VEGETATION MAP

FOR THE

RIVERSDALE DOMAIN

Project Team:

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Suggested Reference to maps and report:
Dedication:

For Anne Lise, my dear wife, who motivated so strongly for this study to be done.

I sincerely hope that this work will enable her, current and future CapeNature colleagues to contribute more towards the conservation and sustainable use of the biodiversity of the rather remarkable biodiversity of the Riversdale region.
EXECUTIVE SUMMARY

- The vegetation of a *circa* 800 000 ha area in the Riversdale region of the southern Cape was classified and mapped at a scale of 1:50 000 for the CAPE Fine-Scale Conservation Plan task team.
- The vegetation was mapped as their occurrence was perceived to be in the 17th century, thus before any transformation due to European impacts.
- The classification system follows a six-tier hierarchy in order to facilitate analyses at biome, habitat type and vegetation unit level.
- Aquatic and terrestrial systems are recognized, with two biomes within aquatic ecosystems and five biomes within the terrestrial ecosystems.
- Aquatic ecosystems cover approximately 12 percent of the domain and terrestrial ecosystems 88 percent.
- At habitat level, 47 habitat types are recognized; six are within the aquatic ecosystems and 41 in the terrestrial ecosystems. Brief descriptions and a photograph are provided for each habitat type.
- At the vegetation unit level, 100 units are recognized, 29 in the aquatic ecosystems and 71 in the terrestrial ecosystems. Diagnostic descriptions are provided for each vegetation unit within the habitat type to which they belong.
- The vegetation maps are available in electronic format (Arc View 3.2) and can be manipulated to suit the need of fieldworkers.
- Field accuracy is estimated to be on average within 100 meter from mapped boundaries and users are strongly urged not to use the maps at a scale of less than 1:50 000.
- Due to time constraints more time was spent in the lowland areas (< 350 meter altitude) than the upland mountainous areas. Recognition of vegetation units in the lowlands are consequently more detailed.
- Current threats to extant examples of the 47 habitat types have been estimated and the following habitat types are regarded as being the most threatened by continuing degradation processes:

<table>
<thead>
<tr>
<th>RATING</th>
<th>ECO</th>
<th>HABITAT TYPES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aquatic</td>
<td>River &amp; Floodplain</td>
</tr>
<tr>
<td>5</td>
<td>Aquatic</td>
<td>Perennial Stream</td>
</tr>
<tr>
<td>7</td>
<td>Aquatic</td>
<td>Wetlands</td>
</tr>
<tr>
<td>8</td>
<td>Aquatic</td>
<td>Riverine Saltmarsh</td>
</tr>
<tr>
<td>9</td>
<td>Aquatic</td>
<td>Estuary</td>
</tr>
<tr>
<td>2</td>
<td>Terrestrial</td>
<td>DUNE Sandplain</td>
</tr>
<tr>
<td>3</td>
<td>Terrestrial</td>
<td>DUNE Sandplain Mosaic Thicket</td>
</tr>
<tr>
<td>4</td>
<td>Terrestrial</td>
<td>DUNE Limestone Mosaic Thicket</td>
</tr>
<tr>
<td>6</td>
<td>Terrestrial</td>
<td>VALLEY Mosaic Renosterveld</td>
</tr>
<tr>
<td>10</td>
<td>Terrestrial</td>
<td>DUNE Mosaic Renosterveld</td>
</tr>
<tr>
<td>11</td>
<td>Terrestrial</td>
<td>DUNE Mosaic Sand Fynbos</td>
</tr>
<tr>
<td>12</td>
<td>Terrestrial</td>
<td>RENOSTER MESIC Mosaic Valley Thicket</td>
</tr>
<tr>
<td>13</td>
<td>Terrestrial</td>
<td>RENOSTER MESIC Mosaic Limestone Fynbos</td>
</tr>
<tr>
<td>14</td>
<td>Terrestrial</td>
<td>GRASSY Fynbos</td>
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</table>
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<th></th>
</tr>
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<td>3</td>
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<td>4</td>
<td>Unit descriptions ..................................................................... 18</td>
</tr>
</tbody>
</table>
1. Introduction

The major objective of the study is to produce a defensible vegetation classification system and vegetation map for the Riversdale and adjacent regions to be used by the CAPE Fine-Scale Planning task team.

Regalis Environmental Services were sub-contracted to deliver the following principle products:

1) A vegetation map:
   - Suitable for analysis at a scale of 1:50 000 and having a mapping accuracy of 80% or more at this level.
   - Comprising of uniquely numbered polygons, clearly drawn on LANDSAT images, with a classification dataset for each polygon in EXCEL format.
   - Rectification of the electronic map after Me. M.E. de Villiers of CapeNature has digitized and collated all the data.

2) A report in MSWORD format that includes:
   - A concisely documented methodology and classification system;
   - Diagnostic floristic and physiognomic descriptions for each vegetation unit identified and where possible a list of rare, threatened or endemic plant species present in the unit (note that the limited budget precludes the collection of detailed physiognomic data, e.g. through BB plots, which restricts a careful C-plan analyses of the affected area as no data will be available on the heterogeneity of the recognized vegetation units);
   - Where possible digital photographs of untransformed examples of the vegetation and habitat units identified;
   - A discussion on the extent to which relevant previous vegetation classification and mapping work were incorporated; and
   - Where possible notes on degree of transformation and causes of degradation within the units.
2. **Study area, proposed classification system and methods used to map the vegetation of the Riversdale domain.**

2.1 **Study area**

The *ca.* 800 000 ha study area is located in the southern Cape, between the Great Brak River in the east and the Breede River in the west, from the coastline to the crest of the Langeberg-OUTENIQUA mountains. The inland boundary follows those of the earlier Little Karoo study (Vlok *et al*., 2005) to ensure that the maps of the two domains are complimentary, if analyses are required for municipalities that extends from the coastal plain into the Little Karoo domain, as in for instance the Hessequa municipality, these domains will have to be merged.

The domain covers the boundaries of the Swellendam, Hessequa and almost the entire Mossel Bay municipalities. Only a small eastern section of the Mossel Bay municipal boundary has been omitted, as the water drainage area of the Great Brak River was used as the eastern boundary. This section will soon be mapped in the Garden Route vegetation map.

2.2 **Proposed hierarchy and classification system.**

Here closely I followed the hierarchical approach used by Vlok *et al* (2005) for mapping the vegetation of the Little Karoo. In this study one of the main challenges was to develop a systematic hierarchy in which as much as possible of the valuable previous work of Muir (1929), Grobler & Marais (1967), Bond (1981), Campbell (1985), Rebelo *et al* (1991), McDonald (1993 a, b & c) and Vlok *et al* (2003) is incorporated. My approach to the study has been strongly influenced by the work of Bond (1981) and Taylor & van der Meulen (1981), which enables the rapid identification and mapping of major vegetation units by largely using vegetation structure and variation in environmental parameters (such as rainfall and soils) within different landscape types.
Taking into account the known variation in the vegetation of the region, gleaned from the above authors, other available maps [e.g. Moll & Bossi (1983), Low & Rebelo (1996)] and my own observations, I developed a hypothetical six-tier classification system. These tiers are similar to those of the adjacent Little Karoo domain, with:

1. The 1st tier splitting all units into aquatic or terrestrial systems.
2. At the 2nd tier the aquatic units are divided between those that drain fresh versus brack water and the terrestrial units are here split on biome level, with the introduction of a Marine biome concept to deal with units that are directly associated with the marine environment (see Figure 2.1).
3. At the 3rd tier the units are divided into habitat types, each of these are largely based on the structural characteristics of the vegetation present within the biome.
4. At the 4th tier the habitat type is subdivided into regions that differ in their floristic component, differences may be in the dominant species present and/or changes in regional endemic species. These sectors are thus regional bio-geographic zones.
5. At the 5th tier habitat types are divided into sectors, which differ in their floristic component, either in the dominant species or in local endemic species present.
6. At the 6th tier I indicate for terrestrial vegetation units if they consists of solid units that have elements of only one biome present, or if elements typical of more than one biome is present (mosaic vegetation types). See Table 2.1.

<table>
<thead>
<tr>
<th>DATE</th>
<th>POLY #</th>
<th>ECO</th>
<th>BIOME</th>
<th>HABITAT</th>
<th>REGION</th>
<th>SECTOR</th>
<th>UNIT</th>
<th>VARIANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>31/08/06</td>
<td>1 Terr</td>
<td>Fynbos</td>
<td>Subalpine</td>
<td>Brakke</td>
<td>Outeniqua</td>
<td>Solid</td>
<td>Outeniqua Subalpine Fynbos</td>
<td></td>
</tr>
<tr>
<td>31/08/06</td>
<td>2 Terr</td>
<td>Fynbos</td>
<td>Subalpine</td>
<td>Brakke</td>
<td>Outeniqua</td>
<td>Solid</td>
<td>Outeniqua Subalpine Fynbos</td>
<td></td>
</tr>
<tr>
<td>31/08/06</td>
<td>3 Terr</td>
<td>Fynbos</td>
<td>Subalpine</td>
<td>Brakke</td>
<td>Outeniqua</td>
<td>Solid</td>
<td>Outeniqua Subalpine Fynbos</td>
<td></td>
</tr>
<tr>
<td>7/9/2006</td>
<td>4 Aqua</td>
<td>Drain</td>
<td>Estuary</td>
<td>Brakke</td>
<td>Groot Brak</td>
<td>Solid</td>
<td>Groot Brak Estuary</td>
<td></td>
</tr>
<tr>
<td>7/9/2006</td>
<td>5 Aqua</td>
<td>Drain</td>
<td>Estuary</td>
<td>Brakke</td>
<td>Groot Brak</td>
<td>Solid</td>
<td>Groot Brak Estuary</td>
<td></td>
</tr>
<tr>
<td>7/9/2006</td>
<td>6 Aqua</td>
<td>Drain</td>
<td>Estuary</td>
<td>Brakke</td>
<td>Groot Brak</td>
<td>Solid</td>
<td>Groot Brak Estuary</td>
<td></td>
</tr>
<tr>
<td>7/9/2006</td>
<td>9 Aqua</td>
<td>Source</td>
<td>Perennial Stream</td>
<td>Brakke</td>
<td>Moordkuils</td>
<td>Solid</td>
<td>Moordkuils Perennial Stream</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2.1** Example of data entered for each polygon, following the 6-tier classification system. Note that VARIANT is the name of the vegetation unit, which is a combination of habitat type and sector name.
Figure 2.1 First three tiers of proposed hierarchy for Riversdale domain.
2.3 Methods used to sample and map the vegetation

All the fieldwork was done in 45 days during August to November 2007. The domain was systematically sampled from the coast towards the mountain, starting in the east (Groot Brak River) working westwards. Hard copy satellite images, printed at a scale of 1:50 000, were used to plan fieldwork and to ensure that the maximum number of remnant examples of the vegetation would be encountered. Public and private roads were used to ensure that at least a section of a theoretical grid of 3 km X 3 km would be intersected and surveyed.

During the fieldwork I firstly determined if the vegetation I noted was in a pristine or transformed state, by observing the presence of alien species and indicators of disturbance and/or presence of sensitive species. Indicators of disturbance vary much in the different habitat types, but often include short-lived, small-seeded species (e.g. Conyza, Galenia, Helichrysum, Stoebe, etc.) and/or non-palatable resprouting species (e.g. Aristida, Bobartia, Leucadendron, etc.). In certain cases where certain woody species (e.g. Chrysanthemoides monilifera, Grewia occidentalis, Rhamnus prinoides, Rhus lucida, etc.) and mat-forming asteraceous herbs (e.g. Helichrysum cymosum, Helichrysum petiolare, etc.) are abundant, it is indicative of a lack of fire and thus also indicating a transformed state. The presence of sensitive species, such as highly palatable species (e.g. Themeda triandra), slow growing non-sprouters (e.g. Leucadendron muirii) and large seeded non-sprouters (e.g. Leucospermum formosum) were also very useful to determine if the local vegetation unit was in a near-pristine condition.

For each recognized vegetation unit I continued searching until I found at least a near-pristine example of the unit, then walked at least 100 meter into the unit and noted the structure of the vegetation (relative abundance of trees, shrubs, herbs, graminoids, etc.) and the dominant and characteristic species present. I also noted typical environmental features of the unit, geology, soils, rockiness, slope and position in the landscape. Following the proposed classification system I then recorded the unit as a unique polygon in an EXEL spreadsheet (see Table 2.1). The boundary of the polygon was then followed
in the field to determine its extent. In cases where an area was completely transformed (e.g. ploughed) I used environmental parameters to interpolate between remnant examples of the vegetation unit. One could, for instance, in the case of a limestone fynbos unit see heaps of limestone rocks on the lands, nearby it may change to heaps of e.g. laterite rocks. In the latter case the boundary of the unit would be drawn using the geology and landscape features of the area. The boundaries of each polygon were mapped onto the hard copy satellite image and then digitized by Me. Riki de Villiers of CapeNature to capture the spatial data in a GIS (ArcView 3.2 Redlands CA).

All the hypothetical vegetation units that were not found in the field were deleted from the proposed classification system and units that were not provided for were incorporated into the classification system.

2.4 References.


McDonald, D.J., 1993b. The vegetation of the southern Langeberg, Cape Province. 2.


3: Results.

3.1 Recognition of units.

Forty-seven habitat types and 100 vegetation units were identified and mapped in the Riversdale domain. Six habitat types were identified in the aquatic and 41 in the terrestrial ecosystem, with 29 vegetation units in the aquatic and 71 units in the terrestrial ecosystem. Taking into account time constraints and the main purpose of this vegetation map, recognition of all the major habitat and vegetation units that should be considered in the development of a systematic conservation plan for the domain, I believe that the approach to the study has been appropriate to deliver a reasonably detailed products at a scale of 1:50 000 for the Riversdale domain.

It should be noted clearly that the map produced should not be regarded as a comprehensive vegetation map based on quantitative sampling of plant communities following for instance the Braun-Blanquet methodologies. It is merely a pragmatic attempt to capture valuable information of previous workers in the region and my own data into a useful product that follow a rigid hierarchy of units. The focus of this study, and consequently most of the fieldwork, has been in the lowlands (altitude of < 350 meters) of the Riversdale domain. Vegetation units in the upper mountainous areas were less carefully surveyed and I fully acknowledge inadequacies in the map for the vegetation at these higher altitudes (cf. work of McDonald noted in Chapter 2). For the lowlands some previous work may perhaps have been improved upon, as several new vegetation units have been recognized in the lowlands.

The proliferation of units and general finer detail of units in the eastern section of the domain (east of Goukou River) is not an artifact of the methodology followed here. It is a natural feature of the domain, seemingly linked to more active erosion of the local landscapes. In addition, this section also receives a higher proportion of summer rain, with rather steep rainfall gradients from the coast to the mountains. The lack of aquatic units in the Albertinia lowlands is similarly also a natural feature, with water drainage
into the deep sandy soils and calcrete outcrops of the area resulting in the lack of surface water drainage systems.

3.2 Mapping accuracy.

Spot checks were done in a GIS of the final digitized maps against detailed aerial photos. In distinct landscape features, *e.g.* pans, rivers, *etc.*, it is clear that the mapped boundaries of the units may be **inaccurate up to 100 meters** in the veld – or 2 mm on a 1: 50 000 map. These inaccuracies are clearly the cumulative result of several processes, *e.g.* ortho-rectification of satellite data (with inaccuracy more amplified in the east), inaccuracy in field mapping and use of different projections to deliver final digitized map.

Readers should also note clearly that certain habitat types and vegetation units couldn’t be mapped with 100% accuracy, as their spatial extent is the interpretation of the field worker. The latter case is in particular true where changes from one unit to another are gradual and linked to climatic gradients, rather than edaphic condition, such as in for instance a change from Proteoid to Ericaceous Fynbos. Even in cases where alteration is due to soil depth, such as in for instance a change from Calcrete to Sandplain Fynbos, the gradient may be gradual and hence the exact point of changeover from one unit to another. The same holds for aquatic versus terrestrial units. Some readers may be surprised at how wide some of the riverine and perennial steams have been drawn. These boundaries are based on changes in the vegetation linked to the particular water drainage feature, as for instance the occurrence of the woody component, rather than the seasonal flow boundaries of the surface water.

Forests tend to be rather small in the domain and they were undoubtedly the most difficult units to map accurately. In many cases they occur on very steep slopes and in deep ravines that are transected by aquatic units. Mapping at a scale of 1:50 000 has been a serious constrain and even in cases where these units were clearly seen in the field it was difficult to map the spatial extent of these units accurately. With the limited fieldwork in the upper mountainous ravines I may have missed several forests and could
not detect them as many of them occur in areas shaded on the satellite images. In other cases I strongly suspected that the pre-European extent of these forests were more extensive and my boundaries will deviate considerably from extant occurrence of the forests. I have little doubt that several readers will question the accuracy of the mapped forests with good reason, as many small ones have been omitted while the estimated original extent of some of the larger forests will appear much larger than their current extent.

Taken all of the above into account I strongly recommend that the products produced in this study should not be used beyond a scale of 1:50 000. Care must be taken in the interpretation of extent of aquatic units and especially the indigenous forests in the region.

3.3 Altered classification system

There were relatively few unexpected surprises in the Riversdale domain. At the biome level the only change to the proposed classification system (Figure 2.1) is the deletion of Succulent Karoo vegetation. The communities found that relate to the Succulent Karoo biome have been classified as belonging to the Subtropical Thicket biome, as a Thicket mosaic with Succulent Karoo habitat type (Figure 3.1). This approach is more consistent with those previously proposed for the Little Karoo and Subtropical Thicket biome.

The number of proposed habitat types have, however, been reduced from 57 to 47 (Figure 3.1). This is mostly due to fewer Subtropical Thicket and Fynbos habitat units found than were predicted. The reduction in habitat types is largely due to the fact that fewer solid units were found than expected, with approximately half the habitat types consisting of mosaic vegetation units. The latter is not an artifact of the mapping methodology, as most of these mosaic units occur naturally as a rather fine-scale patchwork of different vegetation units. Not even mapping the domain at a scale of say 1:20 000 would have altered the current classification much.
Figure 3.1 Hierarchy of 47 habitat types and 100 vegetation units in Riversdale domain.
3.4 Spatial extent of units

Readers should note that the extent of all the units (biome to vegetation unit level) has been mapped as I anticipated their extent to have been in pre-European (ca. 17th century) times. In many cases their current extent differs considerably. A summary of the spatial extent of the biomes is provided in Table 3.1 and their distribution on Map 3.2. The occurrence of the 47 habitat types is indicated on Map 3.3 and those of the 100 vegetation units on Map 3.4. Please note that these maps are also available in electronic format.

 Perhaps the biggest surprise in the Riversdale domain was the number of seasonal pans that were encountered. They and other aquatic units is an important feature of the region, with approximately 12.7 percent of the domain consisting of units belonging to the Aquatic ecosystem (Map 3.1).

The Marine biome concept is somewhat new, but was created to indicate terrestrial units whose ecological processes are closely linked to the marine environment. Although they do not cover a large percentage of the domain, they also represent an important region of the domain with unique attributes and threats. Another prominent, but relatively small biome present is the Afromontane Forest, whose spatial extent may well be somewhat underestimated due to mapping constraints.

<table>
<thead>
<tr>
<th>BIOME</th>
<th>EXTENT</th>
<th>PERCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOURCE</td>
<td>28 747 ha</td>
<td>3 %</td>
</tr>
<tr>
<td>DRAIN</td>
<td>72 550 ha</td>
<td>9 %</td>
</tr>
<tr>
<td>MARINE</td>
<td>6 855 ha</td>
<td>1 %</td>
</tr>
<tr>
<td>FOREST</td>
<td>7 325 ha</td>
<td>1 %</td>
</tr>
<tr>
<td>THICKET</td>
<td>55 595 ha</td>
<td>7 %</td>
</tr>
<tr>
<td>RENOSTERVE LD</td>
<td>315 559 ha</td>
<td>40 %</td>
</tr>
<tr>
<td>FYNBOS</td>
<td>310 786 ha</td>
<td>39 %</td>
</tr>
<tr>
<td>TOTAL</td>
<td>797 417 ha</td>
<td>100 %</td>
</tr>
</tbody>
</table>

Table 3.1: Spatial extent of the seven biomes recognized in the Riversdale domain.
3.5 Threats to habitat types.

The degree of threat of current land-use patterns, invasion by alien vegetation and water abstraction to remaining intact (moderate to pristine ecological condition) examples of the 47 habitat types were rated as low, moderate or high. These data, with the sum of all the threats are presented in Table 3.2.

