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Flora and vegetation of the Mbonambi Beach Arcuate Scar on the Zululand dune barrier, Natal, South Africa

P.J. WEISSER*, E.C.A. SMITH*, A.P. BACKER* and S. VAN EEDEN*

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Editor's note: It is appreciated that this study is descriptive rather than quantitative but, in view of the unique vegetation of the arcuate scars and the current spotlight on conservation in southern Zululand, it is felt that publication of this purely descriptive account is justified.

ABSTRACT

A hundred and seventy-nine species belonging to 63 families were found in 13 communities in the Mbonambi Arcuate Scar. This is a rare type of dune valley that is described here and its vegetation is mapped. The great botanical diversity in a small area (7 ha) can be related to the variety in ecological conditions and the juxtaposition of pristine and disturbed areas. Because most of the adjacent area has been mined and this type of dune valley is rare, it deserves a high conservation status rating. A *Pereskia aculeata* infestation was found that requires urgent attention.

UITTREKSEL

Honderd nege-en-sewentig spesies uit 63 families in 13 gemeenskappe is in 'n seldsame tipe duinvallei (arcuate scar) by Mbonambi aangeteken. Die duinvallei word beskryf en die plantegroei word karteer. Die groot botaniese diversiteit oor 'n klein gebied (7 ha) is die gevolg van die verskille in ekologiese toestande en die feit dat ongeskonde en versteurde gebiede saam voorkom. Aangesien 'n groot gedeelte van die aangrensende gebied alreeds gedelf is, behoort 'n hoë bewaringstatus aan hierdie duinvallei toegeken te word, veral omdat dit so seldsaam is. Die vervuiling van *Pereskia aculeata* het dringend aandag nodig.

INTRODUCTION

During vegetation mapping work in May 1975 near the Mbonambi Mission Station, 17 km north of Richards Bay, a steep dune valley with densely vegetated slopes was discovered (Figure 1). The valley bottom presented a swamp, mainly colonized by reeds, sedges and grasses and the slopes were covered with woody vegetation. The absence of any apparent anthropogenic interference and the lushness of the vegetation contrasted sharply with the degraded, depauperate vegetation of the surroundings. This motivated us to focus our research in this valley as our mandate was to find areas of conservation value (Weisser 1978).

Venter (1972) and Weisser (1978) reviewed the dune literature for the area between Richards Bay and St Lucia. At that time no author had reported the presence of the arcuate scars. The first reference to some of these dune valleys and their location was published by Weisser (1978) and the structures were termed 'arcuate scar' following a suggestion by Hobday (pers. comm.). Vegetation mapping and fieldwork done by the senior author between Kosi Bay and Tugela River showed that arcuate scars are rare, only occurring in two coastal stretches, one north of Richards Bay and one south. From the arcuate scars visited, the Mbonambi arcuate scar was the one with the densest vegetation. In 1983 the Mbonambi and other arcuate scars were shown to K. Tinley. He reported on their geomorphology (Tinley 1985). In his report he refers to them as 'cirques'.

The purpose of this work is to report on the discovery and describe the Mbonambi Arcuate Scar, to make a floristic inventory, to map the vegetation using aerial photographs, and to describe the main plant communities.

MATERIALS AND METHODS

General reconnaissance and plant collecting were undertaken, followed by a more detailed study of specific areas. For the collecting of the specimens, standard herbarium methods were employed. The facilities of the National and Natal Herbaria of the National Botanical Institute were available for the identification of specimens. Plant names are mostly given in accordance with Gibbs Russell *et al.* (1985, 1987).

Vegetation mapping was done from aerial photo No. 35234 (1985) supplied by the Air Survey Co. of Africa Ltd. Photo interpretation was done through direct inspection, enlargement and transfer onto a base map using a Bausch & Lomb ZT-4 Zoom Transfer Scope. The mapping units were delimited according to features visible on the aerial photo. The areas stratified were studied in the field and the plant communities described *in situ* structurally and floristically. Additional structural and floristic information was obtained by doing a topographic profile using a measuring tape and an abney level. The anthropogenic mapping units '*Casuarina equisetifolia*' and '*Eucalyptus* sp.' were not studied. Ground truth and field data were gathered from 1975 to 1987 (Weisser 1987).

* National Botanical Institute, Private Bag X101, Pretoria 0001.
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FIGURE 1.—Aerial view of the Mbonambi Beach Arcuate Scar, October, 1982. The central *Stenotaphrum secundatum*–*Phragmites australis* Reed-swamp is clearly visible. The seaward face is slumping owing to undercutting by the sea.

