The distribution of the genus Aloe in the districts Bethanien, Lüderitz and Warmbad, South West Africa

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ABSTRACT

The purpose of this study was to do a (preliminary) survey of the distribution of the species of the genus Aloe in the south of South West Africa. All available physical and biotic data were collected to compile the distribution map of the various species. The relative density of each of the different species was also determined. A complete background study was made to search for additional information which may help to explain the distribution patterns. It is clear that certain aloes are associated with the winter rainfall such as *Aloe pearsonii*, *A. pillansii*, *A. ramosissima* and *A. erinacea*. Others for instance *A. littoralis*, *A. hereroensis* and *A. claviflora* grow mainly in summer rainfall areas. *A. pachygaster* showed a marked preferance for soils of limestone or dolomite origin. However, the distribution pattern of certain species such as *A. variegata*, *A. karasbergensis* and *A. dichotoma*, was very difficult to explain.

CONTENTS

1 INTRODUCTION

The larger part of southern Africa can be classified as arid to semi-arid, with periodical droughts occurring over most of the region. Owing to this and the cost of water for irrigation the succulent and drought resistant plants have become more and more sought after as garden plants. During the last decade aloes have become so popular that they probably top the list. Apart from this they have also become a collectors item. Aloe fans are known to travel long distances to collect rare species. The southern parts of South West Africa, with its great variety of succulents and relatively high densities, has become a veritable 'collectors paradise'. With the paving of the roads this area was opened up and an ever increasing number of collectors were attracted. When furniture removal vans, filled with aloes, started leaving the territory the authorities became alarmed. During 1970 a study was launched to determine the distribution of the various species of the genus Aloe, especially in the southern parts of South West Africa. Although the thrust of this study was aimed at the genus Aloe, other succulents occurring in the study area also received attention. The results of this study were used to formulate departmental policy and legislation to protect this particularly interesting heritage in South West Africa.

The genus Aloe shows a wide distribution in South West Africa. It was decided, however, to concentrate on the magisterial districts of Bethanien, Lüderitz and Warmbad in the south-western corner of the territory. This area has, as already mentioned, a big variety and high density of aloes and other succulents The study area covered a surface area of 66 892 sq. km — excluding state land and home land areas — between Latitudes 20° 30′ S and 28° 57′ S and Longitudes 16° E and 20° E.

2 METHODOLOGY

The large extent of the study area raised all sorts of practical problems, the least not being to develop a relatively accurate and quick way of determining status and measuring other factors in the field, which could have some influence on the distribution and status of aloes. It was decided to consider each farm in the study area as a sampling unit. On each sampling unit small plots, 1/16 ha in extent, was set out at random in each locality where aloes occurred. In these plots all available physical and biotic data were collected and the relative density of each of the different aloe species determined. To facilitate this, a table was compiled and completed for each small plot.

Aspects covered in the table was a short topographical description of the immediate vicinity, the direction and degree of slope — the latter measured with an Abney level. Loxton's (1966) method was followed to describe the soil with emphasis on the parent material; colour, number, shape and size of stones. With the aid of the geological map of South West Africa (1964) notes on the geological formations were taken down.

The second important aspect considered, was the associated vegetation in the plot. The most prominent plants were annotated and using Acocks (1955) method, a five point scale reading from poor to very good, the relative density for the associated vegetation was classified. A slightly different method was applied to determine the relative density of aloes. If possible, all the aloes in the plot were counted. The average distance between the aloes was determined and classified according to a five point scale reading from very rare to very common. Very rare, represented a relative density of less than two per sample plot. All these details were later used on the distribution maps. The condition of the aloes was also quantified on a five point scale. The classification was based on phenomena such as: general condition of the aloes; the presence of parasites and/or signs of disease; whether the population was well-balanced for example, was there any evidence of seedlings, young plants etc., and whether the plants were damaged by animals or man.

In conclusion, a small uncontrolled contour map as well as a profile of the sample plot was drawn. Any interesting features were photographed. All the data mentioned as well as the rainfall were statistically tested using the wellknown X^2-test and the binomial test for the purpose of testing relationships between factors which were suspected of having an effect on distribution. These in fact did prove valuable in explaining some of the distribution patterns.

As mentioned earlier, a major problem was the large study area. The results should therefore be regarded as preliminary and not a totally accurate representation of the distributions. Furthermore, during the course of the survey the study area was in the grip of a severe drought and large parts of it were uninhabited.

3 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

3.1 Geomorphology

The study area can be divided into six geomorphological regions (mainly after Barnard, 1964). The Karasberg flats cover the whole of the Warmbad districts except for the Karasberg mountains and South Kalahari in the north, and the mountains of the Orange river trough in the south. Several dry tributories of the Orange river originate in the Karasberg mountains and meander across the plains. The most important rivers are the Gamkab, the Haib, the Hom and the Ham. The geological systems Nama, Karoo and the Granite-Gneiss complex form the basis of the flats. The landscape is dominated by soft sloping granite hills. *Aloe hereroensis* can be found on these hills. On the shale plains the circular and semi-circular patterns formed by *A. claviflora* can be observed.

The Karasberg mountains form a geomorphological region of its own and is an excellent example of fault topography. These mountains are built up by the erosion-resisting Kuibis quartzites and old granite gneiss rocks. A landscape of narrow gorges, irregular gneiss ridges and broad sand valleys is found in this region. Along the mountain slopes *A. dichotoma* is a common sight. *A. karasbergensis* also occur in these mountains.

Immediately west of the Karasberg mountains a small part of the Southern Kalahari region is found. A landscape of sand dunes, "streets" and dry pans typifies this region. No aloes were observed in the dune area, however quite a few *A. hereroensis* were found on the shale ridges which originate from the underlaying Karroo System.

The whole of the Bethanien district can be classified as the hilly region of the Swartrand. These hills are mostly flat-topped with extremely broken and rocky slopes. The region can be subdivided into the Swartrand escarpment (2 000 m) to the east and the lower mountains and ridges (1 000—1 500 m) of the locally known Rooirante, to the west. These two regions are drained by the Konkiep River southwards to join the Fish River. An aloe common to this area is *Aloe pachygaster* which is confined to the dolomite and limestones of the Nama System.

A. littoralis and *A. hereroensis* occur along the slopes of the Swartrand escarpment and the ridges of the Rooirante.

To the west of this region, stretching from north to south, lies the Western escarpment. For the greater part the escarpment is not clearly defined and near Aus and Witputs wide valleys intersect the mountains. The escarpment rises to a height of 1 500 to 1 800 m and is built up by the old granite gneiss rocks which are sometimes covered by the Nama System. *A. pachygaster* is readily found on the dolomite and limestones of the Schwarzrand series (Nama System). Furthermore *A. dichotoma*, *A. pillansii*, *A. ramosissima*, *A. pearsonii* and several other species also occur in these mountains. A few rivers originate in the mountains, continuing westwards to disappear in the Namib desert.

To the west of the escarpment the landscape is dominated by the sandflats and insel mountains of the southern Namib. On these mountains a few hardy *A. dichotoma* and *A. ramosissima* struggle to survive in the desert conditions.

3.2 Soils of the study area

Van der Merwe (1962) classified the soils of the study area into two main groups namely: the Sands of the Kalahari and the Soils of the Desert and Semi-desert areas. Basically, the geology and the soils are closely related because the low rainfall prohibits chemical weathering to a large extent.

3.3 Climate

The climate proved to be the most important factor in explaining the distribution patterns of genus Aloe. The cold Benquela current, the St. Helena anticyclone, the relatively high humidity (80%) caused by the cold sea, and the prevailing west and southwesterly winds, are the main factors responsible for the mist conditions along the western escarpment and in the Orange River trough. The small amount of winter rainfall is caused by the northerly movement of the cold fronts normally responsible for rains in the Western Cape. It must however be stressed that a certain amount of summer rainfall reach this area. This means that the area gets a small amount of rain throughout the year, as illustrated by the following table.

	Tsirub (13) *(Lüderitz district)*	Witputz-Süd *(Lüderitz district)*
January	6,9	5,5
February	4,3	10,3
March	19,0	13,4
April	7,3	10,9
May	3,8	7,6
June	10.8	9,5
July	9,5	7,1
August	8,4	6,1
September	3,0	3,5
October	1,4	2,0
November	1,4	5,5
December	2,5	5,3

These mountains contain a unique variety of aloes in this so-called winter rainfall area.

In the summer humid air enters the study area from the north and east and the rare showers are convection storms. The isohyets follow the contour lines, the rainfall decreasing as the landscape falls away in a westerly direction. The rainfall fluctuates between 50 mm and 200 mm per year. The high intensity of the storms, their irregularity, high evaporation and high drainage limit the efficiency of the summer rainfall to a large extent.

Rainfall however plays a very important part in the distribution of certain aloes and is one of the main factors used to clarify the distribution patterns of the different species.

4 BIOTIC BACKGROUND

4.1 Vegetation

The basic classification of the vegetation is based on the work of Giess (1971).

4.1.1 Dwarf shrub savanna

Approximately 80 per cent of the Warmbad and Bethanien districts are covered by this vegetation type. The trees, such as *Acacia karroo, Ziziphus mucronata, Euclea pseudebenus* and *Rhus lancea*, are mostly confined to the dry washes. The only trees adapted to the extremes outside the rivers are *Boscia foetida, Pappea capensis, Ozoroa namaensis, Parkinsonia africana* and a rare *Acacia erioloba*. The tree layer varies from two to six meters. The shrub layer could be divided into large shrubs up to 1,5 to 2 meters, such as *Cataphractes alexanderi, Phaeoptilum spinosum, Rhigozum trichotomum, Acacia nebrownii*. A second layer varies from 20 cm to approximately 1 meter. The following species are dominant:

Petalidium linifolium, Aizoon schellenbergii, Barleria lancifolia, Salsola tuberculata, Zygophyllum ssp., Eriocepholus ssp., Pteronia luciliodes

The grasses common to this area are perennials such as:

Stipagrostis ciliata, S. obtusa, S. uniplumis, Antephora pubescens

and annuals such as:

Schmidtia kalahariensis, Enneapogon brachystachyus, Eragrostis nindensis.

In conclusion great grass plains broken by dry washes with shrubs and a lonely tree typify this vegetation type.

4.1.2 Desert and succulent steppe

This vegetation type occurs in the southern half of Lüderitz district and follows the Orange River westwards, from approximately the middle of the Karasburg district. The vegetation is closely related to the influence of the winter rainfall. The effectivity of the precipitation is responsible for an exceptionally rich species-composition. The landscape is dominated by a dense succulent shrub layer which varies from 30 cm to 1 m +. In dry years grasses are rare. Trees are confined to the drainage systems except tree-aloes such as *Aloe pillansii* and *A. dichotoma.*

Trees such as:

Acacia erioloba, Boscia foetida, Euclea pseudebenus, Ozoroa namaensis, Schotia afra

are confined to the dry rivers.