<table>
<thead>
<tr>
<th>THREATS</th>
<th>TOTAL</th>
<th>URBAN</th>
<th>ALIEN</th>
<th>AGRICULTURE</th>
<th>FIRE</th>
<th>WATER</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 = High; 2 = Moderate; 1 = low</td>
<td>Sum</td>
<td>Towns</td>
<td>Pines</td>
<td>Pinus</td>
<td>Grasses</td>
<td>P ork</td>
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<tr>
<td>Parental Stream</td>
<td>12</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Wetlands</td>
<td>11</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>River &amp; Floodplain</td>
<td>16</td>
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<td>3</td>
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<td>2</td>
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<td>2</td>
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<td>1</td>
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<td>2</td>
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<tr>
<td>Estuary</td>
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<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
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<td>Inland pans</td>
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<td>0</td>
<td>0</td>
<td>2</td>
<td>3</td>
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<td>Primary Dune</td>
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<td>1</td>
<td>1</td>
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<td>0</td>
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<td>DUNE THICKET</td>
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<td>3</td>
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<td>1</td>
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<td>2</td>
<td>0</td>
<td>3</td>
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<td>2</td>
</tr>
<tr>
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<td>2</td>
<td>0</td>
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<td>VALLEY THICKET</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>VALLEY Mosaic Renosterveld</td>
<td>12</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>ARID THICKET Mosaic Succulent Karoo</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>RENOSTER Mosaic / Mosaic Dune Thicket</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>RENOSTER Mosaic / Mosaic Dune Thicket &amp; Fynbos</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>RENOSTER Mosaic / Mosaic Valley Thicket</td>
<td>10</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
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**Table 3.2:** Estimated severity of threats to extant examples of the 47 habitat types.
4: DESCRIPTIONS OF HABITAT TYPES AND VEGETATION UNITS

The sequence in which the units are described here follows those of the final hierarchy proposed in Figure 3.1. I first discuss the aquatic units, then the terrestrial units. Brief descriptions are provided at the biome level, mostly with reference to critical ecological processes. Within each biome I provide descriptions of the habitat types present and here list indicators of characteristic and dominant species that are generic to all the vegetation units present within the habitat type. Finally I provide brief diagnostic descriptions for all the vegetation units recognized in the habitat type. For easy reference I discuss these vegetation units in alphabetical order within their respective habitat types.

4.1 Aquatic units

Two aquatic (phreatic) groups are recognized at biome level, water sources and water drainage units.

The water source units are located in the cooler uplands where rainfall is usually > 500 mm per annum, the substrate is mostly quartzitic, where the soils often have a high organic content (peaty soils) and are thus acidic. The water flowing through these upland seepage areas and streams is fresh and usually has a high oxygen content, but it also tends to be acidic. The plant species associated with these water source units are of a temperate nature, with elements of only the Cape Fynbos and/or Afromontane Forest flora present.

The water drainage units are located in the more arid, subtropical lowlands (annual rainfall usually <500 mm), where the substrate is mostly shale, with soils containing higher nutrient levels (especially nitrogen and phosphates). Water quality varies depending on the nature of the river drainage system, but in the past the upstream water source units would perennially deposited fresh water into these lowland drainage systems. The plant species present in the water drainage units are mostly of a subtropical affinity, with elements of the Subtropical Thicket usually abundant and occasionally with Nama Karoo elements present along the outer boundaries of the units.

Please note that the mapped aquatic units do not indicate the width of the local stream or river. These units indicate the extent of the vegetation that is associated with these water drainage areas. In the case of water source (or perennial stream) units this implies that only subsurface water is perennially available to the plants, with only some surface water periodically flowing throughout the unit. In the case of the water drainage units, subsurface water is only seasonally readily available, but the vegetation has some access to the water. In many cases the extent of the water drainage units does, however, seem to coincide with the approximate 1: 100 year flood line of the local water drainage systems. Fortunately the 2006 field survey was during an exceptional rain year to note the upper flow zone of many of these water drainage units.
4.1.1 Water Sources

Only one habitat type is recognized at this biome level, Perennial streams. All these perennial streams originate in the uplands and change in the lowlands to what is here classified as water drainage units (brackwater systems).

I think that some of the upper tributaries of what was mapped as water drainage systems in this project may have been water sources (perennial streams) in the past, but I am not 100% sure. These upper tributaries seem to start at sites in the lowlands that look as if they may have been the points of a freshwater springs in the past. The occurrence of species such as *Cyperus textilis* and *Scirpoides nodosus*, often with a few *Cliffortia strobilifera*, *Rhus laevigata* and *Zanthedeschia aethiopica* still present, leaves one wondering if these sites were perennial springs in the past. The lowering of the groundwater table probably caused these lowland springs to have stopped flowing, thus in time altering the vegetation present from freshwater dependant plants to more drought tolerant species. It is currently impossible to determine which of these tributaries would have been water sources in the past as the indicative freshwater dependant plants would have been extirpated through abstraction of water.

4.1.1.1 Perennial stream

This rather heterogeneous habitat type is not differentiated into several habitat types, even although several distinct vegetation zones can easily be recognized in the continuum from the upper to the lower sections of this habitat type.

At the higher altitudes this habitat type starts within the Ericaceous Fynbos where subsurface water starts seeping, with surface water only present after heavy rain. Here the vegetation is short (< 1.5 m tall) and mostly dominated by members of the Ericaceae and Restionaceae. After fire there are usually a rich assembly of geophytes (especially Iridaceae and Orchidaceae) present, many of which are rare and endemic and distinctive of the different vegetation units of this habitat type. Lower down the mountain slopes, where several seepage areas unite, surface water is usually present as a distinctive perennial stream and some taller woody shrubs (*e.g. Berzelia intermedia* and *Grubbia rosmarinifolia*) become more prevalent along its edges. Lower down, usually where the perennial stream habitat enters the Mesic Proteoid Fynbos, tall woody shrubs start to dominate the vegetation, typically with species such as *Brachylaena neriifolia*, *Brabejum stellatifolium*, *Cliffortia strobilifera*, *Leucadendron salicifolium* and *Psoralea* species abundant. Wherever these perennial streams enter narrow gorges that protect the site from fire, the vegetation changes rapidly to Afromontane forests, typically with species such as *Cunonia capensis*, *Ilex mitis*, *Ocotea bullata*, *Platylophus trifoliatus*, *Sparmannia africana* and *Virgilia divaricata* prominent.

At the base of the mountains, where the geology change from sandstone to shale, the vegetation of this habitat type often change rapidly and altering into what is here called the water drainage habitat (brack water systems). This is, however, not the case in areas of high rainfall where large volumes of fresh water continue to retain the unit as a
freshwater habitat. In such cases the vegetation does change, often with woody species such as *Brachylaena neriifolia*, *Brabejum stellatifolium*, *Cliffortia strobilifera*, *Halleria lucida*, *Ilex mitis* and *Salix mucronata* abundant along the outer perimeter and *Prionium serratum* present within the surface water zone, often with *Cliffortia odorata* forming dense tangled mats along the outskirts of the surface water zone.

Figure 4.1 Typical example of the upper zone of the Perennial Stream habitat in which members of Ericaceae and Restionaceae are usually dominant. The red-flowered *Erica curviflora* in the foreground is often abundant here.

The Perennial Stream habitat type plays a vital role in delivering high quality water to the lowland habitat types and to the humans that live in the lowlands. Over its entire extent the vegetation of this habitat unit is very sensitive to physical disturbance and to invasion by alien vegetation. When physically disturbed it is very prone to accelerated soil erosion, often losing the peaty soils that are very slow to recover, but vital to retain high quality and quantity of water runoff from the upper water catchment areas.

Physical obstructions to natural water flow regimes in this habitat type often rapidly alter water temperature, oxygen levels and even nutrient status. The latter often result in rapid increased levels of the indigenous pathogen *Phytophora* that can result in large-scale mortality of the indigenous species associated with this habitat type.
Figure 4.2 Mid-slope example of the Perennial Stream habitat, where taller shrubs such as Berzelia and often Leucadendron salicifolium are more prominent.

Figure 4.3 On lower slopes the Perennial Stream habitat often has woody species such as Brachylaena neriifolia and Psoralea species prominent.
Figure 4.3 An example of the **Perennial Stream** habitat unit on the lower foothills of high rainfall areas where the unit remains a fresh-water system on shale derived soils, but is easily identified by an abundance of *Prionium serratum*. Other typical species present are *Calopsis paniculatus*, *Psoralea aphylla* and *Wachendorfia thyrsiflora*.

Five vegetation units are recognized within the Perennial stream habitat type. They are differentiated mostly on differences in the floristic component of the upper seepage areas, especially in terms of localized endemic *Erica* species.

The **Breederivier Perennial Stream** often has pockets of Afromontane Forest present in the narrow upper gorges. *Brabejum stellatifolium* is often abundant in the lower sections, which differentiates it from all the other Perennial Stream units. Along the lower foothills the streambed is often dominated by *Prionium*, which filters the water and retain it clean. Several species are endemic to the upper seepage zones, including *Erica chlorosepala*, *E. crassisepala*, *E. ocellata*, *E. omininoglabra*, *E. oxyandra*, *E. podophylla*, *E. tradouwensis*, *Platycaulos acutus* and *Restio peculiaris*.

The **Cloetesberg Perennial Stream** units drain into the Gourits River drainage system, but it contains species that are typical of both the eastern Moordkuils and western Goukou Perennial Stream units, *e.g.* *Leucadendron conicum* and *Leucadendron salicifolium*. Even in terms of its dynamics the Cloeteberg units seem to be intermediate
between these two units, but despite lacking unique characteristics the Cloetesberg units cannot be united with confidence with either the Moordkuils or Goukou units. It differs from the Goukou Perennial Stream in rarely having *Prionium* dominated streambeds well-developed and from the Moordkuils Perennial Stream unit in having some differentiating species (such as *Leucadendron salicifolium*) present. It seems to represent an important changeover zone as certain widespread species such as *Psoralea aphylla* reach its easternmost distribution within this unit, while others such as *Agapanthus africanus*, *Corycium exisum* and *Protea speciosa* do so within its catchment area. No endemics are known, even from the upper seepage areas, but this may be an artifact of rather poor botanical collecting in the area.

The **Duyvenhoksrivier Perennial Stream** is somewhat similar to the Cloetesberg Perennial Stream unit in being intermediate between the two distinctive units on its western and eastern flanks. It is similar to the Breederivier and Goukou Perennial Stream units in having small pockets of Afromontane forests in the upper ravines and *Prionium* dominated streambeds in the lowlands. It shares some regional endemics, e.g. *Psoralea filifolia*, with the Breederivier and the Goukou Perennial Stream units. Some shared species such as *Brabejum stellatifolium* are present, but they are not as prevalent as they are in Breederivier Perennial Stream units. The same model holds for the upper seepage areas where uncommon species, such as *Nivenia fruticosa*, are also shared with the Breederivier and Goukou Perennial Stream units. This unit is consequently not rich in localized endemic species, but there area some near endemics such as *Empleurum fragrans*.

In the **Goukou Perennial Stream** unit Afromontane forest pockets are not as prevalent as they are in the Breederivier or the eastern **Moordkuils Perennial Stream** units. There are, however, indications that small pockets of forests were more extensive along the base of the Langeberg mountain and perhaps also along the lower drainage zones, areas that are currently densely invaded by *Acacia mearnsii*. *Prionium* dominated streambeds are well developed in the lowlands, often with distinctive species such as *Cyclopia maculata* prominent along the outer perimeter. The latter species indicating that periodic fires are an important ecological process that does not seem to operate well currently, as most of the surrounding land is used for intensive agricultural land-use practices. The upper seepage areas are rich in local endemics, including species such as *Berzelia burchellii*, *galpinii*, *Disa subtenuicornis*, *Erica amicorum*, *E. cubitans*, *E. dysantha*, *E. inclusa*, *E. ixythera*, *E. nematophylla*, *E. obconica* and *E. tetrathecoides*. It seems odd that the Goukou would have more endemic species than the units located to the east and west (Duyvenhoks and Cloetesberg), as the altitudinal, rainfall and edaphic ranges are approximately similar. Is there perhaps some secret in the history of the Goukou River drainage system?

The **Moordkuils Perennial Stream** unit consists of two river drainage systems, the Groot - and Klein Brakrivier systems, but they are in all aspects so similar that I cannot differentiate them. In these high rainfall areas Afromontane forests are once again prominent in protected ravines. In some cases narrow bands of these forests, with species such as *Afrocarpus falcatus*, *Nuxia floribunda* and *Rhus chirendensis* prominent, continue
along the outer perimeter of the unit into the downstream River & floodplain units, which render the exact transition area difficult. *Prionium* dominated streambeds are also present in the lowlands, but they are not as well developed as they are in the Goukou and Breederivier units. *Leucadendron conicum* is typically abundant along the upper streams, but it is not restricted to this unit. In almost all cases the unit seems to have a very “flushy” drainage system, with water tables rising rapidly after rainfall incidents. This may well be why the *Prionium* dominated streambed is less developed here, while the *Cliffortia odorata* dominated fringe is well developed. Several widespread species, such as *Nebelia paleacea*, reach their easternmost distribution in the upper catchment area here. Other prominent species, such as *Cyrthanthus elatus*, reach their westernmost distribution here. Not many local endemics are known from the seepage areas, but there are a few, such as *Erica aneimena*, *E. gillii* and *E. juniperina*.

### 4.1.2 Water Drainage

Five habitat types are recognized within the Water Drainage biome level. Four of these Water Drainage habitat types occur in a predictable sequence, often as a gradient from the upper to the lower points in the landscape. The River and Floodplain units occur from the foothills of the mountains to near the seashore, where it is replaced by the Estuary habitat. The wetland habitat types usually occur along the outer perimeter of the River and Floodplain units, mostly near the upper reaches of the Estuary habitat. In areas where the Wetland habitat is absent the Riverine Saltmarsh habitat replaces it, or they may also occur along the outer perimeter of the Wetland habitat. The fifth habitat type, Inland Pans, is not directly linked with the river systems and their occurrence in the landscape is not readily predictable. These Water Drainage habitat types are usually easy to recognize as they differ from the upstream Perennial Stream habitat units in the quality and volume of the water present. Being located in the lowlands they also differ in being less prone to periodic fires.

It should, however, be noted that since the Perennial stream and Water Drainage units often form a continuum from the highest to the lowest points in the landscape it is not always easy to determine the exact point at which they change from the one to the other. The local flora is usually indicative of zones where either water is only periodically available or where water quality change to more nutrient rich and/or brackwater systems. Determining these points is particularly difficult in the case of the river systems that drain water from high rainfall areas (e.g. Breede and Goukou Rivers), where large volumes of fresh water are carried all the way to the estuary. The occurrence of species that are absent from the upstream Perennial Stream habitat, such as *Acacia karoo*, *Buddleja saligna*, *Pittosporum viridiflorum*, *Sideroxylon inerme*, etc., was used to determine the changeover point - even if species typical of the upstream habitat (e.g. *Calopsis paniculatus*, *Prionium serratum*, *Salix mucronata*, etc.) remained present in the downstream Water Drainage units.

The occurrence of periodic floods is obviously an important ecological disturbance factor in almost all the Water Drainage habitat types. The frequency and extent of such floods in
turn depends on the nature and extent of the water catchment area of the particular system, with those of the Gourits River differing considerably from those of all the other more freshwater affiliated river systems (Groot & Klein Brak, Goukou, Duyvenhoks and Breede Rivers). The mapped Water Drainage habitat units coincide approximately with the 1:50 year flood line, as this is the zone in which the local vegetation tends to be quite characteristic and well differentiated from the adjacent terrestrial units.

4.1.2.1 Wetlands

Of the three vegetation units recognized within the Wetlands habitat type, two are directly associated with the River and Floodplain habitat type. The exception is the Borrelfontein Wetlands, which are independent from river systems and permanently wet sites.

What is classified as Wetlands here are seasonally inundated sites that are adjacent to the River and Floodplain units. Water levels may vary much during the year, but the sites are inundated at least for several weeks during a year. *Phragmitis australis* is usually dominant along the outer perimeter of these Wetlands, creating an important breeding and roosting area for a number of bird species. *Typha capensis* is usually present in the more permanently wet areas, but it is rarely dominant. Some species typical of the Riverine Saltmarsh (*e.g. Chenolea diffusa, Exomis microphylla, Salicornia meyeriana, Suaeda fruticosa, etc.*) may be present, but they are never dominant.

![Figure 4.4 An example of the Wetlands habitat type, typically with Phragmitis australis abundant along the outer perimeter.](image)
The **Geelbek Wetlands** and **Vogelvlei Wetlands** both have *Phragmites australis* abundant along their outer perimeters and large seasonal fluctuations in their water tables. The Geelbek Wetlands differ from the Vogelvlei Wetlands in rarely drying up completely as they are directly linked to the mainstream of the Brak River system.

The **Borrelfontein Wetlands**, which arguably may also be classified as a Perennial Stream unit, differ in being fed permanently from springs located in the lowlands close to the coast. The vegetation is very different though with a well-developed grass component (mostly *Stenotaphrum secundatum*) and some freshwater dependant shrubs, including the local endemic *Cliffortia longifolia*, present. These wetlands are directly linked to the marine ecosystem and often have an interesting fauna present, *e.g.* an abundance of crabs. They may well be important breeding sites for vital pollinators of specialized plant species of adjacent terrestrial habitat types, *e.g.* tabanid and nemestrinid flies.

### 4.1.2.2 River & floodplain

Several sub-types can also be easily recognized within the somewhat heterogeneous River and floodplain habitat type. As noted before, along the main drainage stream it may in some cases be hard to establish the point where the upland Perennial Stream habitat type changes into this habitat, but diagnostic is the presence of a discrete floodplain in which some tree species (*e.g.* *Acacia karoo*, *Buddleja saligna*, *Halleria lucida*, *Pittosporum viridiflorum*, *Sideroxylon inerme*, etc.) are present. Where not directly connected to an upland Perennial Stream this habitat type has a well-developed grass (*e.g.* *Andropogon appendiculatus*, *Cynodon dactylon*, *Digitaria eriantha*, *Eragrostis capensis*, *Eragrostis curvula*, *Imperata cylindrica*, *Pennisetum macrourum*, *Pentashistis colorata*, *Sporobolus africanus* and *Tristachya leucothrix*) and sedge component (*e.g.* *Cyperis fastigiatus*, *Cyperis laevigatus*, *Cyperis marginatus*, *Cyperis textilis*, *Mariscus congestus*, *Schoenoplectus scirpoides*, etc.) present. Shrubs are rarely abundant, but some are present *e.g.* *Grewia occidentalis* and *Leonotis leonurus*. Characteristic is the presence of at least some *Acacia karoo* trees. Ten vegetation units are recognized within the River and floodplain habitat type, mainly based on variances in the local flora and the dynamics of the river system to which they are connected.

Although the **Bontebok River and floodplain** unit is directly linked to the Breede River and floodplain unit, it is distinguished as a separate unit as the lower sections are dominated by an unusual combination of trees, in parts dominated by *Acacia karoo* and in the lower sections typically with some *Podocarpus elongatus* present. The upper sections represent a seasonal semi-freshwater system with shrubs such as *Cliffortia strobilifera* present, often along with a dense sward of *Pennisetum macrourum* and *Setaria sphacelata*. Uncommon and characteristic shrubs include *Leucadendron bruniioides*, with *Erica filamentos*, as is a near endemic of this unit. Fires occur periodically, when geophytes (*e.g.* *Micranthus junceus* and several orchid species) are abundant.
Figure 4.5 Is this a river or perennial stream? The presence of trees along the outer floodplain zone says it’s a variant of the River and floodplain habitat type.

Figure 4.6 The upland tributaries of drier examples of the River and floodplain habitat type can be recognized by a well-developed graminoid component, a paucity of shrubs, but typically with some *Acacia karoo* present.
Prionium beds are dominant in the perennially wet mainstream of the mid- and upper sections of the Breede River and floodplain unit. This is also the case in the Duyvenhoksriver and Goukourivier River and floodplain units. An oddity in the Breede River unit is the relative abundance of Melianthus major within the floodplain zone, but the main difference between these three units lies in the vegetation present in their seasonally wet tributaries. In the Breede River and floodplain unit these tributaries are often quite brack with Juncus acutus and Juncus punctarius abundant and the grass component not well developed, but Aizoaceae and Amaranthaceae shrubs (e.g. Atriplex vestita, Drosanthemum species, Manochlamys albicans, Suaeda fruticosa, Tetragonia species, etc.) are often present. Remnants of these seasonally wet drainage areas are often heavily grazed by domestic stock and it is hard to guess what they looked like when they were in a pristine condition. I suspect that some uncommon members of the Aizoaceae (e.g. Delosperma macrostigma and Drosanthemum vandermerwei) may have been present or even endemic to these parts of the unit.

