipitation.

VOUCHER SPECIMENS

Namibia:

–27S16E: 6 km north-west from Witputz Police Station (–DA), *Reyneke A. M. 178* (BLFU).

–27S16E: 51 km north of Rosh Pinah en route to Witputz (–DA), *Venter A. M. 583*(BLFU).

–27S17E: 3 km south of farm Uitsig border (–CA), *Giess & Müller* (PRE, M, WIND).

–27S18E: Fish River Canyon Nature Reserve (–DA), *Meyer 2* (WIND, M).

–27S18E: Fish River Canyon Nature Reserve (–DA), *Venter A. M. 630* (BLFU).

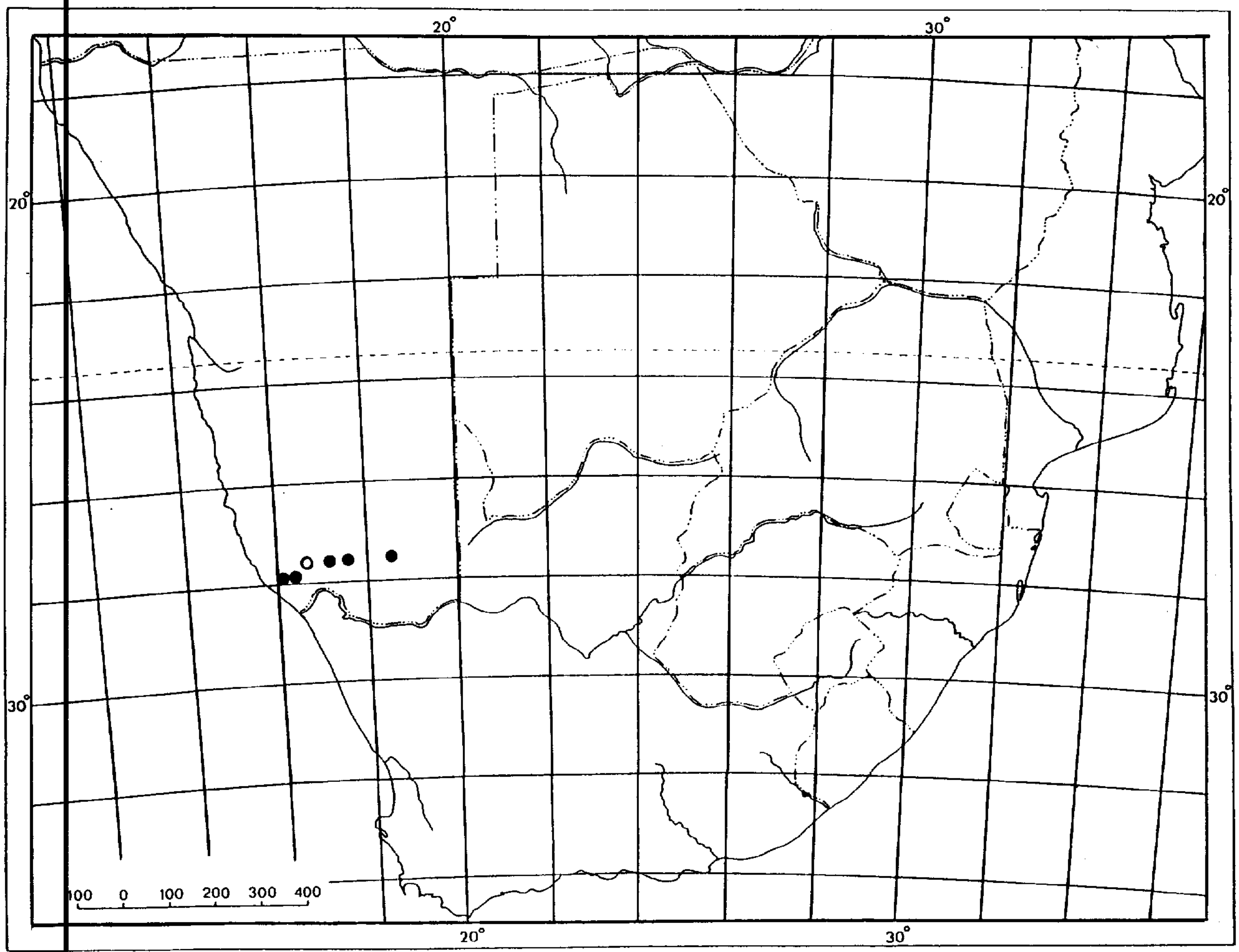


Figure 8.2.26 Known geographical distribution of *Lycium grandicalyx*.

[o : Type locality]

8.2.14 *LYCIUM HIRSUTUM* Dunal in DC., Prodromus 13(1): 521 (1852); Podl. & Roessl.: 124:5 (1969).

Type: South Africa, Cape, Dweka River, *Drège 7866* (G-DC!, holotype).

≡ ***L. hirsutum*** var. ***ochraceum*** Dunal: 521 (1852).

Type: homotypical with *L. hirsutum,* (nom. illegit.).

= ***L. hirsutum*** var. ***cinerascens*** Dunal: 521 (1852), **syn. nov.**

Type: South Africa, Cape, Buffelsvalei, *Drège 7866b* (G-DC!, holotype).

= ***L. glandulosissimum*** Schinz: 183 (1890), (nomen mixtum, synonymy after Podl. & Roessl. (1969)).

Type: Namibia, Aus, *Schinz 474* (Z!, lectotype here declared).

Schinz designated *Schinz 474 & Schenk 94 as syntypes for L. glandulosissimum*. *Schenk 94*, however, is a specimen of *L. pilifolium*).

= ***L. pilosum*** Dammer: 227 (1913) (synonymy by Podl. & Roesl. (1969)).

Types: Namibia, *Range 792* (BΨ; SAM!, lectotype here declared);

Namibia, Naute, *Range 444* (BΨ; SAM!, syntype);

Namibia, Okahandja, *Dinter 258* (BΨ; SAM!, syntype).

DESCRIPTION

A bisexual, sprawling **shrub** of 1–3 m high. **Stems** rigid to somewhat curved, branchlets straight and rigid, young stems ashy-white to creamy white and densely hirsute with short and long stalked glandular trichomes, as well as simple and branched eglandular hairs, old stems dark grey and less hairy to

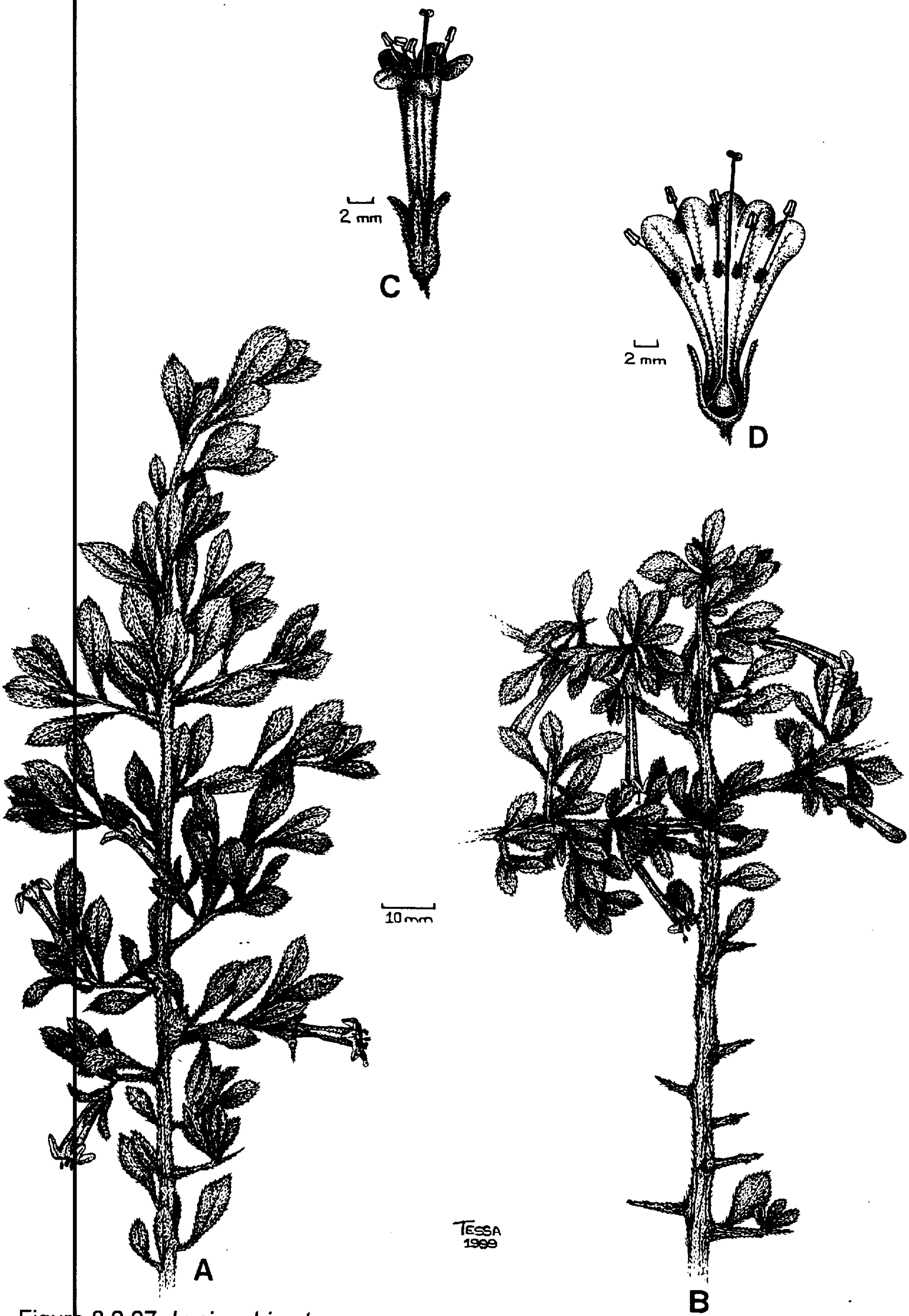


Figure 8.2.27 *Lycium hirsutum.*
A & B: Stem with thorns, leaves and flowers; C: External view of flower;
D: Flower internally showing pistil and stamens.
[A: *A. M. Reyneke 107* (BLFU); B, C & D: *A. M. Reyneke 310* (BLFU)].

glabrous; thorns stout, peg-like, 20–60 mm long, more or less perpendicular to stems, thorns of different lengths occurring intermingled, but often shorter thorns of 10–30 mm on younger stems. **Leaves** solitary on young stems, in clusters of 5–10 on older stems, vestiture as on the young stems; *petiole* 4–7(10) mm long or sub-sessile; *lamina* (6–)10–28(–40) x (2)4–8(10) mm, elliptic or narrowly obovate to obovate, herbaceous, sometimes slightly fleshy, yellowish to greyish green, apices acute to rounded. **Flowers** 5-merous; pedicel 2–5 mm long, vestiture as on young bark. **Calyx** funnel-shaped, 6—10 x 2.5–3 mm, densely hirsute with vestiture as on young bark; *tube* campanulate, 3–5 mm long; *lobes* equal to sub-equal, 4–6 mm long, oblong to triangular-ovate, slightly spreading, apices acute to obtuse. **Corolla** creamy white to dirty white, sometimes with purple venation; *tube* tubular, 14–20(28) x 3–4(–5) mm wide, sparsely to densely hirsute outside, glabrous to rarely pilose at stamen insertion; *lobes* semi-orbicular, 2–3 x 2–3 mm, spreading. **Stamens** inserted 10–12 mm above corolla base, at or well above middle of tube, 2–3 reach corolla mouth, other 2 slightly exserted; *filaments* 6–8(–10) mm long, densely to sparsely pilose at base. **Pistil:** *ovary* subglobose, 2 x 1,5–2 mm, *style* 18–22 mm long, exceed stamens from corolla mouth; *nectary* red and prominent. **Berry** spherical to ovate, 5–6 x 4–5 mm, red. **Seed** ovate, 2 x 2 mm. (Figure 8.2.27). 2n = 2x = 24

VERNACULAR NAMES

"Katbos", "rivierkareedoring", "wolhaarbos", "wolwedoring" (Smith 1966).

DISTRIBUTION AND ECOLOGY:

This species is widely distributed, from the karoo of the Western Cape Province to the Eastern Cape Province and through the Free State to the Northwest

Province and Botswana, as well as into Namibia as far north as Windhoek (Figure 8.2.28).

Plants of *L. hirsutum* are often found to be associated with water, occurring abundantly in the alluvial silt along stream and riverbanks and in gorges. In the dry regions, plants are often found in sandy habitat along dry watercourses. This species is also sometimes found growing in brackish and alkaline soils, or on calcrete ridges in grassland, often in association with *Acacia* spp., e.g. *A. erioloba* and *A. hebeclada*.

Flowering occurs throughout the year, depending on the availabilty of moisture, but this is a winter flowering species, peaking from April to August.

VOUCHER SPECIMENS

Namibia:

–24S16E: Usib River, 8 km NW of Nomtsas (–BD), *Pearson 9325* (K)

–26S16E: Near Aus (–CB), *Dinter 6154* (K).

–27S18E: Noachabeb, Karasberge (–BC), *Ortendah, I. 403* (PRE, K).

South Africa:

–25S20E: Aurob River bed near Mata Mata, Kalahari Gemsbok Park (–CC), *Leistner A. D. 1149* (PRE, K).

–27S27E: Blomspruit and Vals River confluence, Kroonstad (–CA), *Scheepers 1724* (PRE, K).

–28S24E: 10 km west of Riverton (–CA), *Reyneke A. M. 310* (BLFU).

–29S26E: 40 km from Bloemfontein to Reddersburg (–CA), *Reyneke A. M. 107* (BLFU).

–33S21E: 9 km E of Vleiland PO (–CA), *Acocks J. P. H. 20498* (K).

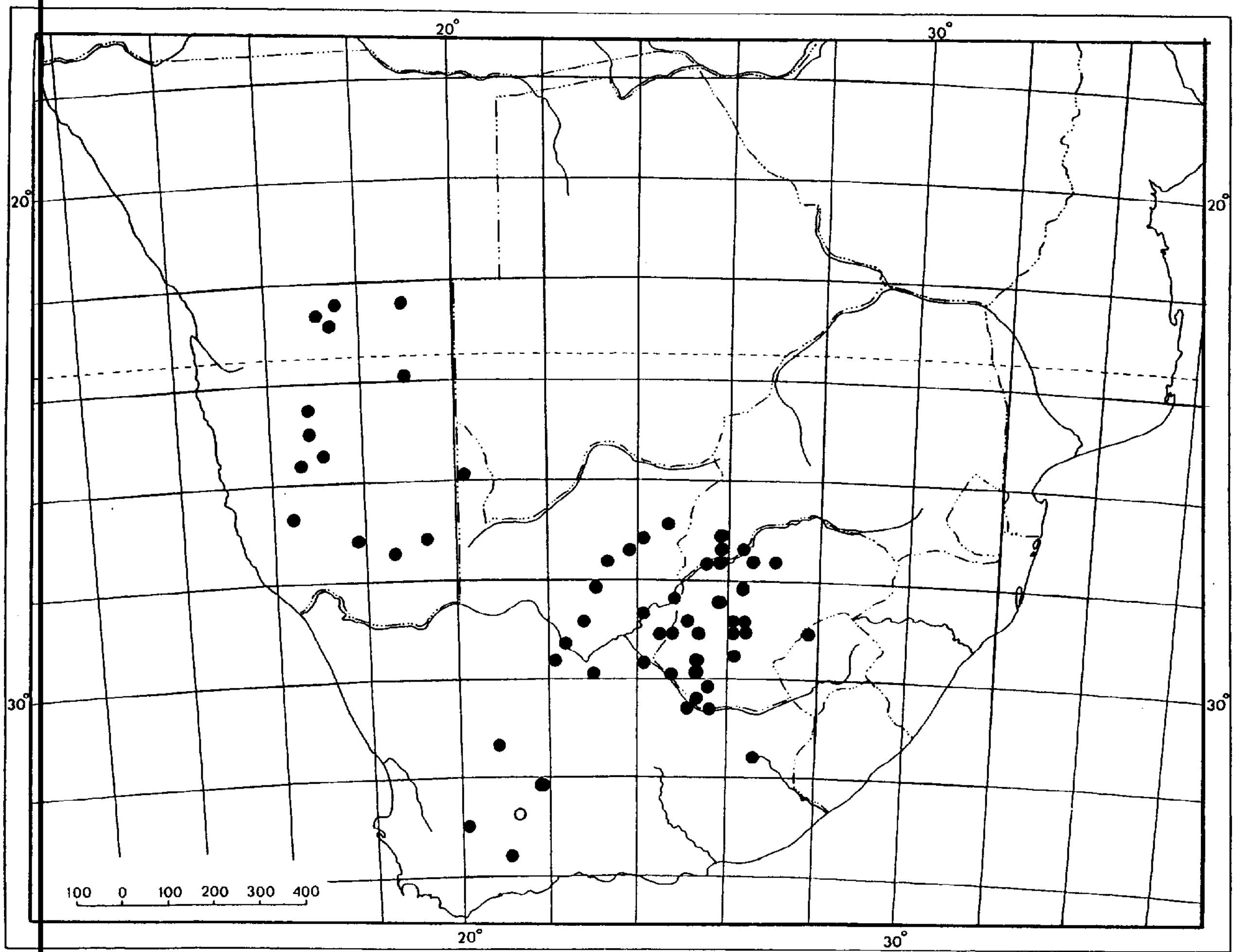


Figure 8.2.28 Known geographical distribution of *Lycium hirsutum*.

[o : Type locality]

8.2.15 ***LYCIUM HORRIDUM*** Thunb. in Prodromus Plantarum Capensis 1: 37 (1794);

154–155, fig. 17 (1808); Poir.: 430 (1814); Roem. & Schult.: 495 (1819); L.: 701 (1825); Walpers: 110 (1844); Dunal: 516 (1852); Miers: 19 (1854); Dean: 9 (1974).

Types: South Africa, Cape, Verlooren Valley, Saldanha Bay and elsewhere, *UPS 5309* (UPS!, lectotype declared here); *5308* (UPS!, syntype); *5310* (UPS!, syntype).

= ***L. apiculatum*** Dunal: 517 (1852), **syn. nov.**; Dean: 10 (1974).

Type: South Africa, Cape, *Drège 7868* (G-DC!, holotype; P!, isotype).

≡ ***L. apiculatum*** var. ***brevifolium*** Dunal: 517 (1852), (nom. illegit.).

Type: Homotypical with *L. apiculatum*.

= ***L. apiculatum*** var. ***longifolium*** Dunal: 517 (1852), **syn. nov.**

Type: South Africa, between Great and Small Fish River, *Drège 7869 aa* (G-DC!, holotype; P!, isotype).

= ***L. echinatum*** Dunal: 515 (1852), **syn. nov.**; Miers: 18 (1854); 2: t. 66 fig. E (1857); C. H. Wright: 114 (1904); Dammer: 230 (1913); Dean: 10 (1974).

Type: South Africa, Cape, Camdeboosberg, *Drège 7870 aa* (G-DC!, holotype; K!, P!, isotypes).

= ***L. kraussii*** Dunal: 517 (1852), **syn. nov.**; Miers: 136 (1854); C. H. Wright: 117 (1904); Dean: 10 (1974).

Type: South Africa, Cape, Uitencap, *Krauss s.n.* (G!, holotype).

= ***L. oxycarpum*** var. ***parviflorum*** Dunal: 518 (1852), **syn. nov.**; Dean: 8, 9 (1974).

Type: South Africa, Vanrhynsdorp, Elephant River, *Drège 3071* (G-DC!, holotype; K!, isotype).

Note: One of the two specimens in P, indicated as isotype of this varietal name, differs from the holotype in G-DC, and the isotype in K. This specimen is identified as *L. cinereum*.

= ***L. oxycladum*** Miers: 14:15 (1854), **syn. nov.**; 2: t. 65 fig. F (1857); C. H. Wright: 115 (1904); Dammer: 229 (1913); Podlech & Roessler 124: 4, 6 (1969); Dean: 10 (1974).

Types: South Africa, Cape, Uitenhage, *Zeyher 81* (K!, lectotype here declared); South Africa, Bedford Division, Smaldeel, *Burke s.n.* (K!, syntype).

= ***L. leptacanthum*** C.H.Wright: 308 (1909), **syn. nov.**; Dean: 10 (1974).

Type: South Africa, Cape Province, Grahamstown, *Cherry E 934* (K!, holotype; PRE!, SAM!, isotypes).

= *L. natalensis* Dammer: 233 (1913), **syn. nov.**; Dean: 10 (1974).

Type: South Arica, Natal, Uvoi River, *Wood, J. M. s.n.* (BΨ, holotype), (synonymy after Dammer's description).

= *L. schoenlandii* Dammer: 229 (1913), **syn. nov.**; Dean: 10 (1974).

Type: South Africa, Cape, Grahamstown, *Schoenland 52* (BΨ, holotype), (synonymy after Dammer's description).

= *L. minutiflorum* Dammer: 356 (1915), **syn. nov.**; Dean: 11 (1974).

Type: South Africa, Southern Kalahari, Elephant River, *Range 1501* (BΨ, holotype; SAM!, lectotype here declared).

= *L. omahakense* Dammer: 353 (1915), **syn. nov.**; Dean: 11 (1974).

Type: Namibia, Omaheke, Epata, *Seiner III 232* (BΨ, holotype), (synonymy after Dammer's description).

= *L. undulatum* Dammer: 354 (1915), **syn nov.**; Dean: 10 (1974).

Type: Homotypical with *L. leptacanthum.*

= *L. eleutherosiphon* C.H.Wright (*nom. nud., in schede*).

South Africa, Cape, Somerset Division, Cookhouse, *Rogers 3468* (BOL!);

South Africa, Grahamstown, *Cherry 934* (BOL!, PRE! SAM!, K!).

DESCRIPTION:

A dioecious, erect, rigid, usually much branched **shrub** of 0.2 to 1.8 m tall, sometimes multi-stemmed by subterranean tillering. **Stems** rigid to sometimes slightly flexuose, tips of branches soft and green but hardens very soon; extremely spinose; young stems whitish, often striped with brown, older stems dark lead-grey or sometimes purplish brown, glabrous; thorns 20–60 mm long, lengthening gradually from young to older stems. **Leaves** fascicled on stems and thorns, clusters 4–8 leafed, sub-sessile or *petiole* 0.5–2 mm long; *lamina* linear or oblong-ovate to narrowly obovate, 7–12(–18) x 1.5–3 mm, succulent, green, macroscopically glabrous, apices obtuse, rarely acute. **Flowers** 4- or 5-merous, functionally unisexual; pedicel 0.5–5 mm long. **Male flowers**: **Calyx** tubular, (2.5–)3–3.5 x 2–2,5 mm, *lobes* triangular, often sub-equal, 0.5–0.8 mm long, erect, apices acute. **Corolla** white with dark purple patch at base of lilac lobes, *tube* narrowly funnel-shaped to tubular, (6–)7–9 x 2–3 mm, glabrous outside, pilose inside at stamen insertion; *lobes* sub-orbicular to semi-ovate, 1.5–2 x 1.5–2 mm, spreading. **Stamens:** 1 or 2 slightly exserted from the corolla-mouth, 2 in corolla-mouth, 5th, when present, included; anthers fertile; filaments inserted 2.5–4 mm above corolla base at about middle of tube, pilose at base. **Pistil:** *ovary* globose to ovoid, 1–1.5 x 1 mm, *style* very short, 0.5–1 mm long, included in corolla tube, *stigma* absent; *nectary* red, prominent. **Female flowers:** same as male flowers, except *corolla tube* smaller, 6–8 x 2–2.5 mm; all *stamens* included in mouth of corolla tube, 2.5–3.5 mm long, *anthers* infertile; *style* 6–9 mm long, slightly exserted from corolla tube; *stigma* present. **Berry:** *male plants*: none; *female plants*: berries ovoid with apex slightly acute, 4–6 x 3–3.5 mm, red. **Seed** ovate, 1.5 x 2 mm. (Figure 8.2.29). 2n = 4x = 48, rarely 2n = 2x =24.

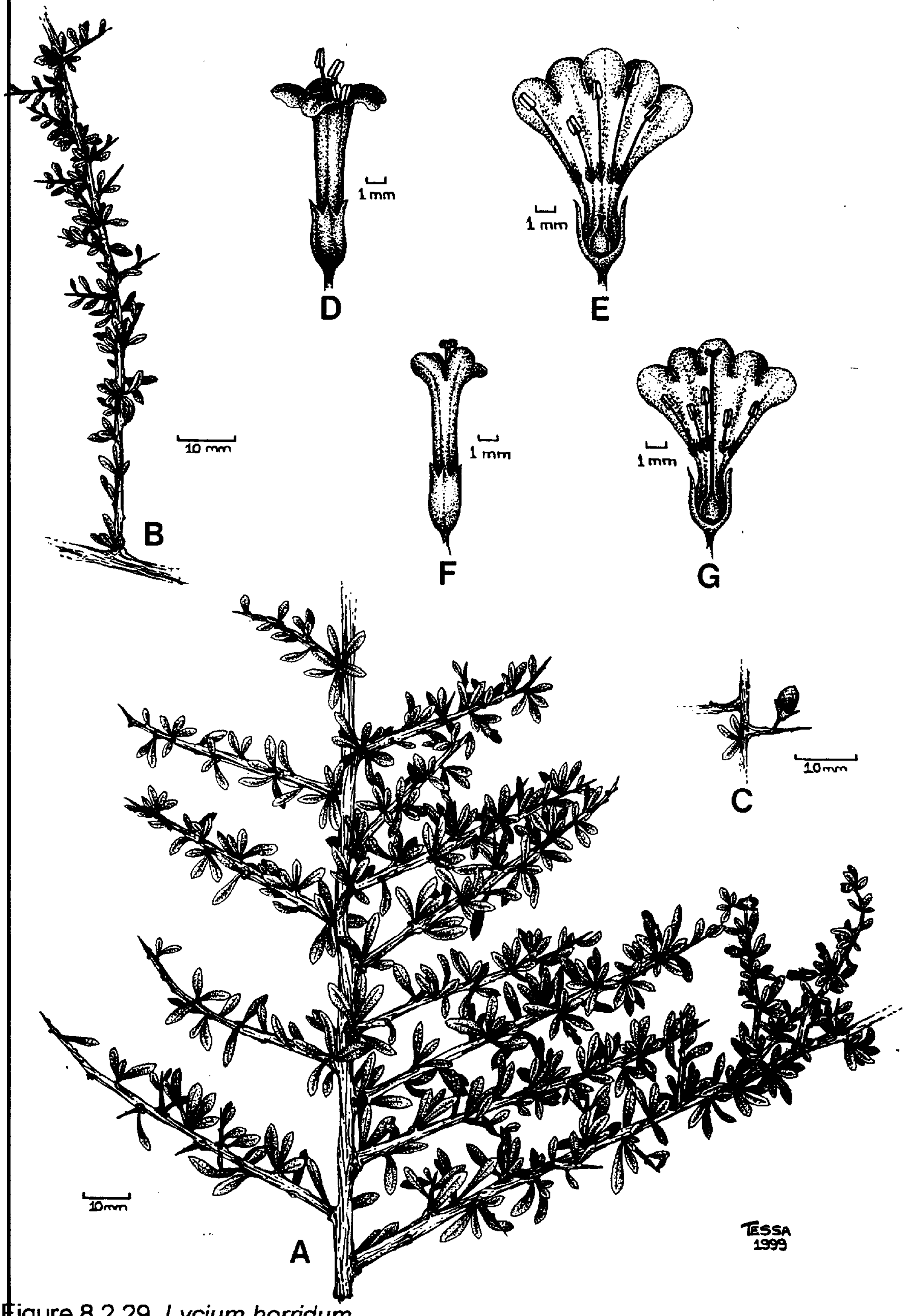


Figure 8.2.29 *Lycium horridum.*
A: Stem with thorns, leaves and flowers; B: Young stem; C: Stem portion with fruit; D: External view of male flower; E: Male flower internally showing ovary with stunted style and fertile stamens; F: External view of female flower; G: Female flower internally showing complete pistil and infertile stamens.
[A: *A. M.Reyneke 141* (BLFU); B & C: *A. M. Reyneke 84* (BLFU); D & E: *A. M. Reyneke 230* (BFLU); F & G: *A. M. Reyneke 246* (BLFU)].

NOTES

This species are often found as pioneers on disturbed, overgrazed or ploughed areas, growing as dwarf shrubs under grazing, becoming bushy shrubs with age. Young shoots and thorns of this species are soft and often grazed by domestic stock, as are the ripe berries.

VERNACULAR NAMES

"Boksdoring", "slangbessie(bos)", "wolwedoring" (Smith 1966).

DISTRIBUTION AND ECOLOGY:

This species is widely distributed over southern Africa in Namibia, Botswana and South Africa, as well as in Zimbabwe just north of the Limpopo River (Figure 8.2.30).

L. horridum has a wide ecological amplitude and is thus found in arid karroid veld, open grassland, scrub along water courses, flood plains, depressions, hillsides, fallow lands, along road shoulders. The types of soil vary as much as the habitats, from gravelly to sandy to clayey, often over calcrete (limestone) or granite.

Flowering occurs throughout spring and summer, depending on the rains. Peak flowering periods are therefore early spring, from August to September, midsummer in January and late summer, from March to April. In Namibia flowering occurs in spring, from August to September, and late summer to autumn, from February to May.

VOUCHER SPECIMENS

Botswana:

–21S21E: 15 km south of Ghanzi en route to Lobatsi (–DA), *Brown R. C. 8279* (K, SRGH, LISC).

–23S24E: Khutse Game Reserve (–BCB), *Tolley 40a/b* (K).

–25S25E: South of Kanye (–AB), *Abel N. 175* (PRE).

Namibia:

–24S16E: Farm Zaris (–CD), *Giess W., Volk O. H. & Bleissner B. 5187* (WIND).

–26S15E: Kausib fountain, 40 km east of Grillental (–DC), *De Winter B. & Giess O. 6096* (K, PRE).

–28S17E: Stormberg, north bank of Orange River (–AD), *Venter A. M. 591* (BLFU).

South Africa:

–23S29E: 10 km south of Louis Trichardt (–BB), *Venter H. J. T. 9204* (BLFU).

–28S21E: 24 km NE of Upington en route to Olifantshoek (–AD), *Venter A. M. 559* (BLFU).

–28S26E: Corneliasrus, near Glen Agricultural College (–CD), *Venter A. M. 565* (BLFU).

–28S27E: 10 km along Senekal turn-off from Windburg highway (–CA), *Reyneke A. M. 84* (BLFU).

–29S23E: Prieska district, farm Remhoogte (–CA), *Venter A. M. 540* (BLFU).

–30S21E: Carnavon Experimental Farm (–DD), *Rosenberg & Rutherford 499* (NBG).

–31S23E: 10 km from Fauresmith to Koffiefontein (–CC), *Reyneke A. M. 230* (BLFU).

–32S21E: 20 km from Frazerburg en route to Williston (–DD), *Ueckerman E. A. 8039* (PRE).

–33S20E: Laingsburg district, Wauchope Monument (–BB), *Acocks J. H. P. 19087* (PRE, K).

–33S26E: Grahamstown, 11 km north of town on Piggots Bridge road (–BC), *Dyer R. A. 912* (GRA, K).

Zimbabwe:

–21S28E: Shasi River banks near Mulala flats (–AC), *Thompson B. R. T35/59* (K, SRGH).

–22S29E: Confluence of Shasi and Limpopo Rivers (–BB), *Drummond 6059* (K).

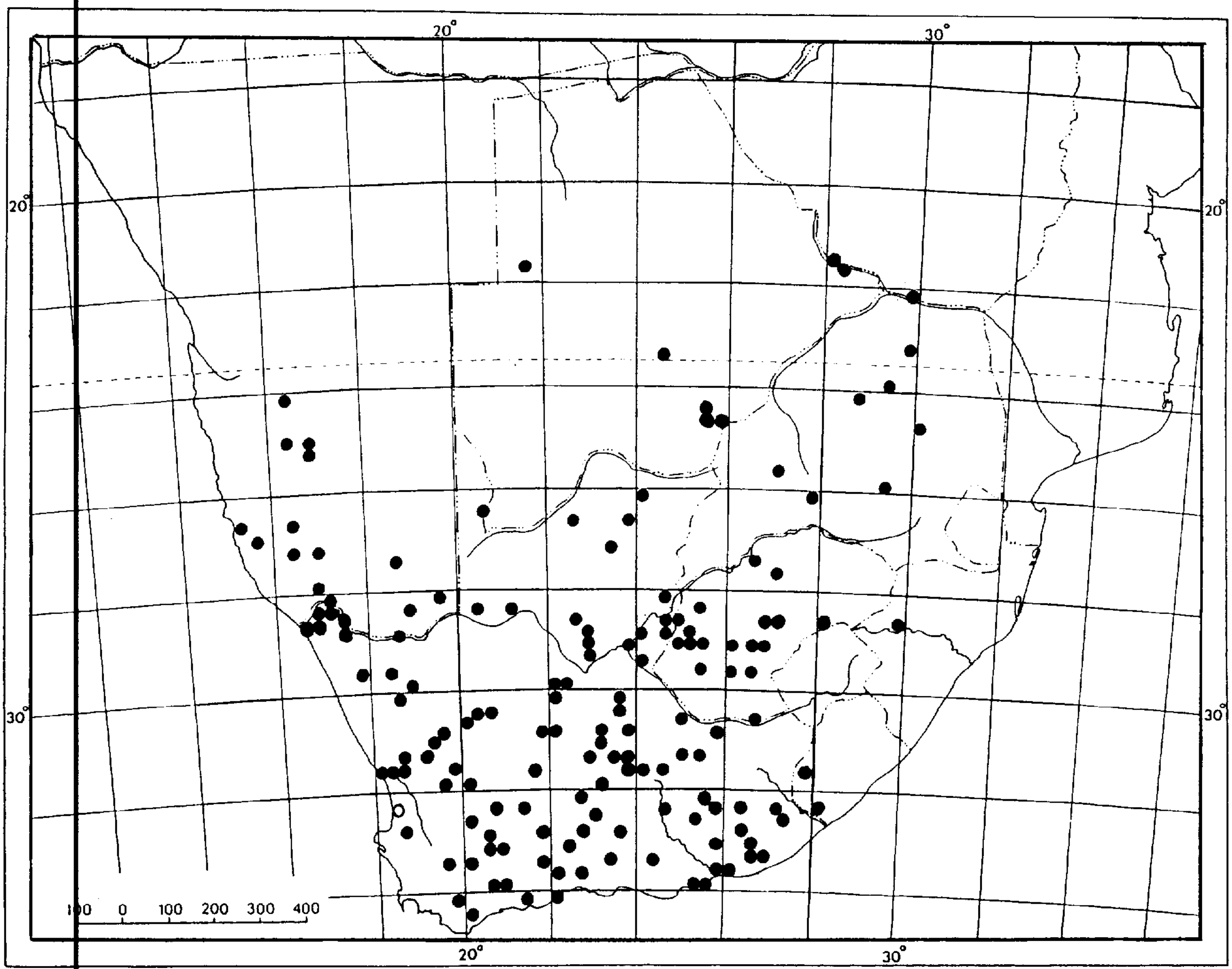


Figure 8.2.30 Known geographical distribution of *Lycium horridum*.

[o : Type locality]

8.2.16 ***LYCIUM MASCARENENSE*** A.M.Venter & A.J.Scott in South African Journal of Botany 65: 428–430 (1999).

Type: Rodrigues, Pointe Coton, *Coode et al. 4330* (K!, holotype).

= ***L. tenue*** var. ***sieberi*** Dunal: 515 (1852); Baker: 216 (1877); Balf. f.: 59 (1870); Cordem.: 462 (1895) (synonymy by A.M.Venter & A.J.Scott (1999)).

Type: Mauritius, Sieber Fl. Maurit. 2: 261 (G-DC!, holotype).

DESCRIPTION:

A bisexual, intricately branched, prostrate, densely foliated **shrub** of up to 1 m high and 4–6 m^2 in surface area. **Stems** up to 2 m long x 2–10 mm in diameter; young stems more or less unbranched, prostrate or pendulous, virtually thornless, dirty white to light brown; older stems with pronounced brachyblasts giving a zig-zag appearance to stems, profusely branched, ash-grey, glabrous; thorns 15–30(–40) mm long on older stems. **Leaves** alternate on young shoots, clustered on brachyblasts in fascicles of 5–10 leaves, sessile to subsessile, glabrous; *lamina* obovate to narrowly obovate, (2–)6–10(–14) x 1–3(–4) mm, succulent and cylindrical, bright green to grey-green, glabrous, apices obtuse, rarely acute. **Flowers** 5-merous; pedicel 1–5(–8) mm long. **Calyx** campanulate, 2.5–3 x 2–3 mm, *lobes* 0.5–0.75 mm long, unequal in size, triangular, apices acute. **Corolla** white with lobes white to pale lilac; *tube* 5–7(–9) x 2–4 mm, glabrous outside, pilose inside at stamen insertion; *lobes* sub-orbicular, 2–3 x 2–3 mm, spreading. **Stamens** inserted 2.5–3(–4) mm above corolla base, just below middle of corolla tube, unequal in length, 5–6 mm long; *anthers* just protruding from corolla mouth; *filament* bases densely pilose.

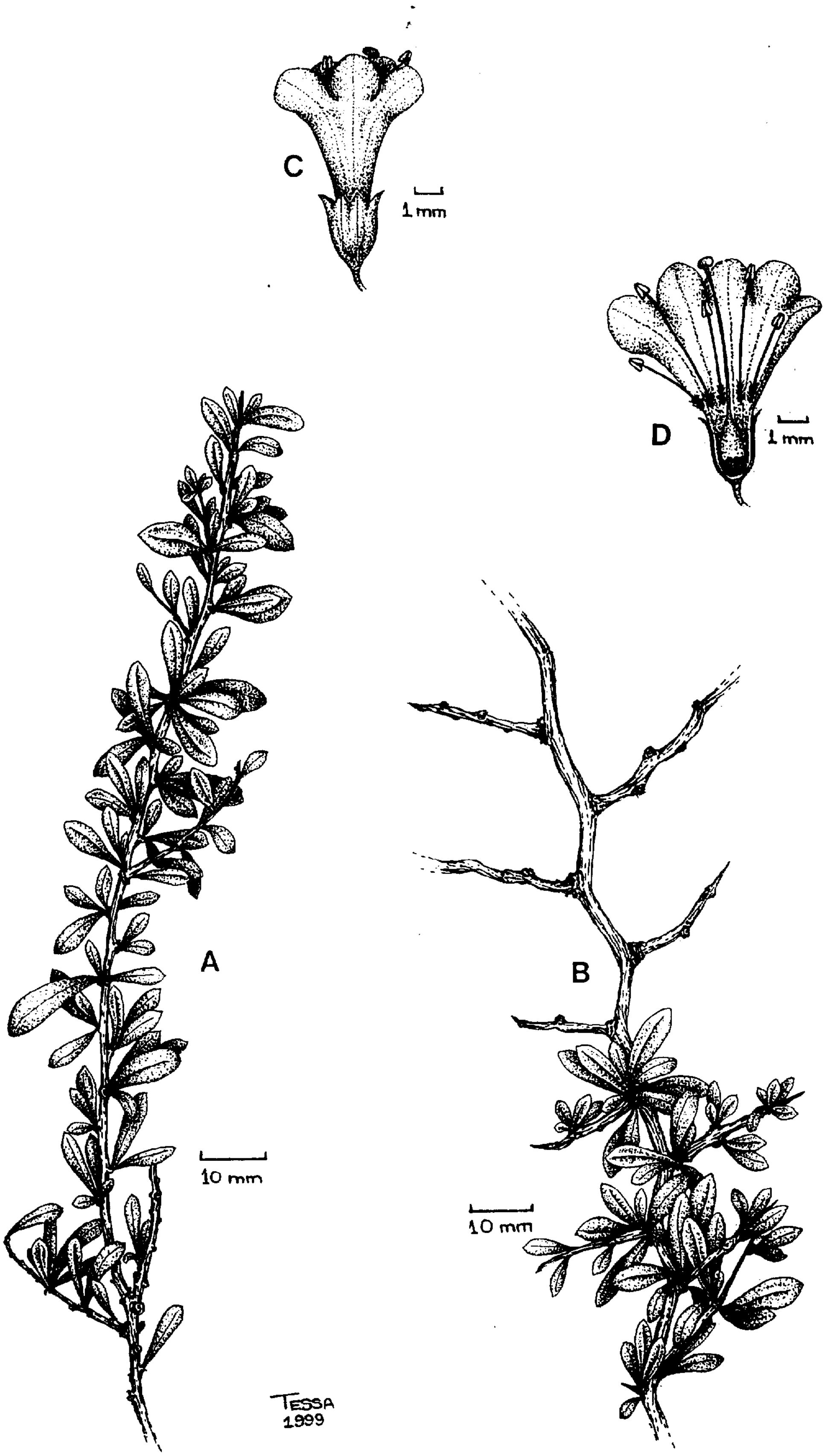


Figure 8.2.31 *Lycium mascarenense*.
A: Young stem, thornless, with leaves; B: Older stem showing the flexuous stem with pronounced brachyblasts; C: External view of flower;
D. Flower internally showing pistil and stamens.
[A: *A. M. Venter 456* (BLFU); B: Morin s.n.; C & D: *A. M. Venter 421* (BLFU)].

Pistil: *ovary* ovoid, 1–1.5 x 0.5–1 mm; *style* 7–9 mm long, protruding from corolla mouth; *nectary* golden-yellow, inconspicuous. **Berry** ovoid, 4–5 x 4 mm, orangey red. **Seed** reniform, 2.5 x 2 mm. (Figure 8.2.31). 2n = 2x =24 (48).

NOTES

L. mascarenense is widespread outside Africa, occurring on Madagascar and the Mascarene Islands as well (Venter & Scott 1999). It exhibits the same ecology on these islands as in Africa.

It is of interest to note that two other plant species, *Guettarda speciosa* (Rubiaceae) and *Scaevola sericea* Vahl (Goodeniaceae), exhibit distribution patterns similar to that of *L. mascarenense*, only much wider eastwards to the Andamans, Maldives, India, Sri Lanka, China, the Ryuku Islands of Japan, Indonesia/Malaysia, Phillipines, Pacific Islands and northern Australia (A. E. van Wyk (PRU) and D. Goyder (K), pers. com.). It would be very interesting to know whether *L. mascarenense* migrated from Madagascar and the Mascarenes to the African continent or vice versa. A comparative study of the DNA of the Asian *Lycium* species with that of the African species may provide the answer.

VERNACULAR NAMES

"Strandkriedoring", "beach box thorn"

DISTRIBUTION AND ECOLOGY

L. mascarenense is found along the moist subtropical coast of northern Kwazulu-Natal, South Africa, and southern Mozambique (Figure 8.2.32). It is confined to the littoral dunes and quaternary coarse-grained calcareous sandstone rock formations which are constantly exposed to salt spray from the sea. *L. mascarenense* is found in two distinct plant communities. The first community occurs on rock surfaces exposed to the strong, abrasive south-western winds and consists of dense prostrate vegetation in which *L. mascarenense* and *Sporobolus virginicus* are the dominants. The second community is dense and about 3 m high and found on rock faces and sand pockets sheltered from the southwestern winds; *L. mascarenense, Mimusops caffra* E. Mey ex A. DC. and *Guettarda speciosa* L. are the most conspicuous members.

L. mascarenense establishes itself in sandy pockets on the calcareous rock or on the dunes and grows into profusely branched shrubs covering large areas of the dunes or may even hang curtain-like over the sea-facing sandstone cliffs. Flowering seems to occur throughout the year, peaking during mid summer in November and December.

VOUCHER SPECIMENS

Mozambique:

–23S35E Inhambane, Massinga, southern coast at Pomene (–AD), *Tinley 2261* (SRGH).

–25S32E Maputo, Sabie near Posto (–DC), *Mendonca 3107* (LISC).

–26S32E Maputo, Santa Maria (–BB), *Mogg 26985* (J).

–26S32E: Cape of Inhaca (–BB), *Correia & Marques 1799*, (LISC, LMU).

–26S32E: Beach at Inhaca lighthouse (–BB), *Moss & Macquire 78* (J).

–26S32E Ponto de Ouro (–DD), *Gomes & Sousa 3903* (PRE, K, LISC, COI).

South Africa:

–27S32E: Kosi Bay, First Dune at Banga Nek (–BB), *Strey & Moll 3913* (PRE).

–27S32E Black Rock (–DD), *Venter A M 421* (BLFU, PRE, K).

–27S32E Black Rock (–DD), *Venter A. M. 456* (BLFU, PRE, K).

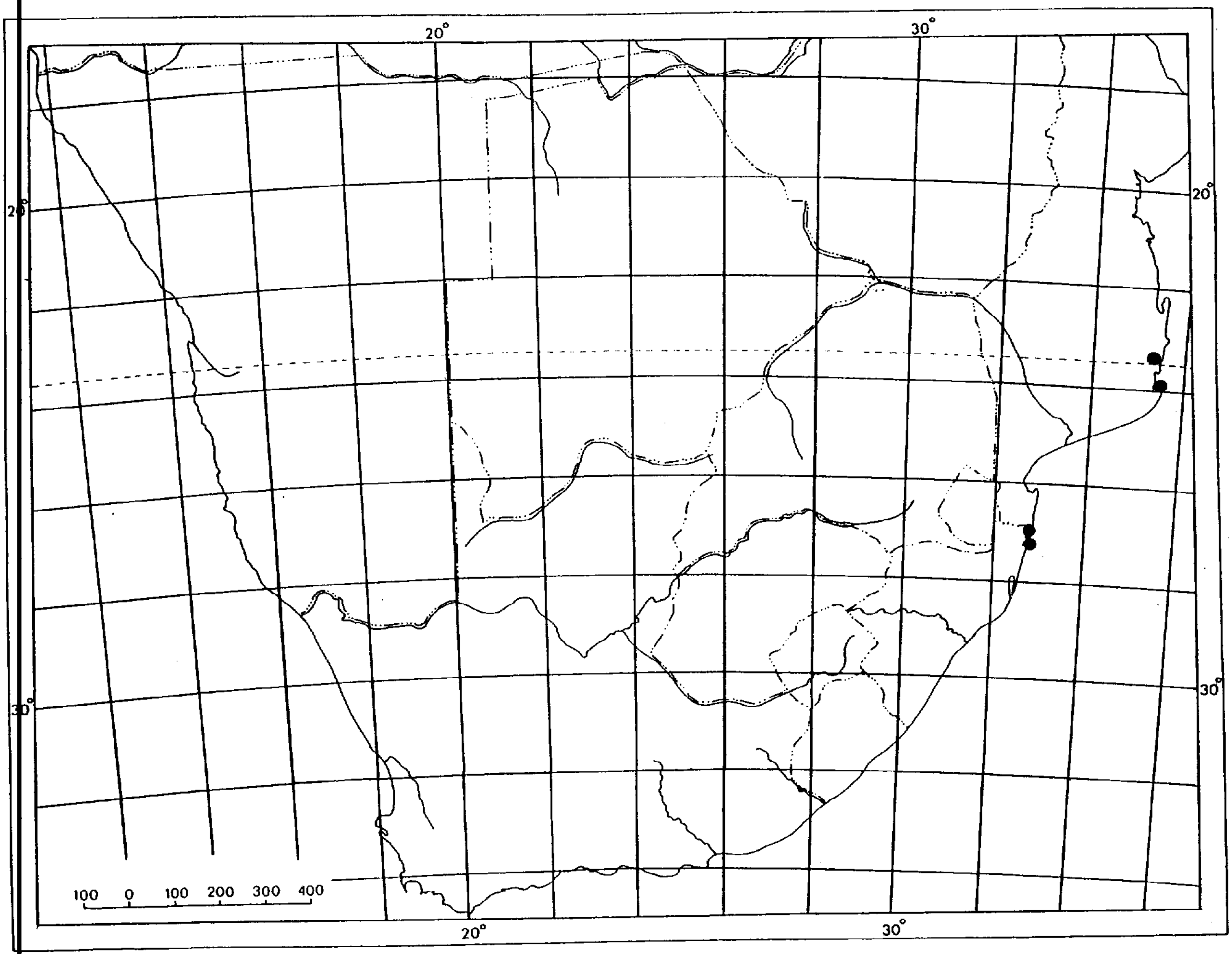


Figure 8.2.32 Known geographical distribution of *Lycium mascarenense* in Africa.

8.2.17 ***LYCIUM OXYCARPUM*** Dunal in DC., Prodromus 13 (2): 518 (1852); C. H. Wright: 113 (1904); Podl. & Roessl. 124: 5 (1969); Dean: 1 (1974).

Type: South Africa, Cape, Gamka River near Wolwekraal, *Drège 845* (G-DC!, holotype).

≡ ***L. oxycarpum*** var. ***grandiflorum*** Dunal: 518 (1852), (nom. illegit.); Dean: 4 (1974).

Type: Homotypical with *L. oxycarpum*

= ***L. oxycarpum*** var ***angustifolium*** Dunal: 518 (1852), **syn. nov.**; Dean: 9 (1974).

Type: South Africa, Cape, *Drège 845aa* (G-DC!, holotype; P!, isotype).

(*Drège 1262* with locality given as "Weltevreden, Prins Albert", is incorrectly indicated in K as isotype)

= ***L. austrinum*** Miers in The Annals and Magazine of Natural History, Ser. 2, 14: 13 (1854), **syn. nov.**; Miers: Pl. 2: t. 65, fig. C (1857); C.H.Wright: 112 (1904).

Type: South Africa, Cape, Gamka River, *Burke s.n.* (K!, holotype).

= ***L. tubulosum*** Nees. (nom. nud., in schede); Dean: 4 (1974).

South Africa, Cape, near Graaff Reinet, *Bolus H. 1327* (BM!,G-DC!, P!).

DESCRIPTION:

A bisexual, erect, much branched **shrub** of 0.9–3 m high, sometimes a small tree of up to 5 m, with spreading crown of curved branches. **Stems** thickened at nodes, younger stems unbranched, pale grey or creamy white, older stems dark brown, glabrous; thorns 5–10 mm long on younger stems, up to 40 mm long on older parts. **Leaves** solitary and alternate on young stems, in clusters of 6–13 on older stems and thorns, sub-sessile or *petiole* up to 5(8) mm long; *lamina* obovate to narrowly obovate to oblong-elliptic, 20–30(–50) x 3–8(–11) mm, herbaceous to semi-succulent, bright green to yellowish green, slightly paler below; macroscopically glabrous, apices acute to rounded. **Flowers** solitary, sometimes 2 per cluster, 5-merous; pedicel 6–11 mm long. **Calyx** tubular to trumpet-shaped, 3–5 x 2–2.5 mm; *lobes* triangular, 0.8–1 mm long, unequal, apices acute, erect. **Corolla** dirty white to cream to greenish-cream with violet lobes and purple venation; *tube* narrowly tubular to trumpet-shaped, occasionally slightly curved (15–)20–24 x 3–5 mm, glabrous outside, sparsely pilose inside from base to above insertion of stamens; *lobes* 2–3 mm long, semi-ovate, spreading. **Stamens** with 2 slightly exserted, 2 in corolla-mouth, 1 included, attached 8–12 mm above corolla base at about middle of tube; *filaments* 14–16(–18) mm long, base of filaments sparsely pilose. **Pistil:** *ovary* obconical, 1.5–2 x 1.5 mm, *style* 17–22 mm long, as long as or sometimes slightly longer than stamens and slightly exserted; *nectary* green and inconspicuous. **Berry** oblong-elliptic, seldom ovoid, red or orange-red, 5–6(10) x 3–5 mm. **Seed** reniform, 2 x 1,5 mm. (Figure 8.2.33). 2n = 2x = 24.

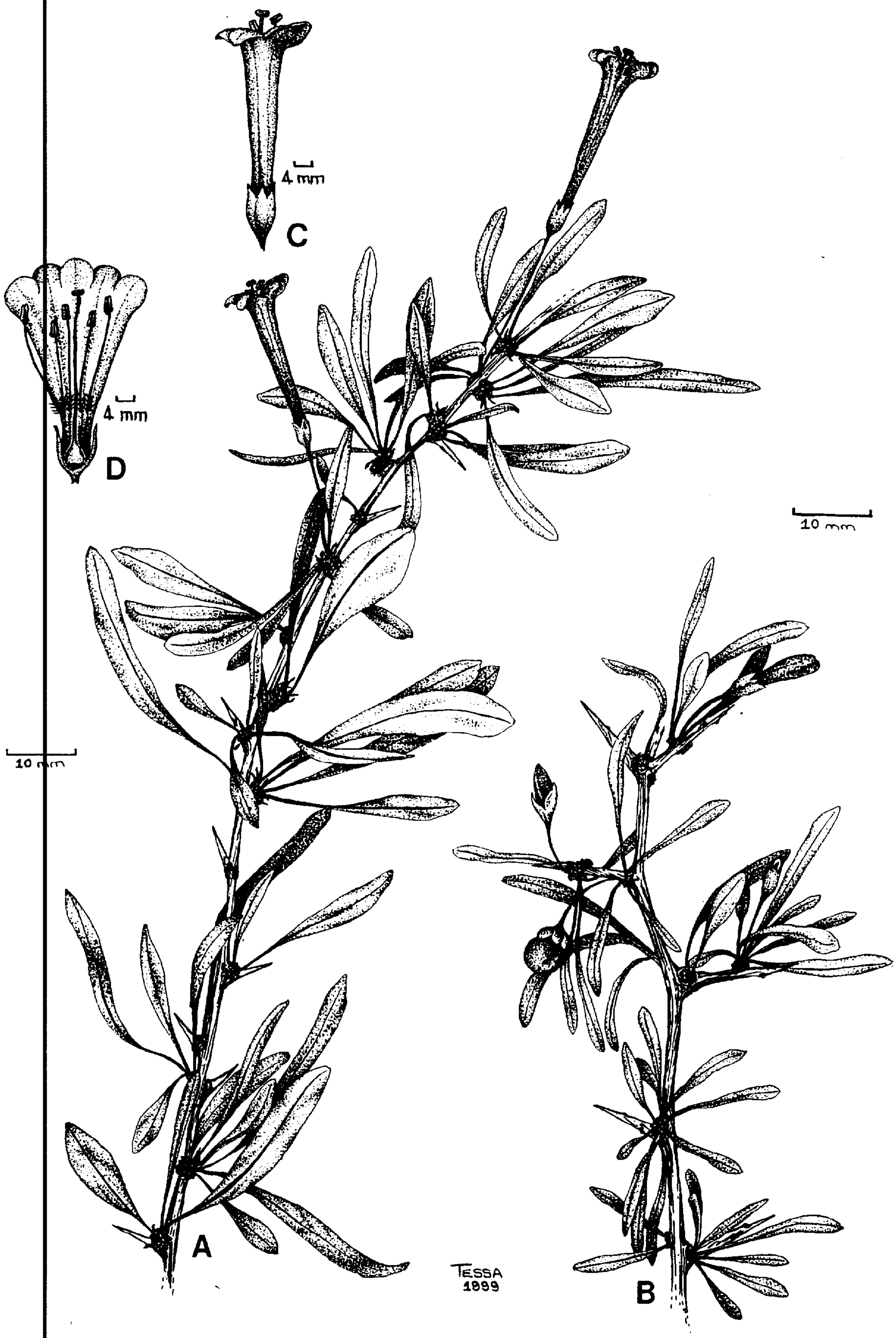


Figure 8.2.33 *Lycium oxycarpum*.
A: Stem with thorns, leaves and flowers; B: Stem with fruit; C: External view of flower; D: Flower internally showing pistil and stamens.
[A, C & D: *A. M. Reyneke 132* (BLFU); B: *W. J. Hanekom 461* (BLFU)].

NOTES

Only two *Lycium* species are regarded by Palmer & Pitman (1972) as sometimes developing into trees, *L. oxycarpum* being one of them. Single stemmed plants with trunks measuring at least 0.1 m in diameter have been observed.

VERNACULAR NAMES

"Wolwedoring", "kareedoring" (Smith 1966)

UTILIZATION

Geologists regard this species as an indicator of subterranean water (C. V. Joubert, Graaff Reinet, pers com).

The thorny older branches are used to erect stock enclosures against smaller predators, hence the vernacular name, "Wolwedoring" (wolf thorn).

DISTRIBUTION AND ECOLOGY

This species is common in the Eastern, Western and Northern Cape Provinces with the upper Orange River and Kalahari subdesert as northern boundaries. It is particularly abundant in the Klein - and Central Karoo (Figure 8.2.34).

L. oxyxarpum may be found in the open karoo fields, but is far more abundant in habitats where more moisture is available, such as along stream banks, ravines, dry stream beds, depressions, and deep sandy or alluvial, well drained soils. Rocky hill slopes with deep, well drained, sandy soil also serves as habitat.

Flowering occurs from May to October as well as in late summer, depending on good rains.

VOUCHER SPECIMENS:

South Africa:

–29S24E: 15 km north of Van der Kloof Dam (–DD), *Reyneke A. M. 9* (BLFU, K).

–32S20E: Farm Houthoek near Sutherland (–CA), *Hanekom W. J. 461* (K, PRE, BLFU).

–32S23E: Graaff Reinett on banks of Sondags River (–BC), *Bolus L.45* (BLFU).

–32S25E: Fish River, Cradock district (–BA), *Cooper T. 1060* (K).

–33S19E: Hex River Valley (–CA), *Van Wyk P. BSA 2145* (STE, NBG).

–33S20E: Cogmans Kloof, Montagu (–CC), *Rourke J. P. 757* (NBG).

–33S22E: Northern entrance to Swartberg Pass (–AD), *Venter A. M. 455* (BLFU).

–33S22E: Boomplaas in Cango Valley, near Oudtshoorn (–AC), *Moffett R. O. 189* (STE, NBG).

–33S25E: Krompoort (–AC), *Henderson L. 577* (PRE).

–33S26E: Schoemanskloof near Oudthoorn (–BC), *Reyneke A. M. 132* (BLFU, K)

–34S23E: Goukamma Rivier, Knysna district (–AA), *Pappe s.n.* (K).

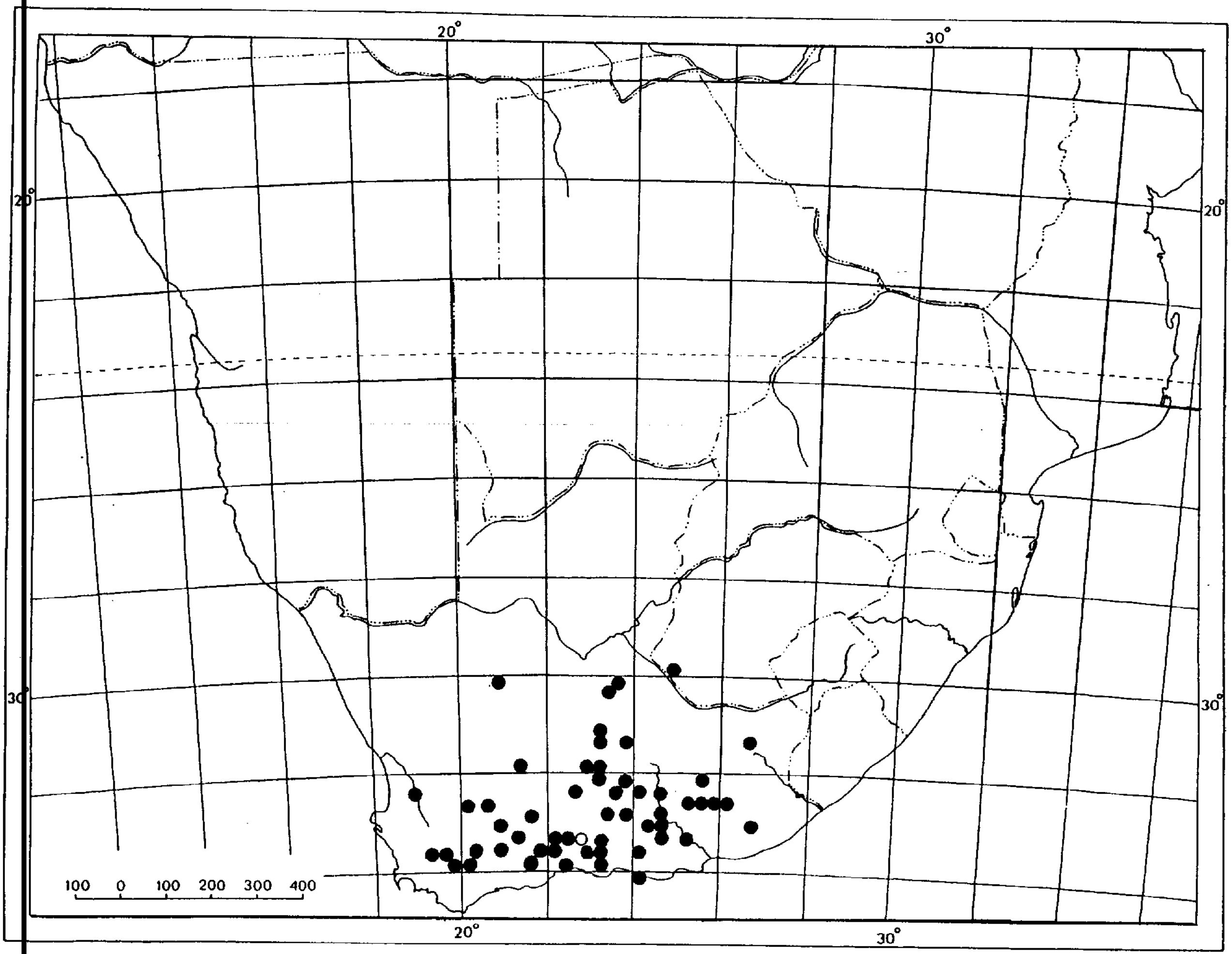


Figure 8.2.34 Known geographical distribution of *Lycium oxycarpum*.