Aloe ramosissima dominates the higher shrub layer and can grow up to a height of 4 metres. Other shrubs that should be mentioned are:

Ceraria fruticulosa, Ceraria namaquensis, Zygophyllum namaquensis, Hermannia grandiflora and *Euphorbia* ssp.

The succulent layer consists mainly of the following families:

Mesembryanthemaceae, Zygophyllaceae, Portulacaceae, Crassulaceae, Euphorbiaceae and Asclepiadaceae.

To the north perennial grasses such as *Stipagrostis ciliata* and *Stipagrostis obtusa* occur.

The strange and interesting cactus-like *Pachypodium namaquanum* also known as elephant's trunk, could be used as an indicator or character species for this vegetation type. The greatest variation of aloe species was found in this region.

4.1.3 Mixed tree and shrub savanna

This vegetation type is also known as the Southern Kalahari savanna. It occurs only in the north-western corner of the Karasburg district. *Aloe hereroensis* was the only aloe observed in this region.

The trees occur mainly on the slopes of the dunes and *Acacia haematoxylon* is very typical for this vegetation type.

The shrub layer is quite often well developed and varies in heigh from 0,6 m to 3 m on the average. The most common species are:

Grewia flava, G. deserticola, Acacia mellifera ssp. *detinens, Rhigozum trichotomum, Phaeoptilum spinosum* and *Acacia hebaclada.*

They occur mostly in the washes and dune streets. The grasses are mainly:

Stipagrostis ciliata, S. uniplumis, S. ambilis, Eragrostis lehmanniana and the annual *Schmidtia kalahariensis* is a common pioneer in over-grazed area.

4.1.4 The semi-desert and savanna transition (Escarpment Zone)

The vegetation in the mountainous areas of the escarpment in the north of Lüderitz and Bethanien districts is representative of the above-mentioned vegetation type.

The trees are mostly confined to the well-watered narrow kloofs. The most common species being:

Ficus ssp. mainly *Ficus cordata, Acacia karroo, Ziziphus mucronata* and *Rhus lancea.*

In the mountains *Aloe dichotoma* is very often quite prominent. An interesting feature is the adaptations of *Boscia foetida* which varies its growth form from a tree to a low-growing or even a creeping type of shrub.

The shrub layer is well-developed and is on the average seldom more than 2 meters in height. Species such as:

Eberlanzia spinosa, Cadaba aphylla, Zygophyllum ssp., *Rhigozum trichotomum, R. obovatum* and *Phaeoptilum spinosum.*

The grass layer consists of the following species: *Digitaria dinteri, Anthephora pubescens, Stipagrostis ciliata* and *S. obtusa.*

4.1.5 Riverine woodlands

The alluvial soils and greater water supply in the riverbeds are responsible for this vegetation type. The tree layer do not exceed 10 meters. The most common species are:

Euclea pseudebenus, Acacia karroo, Acacia erioloba, Ziziphus mucronata and *Rhus lancea.*

The shrub layer is usually also well developed and is on the average approximately 2 to 3 meters high. Most common species are:

Tamarix usneoides, Rhus viminalis, Grewia flava, Phaeoptilum spinosum and *Rhigozum trichotomum*, etc.

Sometimes *Juncus* sp. and *Phragmites* sp. grow in the riverbeds especially near fountains. The Orange River is the only perennial river in the south of South West Africa.

4.2 The infuence of man and his activities

People influence the local distribution of aloes in the way of farming and collecting. Sheep had evidently grazed *Aloe karasbergensis* and *A. claviflora.* However grazing does not seem to be as great an influence as trampling. To a certain extent proof of this was found on the farm Oas (29), in the Warmbad district where a camp was not utilized for a certain period. *A. hereroensis* was found to occur in and around the camp, but a very marked difference was the amount of young plants and seedlings in the camp.

People collecting aloes is another factor endangering this genus. Even though the South West Africa Administration has enforced laws to protect these plants, it is still a known fact that great numbers of them are removed from their natural habitat.

4.3 The influence of parasites

The well-known *Loranthus* sp. found on *Aloe ramosissima*, is so far the only plant parasite observed. Although it may influence the growth of the plant, it is rather improbable that it will influence the distribution pattern of the species to any noticeable extent. Aloes are however rather susceptible to different species of the parasite, Coccidae. On the farm Schwarzeck (130) in the Warmbad district, it was found that the pest-scale influenced the status of the aloes, by killing large numbers of the plants. This scale is especially effective in times of drought. Two species were identified as *Separaspis capensis* Walker and *Duplachinaspis brevipora.*

Other pests are *Eriophys aloinis* an aloe cancer and the well-known "vrot" caused by an insect which is a member of the genus Brachycerus. The last two mentioned pests are rather seldom encountered, so it is not likely that they are responsible for any great loss of plants.

4.4 The influence of wild animals

The following plant-eating animals are known to live in the study area. Springbok *Antidorcas marsupialis*, steenbok *Raphicerus campestris*, gemsbok *Oryx*

gazella, klipspringer *Oreotragus oreotragus*, mountain zebra *Equus zebra hartmannae*, kudu *Tragelaphus strepsiceros*, baboon *Papeo ursinus*, and dassies *Procavia capensis*. Of all these animals, it was observed that the last three definitely feed on the aloes. Baboons are perhaps the only ones that cause great damage to the plants, because it was found that they often destroy the whole plant. There were several occasions where the author observed that *A. hereroensis*, *A. gariepensis* and *A. dichotoma* were severly damaged. Kudus and dassies definitely eat aloes as observed respectively by Van der Schijf (1959) and Swart (1970), but unfortunately the actual amount of damage could not be determined.

5 THE DISTRIBUTION PATTERN OF THE DIFFERENT SPECIES

The distribution of certain aloes is definitely associated with climatic conditions and for the purpose of this study they are grouped together.

5.1 Aloes associated with winter rainfall

These aloes occur in the Desert and Succulent steppe vegetation type (Giess 1971). Their distribution is accordingly related. Although all the other environmental factors were tested the winter rainfall and mist conditions proved to be the only satisfactory explanation for their distribution. The fact that in some cases, for example *Aloe pearsonii*, the plants are mainly confined to the south and south-western aspects, emphasize the important role of the prevailing rains from the west.

5.1.1 *Aloe pearsonii* Schonl

In South West Africa *Aloe pearsonii* (plate 1) is limited to three farms in the south of the Lüderitz district (map 1) and it is also known to occur in some of the mountains in Diamond Area No. 1 and state land. It is however a quite common aloe in the neighbouring Richtersveld across the Orange River to the south. Locally the plants cover whole mountain slopes and there is a definite preference for rather steep south-western slopes ($\pm$ 15—20°). Although the aloe is very limited in its distribution the fact that it occurs in such large numbers sometimes many thousands, is to some extent, reassuring.

5.1.2 *Aloe pillansii* L. Guth

This tall aloe (plate 2) quite often over 10 m high, is one of the rarest aloes in South West Africa. This species is confined to three farms (map 2) and is known to occur in the stateland to the south and west of these farms. The aloes occur from the Orange River northwards for approximately 50 km. Similarly to *A. pearsonii*, they prefer the mountains and are protected from man in that they mostly occur in relatively inaccessable localities in the mountains of the western escarpment. They sometimes do occur on the sandy plains between the mountains.

5.1.3 *Aloe ramosissima* Pillans

The most northern locality of the species is approximately 100 km north of the Orange River, on the farm Pockenbank no. 68 in the Lüderitz district (map 3). The plants grow as shrubs (plate 3) and although their distribution is related to climate there is however no preference for mountains or plains. Very often large numbers were observed near or at the foot of a slope. The occurrence of a plant parasite on this species was a very interesting feature, as already mentioned.

5.1.4 *Aloe microstigma* Salm Dyck

This aloe (plate 4) occurs only in the southern and central parts of the Lüderitz district. Its distribution extends northwards from the farm Witputz-Süd (31) northwards to the farm Kubub (18) and Plateau (38) in the north (map 4). The local distribution is interesting as it grows on rocky outcrops as well as on the level plains in clusters or as individuals. Another interesting feature is that the species is quite common in the Western Cape, there being a very wide gap in its distribution in the Republic and in South West Africa.

5.1.5 *Aloe erinacea* Hardy

One of the rarest aloes (plate 5) in the world, it is endangered by the fact that it is not only very limited in its numbers, but also in its distribution (map 5). The plants occur mainly on the warmer north-western and north-eastern aspects. This is to some extent a paradox, considering the fact that it is the western side of the mountains which is under the influence of the mist and winter rainfall conditions. The only apparent explanation for this deviation must be in the intrinsic properties of the plant. Efforts to transplant the species into the summer rainfall area met with limited success which strengthens the fact that it is a winter rainfall aloe of the first order.

5.1.6 *Aloe gariepensis* Pillans

This aloe (plate 6) occurs in and along the southern sides of all three districts in the study area (map 6). In Warmbad district it forms a girdle which runs more or less parallel with the Orange River, with the most northern point not further than 50 km from the river. After testing the information statistically one can conclude that these aloes normally do not occur in areas with more than 100 mm of rain per annum. When correlated with the associated vegetation a significant relation was found with the succulent vegetation related to the winter rainfall. Although perhaps not so outstanding there is definite indications that the aloe could rather be classified as a winter rainfall aloe than a summer rainfall aloe. In most cases it prefers a slope of more than 10 degrees and considering the already low rainfall there is an apparent preference to well drained soils.

On the farm Schwarzeck (130) Warmbad district the author observed how the detrimental influence of scale in combination with drought conditions were responsible for the dying out of nearly 200 plants of this species. On several occasions baboons were not only responsible for eating the inflorescence, but also for the destruction of whole plants by removing the apices and eating only the juicy parts. Parasites and animals may thus play a role in the local status of the species.

5.2 Aloes associated with summer rainfall

5.2.1 *Aloe littoralis* Bak (A. rubrolutea Schinz)

This aloe (plate 7) is very common in the central and northern parts of South West Africa. In the study area however it occurs widely in the Bethanien district with two isolated occurrences, one each in the Warmbad and Lüderitz districts (map 7). Some interesting features about this aloe is that it is a wellknown host to scale. Sometimes the parasites cover the leaves to such an extent that they appear to be white. The flowering time of the species in the south differs completely from the same species in the central and northern parts of the country. In the north the plant flowers from March to May and in the south during November.

5.2.2 *Aloe hereroensis* Engler

These aloes (plate 8) occur on nearly every farm in the northern parts of the Bethanien, Lüderitz, as well as in the northern and eastern parts of the Warmbad districts. The most southern locality was on the farm Graswater (150) which is approximately 60 km south-east of Warmbad (map 8). The adaptability of the aloe is excellent because it will grow on nearly any terrain from sandy plains to rocky outcrops. However it has a preference for the higher rainfall area, especially between 100 and 150 mm per annum in the study area. An interesting observation was made on the farm Oas 29, Warmbad district, where the owner of the farm did not utilize a certain camp for several years. The total number of *Aloe hereroensis* counted in a 1/16 ha unit was 47, mostly young plants and numerous seedlings. Sheep farming obviously limited the growth of young plants. Furthermore, it was observed that baboons destroyed the plants so that it could be stated that man and animals constitute a limiting factor to the natural distribution of the species.