STUDY AREA

The study area is situated on the dune barrier at Mbonambi Beach, about 20 km northeast of Richards Bay (28°41'13" south and 32°13'20" east, Figure 2). The climate is humid and warm to hot with a high year-round rainfall (Schulze 1965), the mean annual temperature at the Cape St Lucia Station being 21.5° C and the mean annual rainfall 1 292 mm. In this climate plant growth is luxuriant and of a tropical nature (Aubert de la Rue *et al.* 1958, in Venter 1972). A climatic diagram can be consulted in Weisser (1978).

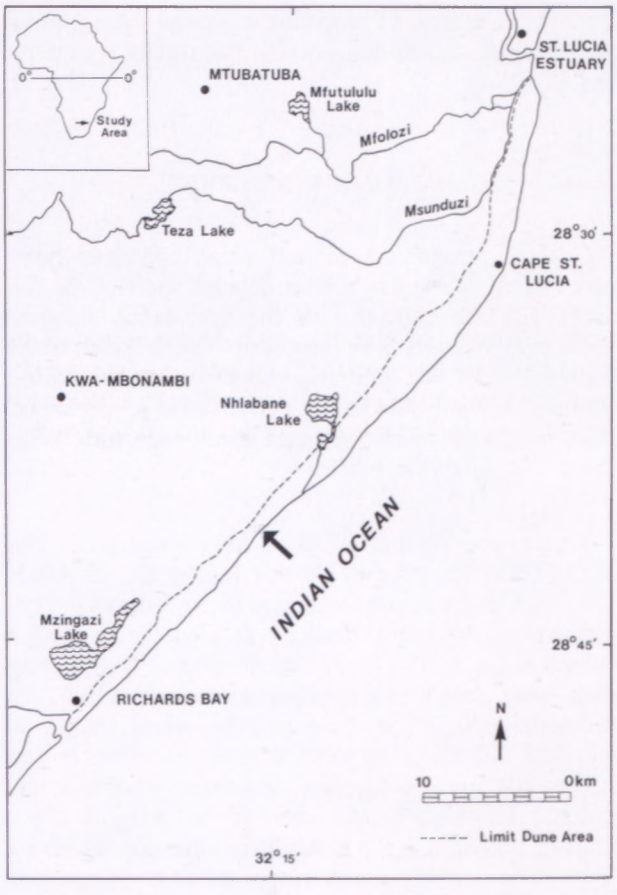

FIGURE 2.—Map showing the position of the arcuate scar (arrow).

RESULTS

Description of arcuate scars

Arcuate scars are valleys opening seaward (Figure 1) caused by the erosive action of springs linked with impermeable beds in the dune barrier. Water from rain percolates through the dunes and accumulates on a clay layer under the dunes. Because of the seaward dip of the impermeable layer, the water is drained seaward causing springs. These springs may cause slumping and back-cutting, resulting in an arcuate valley with steep sides and a swamp in the centre. The circular form offers protection against the strong sea winds. The high humidity and steep valley sides are a good protection against fires and diminish the hours of exposure to direct sunlight as well. The semicircular form of the valley allows the existence of north, south, east and west exposed slopes. There is a marked soil-moisture gradient from the swampy bottom to well-drained dune summit areas. For additional geomorphological information consult Tinley (1985).

Floristics

One hundred and seventy-nine species belonging to 63 families were recorded in the 7 ha area, which includes some areas outside the scar. The most well-represented family was Asteraceae (14 spp.), followed by Poaceae (12 spp.), Cyperaceae (11 spp.), Rubiaceae (10 spp.), Fabaceae (8 spp.) and Celastraceae (8 spp.). The checklist is available on request from the National Botanical Institute, Pretoria.

Main plant communities and their description

Fourteen mapping units with thirteen plant community units were distinguished and their spatial distribution is shown on the vegetation map (Figure 3) and on a profile (Figure 4). The numbering of communities in the text,