[o : Type locality]

8.2.18 *LYCIUM PILIFOLIUM* C.H.Wright in Dyer, Flora Capensis 4, 2: 113 (1904); Dean: 1, 3 (1974).

Type: South Africa, Sutherland division between Kuilenberg and Great Reed River, *Burchell 1360* (K!, holotype; PRE!, isotype).

= ***L. glandulosissimum*** Schinz: 183 (1890), *nomen mixtum,* **syn nov.**.

Types: Namibia, *Schenck 94* (Z!, holotype, *pro parte*).

Namibia, *Schinz 474* (Z!, syntype).

(Schinz designated *Schinz 474* and *Schenck 94* as syntypes for his *L. glandulosissimum*. *Schinz 474,* however, is a specimen of *L. hirsutum*).

= ***L. dinteri*** Dammer: 235 (1913); Dean: 3 (1974), **syn. nov.**

Type: Namibia, Aus, *Dinter 1137* (BΨ, holotipe; SAM!, lectotype, here declared).

DESCRIPTION

A bisexual, rigid dwarf-shrub of 0.3–0.5(–1.0) m high forming clusters through subterranean tillering. **Stems** rigid, erect, nodes closely together; young stems yellowish-white, pilose with multicellular short and long glandular trichomes, older stems greyish-brown to purplish-brown, glabrous; thorns on young stems, numerous, subulate, 10–15 mm long, nearly perpendicular to stem, on older stems peg-like, sometimes branched, leafless or with a few clustered leaves, up to 50 mm long. **Leaves** fascicled in clusters of 5–8 on stems and thorns; sub-sessile or with short *petiole* of up to 2 mm long; *lamina* obovate or narrowly-obovate, 3–10(–

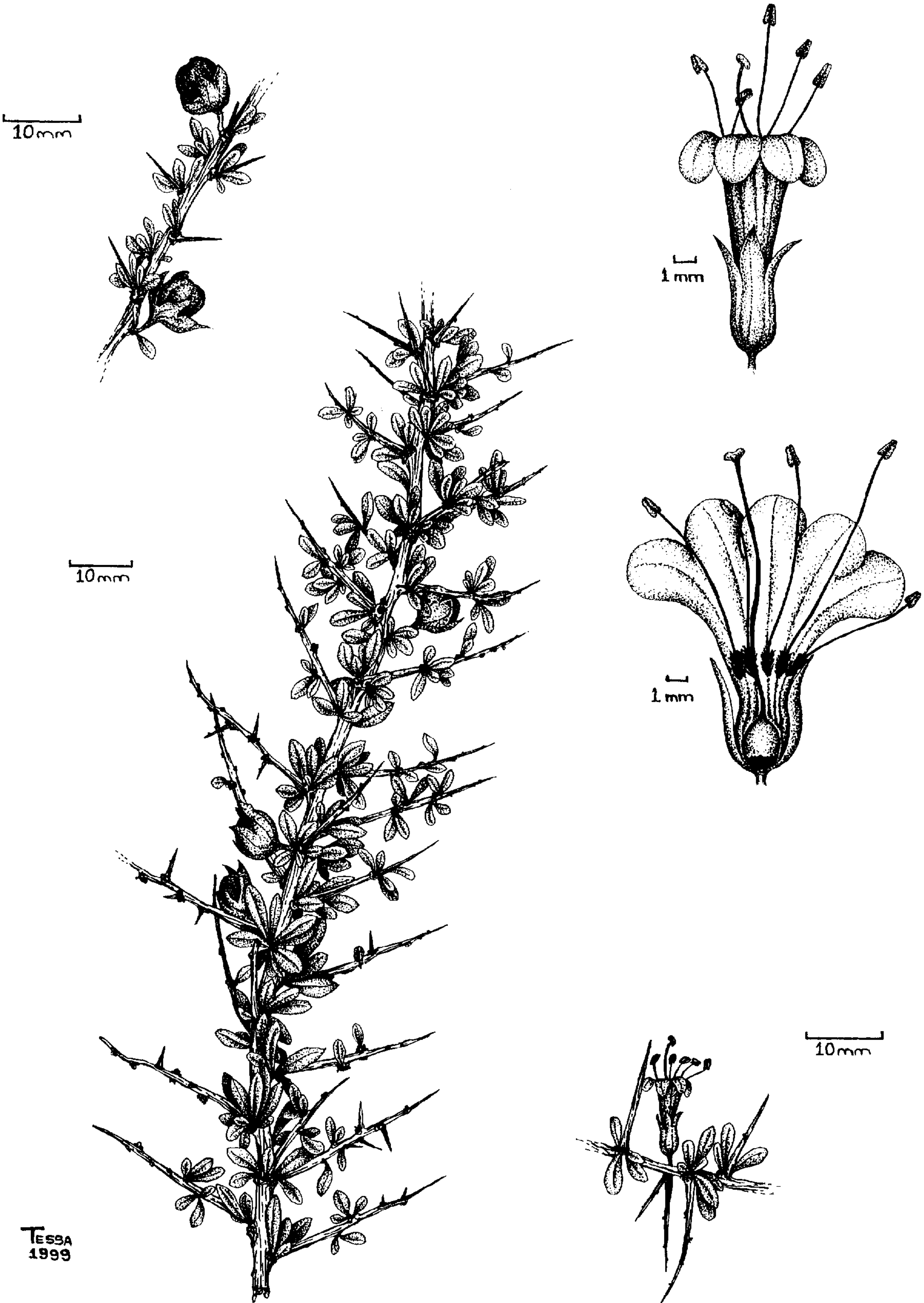


Figure 8.2.35 *Lycium pilifolium.*
A: Stem with thorns, leaves and flowers; B: Stem with flower; C. Stem with fruit; D. External view of flower; E: Flower internally showing pistil and stamens.
[A: *A. M.Reyneke 173* (BLFU); B: *A. M. Reyneke 321* (BLFU); C, D & E: *H. Merxmüller & W. Giess 2915* (WIND)].

18) x 1–4 mm, semi-succulent, dull green, vesture as on young stems, apices acute. **Flowers** 5-merous; pedicel 3–5 mm long, pilose. **Calyx** campanulate, 6–7(–8) x 3–4 mm, minutely hirsute with long and short glandular hairs on the outside; *lobes* oblong-triangular, 3–3.5 mm long, equal or slightly unequal, sub-erect to spreading, apices acute. **Corolla** creamy-white with venation and lobes lilac, narrowly trumpet-shaped; *tube* 7–10(–11) x 3.5–4 mm, glabrous outside, sparsely pilose inside on lower half; *lobes* 3–4 x 3–3.5 mm, ovate-oblong to semi-orbicular, reflexed, apices round. **Stamens** arise 5–6 mm above corolla base, at or just below middle of tube, conspicuously exserted from corolla mouth; *filaments* 8–12 mm long, densely pilose just above base. **Pistil:** *ovary* globose, 1–1.5 x 1–1.5 mm; *style* 11–15 mm long, slightly exceeding longest stamen; *nectary* brownish-yellow, prominent. **Berry** globose, yellow, 6–10 mm in diameter. **Seeds** subdiscoid to ovate, 2.5 x 3 mm. (Figure 8.2.35). 2n = 2x = 24.

VERNACULAR NAME

"Taaikriedoring"

DISTRIBUTION AND ECOLOGY:

This species occurs in the southern parts of Namibia, the Central Karoo and south-western Kalahari of the Northern Cape Province, the western Free State and the Northwest Province (Figure 8.2.36)and is well adapted to sandy calcareous soils and wheathered granite or dolorite gravel in scrub savannah and karroid veld. They are also often found in depressions, dry riverbeds and even sometimes in marshy habitat overlying limestone.

VOUCHER SPECIMENS:

Namibia:

–25S16E: Helmeringhauzen (–DD), *Merxmüller & Giess 2915* (WIND).

–26S15E: 8 km south of Aus (–CA), *Giess W. & Van Vuuren 810* (WIND, K, BOL).

–26S16E: Internment camp south of Aus (–DB), *Reyneke A. M. 173* (BLFU).

–28S16E: Obib Mountain Peak (–BA), *Van Wyk A. E. 9024* (PRE).

South Africa:

–27S23E: 63 km from Kuruman en route to Hotazel (–AA), *Arnold & Musil 528* (PRE).

–28S22E: Floradal, Hay Division (–DB), *Esterhuysen E. 2300* (BOL).

–28S24E: DuToitspan Mine at Kimberley (–DB), *Wilman M. 3617* (K).

–29S17E: 22 km south of Steinkopf, Springbok district (–BC), *Reyneke A. M. 163* (BLFU).

–29S25E: 3 km west of Jagersfontein en route to Koffiefontein (–AC), *Venter A. M. 446* (BLFU).

–29S25E: 36 km west of Petrusburg near Paardeberg (–CC), *Reyneke A. M. 321* (BLFU).

–31S19E: 8 km south-south-east of Calvinia (–BD), *Acocks J. P. H. 18939* (K, PRE).

–33S26E: 35 km from Grahamstown on Bedford road (–AB), *Dyer R. A. 2120* (PRE, GRA).

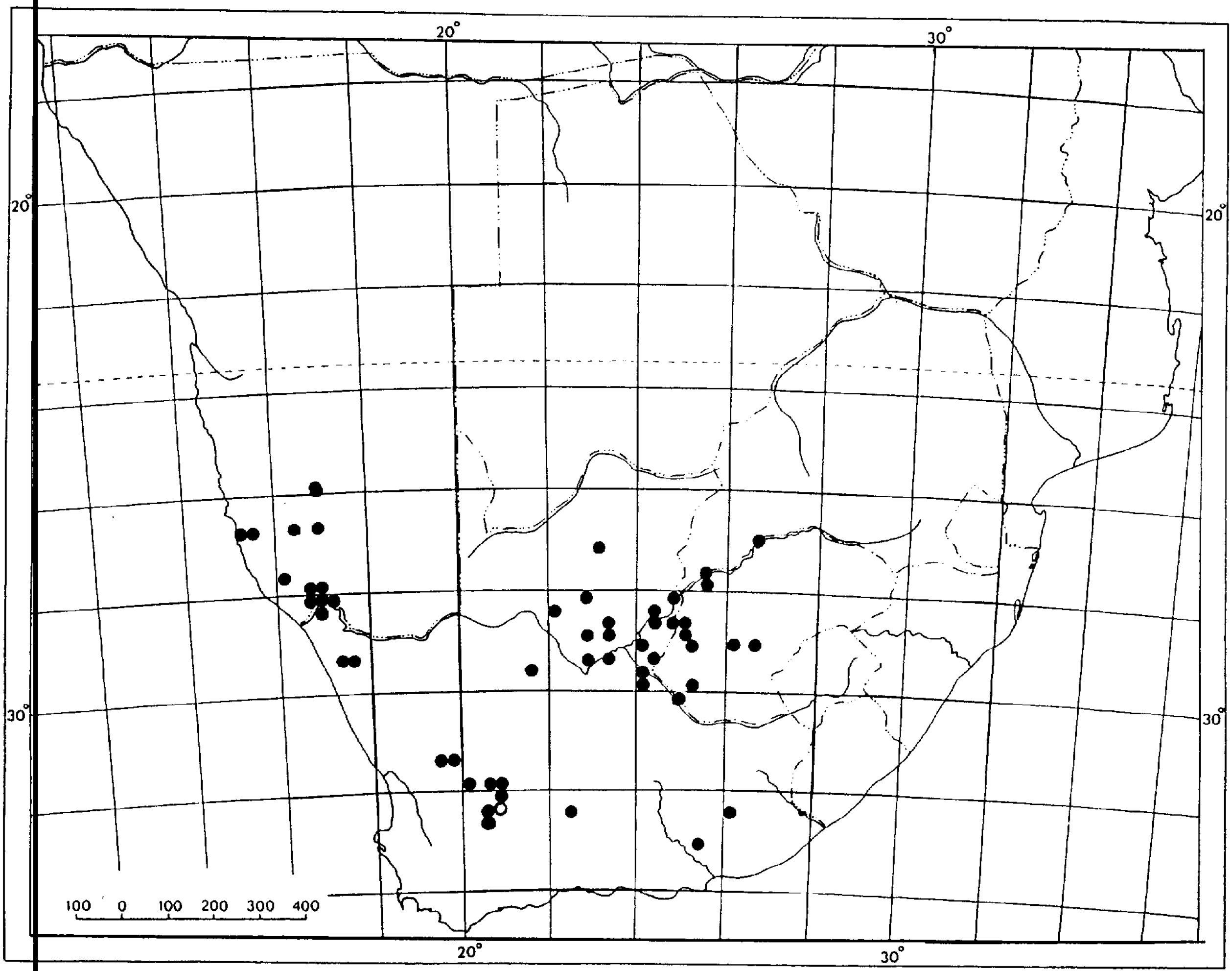


Figure 8.2.36 Known geographical distribution of *Lycium pilifolium*.

[o : Type locality]

8.2.19 ***LYCIUM PUMILUM*** Dammer in Engler, Botanischer Jahrbücher 48: 234 (1913); Dean: 10 (1974).

Type: Namibia, Tschaukaib, *Marloth 4660* (BΨ; holotype; PRE!, lectotype, here declared).

= ***L. colletioides*** Dammer: 234 (1913), **syn nov.**; Dean: 10 (1974).

Type: Namibia, Garub, *Dinter 1055* (BΨ; holotype; SAM!, lectotype, here declared).

(This type specimen is atypical, perhaps a hybrid of *L. pumilum* and *L. horridum*)

= ***L. karasbergense*** Bolus: 97, t 13A (1914), **syn. nov.**; Dean: 12 (1974).

Types: Great Karasberg between Kraikluft and Naruda Süd, *Pearson 8104* (BOL!, lectotype, here declared; K!, isotype);

Namibia, Great Karasberg, Naruda Süd, *Pearson 8133* (K!, syntype);

NE of Naruda Süd, Pearson 8143 (K!, syntype).

= ***L. engleri*** Dammer: 353 (1915), **syn nov.**; Dean: 12 (1974).

Type: Namibia, Namabezerk at Salzbrun to Mariental and Haribis, *Engler 6567* (BΨ, holotype; K!, lectotype here declared).

= ***L. roseum*** Bolus: 271 (1915), **syn. nov.**; Dean: 13 (1974).

Types: South Africa, Kloof at Loeriesfontein, *Bolus 4835* (BOL, holotype); Bolus in Ann. S. Afr. Mus. 9: 272, fig 8c (1915) (Icono-lectotype here declared).

= ***L. salinicolum*** Verdoorn: tab. 487 (1933), **syn. nov.**; Dean: 12 (1974).

Type: South Africa, Free State, Vlakfontein in Fauresmith District, *Verdoorn 895* (PRE!, holotype).

DESCRIPTION:

A bisexual, rigidly erect, thorny **shrub** of 0.6–1,2 m high. **Stems** zigzag, younger stems greyish white, older stems dark purplish-brown and glossy, glabrous; thorns stout, 20–100 mm long, short and long thorns mixed on younger and older stems. **Leaves** in fascicles of 3–8 on stems and thorns, sub-sessile; *lamina* narrowly elliptic or obovate, 10–15 x 1–2 mm, succulent, glaucous, macroscopically glabrous, apex slightly acute to obtuse. **Flowers** 5-merous, 1 or 2 per fascicle, erect, pedicel 5–6 mm long. **Calyx** tubular to campanulate, 2.5–4 x 2–3(–3.5) mm; *lobes* triangular, slightly sub-equal, 0.5–0.8 mm long, erect, apices acute. **Corolla** white with purple veins and pale lilac lobes; *tube* broadly trumpet-shaped, (3–)4–5 x 2–3 mm, glabrous outside, pilose inside at stamen insertion; *lobes* ovate, 3–4 x 3 mm, reflexed. **Stamens** conspicuously exserted; *filaments* inserted 3–4 mm above corolla base, just below corolla mouth, 5–8 mm long, densely pilose 1 mm above base. **Pistil:** *ovary* ovoid, 1.5–2 x 1.5–2 mm; *style* 5–7 mm long, exserted from corolla mouth; *nectary* red, nectar copious, reddish brown, sweet smelling.

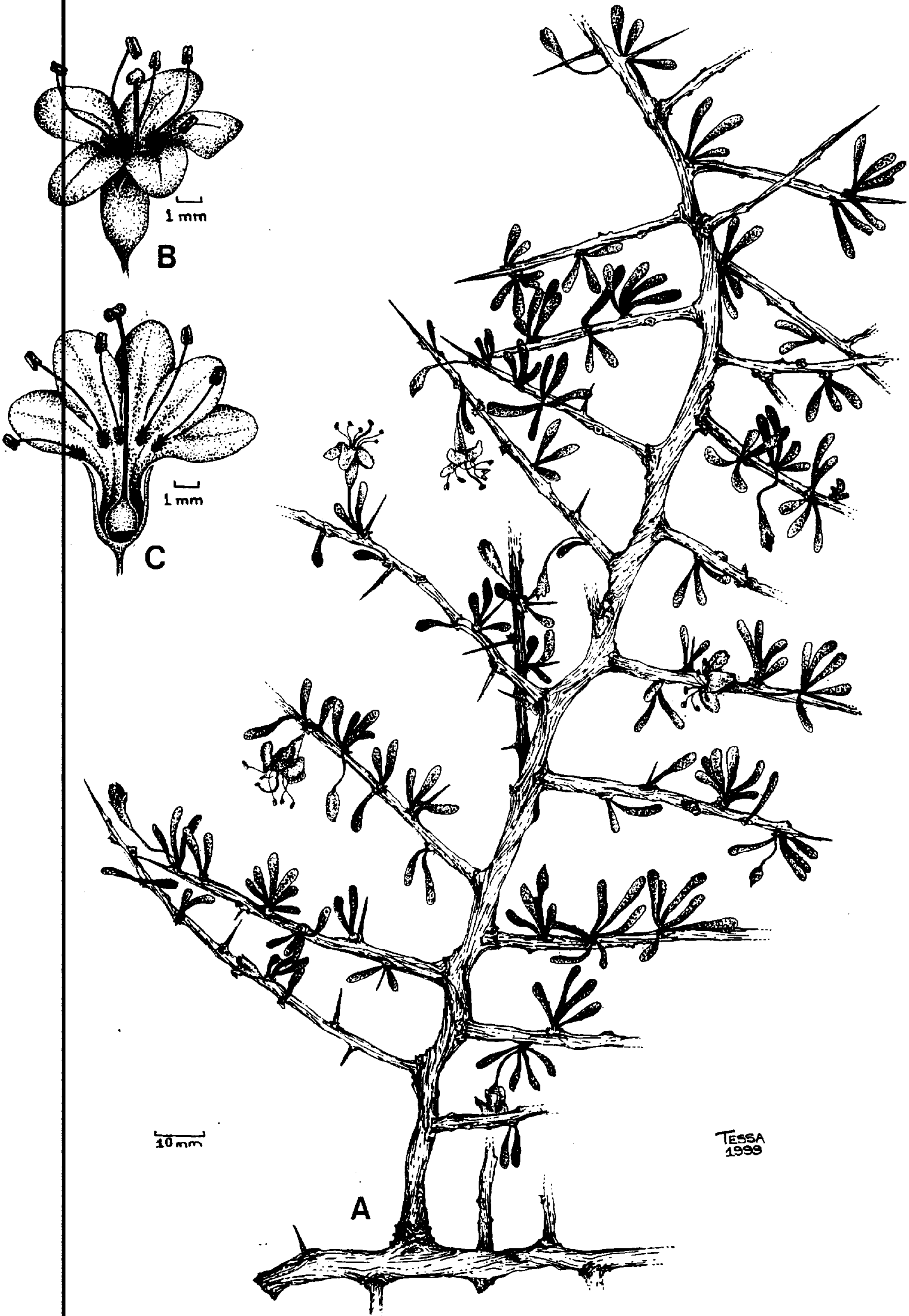


Figure 8.2.37 *Lycium pumilum.*
A: Stem with thorns, leaves and flowers; B: External view of flower;
C: Flower internally showing pistil and stamens.
[A, B & C: *J. P. H. Acocks 20485* (PRE)].

Berry spherical, orange-red to red, 4 mm in diameter. **Seed** subdiscoid to ovate, 1 mm in diameter, numerous. (Figure 8.2.37). 2n = 2x = 24.

VERNACULAR NAME

"Soetkriedoring", "sweet box thorn"

DISTRIBUTION AND ECOLOGY:

This species occurs in the arid regions of the Western, Eastern and Northern Cape Provinces, south-western Free State and south and central Namibia (Figure 8.2.38). Its habitat ranges from sandy streambeds and sandy flats to gravelly or rocky hills and mountain sides, often associated with limestone or black soil.

Flowering occurs in spring during September and October, and again in late summer from January to April depending on rainfall.

VOUCHER SPECIMENS:

Namibia:

–22S14E: Mouth of Swakop River (–DA), *Seydel R. 904* (K, L).

–25S16E: Farm Lisbon (–BB), *Müller M. 1276* (WIND).

–27S18E: At Witkobus (–BB), *Pearson 8958* (K, BOL).

–28S19E: 45 km north of Ariamsvlei Border Post (–BB), *Venter A. M. 556* (BLFU).

South Africa:

–28S20E: 130 km west of Upington en route to Namibia (–AC), *Reyneke A. M. 210* (BLFU).

–29S25E: 5km from Witput en route to Wanda (–AC), *Reyneke A. M. 129* (BLFU).

–30S23E: 31 km from Britstown on Prieska road (–AD), *Herman 1192* (PRE).

–31S19E: 17 km east of Calvinia to Williston (–BC), *Venter A. M. 383* (BLFU).

–31S25E: Rooispruit near Steynsburg (–AD), *Theron G. 732* (K, PRE).

–33S21E: Barrydale–Ladismith road, just west of Groot River bridge (–CA), *Venter A. M. 449* (BLFU).

–33S22E: 26 km SSW of Oudtshoorn (–CA), *Acocks J. P. H. 20485* (PRE).

–34S20E: Bredasdorp Municipal grounds (–CA), *Venter H. J. T. 7451* (BLFU).

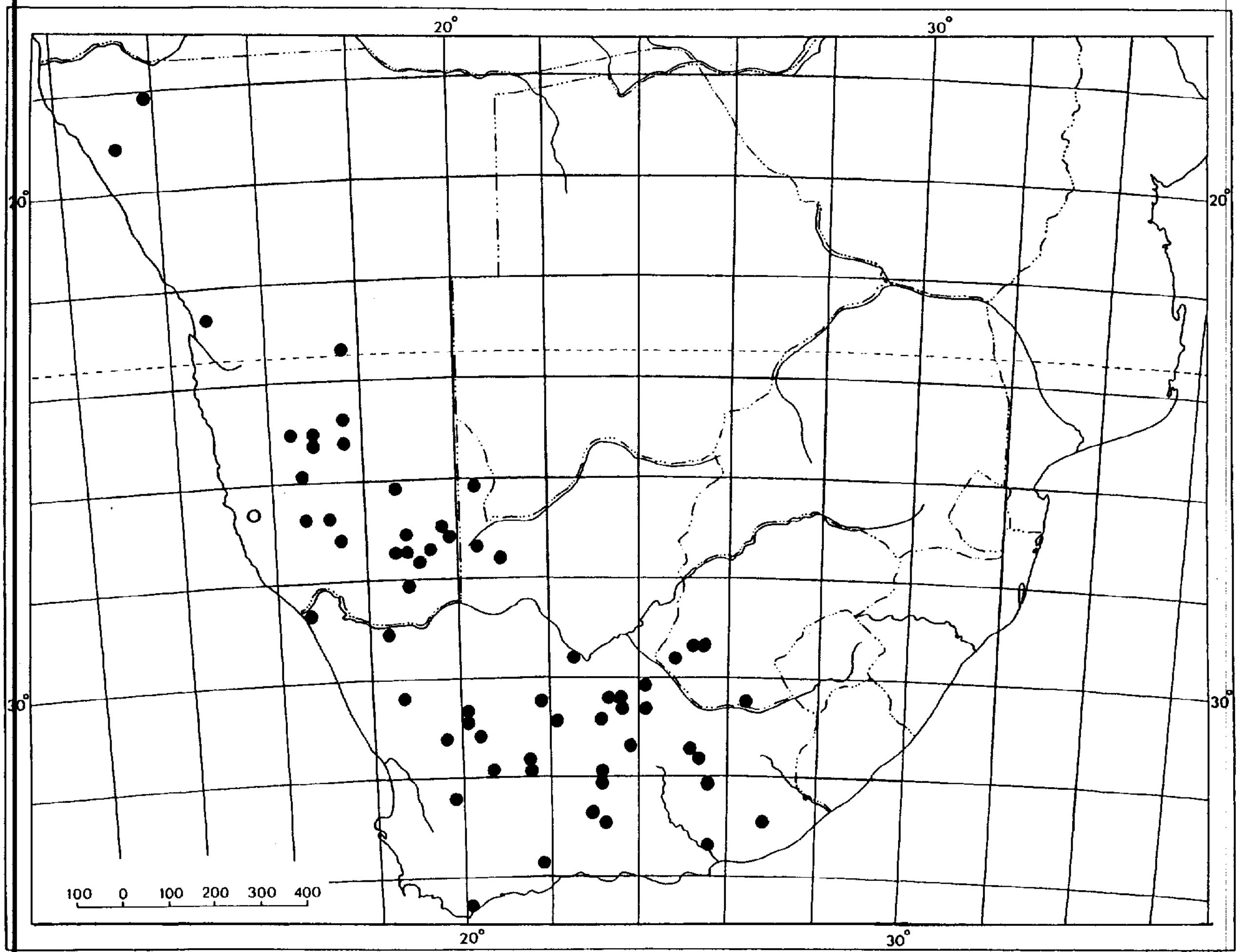


Figure 8.2.38 Known geographical distribution of *Lycium pumilum*.

[o : Type locality]

8.2.20 ***LYCIUM SCHIZOCALYX*** C.H.Wright in Dyer, Flora Capensis 4(2): 114 (1904); Dean: 9 (1974).

Types: South Africa, Cape Province, Graaff-Reinet, *Bolus H. 741,* (K!, lectotype, here declared; BOL!, PRE!, NBG!, isotypes);

South Africa, Cape Province, Witmos Station, *Galpin E.E. 3080,* (K!, PRE!, syntypes);

South Africa, Cape Province, Graaff-Reinet, *Bolus H. 2074*, (K!, PRE!, BOL!, syntypes).

DESCRIPTION:

A bisexual, rigid, erect, profusely branched **shrub** of 0.7–1.7 m high. **Stems** long, stout, young stems pale grey and striated, older stems dark brown to purplish-brown, glossy, glabrous; thorns 10–25 mm long on younger stems, 20–60 mm on older stems, short and long thorns mixed. **Leaves** clustered on stems and thorns, 3–6 leaves per fascicle, sub-sessile; *lamina* oblong obovate or very narrowly obovate, 9–15(20) x 1–2(3) mm, semi-succulent; bright green, macroscopically glabrous, apices obtuse to somewhat acute. **Flowers** 5-merous, pedicel 3–8 mm long. **Calyx** broadly trumpet-shaped, 5–7 x 2,5–3 mm; *lobes* oblong to oblong-triangular, 3–4 mm long, equal, spreading, glabrous, apices acute. **Corolla** creamy white with venation and lobes purple; *tube* trumpet-shaped, 6–8 x 2.5–3.5 mm, glabrous outside, pilose inside at stamen insertion; *lobes* broadly ovate, 3–3.5 mm long, reflexed. **Stamens** inserted 2–3 mm above corolla base, at or just below middel of tube, conspicuously exserted from corolla-mouth; *filaments* 5–7 mm long, base pilose. **Pistil:** *ovary* ovoid, 1–1.5 x 1 mm, *style* 10–12 mm long, exserted as far as stamens; *nectary* brownish-yellow, inconspicuous. **Berry** red,

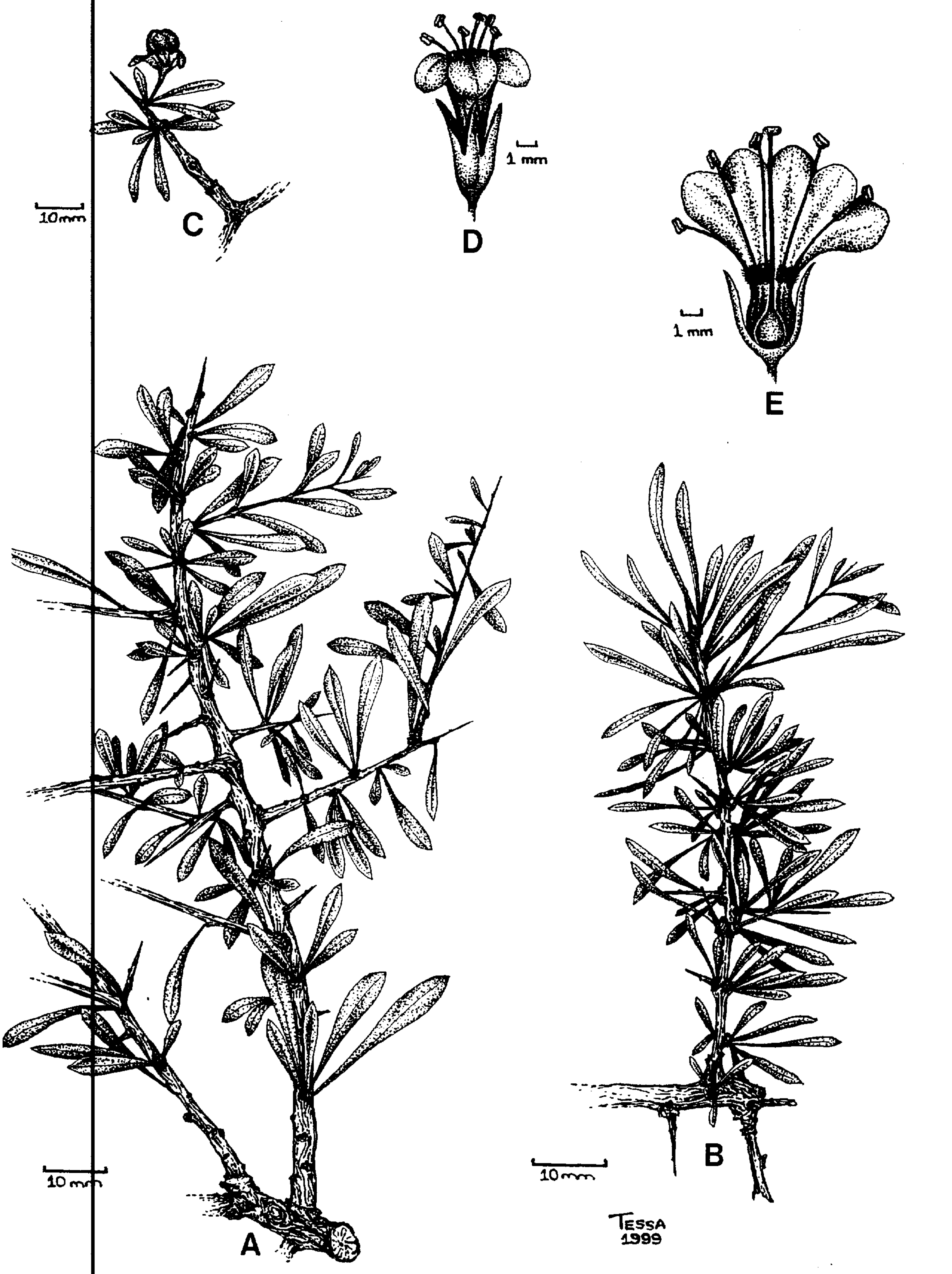


Figure 8.2.39 *Lycium schizocalyx*.
A: Old stem with thorns and leaves; B: Young stem with thorns and leaves;
C: Stem with fruit; D: External view of flower; E: Flower internally showing pistil and stamens.
[A & B: *D. F. Landler 607*(STE); C, D & E: *A. M. Reyneke 336* (BLFU)].

globose, 6–7 mm in diameter. **Seed** subdiscoid to ovate, 2–2.5 x 2 mm. (Figure 8.2.39). 2n = 2x = 24.

VERNACULAR NAME

"Kareedoring"

DISTRIBUTION AND ECOLOGY:

L. schizocalyx is widespread in the arid regions of southern Africa, occurring in the Western, Eastern and Northern Cape Provinces, Free State Province, Northwest Province, Northern Province, southern Zimbabwe, southern and central Botswana, and southern and central Namibia (Figure 8.2.40). The habitat is usually very dry and varies from sandy to gravelly calcareous or brackish soils of depressions, pans and drainage lines. The vegetation in which *L. schizocalyx* is found, ranges from very thorny savanna and grassland to karroid scrub.

Flowering occurs during spring and summer from September to April, peaking in September and again in March, probably depending on precipitation patterns.

VOUCHER SPECIMENS:

Botswana:

–20S22E: West of Lake Ngami, on road from Moego to Kara (–CB), *Smith P. A. 741* (K, PRE, SRGH).

–21S24E: Northern District (–CB), *Smith P. A. 2533* (K, PRE, SRGH).

–24S25E: Mone Valley near Letlakeng (–AA), *Wild H. 4961* (K, SRGH).

Namibia:

–24S16E: Naukluft National Park, west of rest camp (–AA), *Reyneke A. M. 195* (BLFU).

–26S15E: Kausib fountain, 49 km west of Aus to Lüderitz (–DB), *De Winter B. & Hardy 7885* (M, PRE).

–28S18E: Warmbad (–BD), *Dinter 5198* (K, PRE).

South Africa:

–22S29E: 20 km west of Swartwater (–CA), *Venter A. M. 545* (BLFU).

–28S25E: Hammanskraal near Pretoria (–CA), *Hutchinson J. & Mogg E. 2874* (K, BOL).

–29S24E: Jacobsdal, 5 km south of Michville Post Office (–BB), *Acocks J. P. H. 13505* (K).

–31S23E: Victoria West (–AC), *Bayliss R. D. 1189* (K PRE).

–32S21E: 55 km W of Loxton (–DB), *A. M. Reyneke 336* (BLFU).

–33S20E: Laingsburg district, Wauchope Monument (–BB), *Acocks J. H. P. 19087* (PRE, K)

–33S21E: Gamkakloof Reserve (–BC), *Landler D. F. 607* (STE).

–33S26E: Grahamstown, 8 miles north of town on Piggots Bridge road (–BC), *Dyer R. A. 912* (GRA, K)

Zimbabwe:

–20S29E: Gwanda District (–CC), *Davis R. M.* (K, SRGH).

–22S29E: Shasi and Limpopo River confluence, Beit Bridge District (–BB), *Drummond 5947* (K, SRGH).

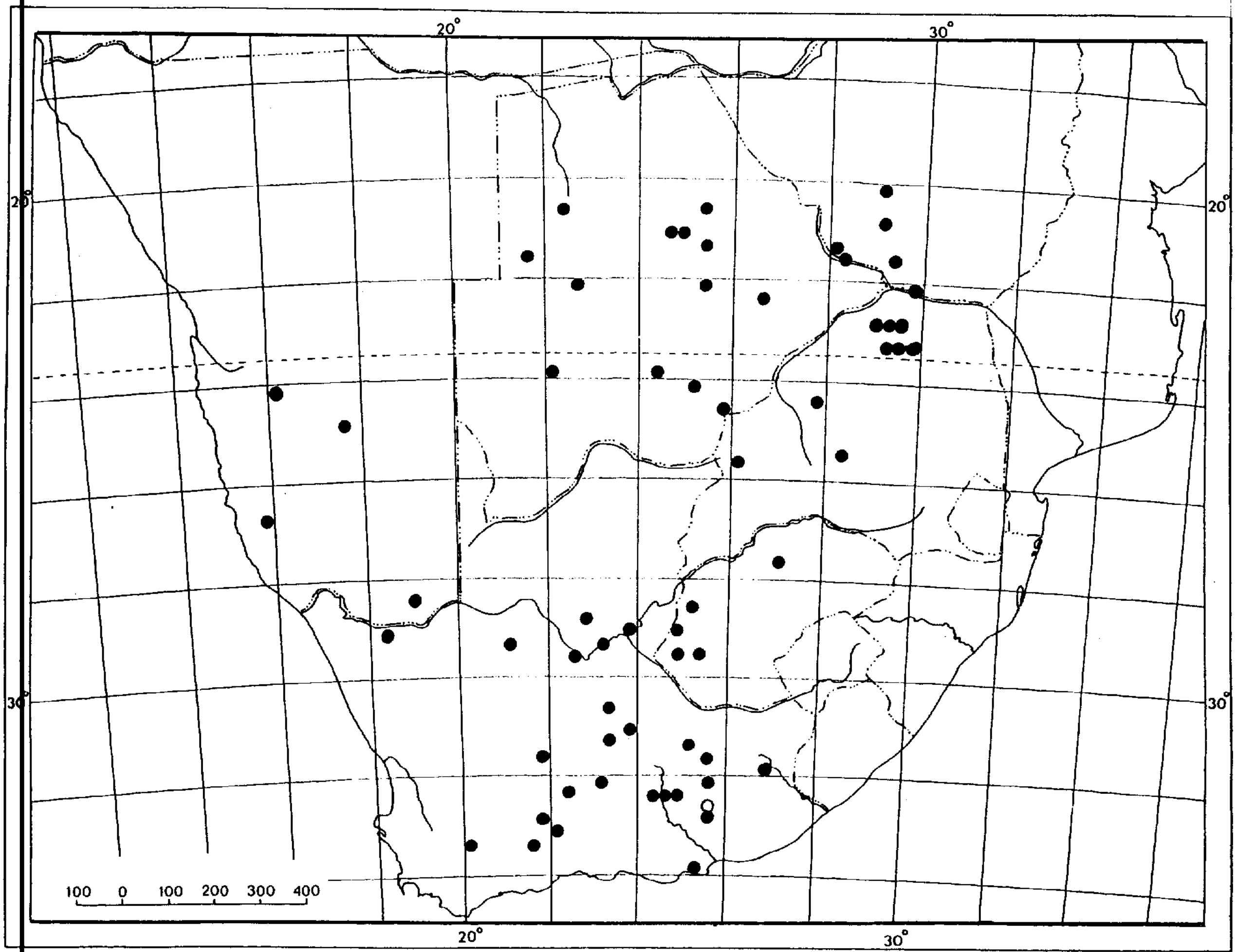


Figure 8.2.40 Known geographical distribution of *Lycium schizocalyx*.

[o : Type locality]

8.2.21 ***LYCIUM SCHWEINFURTHII*** Dammer in Engler, Botanischer Jahrbücher 48: 224 (1913); Feinbrun: 367–370 (1968).

Type: Egypt, Alexandria, *Schweinfurth 67* (BΨ, holotype; K!, lectotype, here declared).

= ***L. europaeum*** var. ***ramulosum*** (Dunal) Fiori: 398 (1902), (synonomy by Feinbrun (1968) (***L. mediterraneum*** var. ***ramulosum*** Dunal: 521 (1852)).

Types: Egypt, Alexandria, *Martins 1831* (G-DC!, lectotype, here declared);

Egypt, *Coquebert s.n* (G-DC!, syntype);

Egypt, *Redoute s.n.* (G-DC!, syntype);

Egypt, *Delile s.n.* (G!, syntype).

= ***L. schweinfurthii*** var. ***aschersonii*** (Dammer) Feinbrun: 368 (1968) (***L. aschersonii*** Dammer: 226 (1913)), **syn. nov.**

Type: Egypt, Alexandria, Acker and Steinbruche, *Ascherson 206* (BΨ, holotype) (synonymy verified from Dammer's description).

DESCRIPTION

A bisexual, rigid, erect **shrub** of 2–3 m high. **Stems** stout, densely branched, often curving, internodes stunted, young stems whitish to pale brown, older stems dark brown, glabrous; brachyblasts prominent; thorns stout, close together, 5–10(15) mm long and leafless on younger stems, 15–35 mm long and with leaves on older stems. **Leaves** densely clustered with 3–10 leaves per fascicle; subsessile or petiole up to 2 mm long; *lamina* obovate to narrowly obovate,

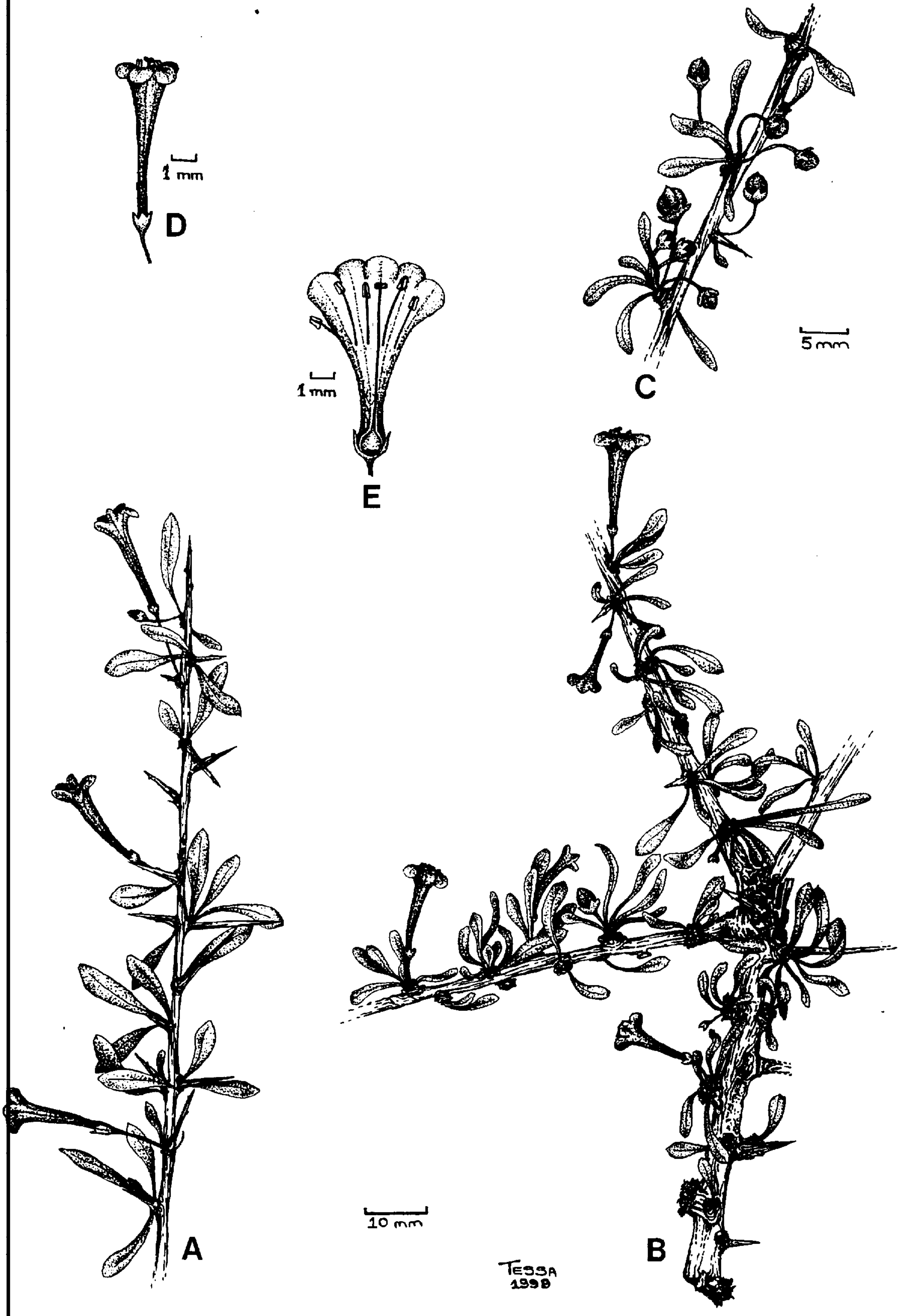


Figure 8.2.41 *Lycium schweinfurthii.*
A: Young stem with short thorns, leaves and flowers; B: Old stem with prominent brachyblasts, thorns, leaves and flowers; C: Stem with fruit; D: External view of flower; E: Flower internally showing pistil and stamens.
[A, B, D & E: *B. Balansa s.n., anno 1853* (BM); C: *G. Schweinfurth s.n., anno 1878* (P)].

sometimes elliptic on sap shoots, 12–20(–25) x 2–4(–8) mm, succulent, dull green, glabrous, apex acute to rounded. **Flowers** 5-merous; pedicel 2–4(–5) mm long. **Calyx** campanulate, 1–1.5 x 1–1.5 mm; *lobes* triangular, very small, 0.4–0.5 mm long, equal, glabrous, apices acute, erect. **Corolla** creamy-white with lilac lobes; *tube* narrowly funnel-shaped, often slightly curved, 11—15(–18) x 2(–3) mm, narrowing to 1mm diam. halfway towards base, glabrous outside and inside, rarely slightly pilose at stamen insertion; *lobes* broadly sub-orbicular 2–2.5 x 2.5–3 mm, spreading. **Stamens** inserted 7–10 mm above corolla base, just above middle of tube, included in corolla-mouth; *filaments* 6–10 mm long, glabrous. **Pistil:** *ovary* ovoid, 1 x 1 mm; *style* 10–18 mm long, just shorter than longest stamen; *nectary* whitish green and inconspicuous. **Berry** spherical to sometimes ovoid, 4–5 mm diam., black. **Seed** ovate, 2 x 1.5 mm. (Figure 8.2.41). 2n = 2x = 24.

DISTRIBUTION AND ECOLOGY

In Africa this species is limited to the winter rainfall, coastal plains of Algeria, Egypt, Libya and Tunisia (Figure 8.2.42). Its habitat is sandy and dry, often in drainage lines of road sholders or wadis.

This species also occurs outside Africa in Palestine, as well as on the mediterranean islands of Cyprus, Crete, Sicilia and the Grecian Islands (Feinbrun 1968), where it is found abundantly and intermingled with other shrubs.

VOUCHER SPECIMENS:

Algeria:

–33N00E: Depression Saad Haoud (–DD), *Boudet, G. 7549* (P).

–34N02E: Moulin fereo, Bou-Sa'ada (–DB), *Kramer K. U. 5285* (Z).

–34S05E: Biskra (–DD), *Balansa B. s.n. anno 1853* (BM, K, P).

–35N00E: Oran (–DA), *Balansa B. 659* (K, P).

Egypt:

–28N29E: Wadi el Bahr (–CC), *Simpson N. D. 6190* (K).

–30N29E: 10 km west of Alexandria en route to Burg-el-Arab (–DC), *Venter A. M. 577* (BLFU).

–31S31E: Rosetta (–AD), *Schweinfurthii s.n. anno 1878* (P).

–31N31E: Kafr-el-Shekg district, Baltim (–CA), *Mashaly I. A. s.n.* (K).

Libya:

–31N16E: Tripoliana district, 70 km east of Sirte (–BA), *Park 66* (K).

–32N20E: Cyrenaica Region, Benghazi Rommel's pool (= Jazirah) (–AA), *Keith H. G. 310* (K, P).

Tunisia:

–32N10E: Hammamet (–DC), *Gandoger 133.* (K).

–36N10E: Sdi-bou-Said (–CB), *Cosson M. s.n.* (K).

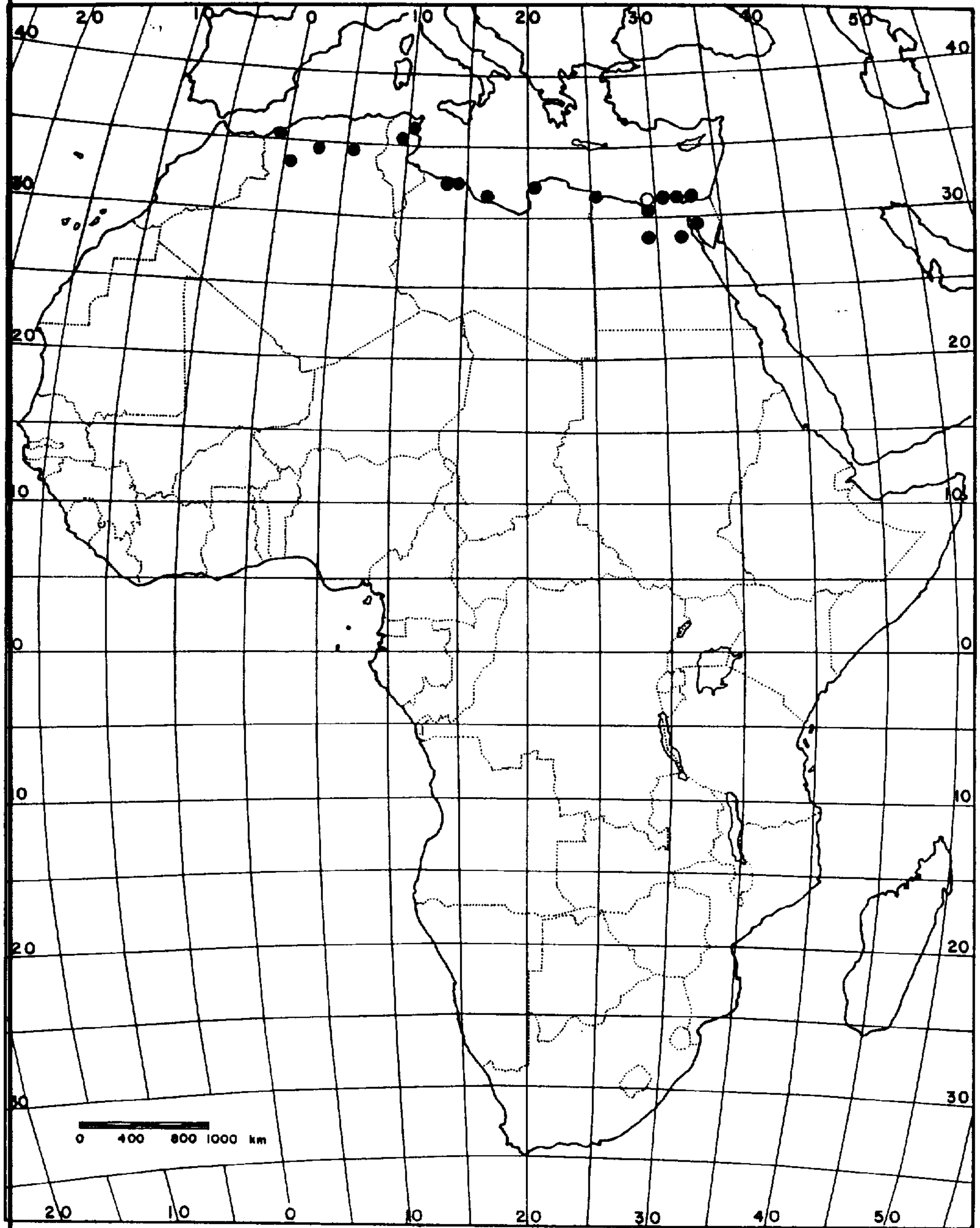


Figure 8.2.42 Known geographical distribution of *Lycium schweinfurthii* in Africa.

[o : Type locality]

8.2.22 ***LYCIUM SHAWII*** Roem. & Schult., Systema Vegetabilium 4: 693 (1819); Shaw: fig. 145 (1757); Feinbrun: 362, fig. 2 (1968); Dean: 1,6 (1974).

Type: Shaw, Travels in Barbary, p 49, fig. 349 (1738) (Icono-lectotype, here declared).

= ***L. mediterraneum*** var. ***cinereum*** Dunal: 524 (1852), **syn. nov.**

Type: Arabia, near Dscheddam, *Schimper 855* (G-DC!, holotype; MONTP!, isotype).

(Homotypical with *L. abeliaeflorum* Rchb.f.).

= ***L. mediterraneum*** var. ***cinnamoneum*** Dunal: 525 (1852), (synonymy by Feinbrun (1968)).

Type: Near the Red Sea, *Acerbi s.n.* anno 1831 (G-DC!, holotype; MONTP!, isotype).

= ***L. mediterraneum*** var. ***leucocladum*** Dunal: 524 (1852), (synonymy by Feinbrun (1968)).

Type: Egypt, *Aucher Eloy s.n.* (G-DC!, holotype; MONTP!, isotype).

= ***L. persicum*** Miers: 12 (1854), (synonymy by Feinbrun (1968)); t. 65, fig. B (1857); C. H. Wright: 254 (1906).

Type: Arabia, Aden, near the sea, *Thomson T. s.n.* (K!, holotype).

= ***L. abeliiflorum*** Rchb. f. 20:10, tab. 15, fig. II, 10 (1862), (synonymy by Feinbrun (1968)).

(Homotypical with *L. mediteraneaum* var. *cinereum* Dunal).

= ***L. arabicum*** Schweinf. ex Boiss.: 289 (1879), (synonymy by Feinbrun (1968)); Dammer: 228 (1913); Feinbrun: 366 (1968).

Types: Egypt, between Keneh and Kosser, *Schweinfurth 1397* (BM!, holotype); Arabia, Quadi Mokatteb and Ramla, *Boissier.*

= ***L. erythraeum*** Schweinf. ex Vatke: 333 (1882), **syn, nov.**

Type: Specimen in Hildebrandt's collection of Apr. 1872 (BΨ, holotype) (synonymy after Vatke's description).

= ***L. sokotranum*** Wagn. & Vierh.: 257 (1906), **syn. nov.**

Type: Sokotra, northern foot of Mount Deraforte at Haulaf, *Pauly 2* (W, holotype; K!, photograph of holotype in W).

= ***L. albiflorum*** Dammer: 226 (1913), **syn. nov.**.

Type: Botswana, 2 km SE of Mamatau, fl. i.1907, *Seiner II.223* (BΨ, holotype) (synonymy after Dammer's description).

= *L.* ***ellenbeckii*** Dammer: 231 (1913); Dean: 1(1974), **syn. nov.**

Type: Ethiopia, Galla plateau (Arusii Galla), Daroli, *Ellenbeck 1823* (BΨ, holotype) (synonymy after Dammer's description).

= *L.* ***jaegeri*** Dammer: 232 (1913), **syn nov.;** Dean: 1 (1974).

Type: Tanzania, Wanege plateau, Mamgati, *Jaegeri 253* (BΨ, holotype) (synonymy after Dammer's description).

= *L.* ***merkeri*** Dammer: 224 (1913), **syn. nov.**

Types: East Africa, Tanzania, Wanege plateau, at Umbugwe abd Iraku, edge of Rift Valley, *Merker 294* (BΨ, syntype);

East Africa, Tanzania, eastern foot of Oldönjo lengai Mountain at Rift Valley, *Merker 758* (BΨ, syntype) (synonymy after Dammer's description).

= *L.* ***tenuiramosum*** Dammer: 225 (1913), **syn. nov.**.

Type: Tanzania, Massai steppe, at Kiutiro, *Zimmermann 1700* in Herb. Amani (BΨ, holotype) (synonymy after Dammer's description).

= *L.* ***withaniifolium*** Dammer: 230 (1913), **syn. nov.**

Type: Ethiopia, Galla plateau, Jaballo-Grogora, *Ellenbeck 1183a* (BΨ, syntype).

Ethiopia, Scheick-Hussein, *Ellenbeck A1* (BΨ, syntype) (synonymy after Dammer's description).

= ***L. ovinum*** Dammer: 352 (1915), **syn. nov.**; Dean: 1 (1974).

Types: Namibia, Northern Hereroland, Omaheke, Epata, *Seiner F ser. III 202* (BΨ, syntype);

Namibia, northern Hereroland, Omaheke, *Seiner F ser. III 311* (BΨ, syntype) (synonymy after Dammer's description).

= ***L. cufodontii*** Lanza: 202, fig. 61 (1939), **syn. nov.**

Types: Ethiopia, *Cufodontis 99* (FT!, lectotype, here declared; FT!, isotype);

Ethiopia, *Cufodontis 73* (FT!, syntype (2 specimens)).

= ***L. javallense*** Lanza: 204, fig. 62 (1939), **syn. nov.**

Type: Ethiopia, Javello (=Yabello), *Cufodontis G. 561* (FT!, holotype).