5.2.3 *Aloe claviflora* Burchell

In the study area *A. claviflora* (plate 9) was found only in the Warmbad district (map 9). It is however a very common species in the northern and Central Cape Province and western Orange Free State.

A. claviflora occurs in nearly the whole of the district, but its numbers are very limited in the Karas Mountains and in the Orange River trough. Except for two observations, they were not found to occur below the 50 mm isohyet and they did not occur north of the 150 mm isohyet. Rainfall would thus be a limiting factor. The plants occur mostly on level ground, having no aspect preference; the soils are sandy, quite often of shale origin and rather alkaline. Only one record could be obtained of this plant being utilized by sheep.

5.3 Aloes associated with soils

5.3.1 *Aloe pachygaster* Dinter

This aloe (plate 10) is limited to Lüderitz and Bethanien districts. It is commonly found in the whole southern half of Lüderitz district, stretching northwards from the Orange River to Aus vicinity. In Bethanien district the most northern locality is in the vicinity of Helmeringhausen (12). To the south numerous small colonies could be found, where Vergelee (169) and Moedhou (182) are the most southern localities (map 10). An interesting fact is that the Fish River forms apparently a natural eastern boundary for the species.

Of all the ecological factors measured the most outstanding feature was the association of this aloe with dolomite and limestone soils. The interesting phenomenon is that soils derived from limestone or dolomite are clayey and are wellknown for their bad drainage ability and this is of cause in conflict with the acceptance that aloes prefer well-drained soil. Nevertheless there is no doubt whatsoever that *Aloe pachygaster* is associated with dolomite and limestone soils.

Similar to *A. claviflora* there is a preference for rather level ground with no affinity for any aspect. This could perhaps be explained that if the slopes were too steep all the water would have run away before getting the opportunity to wet the clayey soil. Furthermore in contrast to other aloes it is apparently adapted to badly drained soils and will not rot or drown under its natural low rainfall conditions.

5.4 Aloes associated with both winter and summer rainfall and no preference for any ecological feature

5.4.1 *Aloe variegata* L.

Aloe variegata (plate 11) known as kanniedood, typifies this small aloe's ability to adapt itself to nearly any environment. The aloe is difficult to observe because it seldom grows higher than 20 cm and tends to grown in or under bushes and rock-crevices. Bearing this in mind the author would not like to bind himself to the given distribution map (map 11) because there may still be numerous localities which were overlooked. In conclusion it can be stated that it does occur in both summer and winter rainfall areas and no definite association with any of the measured environmental factors could be proved.

5.4.2 *Aloe karasbergensis* Pillans

This species (plate 11) is represented in all three districts forming the study area (map 12). Basically one can localize their occurrence into three main zones namely: The western escarpment, the northern part of the Karas mountains and a narrow strip between the Fish River and Grunau. *A. karasbergensis*

displays two growth forms and the author classified them into a "mountain type" and a "sandveld type". The latter tends to form clusters while the mountainous type mostly occurs individually. Similar to *A. claviflora*, *A. karasbergensis* was also observed to be eaten by sheep apparently to restore some or other mineral shortage probably potassium. Although all the possible environmental factors were tested no definite reason could be found for the specie's strange distribution pattern.

5.4.3 *Aloe dichotoma* Masson

Aloe dichotoma (plate 13) occurs in nearly the whole study area except in the north-eastern corner of Bethanien, the western section of the district Lüderitz and the north-eastern corner of the district Warmbad (map 13). It is apparent that *A. dichotoma* is well adapted to its environment with no particular preference for parent soil, aspect, etc. An interesting feature observed however, is the tendency to change its growth form, in more arid regions. It will for instance grow to three or four meters before branching. The author even observed plants growing up to 8 m with no branching at all. Furthermore it is associated with both summer and winter rainfall vegetation. There is also a slight preference for rather steep slopes considering the dense populations which often occur against mountains. In conclusion it was observed that baboons are very fond of the inflorescence of the plants. By feeding on it the flowers are destroyed and eventually very few seeds are left to promote the reproduction of the plants.

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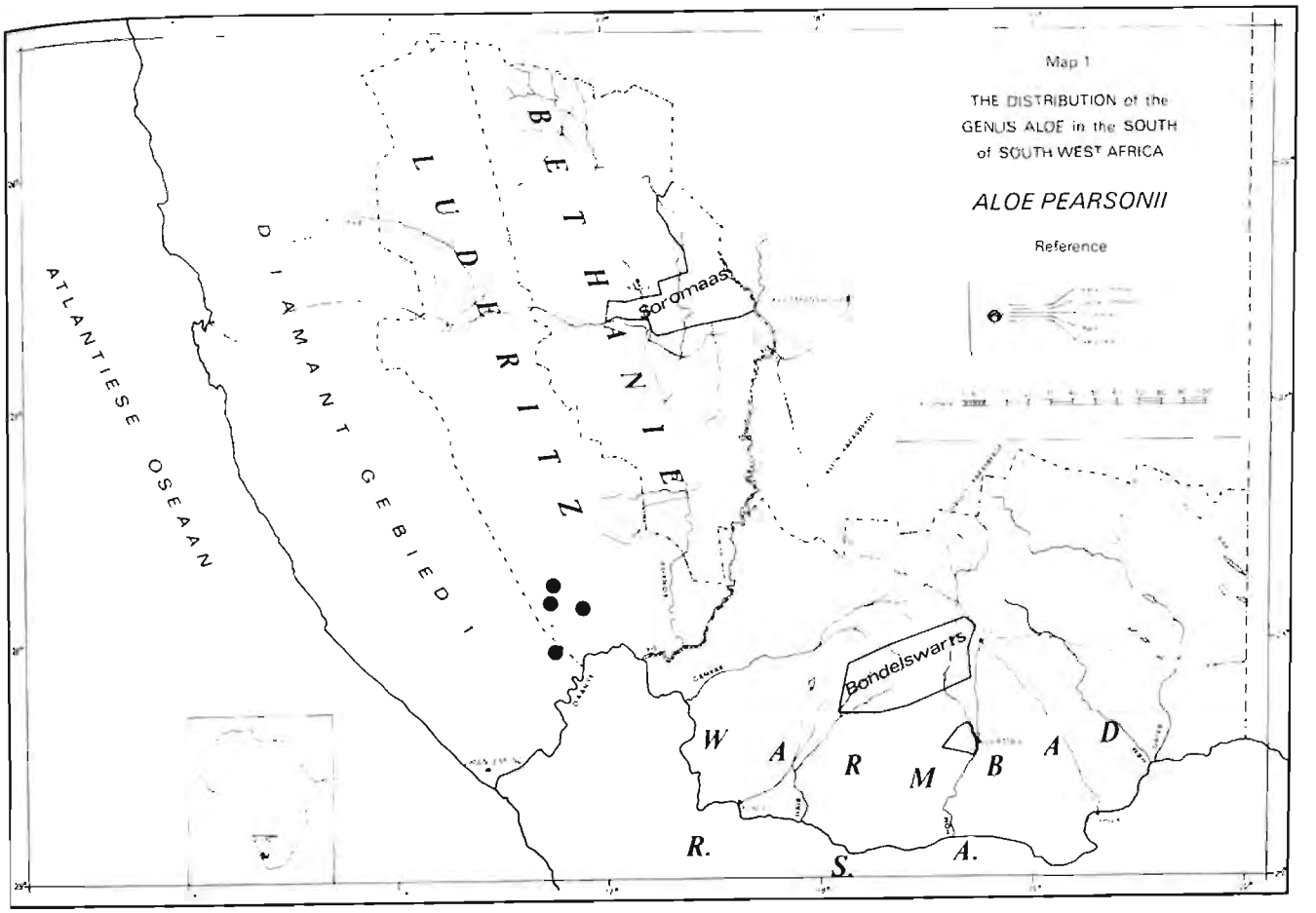
Plate 1. *Aloe pearsonii* Schonl