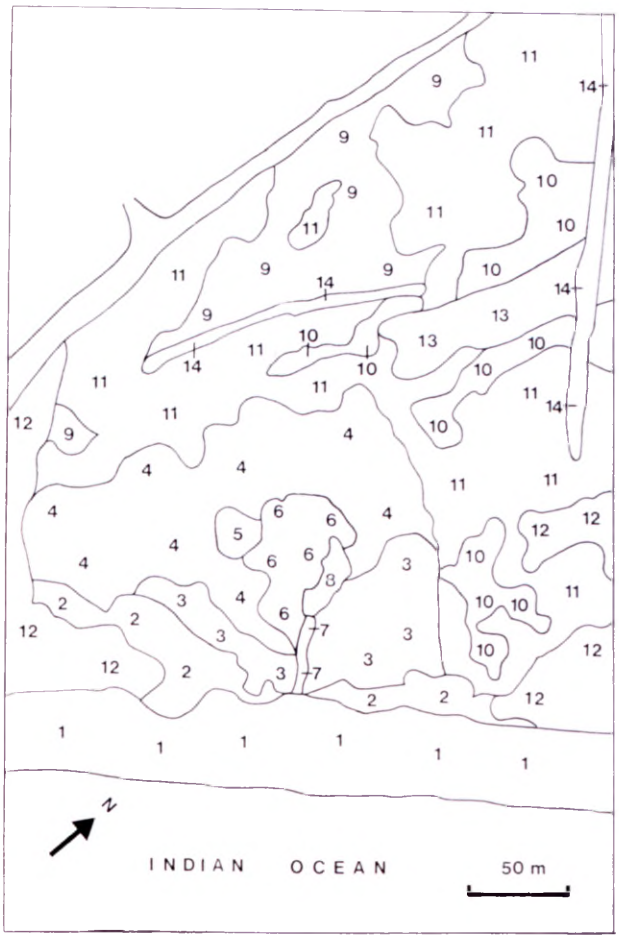

FIGURE 3.—Vegetation map of the arcuate scar and surroundings. 1, Beach and dune pioneers; 2, Cliff vegetation; 3, Dune Thicket and Low Forest; 4, Dune Forest; 5, *Trema orientalis* Woodland; 6, Hygrophilous Forest; 7, *Cyperus latifolius* Marsh; 8, *Stenotaphrum secundatum–Phragmites australis* Reedswamp; 9, Secondary Grassland–Dwarf Shrubland Mosaic; 10, *Acacia karroo* Woodland; 11, Secondary Dune Scrub and Forest; 12, *Casuarina equisetifolia* Plantation; 13, *Eucalyptus* sp. Plantation; 14, Clearings.

the map and the profile is the same, e.g., areas marked with 4 correspond to Dune Forest. The mapping units distinguished were:

1. Beach and dune pioneers
2. Cliff vegetation
3. Dune Thicket and Low Forest
4. Dune Forest
5. *Trema orientalis* Woodland
6. Hygrophilous Forest
7. *Cyperus latifolius* Marsh
8. *Stenotaphrum secundatum–Phragmites australis* Reedswamp
9. Secondary Grassland–Dwarf Shrubland Mosaic
10. *Acacia karroo* Woodland
11. Secondary Dune Scrub and Forest
12. *Casuarina equisetifolia* Plantation
13. *Eucalyptus* sp. Plantation
14. Clearings

1. Beach and dune pioneers

In this mapping unit the plant cover is very low or non-existent and, if present, concentrated at the landward zone in the form of dune pioneer plants, including *Ipomoea pes-caprae*, *Sporobolus virginicus*, *Carpobrotus dimidiatus*, and *Gazania rigens* var. *uniflora*. This community has a low species diversity and is structurally simple. It generally presents one layer of herbaceous plants, with an average height of 0.10–0.65 m and a cover of 10–40%. During our study this community was absent at times, probably destroyed by high tides.

Where the streamlet flows onto the beach, a hygrophilous community developed after 1985, with species such as *Phragmites australis*, *Stenotaphrum secundatum*, *Typha capensis*, *Hydrocotyle bonariensis* and *Zantedeschia aethiopica*. On drier substrates other species such as *Casuarina equisetifolia*, *Chrysanthemoides monilifera*, *Panicum repens*, *Lobelia anceps*, *Senecio* sp. and *Anthospermum littoreum* were present. This area was too small to be mapped separately and was included in the beach mapping unit.