DESCRIPTION

A bisexual, straggling, sometimes scandent **shrub** of 1–2.5(–3) m tall, sometimes stunted (grazing), rarely a tree of up to 4.5 m high. **Stems** intricately branched, very thorny, curving, very young stems sometimes pendulous, young stems greyish white, older stems dark ash-grey, infrequently dark brown to purplish-brown, glabrous; thorns on young stems 5–10(–15) mm long, leafless, on older stems 15–50 mm long, foliated, divaricate. **Leaves** solitary and alternate on young branches, clustered in fascicles of 2–5 on older branches; *petiole* 2–5 mm long; *lamina* narrowly obovate to obovate to elliptic, (12–)20–35(–54) x (4–)8–10(–15)

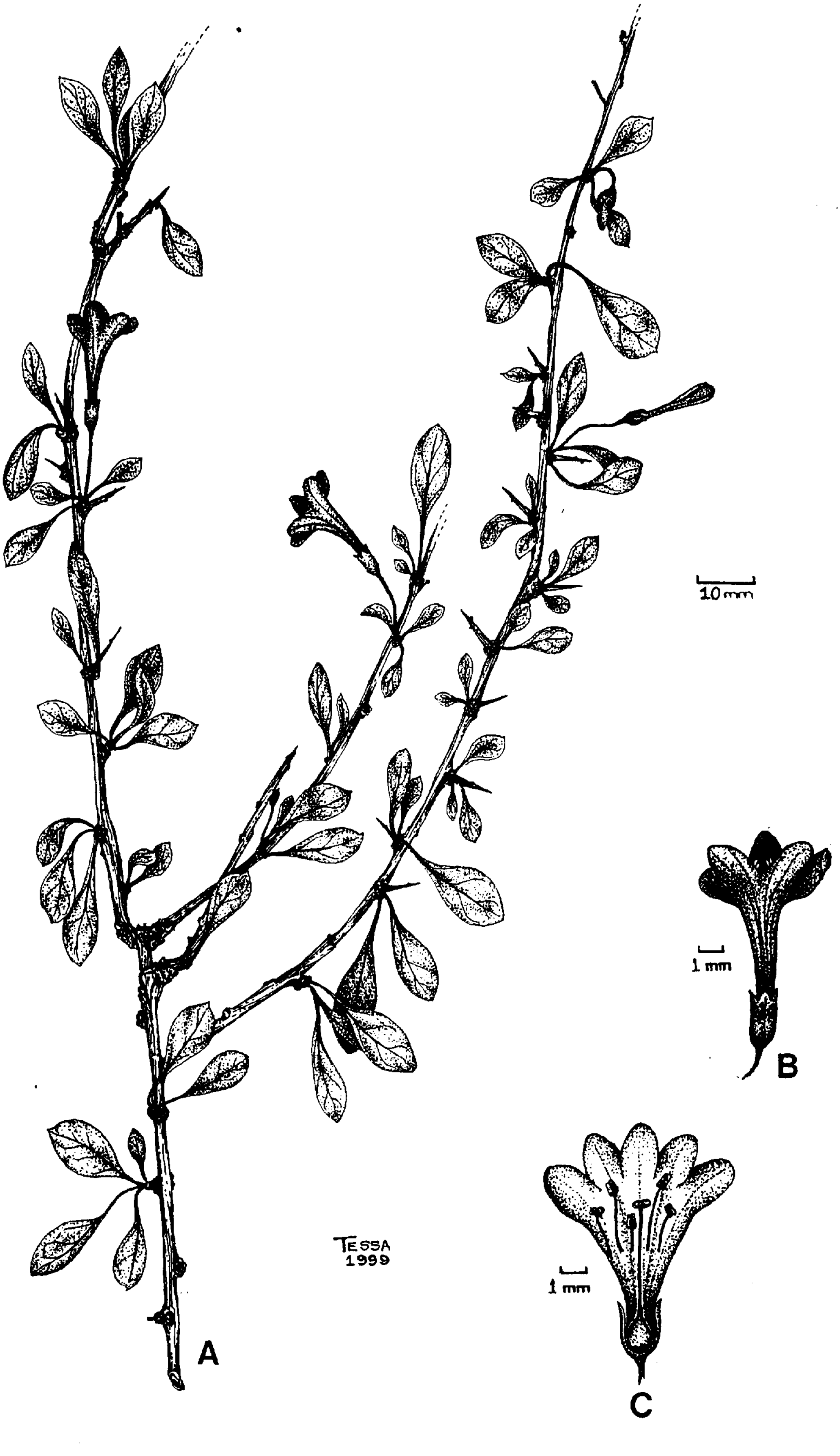


Figure 8.2.43 *Lycium shawii.*
A: Stem with thorns, leaves and flowers; B External view of flower;
C: Flower internally showing pistil and stamens.
[A, B & C: *Obermeyer 2403* (BOL)].

mm, herbaceous, sometimes semi-succulent, bright green and glossy adaxially, slightly paler abaxially, glabrous, apices acute to rounded. **Flowers** 5-merous, pendulous; pedicel (2–)6–8(–12) mm long. **Calyx** narrowly tubular, 3–5 x 1.5–2 mm; *lobes* triangular, 0.5–0.8 mm long, equal, glabrous, apices slightly acute, erect. **Corolla** creamy-white with lobes white, or pale mauve with purple venation; *tube* narrowly tubular, sometimes slightly curved, (10–)12–16 x 2–3 mm, glabrous outside; inside glabrous to sparsely pilose just below stamen attachment; *lobes* ovate-oblong, 3–4 x 2–3 mm, spreading. **Stamens** inserted 7–8 mm above corolla base, just above middle of tube, unequal, 3 stamens included and 2 slightly exserted from corolla-mouth; *filaments* (3–)4–7(–9) mm long, glabrous. **Pistil:** *ovary* globose, 1–1.5 x 1.5 mm; *style* 10–12 mm long, just shorter than longest stamen; *nectary* pale greenish yellow, inconspicuous. **Berry** globose to slightly obovoid, 3–5 mm diam., red. **Seed** ovate, 2 x 1 mm. (Figure 8.2.43). $2n = 2x = 24$.

NOTES

In north-eastern and eastern Africa, heavily grazed plants of *L. shawii* become stunted bushes with smaller leaves and flowers. In Kenya and Tanzania *L. shawii*'s leaves are uncommonly large, up to 50 mm long. This vegetative variation and the fact that this species is distributed over an enormous area of Africa is probably responsible for the large number of synonyms.

VERNACULAR NAMES

Botswana: "libuta";

Ethiopia: "surut";

Somalia: "surut", "surrod", "sorat", "surug", "dhumay", "holaad" (medicine);

Sudan: "sunnuat" (in Bisharin), "sikkup" (in Beni Amer);

Kenya: "olokii" (Massai), "karaku/morangweli" (Kikuyu), "yewo", "ekabekebeke";

Tanzania: "chamiwa" (Kihare).

UTILIZATION

This species is extensively used in eastern and northern Africa: Kenya: "yewo" (green vegetable), "ekabekebeke" (medicine for stomach ache, roots chewed or boiled and extract used as cough cure, also for skin rash or urinary problems). The leaves are eaten as green vegetable. It is heavily browsed by livestock, especially goates, camels, sheep and even giraffe.

DISTRIBUTION AND ECOLOGY:

L. shawii is the most widespread species of *Lycium* in Africa, occurring from north-eastern Egypt and the island of Socotra, through Ethiopia and eastern Africa to southern Africa, in Zimbabwe, Botswana, South Africa and Swaziland (Figure 8.2.44). It is the only indigenous African *Lycium* species covering both the southern and northern hemispheres of Africa. It is further interesting to note that *L. shawii* is distributed in regions where none of the other *Lycium* species occur, it only overlaps with other species in the far south and far north.

This species is also widely distributed in mediterranean Europe (Southern Italy, Sicily and Creta) and eastwards throughout the Middle East (southern Palestine, Sinai) and Arabia (south-western Iran, southern Iraq) to western India which makes *L. shawiii* the most widespread of all lyciums in the world.

Its habitat is usually in arid regions, but growing where moisture collects in dry river-beds, river-banks, valleys, wadis and depressions. Plants are also often found on or near anthills or termite mounds, on dry plains, in grassland with scattered *Acacia*, thorny scrub with *Acacia,* savanna with *Acacia, Boscia, Commiphora*, *Croton* and *Terminalia, Brachystegia* and mopane, *Euphorbia* and mopane. The plants of *L. shawii* are usually entangled in woodland or riverine thickets.

Soils vary, but are usually of limestone, basaltic and granitic origin although plants also grow on black clay or silty alluvial soils. Plants have been collected along seashores in sand, but this is the exception. Leaves of these beach plants are relatively small, probably due to the influence of salt spray.

Flowering in southern and eastern Africa occurs during the summer months of November to February and in autumn till April. In north-eastern Africa flowering does not seem to take place during the summer months of June to August, but rather in spring from January to March and late summer and autumn from September to November.

VOUCHER SPECIMENS:

Botswana:

–19S22E: Okavango near Nokanenge (–CA), *Richards H.M.14801* (K).

–20S22E: Near Toteng on Mogapelwa road (–BD), *Smith P. A. 3966* (K, COI).

Egypt:

–29N32E: Wadi Hagul, west of Gulf of Suez (–CD), *Venter A. M. 574* (BLFU).

–30N32E: 30 km north-west of Suez to Cairo (–AB), *Danin. A. s.n.* (HUJ).

Erythrea:

–09N37E: Depression Saad Haoud (–AC), *Chedeville 2663* (P).

Ethiopia:

–03N38E: Sidamo, 48 km SE of Mega (–BC), *Mesfin &Vollesen 4227* (K).

–04N38E: 10 km SW of Mega to Marsabit (–CD), *Ash J. 2822* (K).

–06N44E: Ogaden, Scillare-Obos (–AA), *Simmon S135* (K).

Kenya:

–00N36E: South side of Lake Naivisha (–CB), *Dale 3061* (K, BM, BR).

–00N39E: Balambala (–AA), *Adamson J. 449.* (K).

–01N35E: Narok-Ewaso, Ngiro (–BB), *Verdcourt 3924.* (K).

–01N37E: South-western floor of Mua Hills (–DA), *Gillet J. B. 16207* (K, BR).

–03N37E: 32 km east of Taveta (–BC), *Dale 3639* (K, BR).

Malawi:

–11S33E: 64 km S of Mzuzu on Eutini road (–BD), *Pawek J. 1753* (K).

Namibia:

–18S21E: Dwaki-camp, Okavango (–BB), *Le Roux P. J. 214* (K, PRE).

South Africa:

–23S29E: 20 km south of Louis Trichardt, at Bandolierskop crossing (–BD), *Schlieben H. J. 7253* (K, B, G).

–24S31E: National Kruger Game Reserwe, north-west of Leeupan near Skukuza (–DC), *Venter A. M. 430* (BLFU).

–278S32E: Western foot of Lebombo Mountains, Inqwavuma district (–AA), *Wells M. J. 2200* (K, PRE).

Socotra:

–12N52E: Jebel Hassala (=Qarat Saleh) (–AB), *Smith & Lavranos 689* (K).

–12N52E: Abd el Kuri (–BC), *Virgo K. J. A35* (K).

Somalia:

–00N42E: Jebil-Camsuma, near village Shek Ahmed Yare (–BB), *Thulin & Warfa 4459* (K).

–04N47E: Central rangelands (–DA), *Gillet, Hemming & Watson 22553* (K).

–09N45E: Erigavo Hills (–CD), *McKinnon S/92* (K, P).

–10N49E: Karin (–CD), *Collonette C. L. 191* (K, FL).

Sudan:

–14N30E: South Tokar Delta at Tagdora Hill (–AA), *Bally P. R. D. B6966* (K).

–21N37E: Kamoikwen (–AA), *Cooke B. K. 113* (K).

Swaziland:

–26S32E: Tshaneni, Lebombo district (–CA), *Barret S. C. H. 410* (K).

–27S32E: Near Ingwavuma Poort, Hlatikula district (–AA), *Compton R. H.* (K, PRE, NBG).

Tanzania:

–02N36E: Ketumbane (–CC), *Greenway 4285* (K).

–03N34E: Yaida Valley near Lake Endasiku (–DC), *Richards H. M. 25154* (K).

–03N36E: Ngare Nayuki 32 km NE of Arusha (–BB), *Beesley J. S. S.* (K, BR).

–04N38E: Lake Kalimawe, Same district (–AC), *Richards H. M. 21938* (K).

–09N34E: 16 km south of Njombe turn-of from Great North Road (–CB), *Milne-Redhead E. & Taylor P. 11061* (K).

Uganda:

–02S34E: Lokapeliethe, Mathiniko, Karamoja (–CB), *Dale 4353* (K).

–02S34E: Kangole (–CB), *Wilson 380* (K, BR).

Zambia:

–148S27E: Near Mumbwa (–CC), *MacCaulay 365* (K).

Zimbabwe:

–17S31E: Salisbury (= Harare) (–CC), *Eyles 5061* (K).

–18S30E: Watkins farm, 10 km from Hartley (–AA), *Hornby R. M. 3441* (SRGH, LISC).

–19S32E: Birchenough Bridge (–CD), *Obermeyer A. A. 2403* (BOL).

–20S28E: Bulawayo district (–BA), *Best 813* (SRGH).

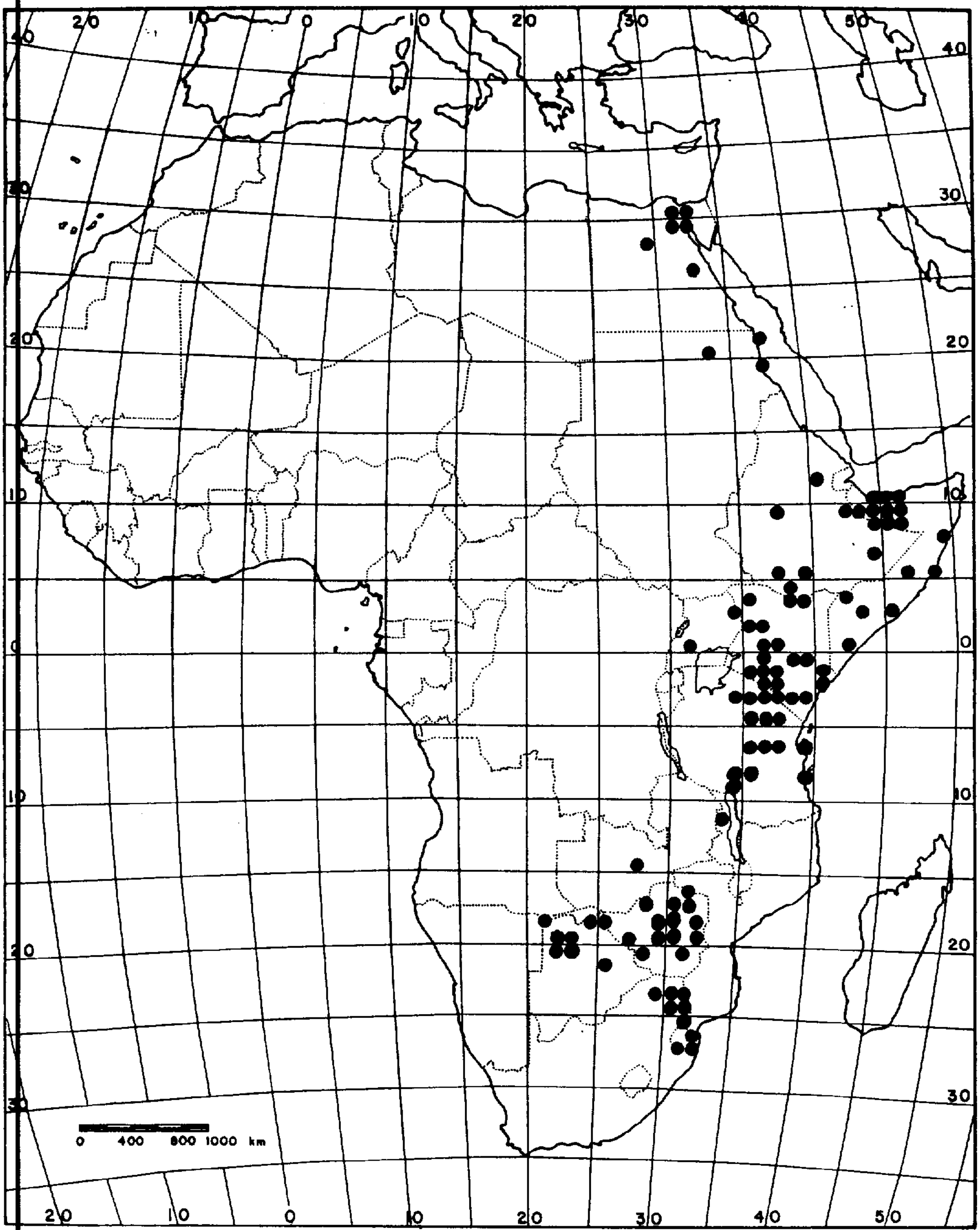


Figure 8.2.44 Known geographical distribution of *Lycium shawii* in Africa.

8.2.23 ***LYCIUM STRANDVELDENSE*** A. M. Venter, **sp. nov.** (to be published in the South African Journal of Botany).

Type: South Africa, Western Cape Province, Lamberts Bay, *Venter A. M. 477* (BLFU).

DESCRIPTION

A dioecious, erect, rigid, thorny **shrub** of 1–1.5 m high. **Stems** stout, erect, young stems pale grey to pale brownish-grey, sometimes striated, older stems grey to brownish-grey, glabrous; thorns 10–60 mm long, of mixed length on younger and older stems. **Leaves** densely fascicled on conspicuous brachyblasts of stems and thorns, fascicles 3–7 leaved; *petiole* 0–1 mm long; *lamina* narrowly obovate to ovate, 9–13 x 2–3 mm, succulent, bright green, macroscopically glabrous, apices obtuse to rarely acute. **Flowers** functionally unisexual. **Male flowers** 5-merous; pedicel (3–)4–5(–7) mm long. **Calyx** campanulate to broadly tubular, 4 x 2–2.5 mm; *lobes* triangular, 1 mm long, about equal in size, apices acute. **Corolla** deep purple with tube sometimes greenish white on outside; *tube* tubular, 11–13 x 3 mm, glabrous outside and inside; *lobes* semi-orbicular, 2.5 x 2 mm, spreading. **Stamens** about equally long, slightly exserted from corolla mouth; *anthers* fertile; *filaments* inserted 4–4.5 mm above corolla base, just below middle of tube, base pilose. **Pistil:** *ovary* broadly ovoid, 1.5–2 x 1.5–2 mm; *style* 1 mm long or absent; *stigma* absent; *nectary* golden brown, inconspicious. **Female flowers** as in male flowers, except: **corolla** tube 10–11 x 2–2.5 mm; **stamens** reach corolla throat, not exserted; *anthers* infertile; *style* 10–12 mm long, reach corolla throat, *stigma* present, pale green. **Berry**: *Male plants*: none; *female plants*: berries ellipsoid,

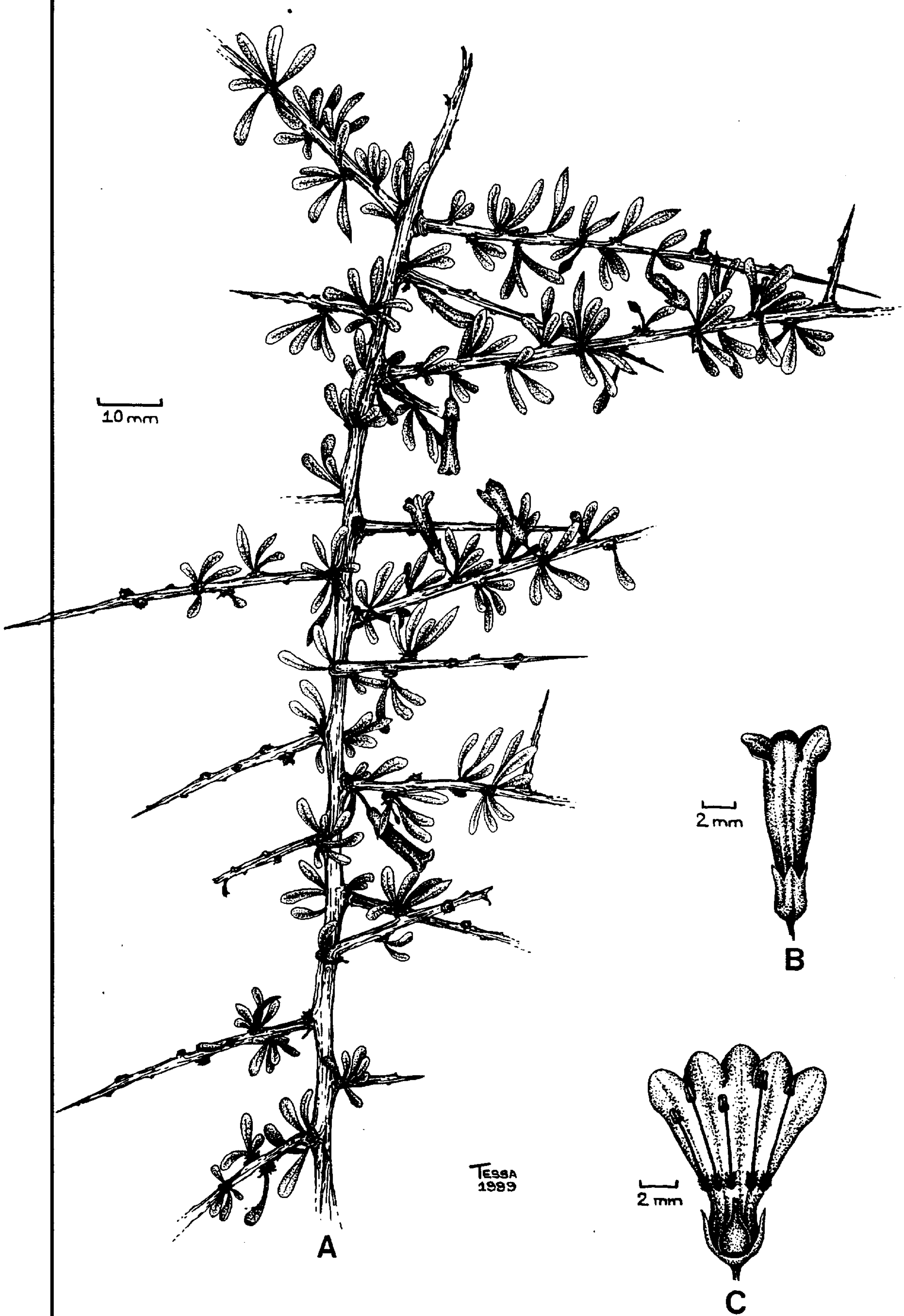


Figure 8.2.45A *Lycium strandveldense.*
A: Stem with thorns, leaves and male flowers; B: External view of male flower;
C: Male flower internally showing ovary with stunted style and fertile stamens.
[A, B & C: *A. M. Venter 478* (BLFU)].

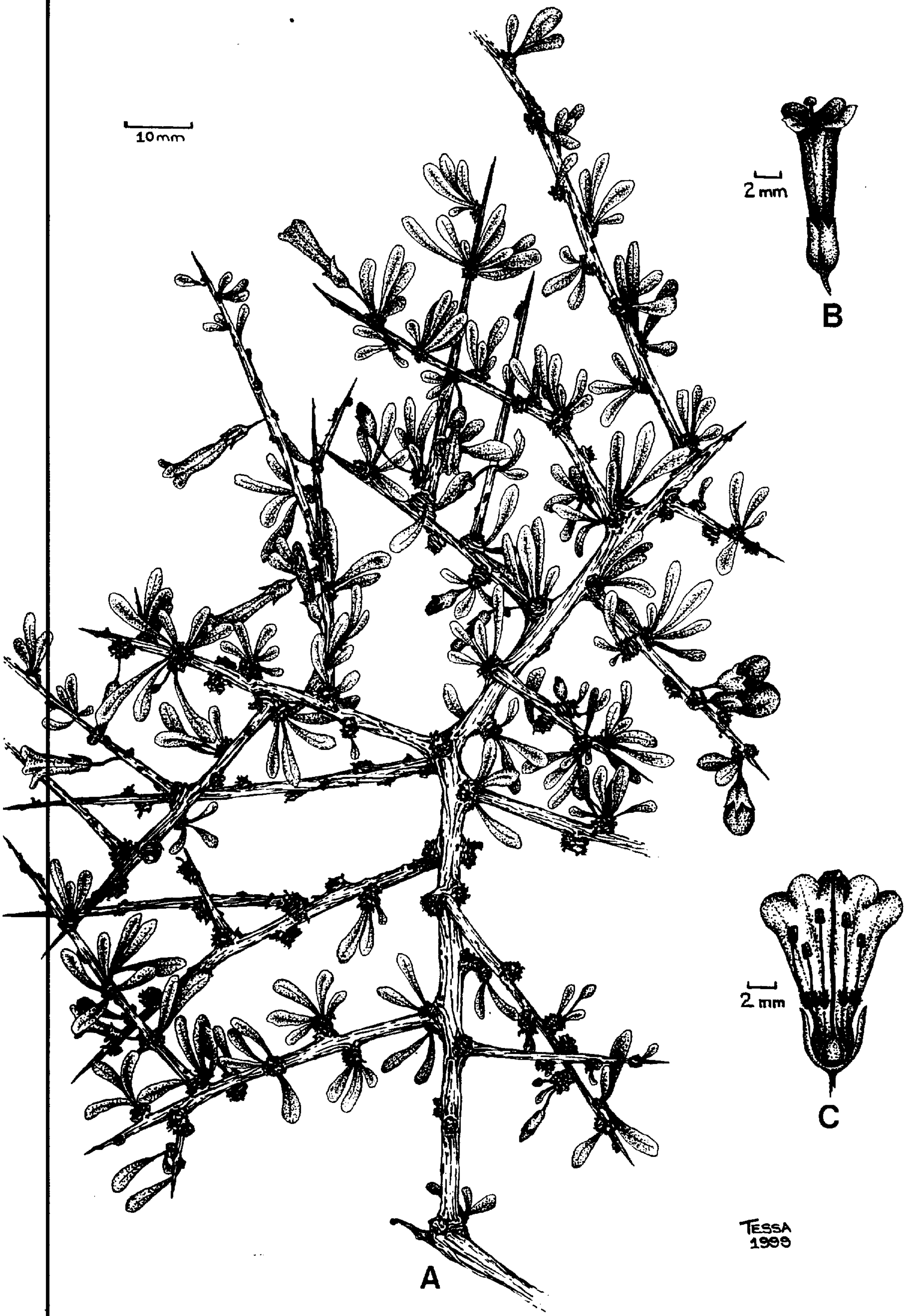


Figure 8.2.45B *Lycium strandveldense.*
A: Stem with thorns, leaves and female flowers; B: External view of female flower; C: Flower internally showing complete pistil and infertile stamens.
[A, B & C: *A. M. Venter 477* (BLFU)].

4–5 x 7–8 mm, red. **Seed** subdiscoid to ovate, 1.5–2 mm long. (Figure 8.2.45A & B). 2n = 4x = 48.

NOTES

It is possible that *L. strandveldense* is of hybrid origin, with *L. afrum* and *L. tetrandrum* the parents, both species occurring in the same area as *L. strandveldense*. Leaf and flowers characteristics resemble that of *L. afrum* closely. As *L. strandveldense* is one of the functionally dioecious species, *L. tetrandrum*, the only other dioecious species in the area, is probably the other parent.

DISTRIBUTION AND HABITAT

L. strandveldense occurs along the Western Cape Province's "Strandveld" or coastal region north of Lamberts Bay (Figure 8.2.46). It is common on the sandy flats and dunes of the low-lying areas near and at the coast.

Flowering specimens have been collected during September to December.

VOUCHER SPECIMENS

South Africa:

–32S18E: 5 km east of Lamberts Bay (–AB), *Venter A. M. 477* (BLFU).

–32S18E: 5 km east of Lamberts Bay (–AB), *Venter A. M. 478* (BLFU).

–32S18E: 0.5 km west of river crossing at Elands Bay (–AD), *Venter A. M. 510* (BLFU).

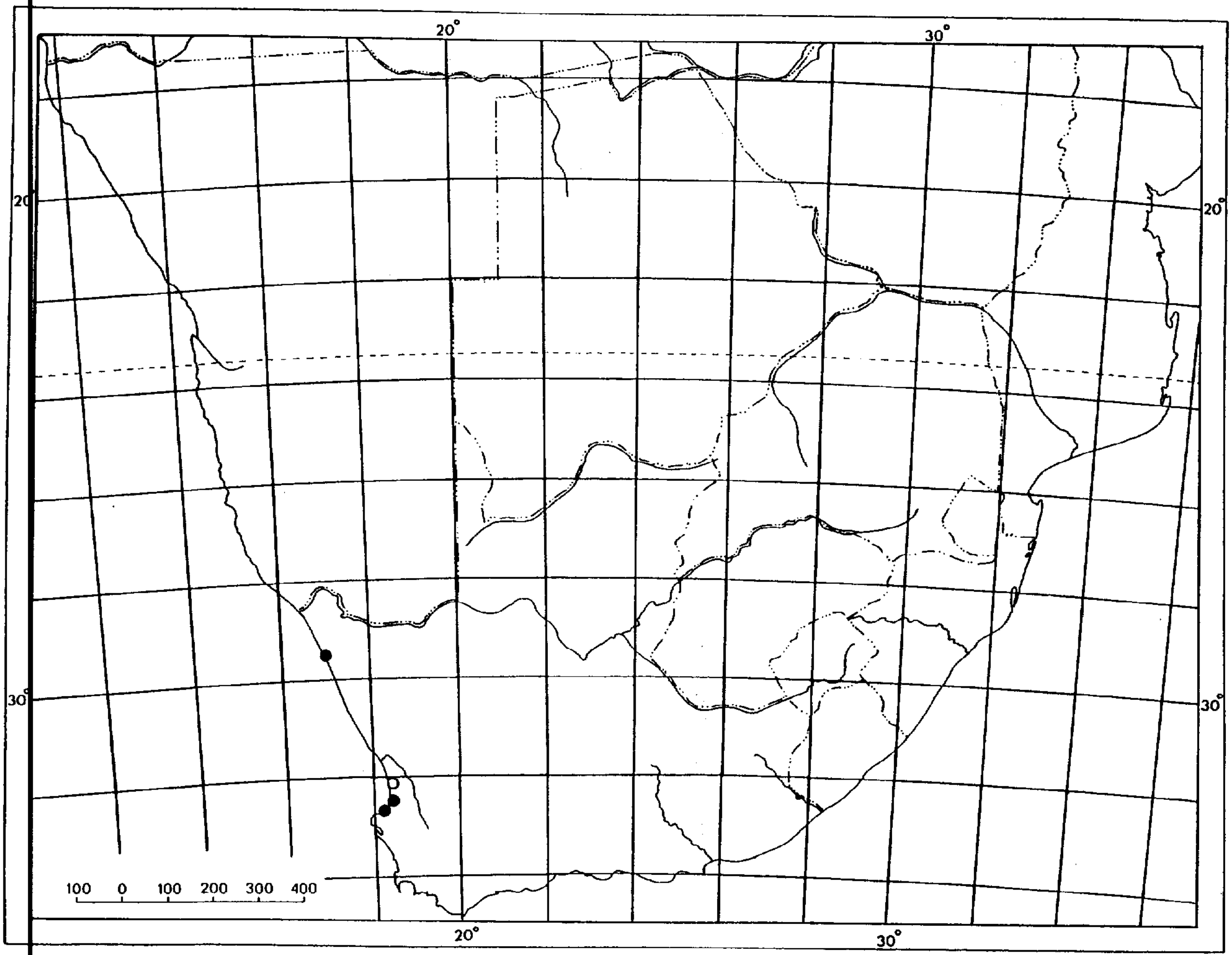


Figure 8.2.46 Known geographical distribution of *Lycium strandveldense*.

[o : Type locality]

8.2.24 ***LYCIUM TENUE*** Willd., Enumeratio plantarum horti Berolensis: 245 (1809); L.: 691 (1819).

Type: Plant cultivated in Europe from seed collected in South Africa, Cape: Herb. Willdenow no 4466 (B!, holotype).

DESCRIPTION

A bisexual, rigid, thorny **shrub** of 1–1.5(–2) m high. **Stems** erect; young stems dirty white to pale grey and striated, older stems dark or lead grey, glabrous; thorns 15–50 mm long, mixed on younger and older stems. **Leaves** sessile, sometimes solitary and alternate on young stems, clustered on older stems and thorns, 3–5 leaves per fascicle; *lamina* narrowly obovate, sometimes obovate, (8–)10–13(–16) x 1–2(–3) mm, semi-succulent, pale green, macroscopically glabrous, apex obtuse to acute. **Flowers** 5-merous; pedicel 2–3(–6) mm long. **Calyx** tubular, (3–)4–5 x 2–3 mm; *lobes* triangular, 1(–2) mm long, unequal, erect; glabrous, apices acute. **Corolla** creamy white with lilac lobes; *tube* narrowly trumpet-shaped, (5–)6–7 x 2–3 mm, glabrous outside, sparsely pilose inside at stamen insertion or rarely glabrous; *lobes* semi-orbicular, 3 x 3–4 mm long, reflexed. **Stamens** inserted 3 mm above corolla base, at about middle of tube, exserted from corolla mouth, unequal; *filaments* 4–5(–6) mm long, base densely pilose. **Pistil:** *ovary* broadly ovoid to spherical, 2–2.5 x 2 mm; *style* 6–7(–8) mm long, exserted about as far as stamens; *nectary* honey-brown, inconspicuous, nectar copious. **Berry** ovoid to elliptical, 5–7 x 4 mm, red. **Seed** ovate 2–3 x 3 mm. (Figure 8.2.47). 2n = 2x = 24.

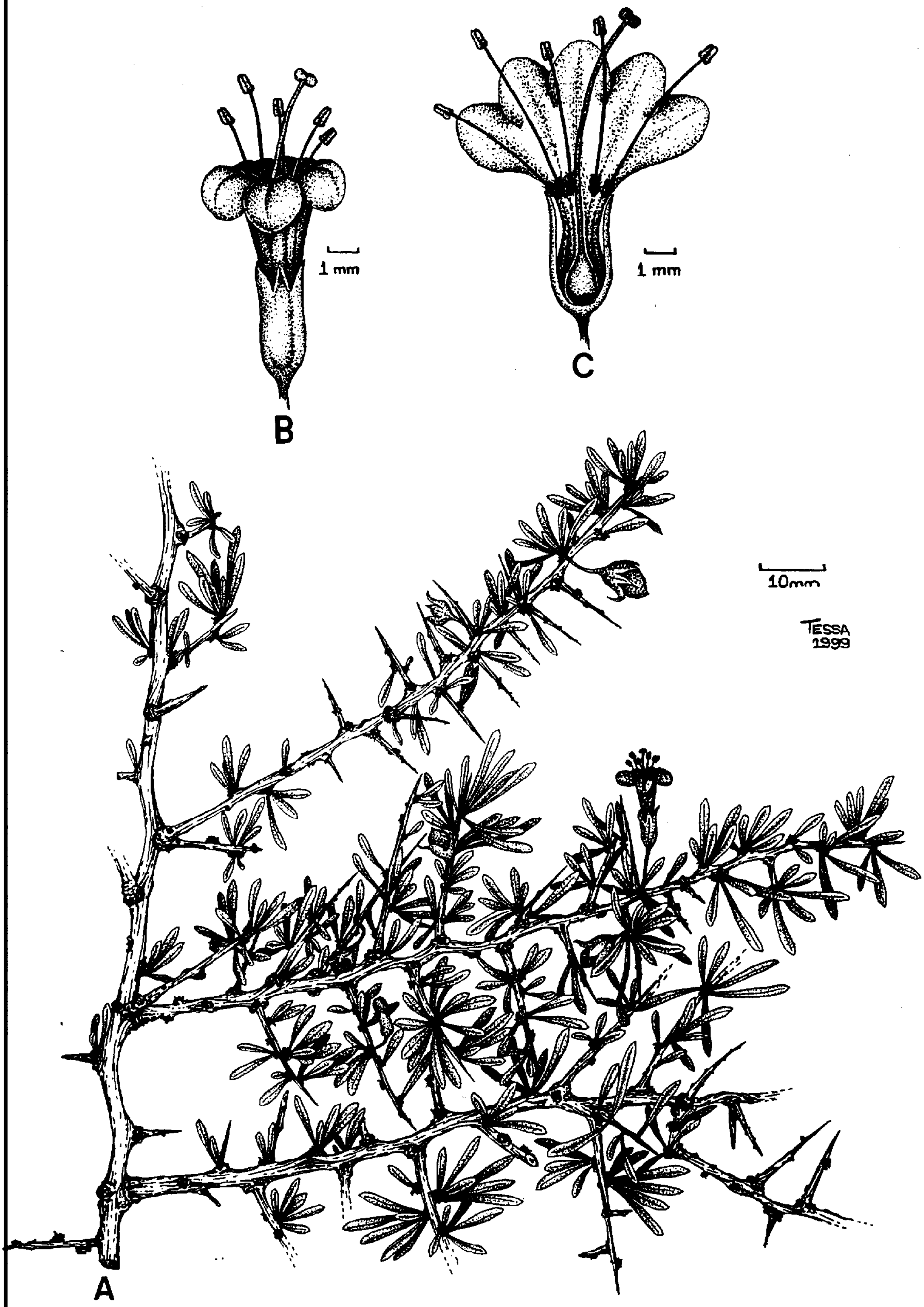


Figure 8.2.47 *Lycium tenue.*
A: Stem with thorns, leaves and flowers; B: External view of flower;
C: Flower internally showing pistil and stamens.
[A, B & C: *A. M. Venter 619* (BLFU)].

DISTRIBUTION AND ECOLOGY

This species occurs in the Western Cape Province, from Ceres in the west to Calitzdorp in the east, an area that receives winter rainfall (Figure 8.2.48). It is not found at the coast, but from slightly to deeper inland as far north as the Swartberg Mountain Range. Its habitat consists of sandy soil near rivers or in dry riverbeds, often of limestone origin. It is also common on the gravelly slopes of the Swartberg Mountain in fynbos, and eastwards also in valley savanna.

Flowering is during summer, peaking in early spring from September to October and in mid summer in January, depending on precipitation.

VOUCHER SPECIMENS

South Africa:

–28S29E: 3 km east of Ladismith on Calitzdorp road (–BD), *Venter A. M. 619* (BLFU).

–33S22E: 12 km west of Oudtshoorn in Huis River Pass (–CA), *Venter A. M. 522* (BLFU).

–34S20E: Along Heuningnes River (–CB), *O'Callaghan M. 625* (NBG).

–34S21E: Stilbaai, Riversdale district (–AD), *Horn D. H. s.n.* (PRE).

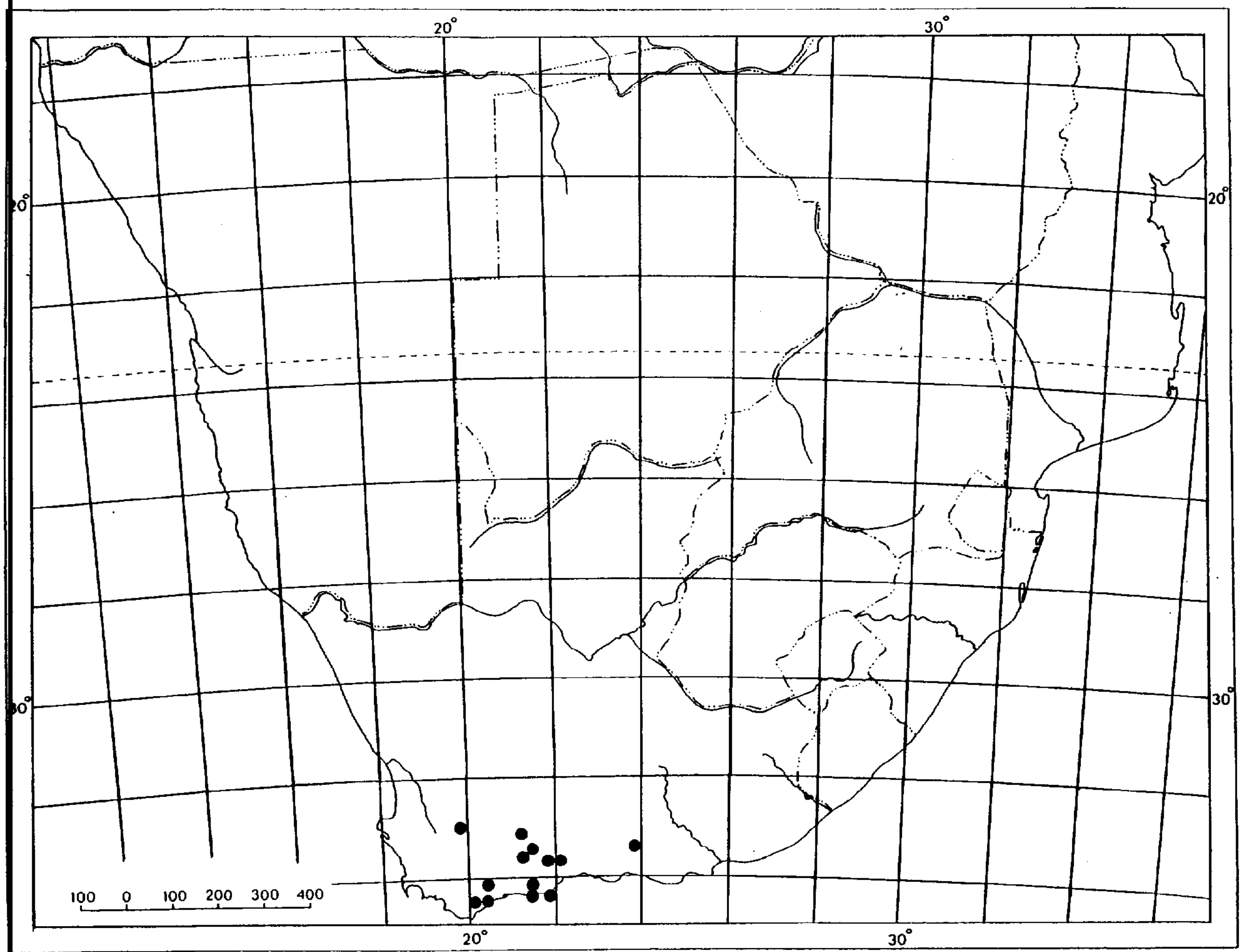


Figure 8.2.48 Known geographical distribution of *Lycium tenue*.

8.2.25 ***LYCIUM TETRANDRUM*** L.f., Supplementum Plantarum 2nd ed.: 150 (1781);

Thunb,: 37 (1794); 154 (1808); L.f.: 700 (1825); Podl. & Roessl.: 124:7 (1969).

Type: South Africa, Cape, between Leeuestaart and beach, *UPS 5313* (UPS!, holotype).

= ***L. microphyllum*** Loisel.: 112 (1801), **syn. nov.**

Type: Plant cultivated in Paris from seed from the Cape, South Africa (P!, holotype).

= ***Lycium marlothii*** Dammer: 233 (1913); Dean: 9 (1974), **syn. nov.**

Types: Namibia, Lüderitz Bay, *Marloth 4648* (BΨ, syntype);

Namibia, Possession Bay, *Schultze 19* (BΨ, syntype) (synonymy after Dammer's description).

DESCRIPTION

A dioecious, rigid, densely branched, very thorny **shrub** of 1–3 m high, often dense clumps up to 3 x 3 m. **Stems** densely foliated, intricately branched, young stems light brown to pale grey with dirty white striations, older stems dark grey, glabrous; thorns 15–50(–60) mm, gradually lengthening from young to older part of stem, sometimes mixed. **Leaves** sessile, clustered on conspicuous brachyblasts of stems and thorns, 4–8 leaves per fascicle, glabrous; *lamina* obovate to narrowly obovate to narrowly elliptic, often obovoid to narrowly

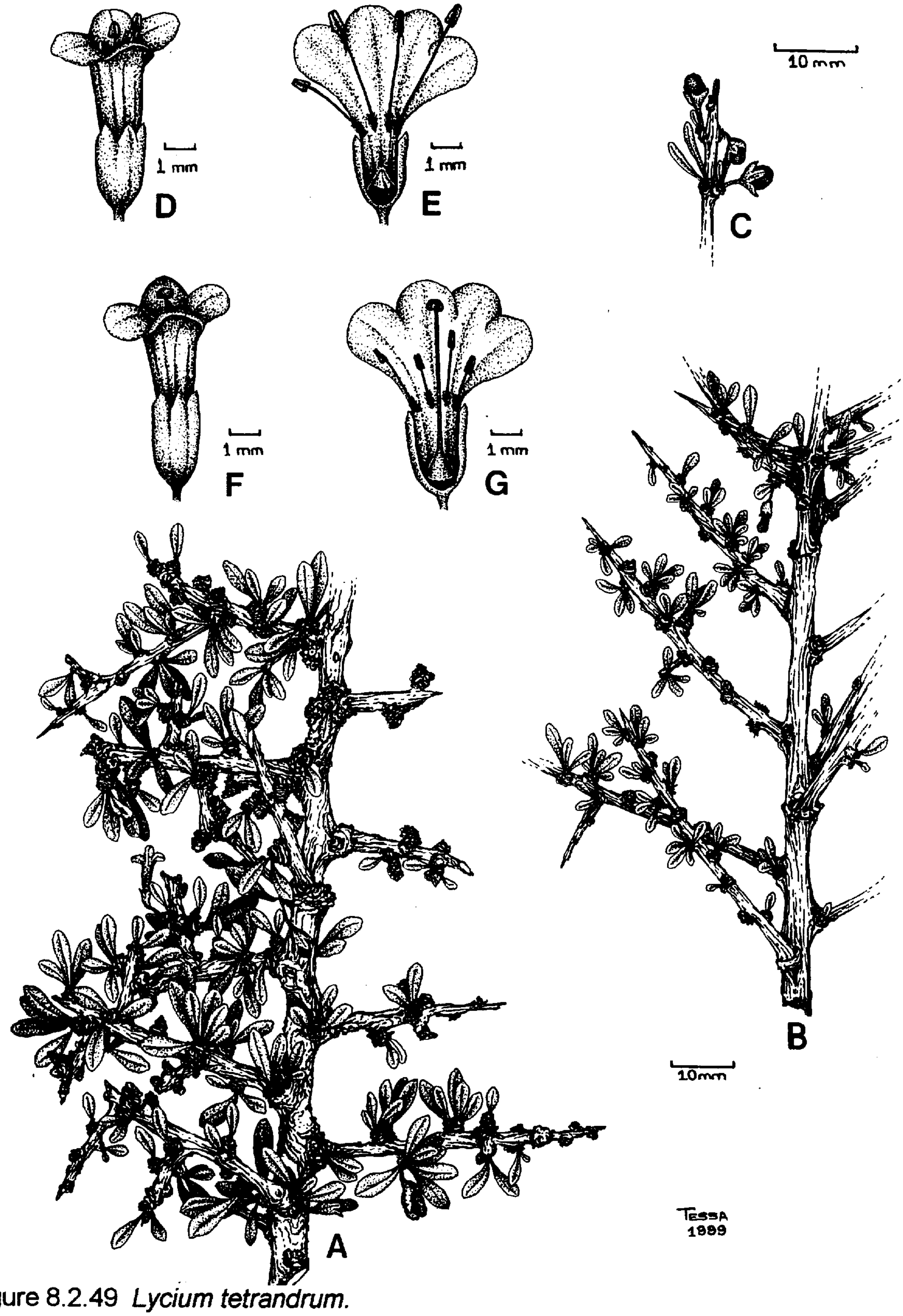


Figure 8.2.49 *Lycium tetrandrum.*
A: Stem with thorns, leaves and flowers; B: Young stem; C: Stem portion with fruit; D: External view of male flower; E: Male flower internally showing ovary with stunted style and fertile stamens; F: External view of female flower; G: Female flower internally showing complete pistil and infertile stamens.
[A: *E. Irish s.n., anno 1984* (WIND); B & C: *W. Giess & E. Robinson 13166* (WIND); D & E: *A. M. Reyneke 196* (BFLU); F & G: *W. Giess & M. Müller 22009* (WIND)].

obovoid or ellipsoid, (5–)10–15(–20) x (1–)2–3 mm, succulent and cylindrical, bright green, often glossy, margins dark brownish-red, glabrous, apices obtuse to acute. **Flowers** functionally unisexual, 4- or 5-merous, pedicel 0.5–3 mm long. **Male flowers**: **calyx** tubular, rarely campanulate, 2.5–3 x 1.5–2(–2.5) mm; *lobes* triangular, 0.5–0.8(–1) mm long, about equal, erect, glabrous, apices acute. **Corolla** creamy white, sometimes with pale lilac lobes or purple veins, *tube* narrowly trumpet-shaped, 5–6 x 1.5–2.5 mm, glabrous outside and inside or sparsely pilose just below stamen insertion; *lobes* sub-orbicular, 1.5–2 x 1.5–2 mm, spreading. **Stamens** inserted 2.5–3 mm above corolla base, at or just below middle of tube, some slightly exserted from corolla mouth; *filaments* 2–4 mm long, base pilose; *anthers* fertile. **Pistil:** *ovary* ovoid, 1.5 x 1 mm; *style* and *stigma* absent; *nectary* dark red, prominent. **Female flowers** with calyx and corolla as in male flowers, except corolla distinctly tubular. **Stamens** as in male flowers, except *anthers* included in corolla tube, sterile. **Pistil:** as in male flowers, except *style* 4–5 mm long; *stigma* fertile, just visible in corolla mouth. **Berry:** *male plants*: none; *female plants*: berries spherical, 3 x 3 mm, red. **Seed** subdiscoid to ovate, 1—1.5 mm long. (Figure 8.2.49). 2n = 6x = 72, rarely 2n = 4x = 48.

VERNACULAR NAMES

"Muisbos", "bokdoring", "kraaldoring", "Cape box thorn" (Smith 1966).

The very famous “Muisbosskerm” Seafood Restaurant of the Cape West Coast, just south of Lamberts Bay, is constructed with stacked branches of *L. tetrandrum*.

DISTRIBUTION AND ECOLOGY

L. tetrandrum occurs along the coastal belt of South Africa from Cape Agulhas west and northwards to Lüderitz Bay in Namibia (Figure 8.2.50). Its habitat is deep sand along riverbanks or floodplains, coastal beaches and dunes, riverbeds and depressions in semi-desert. The soil is often of quartzite, granitic or basaltic origin. The plants occur in the fynbos and strandveld vegetation. Often, however, this species is the only vegetation in the littoral zone where the plants collect windblown sand forming humps or small dunes from which only the tips of the branches emerge (Figure 4.6B).

The Namibian plants flower during the cooler, moister winter months into early spring, from June to September. This pattern also concurs with the moisture providing mists that blow in over the Namibian coast from the Atlantic Ocean. The peak flowering time of plants growing in the Cape Peninsula and westcoast of South Africa is in early spring from August to October. This region has winter rainfall, but the cold temperature is probably the reason why flowering only occurs at the end of the rainy season.

VOUCHER SPECIMENS:

Namibia:

–22S14E: Swakopmund (–DA), *Reyneke A. M. 196* (BLFU).

–23S14E: Sandvis Habour (= Sandwich) (–AD), *Jankowitz W. 228* (WIND).

–24S14E: Fischerbrunn, Diamond Area 2 (–DB), *Irish E. s.n.* (WIND).

–25S16E: Halenberg, 45 km east of Lüderitz (–CA), *Reyneke A. M. 184* (BLFU).

–26S14E: Hottentots Bay (–BB), *Giess & Robinson 13166* (WIND).

–27S15E: Possession Island, (–AC), *Heydom M. J. 1* (NBG).

–27S18E: Farm Us at Us River, Grunau region (–BC), *Giess & Müller 22009* (WIND).

South Africa:

–28S17E: Eksteensfontein near Vioolsdrift (–CA), *Venter H. J. T. 8064* (BLFU).

–29S16E: Port Nolloth (–BD), *Galpin & Pearson 7576* (K, NBG, SAM).

–32S17E: Britannia Bay, Vredenburg (–DD), *Taylor H. C. 5193.* (K, PRE, STE).

–33S18E: Silverstroom beach at Buffels River mouth (–CB), *Boucher C. 3993* (STE, PRE).

–33S18E: Bokbaai, western Cape (–CB), *Venter A. M. 347* (BLFU).

–34S19E: Vogelvlei, Bredasdorp (–DB), *Schlechter 10484* (BM, GRA).

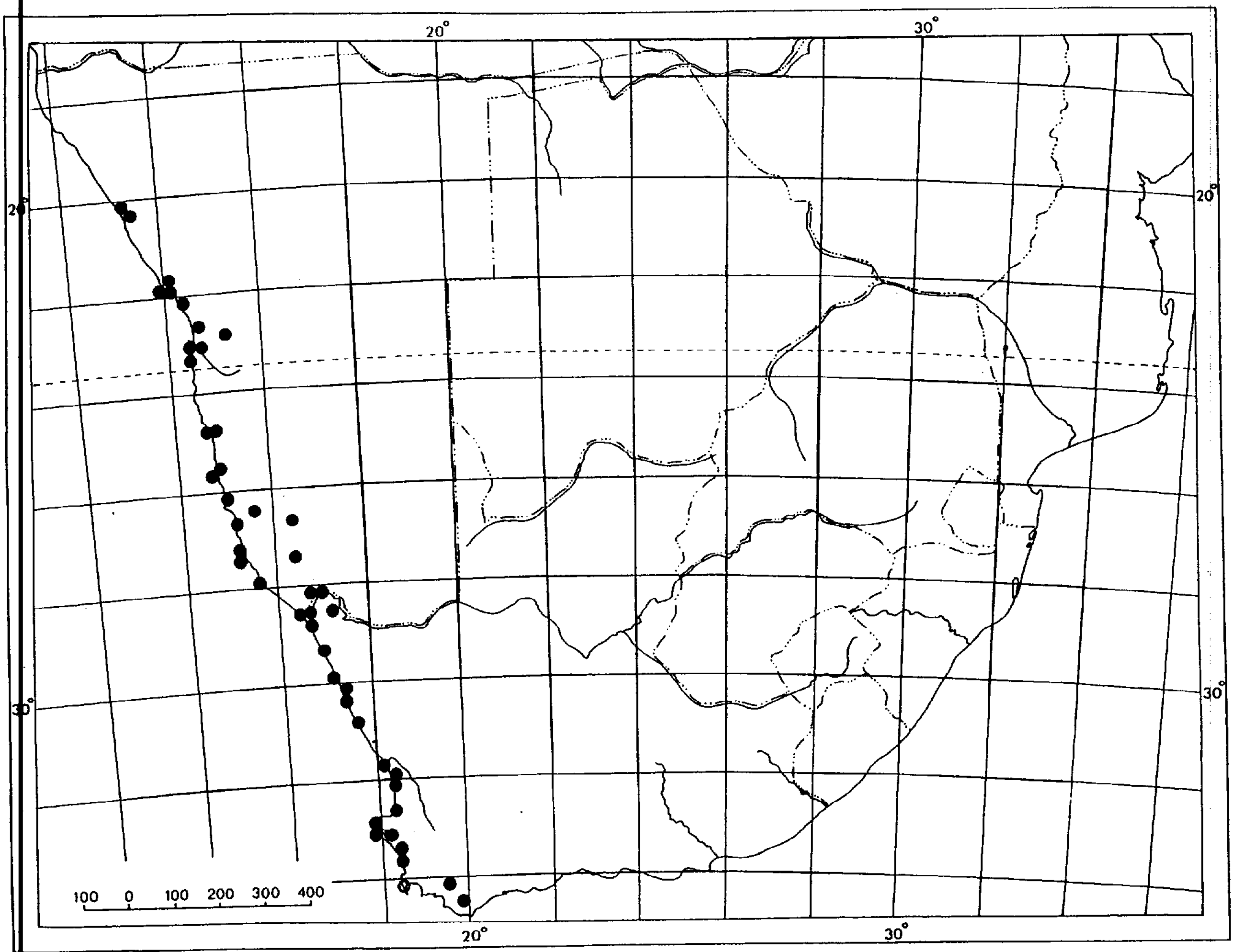


Figure 8.2.50 Known geographical distribution of *Lycium tetrandrum*.

[o : Type locality]

8.2.26 ***LYCIUM VILLOSUM*** Schinz in Verhandlungen des Botanischen Vereins der Provinz Brandenburg 31: 184 (1890);

Podlech & Roessler: 124:8 (1969); Dean: 1, 3 (1974).

Type: Botswana, Olifantskloof, *Schinz 1886* (Z!, holotype).

DESCRIPTION:

A dioecious, much branched **shrub** of 1–3 m tall. **Stems** rigid, erect to spreading; younger stems ashy to creamy white, densely hirsute with simple, short to long stalked glandular trichomes and simple or branched eglandular trichomes, older stems dark grey, glabrous; thorns 20–60 mm long, becoming longer from younger to older stems. **Leaves** often solitary on young stems, fascicled on older stems, 2–6 leaves per cluster; *petiole* absent to 4 mm long, densely hirsute with vestiture as on young stems; *lamina* elliptic or narrowly obovate to obovate, 16–28 x 2–8 mm, herbaceous, rarely semi-succulent, yellowish to greyish green, apices acute to rounded. **Flowers** functionally unisexual, 4–5-merous; pedicel 1–3 mm long, densely hirsute. **Male flowers**: **calyx** trumpet-shaped, 5–7 x 2.5–3 mm, densely hirsute with glandular and eglandular hairs; *lobes* oblong to triangular-ovate, 2.5–3.5 mm long, sub-equal, slightly spreading, apices acute to obtuse. **Corolla** creamy to dirty white; *tube* narrowly trumpet-shaped, 9–12 x 1.5–2 mm, sparsely hirsute outside, inside glabrous or sparsely pilose at stamen insertion; *lobes* broadly semi-ovate to semi-orbicular, 1.5–2 x 2–2.5 mm, spreading, margins densely ciliate. **Stamens** attached 2.5–3 mm above corolla base, at or just below middle of tube, slightly exserted from corolla-mouth; *filaments* 5–8 mm long, about equal, pilose at filament base; *anthers* fertile. **Pistil:** *ovary* sub-globose, 2 x 2 mm; *style* 1–3 mm long, without stigma; *nectary* red and prominent. **Female flowers:**

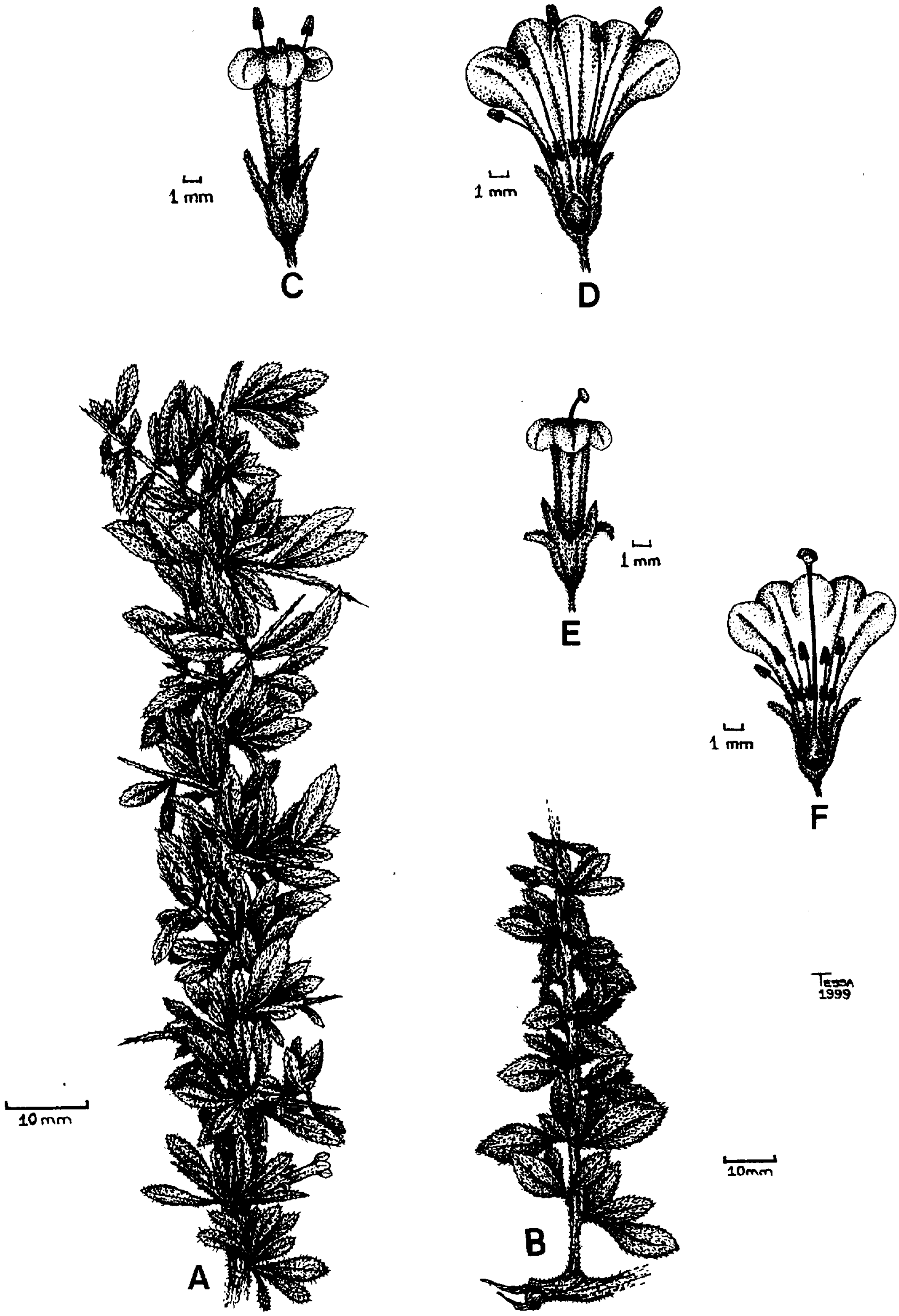


Figure 8.2.51 *Lycium villosum.*
A: Stem with thorns, leaves and flowers; B: Young stem; C: External view of male flower; D: Male flower internally showing ovary with stunted style and fertile stamens; E: External view of female flower; F: Female flower internally showing complete pistil and infertile stamens.
[A: E & F: *A. M.Reyneke 290* (BLFU); B: *P. G.. Zietsman 390* (BNM); C & D: *A. M. Reyneke 50* (BFLU)].

calyx as in male flower; **corolla** as in male flower, except tube tubular, shorter and narrower, 8–11 x 1–1.5 mm; **stamens** as in male flower except anthers infertile, included in corolla tube. **Pistil:** *ovary* and *nectary* as in male flower, style 7–10 mm long with stigma exserted from corolla mouth. **Berry** broadly ovoid to spherical, 3–5 x 3–4 mm, red. **Seed** ovate, 2 x 2 mm. (Figure 8.2.51).