Plate 2. *Aloe Pillansii* L. Guth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of SOUTH WEST AFRICA
ALOE PEARSONII
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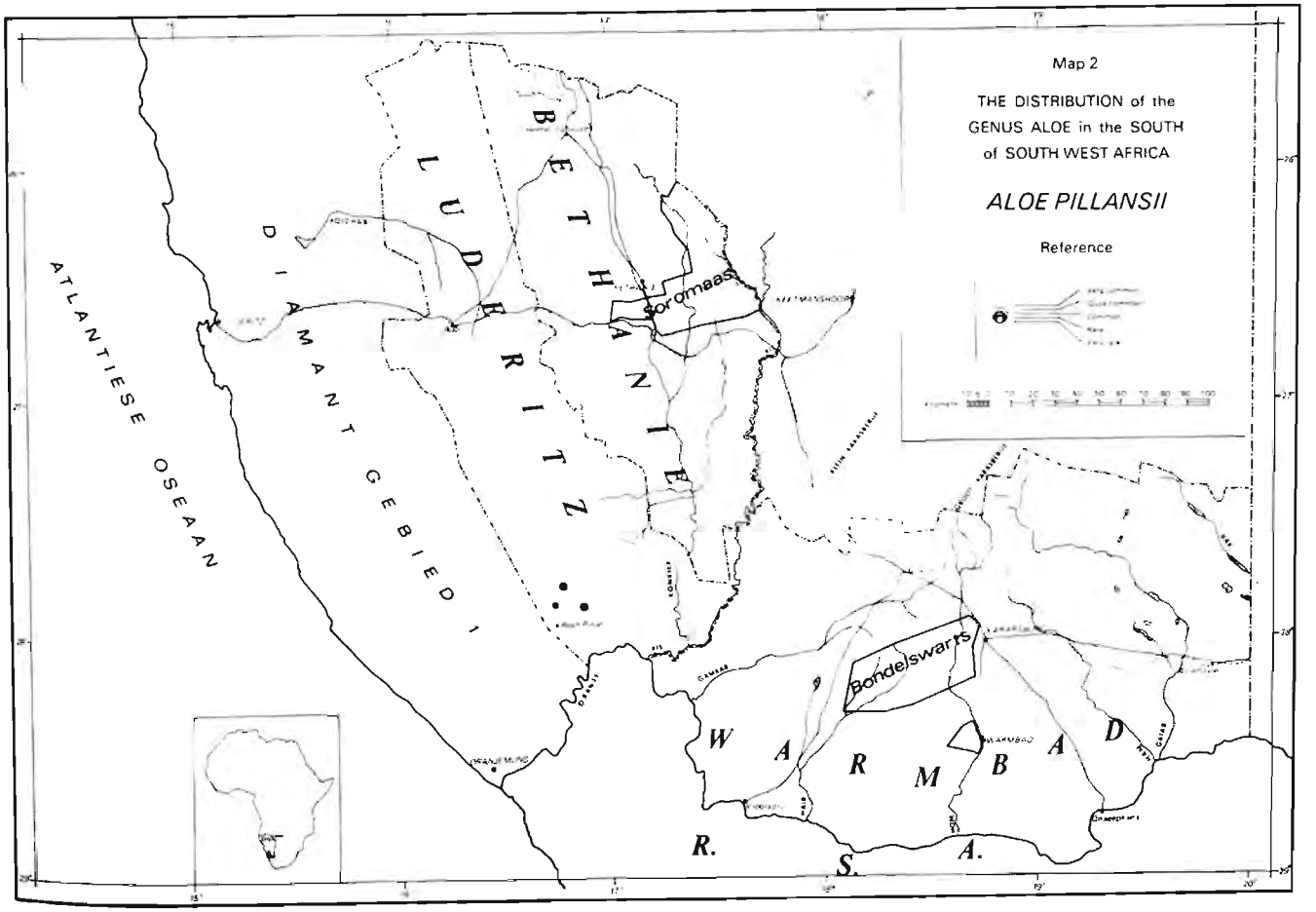
DIAMANT GEBIED
LUDERITZ
BETHANIE
Soromaas
Bondelswarts
WARMBAD
R. S. A.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of SOUTH WEST AFRICA
ALOE PILLANSII
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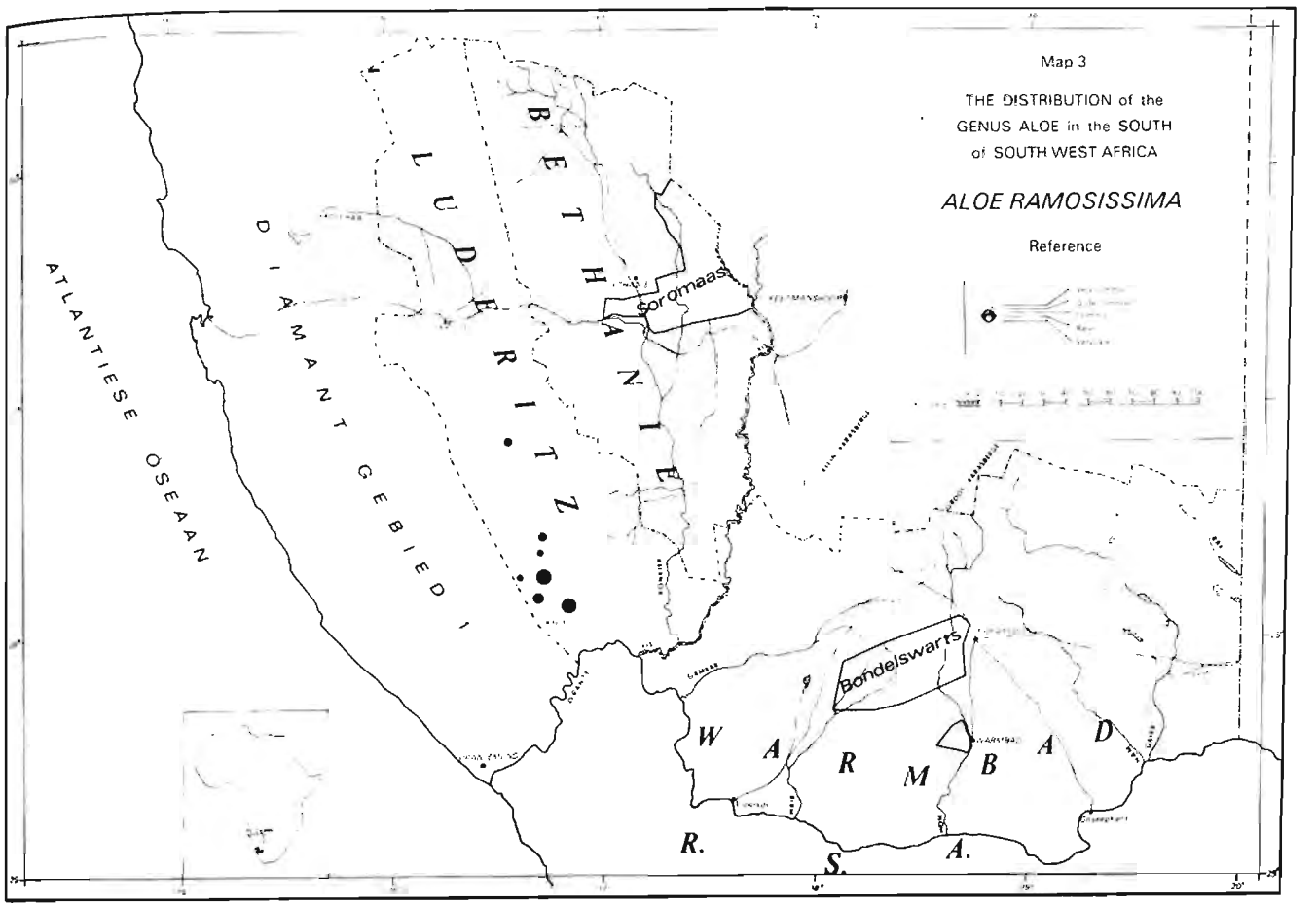
DIAMANT GEBIED
LUDERITZ
BETHANIE
Soromaas
Bondelswarts
WARMBAD
R. S. A.

Plate 3. *Aloe ramosissima* Pillans

Plate 4. *Aloe microstigma* Salm Dyck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Bondelswarts
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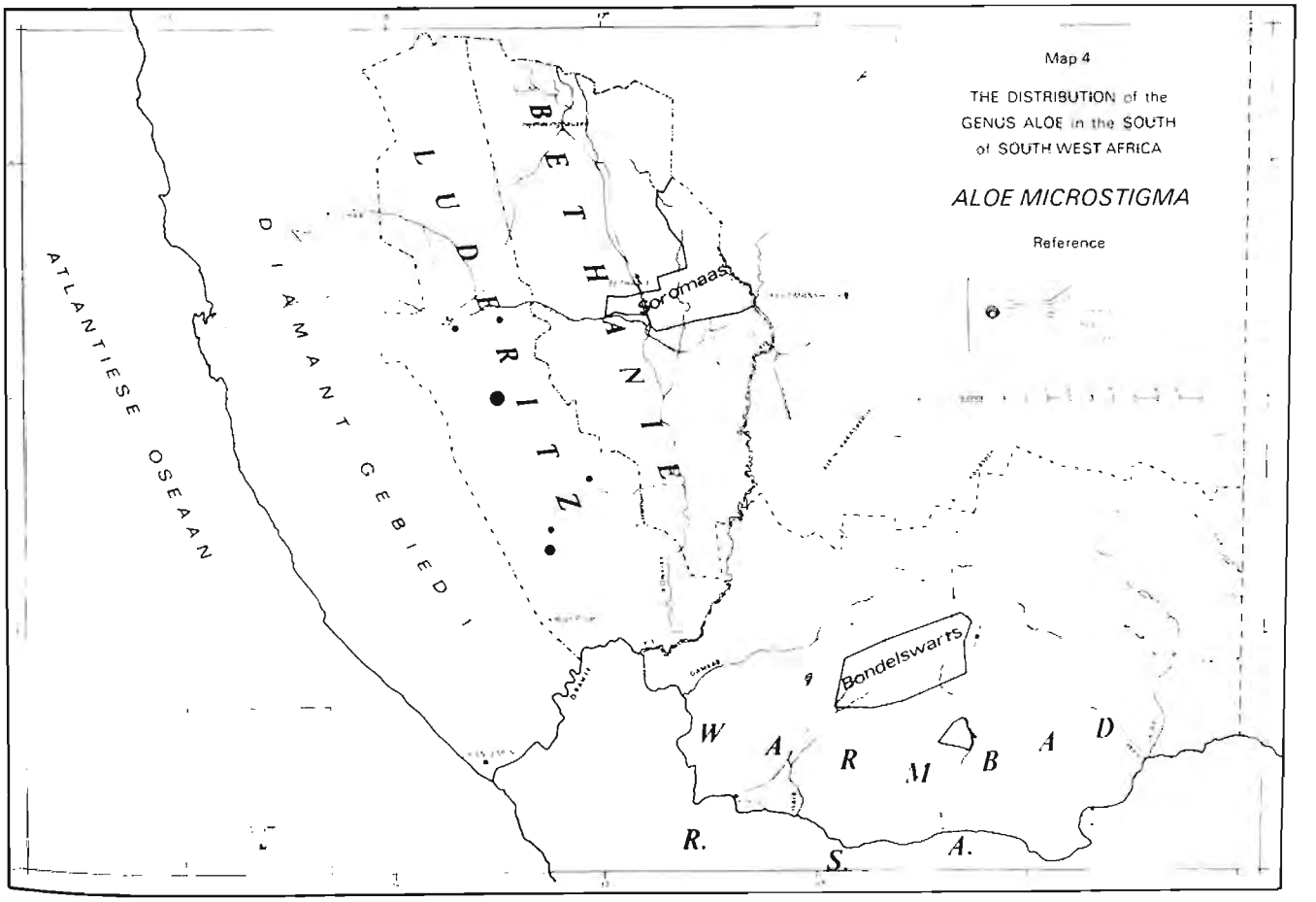
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Sorgmaas
Bondelswarts
WARMBAD
R. S. A.