The Danabaai River and floodplain unit is quite unusual as it consists of short, unbranched river systems that cut through a plateau that falls steeply to the sea. No perennial stream flow here, so typical wetland plants are almost absent, except close to the sea where the vegetation may approach those of the Borrelfontein Wetland unit, with some Cyperis textilis, Mariscus congestus, Typha capensis, but with Stenotaphrum secundatum abundant. In the upper reaches the drainage area is dominated by woody species that are typical of the Subtropical Thicket terrestrial units, e.g. Grewia occidentalis, Scutia myrtina and Sideroxylon inerme often inter-twined with climbers such as Cynanchum obtusifolium and Rhoicissus tridentata. The unit is not rich in species, but is functionally very important to prevent serious flood damage to coastal urban areas during periods of heavy rain. Disrupted examples of this unit caused serious damage during the 2006 floods.

In the Duyvenhoksriver River and floodplain unit the mid- and upper sections of the mainstream is also dominated by Prionium serratum. South of Heidelberg extensive stands of these Prionium beds are less prominent, either indicating that the water drainage speed increases rapidly, or that the water quality degenerates rapidly where tributaries from the shale derived soils deliver water into the system. The vegetation of most of the latter tributaries has been severely disturbed (often ploughed for wheat production, or heavily grazed by domestic stock) in most cases. I suspect that the original water drainage pattern and hence the riverine vegetation has been altered much in this unit, especially as intensive agriculture also removed almost all the floodplain vegetation in the upper region that seems to have consisted of a rather dense woody Thicket-Forest community (reconstructing from a single small remnant example). Much of the latter habitat seems to have been a perfect habitat for Afrocarpus dominated forest-thicket communities (not unlike those still to be seen in the Natures Valley basin), which may well explain the somewhat odd extreme western occurrence of certain epiphytic orchids (e.g. Angraecum pusillum, Polystachya ottoniana, etc.) in the remnant upland Grootvadersbos Forest units. The lowland Riverine forest and still extant upland Grootvadersbos Forest was probably continuous in pre-colonial civilization, a period
when useful trees such as *Afrocarpus* would have been mined rapidly, where after the newly exposed floodplain areas became available for agricultural purposes. Even although I am no expert on the matter, the physical characteristics of the Duyvenhoks Estuary tells me that this river system delivered water slowly to the sea in recent times even although the upper catchment is located in a high rainfall area. If true, this would corroborate the above deduction of the original state of the vegetation in this unit. Currently this unit differs little from the Goukourivier River and floodplain unit, both in the dynamics of the river system and the flora present. They can easily be united as one unit, but I am hesitant to do so as the uplands of the Goukou is rich in endemic species, which seem to imply that there are some inherent different differences between these two river drainage systems. I suspect that the subtle differences with the Goukou River and floodplain unit may also be reflected in the faunal component present in this unit.

Another rather distinctive unit within this habitat type is the **Gondwana River and floodplain** unit. It differs from all the other Gourits River related drainage areas in having the mainstream zone with rather deep sandy, quartzitic pebble beds along originate from the upland Enon conglomerates. Surface water flows only seasonally. *Acacia karoo* is prominent in this unit, but is never dominant. Shrubs such as *Dodonaea angustifolia* and *Passerina obtusifolia* are often locally abundant, but in sites where these shrubs are not abundant grasses and sedges (e.g. *Cynodon dactylon*, *Cyperis marginitus*, *Cyperis textilis*, *Digitaria eriantha*, *Eragrostis capensis*, *Eragrostis curvula*, *Hyparrhenia hirta*, *Pennisetum macrourum*, *Pentasthitis colorata*, *Sporobolus africanus*, *Themeda triandra*, etc.) are abundant. The pebble-bed area is rich in geophytes (e.g. *Brunsvigia*, *Gethyllis*, *Gladiolus*, *Moraea*, *Tritonia*, etc. species). No endemic species are known to occur here, but a particularly odd aspect about this unit is the occurrence of hybrid swarms of species e.g. *Tritonia securigera* X *T. crocata*.

As noted above the flora and dynamics of the **Goukourivier River and floodplain** unit are very similar to those of the Duyvenhoksrivier River and floodplain unit. The Goukou unit seems to be in better condition as *Prionium* dominated riverbeds are currently still extensive, even in the main drainage channel not far upstream from where the river reaches the sea. I suspect that Afromontane forests were less prevalent in the recent past in the upper floodplain parts of this river system, but that many small forests that occurred along the foothills of the Langeberg have been decimated. Even some of the present farm names indicate that forests were more prevalent, but going there is futile as only dense stands of *Acacia mearnsii* remain. Fortunately many of the smaller tributaries of the lower foothills are still intact, mostly as they occur on not easily ploughed quartzitic outcrops (e.g. silcrete hills). In these tributaries the vegetation is often dominated by graminoids, perhaps an artifact of frequent burning and grazing afterwards. Currently the unit is most easily identified by the occurrence of extensive *Prionium* dominated riverbeds, still extant is an outer fringe of a plant community that is less dependant on perennial surface water that include several Fabaceae, with *Cyclopia maculata* and several *Psoralea* species typical. The latter legumes indicate that periodic fires may be required in this unit to ensure healthy rejuvenation of these species.
The **Gouritsmond River and floodplain** is the most unexpected unit within the River and floodplain habitat unit. In hindsight its occurrence should have been foreseen as it represents deep alluvial soils along the lowest basin of a major river drainage system, draining and depositing soils all the way from far inland ecosystems. The unit is typified by the occurrence of very deep deposits of loamy alluvial soils. The latter being ideal for cultivation of agricultural crops, especially since water is readily available from the adjacent river system. Only tiny examples of the natural vegetation of this unit are still extant and even these, I assume are in a very transformed condition. This unit probably represents one of the most naturally productive landscapes within the Riversdale domain, which would have supported large numbers of large herbivores in earlier days, bringing along all their associated disturbance regimes that are no longer operative. Remarkable when present in one of the last remaining examples of this unit was the amazing number of bird species present, ranging from Hoopoe to Fish Eagles calls. Even the limited remnants of this unit may constitute vital habitat for certain faunal components. Currently remaining examples of this unit is dominated by tree and shrub species (e.g. *Acacia karoo, Lycium species, Tamarix usneoides, Zygophyllum morgsana*, etc.), but this may very well be an artifact of the absence of the once abundance of large herbivores in the unit, that could have selected for a more grass dominated unit (presumably a sort of *Acacia* woodland). No rare or endemic plant species are known from this unit, but there were probably none in this highly productive landscape.

![Figure 4.7](image.jpg) One of the few last remaining examples of the **Gouritsmond River and floodplain** habitat, note the dense cover and abundance of trees.
In the **Gouritsrivier River and floodplain** *Prionium* dominated riverbeds are absent from the mainstream, but some are present in major freshwater tributaries, e.g. Vals River. These tributaries are in all respects very similar to those of the Goukou River, but they are included here as they deposit their water into the Gourits River. Some of the non-perennial freshwater tributaries (Gondwana River and floodplain) were separated from this unit, as they have distinct characteristics. The vegetation of the other seasonal tributaries is very similar to those present in the Groot Brak River and floodplain. Here the streambeds are dominated by a well-developed grass and sedge component (e.g. *Andropogon appendiculatus*, *Cynodon dactylon*, *Cyperis fastigiatus*, *Cyperis laevigatus*, *Cyperis marginatus*, *Cyperis textilis*, *Digitaria eriantha*, *Eragrostis capensis*, *Eragrostis curvula*, *Imperata cylindrica*, *Mariscus congestus*, *Pennisetum macrourum*, *Pentashistis colorata*, *Schoenoplectus scirpoides*, *Sporobolus africanus* and *Tristachya leucothrix*) with *Acacia karoo* trees rather prominent and distinctive. In fire-protected sites small thicket bush-clumps are present, often with *Buddleja saligna*, *Gymnosporia buxifolia* and *Sideroxylon inerme* prominent, rather distinctive is the occasional occurrence of *Gymnosporia capitata*.

In the **Groot Brak River and floodplain** *Prionium serratum* is present in the mainstream of almost the entire unit, but not as abundant and dominant as it is in e.g. the Breede and Goukou units. Along the upper tributaries *Cliffortia odorata* tend to form very dense mats, allowing only a few other shrubs and trees (e.g. *Psoralea affinis* and *Salix mucronata*) to persist. Perhaps most distinctive about this unit is the presence of riverine forest within much of the floodplain zone, often with tall *Afrocarpus falcatus* trees present. In the more exposed areas the vegetation of these tributaries are very similar to those of the Gourits River unit, with a well developed grass and sedge component and *Acacia karoo* present. No rare or endangered species are known from this unit, but several unusual *Haworthia* species occur on steep embankments. The endangered *Haworthia parksiana* is restricted to sites located just above this unit, in Renosterveld. Accelerated erosion will certainly result in the loss of this habitat type.

The **Hartenbos River and floodplain** unit is in most respects very similar to those of the Groot Brak River unit except that *Prionium* is almost absent here and Subtropical Thicket replace the riverine forest in the lower floodplain zone. In the lowlands Wetlands and Riverine Saltmarshes are also much better developed, indicating that the river system is more saline than the Groot Brak River unit. The vegetation of the seasonal tributaries also has a well-developed grass and sedge component and *Acacia karoo* is often abundant. As is the case in the Gourits, are small thicket bush-clumps with *Buddleja saligna*, *Gymnosporia buxifolia* and *Sideroxylon inerme* present in fire-protected sites, with *Gymnosporia capitata* occasionally present.
4.1.2.3 Riverine Saltmarsh

This rather distinctive habitat type is very easy to recognize as it is dominated by only a few members of the Amaranthaceae, with grasses, shrubs and trees absent. It is restricted to saline seasonally inundated sites next to rivers. It seems to require very saline clayey soils and is consequently absent from freshwater driven systems, e.g. Goukou and Duyvenhoks Rivers. Small examples of somewhat similar vegetation occurs in some of the upper sections of the lower tributaries of the Breede River system, but the species present is different, lacking a dominance of Chenolea, Salicornia and/or Sarcocornia. Aizoaceae are rare with only Disperma crassifolium present and often abundant.

Only two vegetation units are recognized within the Riverine Saltmarsh habitat type. The Gouritsrivier River Saltmarsh unit seems to differ somewhat from the Groot Brak River Saltmarsh in the species present. In the Gouritsrivier unit Chenolea diffusa and Sarcocornia mossiana are more prominent and Sarcocornia pillansii less abundant than in the Groot Brak unit. Otherwise they share the same other common species, Salicornia meyeriana, Sarcocornia decumbens and Sarcocornia natalensis. No rare species are known from these units, but they seem to play a vital role in the ecology of the local estuaries. They are very sensitive to physical disturbance and seem to be slow to recover when trampled too much.

Figure 4.8 A near pristine example of the Riverine Saltmarsh habitat type, here dominated by Chenolea, Salicornia and Sarcocornia species.
4.1.2.4 Estuary

Estuaries are also easy to recognize, but their inland extent is not always easy to determine as it may change periodically. The presences of submerged aquatic species (e.g. *Zostera capensis*) and a few plant species (*Limonium scabrum*, *Spartina maritima* (alien), *Sporobolus virginicus* (alien), *Suaeda caespitosa* and *Tinopyrum distichum*) that are typical of the outer perimeter of estuaries are, however, helpful to suggest where one should differentiate this habitat from the upland Riverine and floodplain unit.

Five vegetation units (*Breede River Estuary, Duyvenhoksriver Estuary, Goukourivier Estuary, Gouritsrivier Estuary* and *Groot Brak Estuary*) are recognized within the Estuary habitat type. They all differ to some degree in the relative abundance of the abovementioned species typical of this habitat type and in terms of their local dynamics. The shape of the estuary at the river mouth and relative abundance of estuarine plant species present is a useful indicator of the dynamics of the associated upper River and floodplain habitat type. It is well known that this habitat type is very sensitive to physical disturbance, perhaps less well known is how important the inflow of freshwater from the upland water drainage and source units is to retain the faunal component (including breeding habitat of sea fish) is. In all these units the latter aspect has been severely interfered with, obviously with negative consequences and little surprise that the sea fishing industry is currently experiencing serious problems.

![Image](image_url)

**Figure 4.9** A typical example of what is here classified as the **Estuary** habitat type, note the presence of partially inundated grasses (*Spartina* and *Sporobolus*).
4.1.2.5 Inland pans

Unlike all the other water drainage habitat types, Inland pans are rarely linked directly to any river drainage system. In this respect these isolated depressions in the landscape may well be classified as a biome in their own right, especially as their dynamics and flora seems to be quite distinct. I refrain from doing so because their flora is not unique at a generic and higher level and as they occur as isolated features in the landscape.

The abundance of these pans in the region took me by surprise. The excellent rain of 2006 provided a great opportunity to map these habitat types despite the fact that most of them have been completely transformed to wheat fields or pastures, often with the lowest water drainage area raised to create a water source for domestic stock. Such interference alters the depth of the pan, which seems to be an important determinant of the plant community present within the inundated area. Even when not physically disrupted the vegetation of these pans seem to be relished by domestic stock (to my surprise even ferns such as *Marsilea*) as the water dries down. The latter impacting on the flora and compacting the substrate, with substrate condition seemingly equally important as a determinant of the flora present.

In most cases only tiny fragments of the natural flora of these pans are still extant and I hence cannot provide reasonable descriptions. I noted large numbers of bird species utilizing this habitat type during 2006 – even tiny transformed fragments, persuading me to regard these pans as an important habitat type for migrant bird species. The latter perhaps explaining the seemingly odd occurrence of more northern, summer rainfall plant species present in this unit, *e.g.* *Aponogeton junceus* and *Ornithogalum flexuosum*.

**Figure 4.10** An example of a near pristine shallow **Inland pans** unit with *Aponogeton junceus* still present along the outer perimeter.
Figure 4.11 An Inland Pan or wetland? The absence of a *Phragmites* fringe says it is rather an Inland Pan following this classification system.

Based on differences in the plant species present, four vegetation units are recognized within the Inland Pans habitat type. I note again that sampling of these units was very limited due to the degree of transformation within this habitat type. Several more units could probably be recognized, *e.g.* those east and west of the Gourits River may need to be differentiated (here all called Petrosa Inland Pans) and eastern (shallow) and western (often deep) examples of the Windsor Pans.

The **Albertinia Pans** unit differs distinctly from all the other Inland Pan units in having a flora dependant on at least some seasonal freshwater, perhaps since this habitat is supplemented periodically through an underground freshwater supply – especially during winter. Here the vegetation contains species such as *Berzelia intermedia* and *Erica quadrangularis* that are unusual for the Inland Pan habitat and more typical of the upland Perennial stream unit. In being often located at the lower northern base of limestone outcrops these pans often have *Chondropetalum microcarpum* present to abundant. Sedges and grasses are less abundant than in other pans, but graminoids such as *Trichlochin bulbosa* are often abundant as well as some uncommon geophytes such as *Lachenalia muirii*. Along its outer perimeters the localized endemic and threatened species *Erica bauera* is occasionally still present. Due to heavy infestation by alien woody species (*Acacia cyclops* and *A. saligna*), it is hard to reconstruct the original
extent of this unit. It may have been more extensive and a conservative approach in mapping the units was followed here.

The natural lower wall of most of the **Bontebok Inland Pans** has also been raised to provide drinking water to game species, which may well have altered the natural vegetation considerably. It is similar to the Albertinia pans in having fynbos elements dominant, especially short *Elegia* and *Hypodiscus* species, often with *Erica quadrangularis* abundant along the outer perimeter. I strongly suspect that more intensive sampling may result in the discovery of some endemic fauna or flora of these unusual pans.

I named many of the Inland pans **Petrosa Inland Pans** despite the fact that I noted that the flora of those located on quartzite (*e.g.* on silcrete) tended to differ considerably from those located on shale-derived soils. On quartzite species such as *Aponogeton junceus*, *Juncus acutus* and the threatened *Marsilea schelpeana* and uncommon *Ornithogalum flexuosum* is often absent and grasses, such as *Eragrostis plana* and *Sporobolus africanus* much more abundant. Certain species, *e.g.* *Aponogeton distachyos*, *Spiloxene aquatica*, *Juncus capensis* and *Juncus punctarius*, are abundant in both examples. I strongly suspect that more intensive sampling will reveal that species of *Isoetes* is also present in the usually more acidic clear waters of the quartz examples of this unit. Most of these pans located on shale-derived soils have been ploughed up and alien grasses now dominate the vegetation (*e.g.* *Lolium* species), but they oddly enough still attract large numbers of waterfowl when they are filled with water. It would be very interesting to see if the natural vegetation (with several species of Cyperaceae and Juncaceae dominant) will restore naturally by simply camping such pools off.

The **Windsor Pans** are most similar to the Albertinia pans, since they are also close or directly located on limestone. Species such as *Chondropetalum microcarpum* remain common and distinctive, but they seem to be more arid and holding water for a shorter period. Water dependant species such as *Berzelia* are thus absent, but other unusual species are present along the outer perimeter, such as *Leucadendron linifolium*. Geophytes such as *Spiloxene aquatica* remain present, as well as the threatened *Marsilea schelpeana*. Most of these pans are also completely transformed through impacts by agriculture (ploughing and heavy grazing once they dried down). They may have contained an interesting fauna as the finding of the Robertson Dwarf Chameleon (*Bradypodion guttorale*) in this unit suggests.
4.2 Terrestrial units

Five major terrestrial vegetation types are recognized at biome level. Four of these, Afromontane Forest, Subtropical Thicket, Renosterveld and Fynbos are well known and widely recognized biomes.

It is questionable if the fifth unit, Marine, should be recognized at biome level. These units do, however, have unique ecological processes that are more linked to the marine ecosystem than any terrestrial ecosystem and have a rather typical flora. Albeit a poor flora, almost all the species present are endemic or near endemic to this biome. I assume the same holds for the faunal component (invertebrates in particular) of this biome.

4.2.1 Marine

The Marine units, as the name allude, are located just above the marine tidal zone and mostly within the area salt spray from waves. Here the natural vegetation is always sparse, but they often pave the way for other terrestrial ecosystems to establish.

Three habitat types are recognized within the Marine biome, mainly based nature of the vegetation present, which in turn is largely determined by the stability of their substrates. Two of the habitat types, Primary Dune (elsewhere sometimes called Fore Dune) and Drift Sands are closely linked, as the Drift Sands provide sand to the marine system, which builds the Primary Dunes to the northeast of them. Where Drift Sands are stabilized and sand movement is halted, as is often the case through dense infestations of aliens (mainly *Acacia cyclops*), the Primary Dune habitat disappears in time towards the north of such Drift Sand units. In severe cases this may result in the exposure of underlying rock outcrops and the eventual establishment of what is here called the Littoral Vegetation habitat, essentially sparse vegetation on rocky outcrops next to the sea.

The Primary Dune and Littoral Vegetation units are under severe pressure, mostly through coastal urban development, but also regular visitation by humans to gain access to the sea. These units are very sensitive to physical disturbance, even regular trampling by people. Most of the plants present are slow growing as all the Marine units are arid environments, with little freshwater available and high transpiration levels, due to almost constant wind in a saline environment. Despite the demands of the public to retain legal access rights to these units it seems necessary to limit human access to most of the remaining intact examples of these units. Not to favor a few privileged individuals, but mostly to ensure that the larger biome (which is heavily utilized by humans) can remain reasonably intact. Without these remaining intact Marine habitat areas ecological processes will collapse, with catastrophic impacts on the currently highly utilized areas. The potential impacts of such events are heightened by the proposed impacts of global warming, rising of sea levels, *etc*. Without healthy sources of unique genetic plant material that can recolonize and stabilize disturbed sites, this environment will become a chaotic environment in which no human can live.
4.2.1.1 Primary Dune

The vegetation of this habitat is rather uniform throughout the region and only one vegetation unit is recognized within the Primary Dune habitat, the Hartenbos Primary Dune. Typically only a few species, Ammophila arenaria (alien), Arctotheca populifolia, Gazania rigens, Hebenstreitia cordata, Ipomoea pes-caprae, Senecio elegans, Scaevola plumieri, Tetragonia decumbens and Thinopyrum distichum are present. The plants tend to be sparse, but just inland (secondary dunes) the vegetation becomes rapidly more dense and taller, with shrubs such as Morella cordifolia, Passerina rigida, Rhus crenata and often somewhat stunted Sideroxylon inerme present. The latter constitute the transition to Dune Thicket vegetation and the cut-off point between these two units is often difficult to determine. Here I used the absence of the first mentioned species (e.g. Scaevola plumieri, Tetragonia decumbens and Thinopyrum distichum) as indicator to differentiate between the Primary Dune and Dune Thicket units. What is clear, is that the Primary Dune units acts as a precursor to the Dune Thicket units. Wherever they are absent, often due to stabilization of the supporting Drift sand unit, wave action starts eating into the secondary dunes, undermining the sands of the Dune Thicket and the homesteads that are often build there. Only one uncommon, but truly remarkable species is present in this unit, Gladiolus gueinzii.