2n = 4x = 48.

VERNACULAR NAME

"Harige sandkriedoring"

DISTRIBUTION AND ECOLOGY

This species is found in the Northern Cape Province, north of the Orange River, as well as in western Botswana and southern and central Namibia (Figure 8.2.52). *L. villosum* is always associated with deep Kalahari sand flats, dunes or dry river beds in thorny savanna with shrubs and trees, in particular *Acacia* species.

Flowering occurs throughout the year depending on available moisture, but the main flowering time is in winter from April to July.

VOUCHER SPECIMENS

Botswana:

–22S20E: Kgalagadi district, 7 km north-west of Kule, along track to border (–CC), *Bergstrom R. B38* (PRE, SRGH, LISC).

–23S20E: Masetleng Pan, 100 km west of Hukuntsi (–DB), *Parry D. 8544* (PRE).

Namibia:

–22S16E: Lichtenstein (–DD), *Dinter K. 3527* (B).

–23S17E: 33 km south of Windhoek (–AA), *Reyneke A. M. 207* (BLFU).

–27S19E: Farm Warmfontein near Tranental (–AB), *Lensing J. E. J2/76* (WIND).

–28S18E: Sandfontein (–CB), *Wilman M. 1669* (WIND, K, NBG).

South Africa:

–25S20E: Kalahari Gemsbok Park, 9.6 km from Kij Gamiespomp to Auob River (–CB), *Van Rooyen N. 3909* (PRE).

–27S22E: West of Olifantshoek (–DD), *Reyneke A. M. 50* (BLFU).

–27S23E: Kuruman district, 24 km southeast of Severn (–AD), *Leistner O. A. 1448* (K).

–28S21E: Near Groblershoop (–DD), *Reyneke A. M. 52* (BLFU).

–28S24E: Vaalbos National Park, Delportshoop (–AD), *Zietsman P. G. 390* (BNM).

–28S24E: Farm Grootdam, 52 km west of Kimberley (–CA), *Reyneke A. M. 295* (BLFU).

–28S24E: Barkly-West (–DA), *Reyneke A. M. 290* (BLFU).

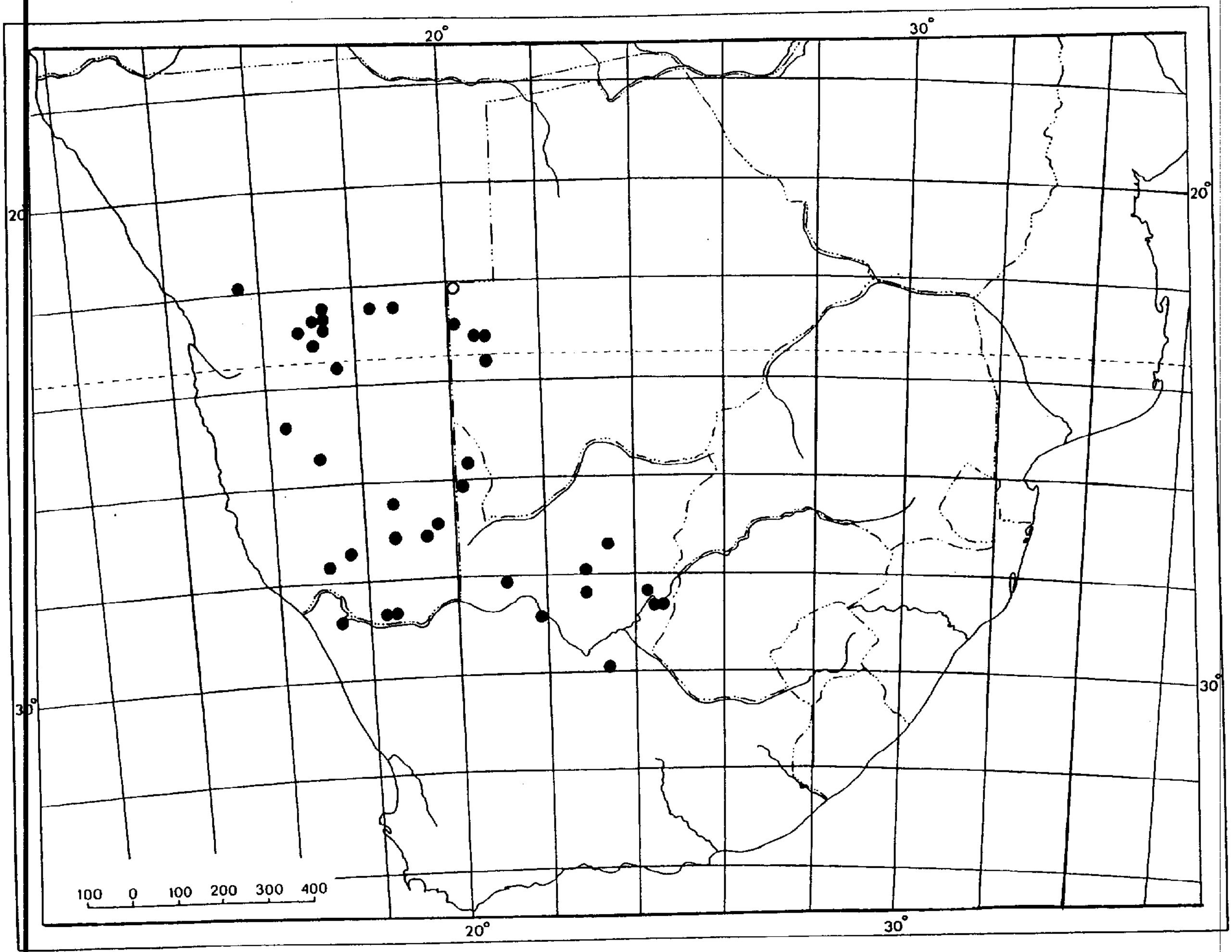


Figure 8.2.52 Known geographical distribution of *Lycium villosum*.

[o : Type locality]

8.3 IMPERFECTLY KNOWN SPECIES

♦ ***L. angustifolium*** Miller: (1768).

Type: Plants cultivated by Miller in the Chelsea Garden

This species is generally associated with South Africa (Jackson 1895). Miller, however, indicated nowhere that the original seed did come from South Africa. It may therefore, not even be a synonym of any of the South African species and is best treated as imperfectly known. The fact that his plants never set fruit, could indicate functionally unisexual male plants where pollination and fertilization were impossible.

♦ ***L. capense*** Miller (1768).

The description of *L. capense* Miller in his Gardener's Dictionary, ed. 8, no. 7 (1768), was based on sterile plants, cultivated from seed collected at the Cape. Miller used this name again in a later edition, but then dropped it from his further publications (Dean, 1974). Don (1838) suggested that this name be equated with Thunberg's *L. tetrandrum,* followed by Wright (1904). However, Miller indicated no type and no type specimen is present in his collection in BM. As the description was based on sterile material it is impossible to determine on which species it was based. This species is, therefore, treated as imperfectly known.

8.4 EXCLUDED SPECIES

♦ *L. italicum* Mill., according to Mr Roy Vickery (Curator of Herbarium, British Museum, London, pers. com.), probably synomymous with *Rhamnus lycioides.*

♦ *L. cordatum* Mill., definitely not a *Lycium*, probably *Carissa bispinosa* according Miller's descriptions of the heart shaped leaves, "paired" thorns and green bark.

CHAPTER 9

RELATIONSHIPS, PHYLOGENY AND CLADISTICS

9.1 Introduction

Since the time of Darwin, taxonomists have been concerned with phylogenetic relationships as well as with formal taxonomic systems. Some definitions of taxonomy have essentially equated it with phylogeny, as a study devoted to determining the evolutionary relationships among organisms. However, this correlation has proven to be a rather impossible accomplishment. The more abundant the phylogenetic and other data, the more obvious the impossibility. One of the major problems with this interpretation, is the requirement of monophyletic origin of taxa for successful phylogenetic results. Taxonomically this assumption is not viable. Taxonomic similarities can be due to evolutionary parallelism or convergence, as well as those strictly due to inheritance from a common ancestor (Cronquist 1975).

However, George Simpson (pers. com. to Cronquist 1975) has for many years been appealing in favour of a more flexible interpretation of the monophyletic criterion, in order to be useful to both cladists and taxonomists. In other words, if all the members of a particular taxon are descended from another taxon of lesser rank, the taxonomic criterion of monophylesis has been sufficiently met. This would then mean that similarities due to inheritance as well as parallelism provide some indication of relationship and should be considered in the formulation of a taxonomic system. The greater the genetic similarity between two groups the greater the likelihood that they will produce similar mutations or reactions to environmental pressure (Cronquist 1975).

Phylogenetic considerations have, however, an important role to play in the establishment of taxonomic systems. The true function of taxonomy is to produce a system of classifying organisms that best reflects their similarities and differences. The ideal taxonomic system should be able to accommodate the new data that are continuously being acquired by applying modern techniques, rather than being at cross purposes with it. This can only be achieved if the taxonomic system is in broad-scale harmony with evolutionary relationships (Cronquist 1975).

Few terms have bedevilled taxonomy and evolutionary literature as much as have monophyly and polyphyly. However, the use of these terms is purely relative depending in how far back in the ancestry we are prepared to go. If life arose only once on earth, all organisms are ultimately monophyletic in origin. Obviously narrower definitions of monophyly are in practice, but there seem to be different interpretations of this concept (Davis & Heywood 1963). In spite of these difficulties with the different interpretations and application of the monophyletic criterion to taxonomy, it is clear that phylogenetic considerations cannot be disregarded completely in the establishment of taxonomic systems. This is not a revolutionary idea. Since taxonomists started classifying plants they tried to incorporate natural grouping into their classification. Subsequent taxonomic treatments used the new data available with this object in mind. It is possible to perceive natural groups without thinking in terms of evolution, as indeed taxonomists did before Darwin, but such a perception is facilitated by an evolutionary frame of reference rather than simply applying phenotypic comparisons (Cronquist 1975). The problem seems to be the distinction between similarities resulting from parallelism or convergence as opposed to those acquired by inheritance and modification, or evolution.

There is a modern trend which feels that the use of the chemical structure of the genes will result in a better set of characters which will enable the establishment of the real relationships among organisms. Molecular methods have provided alternatives to morphological data in phylogenetic reconstruction (Sytsma & Hahn 1997) and, because at nucleotide level, the characters are largely uncoupled from environmental or developmental influences, many of the problems encountered with analysis of morphological characters can be minimized. However, this resulted in minimizing the value and validity of traditional phenotypic characters that are considered to be many steps removed from the genes that govern them. Although genes are important, it is not for their own sake but because of their influence on the phenotype. A "chemical difference" which might seem small, may have a disproportionately large phenotypic effect and vice versa. Predicting the phenotype from the genes is not a simple task.

All characters are fundamentally chemical molecules, which means that morphological characters are but a physical expression of certain chemical characters. However, many chemical characters are without known morphological expression, but they are only additional characters of the organism and therefore, neither more nor less significant taxonomically than morphological ones (Cronquist 1975).

Another modern trend was introduced by Hennig in 1966 together with the advent of numerical taxonomy, resulting in the most recent treatment of data, namely cladistics. The prospects of retrieving phylogeny now seem better than ever with the basic theoretical principles proposed by Hennig, the availability of computer programs that can handle large data sets and the accessibility of new sources of evidence, especially molecular characters (Donoghue & Sanderson 1992).

Hennig's approach stresses the evolutionary history in composing the classification hierarchy excluding all other considerations. He completely ignores the reality of evolution being dependent on both descent as well as modification. By ignoring the role that modification plays in any taxon's evolutionary history, numerical taxonomy or cladistics becomes incompatible with traditional taxonomy and classification (Brummitt 1997).

Plant systematics is a wonderfully diverse discipline, depending on diverse types of data and analyses to improve and refine classifications and ideas about relationships and their evolution. Systematics has taken in and synthesized data from a diverse range of sources, and in turn provided a stable system of names and predictive classifications to all fields of science. With the dawning of the molecular era, the focus has narrowed, resulting in loss of diversity in approaches, making traditional systematic research obsolete. Although molecular data have been a wonderful breakthrough providing insights into problems long thought intractable, and the ability to sequence DNA is an extremely powerful tool, it, however, still remains only one of the approaches of the diverse "set of tools" or holistic approach needed to provide logical, evolutionary probable taxonomic systems and classification (Lammers 1999). The same considerations apply to numerical taxonomy. Although providing a new method of processing data and testing hypotheses, cladistics remain but one of the techniques to be used in taxonomy.

Because of the present exclusion of traditional methods and the dilemma this has caused, attention has been focussed on the pros and cons of molecular versus morphological evidence. Donoghue & Sanderson (1992) have reviewed a number of opinions in this regard and found that most of the molecular phylogenists and cladists feel convinced that molecules can reconstruct the phylogeny with a high degree of accuracy and that molecular data are self-sufficient in that their usefulness does not depend on concordance with other lines of phenotypic evidence. They also feel that morphological evidence should be avoided because this could often be phylogenetically uninformative and even misleading because of the operation of strong selection resulting in homoplasy, difficulty in ordering character states, the high number of autapomorphies and the lack of well defined synapomorphies. They view morphological data as relevant only to studies of plant development. Donoghue & Sanderson (1992) then considered theoretical arguments and selected empirical studies, comparing morphological and molecular cladistic studies of the same taxa to find evidence to support or refute this argument. One problem they encountered was the limited number of solid morphological analyses available. They also found that many difficulties arise when interpreting molecular results, like different modes of inheriting different genomes, inadvertent analysis of paralogous genes, and the difficulty in repeatability of results using some of the molecular techniques. They concluded that, at best, this outlook is premature and, at worst, it will stand in the way of achieving an accurate picture of phylogeny.

Morphology has, traditionally, been the most important source of information in plant taxonomy. A majority of taxonomic groups recognised today are defined by cardinal characters mainly from floral morphology. The relatively recent application of molecular data and consequent phylogenetic concept, has challenged a number of these groups as being unnatural and paraphyletic. However, morphology should not simply be dismissed in favor of molecular data. Instead, combined analysis of morphological and molecular data sets provide a strong basis for phylogenetic hypotheses and thus also for classification. One advantage of such a combined analysis would be identification of synapomorphies which could allow rapid prediction of the placement of further taxa in the groups being investigated (Sennblad *et al.* 1998).

Investigations using different data sets have also proven that information and results often conflict across data sets. However, combined analyses could potentially, and often do, resolve these species-level relationships, especially those weakly supported or unresolved in each independent analysis (Olmstead & Sweere 1994, Manos 1997). Using the new molecular approach Olmstead & Palmer (1992) were able to upset the traditionally held view (Martin & Dowd 1984, D'Arcy 1979) based on morphology, that the Solanoideae were the more primitive subfamily of the Solanaceae. According to their results the Cestroideae are the ancestral subfamily from which the monophyletic Solanoideae were derived. However, it is to be hoped that such "revolutionary" results will not be incorporated into taxonomic treatments without being subjected to scrutiny by the taxonomist.

An important fact about cladograms is that only relationships between taxa are established, origin or parentage of these taxa are not indicated (Lipscomb 1998). Shared plesiomorphic characters may not necessarily identify a monophyletic group (Sennblad *et al.* 1998). Cladograms, therefore, are insufficient to supply all the necessary taxonomic information for classification purposes.

The initial aim of the present cladistic treatment was to establish possible relationships between the African *Lycium* species by using both morphological and molecular data. However, the results of the molecular data on *Lycium* are as yet inconclusive, and are therefore excluded from this analysis. Only the cladistic results based on the morphological and cytological data will be discussed.

9.2 Results

The strict concensus tree consisting of 62 steps (CI = 0.35, RI = 0.67) (Figure 9.1) of the 62 most parsimonious trees, using all 30 morphological characters of the initial matrix (Tables 9.1 & 9.2) resulted in a largely unresolved cladogram. Bootstrap values indicated support for a *L. arenicola* and *L. tetrandrum* clade, as well as a *L. hirsutum* and *L. villosum* clade. There was also reasonable support for the dioecious clade consisting of *L. arenicola, L. tetrandrum, L. gariepense, L. horridum* and *L. strandveldense*.

After eliminating the characters not contributing to the resolution of the cladogram, the remaining 21 characters were insufficient to resolve the 28 taxa included in the analysis. The resultant strict consensus cladogram of 26 most parsimonius cladograms, consisting of 38 steps (CI = 0.45, RI = 0.77) (Figure 9.2) was still largely unresolved and the topography corresponded more or less to the first cladogram. Both the Consistency Index (CI) and Retention Index (RI) were higher using the reduced character matrix. The three well supported clades found in the first cladogram, were consistent for the second tree.

The hypothesized phylogenetic, most parsimonious cladogram constructed, using MacClade (Figure 9.3) consisted of 72 steps and included three major clades with a number of mini clades. The first major clade consisted of the dioecious species, *L. arenicola, L. tetrandrum, L. horridum, L. gariepense, L. strandveldense* and *L. villosum* grouped together with the bisexual *L. hirsutum* and the mini clade of *L.acutifolium* and *L. mascarenense.* The second major clade consisted of four mini clades, these being *L. grandicalyx* and *L. bosciifolium*; *L. oxycarpum, L. eenii* and *L. shawii*; *L. afrum* and *L. amoenum*; and lastly, *L. schweinfurthii* and *L. europaeum.* The third major clade included three mini clades, *L. pumilum* and *L. ferocissimum, L. cinereum* and *L. tenue, L. schizocalyx* and *L. pilifolium*, and a separate branch of *L. decumbens*. The alien *L. barbarum* did not show close affinity to any of the African species.

9.3 Discussion

The cladograms (Figures 9.1 & 9.2), constructed using PAUP, were largely unresolved and therefore, meaningless to establish relationships between the species investigated. Most of the clades did not constitute natural groupings, probably because, although the characters used were taxonomically "good" differentiating characteristics, they were not phylogenetically significant characters. Morphological similarities and differences, although constituting diagnostically and taxonomically valuable characteristics, are only of cladistic value in so far as they indicate shared inheritance. This would explain the still largely unresolved tree resulting from the rerun (Figure 9.2).

Without at least as many characters as taxa to be treated, resolved cladograms are impossible. The more phylogenetically meaningful the characters included in the analysis, the better the resultant cladogram (Sanderson & Donoghue 1989, Olmstead & Sweene 1994, Persson *et al.* 1994). It is clear, therefore, that the remaining 21 characters of the second matrix were insufficient to improve on the initial tree. Even after eliminating the characters indicated in the MacClade treatment to be phylogenetically uninformative, there could be no guarantee that the remaining 21 characters were of cladistic significance. Finding a large number of morphological characters of cladistic significance is extremely difficult, if not impossible, and it is in this situation that molecular data have their application, because the amount of molecular data available is vast.

Another factor influencing the resolution of the trees, is the frequency with which new *Lycium* species originate by hybridization as indicated in the previous chapters. Cladistics is based on the principle of divergent origin and cannot accommodate hybrid taxa or reticulate evolution.

In both the PAUP cladograms (Figures 9.1 & 9.2), grouping the dioecious species of *L. arenicola, L. tetrandrum, L. horridum, L. gariepense* and *L. strandveldense* together, seems very logical and in agreement with all considerations evolved from the present taxonomic investigation. However, the absence of the sixth dioecious species, *L. villosum* from this dioecious clade is unexpected. This separation will mean that unisexual flowers have evolved twice within the African lyciums, a rather unacceptable assumption. The close relationship of *L. hirsutum* and *L. villosum* as indicated by the cladogram, can be explained by the indication (Chapter 6) that *L. villosum* is of hybrid origin with *L. hirsutum* the bisexual parent and contributing most of the vegetative characteristics of *L. villosum*. However, cladistic analysis is unable to accommodate hybridization, hence the incorrect grouping. The use of only morphological characters, compounded the problem.

The clade indicating a close relationship between *L. tetrandrum* and *L. arenicola* (Figures 9.1 and 9.2) agrees with the taxonomic assumption based on the morphological and cytogenetical evidence found in this investigation.

The cladogram, constructed with MacClade (Figure 9.3), is the product of a completely different approach to PAUP in that it is a hypothesized phylogenetic reconstruction, in which logical clades are manipulated using evolutionary principals, attempting to find the most parsimonious tree, with the best supported branches. The MacClade cladogram agrees broadly with the expectations of the present taxonomic investigation, however, a number of interesting aspects were encountered.

♦ Both the PAUP and MacClade analyses show that *L. villosum* and *L. hirsutum* are closely related. Trying to separate these two species in any way compromised the parsimony of the MacClade cladogram. Grouping *L. villosum* with the five other dioecious species added at least three additional steps to the cladogram.

♦In the third major clade *L. decumbens* is, surprisingly, not in the same mini clade as *L. pumilum* with which it shares a close floral affinity. Trying to group these two species together in a mini clade resulted in a lengthening of the tree, two to four additional steps depending on where this clade was added to the cladogram.

♦The close relationship between *L. afrum* and *L. strandveldense* is not indicated in the cladogram. Trying to group these two species together is just not parsimonious, resulting in a cladogram with a number of additional steps.

♦Based on morphology, it is impossible to indicate the relationship of *L. grandicalyx* with any of the other African *Lycium* species. Its cladistical combination with *L. bosciifolium* is surprising, but not taxonomically unacceptable.

From the information provided by the cladograms, it is impossible to reach any meaningful conclusion as to the relationships between the different African *Lycium* species. Hitchcock (1932) indicated that the closest relatives of certain South American *Lycium* species were to be found, not in South America, but in North America. The next logical step in the phylogenetic study of *Lycium* would be to conduct a cladistic analysis that includes all the species of South America, North America and Africa, and using morphological, cytological and molecular data together. This would probably provide better resolution of relationships in the genus *Lycium*, than when only the species of a selected geographical region are included in an analysis.

Morphological characteristics will always play an important role in taxonomy, no matter how many new and futuristic techniques are devised to produce data to perfect phylogenetically based systems. Morphological characteristics are often the visible expression of chemical, genetical and molecular characteristics (Cronquist 1975). The idea to dispense with traditional phenotypic characteristics in favor of molecular characteristics, which is perceived as the only way to find the real relationships among organisms because the genes contain the basic and better characteristics, is a beguiling fallacy. The creation of that ideal natural classification system depends on an unbiased evaluation and integration of all the available data from as many sources as possible.

The addition of molecular data and numerical techniques have been an important development and can be taxonomically very useful, for clarification of relationships and natural grouping of taxa. However, Donoghue & Sanderson (1992) are disturbed because, at present, it seems as though the new methods and techniques receive more attention than the information upon which phylogenies are based. It is also important to keep in mind that data produced by modern techniques are neither more nor less significant, taxonomically, than traditional morphological data. It would be unwise and a loss to taxonomy to summarily exclude any data, techniques or sources, new or old. To rate one technique or data source more important than another or even the exclusion thereof, would be equally disastrous. The only firm conclusion to be drawn from this investigation of methods, literature, perceptions, certainties and assumptions, is that molecular and numerical taxonomy do not provide the long awaited and hoped for answers to taxonomic headaches.

able 9.1 List of morphological and cytological characters used in the cladistical analysis. (Character states indicate as (0) or (1))

Chromosome number: 2n = 24 (0) and 2n = 48 / 72 (1).

Sex determination: bisexual species (0) and dioecious species (1).

Nectary colour: greenish or golden brown (0) and red (1).

'4. Nectary shape: inconspicuous (0) and conspicuous (2).

'5. Leaf and stem vestiture: macroscopically glabrous (0) and covered in glandular or eglandular trichomes (1).

Calyx lobe shape: triangular (0) and oblong deltoid (1).

Calyx incision: a third or less of the total length (0) and a half or more (1).

Corolla tube shape: campanulate to broadly funnel-shape and tubular to narrowly funnel-shaped (1).

Corolla tube length: shorter than 10 mm (0) and longer than 10 mm (1).

0. Corolla incision: a third to half of corolla tube length (0) and less than a quarter of the tube length (1).

1. Corolla lobe reflextion: lobes reflexed (0) and lobes spreading (1).

2. Stamen exsertion: Stamens clearly exserted (0) and stamens more or less included in corolla tube (1).

'13. Filament bases: pilose (0) and glabrous (1).

4. Pollen shape: subprolate (0) and euprolate (1).

5. Number of floral parts: five (0) and four/five (1).

6. Fruit type: capsule (0) and berry (1).

7. Presence of nectary: absent (0) and present (1).

8. Structure: Woody (0) and herbaceous (1).

'19. Seed shape: Discoid to ovate (0) and reniform (1).

'20. Seed coat sculpture: reticulate (0) and "glabrous" (1).

1. Pollen sculpture: striate-reticulate (0) and rugulate (1).

'22. Fruit size: larger that 9 mm in diam. (0) and less than 7 mm in diam. (1).

3. Leaf characteristics: flattened / herbaceous (0) and round / succulent (1).

4. Petiole present or absent: present (0) and absent (1).

5. Type of trichomes: glandular (0) and glandular as well as eglandular (1).

'26. Calyx length compared to corolla tube length: calyx less or equal to (0) and calyx longer than half the corolla tube length (1).

'27. Insertion of stamens to corolla: halfway or below the middle of corolla tube (0) and above halfway (1).

8. Corolla colour: Maroon / purple corolla (0) and white (with lilac lobes) (1).

9. Leaf colour: glaucous (0) and green (1).

'30. Fruit colour: Yellow or black (0) and red (1).

'Characters excluded as uninformative after analysis with MacClade 3.04

ɪpecies are numbered in alphabetical order from 1 to 26 with the wo outgroups, *Datura* and *Nicotiana* numbers 27 and 28 respectively.

Table 9.2 Morphological data matrix used for cladistic analysis of African Lycium species.

See Table 9.1 for list of characters and character states. Taxa numbers correspond to the sequence of the species list of Chapter 8 (Contents p i–ii). (Outgroups: 27: *Datura stramonium;* 28: *Nicotiana glauca).*

Characters / Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	0	0	1	0	0	0	0	1	1	1	1	1	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	1	0	0
2	0	0	0	0	0	0	0	1	0	1	1	1	0	1	0	0	1	0	0	1	0	0	1	0	0	0	1	0	1	0
3	1	1	1	1	0	0	0	1	1	1	1	1	0	0	1	0	1	0	1	1	0	1	1	1	0	0	1	1	0	0
4	0	0	0	0	0	0	0	1	0	1	1	0	1	1	0	0	1	0	0	1	1	1	0	0	0	0	1	1	0	0
5	0	0	1	1	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
6	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	1	0	1	1	1	0	0	1	1	0	0
7	0	0	1	0	0	0	0	1	1	0	1	0	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	1	0	0
8	0	0	0	0	0	0	0	1	0	1	1	1	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	1	0	0
9	0	0	0	0	0	0	0	1	0	1	1	1	1	1	0	0	1	0	0	1	0	1	0	0	0	0	1	1	0	0
10	0	0	1	0	0	0	0	1	1	0	0	0	0	1	0	0	1	0	0	1	0	0	0	1	0	1	0	1	0	0
11	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0	0	0	0	1	0	0
12	0	0	0	0	1	0	1	1	0	1	0	0	0	1	0	0	1	0	1	1	0	0	0	0	0	1	0	1	0	0
13	0	0	1	1	1	1	1	1	0	1	1	1	0	0	0	0	1	0	0	1	0	1	0	0	1	0	1	1	0	0
14	1	1	1	0	0	0	0	1	1	1	1	1	0	1	1	0	1	0	0	1	0	1	1	1	0	0	0	1	0	0
15	0	0	1	0	0	0	0	1	1	1	1	1	0	1	0	0	1	0	1	1	0	1	1	1	0	0	0	1	0	0
16	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	1	0	1	1	0	1	0	0	0	0	0	1	0	0
17	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	1
18	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	1	0	1	1	1	0	1	1	1	1	0
19	0	0	1	0	0	1	1	1	1	0	0	0	0	0	0	0	1	0	0	1	0	1	0	1	0	1	0	1	0	0
20	0	0	0	0	0	0	0	1	0	1	1	1	1	1	0	0	1	0	1	0	0	1	1	0	0	0	1	1	0	0
21	0	0	0	0	0	0	0	1	0	1	1	1	1	1	0	0	1	0	0	1	0	1	0	0	0	0	1	1	0	0
22	1	1	1	0	0	0	0	1	1	1	1	1	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0
23	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	1	0	0
24	1	1	1	1	0	0	0	1	1	1	1	1	0	1	1	0	1	0	0	1	0	1	1	1	0	0	0	1	0	0
25	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	0	0	1	0	1	0	0	1	1	0	1	0	0
26	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	–	–	0	1	0	0	0	0	0	1	0	1
27	0	0	–	–	0	0	0	1	0	1	1	1	1	–	0	1	0	1	–	–	–	–	0	0	–	0	0	1	0	–
28	0	0	–	–	0	0	0	1	0	1	1	1	1	–	0	1	0	0	–		–	–	0	0	–	0	0	1	0	–

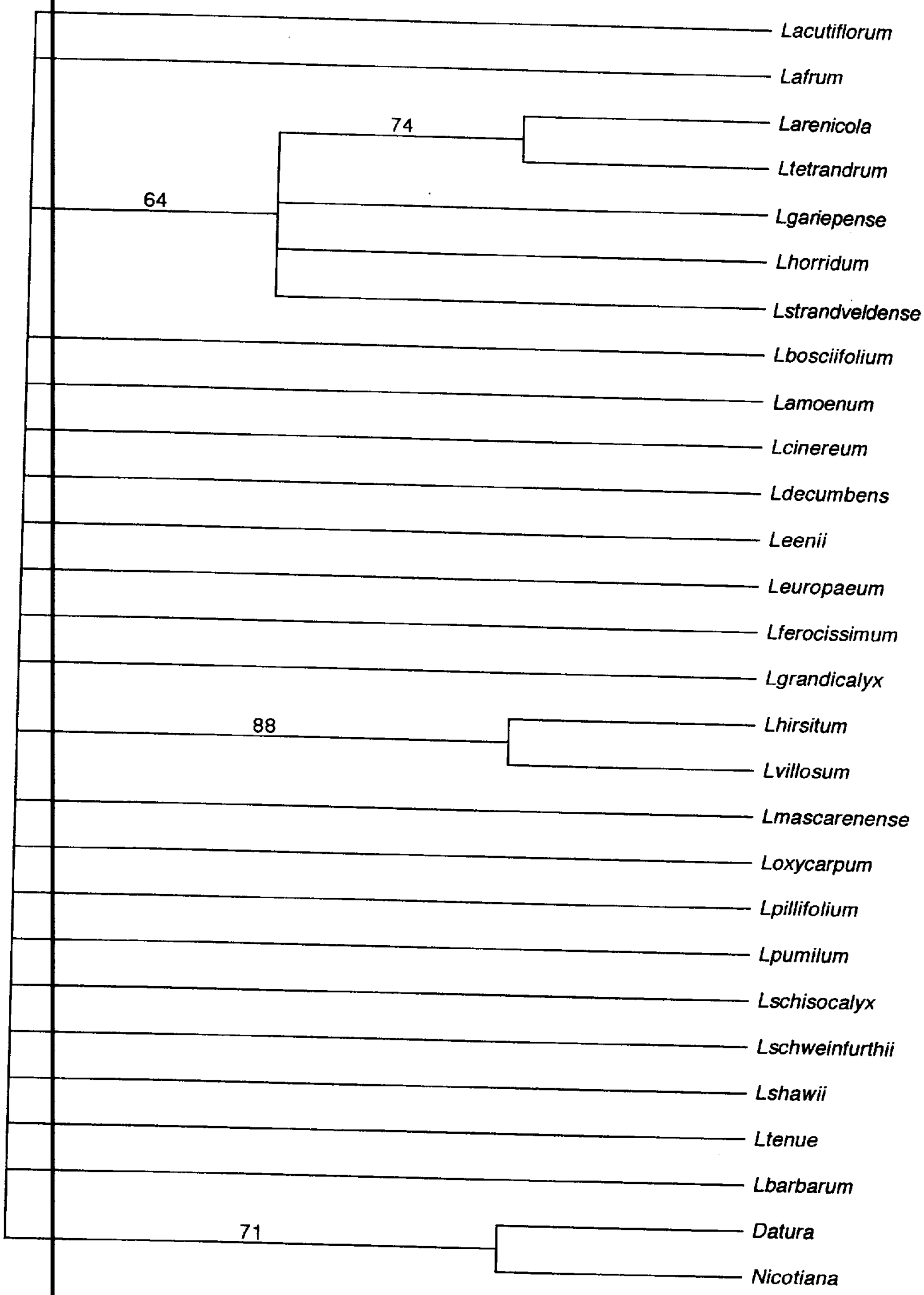


Figure 9.1 The strict consensus cladogram of the 62 most parsimonious trees, using PUAP and based on 30 characters. The bootstrap values are given for the 4 resolved clades, one of which consists of the outgroups, *Datura* and *Nicotiana*.

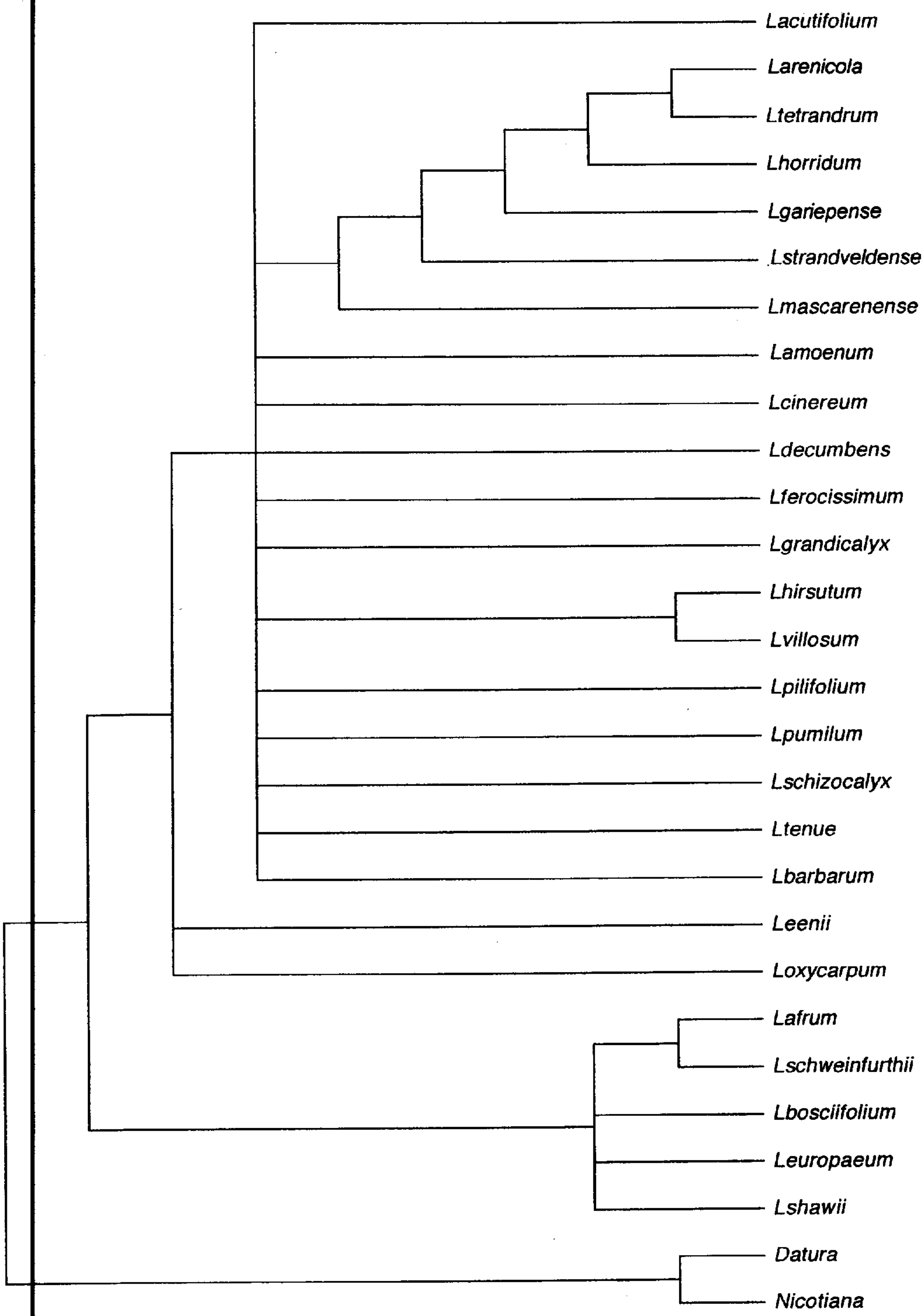


Figure 9.2 The strict consensus tree using PAUP, based on the data matrix consisting of 21 characters after elimination of 9 pylogenetically unimportant characters.

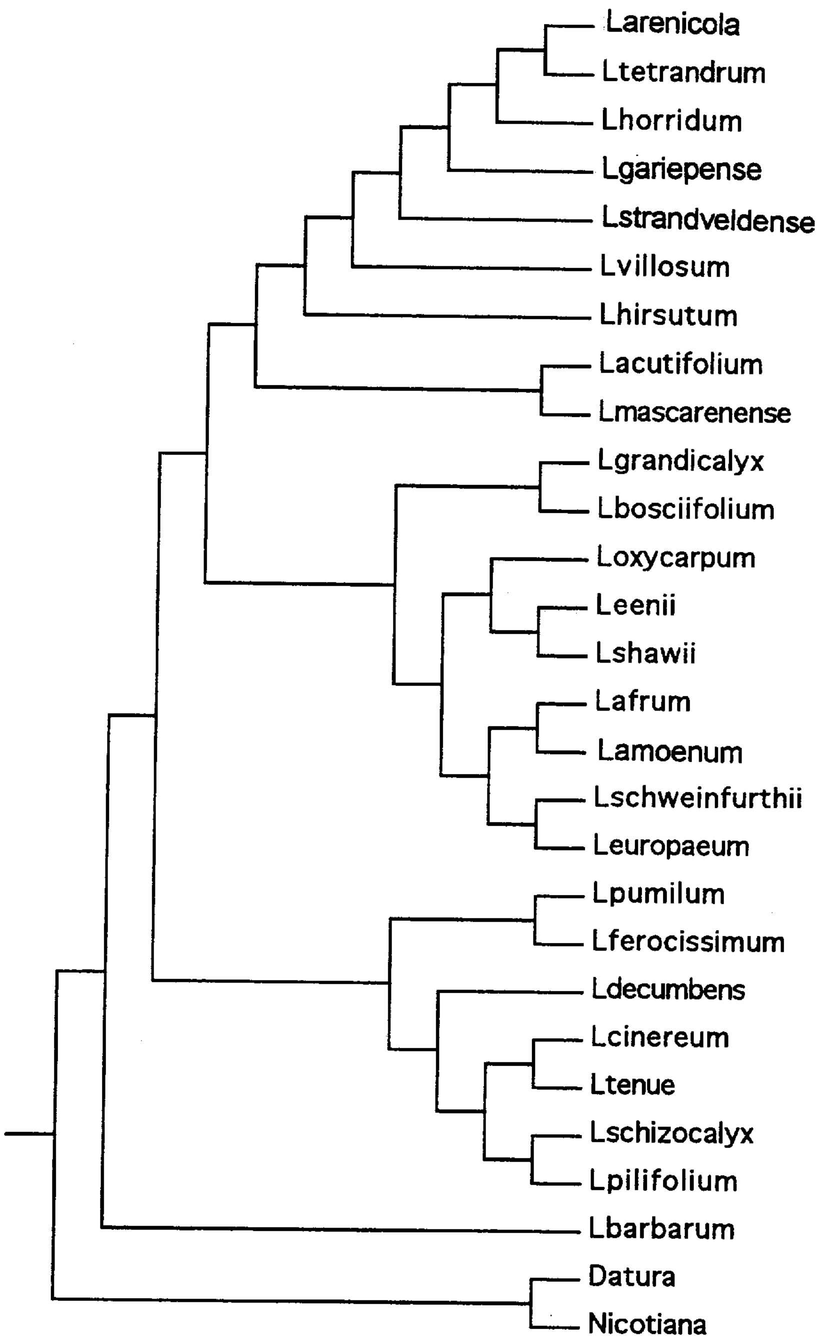


Figure 9.3 A most parsimonious reconstruction of relationships between African *Lycium* species using MacClade 3.04 and incorporating cladistic information from Tables 9.1 and 9.2.

CHAPTER 10

DISCUSSION AND CONCLUSION

The Solanaceae is economically, floristically, ethnobotanically and scientifically, one of the most important flowering plant families (Olmstead & Palmer 1992). The amount of systematic and biological interest in the family is attested to by four recent symposium volumes dedicated to the Solanaceae (Hawkes *et al.* 1979, 1991, D'Arcy 1986, Nee *et al.* 1999). The largest, most widespread and economically probably the most important genus, *Solanum*, has received much of the attention. The only other widespread genus, *Lycium*, does not have much of an economical impact and has consequently received less attention.

10.1 ORIGIN AND DISTRIBUTION

Evidence indicates that the Solanaceae is a Gondwanaland family with its centre of diversity in western Gondwanaland (the present South America) prior to the separation of South America and Africa from about 135 to 65 million years ago (Figure 10.1) (D'Arcy 1979, Hunziker 1979, Dietz & Holden 1970). However, Raven & Axelrod (1974) do not regard the Solanaceae as of great antiquity and state that migration between South America and Africa was still possible as late as the Early Paleocene (64 m.y. BP). This may explain the presence of the Solanaceae in Africa, even if the family is not of Gondwanan origin. The richness of the American solanaceous taxa, including a large number of endemics, attests to the above statement and it is notable that only two tribes occur exclusively outside the Americas (Symon 1991).

A Gondwanan or even somewhat later origin during the Cretaceous period and a spread of taxa before the final loss of contact between the super continent's parts, would present one possible explanation for the natural world-wide distribution of *Lycium* and *Solanum.* Important also, is the fact that *Lycium* occurs throughout the warm, semi-arid parts of the world. According to Chiang (1981) a global trend toward increasing aridity began during the Eocene and Oligocene periods, about 50 million years ago. Plants adapted to semi-arid conditions had a selective advantage and could spread and inhabit larger areas. This trend probably continued in the even more arid Miocene epoch of 25 million years ago and explains the great radiation and spread of *Lycium* northwards through South America and eventually to the arid regions of North America (Chiang 1981). The same may have happened in Africa where the radiation may have been from a centre of diversity in southern Africa (D'Arcy 1991) along a dry corridor (Winterbottom 1967) north-eastwards to the Somalia region. With the tropical belt and the Sahara Desert to isolate the extreme north of the continent, distinctive species may have evolved, e.g. *L. europaeum* and *L. schweinfurthii,* and North African species probably migrated into southern Europe, Arabia and Asia where they evolved into the present day species. This may have happened as long ago as the Early Paleocene (63 m.y. BP) when Africa and Eurasia drifted together and had been connected via Spain and Arabia, and once again some 17 m.y. ago (Cooke, 1972), before the final isolation some 6 million years ago with the flooding of the Mediterranean basin (Kurten 1969). The part that fructivorous birds played in *Lycium*'s distribution, was probably considerable. Unfortunately no *Lycium* fossils are known from Africa to support the above hypothesis of this taxon's evolution and migration(s) over Africa and into Europe and Asia.

The southern African *Lycium* species are concentrated in the Nama Karoo and Succulent Karoo Biomes (Low & Rebelo 1996), more or less from the Swartberg Mountain range in the south to the southern region of Namibia (Figure 10.2). The grassland and savanna east and north of the above mentioned biomes include the next largest concentrations of *Lycium* species. In the moister subtropical Kwazulu-Natal only two species occur, one in the savanna and the other on the sea front.

The most widespread of the *Lycium* species in Africa is *L. shawii* occurring from southern Africa through eastern Africa to north-eastern Africa (and into Arabia and Asia). In southern Africa the most widely spread species are *L. cinereum, L. horridum* and *L. schizocalyx*. All three species must have wide ecological amplitudes as they are found in a variety of habitats. Most of the *Lycium* species reveal positive correlation with brack or salt habitat, as well as limestone rock formations.

10.2 POLLINATION, DIOECY AND EVOLUTIONARY ADVANCED CHARACTERISTICS IN AFRICAN *LYCIUM* SPECIES

The search for a general classification and set of principles that will permit every taxon to fall into its place has led taxonomists to revive, modify and expand the concepts of the earlier taxonomists like De Candolle (*Prodromus systematis naturalis regni vegetabilis* (1823–1841)), Bentham & Hooker (*Genera Plantarum* (1862–1883)), and Engler & Prantl (*Die natürlichen Pflanzenfamilien* (1887–1915)). Bessey, in 1915, published "The phylogenetic taxonomy of flowering plants" in which he described and listed evolutionary principles on which a phylogenetic system should be based. Except for some changes and additions, his principles or dicta are still widely acknowledged. Cronquist (1968) states that relatively primitive and advanced characteristics occur in the same taxon because the evolution of different organs may proceed at different rates or a particular taxon's adaptation to environmental pressure will differ from another's. However, highly primitive and advanced characteristics are seldom mixed haphazardly. Within broad limits advanced characteristics tend to be associated, the same with primitive characteristics (Cronquist 1968). These principals were also implemented to decide on the primitive or advanced nature of the African lyciums.

Cronquist (1968) stated that pollination by insects and animals is one of the characteristics that set the flowering plants apart from the other groups of plants. In taking up insect pollination, flowering plants have exploited a new evolutionary opportunity. The advantage of insect pollination is the production of less pollen and large populations of plants are not required for efficient pollination. However, to attract pollinators, plants had to develop attractants such as nectar or had to reshape the flower. The nectaries of diverse angiosperm families have little in common beyond production of nectar. Nectaries may develop from reduced, modified stamens, modified corolla, or parts of the carpel may function as nectary.

In *Lycium* a circular nectiferous tissue is located in the ovary base (Bernardello 1986b, 1986c). Bernardello (1986c) found that nectar production differs according to the type of pollinator and is influenced by internal factors such as flower shape and size, and nectary surface, as well as external factors like soil and atmospheric humidity and temperatures. In South America *Lycium* species with long tubed corollas have hummingbirds as pollinators and they produce large quantities of less sweet nectar. Butterflies act as pollinators to the shorter tubed *Lycium* flowers, which produce nectar with a higher sugar content.

There are, as yet, no data available on the pollinators of the African *Lycium* species or on their nectar composition. Bird pollination seems likely in some of the long tubed species, e.g. *L. oxycarpum, as* honey seeking birds, e.g. the Malachite Sunbird (Sinclaire & Hockey 1996), do occur in the arid regions where *Lycium* grows. In Africa, however, the white, lilac, purple and maroon colours of *Lycium* flowers may not be attractive to bird pollinators.

The author's own observations indicate that the amount of nectar produced, correlate with the quantity of nectiferous tissue present. Those species with conspicuously enlarged red nectaries, like *L. tetrandrum, L.arenicola* and *L. villosum* produce nectar copiously. The long tubed species, like *L. oxycarpum,* with an inconspicuously shaped and coloured nectary, produce little nectar. *L. pumilum*, with a very short corolla tube, produces copious amounts of sweet smelling nectar. However, there does not seem to be a correlation between tube length and volume of nectar produced.

True dioecy ensures outcrossing, which is generally regarded as an evolutionary advantage (Symon 1979). However, this condition, depending on a go between for pollination, necessitates strategies for pollinator attraction. The development of a nectary is one method, and this could account for the retention of the nectary-associated ovary in the male flowers of the dioecious species of African lyciums. Pollen is the other important pollinator attractant. Pollination investigations, in some members of the Solanaceae, showed a strong association with solitary bees and Syrphid flies, the latter being a well known and indefatigable pollinator, preferring to visit white and blue flowers (Schneider 1969). In southern Africa both these groups are important pollinators (S. V. D. M. Louw, Department of Zoology and Entomology, University of the Orange Free State, Bloemfontein, pers. com.) and could, therefore, be considered as possible pollinators of *Lycium*. The white and lilac to mauve corolla colour would be acceptable to both pollinator types (Schneider 1969). It seems as though female Syrphid flies, in particular, require pollen for normal ovarian function and fecundity (Schneider 1969), explaining the possible importance of "anther attraction" in the female *Lycium* flowers. Bees need pollen and nectar as food and to feed their larvae (Symon 1979), which may explain the "double" reward of nectar and pollen offered by *Lycium's* male flowers and nectar and anthers, even though empty, in female flowers.

The dioecious condition, as well as the presence of a red conspicuously enlarged nectary, are considered as advanced in the African *Lycium*. The significance of the red coloured nectary is still a mystery. Associated with these characteristics are relatively short, tubular to narrowly funnel-shaped white corolla tubes and small, spreading, lilac or mauve coloured lobes.

10.3 HYBRIDIZATION AND SPECIATION

One of the most important mutation types is the duplication of genes, which creates extra copies of genes that are free to mutate into new genes. A large portion of these new genes are apparently the product of gene duplication resulting in polyploidy (Judd *et al.* 1999). Polyploidy is a characteristic feature of the plant kingdom (Grant 1981).

Six of the African *Lycium* species are polyploids. Whether their origin could be ascribed to autopolyploidy, resulting from the union of two or more chromosome complements from the same species or to allopolyploidy, resulting from the union of two or more different genomes (Judd *et al.* 1999), needs further chromosomal investigation. Preliminary chromosomal analyses suggest gene duplication being responsible for polyploidy in *L. tetrandrum.* Chromosomal abnormalities in the other 5 dioecious species suggest hybridization as the source of their polyploidy, and *L. tetrandrum* being one of the parent species. Hybridization is prevalent in many of the flowering plants, especially between species of certain genera (Judd *et al.* 1999). It can create complex patterns of variation and disguise the morphological distinction between species, with evident taxonomic implications as experienced in the African *Lycium* species.

Hybrids are sometimes inviable and then do not reach productive maturity, or they may be perfectly vigorous but sterile due to a failure of successful pairing of the chromosomes during meiosis (Judd *et al.* 1999). Another situation in hybridization occurs when the first-generation plants are viable and fertile but later-generation individuals become inviable or sterile, a process called hybrid breakdown. However, hybridization could also have ecological consequences in so far as genetic diversity and adaptation may result, ultimately, in creating new species (Judd *et al.* 1999).

Interspecific hybridization is critically important in plant evolution as a source of novel gene combinations and as a mechanism of speciation (Judd *et al.* 1999) as was found in the African *Lycium* species. Hybridization is often associated with habitat disturbance. The ecological adaptations that isolate two species may be broken down by natural disturbance that create a habitat suitable for the hybrids. Reduced competition in the wake of disturbance may also favor the growth of hybrids (Judd *et al.* 1999). This could have played a role in the establishment of the "new *Lycium* species", such as *L. strandveldense* which grows in conditions exposed to the harsh salt spray of the coastal zone, or *L. gariepense* which inhabits extremely dry and hot, inhospitable desert country.

Chromosome number in the African lyciums proved to be of taxonomic and diagnostic value with a clear distinction between the diploid hermaphrodite species and the polyploid dioecious species. Polyploidy in *Lycium* is considered to be an advanced condition, an assumption confirmed by the other advanced features of the dioecious species. One of the benefits of polyploidy is the greater physiological buffering in their genotypes, as compared to diploids, owing to the presence of numerous duplications (Grant 1981). Most of the species have pentamerous flowers, but in the two hexaploids, *L. arenicola* and *L. tetrandrum,* about half of the flowers on some plant individuals are tetramerous which may indicate a process of reduction of flower size in progress, and which could then be considered as advanced. All aspects considered, these two species could be regarded as the most highly evolved species of *Lycium* in Africa.

10.4 CLASSIFICATION

Hitchcock (1932), Pojarkova (1955), Bernardello (1987) classified the *Lycium* species of the Americas, Asia and South America respectively into sections as discussed in Chapter 2. The author made no attempt in the present treatment to classify the *Lycium* species of Africa, although they naturally separate into two groups, namely the hermaphrodite and the dioecious species respectively. However, the above mentioned regionally based classifications can not be applied successfully to *Lycium* world wide, because none of them can accommodate the whole spectrum of *Lycium* characteristics. A future classification, including all the *Lycium* species from the different continents, is thus envisaged by the present author.

10.5 NOMENCLATURE

No less than 101 species and 25 varieties were described for Africa and only 25 proved to be correct. Enormous variability in characteristics was responsible for the large number of taxa created. It also became clear that many taxa were based on small, inconsistent differences, such as degree of hairiness of the corolla tube internally. These characteristics were consequently not acknowledged which lead to the drastic reduction in the number of African *Lycium* species.

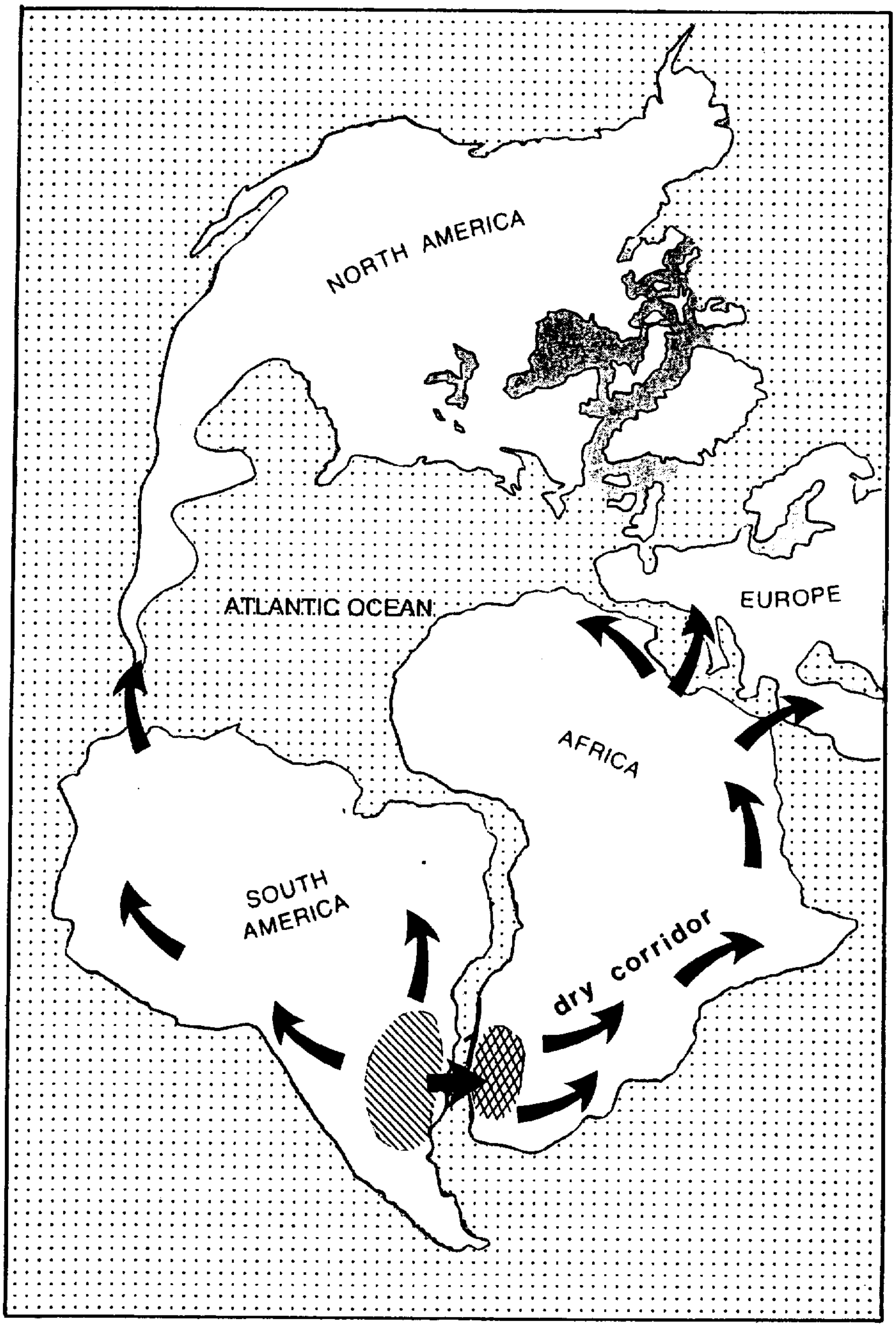


Figure 10.1 Hypothetical radiation of *Lycium* from a South American origin, 65 – 6 million years ago. (Continent outlines and position according to Kurten (1969)).

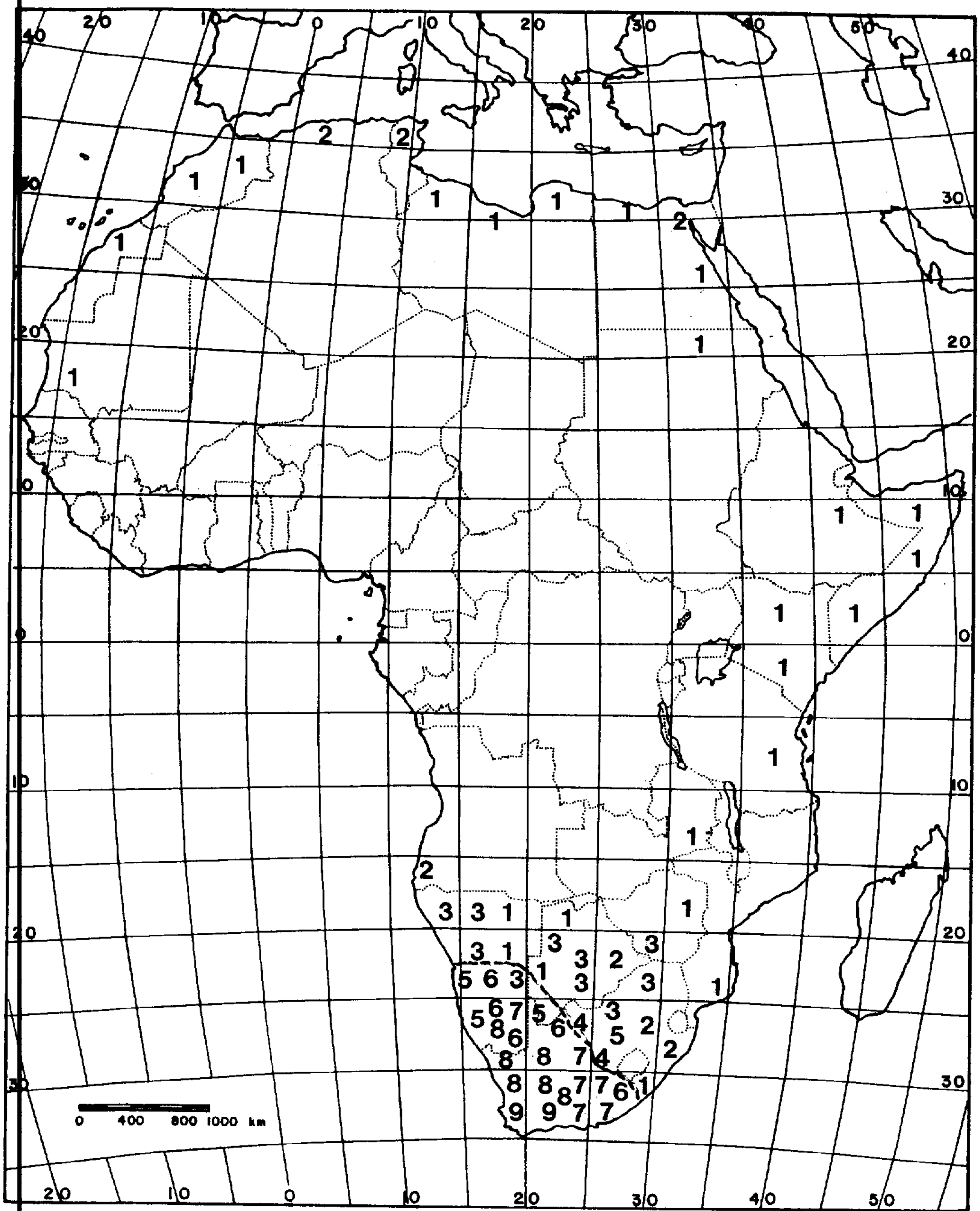


Figure 10.2 Concentration of *Lycium* species in Africa
[Numbers = number of species per 1° grid].