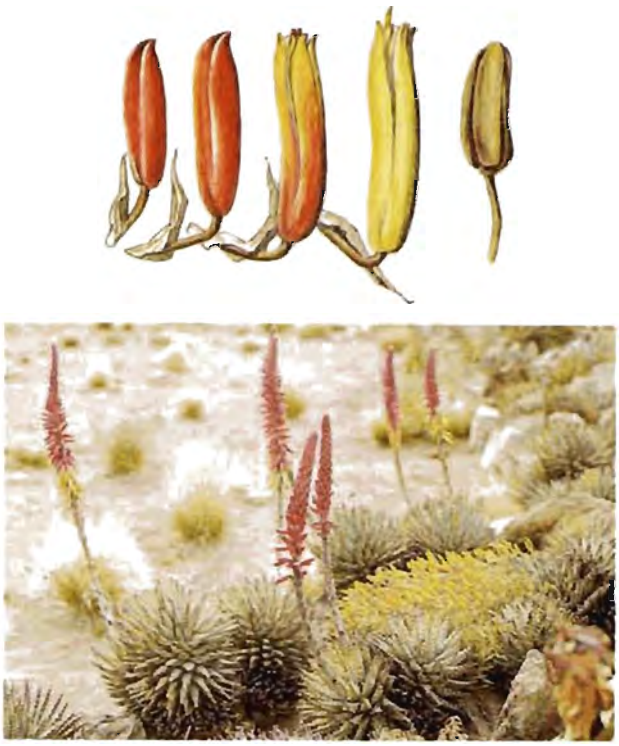


Plate 5. *Aloe erinacea* Hardy

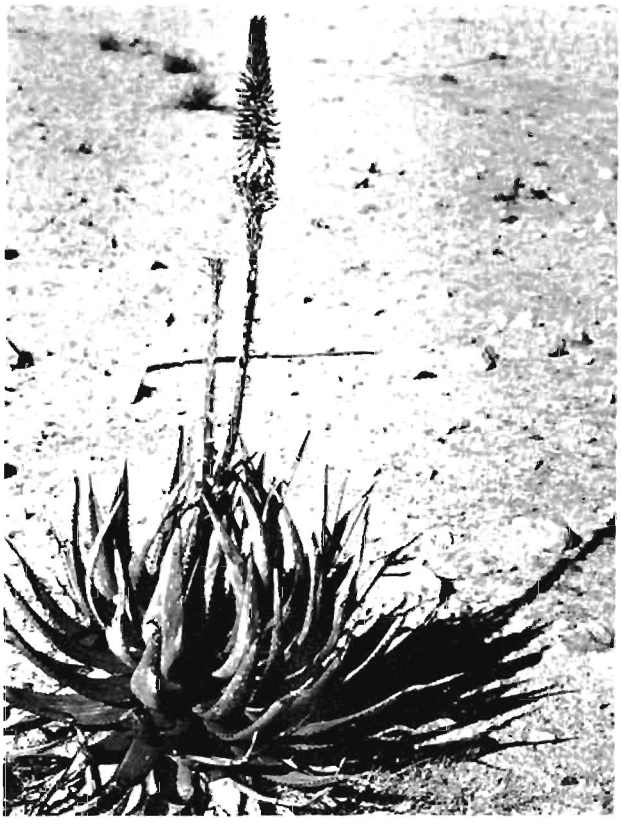
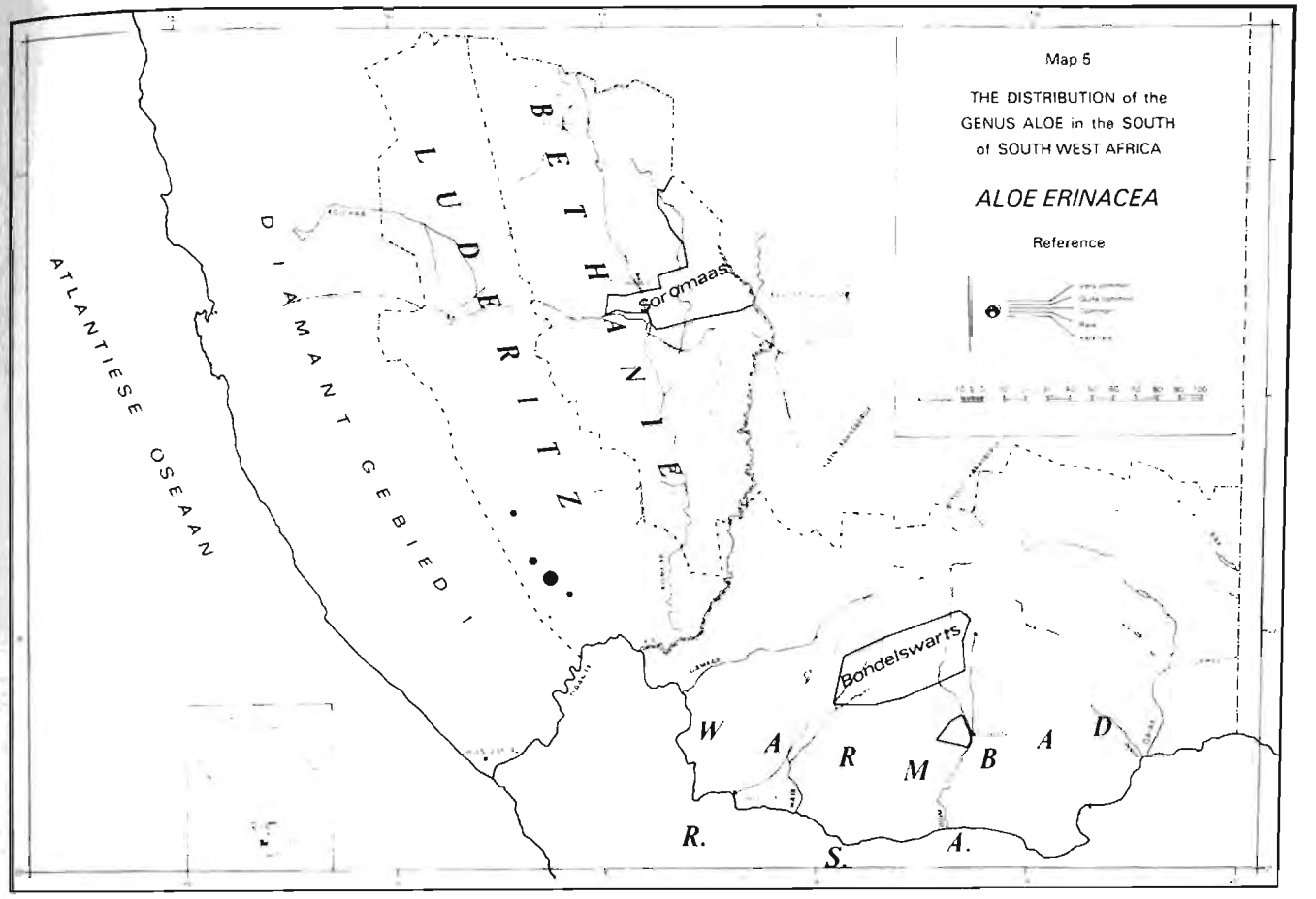


Plate 6. *Aloe gariepensis* Pillans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ALOE ERINACEA
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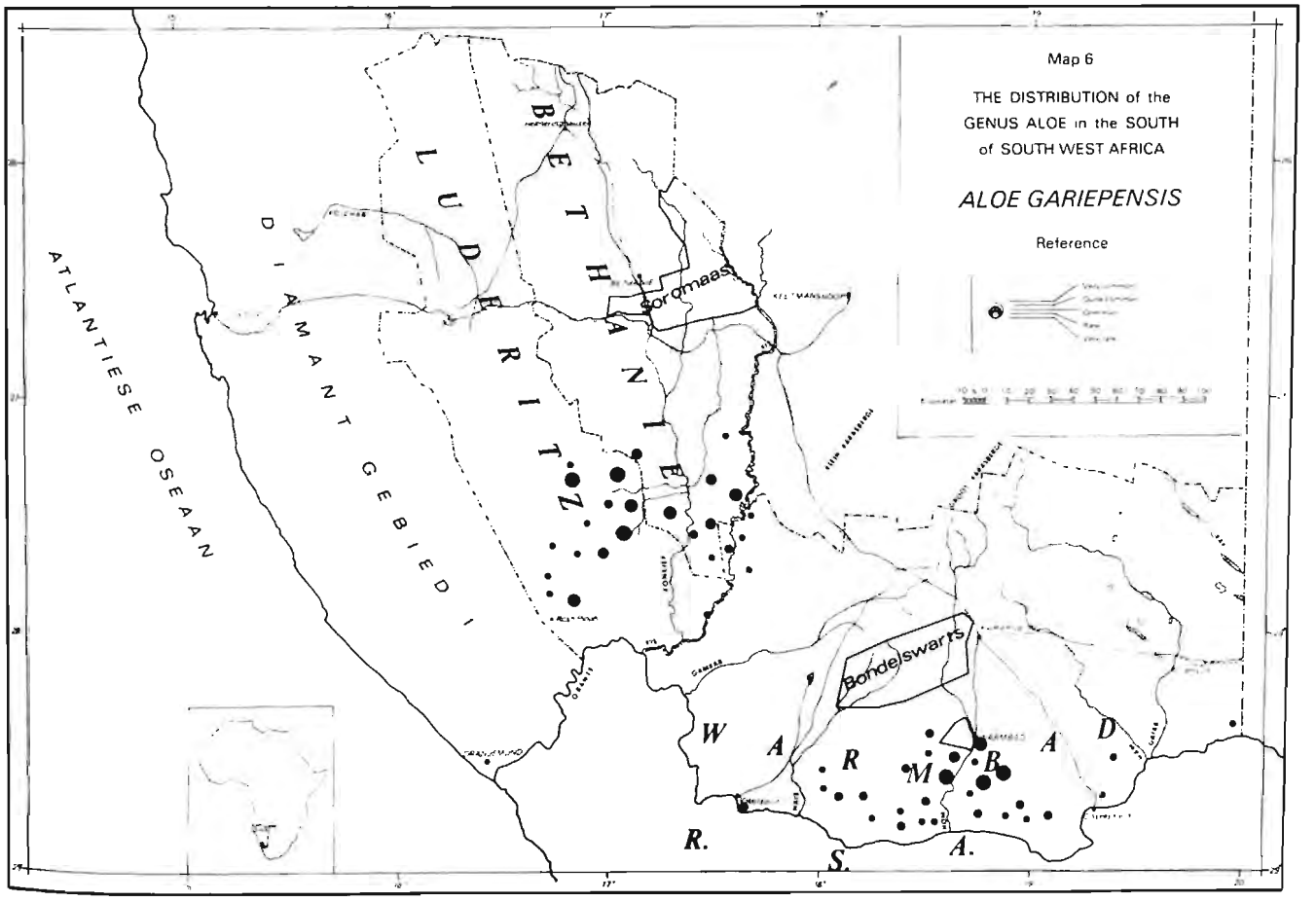
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of SOUTH WEST AFRICA
ALOE GARIEPENSIS
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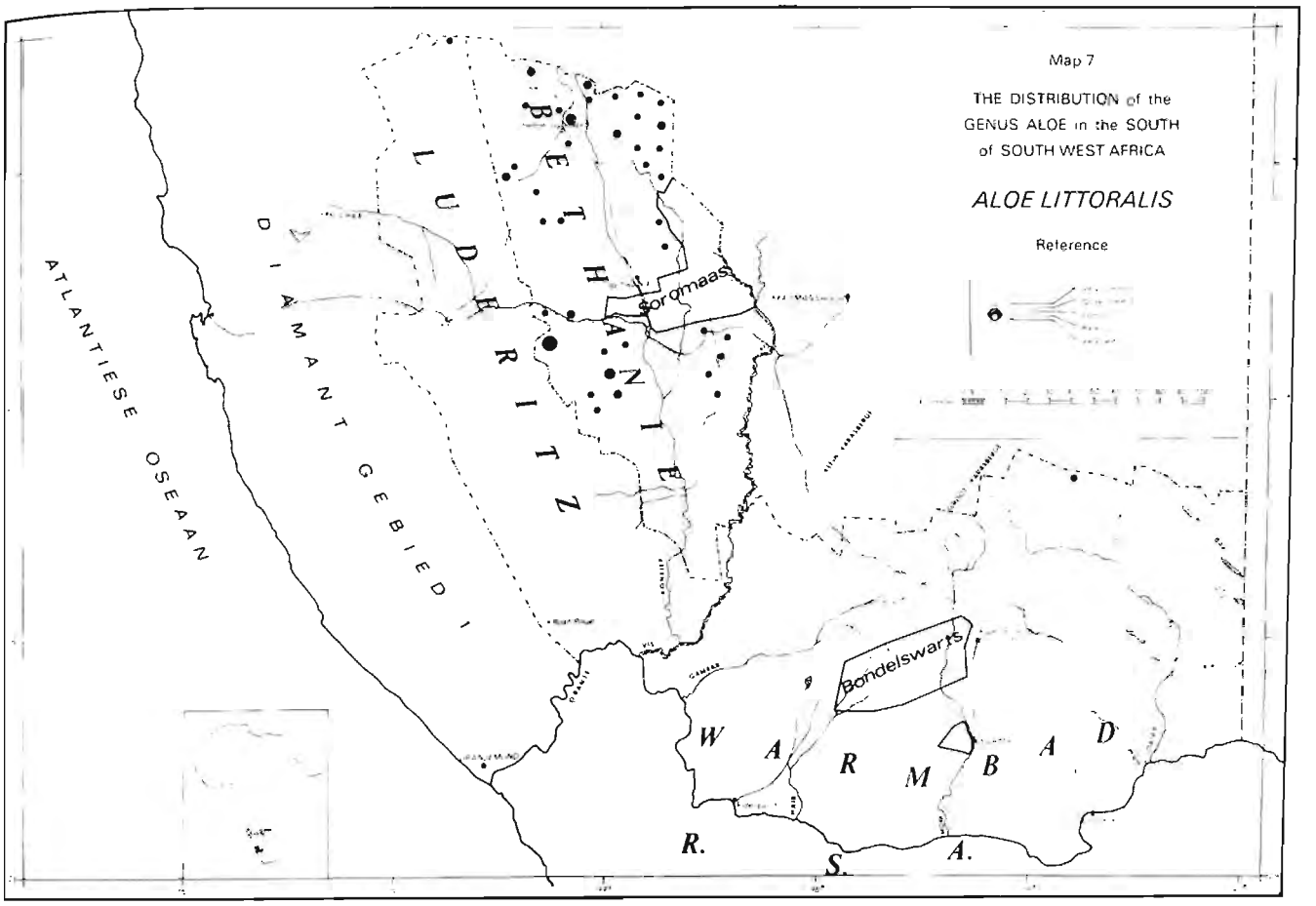
DIAMANT GEBIED
LUDERITZ
BETHANIE
Sorgmaas
Bondelswarts
WARMBAD
R. S. A.