Figure 4.12 Typical example of the Primary Dune habitat with characteristic species such as Scaevola plumieri and Thinopyrum distichum in the foreground.
4.2.1.2 Drift Sands

From a botanist’s point of view this habitat is by far the most boring unit in the Riversdale region, as it is almost devoid of vegetation in its natural state. From an ecological point of view the reverse is true as this is the terrestrial storage of sand that would feed back to the marine system, a sort of “sand in the bank” situation, vital to retain ecological processes in the marine intertidal zone. Only one vegetation unit is recognized within the Drift Sands habitat type, **Gouritz Drift Sands**, as there seems to be no variance in the plant species present. Unfortunately almost all the current examples of this unit have been severely transformed through the establishment of alien species, mostly *Acacia cyclops*. I am sure that there may be subtle variances in this habitat type that would be recognized by better-informed ecologists, perhaps based on specific dynamics of the original sand movement. Here I only recognize major variance in the vegetation and cannot see any.

![Image of Drift Sands habitat](image)

**Figure 4.13** In the background is a typical example of the Drift Sand habitat unit not yet usurped by alien vegetation and still feeding sand to the dependant lower Primary Dune unit and enabling humans to enjoy a summer vacation in the dependent, but more stable secondary dune systems where the vegetation rapidly alters to Dune Thicket communities.
4.2.1.3 Littoral Vegetation

This habitat occurs along the rocky coastline, where the local plant communities vary much, but the total species pool is limited. Despite the internal heterogeneity only one vegetation unit is recognized within the Littoral habitat type, the **Gouritz Littoral Vegetation**.

The vegetation consists mostly of short shrubs and herbs, with species such as *Carpobrotus deliciosus*, *Chenolea diffusa*, *Chironia baccifera*, *Delosperma littorale*, *Drosanthemum cf. hispidum*, *Falkia repens*, *Gazania rigens*, *Helichrysum tenuifolium*, *Limonium scabrum*, *Lycium cinereum*, *Rhoicissus digitata*, *Silene primuliflora*, *Tetragonia fruticosa* and *Zygophyllum uitenhagense* most abundant, grasses are rarely abundant but *Cynodon dactylon* and *Stenotaphrum secundatum* may be abundant in wet sites. Geophytes are also uncommon, but *Chasmanthe aethiopica* and *Haemanthus sanguineus* may be locally abundant. Trees are absent except a few stunted *Pterocelastrus tricuspidatus*, *Schotia afr* and *Sideroxylon inerme*. No endemic species are known, but the uncommon *Coleonema album* is occasionally present, often forming very attractive bonsai-like shrublets.

![Figure 4.14](image_url) **Figure 4.14** Typical example of the Littoral Vegetation habitat that is restricted to rocky sites along the coast. This vegetation is rather sensitive to repeated trampling.
4.2.2 Afromontane Forest

Here the very well established concept for forests is followed, vegetation dominated by trees that form a closed canopy well above ground level. Two habitat types are, however, recognized here, based largely on the structure and flora of the outer perimeter of the forest vegetation.

In the Forest habitat type the outer perimeter consists typically of an ecotone dominated by shrubs and trees that burn periodically, usually with *Laurophyllus capensis*, *Virgilia* and/or *Widdringtonia nodiflora* abundant. Dense mats of *Gleichenia polypodioides* is often also present in this ecotone where small Forest patches occur high up in the mountain. The Forest mosaic with Thicket habitat type is mostly located in more lowland areas and here the ecotone is dominated by non-flammable species that also tend to be abundant within the Subtropical Thicket biome, *e.g.* *Diospyros dichrophylla*, *Canthium inerme*, *Gymnosporia buxifolia*, *Pittosporum viridiflorum* and *Scutia myrtina*.

4.2.2.1 Forest

Although perhaps only marginally different in the species present, I recognize two vegetation units within the Forest habitat type. The *Grootvadersbos Forest* unit is located more towards the west and typically has *Virgilia oroboides* present in the ecotone. *Afrocarpus falcatus* tend to be uncommon in this unit, but that may be an artifact of previous harvesting. The *Outeniqua Forest* unit differs in mostly having *Virgilia divaricata* present in the ecotone and a better developed flora, with certain ferns, *e.g.* *Asplenium flexuosum* and *Marattia fraxinea*, not occurring further west.

![Figure 4.15](image-url) The Forest habitat unit, which is restricted to fire-protected sites.
4.2.2.2 Forest Mosaic Thicket

Only one vegetation unit is recognized within the Forest Mosaic Thicket habitat type, the Wolwedans Thicket-Forest unit.

This unit seems to be restricted to soils with a higher nutrient content, mostly shale derived soils. It often occurs on very steep slopes and due to its substrate seems to be very sensitive to physical disturbance. Once the vegetation has been disturbed soil slips occur readily after heavy rain. The ecotone tends to consist of impenetrable stands of thorny shrubs and trees, whose canopy is hardly lifted from the ground. Towards the inner sections of this habitat the tree canopy does lift above the ground and the species present are very similar to those that occur in the Forest habitat unit. Tree species such as *Calodendrum capense* and *Olinia ventosa* and climbers such as *Rhoicissus tomentosa* do, however, seem to be more abundant in this unit than in the Forest habitat type. Certain fern species, such as *Cyathea capensis* and *Todea barbara*, are absent or uncommon, but *Blechnum* species abound. It may be my imagination but it also seems to have a richer bird fauna present than the Forest habitat.

![Figure 4.16 An example of the Forest-Thicket habitat type in which species such as Virgilia are absent from the outer ecotone zone.](image-url)
4.2.3 Subtropical Thicket

Only Dune and Valley Thicket occur in the region as solid stands, in the other four habitat types recognized within the Subtropical Thicket biome the thicket occurs as fragmented bush-clumps in a matrix of either Fynbos, Renosterveld or Succulent Karoo vegetation. The latter are called Thicket Mosaic units, as it is believed that these Thicket bush-clumps are remnants of original solid stands of Thicket and not recent invaders of the matrix vegetation. The Thicket was most probably fragmented through periodic fires as summer rain decreased and summer drought increased in the region. Especially for the Riversdale plains it should be remembered that the Khoi people farmed these lowlands for many centuries. Early travelers noted that their stock numbers ran into thousands. They obviously used fire to improve grazing for their stock, which would have had a severe impact on the original extent of solid stands of Thicket in the region. Odd that some current landowners still see these thicket areas as problematic breeding sites of vermin and I suspect the Khoi was of the same opinion. Despite their likely impact and fragmentation of the thicket, I ignore the potential impact of the Khoi on the vegetation and only regard post-colonial impacts as recent transformation of the vegetation.

Despite their small size (often not more than 5 meter in diameter) it is interesting that these Thicket bush-clumps retain a subset of species typical either of the Dune, Valley or Arid Thicket. It is never an unpredictable jumble of species. The latter being one of the reasons that I strongly believe that they are not recent invaders of the matrix vegetation, in which case the species combination that managed to establish in the bush-clumps would have been more random.

4.2.3.1 Dune Thicket

The Dune Thicket habitat is dominated by dense stands of often spiny shrubs and trees such as *Azima tetracantha*, *Capparis sepiaria*, *Carissa bispinosa*, *Cassine peragua*, *Euclea racemosa*, *Gymnosporia capitata*, *Lycium cinereum*, *Mystroxylon aethiopicum*, *Nylandia spinosa*, *Pterocelastrus tricuspisatus*, *Putterlickia pyracantha*, *Rhus crenata*, *Rhus pterota*, *Sideroxylon inerme* and *Tarchonanthus camphoratus* abundant and characteristic. Lianas (*e.g.* *Asparagus aethiopicus*, *Cynanchum ellipticum*, *Rhoicissus digitata*, *Sarcostemma viminalis* and *Solanum quadrangulare*) are usually abundant. Succulents are usually also abundant (*e.g.* *Cotyledon orbiculata*, *Crassula nudicaulis*, *Euphorbia caput-medusae*, *Euphorbia clandestina*, etc.), with *Aloe arborescens* quite distinct. In more open areas the vegetation is less spiny and has species such as *Chrysanthemoides monilifera*, *Metalasia muricata* *Passerina rigida*, *Salvia africana-lutea* and *Zygophyllum morgsana* abundant. Localized endemic species to the thicket is probably limited to *Carpobrotus muirii*.

Two vegetation units are recognized in the Dune Thicket habitat type. They do not differ much in the species present, but rather in their structure and combination of species present. The **Gouritz Dune Thicket** occurs mostly as dense stands of woody species, sometimes even with *Euclea undulata* present and then approaching the Valley Thicket
habitat type, but diagnostic is the presence of *Aloe arborescense* and absence of *Aloe ferox*. Interesting is the occurrence of hybrid swarms between these two *Aloe* species where this unit and Valley Thicket units meet, *e.g.* where the Gourits River cuts through the Aasvoëlberg range. Apart from *Carpobrotus muiri* no endemic plant species are known from this unit, but there are some unusual eco-types not known from other units, such as a very attractive variant of *Gladiolus grandiflorus*.

The **Vacca Dune Thicket** unit is more restricted to the coastline and deep sandy soils. Here the vegetation is somewhat less dense and contain more succulents and non-spiny species such as *Chrysanthemoides monilifera*, *Salvia africana-lutea* and *Zygophyllum morgsana*. Grasses (*e.g.* *Ehrharta villosa* and *Stenotaphrum secundatum*), restios (*e.g.* *Ischyrolepis eleocharis*) and geophytes, such as *Brunsvigia orientalis* and *Gladiolus cunonius* are also more prominent in this unit than in the Gourits Dune Thicket.

**Figure 4.17** In the Dune Thicket habitat type the vegetation is dominated by dense stands of woody shrubs and trees, but it is never tall (<3 m), in more open areas succulents such as *Aloe arborescens* (in foreground) are often abundant.
4.2.3.2 Dune Thicket Mosaic Sand Fynbos

The two vegetation units that are recognized within the Dune Thicket Mosaic Sand Fynbos habitat type are somewhat different from each other, as the thicket bush-clumps are more extensive in the one than the other. No difference was noted in the thicket species though, so it is rather an issue of structure of the vegetation than the flora present.

In the **Hartenbos Strandveld** the thicket bush-clumps are usually small and diffuse, with the vegetation dominated by Fynbos elements, but with a surprising abundance of succulents present. Here fire does not seem to be a major determinant of the flora present, but the species present indicate that physical disturbance by large herbivores probably was an important disturbance regime. The unit is of interest as several species reach their easternmost distribution here (e.g. *Euchaetis burchellii*, *Jordaaniella dubia*, *Orphium frutescens* and *Thamnochortus insignis*). *Delosperma virens* seems to be endemic (or at least a near-endemic) to this unit.

The **Ystervarkfontein Fynbos-Thicket** unit differs from the Hartenbos unit in having the thicket bush-clumps more extensive, with Restios such as *Thamnochortus insignis* much more abundant as well as uncommon species such as *Athanasia cochlearifolia* and *Leucadendron galpinii* in the matrix fynbos. The latter species indicate that the matrix vegetation forms part of the Sandplain Fynbos that is typical of the Albertinia-Riversdale region. *Hermannia muirii* is a threatened species present that may be endemic to this unit.

**Figure 4.17** An example of the Dune Thicket mosaic with Sand Fynbos habitat type, where the matrix vegetation is dominated by Fynbos, but where many Dune Thicket bush clumps remain present.
4.2.3.3 Dune Thicket Mosaic Renosterveld

In this habitat type only one vegetation unit is recognized the **Springerbaai Renoster-Thicket**. This habitat unit has small to medium sized thicket bush-clumps present that are typical of the Gouritz Dune Thicket unit. The matrix vegetation is a short coastal variant of Renosterveld with Renosterbos (*Dicerothamnus rhinocerotis*) the most abundant shrub species, but it is not so dominant that other species are excluded. The vegetation is also rich in other small shrubs (such as *Eriocephalus africanus*, *Oedera squarrosa* and *Pelargonium abrotanifolium*), grasses (e.g. *Themeda triandra*) and geophytes (e.g. *Moraea fugax*, *Tritonia crocata*, etc.). Some of the local geophytes are uncommon species, such as *Apodolirion lanceolatum*. This unit is adjacent to and may be confused with the Petrosa Fynbos- Renosterveld, but here the typical Fynbos elements (e.g. *Protea lanceolata*) are absent or rare, with thicket bush-clumps much more prominent than in the Petrosa Fynbos- Renosterveld. No species are known to be endemic to this unit, but some undetermined Aizoaceae (e.g. *Delosperma*, *Lampranthus* and *Trichodiadema*) were noted that might well be restricted to this unit.

![Springerbaai Renoster-Thicket](image)

*Figure 4.18 Springerbaai Renoster-Thicket* is the only example of the Dune Thicket Mosaic with Renosterveld habitat type.
4.2.3.4 Valley Thicket

Spiny shrubs and trees also dominate the Valley-Thicket, but it differs from the Dune Thicket in being largely restricted to deep clayey soils, derived from Bokkeveld shales. The species present also differ, with succulents such as *Aloe ferox* and *Aloe speciosa* prominent and characteristic (thus replacing *Aloe arborescens* largely). The tree component is better developed in the Valley Thicket with species such as *Euclea undulata, Pappea capensis, Rhus glauca, Schotia afra* and *Scolopia mundii* more abundant. The shrub component remains very similar, but certain species such as *Capparis sepiaria, Clutia daphnoides, Ehretia rigida* and *Euphorbia mauritanica* are more prominent in the Valley Thicket.

In higher rainfall areas, *e.g.* near Herbertsdale, the vegetation changes somewhat with non-spiny trees, such as *Buddleja saligna, Cussonia spicata, Olea europaea* and *Sideroxylon inerme* becoming more prominent. I refrain from separating such areas as a separate unit as the changeover is gradual. The taller, less succulent variant of this unit is also often present on a south-facing slope, with the north-facing slope having the more stunted, succulent rich vegetation. Only one vegetation unit is thus recognized within the Valley Thicket habitat type, the **Gouritz Valley Thicket**. Three endemic species are known, *Cotyledon elisiae, Gasteria thunbergii* and *Pelargonium denticulatum*. Some *Drosanthemum* and *Haworthia* species may also be endemic, but their taxonomic status is currently being revised and it is thus not possible to list the specific species.

![An example of the somewhat less spiny Valley Thicket habitat, that is located along the foothills of the Langeberg mountain.](image)

**Figure 4.19** An example of the somewhat less spiny Valley Thicket habitat, that is located along the foothills of the Langeberg mountain.
4.2.3.5 Valley Thicket Mosaic Renosterveld

In this habitat type the Thicket vegetation has a less closed canopy than in typical Valley Thicket and often has *Olea europaea* and *Sideroxylon inerme* more abundant. Succulents such as *Aloe ferox* and *Sarcostemma viminale* remain abundant on arid slopes, with rocky slopes often having several Adromischus, Crassula, Gasteria, Haworthia and other succulent species present. Of particular interest is the occasionally local abundance of the otherwise uncommon *Aloe lineata*.

Fires occur periodically and have created open areas, in which Renosterveld occurs, typical with *Dicerothamnus rhinocerotis*, *Eriocephalus africanus*, *Oedera genistifolia* and *Oedera squarrosa* the dominant shrubs. Most of this habitat is located on shales, but some limestone outcrops are also present, in which unusual shrubs such as *Metalasia erectifolia* are abundant. Geophytes and grasses are abundant after fire, with species such as *Gladiolus involutus* and *Tritonia deusta* present. No endemic species are known from this unit and only one vegetation unit, the **Goukou Renoster-Thicket**, is recognized within this habitat type.

![Figure 4.20](image-url) An example of the Valley Thicket Mosaic with Renosterveld habitat, in which some open areas are located along the upper and more exposed slopes, where species typical of by Renosterveld is dominant.
4.2.3.6 Arid Thicket Mosaic Succulent Karoo

The rather unmistakable Arid Thicket in this unit occurs as fragmented bush-clumps, with species such as Carissa haematocarpa, Euclea undulata, Gloveria integrifolia, Rhus glauca and Rhus undulata abundant. “Heuweltjies” are present in the matrix Succulent Karoo, often with Tylecodon paniculata present on intact examples of these “heuweltjies”. Small shrubs, forming heterogeneous communities with species such as Pteronia incana or Pteronia paniculata locally abundant, dominate the Succulent Karoo vegetation. Succulents are abundant, with species such as Drosanthemum micans, Euphorbia burmanii and Ruschia caroli locally abundant. Some of these succulents, e.g. Astroloba rubriflora and Euphorbia nesemannii are uncommon threatened species. On steep south facing slopes some Dicerothamnus rhinocerotis may be present, but it is never dominant. Only one vegetation unit is recognized within this habitat type, the Bonnievale Gwarrieveld. It may superficially look similar to the more northern Montagu Gwarrieveld, but differs in not having species such as Aloe microstigma and Euphorbia mauritanica abundant.

Figure 4.21 Typical example of the Arid Thicket Mosaic with Succulent Karoo habitat in the background, with Acacia karoo abundant in the water drainage line in the foreground (Breede River & floodplain).
4.2.4 Renosterveld

During this survey a previous observation (Little Karoo study) that Renosterveld is a hodgepodge of rather divergent vegetation units, rather than a clear-cut biome with a single origin, has been corroborated. Despite my misgivings about the soundness of recognizing the Renosterveld as a distinct biome, I retain all the habitat types and plant units in which *Dicerothamnus* (*Elytropappus*) *rhinocerotis* is abundant or dominant as one group of units in a Renosterveld biome.

I essence all these units represent the transitional zone from Fynbos to either Thicket or Succulent Karoo. All the habitat types and hence vegetation units classified as belonging to the Renosterveld occur as mosaic units. The general pattern being that the more eastern units (Brak, Gourits and Goukou Rivers) having a coarse scale mosaic pattern, this is a matrix of vegetation dominated by Renosterbos in which patches of Thicket and/or Fynbos are present, but the latter being too small (< 50 ha) to map individually. Towards the west (Duyvenhoks and Breede Rivers) the mosaic of plant communities present gradually become more a fine-scale mosaic, with elements of the other biomes more readily mixed with the matrix Renosterbos dominated communities. The latter seems to correlate with an increase in summer drought and perhaps more frequent fires during summer. With the increased incidence of fire, elements that cannot withstand fire (mostly Thicket components) were eliminated and some Fynbos elements (especially Asteraceae, but also Ericaceae, Restionaceae, etc.) established. In the more arid areas phytomass accumulation is slow and the areas have a lower fire frequency. Here it is not uncommon to find Thicket and/or Succulent Karoo elements once again more prominent. The most typical Renosterveld vegetation (*sensu* Low and Rebelo, 1998) is thus located within an area of intermediate rainfall (300-400 mm p.a.), of which most (> 60%) occurs in autumn and winter. In areas of lower rainfall the scale tips towards allowing Thicket remnants to remain present and the invasion of Succulent Karoo elements, at higher rainfall Fynbos elements invade, very often what is called Grassy Fynbos (*sensu* Low and Rebelo, 1998). Wherever, the rainfall is aseasonal or tipping towards summer (<40% winter) Subtropical Thicket prevails more abundantly.

The typifying Renosterbos (*Dicerothamnus rhinocerotis*) certainly prefers nutrient rich, clayey soils. Most of the ten habitat types recognized within Renosterveld are thus restricted to clayey soils, mostly derived from the Bokkeveld formation. On Enon conglomerates and/or granite *Dicerothamnus rhinocerotis* may also be abundant, but it is not the dominant species with Fynbos and/or Thicket often being the most abundant vegetation type around. The latter units have rather been referred to either the Fynbos or Thicket Biomes as mosaic vegetation types, as I suspect that they represent units which was relatively recently invaded by *Dicerothamnus rhinocerotis*. It is interesting to note that *Passerina* (*P. falcifolia*, *P. obtusifolia*, *P. vulgaris*, etc.) species are very abundant in certain very wet Renosterveld types (*e.g.* Spiegelsrivier Fynbos-Thicket-Renosterveld), or in sites where the soils have a higher sand fraction (*e.g.* where outcrops of quartzitic conglomerates are present). There seem to be very strong competition between these species at such sites and it would be interesting to know which ecological factors favors *Dicerothamnus rhinocerotis* rather than the *Passerina* species on the more arid, clayey
soils. Without these factors Renosterveld may easily turn into Gannaveld, something one sees on loamy soils further east (e.g. foothills of the Kouga mountains).