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ALPHABETICAL REGISTER OF *LYCIUM* IN AFRICA

= *Acnistus* Miers (*Lycium*)

= *Jasminoides* Medik. (*Lycium*)

=*Jasminoides aculeatum* Micheli (*L. europaeum*)

= *J. africanum, jasmini aculeati foliis et facie* Nissole (*L. afrum*)

= *J. Sinense Halimifolio* Duhamel (*L. barbarum*)

= *Johnsonia* Neck. (*Lycium*)

= *Lycioplesium* Miers (*Lycium*)

= *Lycium abeliiflorum* Rchb.f. (*L. shawii*)

= *L. aciculare* Dammer (*L. bosciifolium)*

L. acutifolium E. Mey. ex Dunal

= *L. acutifolium* var. *angustifolium* Dunal (*L. acutifolium*)

≡ *L. acutifolium* var. *latifolium* Dunal (*L. acutifolium)*

L. afrum L.

= *L. afrum* var. *brevifolium* Dunal (*L. afrum)*

= *L. afrum* var. *longifolium* Dunal (*L. afrum*)

= *L. afrum* var. *subulatum* Dunal (*L. afrum*)

= *L. albiflorum* Dammer (*L. shawii*)

= *L. amoenum* Dammer

L. angustifolium Mill. (imperfectly known species)

= *L. apiculatum* Dunal (*L. horridum*)

≡ *L. apiculatum* var. *brevifolium* Dunal (*L. horridum*)

= *L. apiculatum* var. *longifolium* Dunal (*L. horridum*)

= *L. arabicum* Schweinf. ex Boiss. (*L. shawii*)

L. arenicola Miers

= *L. aschersonii* Dammer (*L. schweinfurthii*)

= *L. austrinum* Miers (*L. oxycarpum*)

≡ *L. bachmannii* Dammer (*L. afrum*)

= *L. bachmannii* Schinz (*L. ferocissimum*)

L. barbarum L.

= *L. barbarum* var. *brevilobum* Post (*L. europaeum*)

L. barbatum Thunb. (not a *Lycium* species)

L. bosciifolium Schinz

= *L. caespitosum* Dinter & Dammer (*L. cinereum*)

= *L. campanulatum* E. Mey. ex C.H.Wright (*L. amoenum, nom. illegit.*)

L. capense Mill. (imperfectly known species)

= *L. carnosum* Poir. (*L. afrum*)

L. cinereum Thunb.

= *L. colletioides* Dammer (*L. pumilum*)

L. cordatum Mill.(not a *Lycium* species)

= *L. crassifolium* Salisb. (*L. afrum*)

= *L. cufodontii* Lanza (*L. shawii*)

L. decumbens Welw. ex Hiern

= *L. dinteri* Dammer (*L. pilifolium*)

= *L. dunaloides* Dammer (*L. bosciifolium*)

= *L. echinatum* Dunal (*L. horridum*)

L. eenii S. Moore

= *L. eleutherosiphon* C.H.Wright (*L. horridum*)

= *L. ellenbeckii* Dammer (*L. shawii*)

= *L. emarginatum* Dammer (*L. bosciifolium*)

= *L. engleri* Dammer (*L. pumilum*)

= *L. erythraeum* Schweinf. ex Vatke (*L. shawii*)

L. europaeum L.

= *L. europaeum* var. *ramulosum* (*L. schweinfurthii*)

L. ferocissimum Miers

L. gariepense A.M. Venter

= *L. glandulosissimum* Schinz pro parte (*L. hirsutum*)

= *L. glandulosissimum* Schinz pro parte (*L. pilifolium*)

= *L. glossophyllum* Dammer (*L. bosciifolium*)

L. grandicalyx Joubert & Venter

= *L. hamilifolium* Mill. (*L. barbarum*)

L. hirsutum Dunal

≡ *L. hirsutum* var. *ochraceum* Dunal (*L. hirsutum*)

= *L. hirsutum* var. *cinerascens* Dunal (*L. hirsutum*)

L. horridum Thunb.

= *L. inerme* L.f. (*Canthium inerme* (L.f.) Kuntze) (Ross 1975)

L. italicum Mill. (not a *Lycium* species)

= *L. jaegeri* Dammer (*L. shawii*)

= *L. javellense* Lanza (*L. shawii*)

= *L. karasbergense* Bolus (*L. pumilum*)

= *L. kraussii* Dunal (*L. horridum*)

= *L. lanceolatum* Veill. (*L. barbarum*)

= *L. lancifolium* Dammer (*L. eenii*)

= *L. leptacanthum* C.H.Wright (*L. horridum*)

= *L. macrocalyx* Dammer (*L. ferocissimum*)

= *L. marlothii* Dammer (*L. tetrandrum*)

≡ *L. mediterraneum* Dunal (*L. europeum*)

= *L. mediterraneum* var. *cinereum* Dunal (*L. shawii*)

= *L. mediterraneum* var. *cinnamoneum* Dunal (*L. shawii*)

= *L. mediterraneum* var. *glabrum* Dunal (*L. europaeum*)

= *L. mediterraneum* var. *leptophyllum* Dunal (*L. europaeum*)

= *L. mediterraneum* var. *leucocladum* Dunal (*L. shawii*)

= *L. mediterraneum* var. *ramulosum* Dunal (*L. schweinfurthii*)

= *L. merkeri* Dammer (*L. shawii*)

= *L. microphyllum* Loisel. (*L. tetrandrum*)

= *L. minutiflorum* Dammer (*L. horridum*)

= *L. namaquense* Dammer (*L. bosciifolium*)

= *L. natalensis* Dammer (*L. horridum*)

= *L. omahakense* Dammer (*L. horridum*)

= *L. orientale* Miers (*L. europaeum*)

= *L. ovinum* Dammer (*L. shawii*)

L. oxycarpum Dunal

= *L. oxycarpum* var. *angustifolium* Dunal (*L. oxycarpum*)

≡ *L. oxycarpum* var. *grandiflorum* Dunal (*L. oxycarpum*)

= *L. oxcyarpum* var. *parviflorum* Dunal (*L. horridum*)

= *L. oxycladum* Miers (*L. horridum*)

= *L. pauciflorum* Dammer (*L. bosciifolium*)

= *L. pendulinum* Miers (*L. acutifolium*)

= *L. persicum* Miers (*L. shawii*)

L. pilifolium C.H.Wright

= *L. pilosum* Dammer (*L. hirsutum*)

= *L. propinquum* G.Don (*L. afrum*)

= *L. prunus-spinosa* Dunal (*L. cinereum*)

L. pumilum Dammer

= *L. rangei* Dammer (*L. bosciifolium*)

= *L. rigidum* Thunb. (*L. afrum*)

= *L. rigidum* var. *angustifolium* Dunal (*L. amoenum*)

= *L. rigidum* var. *latifolium-grandiflorum* Dunal (*L. amoenum*)

= *L. rigidum* var. *latifolium-parviflorum* Dunal (*L. amoenum*)

= *L. roridum* Miers (*L. cinereum*)

= *L. roseum* Bolus (*L. pumilum*)

= *L. salinicolum* Verdoorn (*L. pumilum*)

= *L. schaeferi* Dammer (*L. bosciifolium*)

L. schizocalyx C.H.Wright

= *L. schoenlandii* Dammer (*L. horridum*)

L. schweinfurthii Dammer

L. schweinfurthii var. *ashersonii* Feinbrun (*L. schweinfurthii*)

= *L. seineri* Dammer (*L. cinereum*)

L. serpyllifolium Dunal (not a *Lycium* species)

L. shawii Roem. & Schult.

= *L. sokotranum* A.Wagner & Vierh. (*L. shawii*)

= *L. somalense* Dammer (*L. europaeum*)

= *L. squarrosum* Dammer (*L. bosciifolium*)

L. strandveldense A.M. Venter

L. tenue Willd.

= *L. tenue* var. *sieberi* Dunal (*L. mascarenense*)

= *L. tenuiramosum* Dammer (*L. shawii*)

L. tetrandrum L.f.

= *L. thunbergii* G.Don (*L. barbarum*)

= *L. trothae* Dammer (*L. eenii*)

= *L. tubulosum* Nees (*L. oxycarpum*)

= *L. turbinatum* Veill. (*L. barbarum*)

= *L. undulatum* Dammer (*L. horridum*)

L. villosum Schinz

= *L. vulgare* Dunal (*L. barbarum*)

= *L. withaniifolium* Dammer (*L. shawii*)

= *L. woodii* Dammer (*L. cinereum*)

= *Rhigosum angolense* Bamps (*L. decumbens*)

OPSOMMING

'n Taksonomiese hersiening van *Lycium* L. (Solanaceae) in Afrika word aangebied. Hierdie hersiening bestaan uit ondersoeke na die mikromorfologie van stuifmeel, saadhuide en blaaroppervlakke; meiotiese chromosoomgetalle; geslagtelikheid en tweehuisigheid; makromorfologie van plantdele; nomenklatuur; geografiese verspreiding oor Afrika; ekologiese eienskappe; kladistiese ontledings van die spesies wat in Afrika onderskei is. Hierdie ondersoeke het gelei tot die beskrywings en nomenklatoriese verklarings van die verskillende Afrika-spesies van *Lycium* en tot die opstel van 'n uitkenningsleutel.

Herbariummateriaal uit 38 herbariums, waarvan 18 in Afrika en die res verspreid oor Europa, is bestudeer. Aangesien die taksonomie van *Lycium* in Afrika 'n nagmerrie van verwarring oor wat ware spesies is, geblyk het te wees, en omdat *Lycium* swak herbariumeksemplare maak en baie van die unieke eienskappe dus verlore gaan, is vars materiaal van al die soorte in die veld versamel vir die ondersoek. Vars materiaal is ook gebruik vir die chromosoom- en DNA-ontledings (laasgenoemde nie in hierdie proefskrif bespreek nie).

Op sekere uitsonderings na, is alle tipe-eksemplare wat op *Lycium* in Afrika betrekking het, gevind en ondersoek. Die uitsonderings is hoofsaaklik die tipe-eksemplare wat tydens die tweede wêreloorlog in die Berlynse Herbarium vernietig is, en waarvan daar nie elders in ander herbariums duplikate opgespoor kon word nie. Waar holotipes nie beskikbaar was nie of waar sintipes aangewys is, is lektotipes uit die beskikbare isotipes, sintipes of ekonotipes aangewys.

Die spesies van *Lycium* besit 'n redelik eenvormige morfologie, beide vegetatief en generatief, en dus is daar selde goeie onderskeidende eienskappe teenwoordig. Hiermee saam is daar ook soveel variasie in elke afsonderlike soort dat onderskeiding nog vaer word. Slegs deur toegang tot 'n groot aantal herbariumeksemplare en wye persoonlike versameling kon onderskeidende patrone of kombinasies van eienskappe uitgelig word om afbakening en uitkenning van spesies moontlik te maak.

Groeivorm van die plant, blaarvorm en eienskappe van die blom, soos een- of tweeslagtigheid, kelkvorm, grootte van die kelk in verhouding tot die kroon, die kroon se kleur, grootte en vorm is almal belangrike diagnostiese kenmerke. Beharing is in enkele gevalle diagnosties uniek.

Lycium in Afrika bestaan uit tweeslagtige of tweehuisige spesies. Die plante is houtagtige, digvertakte, doringagtige, regop, klimmende of neerliggende struike of selde bome. *Stingels* besit dorings en bragiblaste. *Blare* alleenstaande of in klossies op bragiblaste gedra, gewoonlik klein en meestal halfsukkulent. *Blomme* 1 of 2 per bragiblast, tweeslagtig of funksioneel eenslagtig. *Kelk* trompet-, klok- of buisvormig. *Kroon* trompet-, klok- of buisvormig, 4–5-delig, heeltemal wit of wit met pers lobbe/merke, of geheel rooipers tot pers. *Meeldrade* kroonstandig, soveel as kroonblare, ingesluit of opvallend uitgestoot; helmdrade met harige kwas aan basis, helmdrade almal vrugbaar in tweeslagtige of funksioneel manlike blomme, steriel in funksioneel vroulike blomme. *Stamper* met 2-hokkige, veelsadige vrugbeginsel en basale ringvormige rooi tot geelgroen nektarklier; styl draadvormig met stempel aan top in funksioneel vroulike blomme, styl afgeknot en stempel afwesig in funksioneel manlike blomme. *Vrug* 'n bessie.

Lycium, met wêreldwyd ongeveer 75 spesies, kom in die droë streke van Suid- en Noord-Amerika, Eurasië en Afrika voor, met die grootste konsentrasie in Suid-Amerika. In Afrika word die grootste konsentrasie van spesies, 23 in totaal, in suider-Afrika aangetref, een kom in oostelike Afrika voor en drie in noordelike Afrika. Een soort, *L. shawii,* is vanaf Suid-Afrika tot in Iran, Asië, versprei en besit dus die wydste verspreiding van alle *Lycium*-spesies.

In suider-Afrika word *Lycium* spesies in die sub-woestynagtige namib-karoo struikveld of in savanna en stroomoewer woud aangetref, een spesie selfs in strandduinplantegroei waar dit aan soutmis uit die see blootgestel is. In die suidweste van suider-Afrika ondervind die *Lycium*-spesies winterreëns, elders somerreëns. In noordelike Afrika kom die *Lycium*-spesies onder winterreëntoestande in struikveld van die halfwoestyn of woestyn voor.

Die *Lycium*-spesies van Afrika word in 'n verskeidenheid habitatte aangetref, wat in die suide wissel van droë vlaktes, dreineringslyne en panne tot heuwelhange in 'n verskeidenheid grondsoorte, wat van sand tot klei varieer. In die noorde word hulle in droë wadis en blootgestelde sandvlaktes gevind. Die *Lycium*-spesies is dikwels met halofitiese grondtoestande te assosieer.

Histories is 101 spesies en 25 variëteite vir *Lycium* in Afrika beskryf of benaam. Na die hersiening het daar, vir Afrika, 26 spesies oorgebly, waarvan 22 endemies is, 3 inheems is en 1 ingebring. geen subspesies of variëteite word onderskei nie.

Sleutelwoorde: Afrika, *Lycium* (Solanaceae), mikromorfologie, pallinologie, seksualiteit, sitogenetika, taksonomie.

SUMMARY

A taxonomic revision of *Lycium* L. (Solanaceae) in Africa is presented. This revision comprises investigations into the micro-morphology of pollen, seed coats en leaf surfaces; meiotic chromosome numbers; sexuality and dioecy; macro-morphology of plant parts; nomenclature; geographic distribution over Africa; ecological characteristics and cladistic analyses of the species distinguished in Africa. These investigations resulted in discriptions with appropriate nomenclature of the different African *Lycium* species and to the compilation of an identification key.

Herbarium material from 38 herbariums, of which 18 are from Africa and the remainder dispersed over Europe, was studied. As the taxonomy of *Lycium* in Africa proved to be a nightmare of confusion as to what constitute real species, and since *Lycium* makes poor herbarium specimens and many of its unique characteristics thus get lost, fresh material of all the species was collected in the field for investigation. Fresh material was also used for the chromosome and DNA analyses (the latter not reported on in this thesis).

With certain exceptions, all type specimens related to *Lycium* in Africa have been found and studied. The exceptions are mainly type specimens that got destroyed in the Berlin Herbarium during the second world war, and of which no duplicates could be located elsewhere in other herbaria. In those cases where no holotypes were found, or where syntypes were given, lectotypes were designated from the available isotypes, syntypes or econotypes.

The *Lycium* species are rather uniform in their morphology, vegetative as well as generative, and therefore sound differential characteristics are seldom present. On the other hand so much variability occurs within each species that distinction between species becomes even more obscure. It was only through accessibility to a large number of herbarium specimens and wide personal collecting that distinctive patterns or combinations of characteristics became clear, thus permitting the distinction and delimitation of species.

Growth form of the plant, characteristics of the leaf, characteristics of the flower, such as uni- or bisexuality, shape and size of the calyx in relation to that of the corolla, the colour, size and shape of the corolla, these are all important diagnostic characteristics. Indumentum is diagnostically unique in a few species.

Lycium in Africa consists of bisexual or dioecious species. The plants are woody, densely branched, thorny, erect, climbing or prostrate shrubs or seldom trees. *Stems* with thorns and brachyblasts. *Leaves* solitary or in clusters on the brachyblasts, usually small and mostly semi-succulent. *Flowers* 1 or 2 per brachyblast, bisexual or functionally unisexual. *Calyx* trumpet-shaped or campanulate or tubular. *Corolla* trumpet-shaped or campanulate or tubular, 4–5-merous, completely white or white with violet lobes/marks, or completely reddish violet to violet. *Stamens* epipetalous, equal to number of petals, included or conspicuously exserted; filaments with basal hairy muff, anthers all fertile in bisexual and functionally male flowers, sterile in functionally female flowers. *Pistil* with 2-locular ovary and numerous ovules, with basal annular red to yellow-green nectary; style filiform with apical stigma in functionally female flowers, style stunted and stigma absent in functionally male flowers. *Fruit* a berry.

Lycium, with approximately 75 species world wide, occurs in the arid regions of South - and North America, Eurasia and Africa, with the main concentration in South America. In Africa the largest concentration of 23 species are found in southern Africa, one occurs in eastern Africa and three in northern Africa. One species, *L. shawii*, is spread from South Africa to Iran, Asia, and thus has the widest distribution of all *Lycium* species.

In southern Africa the *Lycium* species occur in sub-desert namib-karoo scrubland or in savanna or in stream bank forest, one species is even found in the beach dune vegetation where fully exposed to sea salt spray. The species of the south-west of southern Africa experience winter rainfall conditions, the others summer rainfall. In northern Africa the *Lycium* species are found in semi-desert or desert scrub where winter rains prevail.

The African *Lyciums* are found in a variety of habitats that, in the south, vary from arid flats, drainage lines and pans to hill sides in a variety of soil types ranging from sand to clay. In the north they are found in dry wadis and on exposed sand flats. The *Lycium* species are often associated with halophytic soil conditions.

Historically 101 species and 25 varieties were described or named for *Lycium* in Africa. After completion of the revision, 26 species of *Lycium* remained for Africa. Twenty two of these are endemic to Africa, three are indigenous and one is introduced. No subspecies or varieties were distinguished.

Keywords: Africa, *Lycium* (Solanaceae), cytogenetics, micromorphology, palynology, sexuality, taxonomy.

ACKNOWLEDGEMENTS

My sincere appreciation and gratitude to the following persons and institutions who contributed in some way towards the completion of this thesis.

♦ My promotor, Prof. H. J. T. Venter, who has guided my academic footsteps for many years. Without his guidance and invaluable taxonomic insight and knowledge, I could not have completed my work.

♦ My co-promotor, Prof. R. L. Verhoeven, for his assistance, valuable suggestions and comments, and thoroughness which provided an example worthy of emulation.

♦ The curators of the different herbaria, listed in chapter 3, who allowed me to examine their collections or sent the material on loan.

♦ The staff of the National Herbarium in Pretoria, for their time and friendly assistance.

♦ Mrs Estelle Potgieter of the National Herbarium Library for her invaluable assistance and efficient attention to each request.

♦ A special word of appreciation to the staff of Kew Herbarium where I spent quite a number of happy and productive months, especially to Dr David Goyder and Ms Sally Bidgood of Wing C.

♦ Mrs Tessa Claasen whose ability to revitalize herbarium specimens in black and white drawings, is amazing, as well as Dr Louis du Preez and Mrs Celia Roets who produced the excellent colour illustrations for the thesis.

♦ Technical assistance from Miss Gerda Botha for micromorphology; Mrs. Helene Kriel for herbarium specimens, new and borrowed, Miss Susan van Wyk for the chromosomal preparations, Mrs Joan Walker for typing the specimen lists and Martin Wilding for assistance with the scanner.

♦ Cladistical assistance from Miss Rouvay Roodt and Prof. Johan Spies for cytogenetical and cladistical insight.

♦ True friends, colleagues and students for their interest in my work, constant encouragement and friendship that carried me through the rough patches.

♦ My parents who had a dream for my future, who were the first to guide and encourage me to do my best and achieve according to my ability.

♦ My sister for unfailing love and support.

♦ My husband who has encouraged, motivated and supported me, unfailingly, throughout this study, and who was my travelling companion for many kilometers in search of material and information.

For the privilege of discovering and studying the wonders of Creation, I feel a deep and humble gratitude.

APPENDIX : SPECIMEN LIST

This list is representative of the distribution of the different species and not the complete set of specimens examined

L. acutifolium

South Africa:

26S 32E (–CC)	Ndumu Game Reserve.	Ross, J. H. 1914	12/2/1969	PRE, NH, NU
26S 32E (–CC)	Ndumu Game Reserve, KwaZulu-Natal.	Tinley, K. L. 556	19/11/1959	K, NH
28S 30E (–AA)	Kranskop district, Inadi valley near Kranskop.	Acocks, J. P. H. 11614	12/8/1945	NH
28S 30E (–BB)	Rooikop, Natal.	Evans, M. S. 143	0/3/1894	NH
28S 31E (–BB)	Zululand, Hlabisa district.	Ward, C. J. 2339	1/6/1954	PRE, NH, NU
28S 31E (–BD)	Umfolozi Game Reserve.	Bourquin, O. 497	16/9/1965	PRE, NH
28S 31E (–BD)	Umfolozi Game Reserve.	Ward, C. J. 4407	27/9/1962	PRE, NH
28S 31E (–BD)	Umfolozi Reserve, Mbuzana area.	Fakude, E. N. 99	25/2/1967	NU, NH
28S 31E (–BC)	Umfolozi Game Reserve, near Mpila Rest camp.	Venter, A. M. 483	18/4/1995	BLFU
28S 31E (–CD)	Umfolozi Game Reserve, 1 km on Tobothi turn-off.	Reyneke, A. M. 225	13/12/1988	BLFU
28S 31E (–CD)	Umfolozi Game Reserve, Tobothi turn-off.	Reyneke, A. M. 226	13/12/1988	BLFU
28S 31E (–CD)	Umfolozi Game Reserve, Tobothi loop.	Downing, B. 607	10/11/1969	K, PRE
28S 32E (–AA)	Natal, Hluhluwe Game Reserve.	Tinley & Ward 43	8/12/1959	K, PRE, NH
28S 32E (–AA)	12 km from Hluhluwe turn-off from Nongoma road.	Wells, M. J. 2053	19/11/1960	K
29S 29E (–BB)	Camperdown.	Moll, E. J. 1882	18/8/1965	PRE, K, NH
29S 30E (–AB)	Greytown, 26 km to Mooi River.	White, F. 10507	10/3/1973	PRE
29S 30E (–AD)	Albert Falls, Natal.	Comins, D. M. 528	4/4/1952	NU
29S 30E (–BC)	Natal, Botha's Hill.	Hutchinson, 4667	3/9/1930	K
29S 30E (–CB)	Pietermaritzburg, Table mountain.	Killick, D. J. B. 351	10/2/1945	PRE, NH, NU
29S 30E (–CD)	Richmond, Mahlaken River.	Storey, 668	22/11/1945	PRE
29S 30E (–DA)	At Nagel Dam, Camperdown district.	Ward, C. J. 4689	7/9/1963	PRE, NH
29S 30E (–DA)	Valley of Thousand Hills, 50 km inland from Durban.	Watmough, R. 472	3/1/1961	PRE, K
29S 30E (–DA)	Natal, Nagledam, Camprdown district.	Wells, M. J. 1391	13/6/1957	K, NH
29S 30E (–DA)	Natal, Craiglea.	Du Toit, P. C. V. 2429	19/6/1977	PRE, NH
29S 30E (–DB)	Inanda, Natal.	Wood, J. M. 910	0/4/1890	K, BM, NH
29S 30E (–DD)	Reservoir Hills off Burlington Drive, Umgeni River.	Baijnath, H. 437	21/5/1967	NU, PRE, UN
29S 31E (–AA)	Umgeni.	Wood, J. M. 12574	9/2/1914	PRE, NU
29S 31E (–AD)	Mauges, Stanger area 100 km from the sea.	Sutherland, s.n.	0/0/1856	K
29S 31E (–CA)	Near Verulam, Natal.	Wood, J. M. 1129	0/10/1881	K, BM, NH
29S 31E (–CC)	7 km from Umgeni River mouth.	Schlechter, R. 2849	28/6/1893	K, BM, GRA
29S 31E (–CC)	Ebenezar.	Drége, 7872	0/11/1833	G, P
29S 31E (–CC)	Port Natal, Durban.	Grant, s.n.	0/0/1897	K, PRE
29S 31E (–CC)	Near Durban.	Moos, C. E. 4786	21/71918	BM
29S 31E (–CC)	Durban.	Thode Ex Justus, 5117	6/1/1916	STE
29S 31E (–CC)	Berea near Durban.	Wood, J M 123	0/9/1883	K, NBG, BM
29S 31E (–CC)	Durban.	Wood, J M 6122	22/6/1896	BOL
30S 30E (–CA)	Natal: Umzimkulu Gorge, Oribi Flats.	McLean, A. P. D. 406	0/4/1937	K, NH, P
30S 30E (–CB)	Port Shepstone district, Umzimkulu, Horseshoe farm.	Strey, R. G. 5864	5/8/1965	PRE, NU, NH
30S 30E (–CB)	Port Shepstone district, Umzimkulu, Horseshoe farm.	Strey, R. G. 7455	27/3/1967	K, PRE, NU
31S 28E (–CD)	Bashe River, Umtata.	Schlechter, R. 6302	16/1/1895	GRA
31S 28E (–DB)	Umtata, Cap de Bonne Esperanze.	Drege, 4874 b.	-	P
31S 29E (–BC)	Pondoland: Egossa.	Sim, T. R. s.n.	0/8/1899	PRE
31S 29E (–CB)	Umganza.	Mac Nae s.n.	11/2/1961	PRE
31S 29E (–CC)	Transkei, Ntaba Estuary, Port St John's.	Ward, C. J. 8713	30/8/1974	PRE, K
32S 26E (–DD)	Fort Beaufort, Good Hope farm, 10 km E of Alice.	Gibbs-Russell, 4004	13/10/1977	PRE
32S 28E (–AD)	Transkei, confluence of Qora at Ngqageni Rivers.	Ward, C J 5778	3/7/1966	PRE, NH
32S 28E (–BD)	Willowvale district, Dwessa Forest.	Acocks, J. P. H. 13602	19/4/1947	PRE, K
32S 28E (–BD)	Dwesa Nature Res., Ngabara River crossing to Dwes	Van Wyk, A. E. 8349	2/8/1988	PRE
33S 27E (–AA)	Peddie, Cape.	Compton, R. H. 17843	30/11/1945	NBG
33S 27E (–AB)	Begha River valley opposite Wooldrige, Peddi division.	Acocks, J. P. H. 11888	20/10/1945	PRE, K
33S 28E (–BD)	Dwesa Forrest, Willowvale district.	Acocks J. P. H. 13602	–	PRE, K

L. afrum

South Africa:

31S 18E	(–AD)	Matjiesgoeddrif near Piquetberg, NE of Verloren Vlei.	Pillans, N. S. 7895	17/10/1935	K, BOL
31S 18E	(–DA)	Van Rhynsdorp, near Olifants River.	Drege, s.n.	–	K
31S 18E	(–DA)	32 km SS W of Vredendal.	Acocks, J. P. H. 19714	26/8/1958	PRE
31S 18E	(–DC)	Khamiesberg area, Driefontein to Heeren Logement.	Pearson, 6756	22/9/1911	K
32S 18E	(–AB)	Lamberts Bay, Nortier Experimental farm.	Boucher, C. 2578	6/11/1974	K, NBG
32S 18E	(–AD)	Piquetberg, Piquetberg Distr.	Acocks & Hafstrom, 1369	2/9/1938	PRE
32S 18E	(–AD)	Cape, Verloren Vlei.	Stirton, C. H. 6115	5/9/1976	PRE
32S 18E	(–BD)	Piquenierskloof.	Schlechter, R. 10754	6/8/1897	BM, GRA, G, P
32S 18E	(–DD)	Darling.	Schlechter, R. 5342	14/9/1905	BOL, GRA
32S 19E	(–CA)	Vlakrug, Cirtusdal Distr.	Hanekom, W. J. 2871	22/8/1997	NBG
33S 18E	(–CD)	Observatory near Cape Town.	Wilms, F. 3451	19/7/1883	BM
33S 18E	(–AA)	Malmesbury, Langebaan.	Leighton, F. M.	0/9/1932	BOL
33S 18E	(–AB)	5 km from Hopefield to Malmesbury.	Thompson, 270	13/6/1967	PRE
33S 18E	(–AD)	Between Darling and Ysterfontein.	Van Rensburg, W. L. J. 141	15/10/1959	NBG
33S 18E	(–CB)	6,5 km east of farm house at Bokbaai.	Reyneke, A. M. 222	8/11/1988	BLFU
33S 18E	(–CB)	Western Cape at Bokbaai.	Reyneke, A. M. 223	8/11/1988	K, BLFU
33S 18E	(–CB)	Bokbaai at farm house.	Reyneke, A. M. 224	8/11/1988	BLFU
33S 18E	(–CB)	Bokbaai area, 2 km from beach.	Venter, A. M. 346	21/4/1991	BLFU
33S 18E	(–CB)	Bokbaai area, 1 km from beach, near farm house.	Venter, A. M. 348	21/4/1991	BLFU
33S 18E	(–CB)	Melkbosstrand road at R27 crossing.	Venter, A. M. 353	22/4/1991	BLFU
33S 18E	(–CD)	Robben Island.	Adamson, 414	0/9/1962	BOL
33S 18E	(–CD)	Cape Peninsula on Karbonkelberg.	Andreae, H. 109	0/12/1919	PRE
33S 18E	(–CD)	Cape Flats near Cape Town.	Bolus, H. 3743	0/8/1877	K, BOL
33S 18E	(–CD)	Green Point near Cape Town.	Drege, 7867	0/0/1834	K, BM, P
33S 18E	(–CD)	Devils Peak, near Cape Town.	Froenbling, Dr. W.	–	NBG
33S 18E	(–CD)	Chapmans Bay.	Lewis, G. T. 36	17/9/1938	NBG
33S 18E	(–CD)	Van Kamp's Bay, near Cape Town.	MacOwan, 1521	0/1/1854	PRE, K, NBG
33S 18E	(–CD)	Van Kamp's Bay, near Cape Town.	MacOwen & Bolus, 237	0/7/1884	K, P, G, BM
33S 18E	(–CD)	Cape Town, Salt River.	Moss, 5248	17/5/1921	K, BM
33S 18E	(–CD)	Cape Town.	Phillips, E. P. 11	21/7/1907	BM, K, NBG
33S 18E	(–CD)	Cape Town.	Rogers, F. A . 27339	–	G.BOISS
33S 18E	(–CD)	Observatory near Cape Town.	Wolley Dod, A. 1107	15/6/1896	BM
33S 18E	(–DA)	Malmesbury district, Burgers Post, near Pella.	Boucher & Shepard, 4620	6/9/1979	PRE, NBG
33S 18E	(–DA)	Malmesbury, Mamre Hills.	Compton, R. H . 11603	7/9/1941	NBG
33S 18E	(–DA)	Malmesbury, Mamre Hills.	Compton, R. H. 17438	24/9/1945	NBG
33S 18E	(–DA)	Klein Dassenberg, Kanonkop.	Fellingham, A. 1140	6/9/1986	NBG
33S 18E	(–DA)	Bottelary Mountain.	Wasserfall, E. 413	9/9/1943	NBG
33S 18E	(–DA)	Koeberg near Philadelphia.	Wasserfall, E. 924	7/10/1945	K
33S 18E	(–DC)	Killarney.	Lussem, F. V. 30	6/7/1959	NBG
33S 18E	(–DC)	Langebaan near Hopefield, Akkers farm.	Pamphlett, J. 86	16/8/1966	NBG
33S 18E	(–DC)	Peaslake, Durbanville, 3 km to Kraaifontein-Langebaan rd.	Taylor, H. C. 4935	20/7/1963	NBG
33S 18E	(–DC)	Doornhoogte [indicated as Cap bon Spei on sheets].	Zeyher, C-L. 3462	0/0/1847	P, G
33S 18E	(–DD)	Klippiesrug near Stellenbosch.	Smith, H. 1177	18/9/1923	NBG
33S 19E	(–CB)	Worcester, Romans River at railway crossing.	Johnson, S. M. 489	19/9/1952	NBG
34S 18E	(–AB)	Cape, Simon's Bay.	Wright, C. (Herb.302S60)	0/01853	L, P
34S 18E	(–AB)	Cape Peninsula, Noordhoek.	Compton, R. H. 15417	30/11/1943	NBG
34S 18E	(–AB)	Cape Peninsula, Noordhoek plain.	Esterhuysen, E. s.n.	0/9/1939	BOL
34S 18E	(–AB)	Simons Bay.	MacGillivray, F. 579	0/12/1832	K
34S 18E	(–AB)	Constantia, farm Bergfliet.	Purcell, W. F. 4846	12/8/1916	SAM, NBG
34S 18E	(–AB)	Constantia, farm Bergfliet.	Purcell, W. F. s.n. [SAM 90652	11/1/1919	SAM
34S 18E	(–AB)	Constantia, farm Bergfliet, in front of cowshed.	Purcell, W. F. s.n. [SAM 90655	15/8/1916	SAM, NBG
34S 18E	(–AB)	Constantia, farm Bergfliet.	Purcell, W. F. s.n. [SAM 90656	12/8/1916	SAM, NBG
34S 18E	(–AB)	Constantia, farm Bergfliet.	Purcell, W. F. s.n. [SAM 90657	15/8/1916	SAM, NBG
34S 18E	(–AB)	Cape Peninsula, Raapenberg farm.	Wolley Dod, A . 2562	22/4/1987	K
34S 18E	(–AD)	Buffels Bay, Cape Peninsula.	Leighton, F. M.	13/8/1942	NBG
34S 18E	(–AD)	Cape of Good Hope Nature Reserve, Olifantsbos.	Taylor, H. C. 10321	9/9/1981	STE
34S 18E	(–AD)	Cape of Good Hope Nature Reserve, Olifantsbos.	Taylor, H. C. 10322	9/9/1981	STE
34S 18E	(–BA)	Cape Peninsula, Zeekoeivlei.	Compton, R. H. 10869	24/6/1941	NBG
34S 18E	(–BB)	Gordons Bay.	Duthie, A. V. s.n.	28/9/1928	NBG

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34S 18E	(–BB)	Somerset Strand.	Nel, G. C. 1177	20/8/1921	NBG
34S 18E	(–BB)	Stellenbosch district, Van der Stel.	Smith, C. A. 4213	0/6/1927	PRE
34S 19E	(–AB)	Caledon district, near Riviersonderend.	Barker, W. F. 10618	12/8/1969	NBG
34S 19E	(–AB)	Vleitjies, Caledon.	Bayer, M. B. 4456	11/11/1984	NBG
34S 19E	(–AB)	Caledon district, Riviersonderend.	Galpin, G. G. 4354	20/10/1897	K
34S 19E	(–AB)	Caledon district, Riviersonderend.	Zeyher, C-L. 2462	--	BOL
34S 19E	(–AC)	Hermanus, above old harbour.	Van Jaarsveld, E. 4454	12/9/1979	NBG
34S 19E	(–AC)	Vermont on the Hermanus coast.	Gillet, H. C. 4476	7/10/1938	PRE, BOL
34S 19E	(–BD)	Salt River Railway station.	Pillans, N. S. 17019	0/9/1918	BOL
34S 19E	(–CB)	Uiteskraalbos, ravines of Baviaansfontein hills.	Taylor, H. C. 1588	10/11/55	PRE, NBG
34S 19E	(–DB)	Vogelvlei., near Cape Town	Schlechter, R. 10484	23/4/1897	P

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Namibia:

28S 16E (–BA)	Schakal Mountains, near Oranjemund.	Muller, M. 770	1/8/1977	PRE, WIND

South Africa:

28S 17E (–CA)	25 km north of Eksteenfontein, Richtersveld.	Venter, A. M. 405	25/9/1992	BLFU
28S 17E (–CB)	Jenkins Hill, 20 km NNE of+B434 Eksteenfonteir	Germishuizen, G. 4688	10/9/1987	PRE
29S 16E (–DB)	25 km N of Port Nolloth along salt road, Richtersveld.	Reyneke, A. M. 166	21/8/1986	BLFU
29S 17E (–AC)	15 km E of Port Nolloth.	Paterson, & Jones 771	1/9/1996	NBG
29S 17E (–AD)	Richtersveld, Tatasberg.	Venter, H. J. T. 7941	4/8/1978	BLFU
29S 17E (–BB)	Namaqualand, 32 km from Steinkopf to Vioolsdrift.	Van Wyk, A. E. 6561	27/8/1983	PRE
29S 17E (–BC)	Namaqualand, Anenous Pass.	Munro, K. K. (PRE 40871)	0/9/1954	PRE
29S 17E (–CC)	Namaqualand, 40 km E of Springbok.	Reyneke, A. M. 161	21/8/1986	BLFU
29S 17E (–DB)	Sandhoogte, south of Nababeep, Richtersveld.	Hugo, 3038	0/4/1982	PRE, NBG
29S 17E (–DB)	Hester Malan Wildflower Reserve, Springbok.	Rosch & Le Roux 1475	15/9/1977	PRE
29S 17E (–DB)	Springbok municipal grounds.	Van Blerck, J. F. 8	11/6/1986	PRE
29S 17E (–DB)	Namaqualand, south of Nababeep.	Van Zyl, L. & Hugo 3038	0/4/1982	PRE, NBG
29S 17E (–DC)	Rooiberg north slope above Buffels River.	Hilton-Taylor, C. 2133	19/8/1987	NBG
30S 17E (–AD)	Namaqualand, Hondeklip Bay.	Verdoorn & Dyer 1799	21/7/1937	PRE, K
30S 17E (–BA)	Farm Kookfontein, 4,3 km NE from turn-off.	Le Roux & Lloyd 419	2/9/1986	NBG
30S 18E (–AA)	Kammieskroon, just east of town.	Venter, A. M. 561	24/8/1996	BLFU
30S 18E (–AA)	Pedroskloof Farm, 18 km E of Khamieskroon.	Hilton-Taylor, C. 2220	25/8/1987	NBG
30S 18E (–DA)	Obeeb, 15 km SE of Kliprand near Sout River.	Hugo, 498	11/9/1976	PRE, NBG
31S 18E (–AB)	Quaggaskop farm, 6 km W of Nuwerus.	Le Roux, A. 2264	11/8/1977	NGB
31S 18E (–AD	7 km N of Hol River station, farm Klipdrift, Lutzville.	Le Roux, A. 2213	10/8/1977	NBG
31S 18E (–AC)	Just east of Yzerfontein.	Venter, A. M. 374	25/9/1991	BLFU
31S 18E (–BB)	Kalkgat North, Knersvlakte.	Boucher, C. 5133	16/6/1987	NBG
31 S18E (–BC)	Knechtsvlakte, district Van Rhynsdorp, Cape Province.	Bond, P. 1121	23/7/1941	NBG
31S 18E (–BC)	Vanrhynsdorp, Olifants River, 21 km on Rooiberg road.	Le Roux, A. 2127	5/8/1977	NBG
31S 18E (–CB)	Farm "Liebendal" 11 km N of Vredendal.	Hall, H. 3617	24/6/1970	NBG, STE
31S 18E (–CD)	Farm "Holbak" 6 km E of Doringbaai, Vredendal district.	Hall, H. 3586	6/6/1970	NBG
31S 18E (–DA)	2 km NW of Vredendal.	Van der Merwe, 159	8/9/1970	PRE, STE
31S 18E (–DB)	Flats just SE of Mauwerskop S of Vanrhynsdorp.	Oliver, E. G. H. 4970	15/7/1974	NBG
31S 18E (–DC)	Nardous Mountains, at Witbakenkop, old Clanwilliam rd.	Hilton-Taylor, C. 1575	1/10/1986	NBG
31S 19E (–AC)	Niewoudtville Reserve.	Perry, P. L. & Snyman, D. 2256	11/8/1983	PRE, NBG
31S 19E (–BB)	About 45 km north of Calvinia.	Maquire, B. 1971	25/9/1953	NBG, STE
31S 19E (–BB)	44 km north of Calvinia.	Wilman, M. 16971	–	BOL
31S 19E (–BD)	Calvinia.	Schmidt, A. A. 45	0/8/1936	PRE
31S 19E (–CA)	25 km NE of Lokenberg, West Karoo.	Acocks, J. H. P. 18861	21/7/1956	PRE, K
31S 19E (–CD)	Calvinia distr., Spaarbosch, Kalahari region.	Esterhuysen, E. 5321	26/7/1941	BOL
32S 17E (–DD)	Hopefield, 1.6 km E of Paternoster, Western Cape	Barker, W. F. 9693	7/8/1962	NBG
32S 18E (–BA)	Lamberts Bay district, Rietfontein farm near Graafwater.	Van Blerck, J. F. 39	17/8/1986	PRE
32S 18E (–BA)	30 km east of Lamberts Bay.	Venter, A. M. 563	24/8/1996	BLFU
32S 18E (–BA)	Graafwater Station, on road to Lamberts Bay.	Venter, A. M. 499	31/12/1995	BLFU
32S 18E (–BA)	1 km east of Graafwater Station, east of Lamberts Bay.	Venter, A. M. 379	26/9/1991	BLFU
32S 18E (–BB)	Clanwilliam.	Schlechter, R 3301	3/7/1896	PRE
32S 18E (–BB)	Clanwilliam.	Schlechter, R 8009	3/6/1896	BM, G, K, GRA
32S 18E (–BB)	5 km SE of Clanwilliam, Platberg lower slopes.	Taylor, H. C. 10944	15/6/1984	BLFU, STE
32S 18E (–BC)	Between Langevalei & Jackals River.	Drege, s. n.	20/7/1830	P
32S 18E (–CB)	Roscherpan Nat. Res., Strandveld, Velddrift.	Van Rooyen, & Ramsey, 640	22/8/1981	PRE, STE
32S 18E (–DA)	Martin Melks' farm Berg River, Piquetberg district.	Steyn, M. 581	11/9/1949	NBG
32S 20E (–CA)	Houthoek, Sutherland, Karoo.	Hanekom, W. J. 459	28/8/1964	BLFU
32S 20E (–DA)	3 km N of Verlatenkloof Pass, Roggeveld escarpment.	Cloete & Haselan 24a	25/8/1986	BLFU, STE
33S 17E (–BB)	Saldanha Bay, Malmesbury.	Hall, H. 528	5/6/1952	NBG
33S 18E (–AA)	9 km from Darling to Hopefield, Malmesbury district.	Davis, D. K. s.n.	0/9/1950	NBG
33S 18E (–AB)	5 km from Hopefield to Malmesbury.	Thompson, M. F. 270	13/6/1967	NBG
33S 18E (–AD)	Western Cape, Darling.	Marloth, 4020	0/8/1905	K
33S 18E (–CD)	Robbeneiland, Cape Town, Western Cape.	Adamson, 436	0/9/1932	BOL
34S 18E (–AD)	Capetown, Sea Point.	Guthrie, L. 17062	0/5/1921	BOL
34S 18E (–BB)	Sand dunes, Gordon's Bay.	Duthie, A. V. n.s.C248	28/9/1928	STE
34S 19E (–DB)	Salt River station near Strand.	Pillans, N. S. 17020	0/9/1918	BOL
31S 18E (–BA)	Lange Valley to Heerelogement, Clanwilliam division.	Drege, s.n.	–	K, P

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Botswana:

21S 24E (–BB)	Xhumo, near a saline pan.	Smith, P. A. 2533	21/11/1978	SRGH, PRE
23S 24E (–BC)	Khutse Reserve.	Liebenberg, L. C. C. 8992	0/4/1979	PRE
24S 25E (–BB)	Mone Valley near Letlhakeng, Southeastern Botswana.	Wild, H. 4961	15/2/1960	PRE

Lesotho:

28S 28E (–CC)	Leribe.	Dieterlen, A. 11	5/10/1911	P, NBG
29S 27E (–AD)	Maseru.	Williamson, C. 278	22/11/1969	K
29S 27E (–BB)	Mamathes, near Maseru.	Jacot-Guillarmod, A. 490	0/1/1947	PRE
30S 27E (–AB)	Hohales Hoek.	Dieterlen, A. 1215	2/2/1916	P
30S 27E (–AC)	Mohales Hoek bridge over Moakhaleng River.	Dieterlen, M. & M. 1214	0/2/1916	P, NBG
30S 27E (–BC)	Leloaleng.	Dieterlen, A .1197	20/1/1916	NBG, K, P
30S 28E (–CA)	River Thoqhoane (=Thokwana).	Dieterlen, A. 1248	31/12/1916	P

South Africa:

27S 23E (–DA)	Belmont, 20 km towards Hopetown.	Reyneke, A. M. 128	13/3/1977	BLFU
27S 25E (–CB)	Sterkfontein, Oppermanskloof Dam.	O'Connor, T. G. 55	11/12/1974	PRE
27S 25E (–DB)	Bloemhof Dam Nature Reserve.	Carr, 223	6/4/1984	PRE
27S 25E (–DD)	Hoopstad, de Rots Hills surounding Vaal River.	Goossens, A. P. 1268	1/2/1933	PRE
27S 26E (–AC)	Kommandodrif at Odendaalsrus and Maquassie.	Morris, J. W. 1047	22/1/1968	PRE
27S 26E (–BC)	Hopetown, 50 km en route to Bothasville.	Reyneke, A. M. 80	26/1/1977	BLFU
27S 27E (–CA)	Kroonstad distict, farm Middenspruit.	Scheepers, J. C. 1648	19/2/1968	L, PRE
27S 27E (–BA)	Just east of koppies on road to Parys.	Reyneke, A. M. 81	26/1/1977	BLFU
27S 27E (–BD)	Heilbron.	Goossens, A. P. 523	21/1/1931	BLFU, PRE
27S 27E (–DC)	Free State, Vals River.	Chennell, D. DC56	0/3/1911	STE
27S 27E (–DC)	Kroonstad, 5 km towards Lindley.	Reyneke, A. M. 82	27/1/1977	BLFU
27S 27E (–DC)	Heuningspruit crossing, NE of Steynsburg to Vyfspruit.	Smook, L. 6653 (M)	11/12/1987	PRE
27S 28E (–BC)	Frankfort, 6 km to Tweeling.	Retief, E. 1080	28/1/1983	PRE
28S 24E (–BD)	2 km from Riverton to Kimberley.	Reyneke, A. M. 308	20/5/1989	BLFU
28S 24E (–BD)	2 km from Riverton to Kimberley.	Reyneke, A. M. 309	20/5/1989	BLFU
28S 24E (–DA)	Kimberley, Kalkdrift.	Bruekner, 786	0/2/1947	K, PRE
28S 24E (–DA)	Barkly West, Oorwinning.	Lewis, G. J. 562	18/3/1939	NBG
28S 24E (–DA)	Brenlan, Nooitgedacht road, Barkly-west district.	Reyneke, A. M. 218	5/10/1988	BLFU
28S 24E (–DA)	Barkly West.	Reyneke, A. M. 292	20/5/1989	BLFU
28S 24E (–DA)	Barkly West, 20 km towards Kuruman.	Reyneke, A. M. 284	20/5/1989	BLFU
28S 24E (–DA)	Maidavale, Nooitgedacht road, Barkly-west district.	Reyneke, A. M. 339	7/1/1991	BLFU
28S 24E (–DA)	Maidavale, Nooitgedacht road, Barkly-west district.	Reyneke, A. M. 340	7/1/1991	BLFU
28S 24E (–DA)	Maidavale, Nooitgedacht road, Barkly-west district.	Reyneke, A. M. 343	7/1/1991	BLFU
28S 24E (–DB)	Kimberley, 6 miles E by N of Plooysburg.	Leistner, O. A. 1187	27/9/1958	PRE, K
28S 24E (–DC)	Kimberley distr., Modder River.	Flanagan, H.G. 1408	0/11/1892	BOL, PRE
28S 24E (–DC)	Griqualand West, Grange.	Wilman, M. 10	0/4/1919	BOL
28S 24E (–DC)	Kimberley.	Wilman, M. 2392	0/12/1922	BOL
28S 25E (–CC)	Pandamsfontein at Paardeberg, Petrusburg district.	Reyneke, A. M. 299	20/5/1989	BLFU
28S 25E (–CC)	5,5 km west of Modder River crossing to Paardeberg.	Reyneke, A. M. 329	19/1/1990	BLFU
28S 26E (–CD)	Modder River, Glen.	Rossouw, L. 131	24/3/1980	BLFU
28S 26E (–DD)	Bloemfontein district, Glen Agricultural College.	Mostert, J. N. 622	13/11/1952	**Glen**
28S 27E (–AC)	Willem Pretorius Game Reserve.	Kok, D. J. 75	16/2/1966	PRE
28S 27E (–BC)	Senekal, 3 km towards Paul Roux.	Reyneke, A. M. 121	27/2/1977	BLFU
28S 27E (–CA)	Winburg, 15 km towards Bloemfontein.	Reyneke, A. M. 120	27/2/1977	BLFU
28S 27E (–CC)	Korannaberg, bridge over Vet River.	Du Preez, P. J. 1484	1/12/1988	BLFN
28S 27E (–DC)	Ficksburg, Gumtree farm, Schuttes Draai.	Roos, J. H. 1319	25/9/1964	BLFU
28S 28E (–AB)	Broomland, yard of Bervue homestead.	Scheepers, J. C. 1789	7/3/1969	K, PRE
28S 28E (–AB)	Bethlehem, 10km N at Wilgenpoort.	Werger, M. J. A. 302	21/1/1996	PRE
28S 28E (–DA)	Golden Gate, Sunnyside Resort.	Reyneke, A. M. 136	25/10/1977	BLFU
28S 29E (–DB)	Colenso, Kwazulu- Natal.	Schlechter, R. 6884	26/2/1895	BOL
29S 22E (–DA)	Prieska 18 km from town.	Bryant, J. 936a	0/1/1929	K
29S 22E (–DB)	Prieska district, Stofbakkies.	Gubb, A. A . 11000	26/5/1983	PRE
29S 22E (–DD)	Prieska.	Bryant, J. 192	26/2/1921	K, PRE
29S 23E (–AC)	Orange River.	Burchell, 6484	6/11/1814	K
29S 23E (–AC)	Sanddrift at Orange River.	Zeyher, C-L. 1261	0/2/1850	K, P, BM

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29S 23E (–BB)	Orange River at Douglas.	Pole-Evans, 3	–	K
29S 24E (–BB)	Jacobsdal, 16 km towards Kimberley.	Reyneke, A. M. 76	23/1/1977	BLFU
29S 24E (–BB)	Jacobsdal, at Riet River.	Venter, H. J. T. 7260	22/1/1974	BLFU
29S 24E (–CA)	Hopetown.	Gubb, A. A. 11001	23/5/1983	PRE
29S 25E (–AC)	Koffiefontein, bridge across Riet River.	Reyneke, A. M. 106	6/2/1977	BLFU
29S 25E (–AD)	Fauresmith, 40 km towards Petrusburg.	Reyneke, A. M. 139	11/12/1977	BLFU
29S 25E (–CA)	6 km W of Modder River, Koffiefontein to Fauresmith.	Reyneke, A. M. 330	2/4/1989	BLFU
29S 25E (–CB)	Fauresmith, 20 km towards Luckhoff.	Reyneke, A. M. 100	6/2/1977	BLFU
29S 25E (–CB)	90km Bloemfontein to Jagersfontein, via Steunmekaa	Reyneke, A. M. 99	6/2/1977	BLFU
29S 26E (–AA)	Bloemfontein, near old racecourse.	Gemmell, D. M. 6145	20/3/1952	BLFU
29S 26E (–AA)	Bloemfontein, Kings Park.	Potts, Geo. 1131	0/12/1915	BLFU
29S 26E (–CA)	Reddersburg, 27 km towards Edenburg.	Reyneke, A. M. 110	13/2/1977	BLFU
29S 26E (–CA)	29 km from Bloemfontein to Verkeeerdevlei.	Reyneke, A. M. 119	27/2/1977	K, BLFU
29S 31E (–AD)	Stanger, Mowbray Umvoti.	Tingle, A. C. 5	23/3/1968	NH, K
30S 25E (–AC)	Colesberg, farm Haasfontein.	Marais, W. s.n.	0/12/1955	K, PRE
30S 25E (–AC)	Colesberg, 8 km towards Philipolis.	Reyneke, A. M. 71	14/1/1977	BLFU
30S 25E (–AC)	Orange River Bridge, Philipolis - Colesberg.	Ward, C. J. 1024	4/12/1949	NH
30S 25E (–BD)	Aliwal-North, 50 km towards Bethulie.	Reyneke, A. M. 94	29/1/1977	BLFU
30S 25E (–CB)	Norvalspont, 15 km towards Venterstad.	Reyneke, A. M. 142	25/3/1978	BLFU
30S 25E (–CB)	Orange River, NNE of Colesburg.	Acocks, J. P. H. 15550	5/12/1948	PRE
30S 25E (–DD)	Venterstad, 25 km towards Bethulie.	Reyneke, A. M. 55	12/1/1977	BLFU
30S 26E (–BD)	Rouxville, 29 km towards Aliwal North.	Reyneke, A. M. 92	29/1/1977	BLFU
30S 26E (–DA)	Radio Springs, Aliwal North.	Coetzee, J. A. A27 (9281)	4/1/1964	BLFN
30S 26E (–DA)	Aliwal North, Orange River.	Kuntze, s.n.	22/2/1894	K
30S 26E (–DA)	Aliwal North, Warm Springs Camping Ground.	Reyneke, A. M. 11	17/4/1976	BLFU
30S 26E (–DA)	Aliwal North, Ruigtefontein.	Thode, J. A1829	0/2/1929	PRE, NH
30S 27E (–AC)	Wepener, 50 km towards Zastron.	Reyneke, A. M. 89	29/1/1977	BLFU
31S 22E (–DD)	Karoo, Kromrivier.	Potts, Geo. 1108	0/2/1916	BLFU
31S 23E (–DC)	Murraysburg.	Tyson, W. 320	0/12/1878	BOL
31S 24E (–DA)	Roelofsfontein, Richmond.	Hanekom, 1929	–	PRE
31S 25E (–BC)	Schoonbee Station.	Reyneke, A. M. 146	15/4/1978	BLFU, K
31S 25E (–CB)	Vlakfontein, Bloemhof district	Pettifer, H. L. 233	21/2/1977	PRE
31S 26E (–AD)	Molteno, 3 km towards Sterkstroom.	Reyneke, A. M. 60	12/1/1977	BLFU
31S 26E (–BC)	Molteno-to Sterkstroom, Boesmanshoek Pass.	Reyneke, A. M. 61	12/1/1977	BLFU
31S 26E (–DA)	Sterkstroom, Queenstown district.	Burtt-Davy, J. 17050	0/2/1917	BOL
31S 27E (–BC)	Lady Frere region, Cala district.	Pegler, A.	0/2/1910	BOL
31S 27E (–DB)	Between Dordrecht and Barkly East.	Werderman & Oberdieck, 1083	17/11/1958	PRE, K
32S 24E (–BC)	Near Graaff-Reinet.	Bolus, H. 776	0/0/1870	K, GRA
32S 25E (–DA)	Somerset East, near Fish River.	MacOwen, s.n.	0/0/1873	NBG, SAM
32S 25E (–DC)	Bosch berg.	MacOwen, s.n.	0/3/1874	BM
32S 26E (–AB)	Rasfonteinpoort, betweenTarkastad and Cradock.	Reyneke, A. M. 63	13/1/1977	BLFU
32S 27E (–DA)	Kubusie Valley at Port St. Johns.	Acocks, J. P. H. 9191	11/10/1942	PRE
33S 21E (–CA)	Barrydale - Ladismith road just E of Groot River bridge.	Venter, A. M. 451	23/1/1993	BLFU
33S 21E (–CA)	Barrydale - Ladismith road just E of Groot River bridge.	Venter, A. M. 452	23/1/1993	BLFU
33S 22E (–AD)	Northern entrance to Swartberg Pass, near stream.	Venter, A. M. 455	23/1/1993	BLFU
33S 22E (–CA)	Oudtshoorn district, near De Kombuis.	Bolus, H. 12175	0/12/1905	BOL
34S 20E (–BB)	Herbert district, Klipdrift.	Moran, F. C. 21800	0/4/1920	PRE

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Angola:

15S 12E (–AA)	Moçâmedes, Caraculo, Posto Experimental.	De Menezes, 235	4/5/1962	K, SRGH
15S 12E (–BA)	Caraculo, near Apiadeiro & Dais Irmaos.	Torre, 8837	18/02/1956	LISC
17E 11S (–CC)	Moçâmedes, Dais Irmaos.	Santos, 961	4/5/1962	K, LISC

Botswana:

21S 21E (–DA)	Takatswana, 97 km N of Kang on road to Ghanzi.	De Winter, B. 7403	20/2/1960	PRE, K
23S 24E (–CD)	155 km N of Khan to Ghanzi Takatswane.	De Winter, B. 7404	20/02/1960	K, SRGH
24S 21E (–BB)	5 km W of Tshane Pan.	Moss & Jacobsen, K29	4/4/1985	PRE
24S 22E (–AB)	Mahadutlake Pan, 340 km W of Kanye.	Cox, T. J. 406	27/5/1967	K
25S 20E (–BC)	Ooi Kolle KGNP, 5 km east of Nosop.	Blair Rains, A. & A. Yalala 30	13/3/1909	K, SRGH
26S 22E (–AB)	15 km SW of Tsabong.	Cole, D. T. 335	26/10/1993	PRE

Namibia:

17S 12E (–DB)	Kas Otjitande. (Herero Otjingwahuwa).	Malan & Owen Smith 343	25/2/1973	WIND
18S 13E (–BC)	Kaoko-Otavi Quelle.	Rusch, W. 20	0/6/1978	WIND
18S 16E (–CC)	Etosha,8 km west of Okankavejo.	Tinley, K. L. 1573	0/2/1967	WIND
19S 13E (–BB)	12 km W of Warmbad to Sesfontein.	De Winter, & Leistner, 5858	20/5/1957	K
19S 14E (–DB)	18 km ESE of Kamanjab to Outjo.	De Winter, B. 3077	6/4/1955	PRE, K
19S 15E (–BB)	Leeubron.	Brown, S. & Kohlberg, H. 304	14/2/1985	WIND
19S 17E (–AC)	Outjo, farm Franken.	Schwerdtfeger, 1/33	27/12/1952	WIND
19S 18E (–AA)	Damaraland.	Een, T. G. s.n..	0/0/1879	BM
20S 16E (–AA)	11 km NW from Otjovarandu, Etosha Game Reserve.	Joubert, E. D26	12/4/1967	WIND
20S 17E (–CA)	Omuverume plateau - Waterberg.	Rutherford, M. C. 396	25/4/1971	WIND
21S 13E (–DB)	Cape Cross - Omaruru.	Jensen, E. 274	0/3/1963	WIND
21S 14E (–AA)	Damaraland - just S of Brandberg West road near mine.	Craven, P. 742	4/3/1978	BLFU
21S 15E (–CB)	Between Karabib and Outjo.	Werdermann & Oberdieck 2283	25/2/1959	K, PRE, BR
21S 15E (–CC)	Klein Spitskoppe.	Jensen, R. A. C. 44/1428	19/5/1972	WIND
21S 16E (–CB)	55 km from Omaruru to Okahandja, farm Omenje.	Wanntorp, H. & H. E. 344	21/3/1968	PRE
21S 17E (–AA)	Waterberg, Quickborn.	Bradfield, 105	4/10/1929	PRE
22S 14E (–DA)	Swakopmund, Spitzkoppe and Pondok mountains.	Merxmüller, & Giess, 1698	20/2/1958	WIND
22S 15E (–AD)	Nordenburg, Karib district.	Griffin, E. 186	10/9/1975	WIND
22S 15E (–BA)	Karibib district, Namibrand at Glasberg.	Seydel, 441	15/3/1955	K, B
22S 16E (–AB)	Farm Okomitundu.	Seydel, 2932	6/6/1961	K, WIND, B
22S 16E (–BB)	59 km South of Okahandja.	Reyneke, A. M. 205	30/9/1988	BLFU
22S 16E (–CB)	Avas Mountains at Aus.	Pearson, H. H. W. 9518	10/1/1916	K
22S 16E (–CC)	Otjimbingwe district, farm Kaan Damm.	Giess, 13515	14/5/1973	K, WIND, PRE
22S 17E (–CA)	Windhoek.	Gillman, 179	0/2/1921	SAM, NBG
22S 17E (–CA)	Avis, Khomas Hochland.	Seydel, R. 3984	18/4/1964	K, COI WAG
22S 17E (–CA)	Windhoek district, farm Otjisewa.	Wiss, H. J. & Kinges, H. 816	0/1/1948	PRE
22S 17E (–CB)	Windhoek, farm Voigtland, Bismar mountains.	Walter, H. & E. 34	15/11/1952	WIND
22S 18E (–AC)	74 km east of Windhoek to Gobabis.	De Winter, B. 2526	25/2/1955	K
22S 18E (–BD)	Gobabis, farm Sturenfeld.	Walter, H. & E. 4129	20/6/1953	WIND
23S 15E (–AA)	Eastern Namib Desert Park, Onanis Wash.	Jensen, R. A. C. 38/1422	19/4/1972	WIND
23S 16E (–AB)	Nauchas district, farm Djab.	Jensen, R. A. C. 11592	21/1/1972	WIND
23S 16E (–CC)	Solitaire, near Windhoek.	Griffin, R. E. 116	28/5/1975	WIND
23S 16E (–CD)	3 km S of Garries, Bitterfontein road.	Thompson, M. F. 408	26/8/1967	STE
23S 17E (–AC)	Zarachaibes.	Olivier, Muller & Steenkamp 63	0/5/1976	PRE
23S 17E (–CA)	Farm Tsumis, Rehobot district.	Müller, M. 1406	20/3/1980	PRE, K, WIND
24S 16E (–AB)	Bergzebra Park, Naukluft, Maltahöhe.	Van der Westhuizen, P. M. 43	20/12/1968	WIND
24S 16E (–BD)	8 km NW of Nomtsas, at Usib River.	Pearson, H. H. W. 9319	24/12/1915	K, BOL
24S 16E (–DD)	Maltahöhe, farm Nointsas.	Walter, H. & E. 1863	16/3/1953	WIND
24S 17E (–BD)	Hardap Game Reserve.	Müller, M. 201	3/2/1976	PRE, WIND
25S 16E (–BB)	Farm Lisbon, part of Grootfontein farm.	Müller, M. 1268	8/4/1980	WIND
25S 16E (–BC)	Helmeringhausen, farm Nandans/Duwisib.	Volk, O. H. 12509	28/4/1956	WIND
25S 16E (–BD)	Kleinfontein South, 80 km North of Helmeringhausen.	Reyneke, A. M. 189	26/9/1988	BLFU
25S 17E (–BB)	Gibeon.	Van Vuuren & Giess 1157	28/4/1960	PRE, WIND
25S 18E (–CC)	11 km N of Tses Station, Keetmanshoop district.	Giess, Volk & Bleissner 6871	13/5/1963	K, WIND
25S 19E (–AC)	Farm Vergenoeg, Gibeon district.	Giess, & Wolf 10916	26/5/1970	WIND
26S 16E (–CB)	Aus.	Reyneke, A. M. 172	21/8/1986	BLFU

	…turn-off.		…/19[illegible]	WIND
26S 18E (–AB)	46 km NW of Narubis, Keetmanshoop district.	Reyneke, A. M. 175	23/9/1988	BLFU
26S 18E (–CA)	Keetmanshoop.	Acocks, J. P. H. 18016	28/4/1955	K
26S 18E (–CA)	8 km from Keetmanshoop to Abab.	Liebenberg, L. 5236	0/5/1949	K, WIND
26S 19E (–DC)	38 km WNW of Aroab.	Tolken, & Hardy 627	8/3/1965	K, PRE
27S 16E (–BB)	Witpütz, Ndabib Mountains, southern slopes.	Acocks, J. P. H. 18065	3/5/1955	K
27S 17E (–BB)	Gawachab, Lions River.	Müller, M. 797	3/8/1977	WIND, PRE
27S 17E (–BD)	Holoog.	Pearson, H. H. W. 4079	7/2/1909	K, BM
27S 17E (–DA)	Chamaites.	Pearson, H. H. W. 9715	19/1/1916	K, BM
27S 18E (–BB)	Great Karasburg, Kraaikluft Ravine.	Walter, E. 2302	30/3/1953	WIND
27S 18E (–BD)	Great Karasberg, Naruda Süd	Seydel, R. 7958	19/1/1913	K
27S 18E (–DA)	Farm Genadendal.	Pearson, H. H. W. 8130	28/12/1912	BM, K
28S 16E (–DA)	Oranjemund district, Pagvlei, S bank of Orange River.	Giess & Müller 12089	20/5/1972	PRE, WIND
28S 18E (–BA)	2 km south of Karasburg on Warmbad road.	Hardy, 621	20/9/1961	PRE, K
28S 18E (–BD)	Great Namaqualand, south of Warmbad.	Reyneke, A. M. 209	30/9/1988	BLFU
28S 18E (–DA)	Sandfontein.	Pearson, H. H. W. 4042	26/1/1909	K, BM, SAM, NBG
28S 18E (–DA)	Sandfontein, Kalahari region.	Bleek, s.n. 2091/57	0/2/1921	SAM, NBG
28S 18E (–DB)	Farm Eendoorn.	Wilman, M. 15286	0/12/1921	BOL
28S 19E (–CA)	Warmbad, Onseepkans to Karasburg.	Giess & Müller 12154	24/5/1972	PRE, K, WIND
		Davidse 6225	1/2/1974	WAG

South Africa:

26S 20E (–BC)	Kalahari Gemsbok Park, Twee Rivieren.	De Beer, G. C. O. A 73	15/3/1981	PRE
27S 20E (–AC)	192 km NW of Upington, Obogarap, Gordonia district.	Leistner, O. A. 1785	8/4/1960	K
28S 16E (–BD)	Richtersveld, Mountains SW of Koeboes.	Herre, M. 11761	17/9/1929	NGB
28S 16E (–CB)	3 km east of Alexander Bay to Reuning.	Venter, A. M. 393	20/9/1992	BLFU
28S 16E (–BD)	Bloed Drift road W of Annisfontein.	Venter, A. M. 397	20/9/1992	BLFU
28S 16E (–BD)	Entrance to Kleinhelskloof, Richtersveld.	Venter, A. M. 401	25/9/1992	BLFU
28S 16E (–BD)	Top of Kleinhelskloof, Richtersveld.	Venter, A. M. 402	25/9/1992	BLFU
28S 17E (–AA)	Kook River, west of Koeboesberg, Richtersveld.	Venter, A. M. 406	28/9/1992	BLFU
28S 17E (–AA)	Kook River, west of Koeboesberg, Richtersveld.	Venter, A. M. 407	28/9/1992	BLFU
28S 16E (–BD)	On ridge above old Numees Mine, Richtersveld.	Venter, A. M. 408	29/9/1992	BLFU
28S 16E (–BD)	Richtersveld, W of Koeboesberg.	Venter, A. M. 420	1/10/1992	BLFU
28S 16E (–CB)	2 km east of Alexander Bay, bank of Orange River.	Reyneke, A. M. 167	21/8/1986	BLFU
28S 16E (–DA)	South bank of Orange River at Arris Drift.	Pillans, N. S. 5258	0/9/1926	BOL
28S 16E (–DA)	Entrance to Beauvillon Mine, Alexander Bay road.	Venter, A. M. 396	20/9/1992	BLFU
28S 17E (–AC)	Vioolsdrift, upper reaches of the Gannakouriep River.	Van Jaarsveld, & Kritzinger 6289	21/9/1981	NBG
28S 17E (–CD)	Kouefontein, east of Kliphoogte, Vioolsdrift.	Van Berkel, N. J. 10	12/11/1978	NBG
28S 20E (–CB)	Augrabies district, farm Waterval.	Burgoyne, P. 1544	22/12/1992	PRE
28S 20E (–CB)	Augrabies National Park, 1 km E of camp.	Venter, A. M. 398	20/9/1992	BLFU
28S 20E (–DC)	Letterkop Botanical Reserve, Kakamas.	Wasserfall 1165	15/7/1946	K, PRE
28S 21E (–AC)	Left bank of Orange River.	Pearson, H. H. W. 1603	25/6/1908	SAM, NBG
29S 17E (–BB)	Aribes River, Steinkopf district.	Venter, H. J. T. 8830	3/9/1980	BLFU
29S 17E (–BD)	22 km south of Steinkopf.	Reyneke, A. M. 164	21/8/1986	BLFU
29S 17E (–DB)	3 km north of Nababieb on Steinkopf road.	Reyneke, A. M. 162	21/8/1986	BLFU
29S 17E (–DC)	Namaqualand, summit of Messelpad Pass.	Acocks, J. P. H. 14221	25/3/1948	PRE
29S 17E (–DC)	Buffels River, Namaqualand.	Compton, R. H. 17249	6/9/1945	NBG
29S 19E (–BC)	Gannapoort, 40 km SE of Pofadder.	Leistner, O. A. 2458	21/5/1958	K, PRE
29S 20E (–CD)	11 km ENE of Zooafskolk along Dagab.	Acocks, J. P. H. 18838	20/4/1956	PRE, K, BOL
29S 21E (–AC)	Kenhardt.	Acocks, J. P. H. 18837	0/4/1956	K
29S 21E (–AC)	144 km south of Kenhardt.	Hall, H. 681	30/3/1953	NBG
29S 22E (–BC)	Prieska.	Bryant, E. G. J 269	3/4/1921	PRE, K, BOL
29S 22E (–DB)	Prieska, in the Bos Resort.	Muller, P. 526	17/3/1969	PRE
30S 17E (–BB)	3 km S of Garies to Bitterfontein, near Hondeklip Bay.	Thompson, M. F. 408	26/8/1967	PRE, NBG
30S 18E (–CA)	Garies, Namaqualand.	Thorne, s.n. 2091/45	0/6/1930	SAM. NBG
30S 21E (–AC)	Vanwyksvlei, Jan Louw's kolk,S of Swartkop.	Thompson, M. F. 3132	18/5/1976	K, PRE, NBG
30S 22E (–CD)	Carnarvon district, Rhenosterkolk.	Acocks, J. P. H. 1709	0/2/1937	PRE
30S 23E (–AD)	31 km from Britstown to Prieska, Jagskerm turn-	Herman, P. 1181	16/3/1988	PRE
31S 18E (–DB)	3 km NE of Vanrynsdorp, farm Tree-Top.	Le Roux, A. 2014	3/8/1977	NGB
31S 19E (–AD)	Hantams River between Calvinia & Loeriesfontein.	Snyman, D. 995	8/1/1986	NBG

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Botswana:

21S 23E (–DB)	SW District, Deception Pan (Pink Pan).	Smith, P A 4174	17/3/1983 BR, PRE
22S 21E (–BC)	24 km along Okwa Valley track W of Kang-Ghanzi road.	Kreulen, A. R. 561a	30/1/1979 PRE, SRGH
22S 22E (–BA)	Damara Pan, Kalahari.	Van Son, G. 29016	20/4/1930 PRE, LISC
23S 24E (–AD)	121 km NW of Molepoldo, Kuke Pan.	Storey, R. 4897	15/6/1955 K, PRE, LISC
23S 24E (–CD)	South-West, Takatshwane Pan (= Kuchwe pan).	Wild, H. 5090	20/2/1960 K, PRE
23S 26E (–AB)	Shoshony (Mahalapye).	Woollard, J. 980	20/5/1981 SRGH
23S 26E (–BB)	Mahalapye Morale Experimental Station.	De Beer, 579	4/2/1958 K
24S 25E (–BD)	Mokoladi, 12 km S of Gabarone.	Cole, D. T. 393	30/1/1994 PRE
24S 25E (–DB)	Gaborone district, Content farm.	Hansen, O. J. 3436	19/8/1978 K, PRE, BM
24S 26E (–AC)	Mochudi.	Mitchison, N. A41	22/04/1967 K
24S 26E (–CB)	8 km NE of Sihursm at Manis, (Mochudi).	Woollard, J. 806	19/10/1980 SRGH

Lesotho:

30S 27E (–BC)	Quthing, southern Lesotho.	Williams, 744	18/6/1970 K

Namibia:

18S 13E (–CD)	Kaokoveld.	Giess, W. & Wiss, 3311	8/10/1960 WIND
18S 15E (–DD)	Between Okondeka & Adamax.	Le Roux, 593	15/1/1974 PRE, WIND
20S 17E (–CB)	About 60 km E of Otjiwarongo, farm Uitsig.	Pehlemann, I. 1401	– WIND
21S 14E (–AA)	Damaraland, Brandberg West, near Brandberg mine.	Craven, P 742	4/3/1978 WIND
23S 16E (–DA)	Moutonsvley, Rehoboth.	Volk & Giess 1441	17/2/1956 WIND
23S 17E (–AC)	Rehoboth district, Nauchas, farm Moutonsvley.	Volk, O. H. 11448	2/2/1956 WIND
24S 16E (–AB)	Nankluft Plateau.	Müller, M & Tilson 868	16/5/1978 WIND
24S 16E (–CA)	Farm Uitkoms.	Müller M 1341	8/4/1980 WIND
24S 16E (–CD)	Maltahöhe Farm Zaris.	Giess, Volk & Bleissner 5187	18/12/1963 WIND
24S 16E (–DD)	Maltahöhe.	Walter, H. & E. 2074	20/3/1953 WIND
24S 17E (–DA)	Mariental.	Volk, O. H. 12248	2/4/1956 WIND
25S 16E (–BB)	Helmeringhausen, farm Lisbon.	Müller, M. 1284	8/4/1980 WIND
26S 15E (–CA)	Luderitz, Griffith Bay.	Müller & Jankowitz 285	24/6/1975 WIND
26S 16E (–DA)	Great Namaqualand, Schakalskuppe.	Pearson, H. H. W. 4258	– K
26S 19E (–DC)	11 km W of Aroab on road to Keetmanshoop.	De Winter, B. 3388	3/5/1955 K, WIND
26S 20E (–BC)	24 km along Nosob River from Kalahari Gemsbok Park.	Story, R. 5493	16/7/1956 K
27S 16E (–DC)	Spergebied.	Jurgens, 28226	9/10/1988 PRE
27S 16E (–DD)	Zebrafontein.	Reyneke, A. M. 168	22/8/1986 BLFU
27S 18E (–BB)	Great Karasberg, NE of Naruda-Süd.	Pearson, H. H. W. 8143	28/12/1912 K, BOL
27S 18E (–BD)	Great Karasberg, Naruda-Süd.	Pearson, H. H. W. 8133	28/12/1912 K
27S 19E (–CA)	Farm Blinkoog, river terraces.	Walter, H. & E. 240	3/4/1953 WIND
27S 19E (–DB)	Stahlpan.	Jankowitz, W. 160	19/3/1971 WIND
28S 18E (–BA)	18 km SE of Karasburg, farm Klein Aub.	Giess, Volk & Bleissner, 7021	17/8/1963 WIND

South Africa:

22S 29E (–BC)	Dongola Botanical Reserve, Soutpansberg.	Verdoorn, 2072	14/7/1970 PRE
23S 29E (–BB)	40 km S of Louis Trichardt on tropic of Capricorn.	Venter, H. J. T. 9198	8/4/1988 BLFU
23S 29E (–CD)	Pietersburg municipal grounds.	Acocks & Haffstrom, 1370	4/10/1938 K, PRE
23S 29E (–CD)	Transvaal, Pietersburg district, Marabastad.	Leendertz, 802	20/9/1905 K
24S 28E (–BB)	Magalakwin, Nylstroom district.	Smuts, J. C. 2005	0/6/1926 PRE, K
24S 28E (–DA)	Naboomspruit, Wonderkrater.	Scott, L. 83	5/4/1977 BLFU
24S 28E (–DA)	Naboomspruit, Wonderkrater.	Scott, L. 146	5/4/1977 BLFU
24S 29E (–AA)	Potgietersrus distict, Cash Store near Grass Valley.	De Winter, B. 2238	14/2/1954 K, PRE
25S 25E (–DA)	Mafekeng district, Mogosane.	Tittlestad, PRE 40772	0/6/1948 PRE
25S 27E (–AA)	Pilanesberg.	Phillips & Schweickerdt, 3	13/5/1933 PRE
25S 27E (–DD)	Transvaal, Rustenberg area, Scheerpoort.	Leendertz, 738	– K
25S 28E (–AD)	Pretoria district, Hammanskraal.	Hutchinson & Mogg, 2874	26/1/1929 K
25S 28E (–BA)	Transvaal, Rooikop farm.	Gillet, J. B. 2629	4/12/1928 K
25S 28E (–CA)	Pretoria, Derdepoort.	Jonker, P. 30	23/9/1969 PRE
25S 30E (–AB)	Sekukuniland, Greenlands farm, Luki mountains.	Barnard & Mogg, 597	10/1/1939 K, BM, PRE
27S 23E (–AA)	Kuruman district.	Gubb, A. A. 252-69	24/2/1982 PRE
27S 25E (–AD)	Bloemhof district, Rooikop.	Pole-Evans, I. B. 1248	20/4/1924 K

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27S 25E	(–DB)	Bloemhof Dam Nature Reserve.	Carr, 223	6/4/1984	PRE
28S 16E	(–DA)	Richtersveld, Arries Drift.	Pillans, N. S. 5257	0/9/1926	K, BOL
28S 21E	(–BD)	28 km east of Upington to Groblershoop.	Reyneke, A. M. 213	3/10/1988	BLFU
28S 21E	(–DA)	62 km east of Upington to Groblershoop.	Reyneke, A. M. 214	3/10/1988	BLFU
28S 22E	(–DD)	Hay Division, Bingap.	Acocks, J. P. H. 5769	18/6/1938	K
28S 23E	(–CC)	Griqua Town, Hay Division.	Wilman, M. 4072	0/2/1937	K
28S 23E	(–DD)	5km west of Campbell on Kimberley - Griquatown road.	Reyneke, A. M. 216	3/10/1989	BLFU
28S 24E	(–BA)	Gordonia, C.P.A.N.G Reserve, lower Auab River.	Lang, H. PRE 31729	0/4/1933	K, NH, BR
28S 24E	(–BB)	Cape, Warrenton.	Acocks, J. P. H. 5741	0/6/1938	K, BOL
28S 24E	(–BC)	Barkly West, Kareepan.	Hanekom, 2078	26/1/1973	K, P
28S 24E	(–BD)	1km from Riverton turn-off from Windsorton Road.	Reyneke, A. M. 282	25/5/1989	BLFU
28S 24E	(–CA)	Douglas district, near Schmidts Drift.	Acocks, J. H. P. 1683	0/2/1937	PRE
28S 24E	(–CA)	Rooipoort farm.	Phelan, A. J. 1100	1/1/1991	PRE
28S 24E	(–CD)	Kimberley, Koedoesberg.	Acocks, J. P. H. 8495	27/12/1937	K, BOL
28S 24E	(–DA)	Barkley West, Blesmanspoort.	Acocks, J. P. H. 2488	8/10/1937	PRE, K
28S 24E	(–DB)	6–7 km from Kimberley on road to Boshoff.	Esterhuysen, 968	15/3/1939	K, BOL
28S 24E	(–DB)	Near Kimberley.	Lewis, G. J. 532	15/3/1939	NBG, SAM
28S 24E	(–DB)	7 km from Kimberley on road to Griquatown.	Reyeke, A. M. 272	10/5/1988	BLFU
28S 24E	(–DB)	7 km out of Kimberley on Griquatown road.	Reyneke, A. M. 273	10/5/1988	BLFU
28S 24E	(–DB)	20km from Kimberley to Griquatown.	Reyneke, A. M. 276	10/5/1988	BLFU
28S 24E	(–DC)	Magersfontein, North Cape.	Gubb, A. A. 130/50	8/12/1980	PRE
28S 24E	(–DC)	Kimberley district, Langeberg farm.	Zietsman, P. C. 97	30/4/1987	PRE
28S 24E	(–DD)	Benfontein.	Gubb, A. A. 276-29	25/3/1982	PRE
28S 25E	(–CC)	Modder River between Kimberley and Petrusburg.	Reyneke, A. M. 297	20/5/1989	BLFU
28S 25E	(–CC)	Modder River between Petrusburg and Paardeberg.	Reyneke, A. M. 326	17/1/1990	BLFU
28S 25E	(–CC)	5 km W of Modder River Bridge to Paardeberg.	Reyneke, A. M. 328	19/1/1990	BLFU
28S 25E	(–CC)	Boshof district, Leifontein.	Venter, H. J. T. 8016	4/8/1980	BLFU
28S 25E	(–DD)	36 km Bloemfontein to Bultfontein.	Reyneke, A. M. 78	26/1/1977	BLFU
28S 29E	(–BB)	Near Colenso, Natal.	Wood, s.n. (2091/59)	4/2/1891	SAM, NBG
28S 30E	(–CA)	Weenen district, Tugela River Valley, farm Zingela.	Balkwill, K. 5093	16/11/1989	BLFU, J
28S 30E	(–CC)	Weenen district, Ukasine area, Blaaukranz river bridge.	Edwards, D. 2061	16/5/1957	K, PRE
28S 30E	(–DC)	Mooi River, Natal.	Wood, J. M. 5302	14/4/1894	P
29S 17E	(–BD)	Steinkopf district.	Venter, H. J. T. 8255	0/9/1980	BLFU
29S 19E	(–DC)	Brandvlei district, farm Uitsig	Dean, S. J. 653	22/5/1989	PRE
29S 20E	(–DA)	Prieska.	Bryant, 941	0/5/1933	K
29S 22E	(–BC)	Turn-off to Griquastad from Groblershoop-Prieska rd.	Reyneke, A. M. 215	31/10/1988	BLFU
29S 22E	(–DA)	Prieska, Buisvlei.	Acocks, J. P. H. 2553	2/11/1937	K, PRE
29S 22E	(–DA)	Prieska.	Bryant, 925	0/5/1933	K, PRE
29S 24E	(–AD)	Belmont Station.	Schweikerdt, 1164	27/3/1933	GRA
29S 24E	(–BA)	Hopetown area, Valschfontein.	Acocks, J. P. H. 2595	0/12/1937	K
29S 24E	(–DB)	20 km Luckhoff to Rooipan.	Reyneke, A. M. 135	24/7/1977	BLFU
29S 25E	(–AB)	Petrusburg area, Bestersput.	Acocks, J. P. H. 8469	0/12/1937	BM, K
29S 25E	(–AB)	Petrusburg area, Bestersput.	Acocks, J. P. H. 8485	15/12/1937	K
29S 25E	(–AB)	50 km Petrusburg to Jacobsdal.	Reyneke, A. M. 74	12/1/1977	K, BLFU
29S 25E	(–CB)	10 km from Fauresmith to Koffiefontein	Reyneke, A. M. 229	2/4/1989	BLFU
29S 25E	(–CB)	Fauresmith district, in kloof of Riet river.	Humbert, M. H. 10474	29/8/1934	P
29S 25E	(–CB)	Fauresmith, farm Greenvlei.	Verdoorn, I 1648	0/10/1935	PRE, K
29S 26E	(–AA)	Bloemfontein near old racecourse.	Gemmell, D. M. 6147	18/3/1952	BLFU
29S 26E	(–AA)	Bloemfontein area.	Gemmell, D. M. 6154	20/3/1952	BLFU
29S 26E	(–AA)	Bloemfontein, Victoria Park.	Potts, G. 1132	0/4/1916	BLFU
29S 26E	(–AA)	Bloemfontein, University grounds.	Potts, G. 2846	0/2/1917	BLFU
29S 26E	(–AA)	Inner courtyard of Botany Department.	Reyneke, A. M. 156	1/10/1982	BLFU
29S 26E	(–AA)	Bloemfontein, Naval Hill plateau.	Reyneke, A. M. 118	25/2/1977	BLFU
29S 26E	(–AC)	Glen Agricultural College, Bloemfontein district.	Reyneke, A. M. 20	2/8/1976	K, BLFU
29S 26E	(–CA)	27 km from Reddersburg to Edenburg.	Reyneke, A. M. 112	13/2/1977	BLFU
30S 20E	(–CC)	NW Cape, Soutputs, on way to Breekbeenkolk.	Burger & Louw, 126	2/9/1986	NBG
30S 25E	(–AB)	Farm in Phillipolis district.	Vorster, L. F. 1583	11/4/1964	Glen
30S 25E	(–BC)	Bethulie, 6.5 km SW of Springfontein.	Acocks, J. P. H. 20793	9/11/1959	PRE, K
30S 25E	(–CB)	Oviston Nature Reserve.	Fourie, H. 485	27/11/1972	PRE

L. cinereum

30S 26E (–AD)	50 km from Aliwal North to Bethulie.	Reyneke, A. M. 95	29/1/1977	BLFU
30S 26E (–CA)	Aliwal North, Knapdaar area, Silvermere farm.	Burrows, H. H. s.n.	9/5/1992	GRA
30S 26E (–CB)	Burgersdorp, Aliwal North district.	Peacock, T. W. 42	23/10/1908	GRA
30S 26E (–CD)	10 km from Burgersdorp to Venterstad.	Reyneke, A. M. 117	13/2/1977	BLFU
30S 26E (–DA)	Elandshoek, near Aliwal North.	Bolus, F. 109	0/8/1900	BOL
30S 26E (–DA)	Aliwal North hot springs.	Coetzee, J. A. A25	1/10/1964	BLFU
30S 26E (–DC)	Thicket just behind Cannon Rocks.	Jarman, C. 1	20/10/1992	GRA
30S 27E (–AC)	Zastron, open air school.	Venter, H. J. T. 8777	8/18/1982	BLFU
31S 20E (–BD)	5 km SW of Williston.	Acocks, J. P. H. 15153	22/10/1948	K
31S 19E (–BA)	On way to Matjiesfontein.	Burger & Louw, 293	4/9/1986	BLFU, STE
31S 19E (–BA)	About 45 km north of Calvinia.	Johnson, S. M. 582	25/9/1952	NBG
31S 20E (–DC)	Middelpas, 2 km on way to Calvinia.	Burger & Louw, 230	3/9/1986	PRE
31S 20E (–DC)	Middelpos, 2 km on road to Calvinia.	Burger & Louw, 232	3/9/1986	NBG
31S 21E (–AA)	Farm Grootfontein, 42 km N of Williston.	Germishuizen, G. 6225	26/3/1993	PRE
31S 21E (–CD)	Fraserburg East of outer limits.	Coetzer, L. A. 56	10/4/1971	STE
31S 23E (–CC)	Three Sisters, 4 km along road to Richmond.	Venter, H. J. T. 9225	15/4/1990	BLFU
31S 24E (–BD)	Grootfontein, Middelburg, Cape.	Gill, G. 119	17/12/1927	BOL
31S 25E (–AC)	Cape, Middelburg.	Acocks, J. P. H. 15690	20/2/1950	K
31S 25E (–AC)	Cape, 5 km east of Rosemead, Middelburg.	Acocks, J. P. H. 16329	28/2/1952	K, PRE, BOL
31S 25E (–AC)	Steynsburg area, Seekoevlei near The Poplars.	Archibald, E. T. A. 3090	6/4/1945	GRA
31S 25E (–AC)	Middelburg, 3 km east of Grootfontein College.	Van Zinderen Bakker, E. 1123	18/2/1963	PRE
31S 25E (–CA)	Middelburg district, Steynsburg, farm Gryskop .	Archibald, E. T. A. 3151	7/4/1945	GRA
31S 27E (–AA)	Dordrecht district,Swempoort, near Waschbankspruit.	Müller, D. B. 746	20/4/1971	GRA
32S 21E (–AD)	Aarfontein farm, between Sutherland and Fraserburg.	Moffett, R. O. 3722	21/9/1985	BLFU, STE
32S 20E (–AD)	Roggeveld, Knollefontein, on turn-off to Kanolfontein.	Cloete, I. & Haselau, W. 74	27/8/1986	NBG
32S 22E (–DB)	Farm Rystkuil near Sout River on way to Neverset.	Retief & Reid, 264	8/10/1983	K, PRE
32S 26E (–CA)	Bedford, Brakfontein catchment area.	Hobson, S. 11643	30/1/1990	GRA
32S 28E (–AC)	Butterworth, Hospital Hill.	Pegler, A. 1761	13/12/10	K, BOL
32S 28E (–BB)	Transkei between Gekau River and Bashee River.	Drege, s.n.	–	K
33S 18E (–DC)	Doornberghoek, Middleburg distrtrict.	Acocks, J. P. H. 8683	11/5/1938	K
33S 19E (–CB)	Near Brandvlei Kop, Worcester district.	Compton, R. H. 18042	21/6/1946	NBG
33S 19E (–CB)	Worcester veld reserve.	Midgley & Rosenberg, 52	13/8/1986	NBG
33S 20E (–BA)	Snyderspoort through the Baster Mountains.	Thompson, 3162	19/5/1976	NBG, PRE
33S 20E (–CB)	Ladismith, Kruisrivier farm, 4 km S of Bloudoring.	Hilton-Taylor, C. 2001	7/10/1986	NBG
33S 21E (–CA)	Barrydale-Ladismith road, at Groot River bridge.	Venter, A. M. 450	23/1/1993	BLFU
33S 21E (–DB)	Gamka Mountain Res., Keurkloof near Zebra Ridge.	Allardice, R. 1702	12/8/1987	NBG
33S 22E (–CA)	16½ miles SW by S of Oudshoorn.	Acocks, J. P. H. 20485	22/5/1959	PRE, STE
33S 22E (–DA)	Oudtshoorn district, Farm Aangenaam, near De Rust.	Dahlstrand, K. A. 2394	3/4/1973	PRE
33S 24E (–BC)	10 km WNW of Wolwefontein, Steytlerville district.	Acocks, J. P. H. 16009	2/9/1951	K
33S 25E (–BC)	Alexandria, Korhaanvlakte Addo Nat. Park.	Archibald, E. T. A. 3799	18/10/1951	GRA
33S 26E (–AC)	35 km from Grahamstown towards Carisle Bridge.	Dyer, R. A. 2103	0/9/1929	K, PRE, GRA
33S 26E (–BA)	Ecca Reserve.	Chan, J. 196	4/6/1992	GRA
33S 26E (–BA)	24 km northwest of Grahamstown.	Martin, B. E. 696	30/11/1950	NBG, STE
34S 20E (–AD)	De Hoop, Melkkamer, tall gate.	Fellingham, A. 901	30/1/1985	NBG
34S 20E (–AD)	Old lands, along track to melkkamer.	Fellingham, A. 1011	29/4/1985	NBG
34S 20E (–BC)	De Hoop-Potberg Nature Reserve, Potberg house.	Scott, A. 483	30/1/1985	PRE
34S 21E (–AD)	Stillbaai, Botterkloof.	Thompson, 3716	14/3/1978	NBG, PRE

Zimbabwe:

22S 30E (–BD)	Limpopo River near Usutui.	Maasstrom, Van Graan & Hardy 452	2/5/1973	PRE
23S 26E (–AB)	Shoshony.	Woollard, J. 980	20/5/1981	SRGH

L. decumbens

Angola:

15S 11E	(–DA)	Moçamedes, San Antonio, coast of Porte Alexandre.	Mendes, 73	15/9/1955	LISC
15S 11E	(–DB)	Cabo Negro.	Martinos & Martos, 4518	–	K
15S 11E	(–DD)	Porte Alexandre (= Tombua.)	Mendes, 1181	29/12/1955	LISC
17E 11S	(–CC)	Kunene, at Mosamedes.	Menenes, 3789	12/2/1971	P, K, BM
17S 11E	(–BB)	Moçamedes Prov., National Park Jena, Kunene River.	Ward & Ward, 23	27/1/1975	K, WIND
17S 11E	(–CC)	Mouth of the Kunene River.	Torre, 8438	14/7/1956	LISC
17S 11E	(–CC)	Moçamedez (= Namibe), Kunene Mouth.	Teixeira et al 12719	12/10/1968	LISC
17S 11E	(–CC)	Moçamedez, P.N. Iona, Kunene Mouth.	Teixeira et al 13121	4/5/1969	LISC

Namibia:

20S 13E	(–AA)	Unjab Mouth, water hole.	Muller, M. & Loutit, B. 1188	14/8/1979	WIND
20S 14E	(–DD)	8 km south east of Ugab River Settlement.	Müller, M. & Loutit, B. 1060	8/8/1979	WIND
21S 13E	(–DB)	Omaruru, Lagunenberg, southeast of Cape Cross.	Giess, W. 3556	15/6/1961	WIND
21S 14E	(–CA)	Cape Cross, about 500 m from the coast.	Giess, W. 8715	29/4/1965	WIND
21S 14E	(–CA)	Cape Cross.	Jensen, W. 274	0/3/1963	WIND
21S 14E	(–CC)	Cape Cross, mountain at lagune.	Giess, W. 10470	29/6/1967	WIND
21S 14E	(–DD)	Cape Cross, 1 km north of Memorial Cross.	Venter, A M. 621	21/2/1999	BLFU
22S 14E	(–DA)	Swakop River Mouth.	Seydel, 904	–	WIND
26S 15E	(–DC)	Kaukausigfontein, southern Namib	Ward, C. J. & Seely, M. 10203	19/4/1988	K

L. eenii

Namibia:

19S 15E	(–CA)	Farm Westfalen, mountains at Kaikop (Gnaut).	Schwerdtfeger, 2/353	13/5/1953	WIND
20S 13E	(–AB)	21 miles east of Torra bay.	Giess, Volk & Bleissner, 6202	4/4/1963	WIND
20S 13E	(–BC)	34 km west of farm Wêreldsend on road to Torra Bay.	Giess, W. 7981	15/4/1964	PRE, WIND
20S 14E	(–CC)	6 km south of Gai-as	Müller, M. & Loutit, B. 1113	11/8/1979	WIND
20S 14E	(–CC)	Between Brandberg West-Ugab crossing and Gai-as rd.	Craven, P. 1511	31/3/1984	WIND
20S 14E	(–CA)	Farm Nickberg, south boundary, Damaraland.	Craven, P. 1006	15/7/1978	WIND
20S 14E	(–CB)	Damaraland.	Craven, P. 862	11/6/1978	WIND
20S 14E	(–DC)	Welwitschia, Gaias	Craven, P. 1370	2/5/1982	WIND
20S 14E	(–DD)	Gai-as.	Müller, M. & Loutit, B. 1157	12/8/1979	WIND BOL
20S 15E	(–BB)	64 km west of Outjo.	Esterhuyse, C. J. 446	0/1/1960	WIND, PRE
20S 16E	(–AA)	District Outjo, farm Klein Beginn.	Giess & Leippert, 7301	4/6/1963	PRE, WIND, NBG
20S 16E	(–AD)	Omatjenne experimental farm, Otjiwarongo.	Giess, W. 8186	20/4/1964	WIND
20S 16E	(–BC)	Otjiwarongo Extension 5, area south of town.	Craven, P. 551	26/12/1977	WIND
20S 16E	(–BC)	Otjiwarongo Extension 5, Municipal area south.	Craven, P. 553	26/12/1977	WIND
20S 16E	(–BC)	Otjiwarongo. Grootplaas, Omatjenne.	Volk, O. H. s.n.	0/3/1940	WIND
20S 17E	(–CA)	Okosongomingo, 150 km Otjiwarongo to Waterberg.	Wanntorp, H. & H. E. 606	3/4/1968	PRE
21S 14E	(–BA)	Brandberg.	Giess, W. 3632	17/6/1961	PRE WIND
21S 15E	(–CC)	Damaraland, Black Range farm.	Ward, 10905	4/4/1990	PRE
21S 15E	(–DA)	Erongo Mountains, farm Bergsig.	Craven, P. 840	16/4/1978	WIND
21S 15E	(–DC)	Ameib, S. Erongo Mountains.	Jensen, M. K. 485	19/2/1970	PRE, WIND
21S 15E	(–DC)	Ameib River.	Jensen, R. A. C. s.n.	24/2/1972	WIND
21S 15E	(–DC)	Ameib, main dam.	Jensen, R. A. C. s.n.	21/4/1972	WIND
21S 15E	(–DD)	Farm Daheim, Karibib District.	Kinges, H. 3233a	17/2/1953	PRE
21S 15E	(–DD)	Karabib, Okomitundu.	Seydel, R. 1243	19/12/1959	PRE
21S 16E	(–BB)	113 km N of Okahandja to Otjiwarongo, farm St	Venter, A. M. 490	12/7/1995	BLFU
21S 16E	(–DD)	Okahandja, Waterberg district.	Bradfield, 209	10/1/1928	K, PRE, WIND
21S 16E	(–DD)	Okahandja, farm Eckenberg.	Walter, H. & E. 230	26/4/1952	WIND
21S 18E	(–CD)	Steinhauzen, Okaruako.	Van Zyl, L. 25	26/4/1984	WIND
21S 18E	(–DB)	District Gobabis, farm Stürmfeld.	Walter, H. & E. 4729	20/6/1953	WIND
21S 19E	(–AD)	Farm Tsüwandes, Outjo distict.	Schwerdtfeger, 2/55	19/2/1953	WIND
22S 14E	(–DA)	Swakopmund.	Seydel, R. s.n.	1/4/1957	Z
22S 16E	(–AB)	Karabib, Onjossa farm.	Seydel, R. 4033	5/6/1964	K, COI, WIND
22S 16E	(–BB)	59 km S of Okandja on road to Windhoek.	Venter, A. M. 205	30/9/1988	BLFU
22S 16E	(–DD)	Claratal, 43 km SW of Windhoek.	De Winter, 2567	21/3/1955	K, WIND, PRE
22S 16E	(–DD)	Between Haris and Hoffnungsfelde.	Pearson, H. H. W. 9533	8/1/1916	K, BOL
22S 17E	(–CA)	Municipal area, Windhoek.	Hanekom, W. J. 219	6/11/1962	WIND
22S 17E	(–CA)	Municipal area, Windhoek.	Hanekom, W. J. 353	17/12/1962	WIND, PRE
22S 17E	(–CA)	Windhoek,southern outskirts of town.	Venter, A. M. 553	8/7/1996	BLFU
22S 17E	(–CA)	East of Avis dam.	Schwerdtfeger, 2/297	14/4/1953	WIND
22S 17E	(–CB)	29 km from Windhoek on Gobabis Road.	Liebenberg, L . 4538	0/4/1949	WIND, PRE
22S 17E	(–CB)	Finkelstein, Windhoek bergland.	Seydel, R. 4172	16/2/1965	K
22S 17E	(–CC)	Anas mountains, farm Gochaganas, Windhoek.	Merxmüller & Giess, 876	19/12/1957	WIND, PRE
22S 18E	(–AD)	Witvlei (Gobabis).	Mason, M. & Boshoff, A. 1603	0/3/1968	PRE
22S 18E	(–AD)	Witvlei town-lands (Gobabis).	Mason, M. & Boshoff, A. 2569	17/4/1969	PRE
23S 17E	(–BA)	Windhoek, Antabib reservoir dam.	Griffin, R. E. 27	20/4/1975	WIND
23S 17E	(–BD)	About 32 km N of Uhlenhorst on farm "SIB".	Boshoff, A. & Mason, M. 3616	0/3/1969	PRE
23S 17E	(–CB)	Rehobot, 5 km along Tsumis Park turnoff.	Immelman, K. 566	10/3/1983	PRE
24S 16E	(–AB)	Büllspoort at old police station,4 km SW of farmhouse.	Griffin, R. E. 86	24/5/1975	WIND
24S 16E	(–AB)	Bullspoort.	Liebenberg, L. 5089	0/5/1949	PRE, WIND
24S 16E	(–AB)	Bullspoort district.	Liebenberg, R. 5100	0/5/1949	WIND
24S 16E	(–BD)	Maltahöhe, farm Nomtsas.	Walter, H. & E. 1862	16/3/1953	WIND
24S 16E	(–BD)	Farm Nomtsas, Haweb River sheep post, Maltahöhe.	Walter, H. & E. 1884	16/3/1953	WIND
24S 17E	(–BD)	Hardap Dam.	Richards, P. s.n.	0/4/1984	WIND
24S 17E	(–DA)	Farm Haribes, Mariental.	Volk, O. H. 12163	2/4/1956	WIND
24S 17E	(–DB)	Mariental, Hardap Game Reserve.	Le Roux, 1226	0/9/1974	WIND
24S 17E	(–DB)	10 km north of Mariental.	Acocks, J. P. H. 18119	10/5/1955	K

L. eenii

24S 17E	(–DB)	Just N of Mariental to Kalkrand.	De Winter, 3486	10/5/1955	K, PRE, WIND
24S 17E	(–DB)	Hardap Game Reserve.	Müller, M. 202	3/2/1976	WIND, PRE
24S 18E	(–DC)	Kubus, Karabid Namibrand.	Seydel, R. 481	14/4/1955	B, K
25S 14E	(–AD)	Awas Mountains at Aub (= Auas Mountains).	Pearson, H. H. W. 9519	10/1/1916	K
25S 16E	(–BD)	Kleinfontein-South, 80 km N of Helmeringhausen.	Reyneke, A. M. 189	26/9/1988	BLFU
26S 17E	(–CD)	Bethanie district, Toras.	Range, P. 1764	12/7/1913	SAM, NBG
26S 19E	(–BC)	Kiriis dal (Kiribis on herb sheet).	Range, P. 1601	0/6/1912	SAM, NBG
28S 18E	(–BB)	2 km S of Karasburg on Warmbad road.	Reyneke, A. M. 209	2/10/1988	BLFU

L. europaeum

Algeria:

35N 00W (–DA)	Oran.	Wolfe,	0/2/1857	P, K
36N 03E (–BA)	Near d'Aumale (= Sour el Ghozlane).	Charey, Alcida 1005	1/7/1866	P
36N 06E (–BC)	Constantine.	Garriques, 481	24/11/1892	P
36N 30E (–CC)	Entrance to St Eugeni (=Bologuine Ibnou Ziri).	Chabert, A.	29/12/1880	FI
36N 30E (–CC)	Lake St Eugene (=Bologuine Ibnou Ziri).	Jamin, 944	0/0/1850	P

Mauritania:

16N 10W (–DC)	Guell (=Guellaba ridge).	Chudeau, M. s.n.	10/5/1911	P
18N 16W (–AA)	Noua Kchott.	Chudeau, M. s.n.	13/2/1908	P
20N 17W (–CC)	2 km east of Port Ettienne (=Nouadhibou).	Caille, O. 25419	2/3/1909	P
20N 17W (–CC	Port Ettienne (=Nouadhibou).	Chudeau, M. 23	14/4/1908	P
20N 17W (–CC)	Port Ettienne (=Nouadhibou).	Chudeau, M. 38	14/4/1908	P
22N 12W (–CB)	Adrar Region, Zoukar (=Zouerate).	Chevalier, L. s.n.	16/1/1937	P

Morocco:

29N 09W (–AA)	12 km E of Tiznit.	Miller, Russel & Sutton, 595	3/4/1974	K, BM
29N 10W (–AC)	W of El Hoveima Kale Idris (=Hueriria Yebel).	Davis, 51383	17/4/1971	BM, E
29N 10W (–AA)	Agadib (Verwysings na Agadir).	Trettewy, A. W. 50	1/2/1936	K
32N 09W (–CB)	Safi.	Ball, J. s.n.	9/6/1871	P
33N 07W (–CA)	Fedhala.	Trettewy, A. W. 109	0/2/1930	K
33N 07W (–DA)	Casa blanca, Mazagan.	Hooker, s.n.	0/4/1871	K
35N 03W (–BB)	Al Hocciema.	Heath, 304	–	K
35N 04W (–AA)	Ras Sidi-el-Ahbed, Bokoia.	Font Quer, 400	24/8/1928	BM
	Surrounding of Keira.	Balanza s.n.	0/5/1867	P

Tunisia:

36N 10E (–DC)	30 km NE of Grombalia.	Jansen, 287	25/4/1965	WAG

L. ferocissimum

Lesotho:

29S 27E (–BC)	Maseru, Thaba Bosigo	Schmitz, M. 7498	0/4/1977	PRE
29S 27E (–CD)	Mission Station Likhoele, district Mafeteng.	Dieterlen, A. 9a	0/2/1915	BM, PRE, P

Morocco:

31N 09W (–DB)	French Lambert, North Morocco Zone, Essaouira.	Jury, Rejdali & Watson, 9121	8/7/1987	BM
33N 08W (–BA)	20 km south of El Jadida, south of Jorf Las.	Van Slageren, M. & Birouk, A. s.n.	16/6/1995	K
34N 06W (–BB)	Bouknadel, 8 km N de Salé. (prov Rabat-Salé).	Lewalle, J. 11248	10/11/1985	L
36N 12W (–DB)	El Jadida.	Prondergast, H. D. 254	22/6/1990	K

South Africa:

25S 30E (–CB)	Transvaal, Waterval Boven.	Mason, E. 73	0/0/1922	K
27S 27E (–AB)	Kroonstad.	Pont, J. W. 369	0/2/1929	PRE
27S 27E (–BD)	Heilbron.	Uys, s.n.	6/5/1941	PRE
27S 27E (–CA)	Kroonstad district, west of Vals River.	Potts, Geo. 679	0/11/1928	BLFU
28S 21E (–BC)	Distict of Albany.	Story, 2696	25/7/1947	K, PRE
28S 27E (–CD)	Korannaberg, farm Mequatling.	Du Preez, P. J. 1483	7/12/1988	BLFU
28S 27E (–CD)	Excelsior district, Korannaberg.	Du Preez, P. J. 1634	26/1/1989	PRE
29S 25E (–CB)	Fauresmith Veld Reserve.	Pont, J. W. 2962	0/3/1936	K
29S 26E (–AA)	Rayton, north of Bloemfontein.	Lumley, M. 14	21/4/1977	NBG
29S 26E (–AA)	Bloemfontein, unused kraal in Rayton.	Reyneke, A. M. 134	16/4/1977	BLFU
29S 27E (–AB)	Modderpoort Missionary Station, Ladybrand.	Reyneke, A. M. 133	10/4/1977	K
29S 27E (–AB)	Ladybrand district: Modderpoort Missionary Stat	Venter, H. J. T. 7697	10/5/1978	PRE. BLFU
30S 23E (–BC)	Britstown, farm Volstruispoort.	Retief & Germishuizen, 15	14/1/1986	K
31S 28E (–DB)	Peddie district, near Maitland.	Marloth, R. 11620	0/6/1923	PRE
31S 28E (–DB)	Umtata Commonage.	Miller, O. B. B/690	0/10/1948	PRE
33S 17E (–BB)	Saldanha Bay.	Neser, S. s.n.	6/5/1972	NBG
33S 18E (–AA)	Geelbek, Malmesbury, Cape.	Compton, R. H. 19912	24/8/1947	NBG
33S 18E (–AD)	Darling.	Judd, R. A. s.n. (7/88)	11/7/1988	GRA
33S 18E (–AD)	Malmesbury district, Darling, slopes of Slangkop.	Rycroft, H. B. 1777	13/8/1954	NBG
33S 18E (–CB)	Near Melkbos Beach.	Reyneke, A. M. 220	8/11/1988	BLFU
33S 18E (–CD)	Robben Island.	Buys, s.n.	0/0/1978	NBG
33S 18E (–CD)	Moulle Point, Peninsula.	Pillans, 3235	6/5/1918	PRE
33S 18E (–CD)	Robben Island.	Walgate, M. 515	20/8/1943	NBG
33S 18E (–CD)	Cape, Mowbray.	Wilms, 3452	8/7/1883	BM
33S 18E (–DA)	Dassenberg, Malmesbury district.	Boucher, C. 4431	10/7/1979	NBG
33S 18E (–DA)	Malmesbery, Helderfontein farm.	Boucher, C. 4705	10/7/1979	K, NBG
33S 18E (–DC)	Farm Verona, Durbanville.	Bos, J. J. 267	22/7/1963	PRE, STE
33S 18E (–DD)	Stellenbosch.	Sylvester, J. 63312	0/5/1947	SAM, NBG
33S 19E (–CB)	3 km northeast of Brewelskloof.	Bayer, M. B. 1531	2/2/1981	NBG
33S 22E (–CA)	26 km SSW of Oudtshoorn.	Acocks, J. P. H. 20485	22/5/1959	K
33S 24E (–DA)	Baviaanskloof between Cambria and Patensie.	Van Wyk, C. M. 396	1/11/1980	NBG
33S 24E (–DD)	Hankey district, Hankey Pass.	Cowley, R. M. 957	3/10/1979	GRA
33S 24E (–DD)	Humansdorp near Scott Cave, Gamtoos Valley.	Wells, M. J. 2739	21/11/1963	GRA
33S 25E (–BD)	Addo National Park, Renoster camp.	Botha, B. P. 5647	27/10/1976	GRA
33S 25E (–BD)	Farm Vista, 5 km from Paterson to Addo.	Retief, E. 351	9/6/1978	K
33S 25E (–CD)	Uitenhage.	Harvey, 1034	—	BM
33S 25E (–CD)	Uitenhage.	Prior, 5137	-	K
33S 25E (–CD)	Uitenhage, Zwartkops Rivier.	Zeyher, 3460	0/2/1847	P
33S 25E (–DC)	Markhan Residential area, 16 km N of Port Elizabeth.	Dahlstrand, K. A. 1891	14/5/1970	STE, GRA
33S 25E (–DC)	Eastern Cape, Perseverance, Swartkops River.	Long, 684	1/8/1932	K, PRE
33S 25E (–DC)	Redhouse.	Paterson, F. 629	0/4/1915	K, BOL
33S 25E (–DC)	Port Elizabeth, Swartkops River	Theron, G. 660	3/10/1949	K
33S 25E (–DC)	Port Elizabeth, Swartkops River	Theron, G. 661	3/10/1949	PRE
33S 25E (–DC)	Port Elizabeth, Van Stadens River.	Theron, G. 662	5/10/1949	K
33S 26E (–AA)	Riebeeck-oos, Albany.	Barker, W. F. 9813	11/12/1962	NBG
33S 26E (–AB)	Helspoort Kloof, Uitenhage district.	Fries, Norlindh, & Weimark, 989	13/9/1930	PRE

L. ferocissimum

33S 26E (–AD)	Assegaai River, Albany.	Compton, R. H. 19069	10/1/1947	NBG
33S 26E (–BA)	Albany, Botha's Hill.	Lots & Goddijn, 733	0/11/1926	L
33S 26E (–BA)	Botha's Hill, Fort Beaufort Road.	Venter, A. M. 606	21/9/1998	BLFU, GRA
33S 26E (–BC)	Grahamstown.	Humbert, 10320	25/8/1933	P
33S 26E (–BC)	Grahamstown.	Rogers, F. A. 27320	0/1/1923	K, PRE
33S 26E (–BC)	Ecca Pass 30 km north of Grahamstown.	Judd, R. A. s.n.	23/4/1988	GRA
33S 26E (–CA)	Bushmans River crossing, near Grahamstown.	Barker, W. F. 9265	26/6/1961	NBG, STE
33S 26E (–CA)	Grahamstown.	Bokelmann, H. s.n.	0/11/1963	NBG
33S 26E (–CC)	Delville farm near Grahamstown.	Reed, J. E. 28	12/10/1968	GRA
33S 26E (–DA)	South Wel. Bathurst district.	Bayliss, R. D. A. B229	1/3/1973	PRE
33S 26E (–DA)	Boknesstrand, Alexandria.	Burrows, H. H. 2831	5/3/1989	GRA
33S 26E (–DB)	Port Alfred division, Bathurst	Rogers, F. A. 16651	0/8/1915	BM
33S 26E (–DB)	Port Alfred.	Du Preez, P. J. 1501	26/12/1988	BLFU
33S 26E (–DB)	Port Alfred.	Tyson, W. s.n.	0/4/1916	PRE
33S 26E (–DB)	Port Alfred.	Tyson, W. 17268	0/3/1916	PRE
33S 27E (–AA)	Peddie district, Kafferdrif.	Marais, 418	29/7/1954	K, PRE, GRA
33S 27E (–BA)	Lushington Valley, Albany district.	Britton, L. 2732	25/3/1921	GRA
34S 18E (–AB)	Fishhoek, Cape.	Munro, H. K. PS154	0/4/1927	PRE
34S 18E (–AB)	Hout Bay beach.	Reyneke, A. M. 219	7/11/1998	BLFU
34S 18E (–AB)	Kalk Bay, near Simonstown.	Wolley Dod, A. H. 2157	22/11/1896	BOL
34S 18E (–AB)	Cape Peninsula, Ronde vlei, Simonstown.	Weintraub, 18908	31/8/1930	BM
34S 18E (–AD)	Cape of Good Hope National Reserve, Olifantsbos.	Taylor, H. C. 7770	22/6/1970	K, NBG, PRE
34S 18E (–AD)	Seapoint, near Cape Town, Cape Peninsula.	Dawson, A. C. s.n.	0/1/1915	BOL
34S 18E (–BA)	Eerste River Forest Station, Cape Flats.	Britton, P. 6	8/6/1972	NBG
34S 18E (–BB)	Zeekoeivlei, near Simonstown.	Bond, P. 1010	24/6/1941	NBG
34S 18E (–BB)	Gordons Bay.	Markotter, E. 15003	25/2/1927	STE
34S 18E (–BB)	Somerset Strand.	Parker, R. N. 4175	12/4/1947	K, NBG
34S 18E (–CC)	Hottentothuisie picnic spot, Cape Point.	De Villiers, P. 164	22/9/1978	PRE
34S 19E (–AC)	District of Caledon, Hermanus.	Rogers, F. A. 20551	–	K
34S 19E (–BA)	Enon Cape, Caledon.	Thode, A2721	0/10/1930	K
34S 20E (–AC)	Salt River Station, Bredasdorp.	Pillans, N. S. 17018	0/9/1918	BOL
34S 20E (–CC)	4 km east of Struis Bay.	Venter, A. M. 516	5/1/1996	BLFU
34S 23E (–AA)	Knysna.	Maude, s.n.	23/3/1928	BM
34S 23E (–AB)	Plettenberg Bay.	Pappe, s.n.	–	K
34S 23E (–AB)	Robberg, Knysna.	Viljoen, A. 85	0/4/1975	BLFU
34S 23E (–AB)	Keurbooms Rivier, east bank.	Fourcade, F. G. 6122	28/9/1943	STE, BOL
34S 24E (–BB)	Humansdorp.	Wagner, D. S. 17135	0/6/1982	NBG

Tunisia:

35N 09E (–CC)	Makthar.	Davis, 69869	3/5/1984	EDINB
35N 10E (–DC)	Near Sahline, between Sousse and Monastir.	Davis, 48046	9/9/1968	EDINB

L. gariepense

Namibia:

27S 16E (–CD)	Farm Witputz, owned by Van der Westhuizen.	Venter, A. M. 628	30/4/2000	BLFU
27S 16E (–DD)	Against hill at Zebrafontein.	Reyneke, A. M. 183	24/9/1988	BLFU
28S 16E (–BA)	Obibberge, schluchten unterhalb.	Merxmüller, H. & Giess, W. 28638	20/9/1972	WIND
28S 17E (–AA)	S Namibia, crossing of Jan Haak Road and Fish River.	Venter, A. M. 590	1/9/1997	BLFU
28S 17E (–AB)	S Namibia, 21 km W of Jan Haak rd-Fish River crossing.	Venter, A. M. 584	1/9/1997	BLFU
28S 17E (–AB)	S Namibia, 21 km W of Jan Haak rd-Fish River crossing.	Venter, A. M. 585	1/9/1997	BLFU
28S 17E (–AB)	S Namibia, 21 km W of Jan Haak rd-Fish River crossing.	Venter, A. M. 587	1/9/1997	BLFU

L. grandicalyx

Namibia:

27S 16E (–CC)	58 km N of Rosh Pinah.	Venter, A. M. 589	1/9/1997	BLFU
27S 16E (–CD)	13 km N of Witputz Police Station.	Venter, A. M. 485	26/6/1995	BLFU
27S 16E (–DA)	51 km N of Rosh Pinah.	Venter, A. M. 583	10/7/1997	BLFU
27S 16E (–DA)	9,6 km north of Witputz Police Station.	Merxmüller, H. & Giess, W. 344	–	PRE, M, BLFU
27S 16E (–DA)	6 km NW of Witputz Police Station.	Reyneke, A. M. 178	24/9/1988	BLFU
27S 17E (–CA)	3 km south of border, of farm Uitsig.	Giess & Müller, 14286	7/5/1990	PRE, M, WIND
27S 17E (–DA)	Fish River Gorge, I km south of main view point.	Venter, A. M. 630	1/5/2000	BLFU
27S 17E (–DA)	Fish River Gorge, starting point of hiking trail.	Van Jaarsveld, E. 8767	2/7/1986	NBG
27S 17E (–DA)	Fish River Canyon Nature Reserve.	Meyer, 2	–	WIND, M

L. hirsutum

Lesotho:

29S 27E (–BB)	Cana.	Dieterlin, A. 9	5/10/1911	P

Namibia:

22S 17E (–BC)	29 km from Windhoek on Gobabis road.	Liebenberg, L. 4530	0/4/1949	WIND
22S 17E (–BC)	Farm Bodenhausen.	Seydel, R. 2344	19/4/1960	WIND
22S 17E (–CA)	Municipal area, Windhoek.	Hanekom, W. J. 94	14/7/1962	WIND
22S 17E (–CA)	Windhoek, Berg Street.	Keet, J. D. 1673	0/4/1948	PRE
22S 17E (–CA)	Windhoek bergland, banks of Avis Rivier.	Seydel, R. 3544	9/6/1963	L, G
22S 17E (–CA)	Windhoek bergland.	Seydel, R. 3844	18/12/1963	G
22S 17E (–CA)	Immental, Schieferhügel.	Von Koenen, E. 398	0/11/1979	G
22S 17E (–CD)	Binsenheim, Schaf River.	Leipert, 4529	15/7/1963	WIND
22S 18E (–BD)	Gobabis.	Schlieben, H. J. 10396	27/4/1965	PRE
23S 14E (–AB)	Walvis Bay district, Lower Kuiseb Delta.	Ward, C. J. 11932	6/4/1992	PRE
23S 18E (–DD)	Near Black and White Nossob river junction.	Codd, L. E. 5835	22/11/1949	WIND
24S 16E (–BD)	8 km NW of Nomtsas, banks of Usib River.	Pearson, 9325	24/12/1915	K
24S 16E (–DD)	Okahandja.	Dinter, 258	–	NBG
25S 16E (–DA)	Bethamin, farm Aruab.	Lind, P. 432	24/4/1979	WIND
25S 17E (–AC)	Farm Rosstroppe.	Müller, M. 1320	9/4/1980	WIND
25S 17E (–AC)	Farm Naos, Rehoboth.	Schwerdtfeger, 4235	11/7/1953	WIND
26S 16E (–CB)	Aus, Great Namaqualand.	Dinter, 4171	29/10/1922	NBG, BM
26S 16E (–CB)	Aus.	Dinter, 6154	2/3/1929	K
26S 16E (–CB)	Aus Townlands.	Owen-Smith, G. 1097	7/3/1979	WIND
26S 16E (–CB)	4 km south of Aus, at shooting range.	Reyneke, A. M. 176	23/9/1988	BLFU
27S 17E (–BB)	Keetmanshoop, farm Gawachab.	Merxmüller, H. & Giess, W. 32498	5/10/1977	PRE, WIND
27S 18E (–BC)	Groot Karasberge, Noachabeb.	Örtendahl, I. 403	13/6/1981	PRE, K
27S 19E (–AB)	Farm Warmfontein.	Lensing, J. E. J 2/76	22/7/1976	WIND

South Africa:

25S 20E (–CC)	Kalahari Gemsbok Park, Mata Mata, Auob riverbed.	Leistner, D. A. 1149	29/6/1958	K, PRE
26S 24E (–DC)	Vryburg district, Goedewacht (=Goedverwacht).	Henrici, M. 119	18/4/1924	PRE
26S 24E (–DC)	Vryburg.	Pole-Evans, I. B. 15823	21/9/1917	PRE
27S 23E (–BD)	Kuruman.	Silk, E. 108		PRE
27S 24E (–AA)	Vryburg, Zoetvley.	Speedy, J. G. 17/16	10/8/1988	PRE
27S 25E (–BB)	Leeuwfontein 10 km west of Wolmaranstad.	Van Wyk, A .E. 552	31/8/1974	PRE
27S 25E (–BD)	Wolmaranstad, Boskuil.	Sutton, J. D. 133	16/5/1929	PRE
27S 25E (–DA)	Western Transvaal, Bloemhof district.	Barrett-Hamilton, 6409	25/7/1902	BM
27S 25E (–DA)	Kaffraria, Bloemhof district.	Burtt-Davy, J. 12816	—	BOL
27S 25E (–DA)	Bloemhof Dam Nature Reserve.	Carr, J. D. 226	6/4/1984	PRE
27S 25E (–DB)	Bloemhof, Sandveld Reserve, Kameelfontein.	Viljoen, A. J. 149	—	PRE
27S 26E (–AD)	Christiana, Hartebeespan.	Burtt-Davy, J. 9622	20/6/1910	PRE
27S 26E (–DA)	Bothaville district, Essex farm, Otterspruit.	Fulls, E. R. 273	10/2/1993	PRE
27S 27E (–CA)	Kroonstad, confluence of Blomspruit and Vals River.	Scheepers, 1724	5/4/1968	PRE, K
28S 22E (–DD)	Hay Division, Biesieputs.	Acocks, J. P. H. 2329	24/6/1937	PRE, K
28S 24E (–CA)	N. Cape, NW corner of Rooipoort farm.	Phelan, A. J. 1006	5/9/1990	PRE
28S 24E (–CA)	Boomplaas, between Smitsdrift and Delportshoop.	Reyneke, A. M. 293	20/5/1989	BLFU
28S 24E (–CA)	10 km on Barkly West turnoff from Riverton Road.	Reyneke, A. M. 310	20/5/1989	BLFU
28S 24E (–DB)	Dronsfield, 10 km north of Kimberley.	Gubb, A. A. 11008	-	PRE
28S 24E (–DB)	Near Kimberley.	Moran, 1	0/9/1915	BOL
28S 24E (–DB)	Diamond Fields north of Kimberley.	Nelson, 28	0/8/1880	K
28S 24E (–DB)	10km Kimberley towards Griquatown.	Reyneke, A. M. 77	23/1/1977	BLFU
28S 24E (–DB)	4 km from Kimberley to Griquatown.	Reyneke A. M. 271	10/5/1988	BLFU
28S 24E (–DB)	30 km from Kimberley to Griquatown.	Reyneke, A. M. 278	10/5/1988	BLFU
28S 25E (–CC)	Modder River Bridge between Petrusburg & Kimberley.	Reyneke, A. M. 298	20/5/1989	BLFU
28S 25E (–DB)	10 km from Dealesville to Boshof.	Reyneke, A. M. 302	20/5/1989	BLFU
28S 26E (–AB)	Sand River Crossing at Port Allen.	Joffe, H. 400	17/10/1987	PRE
28S 26E (–CC)	Krugerdrift Dam Nature Reserve, Bloemfontein district.	Muller, D. B. 1913	28/4/1976	PRE
28S 26E (–CD)	Glen Agricultural College, Bloemfontein district.	Reyneke, A. M. 14	2/5/1976	BLFU
29S 22E (–AD)	Asbestos Mountains.	Marloth, 2036	0/7/1894	K, PRE

L. hirsutum

29S 22E (–DA)	Prieska, at Orange River.	Burchell, 1644	16/9/1811	K
29S 22E (–DD)	Keikamspoort.	Burchell, 1614	13/9/1811	PRE
29S 24E (–BA)	Along Modder River.	Pearson H H W 1658	20/6/1908	NBG
29S 24E (–BA)	Banks of Modder River	Pearson 2953	30/6/1908	NBG
29S 24E (–BA)	Modderrivier, Cape Province.	Pole-Evans, I. B. 18829	0/9/1918	PRE
29S 24E (–BB)	Jacobsdal.	Goossens, A. P. 2954	18/8/1923	BLFU
29S 24E (–CA)	Near Hopetown, near Orange River.	Bolus, 2215	0/8/1871	K
29S 24E (–DC)	Farm Bleskop, 29 km from Luckhoff to Petrusville.	Herman, P. 331	27/2/1981	PRE
29S 25E (–AB)	1½ km west of Petrusburg to Kimberley.	Reyneke, A. M. 301	20/5/1989	BLFU
29S 25E (–CB)	Fauresmith area Riet River.	Humbert, 10465	30/8/1933	P
29S 25E (–CB)	Fauresmith, Kakabasdrift farm at Riet River.	Smith, C. A. 4501	10/9/1927	PRE
29S 25E (–CB)	Fauresmith, Samor farm.	Smith, C. A. 4367	20/8/1927	PRE
29S 25E (–CB)	Edenburg, Riet River Siding.	Smith, C. A. 4463	7/9/1927	PRE
29S 25E (–CB)	Riet River at Fauresmith.	Henrici, M. 2455	0/5/1932	PRE
29S 25E (–CD)	45 km from Bloemfontein to Jagersfontein.	Reyneke, A. M. 98	6/2/1977	BLFU
29S 26E (–AA)	Bloemfontein near river.	Hanekom, 613	15/8/1966	K, PRE
29S 26E (–AA)	Around Bloemfontein.	Pole Evans, I. B. 1241	20/5/1912	K
29S 26E (–AA)	Victoria Park, Bloemfontein.	Potts, Geo. 1385	0/4/1916	BLFU
29S 26E (–AA)	UOFS, Botany & Genetics' inner courtyard.	Reyneke, A. M. 152	28/5/1980	BLFU
29S 26E (–AB)	Renosterspruit, Bloemfontein.	Potts, Geo. 1113	0/12/1915	BLFU
29S 26E (–CA)	40 km Bloemfontein to Reddersburg.	Reyneke, A. M. 107	13/2/1977	BLFU
30S 25E (–CA)	Colesberg.	Marloth, R. 1919	0/6/1889	BOL, PRE
30S 26E (–AD)	Fauresmith, Groenvlei farm.	Mogg, A. O. D. 13619	7/5/1937	PRE
30S 26E (–BA)	29 km from Kimberley to Barkly West.	Reyneke, A. M. 311	20/5/1989	BLFU
30S 26E (–BA)	Smithfield district, farm Finkelspruit.	Reyneke, A. M. 332	30/4/1990	BLFU
30S 26E (–CA)	Wildplaas at Vergelegen, Bethulie district.	Muller, D. B. 1005	23/8/1972	PRE, BLFU
30S 26E (–CA)	Banks of the Orange River.	Pearson, 1630	24/6/1908	NBG
30S 26E (–DA)	Aliwal North.	Kuntze, O. s.n.	22/2/1894	K
30S 26E (–DA)	Orange River bank at Aliwal North.	Reyneke, A. M. 93	29/1/1977	BLFU
31S 20E (–BD)	Williston.	Van der Schyff, H. P. 7057	20/7/1967	PRE
32S 21E (–BB)	Beaufort West district, Layton.	Shearing, D. A. M. Bb 1249	21/2/1986	PRE
31S 26E (–DA)	Klass Smits River banks, Roderandplaas, Queenstown	Galpin, E. E. 2516	13/11/1898	PRE, K
32S 21E (–DD)	Leeu Gamka, Blaauwkrantz.	Dean, S. J. 1041	28/8/1990	PRE
33S 20E (–AA)	Dweka River (=Dwequa River).	Dregé, 7866a	3/4/1827	G, P
33S 20E (–AA)	Dweka River.	Drége, 7866b	29/12/1829	P
33S 21E (–CA)	10 km east of Vleiland Post Office.	Acocks, J. P. H. 20498	24/7/1959	K, PRE, STE
28S 23E (–CB)	Asbestos Mountains.	Marloth, 894	—	K
29S 23E (–AA)	Asbestos Mountains.	Marloth, 2037	0/7/1894	PRE

L. horridum

Botswana:

21S 21E (–DA)	15 km S of Ghanzi on road to Lobatsi.	Brown, R. C. 8279	1/2/1970	K, SRGH, LISC
23S 24E (–BC)	Khutse Game Reserve.	Tolley, 40a/b	–	K
24S 25E (–AD)	Region Molopolele (Kalahari).	Humbert, M. H. 15380	13/4/1934	P
24S 25E (–DA)	Thamaga.	Camerik, A. M. 134	–	K, PRE
25S 25E (–AB)	South of Kanye.	Abel, N. 175	6/7/1983	PRE
25S 25E (–BA)	Lobatsi district, 6 km on road to Mafekeng.	Miller, B/500	0/4/1947	SRGH

Namibia:

24S 16E (–AB)	Bullspoort.	Liebenberg, 5121	0/5/1949	WIND
24S 16E (–CD)	Farm Zaris.	Giess, Volk, & Bleissner, 5187	18/2/1963	WIND
25S 14E (–DD)	Saddle Hill, Lüderitz Bay.	Seely-Robinson, 413	17/1/1973	WIND
25S 16E (–BB)	Kleinfontein south, 80 km north of Helmeringhausen.	Reyneke, A. M. 190	26/9/1988	BLFU
25S 16E (–DD)	2 km north of Helmeringhausen.	Lavranos, Barad, Pehleman 19227	1/12/1981	WIND
26S 15E (–CA)	20 km east of Luderitz.	Venter, H. J. T. 8637	28/10/1981	BLFU
26S 15E (–DC)	40 km east of Grillental, Kaukausib fountain.	De Winter, B. & Giess, W. 6096	30/8/1958	K, PRE
27S 17E (–AC)	Keetmanshoop region, farm Huns.	Liebenberg, L. C. 5237	0/4/1949	WIND
27S 16E (–AD)	Anib River, 15 km southeast from. Tsausberg.	Wendt, W. 21/5	0/10/1977	WIND
27S 16E (–BB)	Witpütz, Udabib mountain.	Müller, M. 798	3/8/1977	WIND
27S 16E (–CC)	58 km north of Rosh Pinah.	Venter, A. M. 588	1/9/1997	BLFU
27S 16E (–DD)	Namuskluft mountains.	Jankowitz, W. 175	9/5/1971	WIND
27S 18E (–BC)	Farm Us, at Us River.	Giess & Muller, 12009	17/5/1972	WIND. PRE
28S 16E (–BB)	5 km north of Rosh Pinah.	Craven, P. 1224	5/9/1981	WIND
28S 17E (–AD)	Stormberg, along Jan Haak road, Orange River banks.	Venter, A. M. 591	1/9/1997	BLFU
28S 18E (–BD)	Warmbad.	Giess & Muller, 12122	22/5/1972	PRE, WIND
28S 19E (–BA)	Farm Heiragabis, 88 km from Karasburg to Ariamsvlei.	Hardy, D. S. 1936	–	WIND

South Africa:

23S 29E (–BB)	Louis Trichardt Farm.	Venter, H. J. T. 9204	8/4/1998	BLFU
23S 29E (–CD)	Pietersburg municipal area.	Acocks & Haffstrom, 1370	4/10/1938	WIND
24S 28E (–BB)	Magalakwin.	Smuts, J. C. 2005	0/6/1926	PRE, K
24S 29E (–DD)	Ironstone farm, Lydenburg district.	Mogg, 800	9/1/1939	PRE
24S 30E (–CA)	Sekuniland, farm Groenland, near Lulu Mountains.	Barnard & Mogg, 16999	10/1/1939	K
25S 26E (–AA)	Nietverdiend, Marico district.	Cole-Carter, 838	14/12/1969	PRE
25S 26E (–DA)	Swartruggens.	Sutton, J. D. 1164	12/9/1936	PRE
25S 27E (–AA)	Pilanes Nature Reserve.	Glen, 1910	1/4/1990	PRE
25S 27E (–CA)	Near Rustenburg.	Van Son, 29017	5/3/1930	BM, PRE
25S 28E (–CA)	Jukskei River along Pretoria - Krugerdorp road.	Repton, 1006	11/4/1934	PRE
25S 29E (–CD)	Carlton Hills, Middelburg to Ludlow.	Acocks, J. P. H. 8644	5/5/1938	K, PRE
26S 20E (–BC)	Kalahari Gemsbok Park, 8 km north of Tweerivieren.	Leistner, O. A. 1855	18/4/1960	K, PRE
26S 22E (–DA)	Mashowing River banks at Dorham, Kuruman district.	Acocks, J. P. H. 2500	11/10/1937	K
26S 23E (–DB)	Cape, Herbert division, Eureka.	Acocks, J. P. H. 8756	–	K
26S 25E (–DA)	5 km from Delarayville to Sannieshof.	Germishuizen, 1040	27/1/1979	PRE, K
26S 27E (–BB)	Tvl, Randfontein, Libanon.	Taylor, L. E. 5051A	15/11/1956	NBG
27S 23E (–AB)	Kimberley Division, Nooitgedacht.	Acocks, J. P. H. 2530	–	K
27S 26E (–BC)	Sandfontein farm, 24 km west of Bothaville.	Schweikerdt, 1073	0/3/1933	K
27S 27E (–CA)	Kroonstad district, farm Middenspruit.	Scheepers, 1648	19/2/1968	K
28S 16E (–BD)	Richtersveld, Numees mine.	McDonald, D. J. 672	18/9/1981	PRE, NBG
28S 16E (–DA)	Little Namaqualand, Arris Drift, Richtersveld.	Pillans, N. S. 5258	0/10/1926	K
28S 16E (–DB)	Richtersveld, Goariepvlakte.	Jürgens, N. 22352	18/8/1987	PRE
28S 16E (–DB)	Richtersveld, Holgatrivier.	Pienaar, B. J. 1130	6/9/1987	PRE
28S 16E (–DC)	Little Namaqualand, Witbank.	Pillans, N. S. 5204	0/9/1926	K, BOL
28S 16E (–DC)	Between Holgat and Witbank, Little Namaqualand	Pillans, N. S. 5214	0/10/1926	K, BOL
28S 17E (–AA)	Southwest of Kodaspiek.	Thompson, M. & le Roux, 263	1/9/1977	NBG
28S 17E (–AC)	Northern foot of Rosyntjie Mountains.	Thompson, M. & le Roux, 201	30/8/1977	NBG
28S 17E (–AC)	Richtersveld National Park, Dabie River.	Williamson, 5560	0/2/1995	NBG
28S 17E (–CA)	Along road to Springbok Flats.	Venter, H. J. T. 8081	29/8/1980	BLFU
28S 17E (–CB)	Richtersveld, 29 km Eksteensfontein to Mt Stewart.	Germishuizen, 4588	29/8/1987	PRE
28S 17E (–CD)	Richtersveld, 10 km Eksteensfontein to Mt Stewart.	Nicholas, A. 2562	30/8/1987	PRE, NBG

[illegible]	Carnarvon Division, Rhenosterhoek.	[illegible]	23/1/1996	PRE
30S 22E (–CC)	12 km from Carnarvon to Vanwyksvlei.	Acocks, J. P. H. 1706	0/2/1937	K, PRE
30S 23E (–AC)	25 km from De Aar to Phillipstown, farm Welgegund.	Powrie, L. W. 594	17/2/1988	NBG
30S 23E (–BA)	Britstown district, farm Agterplaas.	Herman, P. 586	5/4/1981	PRE, WAG
30S 23E (–BC)	Farm Volstruispoort, at Brinkpan, Britstown district.	Retief & Germishuizen, 11415	15/1/1986	PRE
30S 23E (–CC)	50 km from Victoria West to Britstown.	Retief & Germishuizen 15	14/1/1986	PRE, K
30S 23E (–DD)	Near Mynfontein Station.	Venter, A. M. 481	13/12/1994	BLFU
30S 24E (–DB)	Colesberg, Doornkloof Nature Reserve.	Acocks, J. P. H. 15551	10/10/1949	K, PRE
30S 25E (–DD)	18 km Venterstad to Steynsburg.	Hahndiek, A. D126B	15/41983	GRA
30S 26E (–DA)	Elands Hoek, near Aliwal North.	Reyneke, A. M. 58	12/1/1977	BLFU
30S 26E (–DA)	Aliwal North.	Bolus, F. 6865	0/8/1903	K
30S 26E (–DA)	Ruigtefontein, Aliwal North.	Thode, J. A498	0/2/1925	PRE, K
30S 26E (–DA)	Radio Springs, Aliwal North.	Thode, J. A1830	0/4/1929	K
31S 18E (–BC)	Knechtsvlakte, Vanrynsdorp district.	Coetzee, J. A. A25	4/1/1964	BLFU, PRE
31S 18E (–CA)	Van Rhynsdorp near Olifants River.	Compton, R. H. 11056	23/7/1941	NBG
31S 18E (–CA)	Ebenezar.	Drège, 3071	30/7/1830	P
31S 18E (–CB)	Lutzville to Vredendal, Hol River, 6 km E of Lutzville.	Drège, 7872	0/11/ 1833	P, K
31S 18E (–CB)	Farm Liebendal, 11 km north of Vredendal.	Le Roux, A. 2171	9/8/1977	PRE, NBG
31S 18E (–DA)	Van Rhynsdorp.	Hall, 3616	24/6/1970	NBG
31S 19E (–AB)	N of Perdeberg, between Calvinia and Loeriesfontein.	Schlechter, R. 8091	2/7/1896	GRA
31S 19E (–AC)	Nieuwoudville Wild Flower Reserve.	Snijman, 996	8/1/1986	PRE, NBG
31S 19E (–DB)	Onder Downs, East of Calvinia.	Perry & Snijman,	19/4/1983	GRA
31S 19E (–DC)	Calvinia region, Boschberg.	Thompson, 2438	20/8/1975	NBG
31S 20 E (–BD)	15 km fom Williston to Calvinia.	MacOwan, 1875	0/3/ 1904	BM
31S 20E (–CC)	Farm Bloemfontein on Rooiwak road to Calvinia.	Reyneke, A. M. 246	2/4/1989	BLFU
31S 21E (–DA)	Zak River, Frazerburg Div.	Steiner, K. 517	28/10/1963	NBG
31S 22E (–BD)	Meltonwold, Victoria-Wes district.	Burchell, 1514	31/8/1811	K
31S 23E (–AA)	Rietpoort, 36 km from Victoria West to Britstown.	Taylor, H. C. 6871	0/0/1966	PRE, NBG
31S 23E (–AA)	30 km from Victoria West to Britstown.	Herman, P. 1140	14/3/1988	PRE
31S 23E (–AC)	40 km from Victoria West.	Venter, A. M. 480	13/12/1994	BLFU
31S 23E (–BD)	17 km south of Richmond.	Acocks, J. P. H. 16407	17/6/1952	K
31S 23E (–CC)	Drie Susters.	Venter, H. J. T. 9226	15/4/1990	BLFU
31S 23E (–CC)	Drie Susters.	Reyneke, A. M. 266	10/4/1988	BLFU
31S 23E (–DB)	10 km west of Richmond.	Venter, H. J. T. 9223	15/4/1990	BLFU
31S 24E (–CA)	15 km southeast of Hanover at Seekoei River.	Reyneke, A. M. 267	10/4/1989	BLFU
31S 25E (–AC)	Strathfillan, north of Conway at Little Brak River.	Skead, C. J. s.n.	11/11/1980	GRA
31S 25E (–AC)	7 km from Middelburg (CP) to Rietpoort.	Acocks, J. P. H. 18847A	9/5/1956	K
31S 25E (–AC)	Grootfontein, Middelburg (CP).	Comins, 723	8/3/1945	PRE, K
31S 25E (–AC)	Doornberghoek, Middelburg (CP).	Leistner, O. A. 487	6/11/1955	K, GRA, PRE
31S 25E (–BC)	30 km from Graaff-Reinet to Middelburg.	Acocks, J. P. H. 8683	11/5/1938	K
32S 18E (–DC)	Wittewater.	Reyneke, A. M. 149	16/4/1978	BLFU
32S 20E (–BC)	26 km northwest of Sutherland.	Hutchinson, 3048	23/2/1929	K, BOL
32S 20E (–CA)	Karoo, Houthoek, Sutherland.	Bayer, M. B. 1561	—	NBG
32S 20E (–DC)	Cape, Farm De Plaat.	Hanekom, W. J. 460	24/8/1964	PRE, BLFU
32S 21E (–AC)	Die Rante, Aarfontein farm.	Fellingham, 1208	14/4/1986	BLFU, STE
32S 21E (–AC)	Die Rante, Aarfontein farm.	Hugo, L. 255	11/5/1976	NBG
32S 21E (–DD)	20 km from Frazerburg to Williston.	Hugo, L. 255	11/5/1976	NBG
32S 22E (–BA)	Beaufort West district, Bleak House farm.	Ueckerman, E. A. 8039	2/9/1991	PRE
32S 22E (–DB)	Beaufort West district, farm Rystkuil.	Gibbs-Russell, Robinson, & Herman 29	13/2/1978	PRE
32S 22E (–DC)	Prince Albert, Trakaskuil.	Retief & Reid 305	9/10/1983	PTA
32S 23E (–BA)	Murraysburg, Toorfontein.	Dean, S. J. 734	12/12/1989	PRE
32S 23E (–DC)	Jansenville district, Slangfontein.	Henrici, 5153	13/1/1956	PRE, Glen
32S 24E (–BC)	Graaff-Reinet.	Hoffman, M. T. 878b	10/5/1985	GRA
32S 25E (–BA)	Cradock, Beletskloof Halt on Zuurfontein Road.	Bolus, H. 282	0/1/1866	BOL, K, NBG
32S 25E (–BA)	Cradock, Bergkwagga National Park.	Acocks, J. P. H. 16217	29/10/1951	K, PRE
32S 25E (–BA)	Karreebosch, Cradock.	Brynard, 178	17/1/1953	PTE
32S 25E (–BA)	Karreebosch, Cradock.	Long, F. R. 774	9/9/1932	K, GRA, PRE
		Long, F. R. 783	0/9/1932	K

32S 25E (–BA)	75 km Tarkastad to Cradock.	Reyneke, A. M. 65	13/1/1977	BLFU
32S 25E (–BD)	Kromrivier, Upper Coerney River.	Archibald, E. E. A. 5834	31/3/1953	GRA
32S 25E (–DB)	Cape, Cockhouse.	Rogers, F. A. 2760	0/5/1912	BOL, GRA
32S 25E (–DB)	Eastern Cape, Cookhouse.	Rogers, F. A. 4480	1/3/1909	BM
32S 26E (–AC)	Tarkastad district, farm Mostertshoek near Bloemhof.	Reyneke, A. M. 62	12/1/1977	BLFU
32S 26E (–CD)	Andries Vosloo Kudu Reserve, near Fort Brown.	Judd, R. A. (8/88)	7/8/1988	GRA
32S 27E (–AC)	Cathcart.	Compton, R. H. 19319	15/1/1947	GRA
32S 27E (–CB)	Stutterheim, Kobusie River valley at St. Johns.	Acocks, J. P. H. 9191	11/10/1942	K
32S 28E (–AC)	Butterworth, Transkei.	Lewis, 2812	–	NBG, SAM
33S 19E (–BA)	Karoopoort near turn-off to Sutherland.	Burger, P. 121	16/3/1986	NBG
33S 20E (–AC)	Avondrus farm, 30 km SE of Touwsrivier.	Hilton-Taylor, 1918	6/10/1986	NBG
33S 20E (–BA)	Whitehill, near Matjesfontein, Karoo.	Humbert, M. H. 9734	7/8/1933	P
33S 20E (–BB)	Laingsburg district, Wauchope Monument.	Acocks, J. P. H. 19087	21/10/1956	K, PRE
33S 20E (–BB)	Laingsburg, Cape, Whitehill Ridge, White Hill.	Compton, R. H. 8516	26/2/1940	NBG
33S 20E (–BB)	Laingsburg, Whitehill Ridge.	Compton, R. H. 13380	17/8/1942	NBG
33S 20E (–DC)	Farm De Plaat.	Fellingham, A. 1305	30/5/1987	NBG
33S 20E (–DD)	Lemoenshoe; Montagu district.	Thompson, M. F. 2681	17/3/1976	NBG
33S 21E (–BB)	62 km from Oudtshoorn en route to Beaufort West.	Venter, A. M. 528	7/1/1996	BLFU
33S 21E (–BD)	Gamka mountain reserve, near reservoir.	Erasmus, R. 181	25/2/1989	NBG
33S 22E (–AB)	Botterkraal, 45 km NE of Prince Albert.	Zietsman, P. C. 1612	7/4/1986	PRE
33S 22E (–CA)	Oudtshoorn.	Britton, L. 6	0/3/1909	K
33S 22E (–DA)	Oudtshoorn district, farm Aangenaam.	Dahlstrand, K. A. 2394	3/4/1973	PRE, NBG
33S 23E (–AD)	32 km north of Willowmore.	Barker, W. F. 7125	3/12/1950	GRA
33S 24E (–AD)	Steytlerville, 10 km WNW na Wolwefontein.	Acocks, J. P. H. 16007	2/9/1951	PRE
33S 25E (–BB)	Port Elizabeth, Klein Vischrivier.	Drège, 7869	16/10/1829	P
33S 25E (–CD)	Uitenhage, Zwartkops River.	Ecklon, s.n.	0/2/0000	GRA
33S 25E (–CD)	Uitenhage, Swartkops River Valley.	Zeyher, 3461	0/1/1847	K, P
33S 25E (–CD)	Uitenhage.	Zeyher, 865	–	K, BM
33S 25E (–DB)	West bank of lower end of Sondags River.	Raal, P. 1831	5/7/1989	GRA
33S 25E (–DC)	Cradock Place, Port Elizabeth	Galpin, E. E. 6427	0/5/1902	GRA
33S 25E (–DC)	Perseverance, Zwartkops, Port Elizabeth.	Long, F. R. 682	1/8/1932	K, GRA
33S 25E (–DC)	Korsten Commonage, Port Elizabeth.	Long, F. R. 1171	29/1/1934	K, GRA
33S 25E (–DC)	Redhouse, near Port Elizabeth, at Zwartkops River.	Paterson, J. V. 494	5/3/1909	K, BOL, GRA
33S 25E (–DC)	Zwartkops, Port Elizabeth.	Theron, G. C. 660	3/10/1949	PRE, K
33S 25E (–DC)	Eastern Cape, Coega, Hougam Park.	Venter, H. J. T. 7456	4/1/1977	BLFU
33S 26E (–AC)	Bushman's River Station, Alexandria district.	Galpin, E. E. 2978	28/12/1898	K
33S 26E (–BA)	Grahamstown, Ecca Pass.	Jacot Guillarmod, 9005	24/6/1982	K, PRE, GRA
33S 26E (–BB)	8 km to Committees Drift, from Grahamstown turn-off.	Venter, A. M. 611	21/9/1998	BLFU
33S 26E (–BC)	Oatlands Park, Grahamstown.	Daly, M. & Cherry, E. 999	0/4/ 1908	K
33S 26E (–BC)	13 km N of Grahamstown, Piggot Bridge Road.	Dyer, R. A. 912	0/4/1927	K, GRA
33S 26E (–BC)	15 km from Grahamstown to Fort Beaufort.	Marais, 428	24/8/1954	PRE, K, GRA
33S 26E (–BC)	Queens Road near gate, near Grahamstown.	Shönland, 4344	0/5/1919	GRA
33S 26E (–BD)	Korhaan Vlakte, Addo National Park.	Archibald, E. E. A. 5263	23/9/1953	GRA, PRE
33S 26E (–CA)	Kolsrand, Alexandria, Eastern Cape.	Archibald, E. E. A. 3987	21/5/1952	GRA, PRE
34S 19E (–BB)	8 km NW of Riviersonderend, Caledon district.	Heginbotnam, 102	18/9/1949	NBG
34S 20E (–AB)	Cape, Bredasdorp.	Venter, A. M. 518	5/1/1996	BLFU
34S 21E (–AB)	Gourits River, Riversdal district at Middeldrift.	Muir, J. 1984	0/4/1915	PRE, BOL
34S 22E (–AA)	Mossel Bay.	Prior, s.n.	0/8/1947	K

Zimbabwe:

21S 28E (–AC)	Shashi banks near Mulala flats, Beit Bridge district.	Thompson, B. R. T35/59	0/5/1959	K, SRGH
21S 28E (–CB)	Mangwe district, Thornville Ranch.	Plowes, D. C. 1316	–	K, SRGH
22S 29E (–BB)	Shashi Plain, Beit Bridge.	Davies, R. M. 882	0/12/1954	SRGH
22S 29E (–BB)	Gwanda District, Sehashi Plain.	Davies, R. M. 887	0/12/1954	K
22S 29E (–BB)	Confluence of Shashi and Limpopo Rivers.	Drummond, 6059	2/5/1959	K
22S 29E (–BB)	Junction of Shashi and Limpopo Rivers, Shashi Camp.	West, O. 3708	28/8/1958	K

L. mascarenense

Moçambique:

23S 35E	(–AD)	5 km from Massinga near Maquna Caniçade.	Correira, 1949	–	K, BLFU
23S 35E	(–DC)	Inhambane, Southern coast, Pomene.	Tinley, 2261	0/12/1971	SRGH
25S 32E	(–AA)	Maputo, Sabie near Posto.	Mendonca, 3107	28/11/1944	LISC
26S 32E	(–BB)	Maputo, Inhaca Island, Cape of Inhaca.	Correia & Marques, 1799	13/6/1970	LISC, LMU
26S 32E	(–BB)	Inhaca Island, 37 km E of Maputu, Ile aux Bentiers.	Mogg, A. O. D. 27596	30/9/1957	K, PRE, SRGH
26S 32E	(–BB)	Inhaca Island.	Mogg, 32023	20/7/1956	PRE, SRGH
26S 32E	(–BB)	Inhaca lighthouse, on beach.	Moss, M. & Maquire, 78	7/7/1949	J
26S 32E	(–BB)	Inhaca Island, point near lighthouse.	Verdoorn & Mauve, 37	29/10/1962	PRE
26S 32E	(–DD)	Bella Vista, Ponto de Ouro district.	Balsinhas, 1201	9/4/1968	COI
26S 32E	(–DD)	Maputo, Ponta do Ouro.	Gomes & Sousa, 3903	23/12/1948	K, PRE, LISC, COI
26S 32E	(–DD)	Maputo, Ponta do Ouro.	Mendonca, 2904	18/11/1944	LISC
26S 32E	(–DD)	Ponto do Ouro (RSA border).	Gomez & Sousa, 3872	7/11/1948	K
26S 32E	(–DD)	Ponto do Ouro.	Groenendijk & De Konig, 184	13/1/1983	LMU

South Africa:

27S 32E	(–BB)	Black Rock, Kosi Bay area.	Venter, A. M. 421	2/12/1992	BLFU
27S 32E	(–BB)	Black Rock, Kosi Bay area.	Venter, A. M. 456	20/12/1993	BLFU
27S 32E	(–BB)	Kosi Bay area, Black Rock.	Venter, H. J. T. 6271	29/5/1971	K, PRE
27S 32E	(–BB)	Black Rock, north of Manzengwenya.	Buthelezi, 663	23/6/1986	PRE
27S 32E	(–BB)	Banga Nek, First Dune.	Strey & Moll, 3913	26/11/1967	PRE, K

(–BB)	15 km N of Van der Kloof Dam.	[illegible] A. M. 165	6/2/1977	BLFU
30S 23E (–AD)	Wildebeeskuil, Pearston, Somerset East district.	Reyneke, A. M. 9	11/4/1976	K, BLFU
30S 23E (–BA)	Britstown district, farm Agterplaas.	Hobson, M. T. 877	10/5/1986	GRA
31S 21E (–CD)	Farm Grootfontein, 19 km SW of Fraserburg.	Retief & Germishuizen, 97	15/1/1986	K
31S 22E (–DD)	Kromrivier, Karoo.	Coetzer, L. A. 68	10/4/1971	PRE, STE, K
31S 23E (–AA)	36 km from Victoria West to Britstown, farm Rietpoort.	Potts, Geo. 1107	0/2/ 1916	BLFU
31S 23E (–AC)	Victoria West, Hoekplaas farm.	Herman, P. 1117	14/3/1988	PRE
31S 23E (–AC)	Victoria West, near reservoir.	Henrici, 5150	12/1/1956	PRE
31S 23E (–BD)	17 km north of Richmond, along the N1.	Smith, C. A. 2406	20/2/1926	PRE
31S 23E (–CC)	Drie Susters.	Venter, A. M. 370	20/9/1992	BLFU
31S 23E (–DD)	Murraysburg.	Venter, H. J. T. 9224	15/4/1990	BLFU
31S 26E (–DC)	Klass Smit's River at Langverwacht, Rooderand farm.	Tyson, W. 109	0/10/1879	K
32S 18E (–BD)	Calitzdorp district, Tierkloof in Gamkaberg.	Galpin, 2517	13/11/1898	K, PRE, NH, GRA
32S 20E (–CA)	Farm Houthoek near Sutherland.	Boshoff, A. F. 172	9/6/1975	STE
32S 20E (–DA)	3 km N of Verlatekloof Pass, en route to Sutherland.	Hanekom, W. J. 461	24/8/1964	K, PRE, BLFU
32S 21E (–DC)	Whitehill Karoo Garden, Laingsburg.	Cloete, I. & Haselau, W. 20	25/8/1986	NBG
32S 22E (–BC)	Gamka River, near Wolwekraal.	Compton, R. F. 23905	21/3/1953	NBG
32S 23E (–AA)	Rietbron, Cape Province.	Drége, 845	4/3/1827	P
32S 23E (–BB)	Voor Sneew Mountains, Graaff-Reinet district.	Van Jaarsveld, E. J. 1726	28/2/1977	NBG
32S 23E (–BC)	Graaff-Reinet, on banks of Sondags River.	Burchell, 2840	29/3/1813	K
32S 23E (–CD)	Farm Kalkdam along Bosduiwe River, Beaufort West.	Bolus, 45	0/3/1873	K, PRE, GRA
32S 23E (–DD)	Farm Van Rooyenskraal, district Willowmore.	Retief & Reid, 308	10/10/83	K, PRE
32S 24E (–AC)	Aberdeen.	Retief & Reid, 440	10/11/83	PRE
32S 24E (–BC)	In scrub near Graaff Reinet.	Lynes, 1143B	27/6/1937	BM
32S 24E (–BC)	20 km Graaff-Reinet to Middelburg.	Bolus, 1327	0/4/1890	SAM, NBG
32S 24E (–BC)	Graaff-Reinet to Pearson.	Reyneke, A. M. 67	14/1/1977	BLFU
32S 24E (–BC)	32 km north of Graaff-Reinet.	Theron, G. 713	26/1/1950	PRE, K
32S 24E (–DC)	Jansenville district, Slangfontein.	Theron, G. 1863	12/2\1956	PRE, K
32S 25E (–BA)	Cradock, National Bergkwagga Park.	Hoffman, M. T. 877	10/5/1986	GRA
32S 25E (–BA)	District Cradock.	Brynard, A. M. 262	29/9/1953	PRE, K
32S 25E (–BA)	Fish River, Cradock district.	Cooper, T. 489	0/0/1861	K, BM
32S 25E (–BA)	Baroda, Cradock district.	Cooper, T. 1060	0/0/1889	K
32S 25E (–CA)	Wildebeeskuil, Pearston, Somerset East district.	Gill, G. A. 243	14/5/1928	BOL
32S 25E (–DA)	Espaga Drift, Great Fish Rivier near Somerset East.	Hobson, N. K. 98	26/5/1970	GRA
32S 25E (–DB)	Cookhouse, Cape.	MacOwan, 941	0/11/1864	K, BM, PRE, GRA
32S 26E (–BC)	Ecca Pass.	Rogers, F. A. 2758	0/5/1912	NBG, SAM, GRA
32S 26E (–CA)	Lyndoch near Bedford, Baviaans River valley.	Edwards, D. STE-7379	–	STE, NBG
33S 19E (–CB)	Karoo Garden, Worcester.	Skead, C. J. s.n.	24/5/1981	GRA
33S 19E (–CB)	Veld Reserve, Worcester.	Bayer, M. B. 28	10/8/1971	NBG
33S 19E (–CB)	Worcester.	Olivier, M. C. 89	23/9/1962	PRE, STE
33S 19E (–DA)	Hex River Valley, southern part of valley.	Schlechter, R. 7833	15/6/1896	BOL
33S 19E (–DD)	Worcester, Goree, west of Robertson.	Van Wyk, P. BSA 2145	31/5/1994	STE, NBG
30S 20E (–BB)	Whitehill Karroo Garden, Laingsburg	Hugo, L. 2393	8/7/1980	PRE
33S 20E (–BB)	Whitehill Karroo Garden, Laingsburg.	Compton, R. F. 2838	6/8/1923	K
33S 20E (–BB)	Pietermeintjies, Laingsburg.	Compton, R. H. 8511	26/2/1940	NBG, STE
33S 20E (–BB)	Laingsburg.	Taylor, H. C. 2511	11/7/1960	BOL
33S 20E (–BC)	Montague, Klein Karoo.	Thode, J. 5119	0/1/1918	STE
33S 20E (–CB)	Kruisrivier farm, 4 km S of Bloutoring near Ladismith.	Taylor, H. C. 4873	18/6/1963	STE
33S 20E (–CC)	Montagu, Cogman's Kloof.	Hilton-Taylor, C. 2002	7/11/1986	STE
33S 20E (–CC)	Montagu, Cogman's Kloof.	Barke, W. F. 1038	14/5/1941	NBG
33S 20E (–CC)	Kloof at end of Baden road, north of Montague.	Barker, W. F. 5421	5/8/1949	NBG
33S 20E (–CC)	Montagu, Baden in kloof.	Goldblatt, P. 1689	30/4/1974	NBG
33S 20E (–CC)	Cogmans Kloof, Montagu.	Lewis, G. J. 1740	0/9/1946	NBG, SAM
33S 20E (–CC)	Kareevlakte, Montagu.	Rourke, J. P. 757	28/5/1967	NBG
33S 20E (–CC)	Cogmans Kloof, Montagu district.	Rycroft, H. B. 1609	15/7/1954	NBG
33S 20E (–DB)	Ladismith district, Zorgfliet farm, on Towsberg.	Van Breda, 987	30/8/1960	PRE
		Bredenkamp, C. L. 765	5/10/1993	PRE

L. oxycarpum

33S 20E	(–DB)	Hondewater Siding.	Nel, 11724	0/4/1931	STE, NBG
33S 21E	(–DB)	Groot Karoo, Gamkapoort Nature Reserve, De Keur.	Erasmus, R. 186	13/5/1989	NBG
33S 21E	(–DB)	Gamka mountain reserve.	Erasmus, R. 108	19/8/1987	NBG
33S 21E	(–DC)	Little Karoo, farm Pretoriuskraal.	Laidler, D. F. 502	11/7/1983	STE, NBG
33S 22E	(–AC)	Boomplaas, Cango Valley.	Moffett, R. O. 189	26/6/1974	STE, NBG
33S 22E	(–AD)	Oudtshoorn district, northern end of Swartberg Pass.	Venter, A. M. 455	23/1/1993	BLFU
33S 22E	(–BC)	Oudtshoorn district, farm Doornkraal, near De Rust.	Dahlstrand, K. A. 2246	4/6/1972	PRE
33S 22E	(–CA)	2 km north of Oudtshoorn.	Rycroft, H. B. 3024	27/10/1968	NBG
33S 22E	(–CD)	Montagu Pass, Langkloof.	De Casteleau, 69	0/7/1856	P
33S 22E	(–CD)	Kamanaih Hills, George.	Prior, A. s.n.	0/11/1847	K
33S 22E	(–DB)	Oudtshoorn district.	Zeeman, H. T. 71	20/6/1977	STE
33S 23E	(–CA)	Hoekplaats, 22 km to Uniondale.	Fourcade, H. G. 5670	0/8/1942	STE,
33S 25E	(–AC)	Krompoort, Glen Connor.	Henderson, L. 577	2/12/1981	PRE
33S 25E	(–CD)	Uitenhage.	Prior, A. s.n.	0/2/1848	K
33S 26E	(–AB)	Helspoort, 26 km on Cradock road, near Grahamstown.	Brink, 366	21/7/1975	K, GRA
33S 26E	(–BA)	Glen Melville, Ecca River valley.	Taylor & Edwards, 8778	6/11/1994	K, PRE. GRA
33S 26E	(–BC)	Fish River, Grahamstown.	Van Steenis, 23905	21/10/1975	L
33S 26E	(–BC)	Schoemanskloof Caravan Park, Oudtshoorn.	Reyneke, A. M. 132	10/10/1976	K, BLFU
33S 26E	(–CA)	Grahamstown district, on road to Commitees.	Brink, E. 278	2/10/1992	GRA
33S 27E	(–AC)	Kaffir Drift, Peddie district.	Marais, W. 416	29/7/1954	K, PRE, GRA
34S 23E	(–AA)	Goukamma River, district Knysna.	Pappe, s.n.	0/0/1867	K

L. pilifolium

Namibia:

25S 16E (–DD)	Aus district, Helmeringshausen.	Merxmüller, H. & Giess, W. 2915	17/8/1963	WIND
26S 15E (–CA)	Luderitz district, 8 km S of Aus.	Giess & Van Vuuren, 810	12/8/1959	WIND, K, BOL
26S 15E (–CB)	Inland from Lüderitz.	Range, 1785	13/3/1913	SAM, NBG
26S 16E (–CB)	Near Aus.	Giess, Vlok & Bleissner, 5456	24/2/1963	WIND
26S 16E (–CB)	7 km south of Aus, on road to Rosh Pinah.	Venter, A. M. 580	10/7/1997	BLFU
26S 16E (–DB)	Internment camp, 4 km south of Aus.	Reyneke, A. M. 173	23/9/1988	BLFU
27S 16E (–CA)	Aurus mountain.	Müller, M. 741	31/7/1977	WIND
27S 16E (–DC)	Zebrafontein between Rosh Pinah & Aus.	Botha, D. J. 3339	23/8/1983	PRE, WIND
27S 16E (–DD)	Namuskluft, eastern Mountains.	Jankowitz, W. 175	9/5/1971	WIND
27S 16E (–DD)	Zebrafontein.	Venter, H. J. T. 8927	23/8/1983	BLFU
28S 16E (–BA)	Obib Mountain Peak, Diamond area no 1.	Van Wyk, A. E. 9024	3/9/1983	PRE
28S 18E (–BB)	Farm Klein-Aub, 18 km SE of Karasburg.	Giess, Volk, & Bleissner, 7021	17/5/1963	WIND

South Africa:

26S 26E (–DC)	Klerksdorp, Wolwerand.	Hanekom, W. J. 1496	1/1/1971	K, PRE
27S 23E (–AA)	63 km from Kuruman to Hotazel.	Arnold & Musil, 528	21/3/1982	PRE
27S 25E (–DA)	Bloemhof.	Burtt-Davy, J. 12947	0/3/1912	NBG
27S 25E (–DC)	Bloemhof district, near Kiana Road.	Burtt-Davy, J. 14406	0/3/1912	NBG
28S 24E (–DD)	Kimberley, Du Toitspan Mine area.	Wilman, M. 4045	0/12/1936	BOL, K
28S 17E (–AA)	Richtersveld, Kodaspiek, main ridge SE of beacon.	Oliver, Tolken & Venter, 444	2/9/1977	PRE
28S 22E (–AC)	60 km from Upinton to Olifantshoek.	Burgoyne, P. 1431	16/12/1992	PRE
28S 22E (–BB)	Lucas Dam, Hay division.	Wilman, M. 7267	0/2/1947	K, PRE, BOL
28S 22E (–BD)	Hay district, Floradale.	Esterhuysen, E. 2300	0/4/1940	BOL
28S 22E (–DD)	Rosendal, west of Griquatown.	Gubb, A. A. 12687	12/4/1984	PRE
28S 23E (–CB)	Cape, Griquatown, Asbestos Mountains.	Pole-Evans, I. B. 25	20/3/1920	K
28S 23E (–CD)	Griqualand West, Griquastad in Leeuwenkuil valley.	Burchell, 1899	14/12/1811	K
28S 24E (–AD)	Newlands, Barkly West district.	Esterhuysen, E. 965	0/5/1939	NBG
28S 24E (–AD)	22 km from Barkly West on way to Kuruman.	Reyneke, A. M. 285	20/5/1989	BLFU
28S 24E (–AD)	22,5 km from Barkly West on way to Kuruman.	Reyneke, A. M. 286	20/5/1989	BLFU
28S 24E (–AD)	22,5 km from Barkly West on way to Kuruman.	Reyneke, A. M. 287	20/5/1989	BLFU
28S 24E (–CB)	40 km W of Kimberley on road to Schmidtsdrift.	Tölken & Schlieben, 1161	6/3/1967	K, PRE, BR
28S 24S (–CC)	36 km west of Petrusburg.	Venter, A. M. 321	19/1/1090	BLFU
28S 24E (–DB)	Kimberley, at Du Toitspan Mine.	Wilman, M. 3617	0/1/1925	K
28S 24E (–DB)	1 km on Wier Siding turn-off, Barkly-west–Riverton road.	Venter, A. M. 464	31/12/1993	BLFU
28S 24E (–DB)	14,6 km from Barkly West on Kuruman Road.	Reyneke, A. M. 283	23/9/1988	BLFN
28S 25E (–CA)	Boshof district.	Steyn, E. 4833	0/4/1933	BLFU
28S 25E (–CC)	Pandamsfontein near Paardenberg, Petrusburg district.	Reyneke, A. M. 300	20/5/1989	BLFU
29S 17E (–AD)	Tatas Mountains, Richtersveld.	Venter, H. J. T. 7941	4/8/1978	BLFU
28S 25E (–BA)	Farm Doornkloof, 20 km from Boshof to Windsorton.	Rall, M. 12	5/4/1991	BFN Mus.
29S 17E (–BC)	Springbok district, 22 km south of Steinkopf.	Reyneke, A. M. 163	21/8/1988	BLFN
29S 21E (–DA)	Farm Angelierspan 64 km W of Marydale, Kenhardt district .	Codd, L. E. 1210	15/5/1946	PRE
29S 23E (–AD)	55 km from Douglas to Prieska, Saxondrift.	Smook, L .& Harding, G. B. 680	7/6/1977	PRE
29S 24E (–AA)	Plooyburg, 1 km south of Riet River.	Gubb, A. A. 12194	22/11/1984	PRE
29S 24E (–AD)	Loveday, Belmont district.	Gubb, A. A. 12438	5/12/1984	PRE
29S 24E (–CA)	Hopetown, Cape Province.	Fries, Nordlindh & Weinmark, 1815	9/10/1930	K
29S 24E (–CC)	69 km W of Petrusville to Strydenburg.	Herman, P. 618	7/4/1981	PRE
29S 24E (–CC)	Kraankuil Station, near Hopetown.	Smith, C. A. 2820	17/4/1926	PRE
29S 25E (–AA)	Kimberley to Jacobsdal, on farm Gruysbank.	Schweickerdt, H. G. 1134	26/3/1933	PRE, NBG
29S 25E (–AC)	3 km W of Jagersfontein, on Koffiefontein road.	Venter, A. M. 466	2/1/1994	BLFU
29S 25E (–CC)	36 km west of Petrusburg near Paardeberg.	Reyneke, A. M. 321	19/1/1990	BLFU
29S 26E (–AA)	Near Bloemfontein.	Bolus, H. 10817	0/2/1904	K
29S 26E (–AA)	Bloemfontein, old race course.	Gemmell, D. M. 6148	20/3/1952	K, PRE
29S 26E (–AA)	Bloemfontein old College grounds.	Gemmell, D. M. 6155	27/2/1952	BLFU
29S 26E (–AA)	Bloemfontein old College grounds.	Potts, Geo. 2844	0/2/1917	BLFU
29S 26E (–AA)	Bloemfontein, Department of Botany, courtyard.	Reyneke, A. M. 155	13/9/1982	BLFN
29S 26E (–BA)	Free State, Sepani.	Brierley, E. M. 108	0/4/1931	BM
30S 24E (–BB)	Rolfontein Nature Reserve.	Jooste, J. F. 183	0/10/1974	PRE

L. pilifolium

31S 19E	(–BC)	20 km Calvinia to Loeriesfontein, Klein Torren.	Coetzer, L. A. 831	27/8/1983	PRE
31S 19E	(–BD)	8 km south-souteast of Calvinia.	Acocks, J. P. H. 18939	20/8/1956	K, PRE
31S 19E	(–BD)	Calvinia.	Schmidt, A. A. 160	0/9/1936	K
31S 20E	(–CC)	22 km from Middelpos, on old road to Calvinia.	Snijman, D. 18	12/11/1974	NBG
31S 20E	(–DC)	Middelpos, about 2 km on road to Calvinia.	Burger & Louw, 231	3/9/1986	STE
31S 20E	(–DD)	Farm Uitkoms on Calvinia to Middelpos road.	Burger & Louw, 204	3/9/1986	STE
32S 20E	(–BB)	37 km from Sutherland, Bloukop.	Van Breda, 2010	7/9/1968	PRE
32S 20E	(–BC)	2,5 km north of Sutherland.	Reyneke, A. M. 335	30/9/1990	BLFU
32S 20E	(–BD)	32 km east by N from Sutherland.	Acocks, J. P. H. 17205	23/9/1953	PRE
32S 20E	(–DA)	Sutherland, Klipbanks River.	Cloete & Haselon, 246/24b	25/8/1986	BLFU
32S 27E	(–AC)	District Cathcart, Happy Valley.	Story, R. 3746	15/2/1949	NBG, GRA
33S 26E	(–AB)	35 km from Grahamstown to Cradock, Carisle Bridge.	Dyer, R. A. 1580	0/7/1929	PRE, GRA
33S 26E	(–AB)	35 km from Grahamstown to Bedford, Carlisle Bridge.	Dyer, R. A. 2120	0/9/1928	K, PRE, GRA

L. pumilum

Namibia:

20S 13E (–AA)	Outjo Mountains 23 km east of Torrabaai.	Giess, Volk & Bleissner, 6197	2/4/1963	WIND
22S 14E (–DA)	Mouth of Swakop River.	Seydel, R. 904	19/2/1957	L, K
23S 17E (–BC)	District Rehoboth, Gravenstein.	Leippert, 4683	27/5/1963	M
24S 16E (–CD)	Distict Maltahöhe, farm Zaris.	Giess, Volk & Bleissner, 5187	18/2/1963	M
24S 16E (–DD)	Maltahöhe district.	Basson, 260	'0/3/1957	PRE
24S 17E (–DA)	Haribes.	Dinter, 2944	0/4/1913	SAM, NBG
24S 17E (–DA)	Haribes, district Gibeon.	Volk, 12055	2/4/1956	M
25S 16E (–BB)	Farm Lisbon.	Müller, M. 1276	8/4/1980	WIND
25S 16E (–DC)	Barby, Teraz Mountains.	MacDonald, 316	10/2/1950	BM
25S 17E (–BA)	Lehmborn at Hannapan near Hatzium.	Range, P. 1939	26/10/1913	SAM, NBG
26S 16E (–DA)	Schakal River.	Schinz, H. 475	0/6/1875	K
26S 17E (–CA)	Bethanien.	Schenk, A. 385	0/2/1885	Z
26S 18E (–BA)	Keetmanshoop.	Schinz, H. 476	0/0/1879	Z
26S 19E (–DC)	12 km west of Aroab towards Keetmanshoop.	De Winter, B. 3388	3/5/1955	K, PRE
27S 17E (–AB)	Inachab, southwest of Seeheim.	Olivier, Muller & Steenkamp, 6370	7/5/1976	K, PRE
27S 18E (–BB)	At Witkobus.	Pearson, 8958	25/12/1915	K, BOL
27S 18E (–BC)	Farm Us.	Giess & Muller, 12009	17/5/1972	PRE, M
27S 18E (–BD)	Great Karasberg, NE of Narudas and Krai Kluft.	Pearson, 8104	0/12/1912	K
27S 19E (–AD)	Karasburg, "Numdis".	Auret, W. P. 5609	1/1/1974	PRE
27S 19E (–CA)	Karasburg, farm Blinkoog.	Walker, H. & E. 2389	2/4/1953	WIND
27S 19E (–CA)	Karasburg, farm Blinkoog.	Walter, H. & E. 2414	3/4/1953	WIND
28S 18E (–BB)	Warmbad, 68 km N of Oranje River, on Karasburg road.	Davidse, 6224	1/2/1974	WAG, M, PRE
28S 19E (–BB)	55 miles E of Karasburg to Ariamsvlei.	Hardy, 1936	5/3/1965	K, PRE
28S 19E (–BB)	45 km north of Ariamsvlei Border Post.	Venter, A. M. 556	9/7/1996	BLFU

South Africa:

28S 16E (–DA)	Little Namaqualand, south bank at Arris Drift.	Pillans, N. S. 5257	0/9/1926	K
23S 14E (–BA)	Kuiseb Delta, main Kuiseb course near B area reservoir.	Ward, C. J. 9233	1/1/1979	PRE
26S 20E (–AB)	Gordonia, lower Auob River, Kalahari Gemsbok Park.	Lang, s.n. PRE 31729	0/4/1933	PRE, B, K
28S 19E (–DB)	Nous, between Augrabies and Pofadder.	Ueckermann, 7299/B25	15/9/1983	PRE
28S 20E (–AC)	130 km from Karasburg road to Upington.	Reyneke, A. M. 210	3/10/1988	BLFU
28S 20E (–BD)	48 km northwest of Upington.	Pole-Evans, I. B. 2155	20/4/1928	PRE
28S 20E (–DB)	21 km WSW of Keimoes to Kakemas.	Davidse & Loxton, 6130	31/1/1974	K, PRE, WAG
28S 20E (–DC)	Kakamas, Letterkop Botanical Reserve, "Rivierkamp".	Wasserfall, 1113	15/7/1946	PRE
29S 18E (–AB)	Kykgat, 144 km north-east of Springbok .	Niewoudt, A4	2/8/1974	K
29S 22E (–DA)	28 km from Prieska.	Bryant, 936a	0/1/1929	K
29S 22E (–DB)	Green Valley Nuts 20 km E of Prieska on farm Muishoek.	Venter, A. M. 492	14/1/1996	BLFU
29S 24E (–DA)	Gannapan 18 km from Luckhof to Jacobsdal.	Reid, 332	–	PRE
29S 24E (–DB)	Bush veld on western side of town.	Malan, P. 922	3/4/1991	BLFU
29S 24E (–DD)	Knoffelhoek, N boundaryat Goemansberg, Hopetown.	Smith, C. A. 5413	0/1/1928	PRE
29S 25E (–AC)	5 km from Witput to Wanda.	Reyneke, A. M. 129	13/3/1977	BLFU
29S 25E (–BD)	Klein Gryskop, Luckhoff district.	Pole-Evans, I. B. 1888	3/9/1925	PRE
29S 25E (–BD)	Farm Klein Gryskop, Luckhoff area.	Smith, C. A. 490	3/9/1925	PRE
29S 25E (–CB)	Bakbank, Fauresmith.	Henrici, 2423	13/5/1931	PRE
29S 25E (–CB)	Fauresmith district, farm Varkfontein.	Verdoorn, 1051	24/II/1931	PRE
30S 18E (–BC)	Banke farm, 29 km E of Platbakkies on Kliprand road.	Perold, 1548	25/9/1987	PRE
30S 20E (–BB)	Bushmanland, Stink Puts, 2.5 km N of Kareeboom.	Le Roux & Lloyd, 255	13/3/1985	PRE
30S 20E (–CA)	1 km on Swartsekolk road, off Brandvlei-Loeriesfontein.	Powrie, L. W. 633	17/3/1988	NBG
30S 20E (–CC)	Soutputs, 2 km from house on road to Breekbeenkolk.	Burger & Louw, 126	2/9/1986	PRE
30S 21E (–BD)	SE of Van Wyk's Vlei, on Humansdam farm.	Harding, 595	4/12/1985	PRE
30S 22E (–CC)	Renoster Kolk, Carnarvon district.	Acocks, J. P. H. 1704	0/2/1937	PRE
30S 22E (–CC)	12 km from Carnarvon to Vanwyksvlei.	Powrie, L. W. 593	17/2/1998	NBG
30S 23E (–AD)	Jagskerm turn-off, 31 km from Britstown to Prieska, .	Herman, 1192	16/3/1988	PRE
30S 23E (–BC)	Britstown district, Volstruispoort farm, Brink pan edge.	Retief & Germishuizen, 14	14/1/1986	PRE
30S 23E (–CC)	Rooipoort, 50 km S of Britstown on Victoria West road.	Ubbink, 669	3/5/1978	PRE
30S 23E (–DA)	5 km west of Britstown.	Pole-Evans, I. B. 2302	19/10/1928	PRE, K
30S 24E (–AA)	Pottfontein, near Phillipstown.	Moss, 4789	24/9/1918	K

L. pumilum

30S 24E	(–CA)	District De Aar, on De Aar-Burgerville road.	Henrici, 3946	4/5/1946	PRE
30S 26E	(–AD)	Groenvlei.	Verdoorn, 1641	0/10/1935	PRE
31S 19E	(–BC)	Calvinia, Tierhoek Reserve.	Henrici, s.n.	3/12/1942	PRE
31S 19E	(–DB)	17 km east of Calvinia on Williston road.	Venter, A. M. 383	27/9/1991	BLFU
31S 20E	(–AB)	Between Williston and Calvinia.	Van der Schijff, 7225	17/8/1947	PRE
31S 20E	(–DC)	NW Cape, Middelpos, 2 km to Calvinia.	Burger & Louw, 232	3/9/1986	PRE
31S 21E	(–DA)	Frazerburg division, Zak River.	Burchell, 1514	31/8/1811	K
31S 21E	(–DC)	Eastern outskirts of Frazerburg.	Coetzer, 56	10/4/1971	K
31S 23E	(–BD)	10 km east of Richmond.	Reyneke, A. M. 269	10/4/1988	BLFU
31S 23E	(–BD)	17 km S of Richmond on road to Drie Susters.	Reyneke, A. M. 331	14/4/1990	BLFU
31S 23E	(–BD)	Northern entrance to Richmond from Drie Susters road.	Venter, H. J. T. 9227	15/2/1990	BLFU
31S 23E	(–BD)	In Richmond town, along river at Olivier Bridge.	Venter, A. M. 529	8/1/1996	BLFU
31S 23E	(–CC)	Three Sisters.	Marloth, 7292	0/1/1916	PRE
31S 25E	(–AC)	3 miles E of Rosmead, near Middelburg (CP).	Acocks, J. P. H. 16329	28/2/1952	K
31S 25E	(–AC)	Middelburg (CP).	Theron, G. 2	15/6/1946	PRE
31S 25E	(–AC)	Middelburg (CP), Town Commonage.	Theron, G. 726	12/2/1950	K
31S 25E	(–AD)	Middelburg (CP), Rooispruit, Steynsburg.	Theron, G. 732	20/2/1950	K, PRE
31S 25E	(–CB)	Doornhoekberg, Middelburg, (CP).	Acocks, J. P. H. 8652	–	K
32S 18E	(–BD)	Beletskloof Halt, Zuurfontein Road.	Acocks, J. P. H. 16217	29/10/1951	K
32S 21E	(–DC)	Prince Albert Road.	Fries, Norlindh & Weimarck, 1812	6/10/1930	PRE
32S 22E	(–DB)	Rystkuil on road Neverset road, at Sout River.	Retief & Reid, 264	8/10/1983	K
32S 22E	(–DD)	Beaufort West district, farm Aardoorns, Blouwater road.	Retief & Reid, 116	6/10/1983	PRE
32S 23E	(–AA)	Cape, Bruinrug.	Shearing, 616	8/7/1984	PRE
32S 23E	(–CD)	Beaufort West district, farm Kalkdam, at Bosduiwe River.	Retief & Reid, 352	10/10/83	K
32S 25E	(–BA)	Cradock, 24 km north on Baroda Allaris farm.	Dyer, R. A. 1032	0/9/1927	L, GRA
32S 26E	(–DD)	Alice, near University of Fort Hare.	Giffen, M. H. 1515	10/5/1943	PRE
33S 21E	(–DB)	8 km from Calitzdorp to Oudtshoorn.	Venter, A. M. 454	23/1/1993	BLFU
33S 21E	(–CA)	Barrydale - Ladismith road,west of Groot River Bridge.	Venter, A. M. 449	23/1/1993	BLFU
33S 22E	(–CA)	26 km south-south-west of Oudtshoorn.	Acocks, J. P. H. 20485	22/5/1959	PRE
33S 24E	(–BD)	District Steytlerville, 9 km NW of Wolwefontein.	Acocks, J. P. H. 16009	2/9/1951	K, PRE
33S 26E	(–BC)	Cradock Road.	Judd, R. A. s.n.	19/3/1988	GRA