Plate 7. *Aloe littoralis* Bak (A. rubrolutea Schinz)

Plate 8. *Aloe hereroensis* Engler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of SOUTH WEST AFRICA
ALOE LITTORALIS
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Bondelswarts
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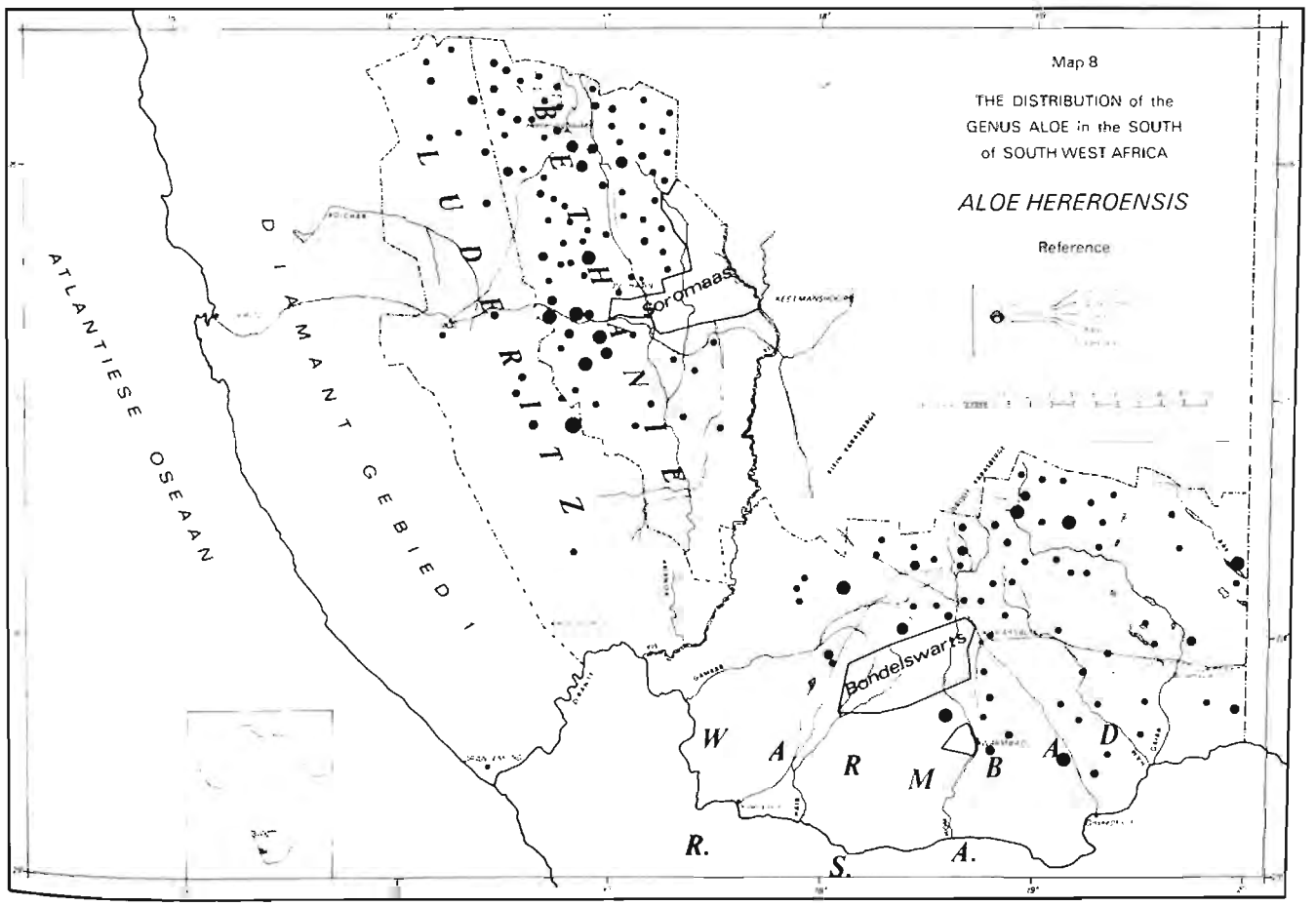
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of SOUTH WEST AFRICA
ALOE HEREROENSIS
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DIAMANT GEBIED I
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BETHANIE
Soromaas
Bondelswarts
WARMBAD
R. S. A.

Plate 9. *Aloe claviflora* Burchell

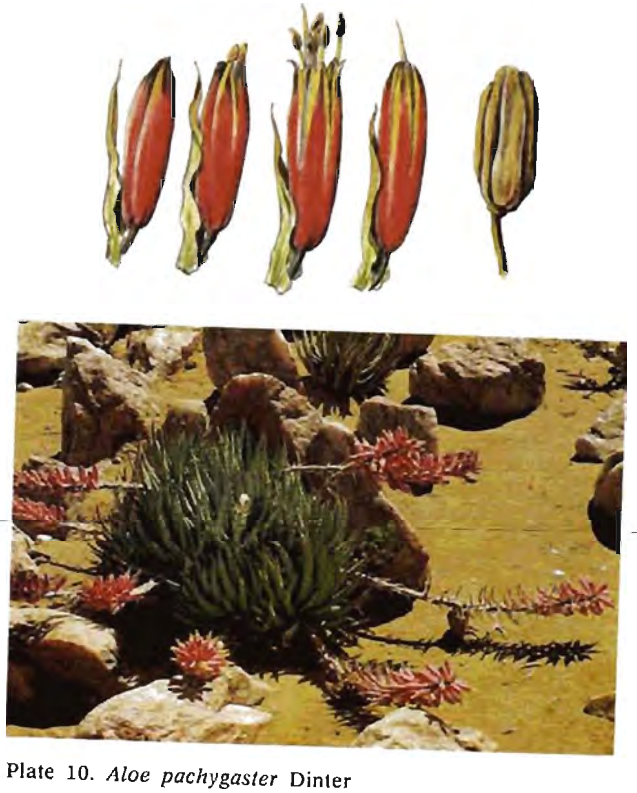
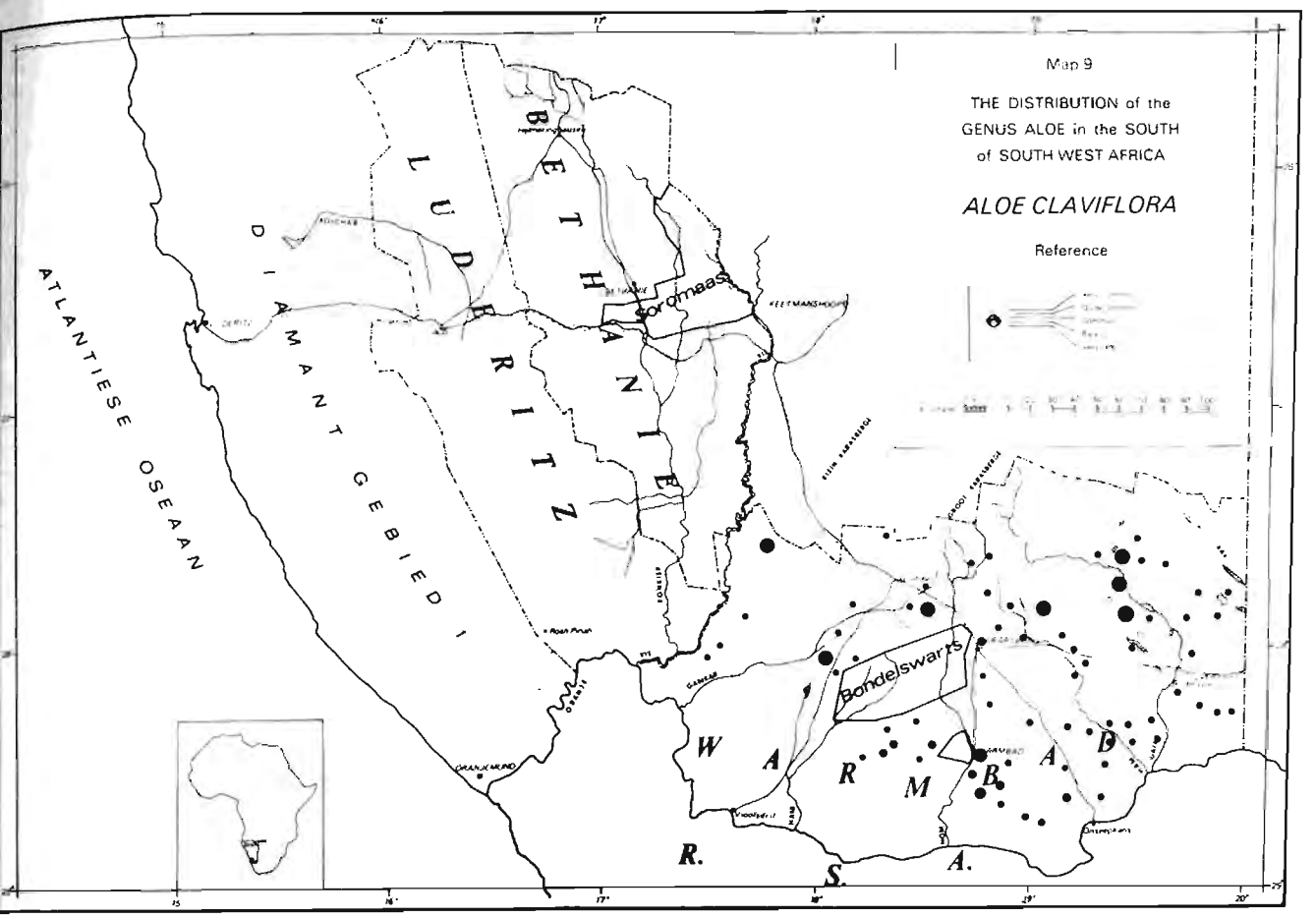