2. Cliff vegetation

Steep cliffs are present on the seaward side of the dune barrier as a result of landslides caused by undercutting by sea waves during storms and high tides. The slumped material and debris accumulates on the base forming a 'piedmont'. Most of this mapping unit is bare or covered with remnants of slumped vegetation. *Strelitzia nicolai* is often conspicuous. Depending on the stability of the substrate and length of exposure, pioneer shrubs and herbs establish themselves, such as *Chrysanthemoides monilifera*, *Ipomoea wightii*, *Carpobrotus dimidiatus*, *Cynanchum obtusifolium*, *Anthospermum littoreum* and *Carissa macro-*

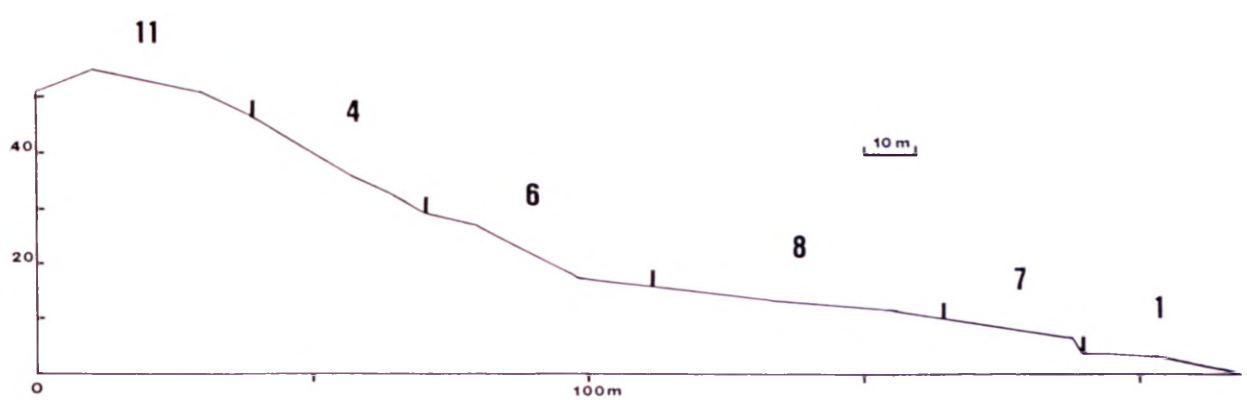

FIGURE 4.—Schematic profile through the arcuate scar, October 1982, revealing the topography and the position of the communities found. 1, Beach and dune pioneers; 4, Dune Forest; 6, Hygrophilous Forest; 7, *Cyperus latifolius* Marsh; 8, *Stenotaphrum secundatum–Phragmites australis* Reedswamp; 11, Secondary Dune Scrub and Forest.

carpa. Some cliff areas have been planted with *Casuarina equisetifolia* for erosion control (mapping unit 12).

Where cliffs are stable and the environment is shady, *Senecio* sp., *Samolus valerandi*, *Lobelia anceps*, *Pycreus polystachyos* and mosses establish themselves.

3. Dune Thicket and Low Forest

This mapping unit comprises the woody vegetation of the southwest-facing side of the arcuate scar (Figure 1). The vegetation is dense and its crown is pruned by onshore winds. The limits with adjacent mapping units are not always clear because transition is often progressive.

Thicket varies in height from 0.5–5.0 m with a total cover of 60–100%. This community is generally formed by a single layer of densely growing woody plants. Occasionally herbs occur but then usually with low cover values. Woody species common in this community are *Mimusops caffra*, *Strelitzia nicolai*, *Brachylaena discolor* and *Chrysanthemoides monilifera*. In the field layer *Microsorium scolopendrium* was present, as well as *Crocosmia aurea*. Climbers noted include *Rhus nebulosa*, *Rhoicissus digitata*, *Cynanchum obtusifolium* and *Ipomoea wightii*.

4. Dune Forest

This mapping unit is typical of most of the higher level slopes of the arcuate scar, where there is no influence of the water table (Figure 1). When exposed to sea winds, the vegetation is stunted and it leads to coastal thicket. The forest has been degraded through clearing on the outskirts and there it is replaced by secondary communities such as Secondary or Grassland-Dwarf Shrubland Mosaic.

In its structure and species composition it is similar to other Zululand dune forest on steep slopes. The height-cover values estimated were 5–8 m /60% cover for the canopy tress, 1–3 m /60% for the subcanopy layer, 1–3 m /10% and 0–1 m /60% for the field layer. Structurally this forest is characterized by a few dominant trees forming a dense canopy, a rather sparse intermediate layer and a field layer that varies in its height and cover depending on which species were able to establish themselves.