Fire is clearly an important ecological process in Renosterveld, but little data are available on appropriate fire regimes. Many species endemic to the Renosterveld units, e.g. *Aspalathus* and *Erica* species, are clearly dependant on periodic fires. Appropriate fire frequency would certainly vary in the different rainfall areas, with more frequent fires (8-15 year fire cycles) in the higher rainfall areas (300-400 mm p.a.) and longer intervals between fires (15-20 year fire cycles) in the lower rainfall areas (250-300 mm p.a.). As fire frequency is directly related to fuel accumulation, defoliation by grazing would certainly also play a role in determining the age at which Renosterveld would require a fire to ensure healthy recruitment of the species present. I do not believe that very frequent fires are healthy, even if they are executed to retain short-lived endemic species, e.g. *Aspalathus* species. The periodic disappearance of non-sprouting species should not be regarded as problematic as they will return after a fire, unless the fire interval has been longer than the period in which seed can remain viable in the soil. Studies on the longevity of soil-stored seed of especially small seeded species, e.g. *Erica* species, would certainly be very useful in this respect.

Despite no data exist to corroborate such a statement, I have little doubt that the most appropriate fire season would be summer and autumn (January-April). Winter-spring (May-November) fires would most probably favor the grass component in Renosterveld, which if continually favored would in time certainly reduce the species richness of the local communities. I should also note that I have little doubt that the grass component, especially of the more palatable C-4 grasses (e.g. *Themeda triandra*), used to be better developed in many of the Renosterveld habitat-types. Several centuries of burning and grazing within the first year after the fire certainly disfavored these palatable grasses and allowed Renosterbos (*Dicerothamnus rhinocerotis*) to increase in density, as it is unpalatable to domestic stock even when young.

Most inappropriate management of Renosterveld remnants include grazing within the first year after a fire, as this is the period when seedlings are most vulnerable to grazing, as well as the endemic annual and geophyte species present. Particularly perturbing is the rather massive increase in ostrich farming in much of the Riversdale domain. Most of the remnant Renosterveld patches occur along wheat fields where the natural vegetation is not fenced off. Ostriches utilize these Renosterveld patches that are mostly located within water drainage areas and trample the vegetation to death. They create a mesh of footpaths where the soil become very compacted and water-runoff is increased towards the drainage lines. I believe that this is not only a serious threat to the Renosterveld, but also the associated Riverine & floodplain habitat, certainly also infrastructure that may be damaged by floods. I should also note that physical disturbance and nutrient enrichment (run-off from dissolved fertilizers) certainly favors the establishment of alien annual grasses (e.g. *Avena, Bromus* and *Lolium* species), the latter being one of the very serious threats to much of the remaining Renosterveld habitat types. Retaining the shrub component seems one of the best methods to prevent the gradual establishment of the alien annual grasses, as they retain a healthy population of seed predators (e.g. rodents).
4.2.4.1 Mesic Renosterveld Mosaic Dune Thicket

I wish I had more time to explore this somewhat unusual habitat as I suspect that some uncommon species would be present, predictably some succulent *Haworthia* or legume (perhaps *Lebeckia*) species. The matrix vegetation is dominated by a rather short and grayish variant of Renosterbos (*Dicerothamnus rhinocerotis*), with few other shrubs prominent, but some widespread Asteraceae *e.g.* *Metalasia densa* are occasionally also common. Even shale tolerant Fynbos elements (*e.g.* *Erica peltata*) are rare. The local Thicket vegetation is often extensive in fire-protected sites and varies much, with rather impressive stands of *Olea europaea* present along steep south facing slopes and ravines, which is unusual for Dune Thicket. *Aloe arborescence* and spiny shrubs such as *Azima tetracantha* are, however, abundant on more arid sites and hence the reference of this unit to Dune Thicket. Only one vegetation unit is recognized within the Mesic Mosaic Dune Thicket habitat type, the **Die Hoek Thicket-Renosterveld**.

![Figure 4.22](image.png) An example of the Mesic Renosterveld Mosaic Dune Thicket habitat. Note the rather abrupt and tidy transition from Renosterveld to the Thicket vegetation. I am sure that some interesting plants live here, but more careful exploration is needed.
4.2.4.2 Mesic Renosterveld Mosaic Dune Thicket and Fynbos

The presence and often local abundance of *Aloe arborescens* and *Sideroxylon inerme* indicate that the Thicket patches present are also more typical of Dune Thicket than Valley Thicket. The unit is, however, located on an often rapid transition from shale to deep quartzitic sands that occur mostly just south of the ferricrete and silcrete hills that are present. Renosterbos is dominant on the clayey soils, often with species such as *Oedera genistifolia* and *Oedera squarrosa* also prominent. Most abundant on the deep sands are Fynbos elements that are typical of the Albertinia Sandplain Fynbos, e.g. Dekriet (*Thamnochortus insignis*) and the uncommon *Leucospermum muirii*. Most of the hills present have been mined, seemingly for kaolin, but on undisturbed sites is a very interesting combination of Fynbos (e.g. *Protea decurrens*), Renosterveld (e.g. *Oedera garnotii*) and Thicket elements present. In the latter occurs the threatened local endemic *Haworthia splendens*. Only one vegetation unit is recognized within the Mesic Mosaic Dune Thicket and Fynbos habitat, **Albertinia Thicket-Fynbos-Renosterveld**.

![Image](image_url)

*Figure 4.23* The Fynbos elements are not visible in this example of the Mesic Renosterveld Mosaic Dune Thicket and Fynbos habitat, but they occur just over the ridge on the more sandy south facing slopes.
4.2.4.3 Mesic Renosterveld Mosaic Valley Thicket

In this habitat unit patches of Gouritz Valley Thicket clumps are present on north facing slopes and rocky outcrops, typically with some *Aloe speciosa* present in the Thicket. Where Thicket occurs on steep south facing slopes trees such as *Buddleja saligna, Pittosporum viridiflorum* and *Sideroxylon inerme* tend to be more abundant. The matrix Renosterveld is dominated by *Dicerothamnus rhinocerotis*, but other small shrubs such as *Eriocephalus africanus* and *Oedera squarrosa* are also abundant. Geophytes are abundant after fire (e.g. *Tritonia crocata*), including some widespread taxa such as *Gladiolus permeabilis ssp. permeabilis* and *Gladiolus teretifolius* that are never common elsewhere.

Two vegetation units are recognized within this habitat type. **Bokdrif Thicket-Renosterveld** is the more arid unit with lots of *Aloe ferox* in the matrix Renosterveld, which also contains the localized endemic *Lebeckia fasciculata*. The **Haelkraal Thicket-Renosterveld** enjoys a higher rainfall and has trees such as *Pittosporum viridiflorum* more prominent in the Thicket. This unit may be considered as an eastern variant of the following habitat type (Renosterveld mosaic with Thicket) due to the relative abundance of Thymelaeeaeceae (*Passerina* and *Struthiola* species) and presence of *Erica cruenta* on the southern slopes of the Renosterveld. It is, however, more arid than those located to the west, with the grass component not very well developed.

![Figure 4.24](image)

**Figure 4.24** An example of the more arid version of Mesic Renosterveld Mosaic Valley Thicket, with the rare *Lebeckia fasciculata* in foreground.
4.2.4.4 Mesic Renosterveld Mosaic Thicket

In this habitat the thicket contain few succulents and is dominated by trees such as *Buddleja saligna*, *Canthium inerme*, *Grewia orientalis*, *Olea europaea*, *Pittosporum viridiflorum*, *Rhus lucida* and *Scutia myrtina*. It occurs in fairly high rainfall areas and has been exploited much by intensive agriculture (wheat production and pastures). The Renosterveld is typically not entirely dominated by *Dicerothamnus rhinocerotis*, as especially members of the Thymelaeaceae (*Gnidia*, *Passerina* and *Struthiola*), but also other Fynbos elements (*e.g.* *Bobartia*, *Erica*, *Leucadendron*, *Restio*, *etc.*) are usually abundant on south facing slopes. Geophytes are present and usually abundant after fire (*e.g.* *Ornithogalum spp.*, *Moraea spp.*, *Tritonia crocata*, *Tritonia deusta*, *Tritonia flabellifolia*, *etc*.), but this habitat is strangely not very rich in geophyte species. Some endemic geophytes are present (*e.g.* *Lachenalia nervosa*), but they seem to associate more with the Thicket than the open Renosterveld. The latter may be due to the greater abundance of grasses (mostly *Cymbopogon*, *Ehrharta*, *Eragrostis*, *Hyparrhenia* and *Pentashistis* species, but *Themeda triandra* is also present) after a fire in this habitat.

![Figure 4.25](image)

Figure 4.25 An example of the Mesic Renosterveld Mosaic with Thicket habitat type.

Five vegetation units are recognized within the Mesic Renosterveld Mosaic Thicket habitat type, based on the abundance of Thicket clumps and the species present in the Renosterveld. The **Duyvenhoks Thicket-Renosterveld** occurs in moderately high rainfall areas where the Thicket clumps are often quite prominent along drainage areas
and the grass component is particularly well developed in the Renosterveld. Here *Hyparrhenia hirta* is often locally dominant, but that may be an artifact of heavy previous grazing practices, with *Themeda triandra* originally more abundant.

The **Plattekloof Thicket-Renosterveld** occurs in a fairly high rainfall area where more frequent fires have reduced the size of Thicket clumps. Much of the Thicket seems to have been replaced by stands of *Rhus lucida* and fire resilient shrubs such as *Otholobium spicatum*, *Passerina falcifolia* and *Struthiola hirsuta*. The latter species are all abundant on south facing slopes, along with some other fynbos elements (*e.g.* *Restio triticeus*), including the uncommon, characteristic *Erica cruenta*. As in other cases the unit does not seem to be rich in geophytes, but some common species such as *Tritonia deusta* are present. No endemic species are known to be present, but that may be due to the fact that the few unploughed remnants of this unit is densely invaded by alien trees (*Acacia mearnsii*). On north facing slopes some succulents such as *Aloe ferox* are present and intact examples of these slopes should be further explored, as they look promising as potential habitat for uncommon species.

The **Riversdal Thicket-Renosterveld** is one of the more arid units of this habitat type, with Thicket patches well-developed in rocky areas and drainage lines, often with succulents such as *Aloe ferox* abundant on north facing slopes. *Dicerothamnus rhinocerotis* dominate the Renosterveld, but other shrubs such as *Eriocephalus africanus* and *Oedera squarrosa* are also abundant. Fynbos elements are rare, even on the south facing slopes and grasses are present, but they are not as abundant as in the other units. Geophytes (*e.g.* *Tritonia deusta* and *Tritonia crocata*) are abundant after fire. The very rare *Agathosma gnidiiflora* may be endemic to this unit, or perhaps marginally shared with adjacent units, as it seems to prefer the ecotone to other units in which Fynbos elements are more abundant.

The **Valsrivier Thicket-Renosterveld** is easily identified by the greater presence of Fynbos elements, such as *Leucadendron teretifolium*, in the Renosterveld. *Dicerothamnus rhinocerotis* is present, but not dominant on south facing slopes, where it seems to be displaced by *Metalasia* and *Passerina* species. The uncommon, but characteristic *Erica cruenta* is also present on south facing slopes. The rare *Erica burchelliana* is a near endemic, shared only with adjacent units in which Fynbos is more abundant. Grasses are also prominent after fire and the unit is consequently not rich in geophyte species. In wet areas the Thicket patches become almost forest like, with species such as *Canthium inerme* and *Pittosporum viridiflorum* often abundant. This unit can be confused with the Plattekloof unit, but this unit is somewhat drier and the Thicket patches are better developed than in the Plattekloof unit.

The **Vlermuiskop Thicket-Renosterveld** is structurally similar to the other units, but here the Thicket clumps are often very fragmented. The unit is unmistakable as it has species such as *Euryops tenuissimus* and *Wiborgia tenuifolia* often abundant in the Renosterveld. Fynbos elements are rare, but patches of *Merxmuellera arundinacea* are sometimes present on quartzite outcrops. Succulents are sometimes abundant on rocky outcrops, including near-endemics such as *Haworthia maraisii* var. *meiringii*. 
4.2.4.5 Mesic Renosterveld Mosaic Thicket and Fynbos

This habitat is most similar to the former habitat type (Renosterveld mosaic with Thicket), but differs in having a better-developed Fynbos component, mostly since small quartzitic outcrops (conglomerate or silcrete) are present. The Renosterveld remains, however, the most prominent matrix vegetation and hence the classification of this unit as belonging to the Renosterveld biome, rather than being a Fynbos mosaic with Renosterveld habitat.

Although not knowing at the time of mapping the individual units, this habitat type turns out to represent a major transitional band between the coast and the mountains in the central part of the mapping domain. What probably spurred me to recognize these units as a unique habitat type during fieldwork (apart from the presence of Fynbos elements in the Renosterveld) was the rather heterogeneous nature of the Thicket bush-clumps present in this unit. In this habitat type the Thicket bush-clumps tend to be small, but well defined without a messy boundary. The Thicket species present, however, varies much and includes species typical of both the Dune Thicket (*Aloe arborescens*, *Azima tertacantha*, *Sideroxylon inerme*, etc.) and Valley Thicket (*Aloe ferox*, *Euclea undulata*, *Gymnosporia capitata*, etc.), along with some elements typical of the wetter upland Thicket units (*e.g. Diospyros dichrophylla*, *Pittosporum viridiflorum*, etc.).

Figure 4.26 An example of the Mesic Renosterveld Mosaic with Thicket and Fynbos habitat unit, showing the abundance of Fynbos elements on the southern slopes, *e.g. Bobartia macrospytaha*, *Erica peltata*, *Protea repens*, etc.
Four vegetation units are recognized within the Mesic Renosterveld Mosaic Thicket and Fynbos habitat type.

The Cooper Thicket-Fynbos-Renosterveld represents the easternmost example of this habitat and it has the greatest jumble of species present. The Thicket bush-clumps are rarely neatly delineated with fire-resilient species such as *Diospyros dichrophylla* often present in the Renosterveld, which tends to be best developed on north facing slopes, and the Fynbos on south facing slopes. The matrix Fynbos-Renosterveld contains a remarkable variance of widespread species depending on slope and substrate. This unit may not be remarkable for containing many rare plant species, but it is ecologically interesting in seemingly having fierce competition between the species present, with the final victors of the landscape not determined yet. Critical in determining the outcome of the competitive interactions between the wide array of species present is the disturbance regime. Previous herbivore grazing – fire regime interactions seem to have been disrupted and hence the current somewhat messy status of the vegetation. No endemic species are known, but a number of interesting ecotypes of *Haworthia* species (*e.g.* *H. magnifica*, *H. pygmaea*, *H. turgida*, etc.) are present that are difficult to assign to clearly defined taxa.

The Heidelberg Fynbos-Thicket-Renosterveld occurs mostly on Enon conglomerate, but a few small silcrete hills are also present. Here the Fynbos is not very well developed, but species such as *Erica peltata*, *Ischyrolepis capensis* and *Restio triticeus* are often common on south facing slopes. A wide array of *Aspalathus* species and an unusual variant of *Podalyria cuneifolia* are also present, but they are never abundant. The rather short local variant of *Dicerothamnus rhinocerotis* is abundant, but never dominant, thus allowing several other shrubs to be abundant (*e.g.* *Eriocephalus africanus*, *Oedera genistifolia*, *Oedera squarrosa*, *Oedera uniflora*, *Pteronia incana*, *Pteronia paniculata*, etc.) and a fair grass component (mostly *Eragrostis* and *Pentashistis* species) to persist. The unit is rich in geophyte species, *e.g.* *Tritonia cooperi* and several *Moraea* species, as well as succulents on rocky outcrops (*e.g.* *Adromischus caryophyllaceous*, *Senecio radicans*, etc.). Several of these succulents are rare species (*e.g.* *Euphorbia globosa*, *Haworthia floribunda*, *Haworthia heidelbergensis*, etc.), with *Haworthia serrata* possibly endemic. The local Thicket bush-clumps contain an unusual mix of species that represent all Thicket types (*e.g.* *Aloe arborescens*, *Buddleja saligna*, *Cussonia thyrsiflora*, *Euclea undulata*, *Gymnosporia capitata*, *Rhus pterota*, *Sideroxylon inerme*, etc.). Botanically this is certainly one of the most interesting units in this habitat type.

Several silcrete hills occur in the Kweekkraal Thicket-Fynbos-Renosterveld unit, with Fynbos elements often quite well developed on south facing slopes that include a few stray members of the Proteaceae (*e.g.* *Leucadendron galpinii*, *Leucospermum praecon* and *Protea obtusifolia*). The unit is in many respects very similar to the Heidelberg unit, as it has a similar mixed subset of Thicket species and it is also rich in succulents and geophytes. The combination of uncommon species present differs, however. Uncommon shrubs present include *Agathosma gnidiiforma* and *Ruellia pilosa* and uncommon succulents present include *Haworthia marginata* and *Drosanthemum muirii*, with *Haworthia retusa* possibly endemic or at least a near endemic. Geophytes such as
Gladiolus virescens, Tritonia deusta and Tritonia flabellifolia are abundant and an undescrbed species of Geissorhiza is endemic to this unit.

The westernmost unit in this habitat, Spiegelsrivier Fynbos-Thicket-Renosterveld, is once again an unconsolidated conglomerate of Fynbos, Thicket and Renosterveld elements. It is the wettest unit in this habitat and mostly occurring on shale derived soils. The vegetation of south facing slopes differs considerably from the more arid north facing slopes. On south facing slopes the Thicket consists mostly of species such as Buddleja saligna, Grewia occidentalis, Pittosporum viridiflorum and Rhus lucida, but Euclea undulata is present on north facing slopes. Passerina and Metalasia species are abundant in the matrix Fynbos-Renosterveld, with Dicerothamnus rhinocerotis abundant only on the north facing slopes. Some Protea neriifolia and Protea decurrens occur on the south facing slopes, along with Erica, Phylica and some Restio species, but these fynbos communities are diffuse and often have Thicket bush-clumps (e.g. Grewia occidentalis, Rhus lucida, etc.) present. No burned examples of this unit were seen but suspect that grasses will be abundant after fire. No rare or endemic species are known to occur here. Some uncommon succulents may, however, be present on the more arid north-facing slopes.

The Spiegelsrivier unit and the Cooper unit seems to represent interesting examples of how Renosterveld probably originated in much of the coastal lowlands, with Arid Thicket elements seemingly receding due to an increase in rainfall and subsequent increase in fires. Typical “weedy” Thicket elements, e.g. Buddleja saligna, Grewia occidentalis and Rhus lucida were clearly favored on the moist south facing slopes and started to become the precursors of a Thicket-Forest communities, which are present along well-watered drainage areas in the unit. Fire-resilient shrubs invaded the more frequently burned open slopes, with Dicerothamnus most successful on the arid north facing slopes and the Passerina-Metalasia-Protea communities more successful on the cooler slopes. The latter does not seem to be due to post-colonial transformation – if these units are man-made, then we should probably blame the Khoi. Whatever their origin, currently these units seem to provide an ideal opportunity to establish long-term monitoring sites to observe potential impacts of the predicted climate change. The wide array of species present will be affected by a shift in climatic conditions, especially if it is associated with an altered fire-regime. New selecting forces will favor different species, with predictably aridification favoring the Renosterveld elements, an increase in summer rain the establishment of a Grass-Fynbos, or an increase in winter rain expansion of the Fynbos component. The remnant Arid Thicket patches seems to be doomed, unless there will be severe aridification, which would favor an increase in the succulent plant component, punctuated by periodic high summer rain events that would enable woody species such as Euclea undulata to reestablish.
4.2.4.6 Mesic Renosterveld Mosaic Grassy Fynbos

This habitat unit represents one step up in moisture gradient from the previous habitat (Mesic Renosterveld Mosaic with Thicket and Fynbos), where the higher rainfall enabled the flammable shrub component to accumulate fuel fast enough to carry regular fires. The Thicket component is consequently absent here and limited to mostly only individual stands of *Rhus laevigata* and *Rhus lucida* on south facing slopes. Grasses (*Cymbopogon, Eragrostis, Pentashistis* species and some *Themeda triandra*) are abundant on north and south facing slopes in the post fire environment, with mostly only *Restio triticeus* present on south facing slopes. *Erica peltata* and *Protea repens* are periodically abundant on the south facing slopes, along with small stands of the uncommon *Protea subulifolia*. *Dicerothamnus rhinocerotis* is most abundant on the north facing slopes, but not dominant, as *Anthospermum aethiopicum, Cliffortia ruscifolia, Metalasia* and *Passerina* species are also abundant. Geophytes seem to be uncommon, with only some *Tritonia flabellifolia* and a few widespread *Babiana* species noted. Towards its more arid western end grasses such as *Merxmuellera arundinacea* become dominant on quartzitic outcrops. The latter being of particular interest as these communities extends eastwards through the Little Karoo into the eastern Kouga-Baviaanskloof mountains. No endemic species are known from the unit and I will be surprised if any are present. Only one vegetation unit is recognized in the Mesic Renosterveld Mosaic Grassy Fynbos habitat type, the **Swellendam Grassy Fynbos-Renosterveld**.