Plate 10. *Aloe pachygaster* Dinter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of SOUTH WEST AFRICA
ALOE CLAVIFLORA
Reference
ATLANTIESE OSEAAN
L U D E R I T Z
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Sordmaas
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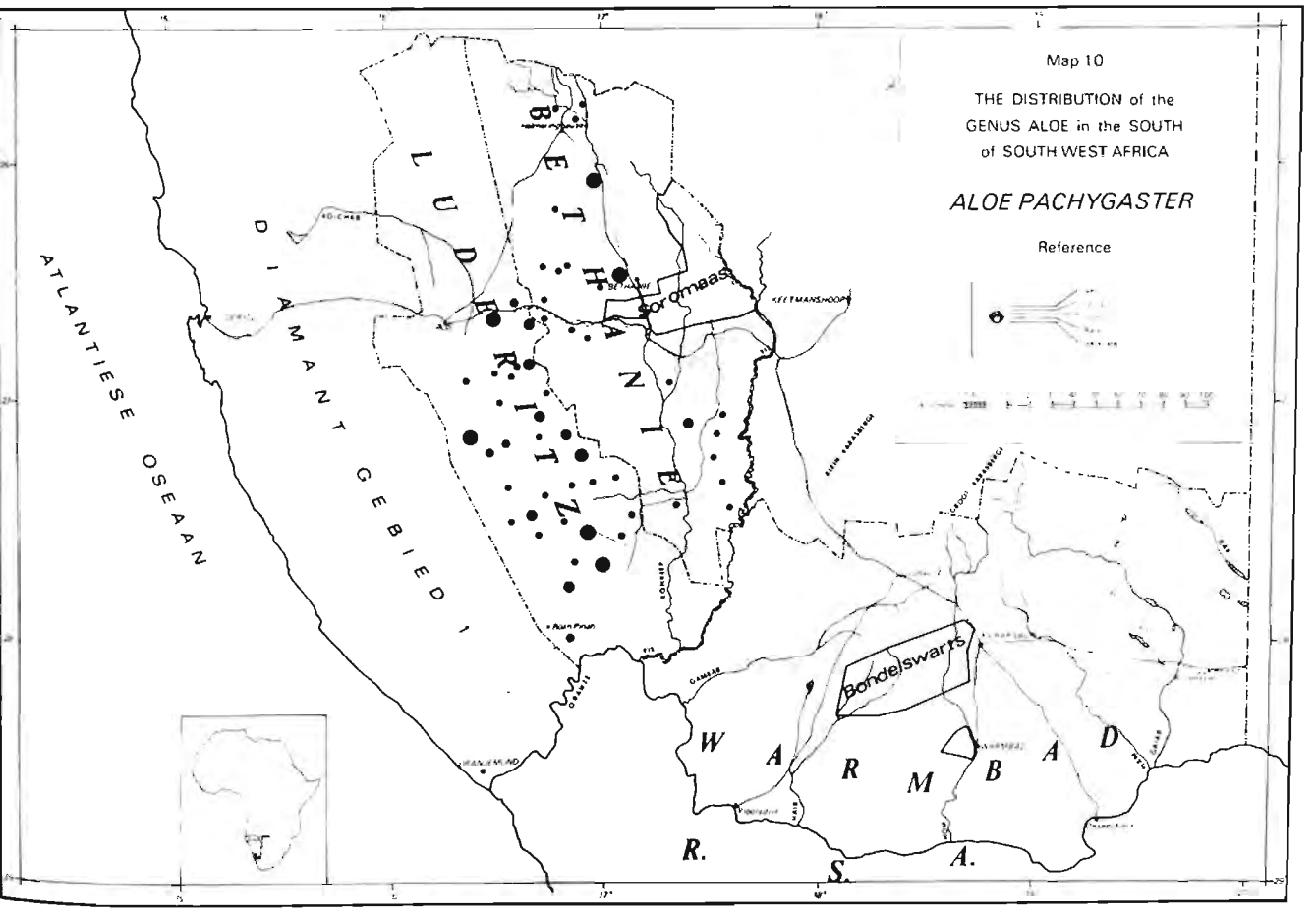
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Reference
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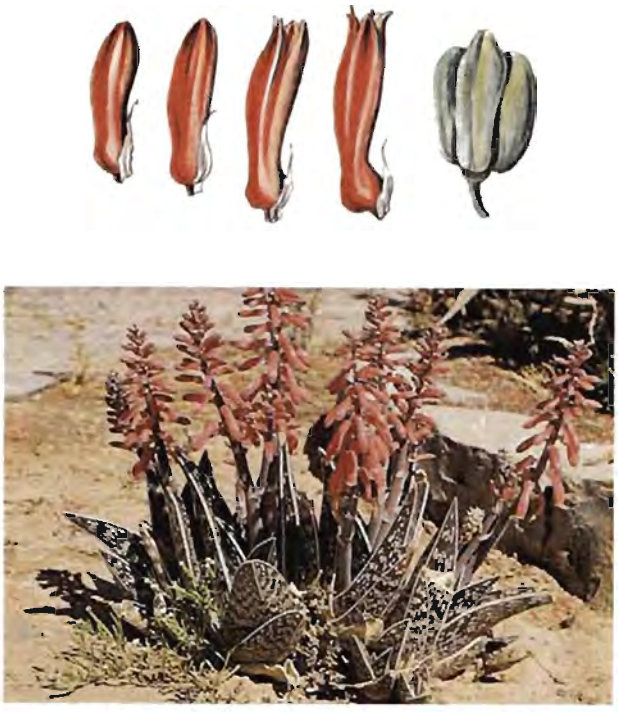
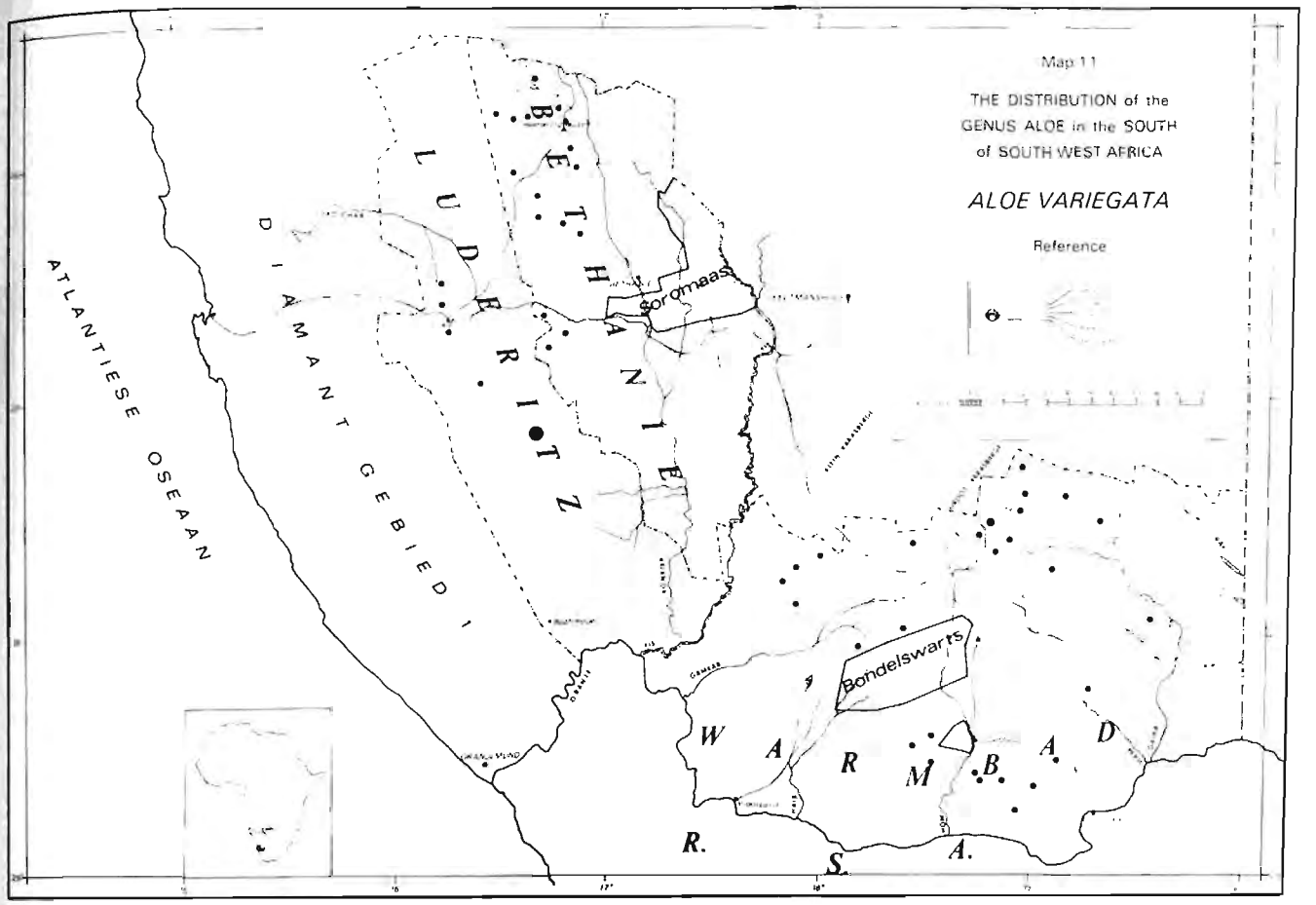


Plate 11. *Aloe variegata* L.