L. schizocalyx

Botswana:

20S 22E (–CB)	On road from Moego to Kara, W of Lake Ngani	Smith, P. A. 741	25/10/1973	K, PRE, SRGH
20S 25E (–CB)	Ngamiland district Makgadigadi Pans.	Barnard, I. 278	15/3/1987	PRE
20S 25E (–AA)	Sigora Pan, 30 km W of Nata river mouth.	Drummond & Seagrief, S. C. 5221	25/4/1957	K
21S 24E (–BA)	Toro Moja, Botletle River.	Ngoni, J. F. 401	21/4/1975	K, SRGH
21S 24E (–BB)	Northern district.	Smith, P. A. 2533	21/11/1978	K, PRE, SRGH
21S 25E (–AD)	Orapa, near Mopipi pan.	Kerfoot, 7757	16/3/1975	PRE
22S 26E (–BC)	Rakop - Serowe,4 km W of Mopipi.	Van Rensburg, H. J. B. 4103	14/6/1970	PRE
23S 22E (–CC)	Tshawe pan.	Skarpe, C. S. 373	5/12/1979	K, PRE, SRGH
23S 24E (–CD)	Kweneng district, Takatokwane.	Maguire, B. 7969	19/12/1969	K
24S 21E (–BB)	Kgalagadi, Tsane (=Tshane).	Miller, O. B. B/1007	0/3/1950	PRE
24S 25E (–AA)	Mone valley near Letlakeng.	Wild, H. 4961	15/2/1960	K, SRGH

Namibia:

24S 16E (–AA)	Nankluft Park, 0,5 km W of camp, along Waterkloof road.	Reyneke, A. M. 195	27/9/1988	BLFU
24S 17E (–DC)	Mbombo .	Barnard, H. H. 32697	0/2/1926	WIND
26S 15E (–DB)	48 km west of Aus to Luderitz.	De Winter & Hardy, 7885	5/3/1963	PRE, M
28S 18E (–BD)	Warmbad.	Dinter, 5198	18/7/1924	K, PRE

South Africa:

22S 29E (–CA)	70 km west of Swartwater on Alldays road.	Venter, A. M. 545	4/2/1996	BLFU
22S 29E (–CC)	Langjan Nature Reserve, NE boundary line.	Henning, T. P. 6	21/3/1983	PRE
22S 29E (–CD)	Zoutpansberg, Zoutpan.	Schweickert & Verdoorn, 474	12/4/1934	K, PRE
22S 29E (–DC)	Waterpoort, Langjon Nature Reserve.	Huntley, 1398	12/12/1967	K
23S 29E (–AD)	43 km from Pietersburg to Dendron.	Coetzee, 1277	8/3/1972	K, PRE
23S 29E (–BC)	Leeuwkraal, Elands River.	Smuts & Gillett, 3054	19/12/1935	NBG, STE
24S 27E (–BD)	Waterberg near Sentrum.	Vahrmeyer, 1301	16/12/1965	M, K, G, PRE
25S 26E (–CA)	Zeerust.	Thode, A1416	0/1/1928	PRE
25S 28E (–AD)	4 km north of Hammanskraal, Pretoria.	Verdoorn, 2352	24/10/1949	K
25S 28E (–CA)	Hammanskraal, between Pretoria and Pienaars River.	Hutchinson, J. & Mogg, E. 2874	26/1/1929	BOL, K
27S 27E (–CA)	Kroonstad district, Free State.	Pont, J. W. 247	0/11/1928	GLEN
28S 17E (–AA)	Richtersveld, Kodaspiek, main valley SE of beacon.	Oliver, Tolken & Venter, 491	2/9/1977	NBG
28S 22E (–DD)	Grassdale, Hay division.	Acocks, J. H. P. 2566	0/9/1937	K, BOL
29S 18E (–AB)	Kykgat, about 144 km northeast of Springbok.	Niewoudt, A4	2/8/1974	K
29S 21E (–AC)	Kenhardt district.	Schlieben, 8944	19/5/1961	K, PRE, BM
29S 22E (–DA)	Prieska.	Bryant, E. G. 925	0/0/1933	STE
29S 23E (–BB)	Few km east of Douglas.	Acocks, J. H. P. 1904	9/3/1937	PRE
29S 23E (–AC)	Lanyon Vale, Hay district.	Acocks, J. P. H. 1975	11/3/1937	PRE
29S 24E (–BB)	Jacobsdal, 8 km south of Michville Post Office.	Acocks, J. P. H. 13505	23/3/1947	K
29S 24E (–DB)	10 km from Luckhoff to P K le Roux Dam.	Reyneke, A. M. 105	6/2/1977	BLFU
29S 25E (–CB)	Fauresmith, Groenvlei.	Verdoorn, 1306	27/4/1934	PRE, K
30S 23E (–CD)	30 km SW of Britstown.	Herman, P. 1068	12/3/1988	PRE
31S 21E (–DB)	Saaifontein, 55 km W of Loxton to Fraserburg.	Reyneke, A. M. 336	30/9/1990	BLFU
31S 23E (–AC)	Three Sisters district, Victoria West.	Bayliss, R. D. 1189	20/3/1963	K, PRE
31S 23E (–BB)	Richmond district, Elandskuilen below Groot Tafelberg.	Acocks, J. P. H. 8738	18/5/1933	K, PRE
31S 23E (–BB)	Richmond district, Elandskuilen below Groot Tafelberg.	Acocks, J. P. H. 8739	18/5/1938	K
31S 25E (–AC)	To Tafelberg from Middelburg.	Hutchinson, J. 3104	6/3/1929	BOL, K
31S 25E (–AC)	1 km on Oorlogspoort turn-off, Middelburg-Steynsburg rd.	Reyneke, A. M. 34	8/5/1976	BLFU
31S 25E (–AC)	8 km Middelburg to Rosmead.	Reyneke, A. M. 144	0/4/1978	BLFU
31S 25E (–DA)	Witmoss Station, Cape.	Galpin, E. E. 3080	–	PRE
31S 26E (–DD)	Queenstown division, Shiloh.	Baur, R. 975	0/1/1885	K
32S 21E (–DD)	16 km south of Fraserburg road.	Theron, G. C. 1302	24/8/1952	K, PRE
32S 22E (–AD)	Stolshoek, Karoo National Park, Beaufort West.	Braack, A. 27	5/9/1983	PRE
32S 23E (–AA)	4 km from Nelspoort station on way to Beaufort West.	Van Jaarsveld, E. J. 1727	28/2/1977	NBG
32S 24E (–AD)	Graaff-Reinet, Karoo Nature Reserve.	Linger, 2030	9/6/1981	BM, PRE
32S 24E (–BC)	In thickets near Graaff-Reinet.	Bolus, 741	0/3/0000	SAM, NBG
32S 24E (–BC)	Graaff Reinet, before Sneeuberg.	Burchell, 2841	29/3/1813	K
32S 24E (–BC)	Karoo Nature Reserve, Graaff-Reinet.	Palmer, A. R. 456	3/3/1980	GRA

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32S 24E (–DD)	Jansenville, between Wolwefontein and Lemoenkloof.	Henderson, 582	3/12/1981	PRE
32S 25E (–DA)	Somerset East region.	MacOwen, 1872	0/11/1872	NBG
32S 25E (–BA)	Pearson district, Wildebeeskuil.	Hobson, F. O. 241	18/3/1984	PRE
32S 25E (–BC)	Cradock district, Great Fish River, at Mortimer.	Lynes, H. M665	25/3/1934	BM
32S 25E (–DA)	Somerset East.	Scott Elliot, 370	0/3/1900	BM
33S 20E (–AC)	Avondrus Farm, 30 km SE of Touwsrivier.	Hilton-Taylor, C. 1976	6/10/1986	NBG
33S 21E (–BC)	Gamkapoort Nature Reserve.	Landler, D. F. 607	5/9/1983	STE
33S 22E (–AA)	Prince Albert, Karoo.	Bond, P. 833	24/1/1941	COMP
33S 25E (–CD)	District Uitenhage.	Krauss, J. B. S. 1841	0/4/1939	G-BOISS
33S 25E (–CD)	Uitenhage.	Prior, s.n.	0/0/1903	K

Zimbabwe:

20S 29E (–CC)	Gwanda District.	Davis, R. M. 2321	16/12/1956	K, SRGH
21S 29E (–CB)	Umsingwane, Beit Bridge district.	Thompson, B. R. T/36/59	0/5/1959	K
22S 29E (–BB)	Shashi-Limpopo confluence, Beit Bridge district.	Drummond, R. 5947	22/3/1959	K, SRGH

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Algeria:

33N 00E (–DD)	Depression Saad Haoud.	Boudet, G. 7549	12/3/1972	P
34N 02E (–DB)	Moulin Ferero, E of Bou-Sa'ada.	Kramer, K. U. 5285	5/10/1974	Z
34N 05E (–DC)	Biskra.	Chevallier, L. s.n.	31/10/1902	P
34N 05E (–DC)	Biskra.	Jamain, s.n.	0/0/1852	P
34N 05E (–DC)	Near Biskra.	Schmidt, 454	0/3/1855	BM, P
34N 05E (–DC)	Biskra.	Balansa, B. S.n.	0/0/1853	K, P
34N 05E (–DD)	Biskra, Oasis de Beni-Mora.	Balansa, B. 959	27/2/1853	BM, K, P, E
35N 00W (–DA)	Oran.	Balansa, B. 659	25/12/1852	P, K
35N 00W (–DA)	Algeria, Oran.	Durando,	0/0/1851	P
35N 00W (–DA)	Algeria, Oran.	Durieu,	1840-1844	P

Egypt:

25N 32E (–DA)	Salmiya.	Simpson, N. D. 5787	8/3/1928	K
28N 29E (–CC)	Wadi el Bahr.	Simpson, N. D. 6190	21/12/1928	K
28N 31E (–CA)	Wadi el Rokham (= Warshet el Rukham).	Simpson, N. D. 233	–	K, P
29N 32E (–DC)	Peninsula of Suez, Egypt.	Russell, s.n.	1859-1860	P
30N 29E (–DC)	Bourg-el-Arab.	Simpson, N. D. 645	24/2/1922	K
30N 29E (–DC)	Along Cairo - Alex road, south of Amria.	Tackholm, B. s.n.	2/4/1961	BM
30N 29E (–DC)	70 km from Ras el Hekma to Burg el Arab.	Täckholm, B. s.n.	3/6/1964	BM
30N 29E (–DC)	West of Alexandria on road to Burg el Arab.	Venter, A. M. 576 & 577	8/12/1996	BLFU
31N 25E (–CA)	7 km south of Sallum.	Osborn, D. & Helmy, I. s.n.	29/10/1965	BM
31N 29E (–BB)	Alexandria, Ramleh.	Bolland, B. G. C. s.n.	20/12/1912	K
31N 29E (–BB)	Alexandria, Ramleh.	Bolland, B. 712	20/7/1913	K
31N 29E (–BB)	Alexandria.	De Lile, s.n.	–	P
31N 29E (–BB)	Victoria, east of Alexandria.	Simpson, N. D. 2088	17/3/1923	K
31N 30E (–AC)	Near Mandara.	Simpson, N. D. 2183	9/10/1923	K
31N 30E (–AD)	North of Rosette (now Rashid).	Simpson, N. D. 3443	6/5/1925	K
31N 30E (–AD)	Rosetta (=Rashid).	Schweinfurth, R. s.n.	16/10/1878	P
31N 30E (–AD)	Rosetta (=Rashid).	Martins, s.n.	0/12/1834	K
31N 31E (–BD)	Gheit el Nassara Damieta.	Simpson, N. D. 994	11/4/1922	K
31N 31E (–CA)	Kafr-el-Shekg distr., Baltim.	Mashaly, I. A. s.n.	20/8/1983	K
31N 31E (–CA)	Baltim.	Simpson, N. D. 5100	28/6/1927	K
31N 32E (–BA)	Near Romaneh (= Rummanah).	Ogilvie Reed, G. H. sn.	24/4/1919	K

Libya:

31N 16E (–BA)	Tripoliana District: 70 km E of Sirte.	Park, 66	9/10/1958	K
32N 13E (–AA)	Wadi Gan.	Mitchell, 214	0/0/1996	K
32N 13E (–AA)	Garian Road, 30 km from Tripoli.	Park, 4	9/10/1958	K
32N 13E (–CC)	Tripoli.	Bommüller, J. 820	19/4/1933	Z
32N 13E (–CC)	Tripoli (=Tarabulus).	Dureyrier, s.n.	28/10/1860	P
32N 14E (–BD)	Tripolitania Region, between Dafniyah and Misurata.	Keith, H. G. 1127	14/10/1962	K
32N 20E (–AA)	Cyrenaica Region, Benghazi Rommel's Pool (=Jazirah).	Keith, H. G. 310	19/3/1959	P, K

Tunisia:

35N 09E (–BA)	Sidi bu-Zayed (Sidi-bou-Said).	Barratte, G. s.n.	18/4/1888	K
36N 10E (–BC)	Hammamet.	Gandoger, 133	0/10/1907	K
36N 10E (–CC)	Tunis.	Johnson, s.n.	0/0/1898	K
36N 10E (–CB)	Sidi-bou-Said.	Cosson, s.n.	11/12/1890	K
36N 10E (–CD)	Carthage.	Cosson, M. s.n.	4/5/1883	P

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Botswana:

18S 24E (–CA)	Savuti, Chobe National Park.	Jacobsen, N. G. H. 3151	25/3/1925	PRE
19S 22E (–CA)	Ngamiland, Okavango near Nokanenge.	Richards, H. M. 14801	20/3/1961	K
19S 23E (–BC)	Northern district: Nqamaga Island.	Smith, P. A . 1736	16/5/1976	SRGH, LISC
19S 23E (–CC)	Imperial Forestry Institute, southwest of Maun.	Miller, 488	1/9/1946	PRE, LISC
19S 23E (–CD)	Matlapen Bridge picnic site.	Smith, P. A. 182	2/12/1972	SRGH, LISC
20S 22E (–AB)	34km from Sehitwa to Nokaneng.	Carr, J. U. 86	21/3/1979	PRE
20S 22E (–BD)	Near Toteng - Mogapelwa road.	Smith, P. A. 3966	12/12/1982	COI, K
21S 25E (–AD)	Orapa.	Allen, A. 275	2/10/1975	PRE, LISC

Egypt:

26N 32E (–BA)	Wadi Hendosse, between Keneh & Kosier (=Quasayr).	Schweinfurth, G. 1397	14/1/1865	BM
28N 29E (–CB)	Wadi el Bahr.	Simpson, 6190	1/12/1928	K
29N 31E (–CD)	Cairo, Wadi Hof, Hulwan.	Lupton, s.n.	6/10/1946	BM
29N 32E (–CD)	Southern coast of Gulf of Suez at Wadi Hagul.	Venter, A. M. 574	12/10/1996	BLFU
29N 32E (–CD)	Southern coast of Gulf of Suez at Wadi Hagul.	Venter, A. M. 575	12/10/1996	BLFU
30N 31E (–AA)	Reseda-Tal bei Helnan, near Cairo.	Keller, A. s.n.	23/3/1903	Z
30N 31E (–AA)	Wadi Hof at Cairo.	Keller, A. s.n.	0/9/1903	Z
30N 32E (–AB)	30 km NW of Suez to Cairo.	Danin, A. s.n.	29/10/1973	HUJ

Erithrea:

09N 37E (–AC)	Bori.	Chedeville, 2663	0/0/1967	P
–	Wadi Melekte area.	Bally, P. R. O. 6806	25/3/1949	K

Ethiopia:

03N 38E (–BC)	Sidamo, 48 km SE of Mega.	Mesfin & Vollesen, 4227	23/5/1986	K
03N 39E (–CC)	Borana, south of Neghelle.	Haugen, T. 1017	3/11/1990	K
04N 38E (–CD)	10 km SW of Mega to Marsabit.	Ash, J. 2822	1/1/1975	K
05N 37E (–CC)	Gamo Gofa, Lower Sagan plain.	Haugen, T. 524	15/2/1985	K
05N 39E (–CB)	20 km S of Waddere on road to Neghekke.	Friis, Gilber t& Volleson, 583	11/2/1972	K
06N 44E (–AA)	Ogaden: Scillare-Obos.	Simmon, S135	4/10/1956	K
09N 42E (–BA)	40 km ESE of Harrar on road to Djigdjigga.	Burger, 2141	27/9/1962	K
11N 40E (–AC)	Wollo-Rayya.	Mercier, J. V168	16/9/1980	FT
12N 43E (–BB)	Djibouti.	Jousveaume, s.n.	0/0/1895	P

Kenya:

00N 37E (–BC)	Sweet Waters Ranch, Nanyuki district.	Gillett, J. B. 16574	26/12/1964	K, BR
00N 36E (–AB)	Thomson Falls on Rumuruti road.	Lawton, R. M. 1679	21/2/1972	K
00N 37E (–AD)	Samburu Game Reserve, between Koitogor and river.	Hooper, S. & Townsend, C.1676	4/5/1977	K
00N 37E (–BC)	13 km N of Isiola to Marsabit.	Gilbert, Gachathi & Gatheri, 5315	11/2/1978	K
00N 37E (–BC)	Isiolo, Central Province.	Gillett, J. B. 12510	3/9/1952	K
00S 36E (–CB)	South side of Lake Naivisha.	Dale, 3061	0/12/1932	K, BM, BR
00S 36E (–CB)	Naivasha, NW of Nairobi.	Lambinen, 75/256	13/4/1975	BR
00S 36E (–CB)	Lake Naivusha.	Polhill, E. 118	24/7/1969	K, BR
00S 36E (–CD)	Rift Valley, Lake Naivusha district.	Polhill, S. 89	10/5/1964	K
00S 38E (–DB)	Nairobi-Garissa road, 16 km E of border.	Gillett, J. B. 19490	1/12/1972	K
00S 38E (–DB)	Thola River, Saueli coast.	Kirk, s.n.	0/ 4/1873	K
00S 39E (–AA)	Balambala.	Adamson, J. 449	21/11/1947	K
00S 39E (–BA)	65 km from Garissa to Modo Gash.	Stannard & Gilbert, 1044	14/12/1977	K
01N 35E (–AD)	Sigor.	Meyerhoff, E. 75	26/7/1978	K
01N 36E (–BD)	Near Ngobis.	Trapnell, 2365	0/9/1957	K
01N 36E (–CC)	Ekebekebeke (Turkana), 16 km from Lokori to Sigar.	Mathew, B. 6420	28/5/1970	K
01N 36E (–CC)	Turkana, Ekabekebeke, Katila forest.	Mathew, B. 6709	6/9/1970	K
01S 35E (–AD)	Road from Keekorok gate to Narok	Kokwaro & Mathenge, 2749	16/8/1971	K
01S 35E (–BB)	Narok-Ewaso Ngiro, Narok district.	Verdcourt, 3824	12/11/1963	K
01S 36E (–BA)	Rift Valley, 28 km from Kikuyu to Narok via Wanyqa.	Verdcourt, 3563	20/1/1963	K
01S 36E (–BC)	Near Asapiri, Kedong Valley, 32 km NW of Ngong.	Rogers, 69	22/11/1932	K, BM

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01S 36E (–BC)	32 km NW of Near Ngong, Kedong Valley.	Scott-Elliot, 6610	0/0/1894	K
01S 36E (–CD)	65 km from Nairobi to Magodi.	Glover & Samuel, 3418	18/1/1962	K
01S 36E (–DD)	Kajiado.	Archer, 289	17/9/1961	K
01S 36E (–DD)	Meto, of Kajiado district.	Horsfull, 3	3/10/1977	K
01S 36E (–DD)	3 km S of Kajiado.	Milne-Redhead & Taylor, 7150	31/10/1955	K, LISC, SRGH
01S 36N (–BC)	Kiserian around Lake Baringa.	Okebiro, D. N. 704	19/3/1989	K
01S37E (–AC)	0.5 km east of Stony Athi River, Nairobi to Mombassa .	Faden, R. B. & A. J. 74/223	16/3/1974	BR, K, WAG
01S 37E (–DA)	SW foot of Mua Hills.	Gillett, J. B. 16207	27/9/1964	K, BR
01S 40E (–DD)	Tana River National Primate Res., 1 km on Woodland rd.	Luke, Q. & Kabuye, C. s.n.	15/3/1990	K
02N 36E (–DB)	Mount Kulal.	Bally, P. R. O. 5652	15/10/1947	K
02N 36E (–DB)	Mount Kulal, Marsabit district.	Lamprey & Field, 15	-	K
02S 36E (–DB)	Namanga-Nairobi road.	Lund, 3104	26/6/1961	K
02S 37E (–AA)	Kijiado district: Selengai Game Reserve.	Kibue, 89	15/12/1969	K, BR
02S 37E (–DA)	1 km S of Marumar Dam, Maralal Area.	Nesbit-Evans, 20	3/6/1968	K
02S 40E (–AC)	Kurawa,48 km S of Garsen, Tana River district.	Polhill & Paulo, 545	23/9/1961	P, K, BR, FT
03N 35E (–AA)	50 miles W of Lodwar.	Padwa, J. H. 137	5/11/1953	FT
03N 35E (–CB)	River at junction to Kakuma on Lokitaung-Lodwar road.	Carter & Stannard, 205	11/6/1977	K, SRGH
03N 38E (–CC)	Furroli, North Province.	Gillett, J. B. 13819	9/12/1952	K
03N 40E (–DD)	Ramu-Banissa road, 28 km from turning to Banissa.	Gilbert & Thulin, 1406	5/4/1978	K, BR
03S 37E (–BC)	32 km E of Taveta.	Dale, 3639	0/3/1937	K, BR
03S 39E (–AA)	Sala, Tsavo East.	Hucks, 1159	11/6/1969	K, BR
04N 35E (–AB)	Nagungumet, 58 km from Lokitaung to Lodwar.	Carter & Stannard, 189	11/4/1977	K
04N 40E (–BB)	Mandera district, 30 km on Ramu-Malka Mari roa	Gilbert, M. G. & Thulin, M. 1525	5/6/1970	K

Malawi:

11S 33E (–BD)	64 km S of Mzuzu, along Eutini road, Mzimba district.	Pawek, J. 1753	24/2/1969	K

Namibia:

18S 21E (–BB)	Dwaki-camp, Okavango.	Le Roux, P. J. 214	16/2/1958	PRE

Socotra:

12N 52E (–BC)	Abd el Kûri .	Virgo, K. J. A35	26/10/1966	K
12N 54E (–CA)	Socotra.	Bent, s.n.	0/6/1897	K
12N 54E (–CA)	Hadibu plain between Hadibu & Suk.	Smith & Lavranos, 106	22/3/1967	K, FT
12N 52E (–AB)	Jebel Hassala (Qarat Saleh).	Smith & Lavranos, 689	5/7/1967	K

Somalia:

00N 42E (–BB)	Jelib-Camsuma, 13km near village Shek Ahmed Yare.	Thulin & Warfa, 4459	5/1/1983	K
00N 42E (–BC)	Jilib area, W of Bagdaad, on road to Axmedyare	Madany, M. H. 89/4	15/5/1989	K
02N 43E (–AD)	Ganderscia = Gardascia.	Tardelli, M. 499	14/4/1988	FT
02N 45E (–AB)	11km NE of Mogadisho (Muqdisho) to Warshiek	Thulin, M. 6308	16/5/1989	K
03N 42E (–AC)	Gedo, 58 km SW of Luuq to Garbaharrey.	Somali Medicinal Plants 197	23/5/1988	K
04N 47E (–DA)	Central rangelands.	Gillet, Hemming & Watson, 22553	6/11/1979	K
05N 46E (–AB)	40 km S of Dusamareb.	Beckett, 314	25/6/1979	K
05N 48E (–DD)	Central rangelands.	Gillett, Hemming & Watson, 22129	28/5/1979	K
07N 49E (–DD)	Mouth of Nogal - EIL (=Noyal).	Hemming, 1668	10/7/1959	K
07N 49E (–DD)	Mouth of Nogal - EIL.	Hemming, 1681	10/7/1959	K
08N 44E (–CD)	Boundary.	Gillett, J. B. 4075	29/9/1932	K
08N 45E (–BA)	Border with Ethiopia boundary at Pellen.	Gillett, J. B. 4154	10/5/1932	K
08N 46E (–CB)	Wadamago.	Peck, E. F. 11	8/4/1941	K
09N 43E (–CC)	Boroma (="Booraame").	Henning, C F 1292	14/9/1957	K
09N 44E (–AC)	Fer libah.	Thomson, 19	0/11/1904	K
09N 44E (–BA)	Jaleelo, 100 km E of Burao on road to Las Anod	Allen & Elmi, 539	10/11/1978	E
10N 44E (–BC)	Raisin de l'Qued futage Mt Dollad & le Ghoubet Kharab.	De la Rüe, A. s.n.	22/6/1938	P
09N 45E (–BB)	Burao.	Glover & Gilliland, 64	30/9/1944	K
09N 45E (–CC)	Sheikh (=Sheekh).	Louside Wood, J. R. 5/73/93	25/5/1973	K
09N 45E (–CD)	Erigavo Hills.	McKinnon, S/92	26/9/1938	K, P

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09N 45E (–DA)	6 km from Borao, Tugdheer region.	Hansen & Heemstra, 6107	15/6/1979	K, WAG
09N 45E (–DA)	Buxoo.	Hemming, 179	20/9/1953	K
09N 45E (–DA)	Burao.	Simmons, B. 81	13/9/1956	K
09N 46E (–AA)	Near Burao.	Gillett & Watson, 23743	7/5/1981	K
09N 46E (–BD)	Erigavo district: British Somalia at Garadag.	McKinnon, A. S. S/227	25/4/1939	K, P
10N 44E (–AD)	30 miles S of Nulham.	Drake-Brockman, 1111	0/3/1913	K
10N 45E (–AC)	Jebel Wotni mountain.	Gillett, J. B. 4798	1/4/1933	K
10N 46E (–AB)	N E Somalia : Karur.	Barbier, 1135	17/1/1985	K
10N 48E (–CB)	Bulleh Golgolo, on Zeila-Berbera road.	Glover & Gilliland, 808	20/3/1945	K, BM
10N 48E (–DB)	90 km from Bosaso.	Hemming & Watson, 3165	19/11/1980	K
10N 49E (–CD)	Karin.	Collenette, C. L. 191	29/10/1929	K, FT
10N 50E (–AA)	Togga Xiriiro.	Beckett, 512	11/2/1980	K
South Africa:				
23S 29E (–BD)	20 miles S of Louis Trichardt, at Bandolierskop crossing.	Schlieben, H. J. 7253	29/9/1955	K, B, G
23S 29E (–BD)	Bandolierskop-Driekoppies crossing, N of Pietersburg.	Van Wyk, A. E. 5703	23/5/1982	K, PRE
23S 29E (–BD)	Bandolierskop-Driekoppies crossing, N of Pietersburg.	Venter, A. M. 435	21/12/1992	BLFU
23S 29E (–CD)	Pietersburg district.	Van der Schyff, H. P. 4433	0/7/1958	K, PRE
23S 30E (–AA)	Soutpansberg: Ben Lavin Nature Reserve.	James, C. 174	17/5/1986	K, PRE
23S 31E (–AB)	Near Shingwedsi River in Kruger National Park.	Lamont, 54	24/2/1949	K, PRE
24S 30E (–BD)	Farm Bedfort, W of Klaserie.	Zambatis, N. 1449	25/4/1982	PRE
24S 31E (–DA)	Nelspruit district, at Leeupan.	Van der Schyff, H. P. 4074	12/9/1954	K, PRE
24S 31E (–DC)	National Kruger Game Reserve, Skukuza, at Leewpan.	Venter, A. M. 430	30/12/1992	BLFU
27S 31E (–BC)	Pongola Bushveld farm.	Nel, N. D. S. 76	0/12/1971	K, PRE, NH
27S 32E (–AA)	Inqwavuna district, western foot of Lebombo mountains.	Wells, M. J. 2200	26/11/1960	K, PRE
Sudan:				
13N 30E (–AB)	Khor Tagget.	Cooke, B. K. 197	3/11/1936	K
14N 30E (–AA)	Tagdora Hill, S-Tokar delta, SouthernSudan	Bally, P. R. D. B6966	4/7/1949	K
15N 32E (–AB)	Jebel Auliyi, 8km W of Erkowit to Sinkat.	Carter, 1856	19/11/1987	K
15N 32E (–CB)	Wisi D Kwantra Elba, Red Sea Province.	Newberry, P. 204	13/1/1928	BM
19N 37E (–AB)	17km S of Suakin.	Carter, 1892	21/11/1987	K
19N 37E (–CA)	Port Sudan, south of town.	Drummond & Hemsley, 985	17/1/1953	K
20N 33E (–CA)	Coastal plain, Incel Macaur.	Schweinfurth, G. 1399	1/5/1864	BM, P
21N 37E (–AA)	Kamoikwen.	Cooke, B. K. 113	18/2/1937	K
Swaziland:				
25S 31E (–DC)	Lebombo district, Tshaneni.	Barrett, S. C. H. 364	18/12/1969	K, PRE
26S 31E (–BB)	Irrigation scheme in NE Swaziland.	Horler, D. N. H. 245	5/1/1973	K, PRE
26S 32E (–CA)	Tshaneni, Lubombo distict, Low Veld.	Barrett, S. C. H. 410	18/12/1969	K
27S 31E (–BD)	Hlatikulu near Gollet.	Compton, R. H. 28896	6/9/1959	NBG
27S 32E (–AA)	Near Ingwavuma Poort, Hlatikula district.	Compton, R. H. 28580	3/5/1959	K, PRE, NBG
27S 32E (–AA)	Near Ingwavuma Poort, Hlatikula district.	Compton, R. H. 28900	6/10/1959	K, PRE, NBG
Tanzania				
03S 37E (–AA)	West Kilimanjaro, NP Stock Farm.	Kerfoot, O. 4393	22/10/1962	PRE
02S 35E (–DD)	Northern Province, Oldonyo Lengai, Rift Valley.	Newbold, J. B 5641	2/6/1961	K
02S 36E (–CC)	Ketumbane.	Greenway, 4285	1/7/1936	K
02S 36E (–DA)	Lugare Longisho.	Thompson, E. 346	2/1/1932	K
02S 36E (–DB)	8 miles S of Namanga.	Verdcourt, 2522	12/12/1959	K, BR
03S 34E (–BD)	Southern Serengeti, Kakesio.	Hornby, 2110	2/5/1941	K
03S 34E (–DC)	Yaida Valley, near Lake Endasiku.	Richards, H. M. 25154	17/1/1970	K
03S 35E (–AB)	Ngorogoro Conservation area.	Henlocker, 492	11/11/1966	K
03S 35E (–AB)	Ngorongoro National Park, above Ol balbal.	Tanner, R. E. S. 3306	25/11/1956	BR, K
03S 35E (–AC)	Kakessio.	Newbold, J. B. 5830	4/7/1961	K
03S 35E (–BA)	Ngorongoro crater.	Pole Evans & Evans, 983	24/6/1938	K
03S 35E (–DD)	10 km Engaruka-Mto wa Mbu.	Leippert, H. 6372	25/2/1966	K

L. shawii

03S 36E (–BB)	Ngare Nanyuki, 20-30 miles NE of Arusha.	Beesley, J. S. S. 185	0/11/1965	K, BR
03S 36E (–BD)	Balbat.	Greenway, 9049	22/11/1956	K, B
04S 35E (–BA)	W of Nou Forest Reserve, Mubulu district.	Procter, 3495	0/1/1967	K
04S 36E (–BB)	Maborera, Masailand.	Hornby, R. M. 12	0/10/1934	K
04S 37E (–AA)	80 km S of Kikuleiva, Masai district.	Leippert, H. 5387	1/8/1965	K
04S 37E (–BB)	Vudee.	Greenway, 2073	30/1/1930	K
04S 38E (–AC)	Lake Kalimawe, Same district.	Richards, H. M. 21938	1/10/1967	K
04S 38E (–CA)	Mkomazi.	Greenway, 3965	23/4/1934	K
04S 38E (–CA)	Mkomozi, Korogwe district, Tanga Region.	Semsei, S. R. 3967	16/9/1965	K, FT
04S 38E (–DD)	Nkomazi.	Mohamedi, J. 1	19/5/1946	K
06S 35E (–DD)	West of Logi.	Thulin & Mhoro, 793	25/8/1970	K
06S 36E (–DA)	Godegode, Central Province, near Mpwapiva.	Hornby, R. M. 3079	16/8/1949	K, SRGH
06S 37E (–AD)	Mkundi, Usambara district.	Gilliman H. 769	5/8/1939	K
06S 39E (–AA)	Zanzibar.	Boivin, s.n.	0/0/1847	P
08S 34E (–BB)	Rujewa - Madibira road, Iringa district.	Richards, H. M. 15594	12/11/1961	K
08S 35E (–AC)	Sao Hill, Ipogoro-M'kawa road, Iringa district.	Richards, H. M. 15585	12/12/1961	K
08S 35E (–AD)	30 km W of Mafinga to Madibira by Ndembera River.	Lovett & Congdon, 1169	26/12/1986	K
08S 39E (–BA)	Hills of Kolo. Kondoa district.	Burtt, 1199	1/5/1928	K
09S 34E (–CB)	16 km S of Njombe turn off from Great North Road.	Milne-Redhead & Taylor, 11061	7/12/1956	K

Uganda:

02N 34E (–CB)	Lokapeliethe, Mathiniko, Karamoja.	Dale, 4353	0/9/1943	K
02N 34E (–CB)	Kangole.	Wilson, 380	0/7/1957	K, BR
02N 34E (–DA)	Karamoja district, Kangole.	Eggeling, W. J. 2945	-	K

Zambia:

14S 27E (–CC)	Mumbwa.	Fanshaw, 6645	6/3/1961	LISC, NDO
14S 27E (–CC)	Near Mumbwa.	MacCaulay, 365	0/0/1911	K
15S 27E (–CD)	Kruger National Park at Namwala.	Mitchell, B. L. 16/17	12/4/1962	K

Zimbabwe:

16S 31E (–CB)	Near Chibui, Musikavanthu African Reserve.	Goodier, R. 936	20/2/1960	K, SRGH, LISC
17S 29E (–DD)	Victoria.	Monro, 632	0/0/1909	BM
17S 30E (–AA)	Mphoeng Reserve.	Wild, 5842	7/3/1962	K
17S 31E (–CC)	Salisbury.	Eyles, 5061	28/8/1927	K
17S 31E (–DC)	Rocky valley, 40km East of Harar.	Burger, W. 2141	27/9/1962	K
18S 29E (–BD)	Gatooma.	Eyles, 5083	27/2/1927	K
18S 29E (–DD)	Que Que, Sable Park.	Chipunga, L. 64	26/4/1976	SRGH
18S 30E (–AA)	Watkins farm, 12 km from Hartley.	Hornby, R. M. 3441	11/10/1973	SRGH, LISC
18S 32E (–DC)	Premier Mines.	Martineau, R. A. S. 244	0/3/1944	SRGH, LISC
19S 27E (–BC)	Nyamandkloon district.	West, O. 3132	0/12/1949	SRGH, LISC
19S 27E (–DD)	District Nyamandhlovu on Tjolotjo Road.	Orpen, F. L. 063/50	4/12/1950	SRGH,
19S 29E (–BD)	Gwelo.	Steedman, E. C. 4755	24/11/1924	B, K
19S 30E (–BB)	Enkeldoorn distict, Charter at Sabakwe river.	Davies, R. D2774	30/5/1960	K, SRGH, LISC
19S 32E (–CD)	Melsetter district, Chipinga near Birchenough Bridge.	Chase, N. C. 977	22/10/1948	K, BM, SRGH
19S32E (–CD)	Birchenough Bridge.	Obermeyer, A. A. 2403	0/1/1938	BOL
20S 28E (–BA)	Bulawayo district.	Best, 813	5/11/1968	SRGH
20S 28E (–BA)	Bulawayo.	Philomena, 45	0/0/1917	BOL
20S 28E (–BA)	Bulawayo.	Rogers, F. A. 10	—	Z
20S 28E (–BA)	Bulawayo, Huntley's farm Sauerdale.	Zealley, A. E. V. 86	23/5/1917	BOL
20S 28E (–BC)	Matobodistrict: Hope Fountain Mission.	Norrgrann, G. 371	-	SRGH, LISC
20S 28E (–DA)	Matopos.	Hodgson, L. M. H 8/46	0/12/1947	SRGH, LISC
20S 31E (–AC)	Shipinga district: Sabi Valley.	Plowes, D. .C H. 2086	15/7/1959	SRGH, LISC
20S 31E (–BA)	Hunyani district: Hayanya Mountains.	Wild, 513	23/12/1945	K, SRGH, LISC
20S 32E (–CD)	Matoles district.	Miller, O. B. 1420	0/11/1952	K

L. strandveldense

South Africa:

29S	16E (–BD)	5 km north of Port Nolloth.	Venter, H. J. T. 8229	3/9/1980	BLFU
29S	16E (–BD)	5 km north of Port Nolloth.	Venter, H. J. T. 8230	3/9/1980	BLFU
32S	18E (–AB)	Lamberts Bay, municipal caravan park, Beach gate.	Venter, A. M. 477	7/12/1994	BLFU
32S	18E (–AB)	Lamberts Bay, 5km east on road to Clanwilliam.	Venter, A. M. 478 & 506	7/12/1994	BLFU
32S	18E (–AB)	Lamberts Bay, 5km east on road to Clanwilliam.	Venter, A. M. 479 & 504	7/12/1944	BLFU
32S	18E (–AD)	North-east corner of Malkop Bay Caravan Park.	Venter, A. M. 507	31/12/1995	BLFU
32S	18S (–AD)	Elands Bay, ½ km west of river crossing.	Venter, A. M. 510	31/12/1995	BLFU
32S	18E (–CA)	10 km north of Dwarskersbos, on road to Velddrift.	Venter, A. M. 513	31/12/1995	BLFU

L. tenue

South Africa:

28S	29E (–DB)	3 km east of Ladismith om Calitzdorp road.	Venter, A. M. 618	17/1/1999	BLFU
32S	19E (–DD)	Ceres, Karoo.	Bayer, M. B. 6389	5/7/1993	PRE
33S	21E (–AA)	Between Seven Weeks Poort and Rooinek Pass.	Zinn, H. 67483	0/10/1952	SAM
33S	21E (–AD)	4 km East of Ladismith on road to Calitzdorp.	Venter, A. M. 521	5/1/1996	BLFU
33S	21E (–CA)	Barrydale - Ladismith road, ½km E of Groot River bridge.	Venter, A. M. 453	23/1/1993	BLFU
33S	21E (–DB)	8 km west of Calitzdorp on Oudtshoorn road.	Venter, A. M. 454	23/1/1993	BLFU
33S	22E (–CA)	12 km west of Oudtshoorn to Calitzdorp in Huisrivierpas.	Venter, A. M. 522	5/1/1996	BLFU
33S	21E (–CC)	Northern intrance to Garcia Pass, Ladismith district.	Venter, A. M. 617	17/1/1999	BLFU
33S	25E (–BD)	Addo Natational Park, Antelope Camp.	Liebenberg, L. C. C. 6612	0/11/1962	PRE, K, GRA
34S	20E (–CA)	10 km from Waenhuiskrans to Cape Agulhas.	Spies, J. J. 6199	22/9/1997	BLFU
34S	20E (–AB)	20 km from Swartberg Pass on road to Gamkakloof.	Venter, A. M. 616	21/9/1998	BLFU
34S	20E (–CB)	Along Heuningnes River.	O'Callaghan, M. 625	8/6/1983	NBG
34S	21E (–AB)	Distict Mossel Bay, plains near Brak River.	Galpin, 4353	15/9/1897	PRE
34S	21E (–AD)	Stilbaai, Riversdale district.	Horn, D. H. S. s.n.	0/9/1965	PRE
34S	21E (–BD)	Near Mossel Bay, Goutitz River Mouth.	O'Callaghan, v Wyk & Fellingham, 306	27/5/1984	NBG

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Namibia:

20S 13E (–AA)	Unjab Mouth.	Müller, M. & Loutit, B. 1188	14/8/1979	WIND
20S 13E (–AD)	23km South East of Torra Bay.	Giess, W. 8017	17/4/1964	WIND
21S 13E (–DD)	Lagunenberg, Kaapkruis.	Giess, W. s.n.	15/6/1961	WIND
21S 14E (–CA)	Swakopmund, Swakop River.	Schmidt, E. 120	26/3/1972	WIND
21S 14E (–CC)	Lagunen Mountains at Cape Cross.	Giess, W. 10470	29/6/1967	WIND
22S 14E (–AB)	Swakopmund, Hentiesbay.	Giess, W. 3554	15/6/1961	WIND
22S 14E (–DA)	Swakopmund.	Engler, 6048	1/4/1913	K
22S 14E (–DA)	Swakopmund.	Lam & Meeuse, 4083	29/8/1938	L
22S 14E (–DA)	Swakopmund.	Pearson, 532	15/1/1904	SAM, NBG
22S 14E (–DA)	Swakopmund.	Reyneke, A. M. 196	9/27/1986	BLFU
22S 14E (–DA)	Swakopmund.	Seydel, 611	19/6/1955	K
22S 14E (–DA)	Swakopmund, mouth of Swakop River.	Seydel, 846	18/12/1956	K
22S 14E (–DA)	Swakopmund, 1 km from coast.	Van Vuuren, D. 979	12/2/1960	WIND
22S 14E (–DA)	Swakopmund.	Young, s.n.	13/11/1930	K
22S 15E (–CC)	Namdas, Trekkopje.	Dinter, 2798	29/3/1913	SAM, NBG
23S 14E (–AB)	Dorob area, Kuiseb Delta, Sandwich Habour district.	Ward, C. J. 9411	22/4/1981	PRE, WIND
23S 14E (–AB)	Wortel near Walvis Bay, Sandwich Harbour.	Seely, M. K. 205	15/1/1977	WIND
23S 14E (–AD)	Sandvis Harbour.	Jankowitz, W. 228	22/12/1971	WIND
23S 14E (–AD)	Sandwich Harbour.	Le Roux & Clinning, 1803	24/9/1977	WIND
23S 14E (–AD)	4 km south of Sandwich Harbour, inland edge of lagoon.	Ward, J. D. 193	13/1/1976	WIND
23S 14E (–BA)	Sandwich Harbour district, Lower Kuiseb, Rooibank area.	Theron, G. K. 3757	0/7/1977	WIND
24S 14E (–DA)	Fischersbrunn, Maab Bay.	Seely, M. K. 1491	11/1/1973	WIND
24S 14E (–DB)	Fischerbrunn, Diamond Area 2.	Irish, E. s.n.	21/5/1984	WIND
24S 16E (–DD)	Namseb.	Pearson, 9338	22/12/1915	K
25S 14E (–BD)	Sylvia Hill.	Seely & Robinson, 286	22/6/1972	WIND
25S 14E (–DB)	Spencer Bay.	Giess & Robinson, 13211	14/1/1974	WIND
25S 14E (–DB)	Spenser Bay:	Giess & Robinson, 13222	16/1/1974	PRE, WIND
25S 14E (–DD)	Lüderitz, Saddle Hill at Spencer Bay.	Seely & Robinson, 413	17/1/1973	WIND
25S 15E (–CA)	Lüderitz, near German church.	Reyneke, A. M. 185	25/9/1988	BLFU
26S 15E (–CA)	Lüderitzbucht.	Hobart Hampden, s.n.	0/0/1927	BM
26S 14E (–BB)	Hottentot Bay.	Giess & Robinson, 13166	10/1/1974	WIND, PRE
26S 14E (–BB)	Hottentot's Bay, Lüderitz at blue mountain.	Seely & Robinson, 409	17/1/1973	WIND
26S 15E (–BC)	Lüderitz district, Koichab Pan.	Owen-Smith, G. 1262	7/10/1979	WIND
26S 15E (–CA)	Near Lüderitz in coastal desert.	Coetzee & Werger, 1790	15/9/1973	WIND
26S 15E (–CA)	Buntfeldschuh, Lüderitz.	De Winter & Giess, 6205	5/9/1958	K + PRE
26S 15E (–CA)	Lüderitzbucht, Diamantberg.	Giess & van Vuuren, 650	5/8/1959	WIND
26S 15E (–CA)	Lüderitz, Halifax Island.	Jensen, M. s.n.	1/6/1971	WIND
26S 15E (–CA)	Lüderitz (Angra Pequena).	Marloth, R. 4748	0/4/1909	PRE
26S 15E (–CA)	Lüderitz Bay, Diamond Mountain.	Menz, E. s.n.	0/9/1947	WIND
26S 15E (–CA)	Lüderitz Bay.	Menz, E. s.n.	14/5/1950	WIND
26S 15E (–CA)	Lüderitz - South.	Merxmüller & Giess, 2346	24/3/1958	PRE
26S 15E (–CA)	Nautilus, North Lüderitz.	Merxmüller & Giess, 3080	23/8/1963	PRE, WIND
26S 15E (–CA)	Griffith Bay.	Müller & Jankowitz, s.n.	24/6/1975	WIND
26S 15E (–CA)	Lüderitzbucht.	Range, 500	-	SAM, NBG
26S 15E (–CA)	Lüderitz Bay, Dias Point.	Reyneke, A. M. 169	22/8/1986	BLFU
26S 15E (–CA)	Kolmanskop, 5 km east of Lüderitz.	Reyneke, A. M. 170	22/8/1986	BLFU
26S 15E (–CA)	Lüderitz, Dias Point.	Venter, H. J. T. 7810	4/8/1978	BLFU
26S 15E (–CA)	20 km east of Luderitz.	Venter, H. J. T. 8637	28/10/1981	BLFU
26S 16E (–CB)	10 km west of Aus on road to Lüderitz Bay.	Leippert, E. 4820	18/2/1963	WIND
27S 15E (–AA)	Lüderitz, Bogenfels, Possession Island.	Rand, s.n.	0/6/1946	SAM, NBG
27S 15E (–AC)	Possession Island, West Coast of Namibia.	Heydorn, M. J. 1	1/5/1988	NBG
27S 15E (–DC)	Kankansib Fountain, 40 km east of Grittental.	De Winter & Giess, 6096	30/8/1958	K, PRE, WIND
28S 16E (–BA)	Lüderitz South, Obib Mountains.	Merxmüller & Giess, 28638	20/9/1972	WIND, LISC
28S 16E (–BB)	Oranjemund, about 6 km north of Rosh Pinah.	Craven, P. 1224	5/9/1981	WIND

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28S	17E (–CA)	Vioolsdrif, Eksteenfontein.	Venter, H. J. T. 8064	29/8/1980	BLFU
28S	17E (–CA)	Vioolsdrif, along road to Springbokvlakte.	Venter, H. J. T. 8081	29/8/1980	BLFU
28S	16E (–CB)	Alexander Bay, Orange River Mouth.	Le Roux & Ramsay, 207	26/8/1978	STE
28S	16E (–CB)	North of Orange River about 500 m from coast.	O'Callaghan, Van Wyk & Morley, 4	11/9/1984	NBG, PRE
28S	16E (–CB)	Oranjemund, north bank of river, 1.5 km from coast.	O'Callaghan, Van Wyk & Morley, 18	11/9/1984	NBG, PRE
28S	16E (–CB)	Oranjemund, north bank of river, 1.5 km from coast.	O'Callaghan, Van Wyk & Morley, 19	11/9/1984	NBG, PRE
28S	16E (–CB)	Oranjemund, 1,5 km from coast, west of river.	O'Callaghan, Van Wyk & Morley, 20	11/9/1984	NBG, PRE
28S	16E (–DA)	Beauvillon gate, 20 km from Alexander Bay to Reuning.	Venter, A. M. 395	20/9/1992	BLFU
28S	16E (–DA)	72 km north of Port Nolloth on way to Alexander Bay.	Werger, M. .J A. 497	19/5/1969	K, PRE
28S	16E (–DC)	Holgat River Mouth, Namaqualand.	Le Roux & Parsons, 3	14/10/1980	PRE
29S	16E (–BD)	Port Nolloth.	Galpin & Pearson, 7576	17/1/1907	K, NBG, SAM
29S	16E (–BD)	Port Nolloth, sand dunes.	Pearson, 506	7/1/1904	K
29S	16E (–BD)	1 km south of McDougall's Bay.	Raitt, L. 298	24/9/1978	STE
29S	16E (–BD)	14 km north of Port Nolloth along salt road.	Reyneke, A. M. 165	22/8/1986	BLFU
29S	16E (–BD)	Port Nolloth.	Rodin, R. J. 1546	5/10/1947	K, PRE, BOL, M,
29S	16E (–BD)	Port Nolloth, sand dunes.	Venter, A. M. 391	19/9/1992	BLFU
29S	16E (–BD)	Port Nolloth, sand dunes.	Venter, A. M. 392	19/9/1992	BLFU
29S	17E (–CC)	Kleinzee, Rooivlei farm.	Drijfhout, P. 2847	6/6/1981	STE
29S	17E (–CC)	Namaqualand, Kleinzee, on farm Brazil.	Le Roux & Ramsey, 247	29/8/1978	NBG, PRE
30S	17E (–AB)	Brazil, south of Port Nolloth.	Van Jaarsveld, E. 5409	6/6/1980	NBG
30S	17E (–AD)	Hondeklip Bay, Namaqualand.	Pillans, N. S. 18161	0/10/1924	NBG
30S	17E (–DC)	Namaqualand, Groen River Mouth.	Le Roux & Ramsey, 278	13/9/1978	NBG
31S	18E (–CA)	Strandfontein.	Boucher, C. 4039	7/11/1978	STE
31S	18E (–CA)	Ebenezar, naby Van Rynsdorp.	Drège, 7872	0/11/1833	K, P, G
31S	18E (–CA)	Vredendal. Olifants River Mouth.	Le Roux & Ramsay, 61	16/08/1978	STE, PRE
31S	18E (–CD)	Robben Island , north of Olifants River Mouth.	Le Roux & Ramsay, 73	16/08/1978	STE
32S	17E (–DD)	Britannia Bay, Vredenburg.	Taylor, H. C. 5193	15/9/1963	K, PRE, STE
32S	18E (–AB)	Berg River area. N of Velddrif.	O'Callaghan, M. 1227	15/10/1986	STE
32S	18E (–AB)	Between Lamberts Bay and Leipoldtville.	Taylor, H. C. 10319	7/9/1981	STE, PRE
32S	18E (–AB)	Lamberts Bay, municipal caravan park.	Venter, A. M. 475	7/12/1994	BLFU
32S	18E (–AB)	Lamberts Bay, just oustside the municipal caravan park.	Venter, A. M. 476	7/12/1944	BLFU
32S	18E (–CB)	Velddrif, Rocher Pan Nature Reserve.	Heyl, C. 3	20/3/1978	STE
33S	17E (–BB)	Malmesbury district, Saldanha Bay.	Hall, H. 530	5/6/1952	NBG
33S	17E (–BB)	Saldana Bay, sea front.	Venter, H. J. T. 9193	13/12/1987	BLFU
33S	18E (–AA)	Cape, just east of Langebaan.	Boucher, C. 2913	17/10/1975	PRE
33S	18E (–AA)	Yzerfontein.	Lewis, 5762	17/4/1961	NBG
33S	18E (–AA)	Yzerfontein beach.	Moffett, R. 2691	7/7/1980	STE
33S	18E (–AA)	Langebaan, just north of town.	Van Jaarsveld & Duncan, 5660	7/7/1980	NBG
33S	18E (–AD)	Western Cape, Darling.	Marloth, R. 4036	0/8/1905	K
33S	18E (–CB)	Silwerstroom beach at Buffel River Mouth.	Boucher, C. 3993	12/10/1978	STE, PRE
33S	18E (–CB)	West Coast: Kabeljoubank, north van Bokbaai.	Reyneke, A. M. 221	8/11/1988	K, BLFU
33S	18E (–CB)	Bokbaai area.	Venter, A. M. 347	21/4/1991	BLFU
33S	18E (–CB)	Ganzekraal, north of Bokbaai.	Venter, A. M. 350	21/4/1991	BLFU
33S	18E (–CB)	Ganzekraal, north of Bokbaai.	Venter, A. M. 351	21/4/1991	BLFU
33S	18E (–CD)	Cape Botany Bay Cliffs, Lion's Head.	Garside, 1733	13/11/1920	K
33S	18E (–CD)	Cape Town at Sea Point.	Moss, 7490	14/1/1923	BM
33S	18E (–CD)	Cape Peninsula, between Sea Point and Clifton.	Pillans, 4021	21/11/1919	PRE
34S	19E (–DB)	Bredasdorp district, near Vogelvlei.	Schlechter, R. 10484	23/4/1897	BM, GRA
34S	19E (–DB)	Bredasdorp district, near Vogelvlei.	Schlechter, R. 10984	23/4/1897	G
34S	19S (–BA)	Genadendal.	Schlechter, R. 10335	-	BM

L. villosum

Botswana:

22S 20E	(–CC)	Ghanzi/Kgalagadi border, 7 km NW from Kule to fence.	Bergstrom, R. B. 38	27/1/1977	PRE, SRGH
23S 20E	(–BA)	5 km NNW of borehole at Dondong.	Bergstrom, R. B. 41	14/2/1977	SRGH, LISC
23S 20E	(–DB)	Masetleng Pan, 100 km west of Hukuntsi.	Parry, D. 8544	16/10/1985	PRE

Namibia:

21S 15E	(–DC)	North of Ukos (= Usakos).	Pearson, 9429	6/1/1916	K, BOL
22S 16E	(–DD)	Lichtenstein.	Dinter, K. 3527	16/5/1922	PRE, B
22S 17E	(–AD)	Windhoek district: Ongeama.	Volk, O. H. 2265	20/6/1939	M
22S 17E	(–BC)	Windhoek, farm Bodenhausen.	Seydel, R. 2344	19/4/1960	K
22S 17E	(–CA)	Immental, Schieferhügel	Von Koenen, E. 398	0/11/1979	BLFU
22S 17E	(–CB)	Windhoek, Finkenstein.	Seydel, R. 3844	18/12/1963	K
22S 17E	(–CB)	Windhoek, Finkenstein	Seydel, 4173	16/2/1965	K
22S 17E	(–CD)	Windhoek, Binsenheim, Schaf River.	Leipert, 4529	15/7/1963	WIND
22S 18E	(–AD)	Gobabis - Windhoek road 29 km from Windhoek.	Liebenberg, 4530	0/5/1949	K, PRE
22S 18E	(–BD)	Gobabis, near junction of Black & White Nossob Rivers.	Codd, L. E. 5835	22/11/1949	PRE
23S 17E	(–AA)	33 km south of Windhoek.	Reyneke, A. M. 207	2/10/1988	BLFU
23S 17E	(–DA)	64 km northeast of Tsumis Park, Rehoboth.	Basson, P. A. 38	0/5/1955	PRE
24S 16E	(–CB)	8 km northwest van Nantsas.	Pearson, H. H. W. 9325	24/12/1915	BOL
25S 17E	(–AC)	Gibeon, farm Rosstroppe.	Müller, M. 1320	9/4/1980	PRE
26S 18E	(–BC)	At Kubib.	Pearson, 9479	15/1/1916	K
26S 19E	(–DC)	11 km west of Aroab to Keetsmanshoop.	De Winter, B. 3402	3/5/1955	PRE, K
27S 18E	(–BA)	Nobabis (= Guigatsis).	Evrard, C. 9222	20/10/1960	PRE
27S 19E	(–AB)	Tranental, farm Warmfontein.	Lensing, J. E. J2/76	22/7/1976	WIND
28S 18E	(–CB)	Sandfontein.	Wilman, M. 1669	0/12/1921	WIND, K, NBG
28S 18E	(–DA)	Sandfontein	Bleek, D. s.n.	–	NBG, SAM
untraceable		Farm Stenkaampspan.	Walter, H. & E. 2443	0/0/1952	M

South Africa:

25S 20E	(–CB)	Northern Cape, Frylinckspan near Seversn.	Gubb, A. A. 11004	4/5/1983	PRE
25S 20E	(–CB)	Kalahari Gemsbok Park, Auob river bed 35 km from Mata Mata.	Leistner, O. A. 1132	23/6/1958	PRE, M
25S 20E	(–CB)	Kalahari Gemsbok Park, 9 km from Kij Gamiespomp to Auob Riv.	Van Rooyen, N. 3909	14/5/1987	PRE
26S 20E	(–AA)	Gordonia, Kafferspan.	Barnard, P. J. 798	24/4/1960	PRE
27S 23E	(–AD)	Kuruman, 24 km SE of Severn.	Leistner, O. A. 1448	26/7/1959	K
28S 17E	(–CD)	Klein Helskloof entrance.	Venter, H. J. T. 8101	30/8/1980	BLFU
28S 21E	(–AA)	Kalahari Gemsbok Park, 7 km SE of Mata Mata, Auob river.	Leistner, O. A. 1149	29/6/1958	PRE
28S 21E	(–DD)	Groblershoop near National road.	Reyneke, A. M. 52	0/8/ 1976	BLFU
28S 22E	(–BD)	Florodale, foot of Wolhaarkop, Kalahari region.	Esterhuysen, E. 2344	0/4/1940	BOL
28S 23E	(–DD)	22 km east of Douglas on road to Kimberley.	Venter, A. M. 543	14/1/1996	BLFU
28S 24E	(–AD)	Vaalbos National Park, Delportshoop.	Zietsman, P. C. 390	20/10/1988	BNM
28S 24E	(–BD)	2 km along turn-off to Riverton from Kimberley road.	Venter, A. M. 468	12/6/1994	BLFU
28S 24E	(–CA)	Farm Grootdam, 52 km West of Kimberley to Griquatown.	Reyneke, A. M. 294	20/5/1989	BLFU
28S 24E	(–CA)	Farm Grootdam, 52 km west of Kimberley to Griquatown.	Reyneke, A. M. 295	20/5/1989	BLFU
28S 24E	(–DA)	Barkly West.	Reyneke, A. M. 290	20/5/1989	BLFU
28S 24E	(–DA)	Barkly West at Nooitgedacht.	Reyneke, A. M. 291	20/5/1989	BLFU
28S 24E	(–DA)	8 km along Riverton road, turnoff from Kimberley road.	Venter, A. M. 362	27/8/1991	BLFU
28S 24E	(–DB)	Kimberley, Dronfield.	McDonald, 77/64	23/3/1977	PRE
28S 24E	(–DB)	7 km out of Kimberley enroute to Griekwastad.	Reyneke, A. M 274	10/5/1988	BLFU
28S 24E	(–DB)	25 km Kimberley enroute to Griekwastad.	Reyneke, A. M. 277	10/5/1989	BLFU
28S 24E	(–DB)	3,2 km along Nooitgedacht road, from Kimberley road.	Reyneke, A. M. 280	20/5/1989	BLFU
28S 24E	(–DB)	4,2 km on Nooitgedacht road, from Kimberley road.	Reyneke, A. M. 281	20/5/1989	BLFU
28S 24E	(–DB)	62 km along Nooitgedacht road, from Kimberley road.	Reyneke, A. M. 288	20/5/1989	BLFU
28S 24E	(–DB)	8 km along Nooitgedacht road, from Kimberley road.	Reyneke, A. M. 289	20/5/1989	BLFU
28S 24E	(–DB)	10 km from Kimberley to Warrenton.	Reyneke, A. M. 303	20/5/1989	BLFU
28S 24E	(–DB)	11 km from Kimberley to Warrenton.	Reyneke, A. M. 304	20/5/1989	BLFU
28S 24E	(–DB)	11 km from Kimberley to Warrenton.	Reyneke, A. M. 305	20/5/1989	BLFU
28S 24E	(–DB)	12,5 km from Kimberley to Warrenton.	Reyneke, A. M. 306	20/5/1989	BLFU
28S 24E	(–DB)	12,5 km from Kimberley to Warrenton.	Reyneke, A. M. 307	20/5/1989	BLFU
28S 24E	(–DB)	10 km E of Kimberley.	Schlieben, 8733	11/5/1961	K, PRE, BM
28S 24E	(–DB)	At Nooitgedacht turn-off from Kimberley road.	Venter, A. M. 388	31/8/1991	BLFU