![Image](image.png)

**Figure 4.27** The Mesic Renosterveld Mosaic with Grassy Fynbos habitat type, note the abundance of *Passerina vulgaris* as overstory and grasses as understorey.
4.2.4.7 Mesic Renosterveld Mosaic Proteoid Fynbos

In this habitat type the Fynbos component is often well developed on south facing slopes and where quartzitic outcrops are present. Grasses are only prominent in the Renosterveld, but even here they are never prominent, but *Bobartia* species tend to be abundant, along with many geophytes (*e.g.* *Tritonia crocata*, *Tritonia deusta* and *Watsonia laccata*). The abundance of *Bobartia’s* indicates an increase in burning frequency and grazing practices, which resulted in the reduction of non-sprouting Fynbos species.

Mostly based on the species present in the Fynbos, two vegetation units are recognized here. In the **Petrosa Fynbos-Renosterveld** *Bobartia robusta*, *Erica versicolor*, *Leucadendron salignum*, *Protea lanceolata* and *Protea neriifolia* are the most abundant species. Here uncommon and endangered species such as *Haworthia pygmaea* and *Satyrium membranaceum* are present, along with westernmost populations of species such as *Satyrium parviflorum*. In the **Swartwater Fynbos-Renosterveld**, *Bobartia macrospyttha* and *Erica diaphana* are the most prominent species, with some *Leucadendron teretifolium* present. Uncommon and rare species present here include *Eulophia platypetala*, *Haworthia magnifica* and an odd variant of *Podalyria cuneifolia*.

![Figure 4.28](image-url) The Mesic Renosterveld Mosaic with Proteoid Fynbos habitat type, note the abundance of *Bobartia* amidst some *Erica* and *Leucadendron* species.
4.2.4.8 Mesic Renosterveld Mosaic Limestone Fynbos

A rather unique and limited habitat type, with only one vegetation unit recognized, the Moquini Limestone-Renosterveld. The unit is not rich in species, but is easy to recognize as it has a very gray-leaved and short (< 50 cm) variant of *Dicerothamnus rhinocerotis* dominant on the loamy-clayey soils, often along with *Themeda triandra* as the most abundant grass species. Limestone outcrops are present, in which, several species reach their easternmost distribution, e.g. *Berkheyia coriacea*, *Elegia muiri*, *Hermannia ternifolia* and *Hermannia trifoliata*. The unit is not very rich in species, but certainly contains an unusual combination of Fynbos species, including *Acmadenia heterophylla*, *Agathosma muiri*, *Aspalathus rubens*, *Disperago anomala*, *Ficinia truncata*, *Helichrysum teretifolium*, *Indigofera denudata*, *Metalasia pungens*, *Osteospermum polygaloides*, *Protea lanceolata*, *Relhania calycina*, *Staberoha cernua* and *Syncarpha paniculata*. No endemic species are known, but the local variant of *Protea lanceolata* is regarded as a threatened ecotype. Careful studies will most probably also reveal other unusual ecotypes, if not sub specific taxa, present in this unit.

**Figure 4.29** The Mesic Renosterveld Mosaic with Limestone Fynbos habitat type in the foreground with the pink-flowered *Acmadenia heterophylla* typical of the local limestone outcrops.
4.2.4.9 Mesic Renosterveld Mosaic Fynbos

This habitat type is perhaps more typical of the Renosterveld that occurs west of the Breede River than those further east. Here the vegetation is structurally rather uniform and dominated by Asteraceous shrubs, with Thicket elements rare and Fynbos elements (e.g., Coleonema aspalathoides, Erica berzeliioides, Erica peltata, Ischyrolepis capensis, Hypodiscus willdenowia, Leucadendron teretifolium, etc.) often abundant on south facing slopes. Several of these Fynbos elements are threatened species (e.g., Leucadendron coriaceum) and some are endemic to this unit (e.g., Liparia striata). Rather remarkable is the relative abundance of coarse C3-grass species (mostly Merxmuellera and Pentashistis species) on north-facing slopes. Although frequent fire regimes do not allow for the persistence of many Thicket elements, some are some present in rocky outcrops (Aloe arborescens, Carissa bispinosa, Putterlickia pyracantha, Sideroxylon inerme, etc.). Unusual and very interesting is the abundance of localized endemic succulent species such as Gibbaeum haagei and several unusual Haworthia populations in the quartzite outcrops present and rocky silcrete hills tops. Despite the heterogeneity of the habitat only one vegetation unit is recognized, the **Verkykerskop Fynbos-Renosterveld**.

![Image of the Mesic Renosterveld Mosaic with Fynbos habitat unit](image)

**Figure 4.30** The Mesic Renosterveld Mosaic with Fynbos habitat unit, here with Chondropetalum microcarpum in the foreground and the typical Renosterveld-Fynbos mix in the background. Many Succulent Karoo species are also present in the white quartz outcrops in the foreground.
4.2.4.10 Mesic Renosterveld Mosaic Succulent Karoo

Only one vegetation unit is recognized within the rather odd Mesic Renosterveld Mosaic Succulent Karoo habitat type, the **Mosselbaai Succulent-Renosterveld**. Here Renosterveld remains the matrix vegetation, but in less frequently burned rocky sites are fragments of Thicket in which woody shrubs and trees (e.g. *Carissa bispinosa*, *Euclea undulata*, *Putterlickia pyracantha*, *Rhus pterota* and *Sideroxylon inermis*) are abundant, along with many succulents (e.g. *Cotyledon orbiculare*, *Gasteria carinata*, *Sarcostemma viminalis*, etc.). The matrix Renosterveld is dominated by *Dicerothamnus rhinocerotis*, but many other asteraceous species are also present, e.g. *Eriocephalus africanus*, *Metalasia pungens*, *Oedera genistifolia* and *Oedera squarrosa*. The Renosterveld is unusual in also containing many succulent species, with some are more typical of inland areas (e.g. *Aloe ferox*, *Euphorbia burmanii*, *Euphorbia clandestina*, *Euphorbia heptagona*, etc.), more western areas (e.g. *Haworthia minima*), uncommon species (e.g. *Haworthia chloracantha*), and some are local endemic species, such as *Euphorbia bayeri*. Several geophyte species are also present (e.g. *Freesia refracta*, *Gladiolus stellatus*, *Tritonia crocata*, etc.) including the uncommon *Cyranthus inaequalis*.

![Image of Mesic Renosterveld Mosaic with Succulent Karoo](image)

**Figure 4.31** The rather uncommon Mesic Renosterveld Mosaic with Succulent Karoo habitat unit, here showing the abundance of succulents on north facing slopes, such as *Aloe ferox*. 


4.2.5 Fynbos

No deviations from current thinking are proposed for the Fynbos biome. The nineteen habitat types that are recognized have all been proposed previously. Perhaps confusing may be the recognition of both Proteoid and Montane Proteoid habitat types. In both cases overstory Proteoid shrubs are abundant to dominant, but in the more lowland Proteoid habitat types the understorey contains less restioids and have the graminoid component usually better developed than the upland Montane Proteoid habitat types.

Fire is undoubtedly the most important disturbance regime in all the Fynbos habitat types, but I am convinced that herbivores play(ed) an important role in some of the lowland habitat types, especially the Dune and Grassy Fynbos habitat types. In the case of the Dune Fynbos types I am also convinced that mole-rat activity plays an important role to ensure nutrient cycling and as a disturbance regime to retain open sites for weaker competitors. Species that are dependant on regular soil disturbance, such as annuals, is for instance abundant in the lowland Sandplain Fynbos habitat types, but they are uncommon in the upland Montane habitat types. These species are clearly dependent on mole-rat activity to persist in the habitat. Recruitment of many of the typical lowland species (e.g. Thamnochortus insignis, Leucadendron galpinii, Leucadendron muirii, Leucospermum praeocox, etc.) can moreover occur in the absence of fire, but seemingly only in sites where physical soil disturbance occurred. In the upland Montane habitat types such recruitment is very rare and usually not successful. Faunal activity thus seems to play a greater role in the ecology of lowland Fynbos plants than in the lives of their upland montane counterparts. This notion is further supported by the presence of invertebrates that are dependant on the presence of larger fauna in the lowland Fynbos, e.g. Flightless Dung Beetle (Circellium bacchus), and their absence in the upland Fynbos habitat types. It is also interesting to note that tortoises (e.g. Angulate tortoise) are also much more abundant in the lowland fynbos than the Montane Fynbos habitat type. This tells me that there are inherent differences in the disturbance regimes of the lowland Fynbos habitat types and their upland Montane counterparts. These differences have not yet been researched well and certainly deserve more attention.

I am, however, not advocating the exclusion of fire or the introduction of large numbers of herbivores in some lowland Fynbos habitat types. Both of these would certainly result in the loss of some plant biodiversity. Regular soil disturbance and suppression of fire clearly favor certain taxa such as Dekriet (Thamnochortus insignis), but it comes at the cost of other species (especially large seeded species such as Leucospermum praeocox). Appropriate fire frequency will vary tremendously between the different habitat types and will depend mostly of the rate of growth of the slowest to mature species, which is largely determined by the local soil nutrient status and rainfall of the habitat type. The appropriate fire season to conserve biodiversity in all the local Fynbos habitat types remains late summer to autumn (December-April). Although currently often questioned, I have not seen any conclusive data that May to November fires are ecologically acceptable. High intensity fires may be obtained during “bergwind” conditions in winter, but post-fire recruitment success of both the flora and fauna still need to be researched well before such fires become prescribed practices.
4.2.5.1 Asteraceous Fynbos

Only one vegetation unit is recognized within the Asteraceous Fynbos habitat type, the **Resiesbaan Asteraceous Fynbos**. Here the typical elements of Fynbos, Proteaceae and Ericaceae are almost absent and even Restionaceae are uncommon, with mostly only *Restio triticeus* and *Ischyrolepis capensis* present. It is only classified as a Fynbos habitat as Renosterbos (*Dicerothamnus rhinocerotis*) is not the dominant species, albeit present amongst many other asteraceous shrubs (*Eriocephalus, Metalasia, Oedera, Stoeb, etc.*), and the rather odd asteraceous geophyte genus *Corymbium*, which is particularly prominent after fire. Grasses (mostly *Cynodon dactylon* and *Digitaria, Ehrharta, Eragrostis species*, but also *Themeda triandra*) and a rich array of geophytes (e.g. several *Babiana, Ixia, Gladiolus species, Tritonia deusta* and *Tritonia flabellifolia*, but also some orchids such as *Pterygodium* and *Satyrium* species) are also prominent after a fire. The unit seems to be very rich in *Aspalathus* species, of which at least one, *Aspalathus grobleri*, is a near endemic. Small clumps of *Acacia karoo* occur here, but few other woody shrubs and trees are present. Several seasonal wetlands are also present, but they have been assigned to a different unit, the Bontebok Inland Pans.

![Figure 4.32](image-url) The rather uncommon Asteraceous Fynbos habitat. Note the presence, but not dominance of Renosterbos and abundance of grasses in the burned background area.
4.2.5.2 Sandolienveld

This is another unusual habitat type for the Riversdale region with only one vegetation unit recognized in the region, the **Drew Sandolienveld**. This unusual habitat was created by quartzitic material that was washed from the uplands to the lowlands where Sandolien (*Dodonaea angustifolia*) and *Clifortia ruscifolia* became the dominant plants. Several Fynbos elements such as *Leucadendron salignum*, *Muralta heisteria*, *Protea repens* and *Serruria acrocarpa* are also present, but they are not dominant. Some of these Fynbos elements are uncommon, threatened species such as *Clifortia varians*. Grasses are present (*e.g.* *Ehrharta*, *Pentashistis* and *Tribolium* species), but they are not very abundant. This habitat type is clearly very arid in summer, to which the relative abundance of succulents attests. Some of these succulents are threatened species, *e.g.* *Acrodon purpureostylosum*. Several geophytes also occur here, *e.g.* *Pelargonium auritum* and *Tritonia flabellifolia*, of which some are uncommon species (*Pelargonium undulatum*). I am rather sure that a careful survey of this unit will reveal some endemic species, despite the rather awful state and degradation through heavy grazing of the remaining examples of the unit.

**Figure 4.33** Another uncommon habitat in the region is the Sandolienveld, distinct by the presence of *Dodonaea angustifolia* and several uncommon succulents and geophytes.
4.2.5.3 Dune Sandplain Fynbos

Initially I thought it would be possible to map the Sandplain vegetation units on neutral sands separately from those occurring on the more acid sands. In the field one can recognize these plant communities easily as they are dominated by different species, especially in terms of the Ericaceae, Proteaceae and Restionaceae present. The acidity of the sands seem to be in part determined by water availability, with wetter sites having more acidic soils. It is interesting to note that members of the Rutaceae largely replace Ericaceae in the more arid neutral sands. It is thus little wonder that the plant communities on more acidic sands are more similar to the upland Montane Proteoid communities (even in the geophytes present such as *Watsonia fourcadel*) than the communities that occur on the neutral sands. The microhabitat variance in the landscape is, however, just too complex to map the plant communities at a scale of 1:50 000. There is moreover often a gradual transition in the dominant species from acidic sands to the neutral sands. Although I was unable to map the micro-scale variance of the often-distinct communities, recognizing three vegetation units in the Sandplain habitat type has captured some of the heterogeneity of the Sandplain Fynbos habitat type.

![Figure 4.34](image_url) Example of the Sandplain Fynbos habitat type in which species of *Leucospermum* often abound amongst Restio’s and a wide variety of other Fynbos related genera such as the Rutaceae rather than the Ericaceae.
The **Albertinia Sandplain Fynbos** occurs mostly on neutral sands, indicating that it is located in a fairly arid environment. Several small seasonal wetlands are present, with which the local endemic *Erica bauera* is associated, but these have been mapped separately as Albertinia Pans. The unit is easily recognized by having *Protea sussanae* and *Leucadendron galpinii* the dominant overstory shrubs, with Dekriet (*Thamnochortus insignis*) also abundant throughout the unit. Some *Leucospermum praecox* is present, but it is never dominant as it is largely replaced by the local endemic *Leucospermum muirii*. Ericaceae are rarely abundant, but the regional endemic *Erica dispar* may be locally abundant, with the local endemic *Erica viscosissima* occurring sporadically. Rutaceae are often prominent, including regional endemics such as *Diosma sabulosa*, with *Agathosma pallens* a local endemic that may be extinct now. Several *Aspalathus* species are abundant after fire, with at least one local endemic (*Aspalathus quadrata*) present. Geophytes are also common, often with *Gladiolus rogersii* prominent in spring. The rare and threatened *Disa hallackii* was recorded here, but it may have been extirpated by the dense invasion of aliens (mostly *Acacia cyclops* and *Acacia saligna*, but also *Leptospermum laevigatum*).

The **Buffelskop Sandplain Fynbos** is located in a fairly high rainfall zone. Here the vegetation is dominated by dense stands of Proteaceae, including *Aulax cancellata*, *Leucadendron salignum*, *Leucospermum praecox*, *Protea neriifolia* and *Protea repens*. *Protea lanceolata* and *Protea sussanae* are occasionally also present, but the latter species occur mostly on the more arid north-facing slopes. *Thamnochortus insignis* is not very abundant in this unit as is replaced by other species such as *Ceratocaryum argenteum* and *Mastersiella purpurea*. Diagnostic is the presence of species such as *Cliffortia ilicifolia*, *Cyclopia genistoides* and *Psoralea affinis* in moist sites. Rare species present include *Aspalathus quadrata*, with a subspecies of *Erica bauera* and *Lobostemon bellidiformis* endemic to this unit. This unit may be confused with the Canca Thicket-Sandplain Fynbos as *Leucospermum praecox* is also abundant there, but the Buffelskop unit can be differentiated by the absence of Thicket bush clumps and presence of species such as *Protea neriifolia*.

The **Heiderand Sandplain Fynbos** unit is also fairly moist, as the presence and often local abundance of species such as *Leucadendron salignum*, *Leucospermum praecox*, *Protea lanceolata* and *Protea repens* attests. *Thamnochortus insignis* is present but not dominant in this unit, with other restioids such as *Mastersiella purpurea* also abundant. Annuals and geophytes (*e.g. Freesia alba*, *Gladiolus rogersii*, etc.) are prominent after a fire in this unit. The threatened *Disa hallackii* also occurred here, but it has been extirpated by housing development and alien infestations. Several species reach their easternmost distribution here, including widespread Ericaceae such as *Erica pulchella* and the regional endemic *Erica dispar*. A rich assembly of ericoid-leaved shrubs is present with species such as *Cliffortia falcata*, *Cliffortia stricta* and *Metalasia muricata* prominent. Rutaceae are also well represented with the regional endemic *Agathosma muirii* present and the threatened *Diosma aristata* endemic to this unit. Other rare species known to be present include an undescribed *Prismatocarpus* species, which may also be endemic to this unit.
4.2.5.4 Dune Sandplain Mosaic Thicket

As the name alludes, this habitat type differs from the other Sandplain Fynbos types in having some Thicket bush-clumps, with mostly species such as *Azima tetracantha*, *Carissa bispinosa*, *Cussonia thyrsiflora*, *Euclea racemosa*, *Olea exasperata*, *Rhus glauca*, *Sideroxylon inerme* and *Tarchonanthus camphoratus* present. These bush-clumps are not always well-developed and tend to be more prominent towards the coastal area, but regional endemics such as *Agathosma muirii* and *Carpobrotus muirii* are associated with them. The presence of these bush-clumps indicate that this habitat type is perhaps more arid than the other Sandplain habitat types.

Only one vegetation unit is recognized within this habitat type, here called the Canca Thicket-Sandplain Fynbos. The matrix Fynbos is dominated by *Leucadendron meridianum*, *Leucadendron salignum*, *Leucospermum praecox*, *Protea repens* and *Protea sussanae*. Dekriet (*Thamnochortus insignis*) is abundant throughout this unit, but many ericoid leaved shrubs are also prominent (*e.g.* *Agathosma collina*, *Agathosma serpyllacea*, *Cliffortia stricta*, *Metalasia muricata*, *Trichocephalus stipularis*, etc.) of which some, such as *Staavia radiata*, reach their easternmost distribution here. Several uncommon regional endemics are known from the unit, including *Aspalathus dasyantha*, *Aspalathus odontoloba*, *Athanasia mundtii*, *Centella brachycarpa*, *Centella calcaria*, *Caesia sp.nov* and *Euchaetis albertiniana*. Threatened species known from the unit include *Disa lugens*, *Freesia leichtlinii* and the local endemic *Amphithalea sp. nov*..

![Image](image_url)

**Figure 4.35** The Sandplain mosaic with Thicket habitat type in which *Leucospermum praecox* and several other Proteaceae are abundant.
4.2.5.5 Dune Sandplain Mosaic Forest and Thicket

This habitat type is very similar to the former Canca unit, but differs structurally in having clearly defined and often well developed stands of a Thicket-Forest community present. The combination of species in these bush-clumps is unusual with *Azima tetracantha*, *Canthium inerme*, *Gymnosporia capitata*, *Mystroxylon aethiopicum*, *Olea europaea*, *Olinia ventosa*, *Pterocelastrus tricuspidatus*, *Rhus pterota*, *Scolopia zeyheri*, *Sideroxylon inerme* and *Tarchonanthus camphoratus* the most abundant species present. In the understorey of these Forest-Thicket communities occur a number of species that are unusual for the region, *e.g.* the ground orchid *Habenaria arenaria*.

Only one vegetation unit is recognized within this habitat, the **Ystervarkpunt Forest-Thicket-Fynbos**. Proteoid shrubs do not dominate the matrix Sandplain Fynbos, but species such as *Leucadendron salignum* and *Protea lanceolata* are present. Dekriet (*Thamnochortus insignis*) is abundant throughout the unit, but many other ericoid shrubs are also present, some of which are uncommon regional endemics, such as *Aspalathus arenaria* and *Aspalathus sanguinea* ssp. *foliosa*. Annuals are abundant in spring, along with geophytes of which some are rare and threatened taxa, such as *Disa lugens* and *Freesia leichtlinii*. At least one local endemic species is known from the unit, *Moraea sp.nov*..