Canopy trees include *Mimusops caffra*, *Apodytes dimidiata*, *Canthium inerme*, *Euclea natalensis*, *Strelitzia nicolai*, *Allophylus natalensis*, *Dovyalis longispina*, and *Psydrax obovata*. In the subcanopy *Tricalysia sonderiana*, *Kraussia floribunda*, *Psychotria capensis*, *Peddiea africana* and *Phoenix reclinata* are common and *Deinbollia oblongifolia*, *Carissa bispinosa* and *Pavetta revoluta* are occasionally found. In the field layer *Commelina* spp., the ferns *Microsorium scolopendrium* and *Stenochlaena tenuifolia*, with herbs *Drimiopsis maculata* and *Asystasia gangetica* were recorded. Locally *Strelitzia nicolai* groups become dominant. Climbers recorded were *Protasparagus falcatus*, *Pyrenacantha scandens*, *Smilax kraussiana* and *Tylophora anomala*.

5. *Trema orientalis* Woodland

The dominant species are *Trema orientalis* and *Strelitzia nicolai*. In the subcanopy *Canthium inerme*, *Psychotria capensis*, *Ficus burtt-davyi* and *Brachylaena discolor* are present and *Stenochlaena tenuifolia* is dominant in the field layer. This community was found as a patch in one area and is a stage in the regeneration of the vegetation on a landslide. *Trema orientalis* will probably soon be replaced with species from the Dune Forest.

In the sampled area the canopy was 5–6 m high with an estimated cover of 50%. The subcanopy was 3–5 m high with 25% cover and the field layer 0–1 m high with 40% cover. Pammenter *et al.* (1985) reported *Trema orientalis* regenerating after fire at the Mlalazi Nature Reserve. No evidence of fire was found inside the arcuate scar. During 1987, after this survey had been completed, a landslide occurred in the scar. The regeneration of vegetation on this landslide, on which *Trema orientalis* was dominant, has been reported on by Weisser *et al.* (1991).

6. Hygrophilous Forest

This forest occurs in patches growing between the central area of the arcuate scar and its slopes (Figures 1 & 4). The forest presented the following height/cover characteristics: trees, 3–12 m/50%; subcanopy trees and shrubs, 1–3 m/30%; tall herbs, 1–2 m/70% and field layer, 0–0.6 m/10%.

The canopy and subcanopy trees recorded are *Ficus sur*, *Rapanea melanophloeos*, *Bridelia micrantha*, *Syzygium cordatum*, *Halleria lucida*, *Berchemia discolor*, *Maesa lanceolata* and *Phoenix reclinata*. In the field layer *Stenochlaena tenuifolia* is often dominant. Other species were *Commelina* spp, *Aneilema schlechteri* and *Phragmites australis*. Climbers noted included *Coccinia palmata*, *Dioscorea sylvatica* and *Ipomoea congesta*.

7. *Cyperus latifolius* Marsh

This community occurs along the main water course of the arcuate scar. It tends to occupy heavy, wet soil. The clay content of these soils is high, and they have either a high water table or surface water. *Cyperus latifolius* is dominant in some areas forming monospecific stands. Other species recorded, especially near the borders of the mapping unit, were *Stenotaphrum secundatum*, *Thelypteris confluens* and *Phragmites australis*. The height of *C. latifolius* is about 1 m and the total cover 70–80%.

8. *Stenotaphrum secundatum–Phragmites australis* Reedswamp

This unit consists of a dense grass mat with occasional reeds and ferns (Figure 5). The height/cover estimates obtained at the site studied were high layer, 2.0–3.5 m (*P. australis* stalks) 5% cover and grass layer, 0–0.8 m/90%.

Important species are the grass *Stenotaphrum secundatum*, the reed *Phragmites australis*, *Zantedeschia aethiopica*, *Stenochlaena tenuifolia* and *Smilax kraussiana*. Also present were *Rhoicissus digitata*, *Rhus nebulosa*, *Ficus burtt-davyi* and *Cyperus* sp.

FIGURE 5.—The central part of the arcuate scar is colonized by a dense grass cover mainly formed by *Stenotaphrum secundatum* with scattered *Phragmites australis*.

9. Secondary Grassland–Dwarf Shrubland Mosaic

At the western boundary of the arcuate scar the plant cover is mainly secondary. The vegetation varies according to successional stage. No cover-height estimates were taken because the mosaic nature of this community makes such data inadequate. Previously this area was used for grazing. Fires were probably common before the Department of Forestry took over the management of the area. The woody element is formed by pioneer trees and shrubs, such as *Dodonaea angustifolia, Eugenia capensis, Tricalysia sonderiana, Phoenix reclinata, Bridelia cathartica, Canthium inerme, Rhus nebulosa, Allophylus natalensis, Enterospermum littorale, Diospyros villosa* var. *villosa, Chrysanthemoides monilifera, Rhus nebulosa, Strychnos spinosa, Maytenus* sp., *Scutia myrtina* and *Antidesma venosum*.