Plate 12. *Aloe karasbergensis* Pillans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of SOUTH WEST AFRICA
ALOE VARIEGATA
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LUDERITZ
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WARMBAD
R.
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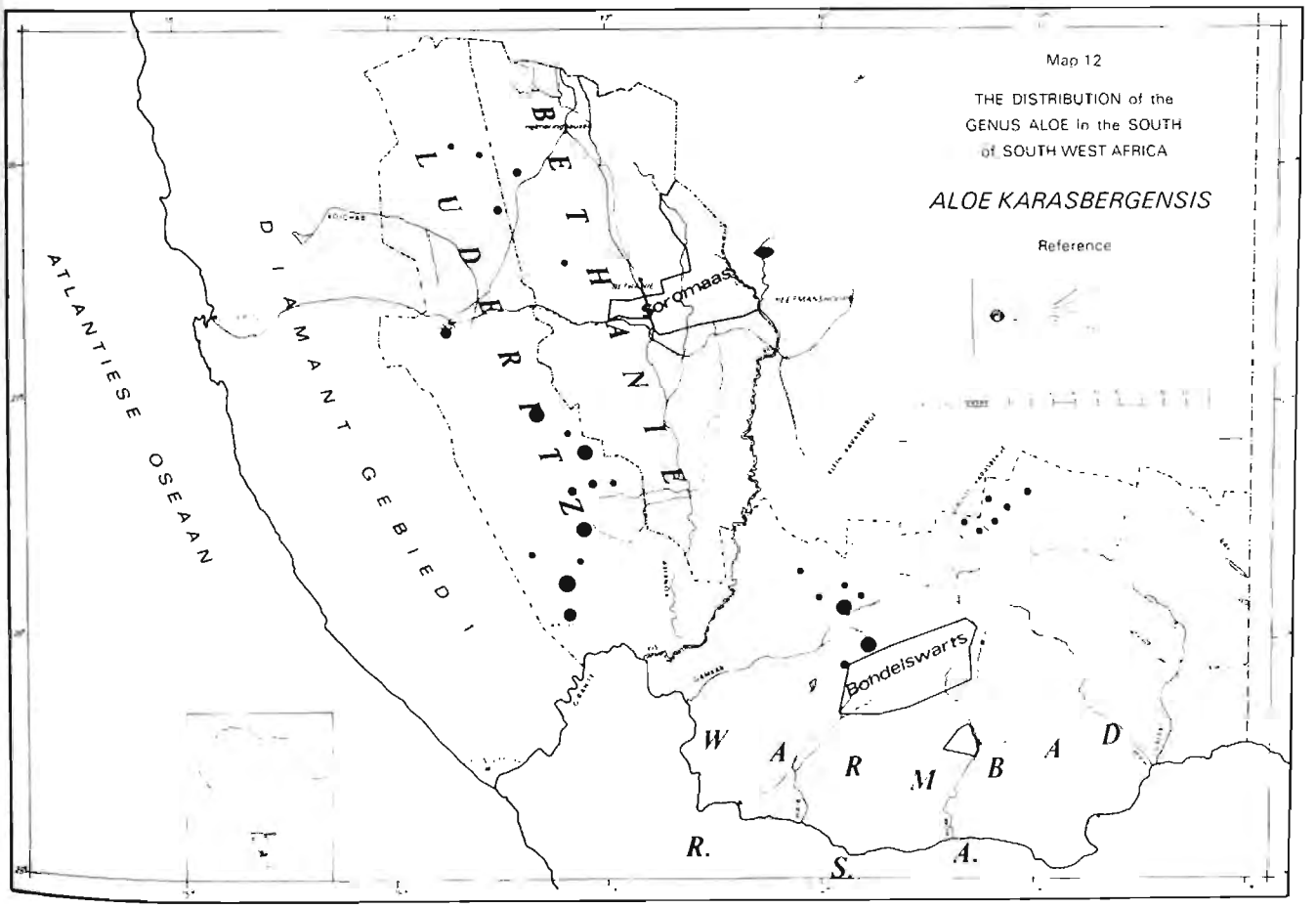
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of SOUTH WEST AFRICA
ALOE KARASBERGENSIS
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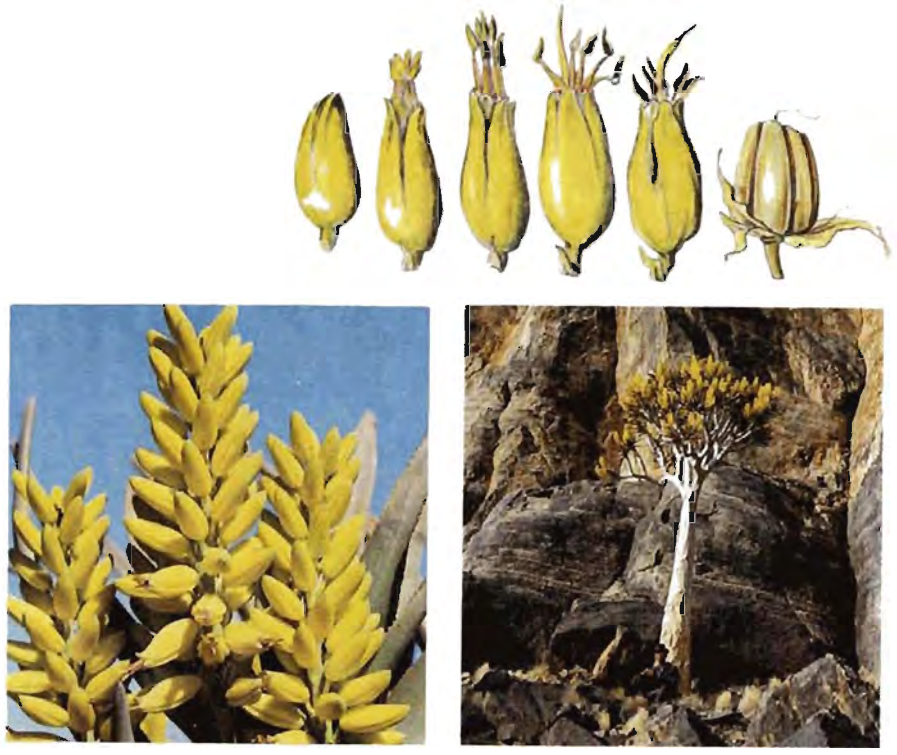
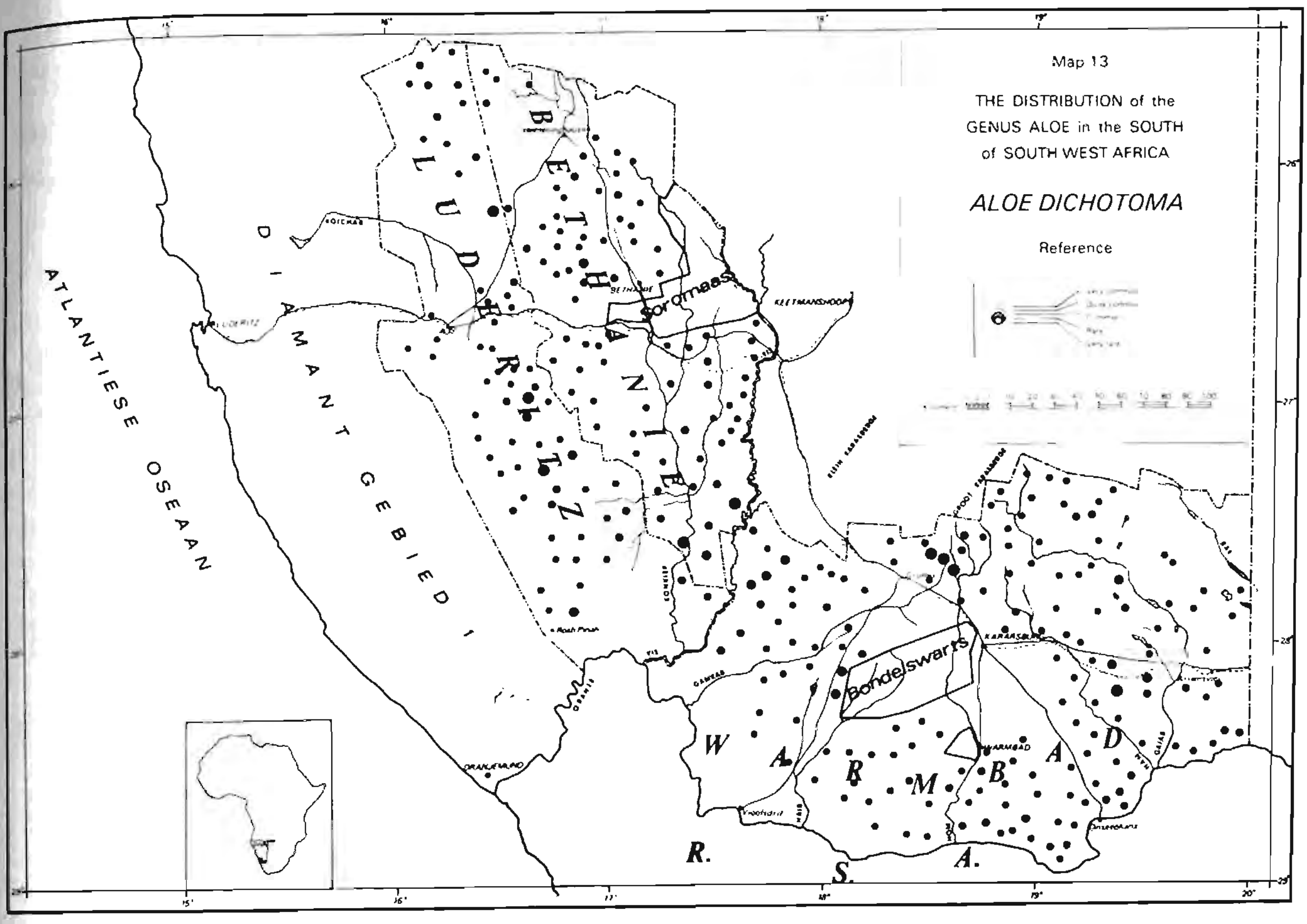


Plate 13. *Aloe dichotoma* Masson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of SOUTH WEST AFRICA
ALOE DICHOTOMA
Reference
ATLANTIESE OSEAAN
DIAMANT GEBIED I
LUDERITZ
BETHANIE
Soromaas
Bondelswarts
WARMBAD
R. S. A.