![Figure 4.36](image-url) The Sandplain mosaic with Forest and Thicket habitat type. Note the abundance of Dekriet and well-developed Thicket-Forest bush-clumps.
4.2.5.6 Dune Limestone Mosaic Thicket

This habitat is rather well known as Limestone Fynbos, but previous authors chose to ignore the often-prominent patches of Dune Thicket vegetation that are present. They tend to be best-developed in fire-protected sites within the limestone outcrops, but can also be prominent along the northern base of the limestone forming an interface with the adjacent Sandplain Fynbos units. Species most abundant in these Thicket bush-clumps are *Azima tetracantha*, *Gymnosporia buxifolia*, *Mystroxylon aethiopicum*, *Olea europaea*, *Pterocelastrus tricuspidatus*, *Rhus glauca*, *Rhus pterota*, *Sideroxylon inerme* and *Tarchonanthus camphoratus*.

The matrix Limestone Fynbos is very easy to recognize by ubiquitously having *Leucadendron meridianum*, *Leucadendron muirii* and *Protea obtusifolia* the most prominent proteoid shrubs. They are, however, rarely dominant and allow a rich assembly of other shrubs (*e.g.* *Acmadenia heterophylla*, *Amphithalea sericea*, *Berkeya coriacea*, *Erica spectabilis*, *Euryops ericoides*, *Metalasia calcicola*, *Syncarpha paniculata*, etc.), graminoids (*e.g.* *Chondropetalum microcarpum*, *Elegia muirii*, *Ficinia truncata*, *Thamnochorus muirii*, etc.), geophytes (*e.g.* *Satyrium carneum*) and succulents (*e.g.* *Adromischus caryophyllacea*, *Cotyledon orbiculare*, *Delosperma litorale*, etc.) to co-occur in the limestone outcrops.

Figure 4.37 A typical example of the Limestone mosaic with Thicket habitat type. Note the difference in vegetation between arid north facing slopes in the foreground and those of a south facing slope in background.
Based on structural variance in the vegetation, in part the relative abundance of the Thicket bush-clumps, but also the species composition and structure of the matrix Limestone Fynbos vegetation, I recognize three vegetation units in this habitat type.

In the **Hectorskraal Thicket-Limestone Fynbos** the thicket bush-clumps are often well developed often with large *Olea europaea* and *Sideroxylon inerme* trees present. Such areas may be confused with the former Ystervarkpunt Sandplain Fynbos unit, but here Limestone Fynbos communities dominate the matrix Fynbos. Several uncommon species are present in these Fynbos communities indicating a close relationship with the limestone communities further west, including *Acmadenia densifolia*, *Acmadenia obtusata*, *Aspalathus acutiflorus*, *Euryops hebecarpus*, *Stoebe muirii*, but some local endemic species are present, e.g. *Lampranthus fergusoniae*, *Metalasia luteola* and *Oedera steyniae*. It shares some local endemic geophytes with the Windsor unit, e.g. *Tritonia squalida*.

The **Vermaaklikheid Thicket-Limestone Fynbos** unit is somewhat odd in being intermediate between the Limestone and Sandplain Fynbos units. Here limestone outcrops are prevalent, with species such as *Protea obtusifolia*, *Leucadendron meridianum* and *Leucadendron muirii* abundant, but in many sites a layer of aeolic sands cover the limestone. Wherever these sands are fairly deep (30-50 cm), Sandplain Fynbos species (e.g. *Leucadendron galpinii*, *Protea sussanae*, etc.) abound even along with species more typical of acidic sands (e.g. *Ceratocaryum argenteum*, *Protea lanceolata*, *Protea repens* and *Watsonia fourcadei*). Characteristic of the unit is the relative abundance of *Leucospermum truncatum*, but some populations of this species are difficult to tell from *Leucospermum praecox*. The latter indicates that this unit is a transitional zone for Limestone Fynbos species that occurs east or west of the Breede River. This notion is supported by the presence of species such as *Adenandra obtusata* that are more abundant west of the Breede River. The transitional nature of the area may explain why no endemic species are known to occur here, but some sub specific taxa are endemic to the unit, such as *Haworthia mirabilis* var. *paradoxa*. It is interesting to note that this species has another variety endemic to the limestone west of the Breede River.

The **Windsor Thicket-Limestone Fynbos** unit is rather arid in which the Thicket bush-clumps are rather fragmented, but often with quite large *Olea europaea* trees present. Succulents are often very abundant, with species such as *Cotyledon orbiculare*, *Euphorbia burmanii*, *Euphorbia caput-medusae*, *Euphorbia clandestina*, *Euphorbia mammilaris* and *Sarcostemma vimenale* locally abundant. The near-endemic *Haworthia variegata* is sometimes locally abundant in the limestone outcrops, but hard to see. Proteoid shrubs are not abundant with mostly only *Leucadendron muirii* present. Abundant shrub species here are *Oedera squarrosa*, *Oedera uniflora* and *Nylandtia spinosa*, with the latter species often locally dominant in the often heavily grazed areas. Rutaceae are not very prominent, but the regional endemic *Agathosma riversdalensis* is sometimes locally abundant. Geophytes are prominent after good rain, especially the near endemic *Tritonia squalida*. Small seasonal wetlands occur within this unit, sometimes with *Leucadendron linifolium* along their outer edges, but they were mapped separately as Windsor pans.
4.2.5.7 Proteoid Silcrete-Ferricrete Fynbos

This habitat type is structurally most similar to the more upland Montane Mesic Proteoid habitat type, but it differs in having the restioid component not as well-developed and the graminoid component more prominent. Ericoid shrubs are also very abundant here, but members of the Ericaceae are not as prominent as they are in the Montane Fynbos. After fire grasses (*Digitaria, Ehrharta, Eragrostis* and especially *Pentashistis* species) are very abundant, along with other graminoids such as *Lanaria lanata*. Only one vegetation unit is recognized within this rather wet habitat type, the **Gondwana Silcrete Fynbos**.

In pristine examples the unit is dominated by a dense overstory of proteoid shrubs, with *Leucadendron rubrum, Leucadendron salignum, Leucospermum cuneiforme, Protea coronata* and *Protea neriifolia* most abundant, but species such as *Mimetes cucculatus* are also present. The ericoid shrub component is somewhat similar to the lowland Sandplain Fynbos in having non-ericaceous species such as *Agathosma capensis, Cliffortia ilicifolia, Cliffortia stricta, Helichrysum cymosum, Metalasia acuta, Metalasia densa, Pelargonium fruticosum, Phylica axillaris, etc.* abundant. Geophytes are also abundant in the post-fire environment, with species such as *Watsonia laccata* prominent. Despite ones intuition when first encountering this unit there seems to be no endemic species present, which may well indicate a relatively recent origin of the unit, but there are some uncommon widespread species present, such as *Pelargonium radens*.

![Figure 4.38](image) A typical example of the Proteoid Silcrete-Ferricrete habitat type.
4.2.5.8 Proteoid Silcrete Mosaic Renosterveld and Thicket

In this habitat unit silcrete topped hills is the most prominent landscape feature, with the upper flat hilltops usually having shallow sandy soils, with the lower slopes mostly consisting of clayey soils derived from shales. Where silcrete outcrops are extensive I separated the habitat type, but where these hills are fragmented I could not do so and this habitat type represents those fragmented landscapes. The rocky outcrops of quartzitic material provide fire-protected sites in which most of the Thicket bush-clumps are present. Thicket species present in this habitat depends on the local availability of water, but mostly only common Thicket species are present, e.g. *Aloe arborescens, Aloe ferox, Buddleja saligna, Carissa bispinosa, Gymnosporia buxifolia, Putterlickia pyracantha, Rhus lucida, Rhus pterota* and *Sideroxylon inerme*. The Fynbos elements are most prominent on the south facing slopes and always have the proteoid overstory well developed, with species such as *Leucadendron salignum, Leucospermum cuneiforme* and *Protea neriifolia* most abundant. Renosterbos (*Dicerothamnus rhinocerotis*) is usually dominant on north facing slopes, along with many other asteraceous shrubs (especially *Metalasia* species) and often also a well-developed graminoid component.

![Image](image-url)

**Figure 4.39** An example of the Proteoid Silcrete mosaic with Renosterveld and Thicket habitat type showing a prominent silcrete topped hill that is typical of this habitat type.
Based on variance in the structure of the vegetation and species present, I recognized three vegetation units in the Proteoid Silcrete Mosaic with Renosterveld and Thicket habitat type.

In the easternmost example, the **Leeukloof Fynbos-Renoster-Thicket** the Thicket bush-clumps are best developed and usually have somewhat fire-resilient species such as *Diospyros dichrophylla*, *Grewia occidentalis*, *Pittosporum viridiflorum* and *Rhus lucida* abundant in the Renosterveld on north facing slopes. In intact examples *Protea neriifolia* form dense stands on the south facing slopes, often along with *Protea lanceolata* and ericoid shrubs such as *Erica versicolor* and the regional endemic *Erica dichrus*. In most cases this habitat has been burned frequently for grazing purposes with only an abundance of resprouting shrubs such as *Leucadendron salignum* and *Leucospermum cuneiforme* and graminoids such as *Lanaria lanata* remaining. *Passerina falcifolia* and other Thymelaeaceae are abundant in the Renosterveld, as is the case in other wet Renosterveld types. Geophytes (such as *Babiana fourcadei* and *Watsonia laccata*) are also prominent after fire. An odd variant of *Protea nitida*, with erect branches less than 1 m tall, occurs sporadically on south facing slopes. One of the threatened species known to occur here is *Salvia mairii* that also occurs sporadically in the local Fynbos.

The **Proteus Fynbos-Renoster-Thicket** is most similar to the Leeukloof unit, but differs in having the Thicket mostly as fragmented bush-clumps, except in the drainage areas of north-facing slopes where they are often well-developed. The species present in the Fynbos also differs with *Erica dichrus* absent and *Erica versicolor* more prominent, but *Protea neriifolia* remain abundant. Renosterbos (*Dicerothamnus rhinocerotis*) is most abundant on the north-facing slopes, but it is rarely dominant, with other asteraceous shrubs such as *Metalasia acuta*, *Metalasia densa* and *Metalasia pungens* also abundant. Geophytes (e.g. *Babiana fourcadei* and *Watsonia laccata*) and graminoids (especially *Lanaria lanata*) are also abundant after fire, with some rare threatened species also present, such as *Satyrium muticum*.

In the westernmost unit, the **Vergenoeg Renoster-Thicket-Fynbos** only very fragmented and species depauperate (e.g. *Aloe arborescens*, *Carissa bispinosa*, *Diospyros dichrophylla* and *Grewia occidentalis*) Thicket bush-clumps are present. Most of the unit consists of a heterogeneous matrix of Fynbos communities, with small stands of *Protea coronata* and *Protea neriifolia* along with an abundance of *Erica discolor* present on wetter south facing slopes, that changes to *Protea decurrens* communities on drier south facing slopes and odd Grassy Fynbos communities with species such as *Protea piscina* present on north facing slopes. Apart from *Lanaria lanata* graminoids are not very prevalent and consists mostly of *Pentaschistis* and *Merxmuellera* species, with *Restio triticeus* the most abundant restioid. Renosterbos (*Dicerothamnus rhinocerotis*) is sometimes locally dominant on north facing slopes, but it is not very prevalent in this unit. Rare species known from this unit include threatened species such as *Leucadendron coriaceum*, but many unusual variants of *Haworthia* species are also present in rocky outcrops.
4.2.5.9 Proteoid Enon Conglomerate Fynbos

In this singular habitat type only one vegetation unit is recognized, the **Bontebok Proteoid Fynbos**. This habitat is most similar to the following habitat type (Proteoid Enon Mosaic Renosterveld and Thicket) but differs in having Thicket and Renosterveld prominent. There are a few small Thicket patches on north facing slopes, but they seem to relate more to the adjacent Breede River and floodplain unit. Some Renosterbos (*Dicerothamnus rhinocerotis*) is also present in this unit, but it is never dominant and rather replaced by *Cliffortia ruscifolia* as the dominant species. The Fynbos component is moreover so distinctly different from those in the other two vegetation units (Brandwag and Gondwana) that I have no hesitation in recognizing this as a distinct habitat type.

Frequent burning practices reduced the reseeding overstory proteoid component with only some stands of *Protea repens* still present, but the resprouting *Leucadendron salignum* abounds. Several other smaller Proteaceae are also present, *e.g.* *Leucospermum calligerum, Protea decurrens, Protea piscina, Serruria acrocarpa, etc.* It is interesting to note that the resprouting *Leucospermum cuneiforme* is not as abundant as it is in the nearby upland Montane Fynbos units. Here the Fynbos communities are very patchy and differ substantially in the species locally dominant, resulting in a rich array of species present, many of which are endemic or near-endemic to this unit, *e.g.* *Acmadenia laxa, Aspalathus burchelliana, Aspalathus grobleri, Diosma fallax, Erica filamentosa, etc.*

![Figure 4.40](image-url) The Proteoid Enon Conglomerate habitat type showing *Leucospermum calligerum* in the foreground.
4.2.5.10 Proteoid Enon Mosaic Renosterveld and Thicket

The Proteoid Enon Mosaic Renosterveld and Thicket habitat may look superficially similar to the Proteoid Silcrete Mosaic Renosterveld and Thicket habitat, as the structure of the vegetation is rather similar. The habitat types confined to Enon conglomerates are, however, more arid with the Thicket component well developed in fire-protected sites on north and south facing slopes and mostly comprising of Valley Thicket species. Succulents (e.g. Aloe speciosa, Euphorbia atrispina, Sarcostemma viminale, etc.) are consequently much more abundant. The Fynbos on south facing slopes also contain overstory proteoid shrubs such as Leucadendron eucalyptifolium, Protea coronata, Protea lanceolata and Protea neriifolia, but they are rarely dominant. The Renosterveld of the north facing slopes is usually very grassy, with species such as Brachiaria serrata, Cynodon dactylon, Digitaria eriantha, Eragrostis capensis, Eragrostis curvula, Eragrostis obtusa, Eustachys paspaloides, Harpochloa falx, Sporobolus fimbriatus, Themeda triandra, Tribolium uniolae, etc. abundant.

Two somewhat similar vegetation units are recognized in this habitat type. The Brandwag Fynbos-Renoster-Thicket differs from the Gondwana Fynbos-Renoster Thicket in having threatened species such as Euphorbia bayeri, Haworthia parksiana and Haworthia kingiana as near-endemic species. A more careful survey of the Gondwana unit will probably reveal its own component of endemic species present.

![The Proteoid Enon Conglomerate mosaic with Renosterveld and Thicket habitat type showing the abundance of Thicket on northern slopes.](image)

**Figure 4.41** The Proteoid Enon Conglomerate mosaic with Renosterveld and Thicket habitat type showing the abundance of Thicket on northern slopes.
4.2.5.11 Grassy Fynbos

The Grassy Fynbos habitat is located in a zone of fairly high rainfall and has nutrient rich soils that are mostly derived from shale. They occur on hills located immediately to the south of the coastal mountain range (Langeberg-Outeniqua mountains) in a position that is fully exposed to the dry, warm “bergwind” of winter. If not for the desiccating action of these winds, creating a high fire risk, I suspect that this habitat would have consisted of Forest-Thicket vegetation, rather than being dominated by grasses. In fire protected sites (e.g. rocky outcrops and ravines) one still sees remnants of Forest-Thicket communities with species such as Canthium inerme and Diospyros dichrophylla present, often along with other indicators of past forest sites, such as an abundance of Pteridium aquilinum.

Here I remain within the well-known concept of Grassy Fynbos, a unit in which graminoids (especially true grasses) are abundant in the understorey, with an often poorly developed overstory of proteoid shrubs, but ericoid shrubs not uncommon. This may well be the only habitat type in the region in which fires occurred naturally during winter and spring, which would favor the graminoid component. The graminoid component would have attracted grazing herbivores (e.g. buffalo), which would have further favored the grass component. Currently unpalatable grasses (e.g. Pentashistis species and Heteropogon contortus) dominate much of the unit, but I suspect that more palatable sweet-grasses (e.g. Digitaria eriantha, Eustachys paspaloides, Harpochloa falx, Themeda triandra, etc.) were more prominent in the past.

Figure 4.42  A typical example of the Grassy Fynbos habitat in the region, without the mountain backdrop the site could have been located in the Eastern Cape.
Although this habitat tends to be structurally very uniform, I recognize three vegetation units in the Grassy Fynbos habitat type. Differences are mostly based on the species present, but even these are subtle. I should note that I was often struck by the similarity of these units to many Grassy Fynbos units located in the eastern Cape, especially those in the vicinity of Grahamstown. Plant growth-forms that are otherwise uncommon in other habitat types, e.g. broad-leaved geophytes such as *Helichrysum nudifolium* and sprouting members of the Apocynaceae (e.g. *Pachycarpus*), are often present here. They are also common in the Grassy Fynbos of the eastern Cape Grassy Fynbos and hence my relation of these units to those located much further east. One would expect that the local and eastern Cape Grassy Fynbos would share some uncommon species with long-distance seed dispersal mechanisms, e.g. terrestrial orchids and Apocynaceae such as *Brachystelma*. No data are available to support this notion and hence the differentiation of these units.

The **Buffelsjachts Grassy Fynbos** is the westernmost unit in this habitat type. As in all other cases it is dominated by a well-developed graminoid component, with almost no oysterly proteoid shrubs present. Even sprouting species such as *Leucadendron salignum* and *Leucospermum cuneiforme* are never abundant here, indicating that the absence of proteoid shrubs is not due to recent transformation. The local abundance of some weedy indigenous species such as *Anthospermum aethiopicum* and *Stoebe plumosa* indicate that some disturbance has taken place, perhaps the eradication of small forest-thicket patches. *Cliffortia ruscifolia* is often abundant on north facing slopes, as is the case with many other units associated with the Breede River system, but *Dicerothamnus rhinocerotis* is uncommon on these north-facing slopes. Geophytes are abundant after fire, including uncommon species such as *Cyranthus odorus*, *Gladiolus emiliae* and *Gladiolus engysiphon*. A rare and threatened geophyte *Cyranthus leptosiphon* is endemic to this unit.

The **Grootberg Grassy Fynbos** is distinct in containing a different subset of species, as for instance uncommon species such as *Aloe ciliaris* var. *muirii* and *Eulophia platypetala* that occur on rocky outcrops. It shares other uncommon species such as *Aspalathus florifera* with the more eastern Wolwedans unit. I strongly suspect that the “lost” *Cyranthus ochroleucus* occurs here, especially since this species is closely related to *Cyranthus* species that are typical of the eastern Cape Grasslands. If proved to be so, this species will be endemic to this unit. The seemingly odd relationship with the eastern Cape vegetation is clearly evident through the presence of *Aloe ciliaris* in the unit.

Small forest patches are often present in water drainage lines in the **Wolwedans Grassy Fynbos** unit. Here ericid shrubs are often prominent in the matrix Fynbos, *e.g.* *Erica sparsa* and *Phylica axillaris* on southern slopes, with *Metalasia acuta* and *Passerina falcifolia* prominent on north facing slopes. Proteoid shrubs, *e.g.* *Leucadendron eucalyptifolium* and *Protea neriifolia*, may have been present on south facing slopes, but most of the remnants of this unit has been transformed to pastures. The unit is not very rich in species, but it shares some uncommon geophytes with its western congeners, *e.g.* *Gladiolus emiliae*. No endemic species are known from this unit, but an odd ecotype of *Gladiolus exilis* present may turn out to be a distinct species endemic to the unit.
4.2.5.12 Grassy Fynbos Mosaic Thicket and Forest

Only vegetation unit is recognized in this habitat type, the **Grootvadersbos Thicket-Forest-Grassy Fynbos**. This habitat represents one step up in the rainfall gradient from the previously discussed Grassy Fynbos habitat. It is differentiated from the Grassy Fynbos by the occurrence of often clearly delineated Forest-Thicket communities, but also by the paucity of species in the matrix Grassy Fynbos. The matrix Grassy Fynbos is dominated by grasses (mostly *Eragrostis* and *Pentaschistis* species, but *Themeda triandra* is sometimes also abundant), with even the ericoid shrub component present consisting of a few species, *e.g.* *Aspalathus angustifolia*, *Aspalathus laricifolia*, *Berzelia intermedia*, *Cliffortia linearifolia*, *Erica cerinthoides* and the uncommon *Erica cruenta*. Geophytes also tend to be uncommon, with seemingly only widespread species such as *Babiana patersoniae*, *Gladiolus liliaceus*, *Ixia orientalis*, *Moraea tripetala*, etc. present in the Grassy Fynbos. The only known endemic, *Freesia sparmannii*, occurs in the ecotone to the Forest-Thicket vegetation.

The Forest-Thicket component was probably more abundant in the past, with recent increased of the use of fire by the Khoi and subsequent colonial settlers resulting in the demise of these woody communities.