Occasional trees, e.g. *Syzygium cordatum, Brachylaena discolor, Erythrina* sp. and *Carissa macrocarpa* may occur. The grasses *Aristida junciformis* subsp. *junciformis* and *Imperata cylindrica* are common and the sedge *Cyperus obtusiflorus* was recorded. In some areas the shrubs *Salacia kraussii, Helichrysum kraussii* and *Passerina rigida* are dominant. Climbers present include *Rhoicissus digitata, Smilax kraussiana, Senecio mikanioides*, and *Dalbergia armata*.

10. *Acacia karroo* Woodland

This woodland represents a successional stage that has developed from dune grassland. Some areas that were grassland in 1937 are today covered with *Acacia karroo* of about 5 m tall. The following height/cover values were recorded: field layer, 0–0.3 m/50%; understorey, 0.3–2.5 m/20%; tree layer, 2.5–5.0 m/60%.

Apart from *Acacia karroo* the following woody species were recorded: *Brachylaena discolor, Eugenia capensis* and *Rhus natalensis*. Climbers present in this community are *Senecio mikanioides, Cynanchum natalensis, Mimusops caffra, Canthium inerme, Bridelia cathartica, Rhus nebulosa, Phoenix reclinata, Tricalysia sonderiana, Pavetta revoluta* and *Apodytes dimidiata*. In the field layer *Commelina* spp., cf. *Brachiaria* (Poaceae), *Achyranthes aspera, Laportea peduncularis, Asystasia gangetica* and *Microsorium scolopendrium* were noted.

11. Secondary Dune Scrub and Forest

This unit follows Communities 9 and 10 in the succession and, depending on the degree of development, it will be a secondary scrub or forest. The physiognomy is very variable. The values of the field layer were 0–0.75 m and the shrub layer, 0.2–6.0–8.0 m. The field layer ranges from 5–60% cover and the shrub layer from 60–90%.

The following species were encountered: *Brachylaena discolor, Eugenia capensis, Carissa macrocarpa, Dodonaea angustifolia, Strelitzia nicolai, Rhus natalensis, Rhus nebulosa, Apodytes dimidiata, Canthium inerme, Kraussia floribunda, Scutia myrtina* and *Allophylus natalensis*. In the subcanopy *Peddiea africana, Eugenia capensis, Tricalysia sonderiana, Psychotria capensis* and *Phoenix reclinata* were present. The field layer was mainly formed by *Microsorium scolopendrium, Asystasia gangetica* and *Commelina* spp. Climbers were *Dioscorea sylvatica, Dalbergia armata, Secamone alpinii, Cynanchum* sp., *Cissampelos torulosa, Pupalia* cf. *atropurpurea* and *Rubia cordifolia*.

12. *Casuarina equisetifolia* Plantation

Some areas were planted with *C. equisetifolia* to stabilize erosion zones, mainly near the seaside. Some selfseeding and colonization of areas by *C. equisetifolia* was observed.

13. *Eucalyptus* sp. Plantation

This community is artificial and was not studied.

14. Clearings

Vegetation clearing was done as part of the mining exploration activities. These clearings are outside the arcuate scar.

ADDITIONAL OBSERVATIONS AND CONSERVATION PRIORITIES

The structure of the arcuate scar with an impermeable layer at its base causes a hydric gradient. There is also a gradient in relation to exposure to sun and to saltspray-bearing winds that increase the variety of ecological conditions. These varied ecological conditions give rise to the presence of a variety of communities with many species, 179 species having being recorded on 7 ha.

Most of the vegetation in the arcuate scar is pristine, as the steep landward slopes are not affected by the previously frequent fires. Moreover, topography is too steep to allow cultivation and therefore the area was not cleared by the local inhabitants.

Arcuate scars should be conserved because 1, pristine vegetation is rarely found in the area; 2, they are reservoirs of species from where recolonization of dunes can take place after mining (Camp & Weisser 1991); 3, they are rare geomorphological features and (4) they have high species and habitat diversities in a very small area. From the scientific point of view we have here a model situation where the effect of parameters such as exposure, relief and water factor can be preferentially studied. For these reasons the Mbonambi Arcuate Scar deserves to be conserved. The Richards Bay Minerals has therefore agreed not to mine this area and to contribute to its protection and conservation. One of the conservation aspects that need urgent attention is the control of the noxious weed *Pereskia aculeata* that was observed growing in the arcuate scar.

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