![The Grassy Fynbos mosaic with Thicket and Forest habitat type showing the rapid transition from the tree dominated communities to Fynbos.](image)

**Figure 4.43** The Grassy Fynbos mosaic with Thicket and Forest habitat type showing the rapid transition from the tree dominated communities to Fynbos.
4.2.5.13 Grassy Fynbos Mosaic Thicket and Waboomveld

This habitat type consists of a heterogeneous jumble of plant communities, all to some extend quite easily recognized individually, but they mostly occur as fragmented units in different micro-habitats in a rather fragmented landscape with an equally complex geology of conglomerate, sandstone, silcrete and shales. The matrix vegetation is mostly a Grassy Fynbos that approaches the Gondwana Silcrete Fynbos, but here the grass component is better developed and proteoid shrubs are less abundant. The relative abundance of graminoids such as *Lanaria lanata* may be an artifact of frequent burning and grazing practices, but sprouting shrubs such as *Leucadendron salignum* and *Leucospermum cuneiforme* are not super-abundant. Ericaceae are rarely abundant, but other ericoid shrubs, such as *Aspalathus laricifolia, Metalasia densa, Passerina vulgaris, Phylica axillaris, etc.* are often abundant. The presence of diffuse *Protea nitida* communities on south facing slopes differentiate this unit from those located nearby. There are also clearly defined Thicket bush-clumps in fire-protected sites, with fire resilient species such as *Diospyros dichrophylla* and *Rhus lucida* often common in the matrix fire-dependant Fynbos communities.

Only one vegetation unit is recognized here, the **Cloetes pass Grassy Fynbos Mosaic** unit. No endemic species are known from this unit, but some uncommon species such as *Aspalathus florifera* are present.

![Figure 4.44](image-url) The Grassy Fynbos mosaic with Thicket and Waboomveld habitat, that consists of a jumble of plant communities sitting in different micro-habitats.
4.2.5.14 Waboomveld

The Waboomveld habitat type is, as the name alludes, typified by the presence and relative abundance of *Protea nitida*. Waboom is, however, not the only distinct feature of this habitat type. Here the soils are often a nutrient rich loamy-sand and the rainfall predictable and not too low (± 300-400 mm p.a.), an environment in which graminoids flourish, along with many ericoid-leaved shrubs and geophytes. I was rather amazed to see how feebly developed this habitat type is along the base of the coastal mountains (Langeberg-Outeniqua mountains). I could detect its presence, albeit often very narrow and diffuse, in most cases. If mapping at a much finer scale (e.g. 1:10 000), I would have recognized many more vegetation units here, especially since they often contain localized endemic species, *e.g.* *Gladiolus roseovenosus*. All the diffuse and unmapped other Waboomveld units were included in the Montane Mesic Proteoid habitat type.

Only one vegetation unit is recognized here as the Waboomveld habitat type, the **Towerland Waboomveld**. *Protea nitida* is typically the dominant overstory species, but other proteoid species such as *Leucadendron eucalyptifolium*, *Leucadendron salignum* and *Protea neriifolia* are also present. In this unit the understorey is rich in graminoids, with otherwise uncommon grasses (*e.g.* *Andropogon appendiculatus*) locally abundant. Some widespread geophytes reach their easternmost distribution here, *e.g.* *Agapanthus africanus*, perhaps typifying this unit. Uncommon ericoid shrubs present include the regional endemic *Lidbeckia vlokii*, a species better known from granite outcrops in the lowlands. Threatened and uncommon geophytes include species such as *Gladiolus roseovenosus*, showing an affiliation with the more eastern vegetation units.

![Figure 4.45](image)

The Waboomveld habitat, showing the main structural feature of this habitat, Waboom (*Protea nitida*) and relative abundance of graminoids.
4.2.5.15 Waboomveld Mosaic Thicket

Waboom (*Protea nitida*) remains relatively abundant and the distinctive species of this habitat type, which differs from the Waboomveld habitat type in being more arid and having Thicket components (e.g. *Carissa haematocarpa*, *Cynanchum obtusifolium*, *Buddleja saligna*, *Pterocelastrus tricuspidatus*, etc.) and succulents (e.g. *Adromischus leucophyllus*, *Aloe comptonii*, *Crassula arborescens*, etc.) are abundant on the lower slopes. Grasses are usually prominent (e.g. *Cymbopogon*, *Ehrharta*, *Eragrostis*, *Merxmuelera*, *Pentameris*, *Pentaschistis*, etc.) here and restioids (e.g. *Ischyrolepis*, *Restio*, *Rhodocoma*, etc.) are less abundant than in other Fynbos habitat types. No species are known to be endemic in this habitat, but uncommon species include *Paranomus candicans* and *Protea subulifolia*.

Only one vegetation unit is recognized within the Waboomveld Mosaic Thicket habitat type, here called the **Montagu Thicket-Waboomveld**. This unit is not restricted to the Riversdale domain, it continues along the northern slopes of the Langeberg into the Little Karoo domain.

![The Waboomveld Mosaic Thicket habitat, showing the prominent patches of Thicket bush-clumps along the lower slopes.](image)

**Figure 4.46** The Waboomveld Mosaic Thicket habitat, showing the prominent patches of Thicket bush-clumps along the lower slopes.
4.2.5.16 Montane Arid Proteoid Fynbos

This relatively arid habitat type occurs mostly on the more inland north facing slopes of the coastal mountain ranges, with only one small area included in the Riversdale domain. Only one vegetation unit is thus recognized within the Montane Arid Proteoid Fynbos habitat type, the **Muiskraal Arid Proteoid Fynbos**.

Here the overstory proteoid shrubs are rarely dense, but species such as *Leucadendron salignum*, *Leucospermum cuneiforme*, *Protea lorifolia* and *Protea repens* are abundant. Uncommon proteoid shrubs present include *Leucospermum erubescens*, a distinctive species that is absent from all the other vegetation units. Ericoid shrubs are prominent (*e.g.* *Erica galpinii*, *Erica anguliger*, *Erica articularis*, *Erica plukenetii*, etc.) as well as restioids (*e.g.* *Cannamois scirpoides*, *Ceratocaryum decipiens*, *Elegia galpinii*, *Hypodiscus aristatus*, *Mastersiella purpurea*, *Restio triticeus*, *Rhodocoma fruticosa*, *Willdenowia glomerata*, etc.). Rare species known to be present include *Aspalathus longifolia*, with an *Aspalathus sp. nov.* probably endemic to this unit.

Figure 4.47 The Arid Proteoid Fynbos habitat type, here showing typical sparse cover of proteoid shrubs and rapid transition to karroid communities.
4.2.5.17 Montane Mesic Proteoid Fynbos

This habitat type is best developed on rocky, sandy to sandy-loamy soils on the mid and lower southern slopes of the mountain ranges. It does, however, also occur higher up the mountains where shale bands are present at high altitude. Characteristic is the very well developed canopy of overstory proteoid shrubs, which may consist of Leucadendron and/or Protea species. Ericoid shrubs along with restioids are also abundant, with graminoids usually less prominent, except where shale bands are present. A rich assembly of geophytes is usually abundant after a fire. Unlike the Proteoid Fynbos units of the lowlands annuals are uncommon here, even in the post-fire environment. Most of the short-lived herbs are Asteraceae and legumes, with the latter probably playing an important role to restore nitrogen levels after an intense fire. Several species of Aspalathus can be super-abundant after a high intensity fire.

The plant communities present are heterogeneous and change rapidly as edaphic and/or rainfall conditions alter. Based on differences in the dominant and characteristic species present I recognize seven vegetation units in the Montane Mesic Proteoid Fynbos habitat type, but many more would be recognized when a finer scale study is undertaken for these mountainous areas.

Figure 4.48 The Mesic Proteoid Fynbos habitat, showing typical dense stands of overstory proteoid shrubs. Note the variance in dominant species from the bottom to the top of the slope.
The **Aasvoëlberg Mesic Proteoid Fynbos** unit is unusual as it is isolated on an inselberg in the lowlands. Despite its isolation it does not differ much from Langeberg Mesic Proteoid Fynbos, by having species such as and *Leucospermum cuneiforme*, *Leucadendron salignum* and *Protea neriifolia* as the dominant species. It is, however, not very rich in species, especially *Erica* species, with mostly only *Erica versicolor* present. Asteraceous shrubs, such as *Syncarpha paniculata* are abundant. Some odd uncommon species have made it to this unit, such as *Liparia splendens*, but no other rare or endemic species are known. This unit may well be one of the youngest within this habitat type.

The **Groothberg Mesic Proteoid Fynbos** also occurs as a somewhat isolated unit that is most similar to the Langeberg Mesic Proteoid Fynbos, but it differs in having mostly quite deep loamy soil. Here the proteoid overstory is very dense and consists mostly of the non-sprouting species *Leucadendron eucalyptifolium*, *Protea coronata* and *Protea neriifolia*. In shallower soils sprouters such as *Leucospermum cuneiforme* and *Mimetes cucculatus* may also be abundant. Ericoid shrubs are not very abundant, with mostly only *Penaea macronata* locally abundant. It is also not rich in restioid species, with only *Elegia filicaea* locally abundant. This may be an artifact of the area sampled, which was rather moribund and in bad need of a fire. No rare or endemic species are known from this unit, but I strongly suspect that this is due to poor collecting from the area. I will not be surprised if something like *Leucospermum formosum* and some interesting Scrophulariaceae appears after a fire.

**Kanetberg Mesic Proteoid Fynbos** occurs in a high rainfall zone mostly on the northern slopes of the Langeberg. Many overstory proteoid shrub species are present (e.g. *Leucadendron eucalyptifolium*, *Leucadendron salignum*, *Leucadendron tinctum*, *Leucospermum cuneiforme*, *Mimetes cucculatus*, *Protea eximia*, *Protea coronata*, *Protea neriifolia*, *Protea repens*, etc.), but they rarely occur in very dense stands. Restioids are often very prominent with species such as *Elegia galpinii*, *Hypodiscus albo-aristatus*, *Hypodiscus aristatus*, *Ischyrolepis ocreata*, *Restio filicaulis*, *Rhodocoma fruticosa*, *Thamnochortus cinereus* and *Wildenowia glomerata* abundant. Rare and localized species know from this unit include *Acmadenia nivenii* and *Acmadenia trigona*. This unit is much more extensive in the adjacent Little Karoo domain.

The **Langeberg Mesic Proteoid Fynbos** is a large and heterogeneous unit that occurs along the mid southern slopes of the Langeberg. It is most similar to the Ruitersbos Mesic Proteoid Fynbos in being dominated by often very dense stands of *Leucadendron eucalyptifolium*, *Leucadendron salignum*, *Leucadendron spissifolium*, *Leucospermum cuneiforme*, *Mimetes cucculatus*, *Protea eximia*, *Protea coronata* and *Protea neriifolia*, but differs in having localized endemic proteoid species such as *Leucospermum winteri* present. Ericoid shrubs are often prominent, with species such as *Berzelia intermedia*, *Erica versicolor*, *Erica vestita*, *Metalasia trivialis*, *Penaea cneorum*, *Phyllica axillaris* and *Syncarpha paniculata* abundant. Distinctive localized endemic species include *Berzelia burchellii*, *Berzelia galpinii*, *Disa schlechteriana*, *Erica amicorum*, *Erica atropurpurea*, *Erica blenna*, *Erica garciae*, *Erica grata*, *Erica macilenta*, *Erica nematophylla*, *Erica rhodantha*, *Erica tetrahecoides* and *Erica winteri*. 
The **Marloth Mesic Proteoid Fynbos** is structurally most similar to the Langeberg Mesic Proteoid Fynbos and also a large heterogeneous unit dominated by often dense stands of *Leucadendron eucalyptifolium*, *Leucadendron salignum*, *Leucadendron spissifolium*, *Leucospermum cuneiforme*, *Mimetes cucculatus*, *Protea eximia*, *Protea coronata* and *Protea neriifolia*. It differs, however, in having proteoid species such as *Serruria balanocephala* and other localized endemic species such as *Erica chartacea*, *Erica chlorosepala*, *Erica mundii*, *Erica omninoglabra*, *Erica oxyandra*, *Erica peziza*, *Erica polifolia* and *Erica pubigera* present.

The **Muiskraal Mesic Proteoid Fynbos** is similar to the Kanetberg Mesic Proteoid Fynbos in having *Leucadendron eucalyptifolium*, *Leucadendron salignum*, *Leucospermum cuneiforme*, *Mimetes cucculatus*, *Protea eximia*, *Protea neriifolia* and *Protea repens* abundant, with ericoid shrubs and restioids also prominent. Localized endemics species known to be present in this unit include *Aspalathus grandiflora* and *Otholobium bowieanum*.

The **Ruitersbos Mesic Proteoid Fynbos** is structurally similar to the Langeberg and Marloth Mesic Proteoid Fynbos, with proteoid shrubs like *Leucadendron eucalyptifolium*, *Leucadendron spissifolium*, *Leucospermum cuneiforme*, *Mimetes cucculatus*, *Protea aurea*, *Protea eximia* and *Protea neriifolia* often forming dense stands, but it differs in having rare proteoid species such as *Leucospermum formosum* present. Ericoid shrubs that are abundant include *Erica deliciosa*, *Erica glomiflora*, *Erica sparsa* and *Erica versicolor* and restioids that are abundant include *Cannamois virgata*, *Mastersiella purpurea* and *Restio triticeus*. Local endemic species that are characteristic of this unit include *Acmadenia tetragona*, *Erica gillii* and *Penaea acutifolia*. 
4.2.5.18 Montane Mesic Proteoid Fynbos Mosaic Waboomveld

This habitat type is very similar to the Mesic Proteoid Fynbos, but differs in having some shale bands present in which Waboom (*Protea nitida*) is often locally abundant. Unlike typical Waboomveld, graminoids are rarely very prominent, but restioids and ericoid shrubs are abundant. Two vegetation units are recognized in this habitat type, in both cases the matrix vegetation is most similar to the Marloth Mesic Proteoid Fynbos.

In the **Stonehaven Waboom-Mesic Proteoid Fynbos** the unit is somewhat arid with many of the communities dominated by *Leucadendron eucalyptifolium* and *Protea repens*. The soils are not very humic and are usually very rocky. *Erica vestita* is a prominent ericoid shrub and *Coleonema virgata* is a localized endemic.

The **Tradouw Waboom-Mesic Proteoid Fynbos** occurs in a wetter area with an array of divergent plant communities present. In some communities the restioid *Cannamois virgata* is dominant along with *Widdringtonia nodiflora*. Other communities have overstory proteoid shrubs (*e.g. Protea neriifolia*) dominant in which localized endemics such as *Erica tradouwensis* and *Leucadendron tradouwense* are present. An oddity of the unit is that the post-fire environment can be dominated by *Osteospermum* species.

![Figure 4.49](image-url) The Mesic Proteoid Fynbos mosaic with Waboomveld habitat type, showing the dense overstory of *Leucadendron eucalyptifolium*. 
4.2.5.19 Montane Ericaceous Fynbos

Along with the Subalpine habitat type, this habitat is perhaps the true home of authentic Fynbos, with endemic families (e.g. Geissolomataceae) and many species of endemic genera (e.g. Stilbe, Stylapterus, etc.) residing in this habitat type and nowhere else. It is strongly linked with the Perennial Stream habitat type, with the upper ends of the latter almost always nested within the Ericaceous Fynbos. The Ericaceous Fynbos habitat thus fulfilling an important water catchment function, if things go wrong here, the entire water drainage system lower down will be at risk.

This habitat type is restricted to high rainfall areas on the upper mountain slopes, in some cases very steep south facing slopes that are almost permanently wet. The soils are sandy, often humic and nutrient deficient, they can be deep or shallow as many rocky outcrops are present. It differs from the Proteoid Fynbos habitat types in having only a sparse cover of proteoid shrubs, with species such as Protea cynaroides and Protea speciosa typical and rarities such as Mimetes splendidus characteristics. Ericoid leaved shrubs (representing many different families) are dominant along with restioids. This habitat type contain a rich assembly of plant communities with the three recognized vegetation units representing the highest heterogeneity of all the habitat types recognized in the Riversdale domain. In the post fire environment some characteristic graminoids (e.g. Ehrharta dura) may be abundant along with a rich assembly of geophytes, especially Iridaceae and Orchidaceae, but graminoids are otherwise uncommon. Restioids are often locally dominant in well-watered sites.

Figure 4.50  The Ericaceous Fynbos habitat type, showing abundance of ericaceous shrubs and sparse cover of overstory proteoid shrubs.
The Ericaceous Fynbos habitat is undoubtedly very vulnerable to water stress and high temperatures. Even in mid summer this habitat often enjoys cool foggy weather and many of the local species seem to require such conditions. It may be at risk for the predicted increased temperatures linked to global climate change. Another probably more imminent threat is abstraction of water from deep aquifers. Abstraction sites may well be located quite far from these units, but may result in lowered water tables and altered hydrological patterns within this habitat type. Seen in the light of its importance as water catchment areas and its very high biodiversity value, this habitat type should be protected maximally.

An interesting feature of this habitat type is that it is rarely heavily invaded by alien species, mostly only some *Pinus pinaster*. This may well be due to the high densities of resprouting species (especially restioids) in this habitat type. A high degree of competition in the post-fire environment may prevent alien species from establishing readily in this habitat.

Although structurally very similar I recognize three vegetation units within the Montane Ericaceous Fynbos habitat type, mostly based on changes the localized endemic species present. All three these units are highly heterogeneous and warrant considerable subdivision, which is not possible at a scale of 1:50 000.

The westernmost unit, the **Breede Ericaceous Fynbos**, varies from fairly arid in the west to more moist towards the east. Most remarkable about this unit is that it has a plant family endemic, the Geissolomataceae, with *Geissoloma marginata* its only species. Many localized species are endemic to this unit, including *Erica comata*, *Erica crassisepala*, *Erica oophylla*, *Erica stenantha*, *Ischyrolepis affinis*, *Leucadendron radiatum*, *Mniothamnea bullata*, *Platycaulos acutus*, *Restio fragilis*, *Restio implicates*, *Restio peculiaris*, *Spatalla nubicola*, *Stylapterus ericifolius* and *Thamnea gracilis*.

Most of the **Langeberg Ericaceous Fynbos** is quite wet. Several localized endemic species may be present, but this unit is botanically not very well explored. The unit shares several uncommon Ericaceae and Restionaceae species with the Breede Ericaceous Fynbos and several more widespread species (e.g. *Erica deliciosa*) with the more eastern Ruitersberg unit. I suspect that this vegetation unit will yield many botanical surprises when it is better explored.

Several species typical and common to both the Breede and Langeberg units (e.g. *Protea speciosa*) are absent in the **Ruitersberg Ericaceous Fynbos**. These are replaced with a different set of species that extend their distribution from this unit eastwards to the Tsitsikamma mountains, e.g. *Agathosma blaelioiides*, *Cyrthanthus elatus*, *Erica uberiflora* and *Mimetes pauciflorus*. Not many localized endemic species are known from this unit, but there are some, such as *Acadenia rupicola*, *Agathosma plantifolia*, *Erica juniperina* and *Erica velatiflora*. 
4.2.5.20 Subalpine Fynbos

This habitat type is most similar to the Ericaceous Fynbos habitat, but differs in being restricted to rocky crests of high peaks, mostly above 1350 m altitude. Snow occurs sporadically in winter, but it rarely lasts for a long period of time. The vegetation is generally sparser than is typical of the Ericaceous Fynbos and it lack tall plants (> 1 meter tall). It is dominated by ericaceous shrubs and restioids, but tends to have a rich component of graminoids of which certain species are characteristic and endemic to this unit, e.g. *Pentameris uniflora*. Geophytes are usually prominent after a fire.

The rather slow growing plants of this habitat tend to be very vulnerable to trampling and nutrient enrichment of the usually nutrient deficient soils. Despite the remoteness of this habitat, the high peaks tend to be targeted for installation of radio telecommunication masts. The resultant trampling and use of concrete materials at such sites result in the rapid demise of the local flora.

Only one unit is recognized within this habitat type, the **Outeniqua Subalpine Fynbos**, which has species such as *Erica outeniquae* endemic. I am, however, sure that with a more detailed survey it would be possible to recognize more subalpine units in the central Langeberg. These units may occur at an altitude lower than the typical 1300 m, but the occurrence of characteristic invertebrates such as *Colophon* beetles on these peaks indicate that they could possibly qualify to be classed as Subalpine Fynbos, rather than Ericaceous Fynbos as they are currently treated.

![Figure 4.51](image-url)  
*Figure 4.51* The Subalpine Fynbos habitat type, showing abundance of geophytes and graminoids soon after a fire.